Improving Surface Water Datasets for California
Benefits for Water Resource Management

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What is NHD?

Overview

- National Hydrography Dataset
- Nation-Wide GIS Dataset
  - What is GIS Data?
- Provided and Hosted by USGS
- Hydrography/Surface Water
  - Rivers
  - Lakes
  - Swamps
  - Canals
  - Springs
  - Etc.
- Available Publically
- Authoritative to Many Agencies
CGST’s History With NHD

• 10+ Years Working with NHD
• 8+ Years as CA Substewards of NHD
• Multiple Collaborations/Projects
• Substewardship and Going Beyond Data Deliverables:
  o Working with stakeholders
  o Increased awareness of and user engagement with NHD
  o Development of mapping standards for CA
CGST’s History With NHD

Data Stewardship, User Engagement, and Benefits for All

NHD
- NHD Update Tools
- NHD Data
- NHD Utility Toolset
- NHD Hydro Events
- Hi-Res NHD Plus
- NHD Schema and Rules

RESULTS
- Cooperation
- Cohesive Data
- Maintenance Planning
- Communication
- Awareness
- User Engagement
- Better Stewardship

BENEFICIARIES
- Regional Agencies
- Tribal Nations
- State Agencies
- General Public
- Federal Agencies
- NHD Sub-Stewards
CA DWR and CSU Collaboration

Background

• CA Drought Funding Origin
• Official State Stewardship in 2016
• Leveraging established NHD expertise and workflow at CSUs
  o Northridge: CGST
  o Chico: GIC
• Opportunities for students and young professionals
CA DWR and CSU Collaboration

Current Work

• Slated for next 4 years
• Realizing a fully updated NHD for all of CA
  o Including US Forest Service (USFS) Lands
  o ~80% of CA area completed or nearly completed by CSUs
  o ~20% of CA area remains in USFS Lands
• Pilot testing new methodologies
  o Higher resolution updates
  o Deriving local res NHD from LiDAR
  o Other focused feature improvements and representation
NHD Beyond Map Making

NHD as a Cartographic Product

- Staple/most common use case
- Topographic maps/basemaps
- Reference layer for hydrography
- Water feature type labels and water feature names

But... NHD has many more uses beyond map making!
Surface Water Resource Inventory

• Current and Up-To-Date
• Reflecting Real-World Conditions
  o Through wealth of NHD data components
• Consistent
• Robust
• Helps Support:
  ✓ Water Resource Management
  ✓ Watershed Health Assessments
Change Analysis

• Date Stamps
• Metadata
• Visualize and Analyze Change Over Time
• Directly Supports Work In:
  ✓ Climate change analysis
  ✓ Predictive modeling
  ✓ Emergency response
  ✓ Urbanization/development and human use impacts
NHD as a Base Hydrographic Dataset

- CA Water Board’s Basin Plan Mapping Project
  - Used NHD as Base Dataset
  - Statewide
  - Associated Regional and State Basin Plan Information to the NHD:
    - Water Quality Objectives
    - Beneficial Uses
    - Total Maximum Daily Load Thresholds
    - Other Descriptive Attributes

CA Basin Plan Beneficial Use Viewer:
https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=116f7daa9c4d4103afda1257be82eb16
NHD as a Base Hydrographic Dataset

- CA Water Boards WQ Integrated Report
  - Federal Clean Water Act (CWA)
  - Quality of Surface Waters
    - Assessment of Pollutant Levels
  - 305(b) Reporting: Sets Condition Categories for Assessment
  - 305(d) Reporting: Lists Impaired Waters
  - Uses NHD as base dataset for map viewer with TMDL data

CA WQ Integrated Report Map: https://waterboards.maps.arcgis.com/apps/webappviewer/index.html?id=e2def63ccef54eedbee4ad726ab1552c
Hydro Addressing/Linking User Data to NHD

• Associating User Data to NHD
• Examples:
  o Biological Data
    ✓ Fish spawning sites
    ✓ Rare species locations
  o Infrastructure Data
    ✓ Monitoring stations
    ✓ Gates
    ✓ Fish screens
  o Environmental Impact Data
    ✓ Hazardous events
    ✓ Pollution site
Hydro Addressing/Linking User Data to NHD

• Benefits
  
  o Association with NHD and better data compatibility
  
  o Ease of maintenance
  
  o Data sharing

• Compilation of Linked Data
  
  o USGS NHD Linked Data Registry: https://www.sciencebase.gov/catalog/item/530d0115e4b08f991722dce3

• USGS Hydro Addressing Tool
  
  o Accessible
  
  o Largely Automated
  
  o Flexible
High Resolution NHDPlus

- Derived from NHD
- Value Added Attributes:
  - Stream Order
  - Mean Annual Flow
  - Average Flow Velocity
  - Precipitation
  - Temperature
  - ...and more!

NHD shows us where the water is.
NHDPlus can show how much water is in the streams.
High Resolution NHDPlus

- Health and Environmental Hazards
- Watershed Boundaries
- Streams and Rivers
- Species Data
- Lakes and Ponds
- Elevation Data
- Catchment Attributes
  - Upstream Cumulative Stream Length
  - Stream Order
  - Flow Velocity
High Resolution NHDPlus

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Temporal/Historical Studies
Comprehensive Analysis Using Contemporary Conditions
Predictive Analysis/Modeling
High Resolution NHDPlus

Gold Kings Mine Case, 2015

- Southwestern Colorado
- US EPA mine inspection
- Accidental release of 3 million gallons of acidic, metal-rich mine wastewater to Cement Creek and Animas River
- Toxic spill modeling tool by Center for Water Science and Engineering (Virginia)
  - NHD
  - NHDPlus
  - Forecasting downstream transport of contaminated water
  - Real-time emergency planning and response potential

The Durango Herald

- Arsenic
- Lead
- Mercury
- Iron
- Copper
- Zinc
- Selenium
- Etc.
High Resolution NHDPlus

Gold Kings Mine Case, 2015

- Modeling Components
  - Time of Arrival Analysis:
    - 48 hours
    - 8 day
  - Validation Using Stream Gauges
- Appropriate and timely response to impacts:
  - Drinking Water
  - Recreation
  - Irrigation
Future of NHD

• Higher Resolution Data
  o LiDAR
  o Elevation
  o Modeling
  o Automation/Machine Learning
• Shift to 3D Modeling
• Seasonality and Periodicity Modeling
  o Addressing regional impacts of drought and climate change
• Benefits to Water Resources:
  ✓ More Detail
  ✓ More Accuracy
  ✓ More Data Compatibility

INTRODUCING THE 3D HYDROGRAPHY PROGRAM
A New Approach to Water Data

Building on the decades of experience developing and managing the National Hydrography Datasets, the USGS is establishing the 3D Hydrography Program (3DHP) initiative to completely refresh the Nation’s hydrography data and improve discovery and sharing of water-related data.

When fully implemented, 3DHP is estimated to provide more than $1 billion in benefits every year, in addition to myriad societal benefits. Additionally, decisions that directly affect water would be better informed. The next generation of surface water mapping under the new 3DHP will incorporate the most relevant and impactful components of the existing hydrography data and accomplish major spatial accuracy improvements. The resulting products and services will be freely available and openly accessible.

The 3DHP will significantly improve the level of detail, currency, and inclusion of hydrography data by deriving a 3D stream network and hydrologic units from accurate, high-quality 3D Elevation Program (3DEP) data, as well as hydrologically enhanced digital elevation and other surfaces to support...
Thank you!

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