Improving Surface Water Datasets for California

Benefits for Water Resource Management

2022 WRPI Annual Conference

Resilience Panel

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CGST — CENTER FOR GEOSPATIAL SCIENCE & TECHNOLOGY, California State University. Northridge

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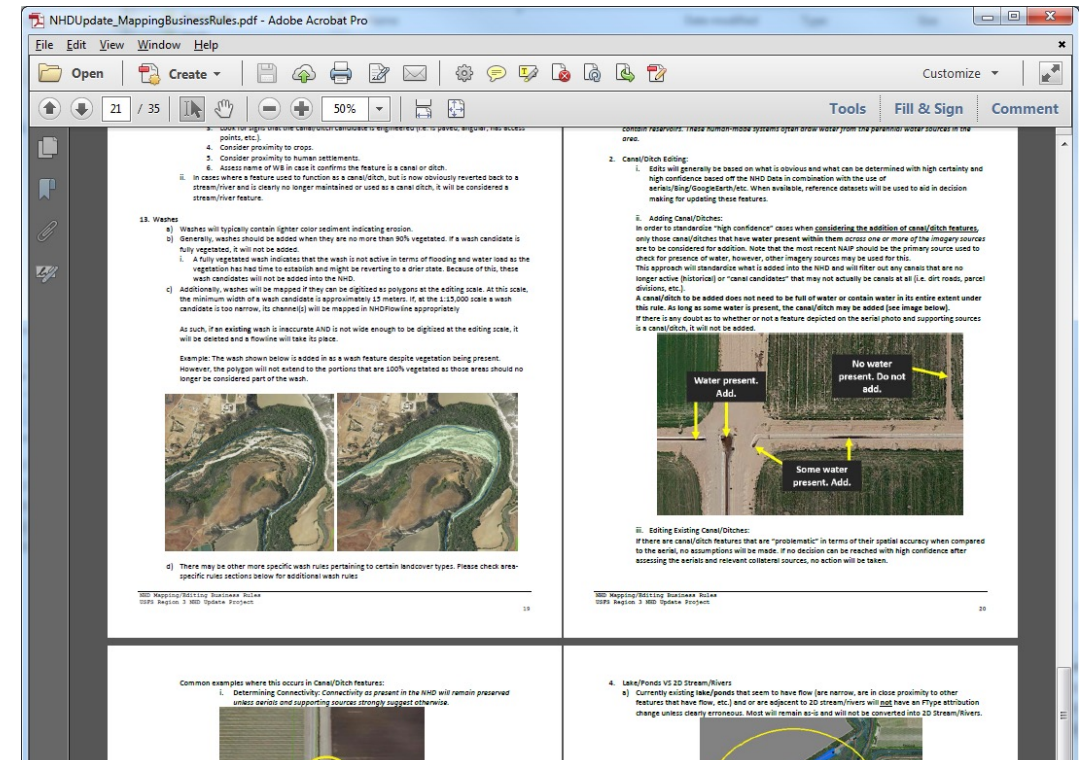# What is NHD?

Overview

- National Hydrography Dataset

- Nation-Wide GIS Dataset

    o What is GIS Data?

- Provided and Hosted by USGS

- Hydrography/Surface Water
    o Rivers
    o Lakes
    o Swamps
    o Canals
    o Springs
    o Etc.

- Available Publically

- Authoritative to Many Agencies
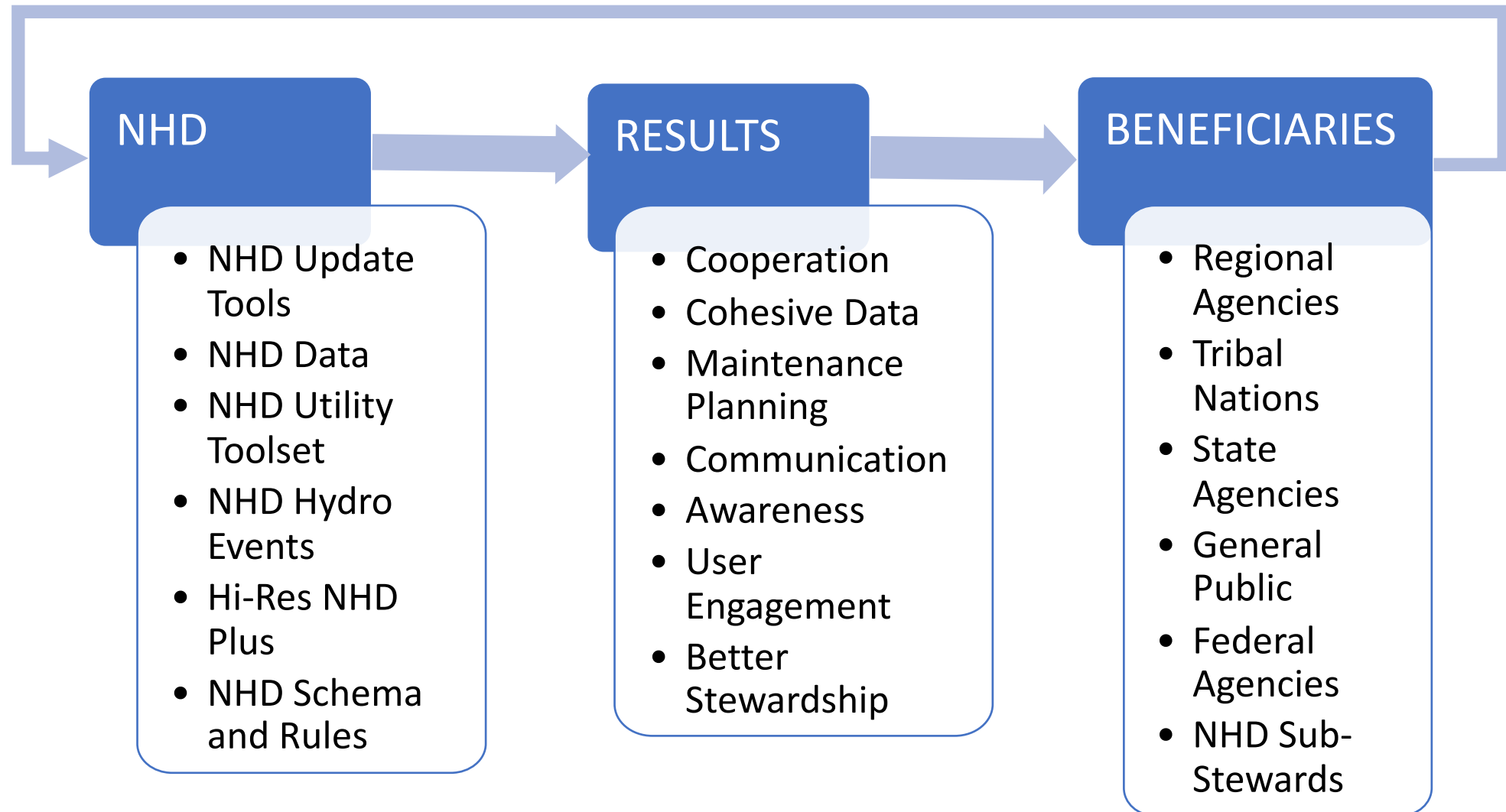
CGST's History With NHD

- 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
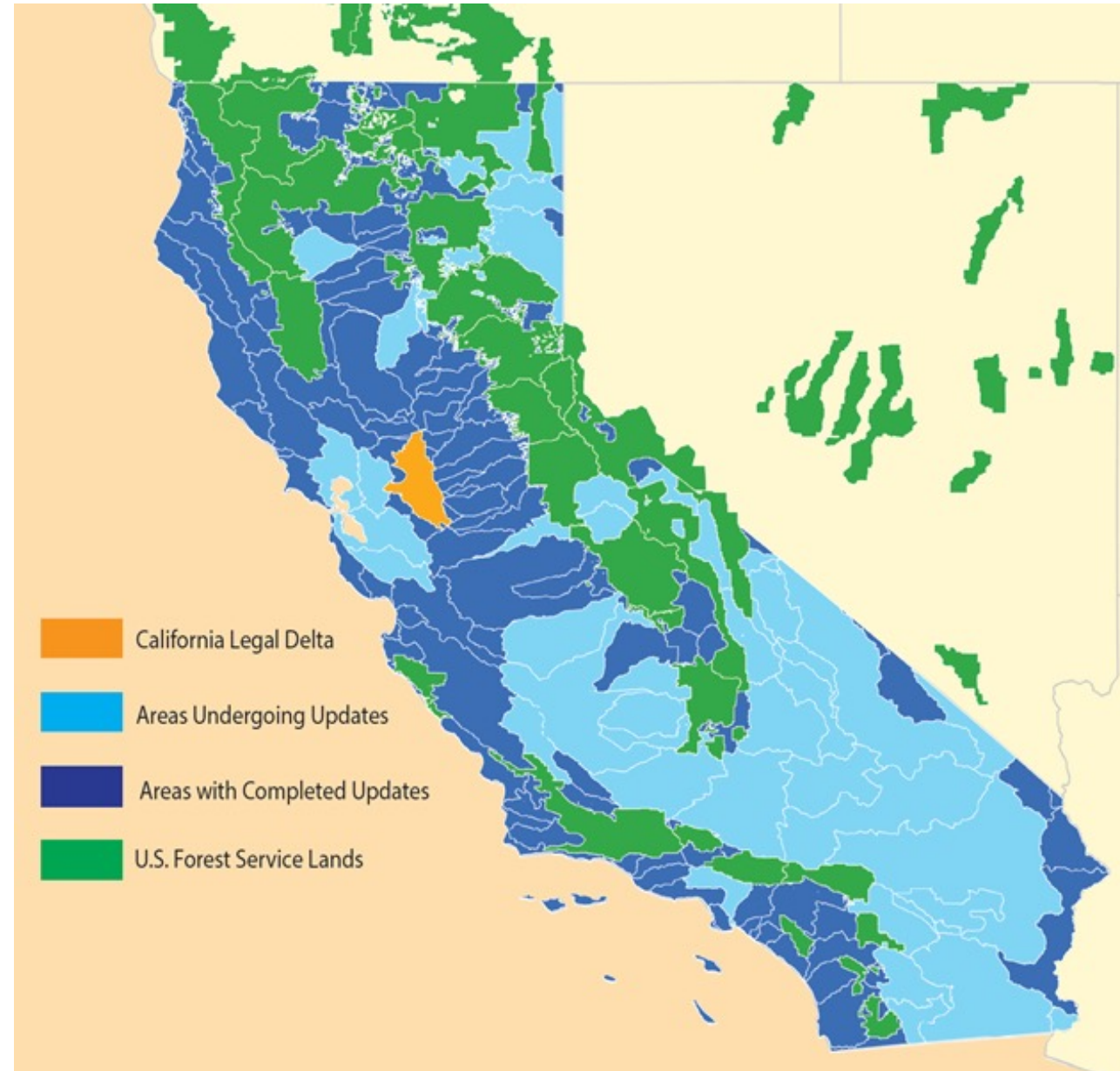
Background

- CA Drought Funding Origin

- Official State Stewardship in 2016

- Leveraging established NHD expertise and workflow at CSUs
  - Northridge: CGST
  - Chico: GIC

- Opportunities for students and young professionals
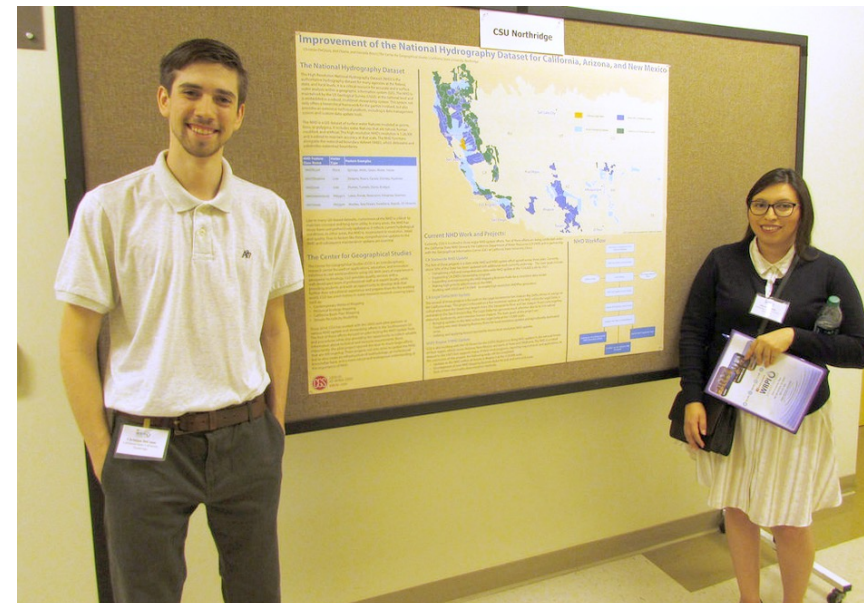
CA DWR and CSU Collaboration

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

Legend:
- California Legal Delta
- Areas Undergoing Updates
- Areas with Completed Updates
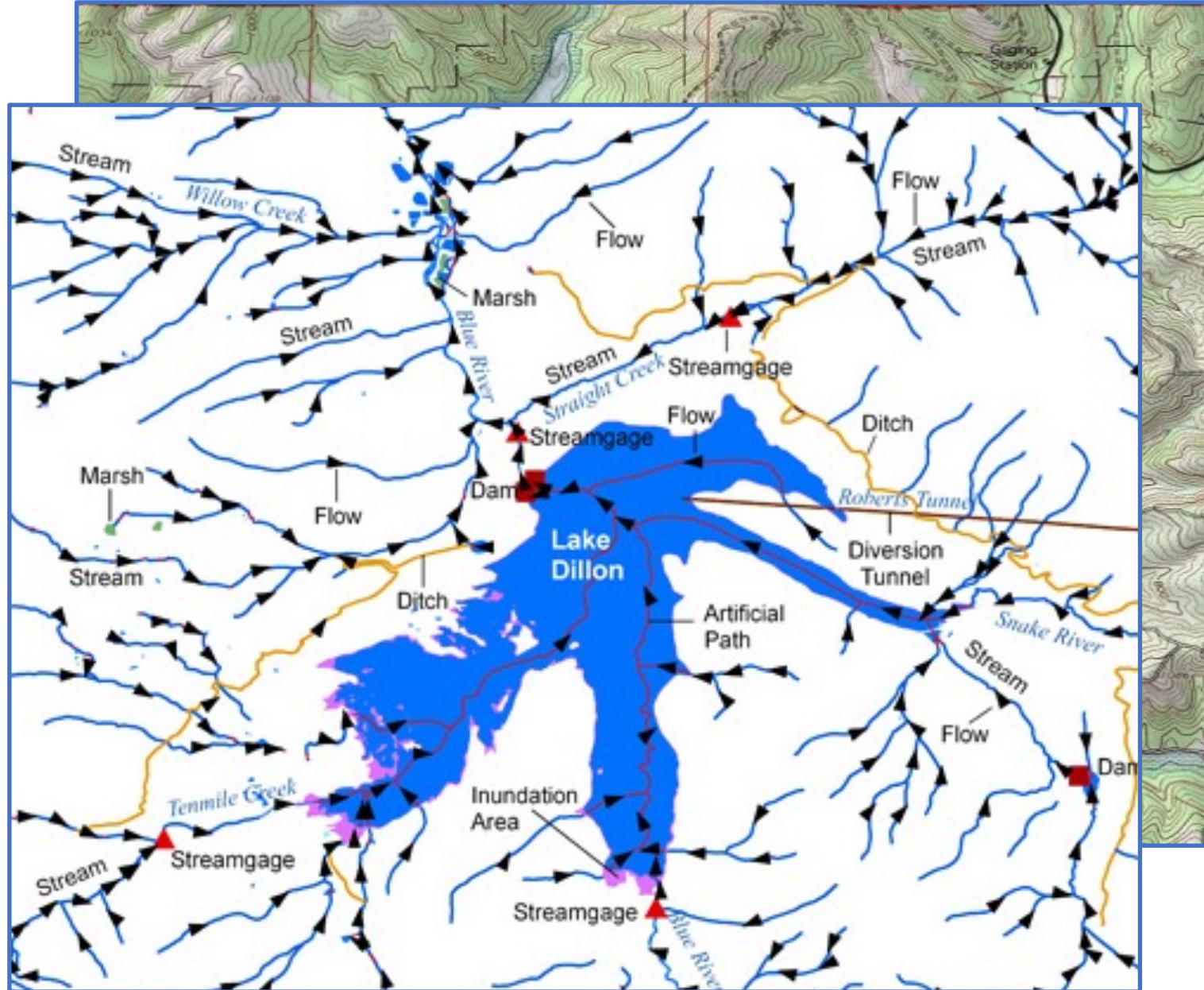- U.S. Forest Service Lands

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

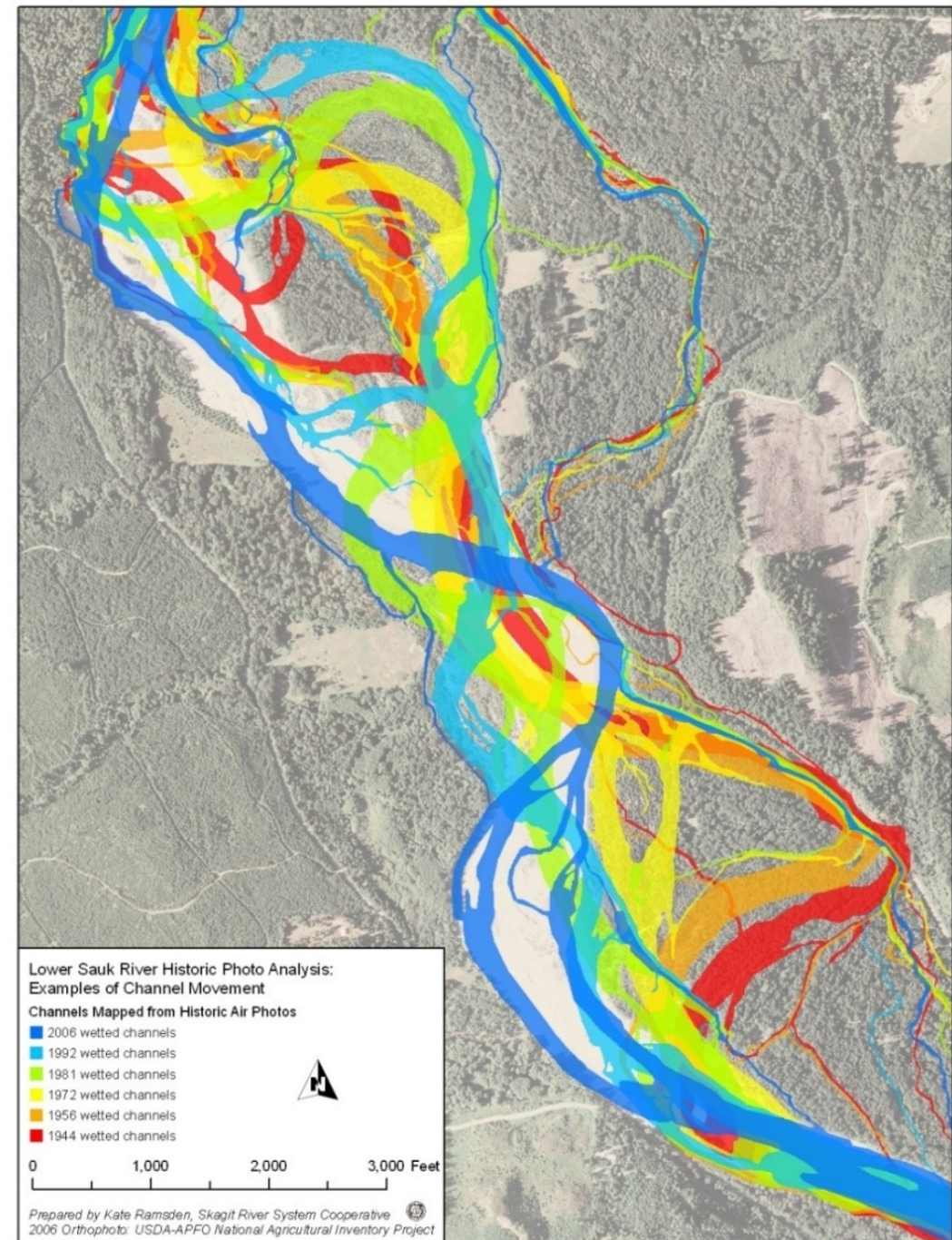*But... NHD has many more uses beyond map making!*

Surface Water Resource Inventory

- Current and Up-To-Date

- Reflecting Real-World Conditions
  - 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

Lower Sauk River Historic Photo Analysis:
Examples of Channel Movement

Channels Mapped from Historic Air Photos
- 2006 wetted channels
- 1992 wetted channels
- 1981 wetted channels
- 1972 wetted channels
- 1956 wetted channels
- 1944 wetted channels

0   1,000   2,000   3,000 Feet

Prepared by Kate Ramsden, Skagit River System Cooperative
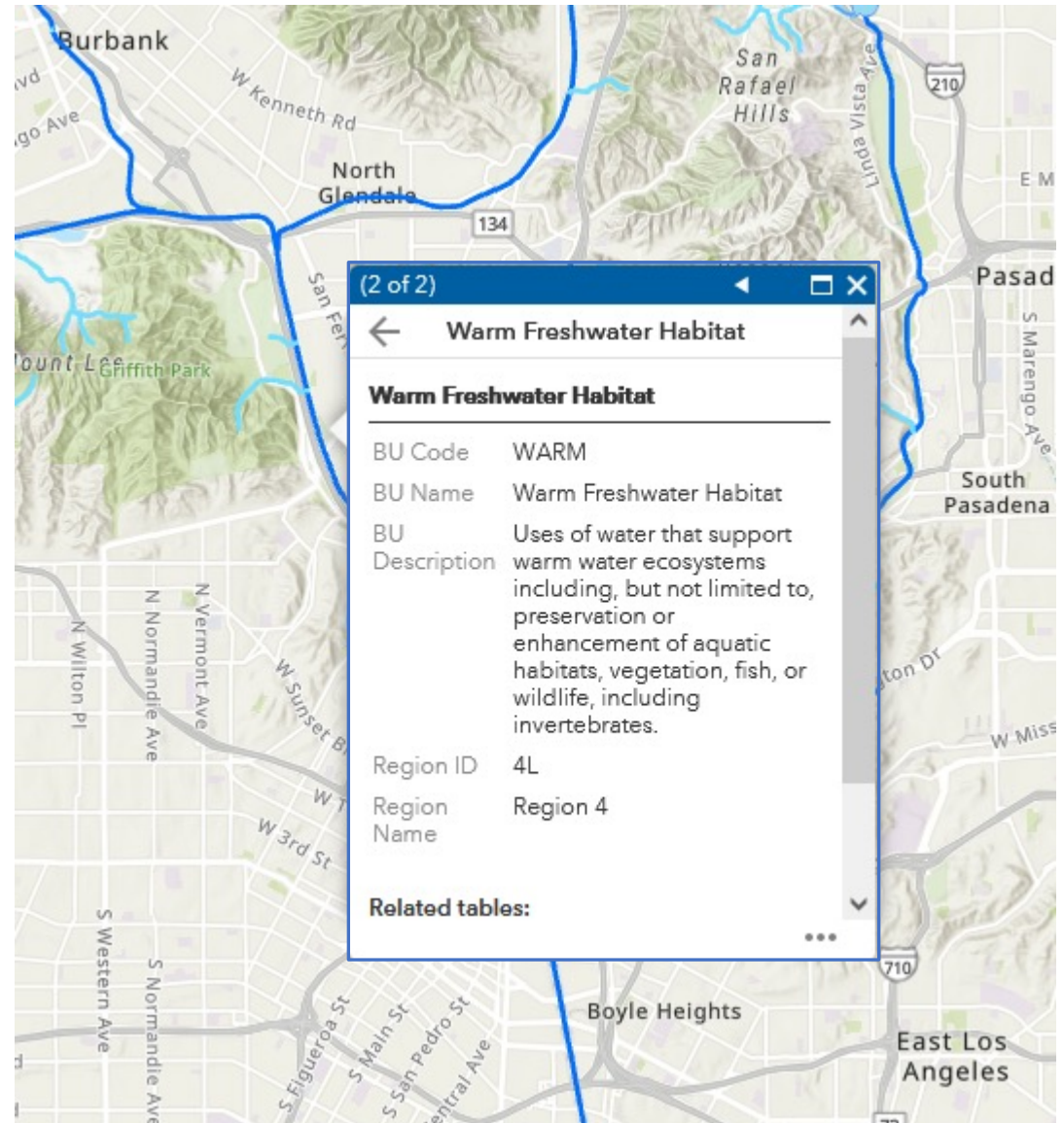2006 Orthophoto: USDA-APFO National Agricultural Inventory Project

NHD as a Base Hydrographic Dataset

- CA Water Board's Basin Plan Mapping Project

  o Used NHD as Base Dataset

  o Statewide

  o 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
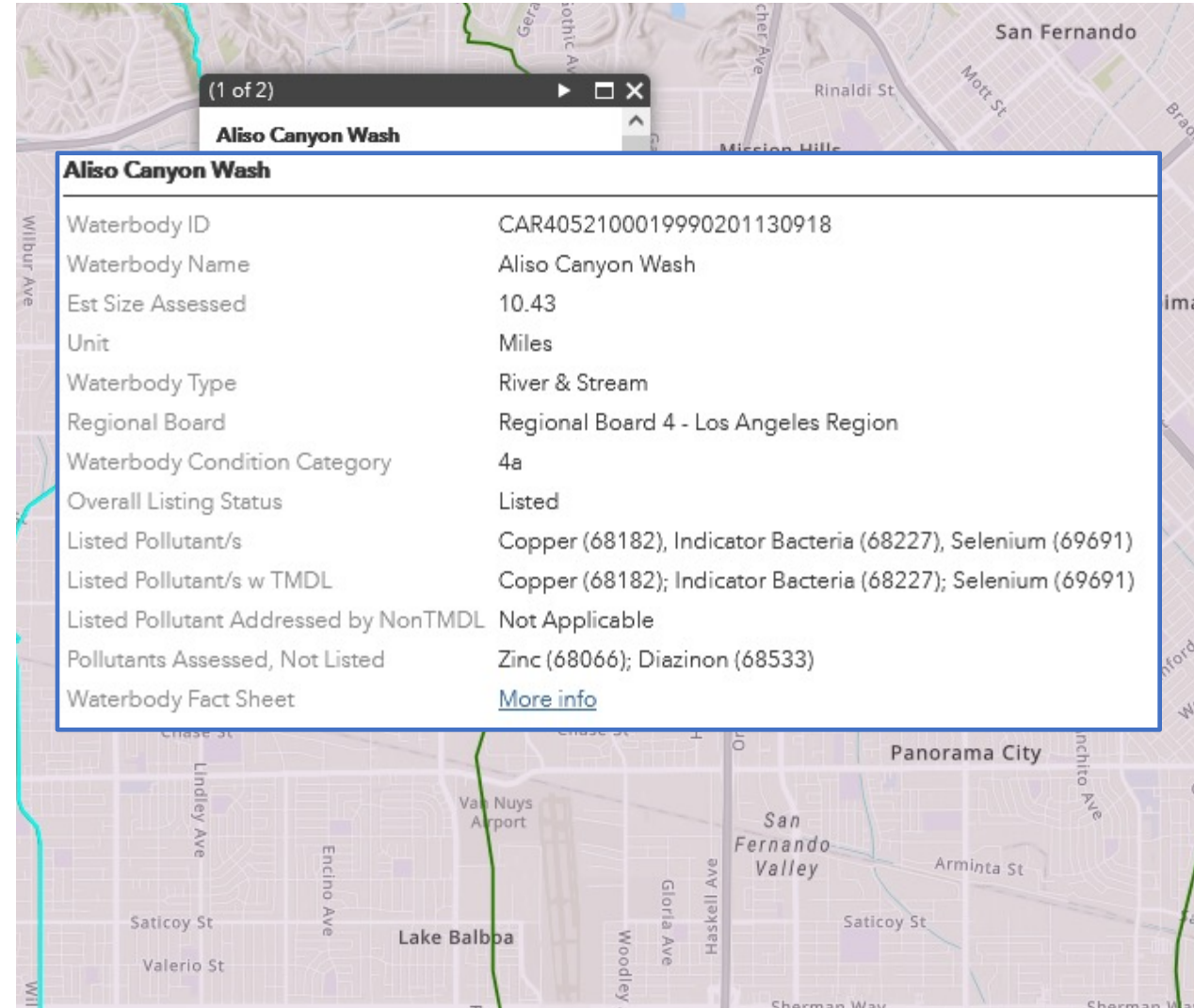
NHD as a Base Hydrographic Dataset

- CA Water Boards WQ Integrated Report

  o Federal Clean Water Act (CWA)

  o Quality of Surface Waters

    - Assessment of Pollutant Levels

  o 305(b) Reporting: Sets Condition Categories for Assessment

  o 305(d) Reporting: Lists Impaired Waters

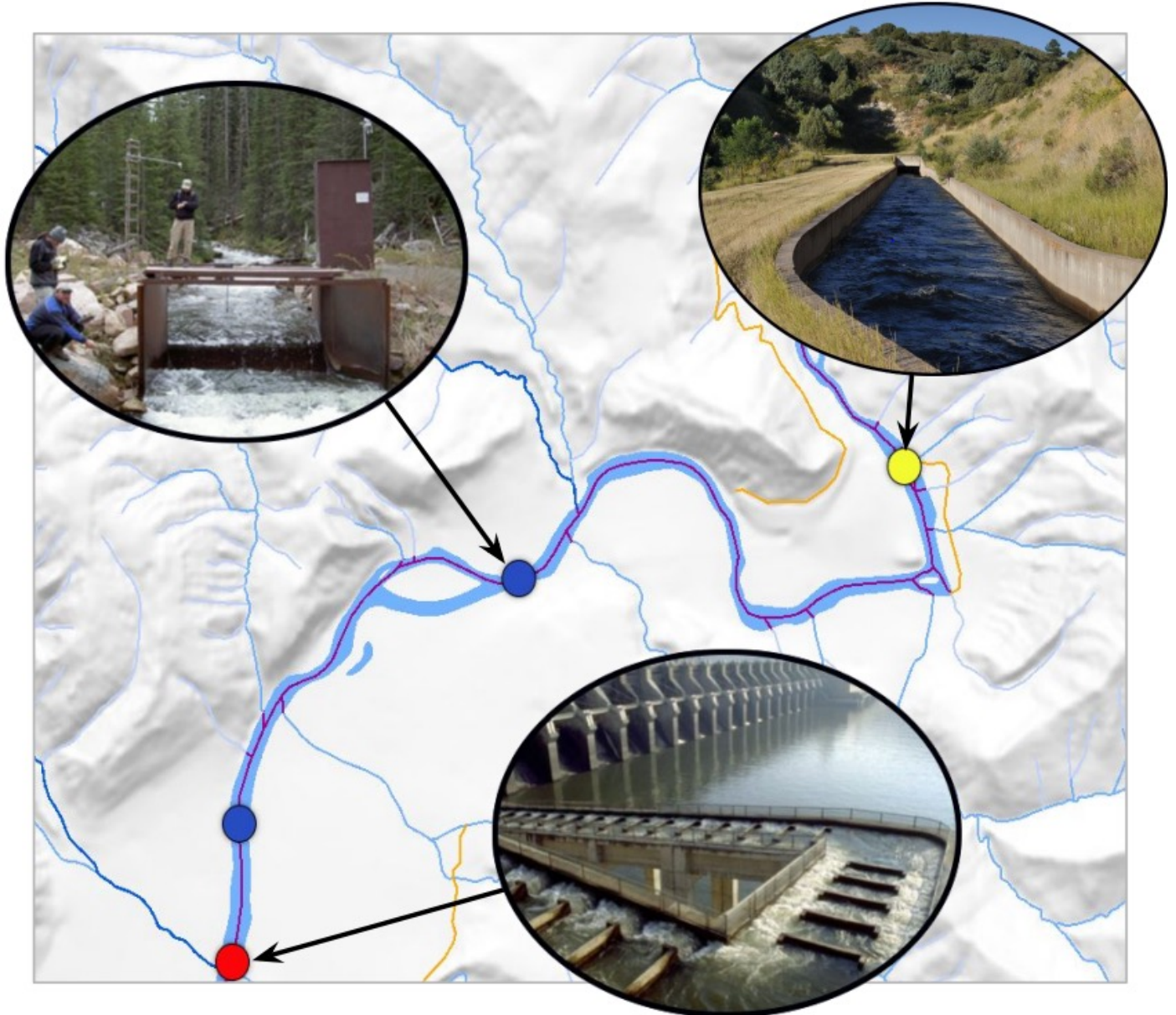 o Uses NHD as base dataset for map viewer with TMDL data

CA WQ Integrated Report Map:
https://waterboards.maps.arcgis.com/apps/webappviewer/index.html?id=e2def63ccef54eedbee4ad726ab1552c

(1 of 2)

Aliso Canyon Wash

Aliso Canyon Wash

Waterbody ID	CAR40521000199990201130918
Waterbody Name	Aliso Canyon Wash
Est Size Assessed	10.43
Unit	Miles
Waterbody Type	River & Stream
Regional Board	Regional Board 4 - Los Angeles Region
Waterbody Condition Category	4a
Overall Listing Status	Listed
Listed Pollutant/s	Copper (68182), Indicator Bacteria (68227), Selenium (69691)
Listed Pollutant/s w TMDL	Copper (68182); Indicator Bacteria (68227); Selenium (69691)
Listed Pollutant Addressed by NonTMDL	Not Applicable
Pollutants Assessed, Not Listed	Zinc (68066); Diazinon (68533)
Waterbody Fact Sheet	More info

Hydro Addressing/Linking User Data to NHD

- Associating User Data to NHD

- Examples:
    - Biological Data
        - ✓ Fish spawning sites
        - ✓ Rare species locations
    - Infrastructure Data
        - ✓ Monitoring stations
        - ✓ Gates
        - ✓ Fish screens
    - Environmental Impact Data
   - ✓ Hazardous events
        - ✓ Pollution site

Hydro Addressing/Linking User Data to NHD

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

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

- USGS Hydro Addressing Tool
  - Accessible
  - Largely Automated
  - Flexible

High Resolution NHDPlus

- Derived from NHD

- Value Added Attributes:
    - Stream Order
    - Mean Annual Flow
    - Average Flow Velocity
    - Precipitation
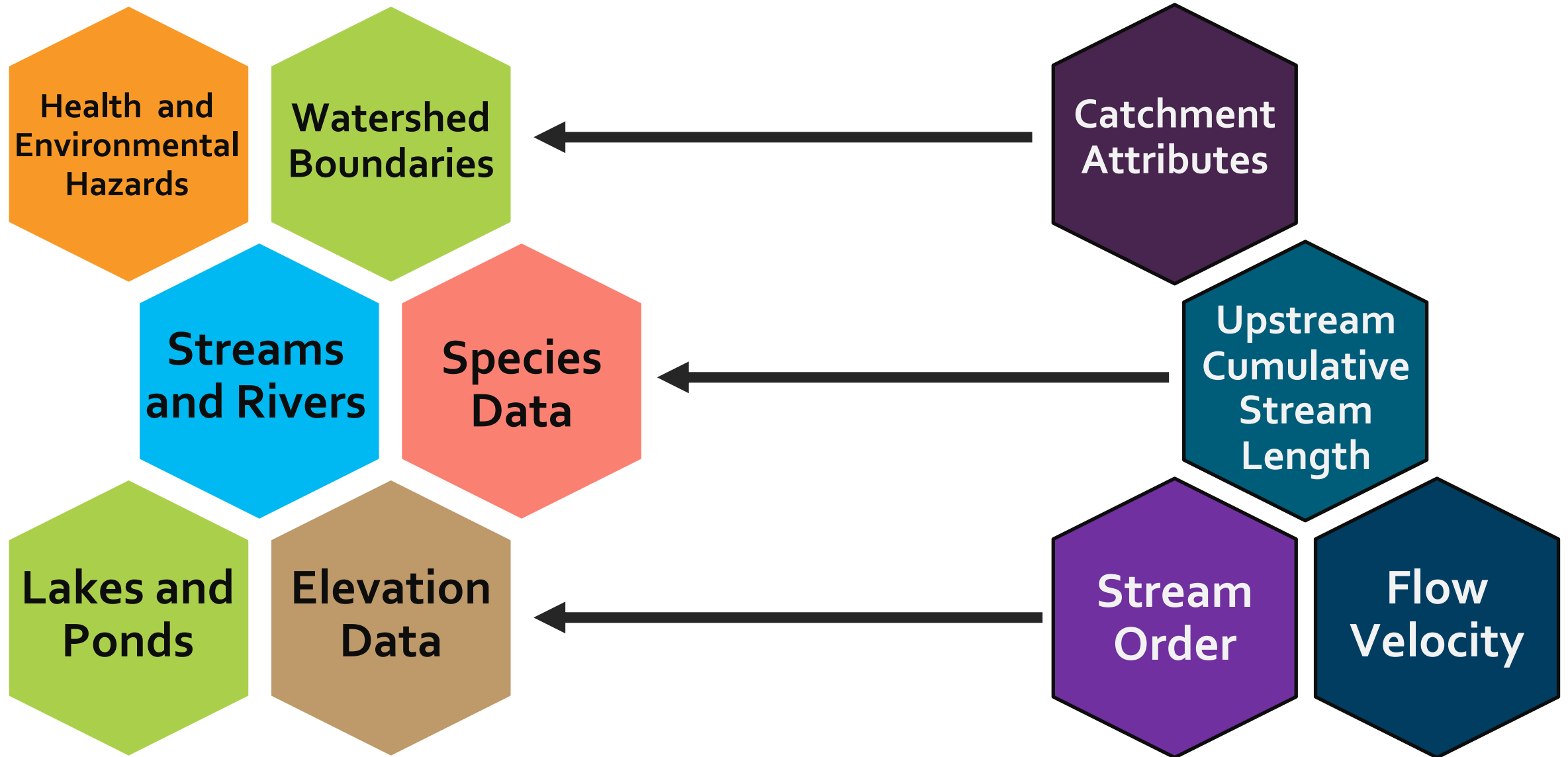   - Temperature
    - *...and more!*
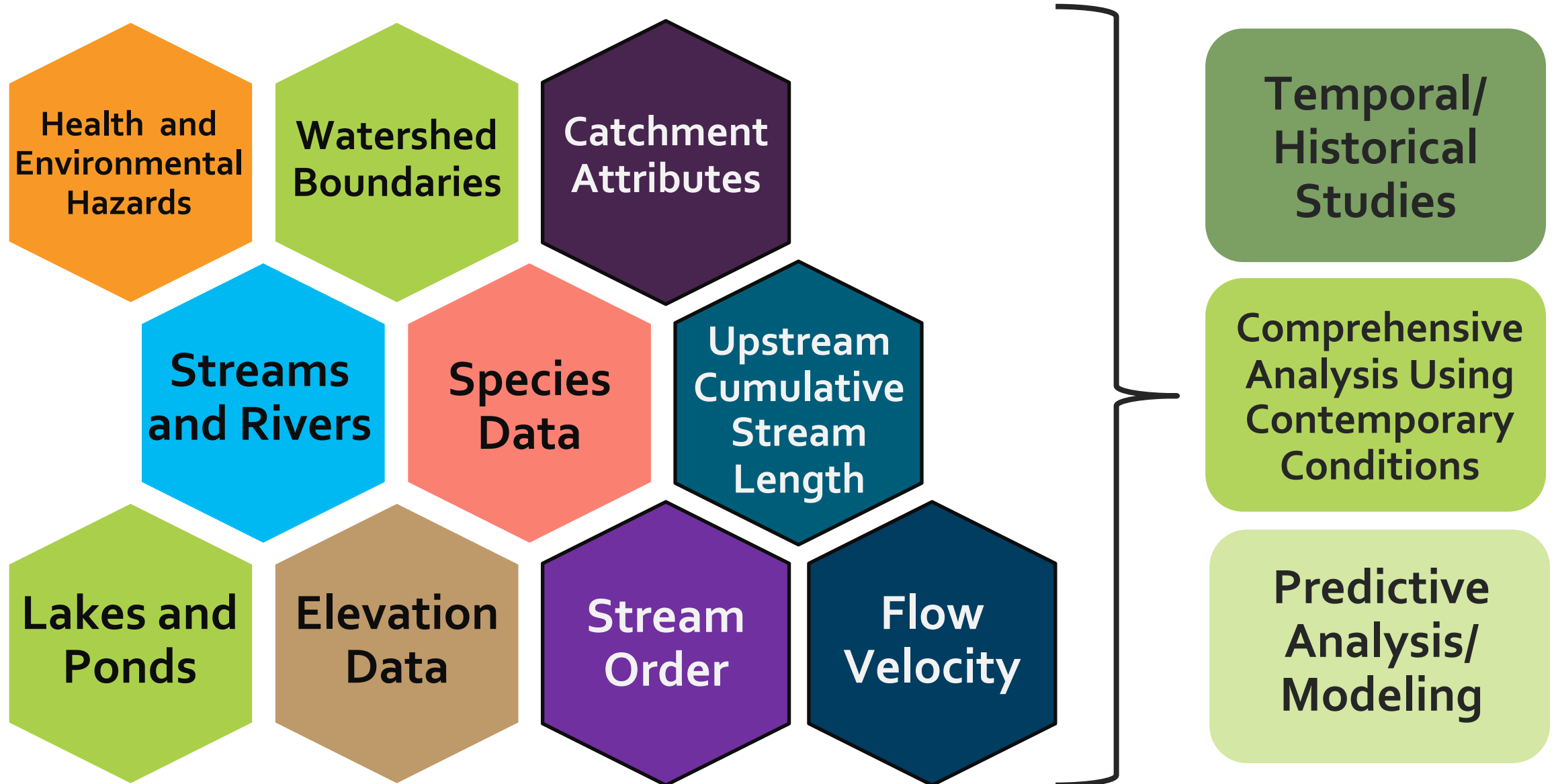
NHD shows us where the water is.
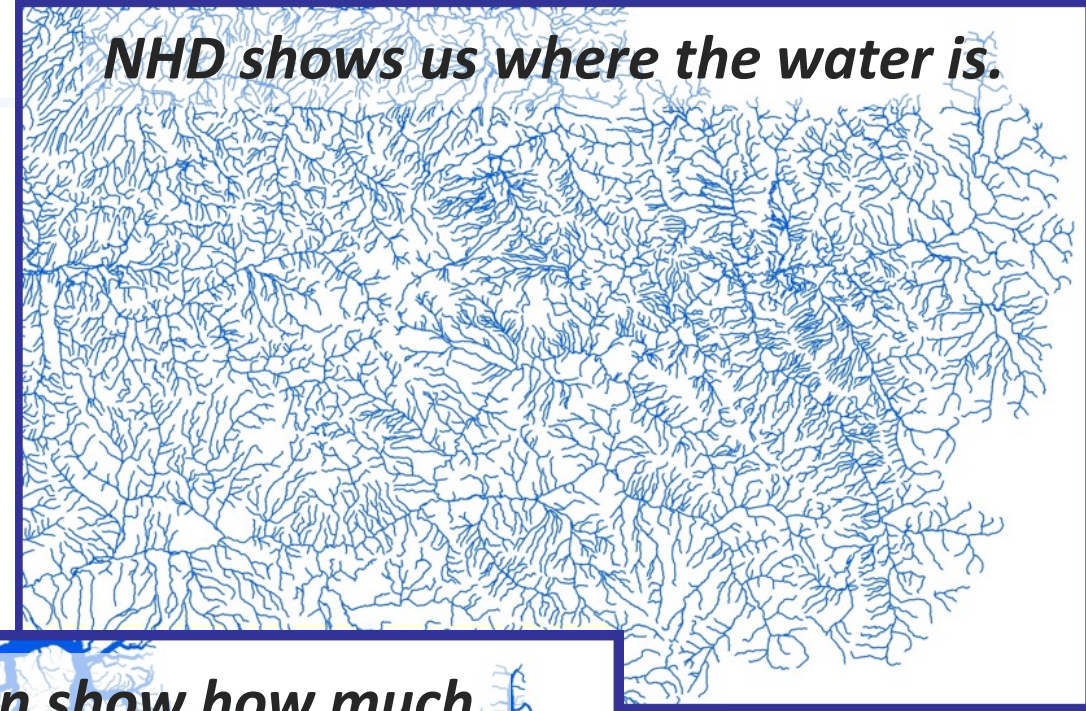
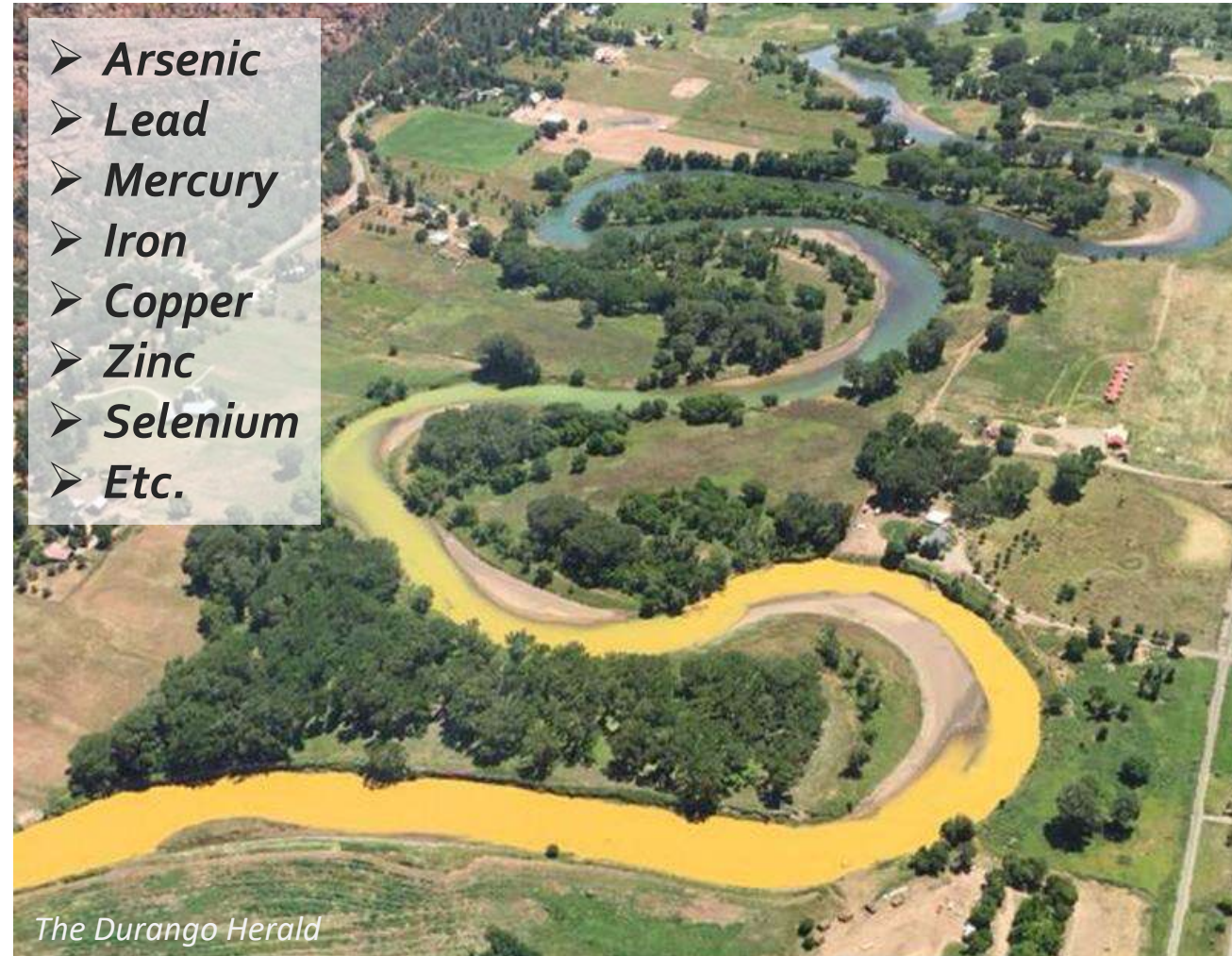*NHDPlus can show how much water is in the streams.*
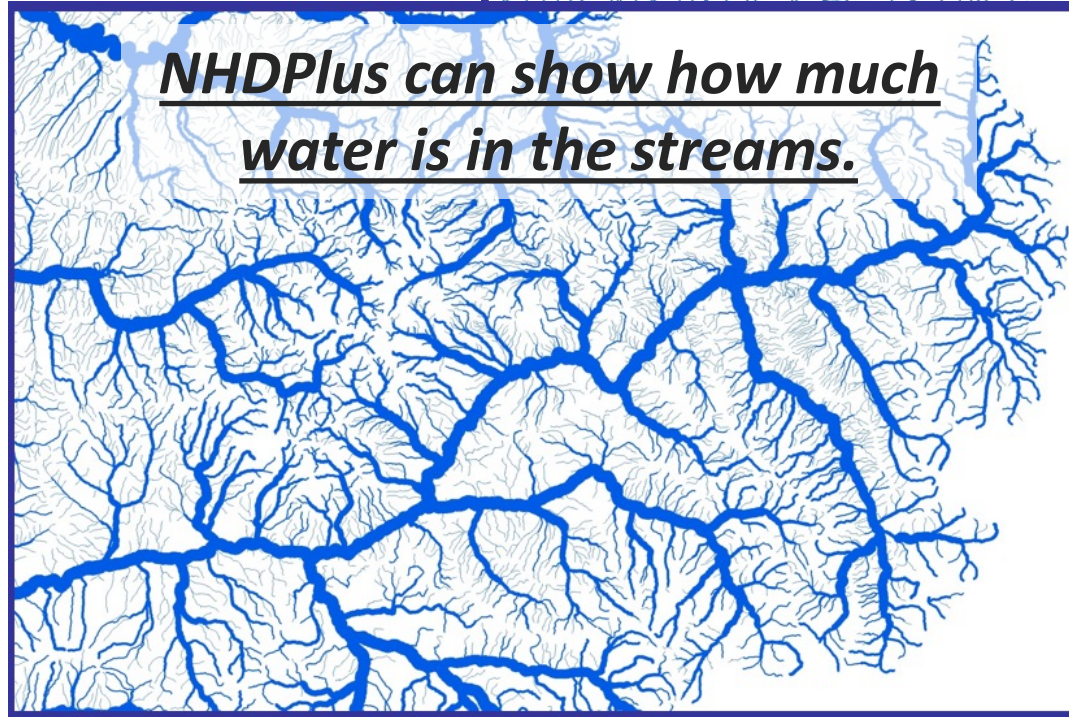
High Resolution NHDPlus

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)

  o NHD

  o NHDPlus

  o Forecasting downstream transport of contaminated water

  o *Real-time* emergency planning and response potential

> *Arsenic*
> *Lead*
> *Mercury*
> *Iron*
> *Copper*
> *Zinc*
> *Selenium*
> *Etc.*

The Durango Herald

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

Downstream Quick Trace
- 8/5/2015 to 8/6/2015
- 8/6/2015 to 8/7/2015
- 8/7/2015 to 8/8/2015
- 8/8/2015 to 8/9/2015
- 8/9/2015 to 8/10/2015
- 8/10/2015 to 8/11/2015
- 8/11/2015 to 8/12/2015

Gold King Mine
Colorado

★ Gold King Mine
→ Direct path from GKM to Animas River (Estimated)
→ Animas River
→ San Juan River

UTAH
COLORADO
ARIZONA
NEW MEXICO

Banks Environmental Data

Future of NHD

- Higher Resolution Data
  - LiDAR
  - Elevation
  - Modeling
  - Automation/Machine Learning
- Shift to 3D Modeling
- Seasonality and Periodicity Modeling
  - 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.**
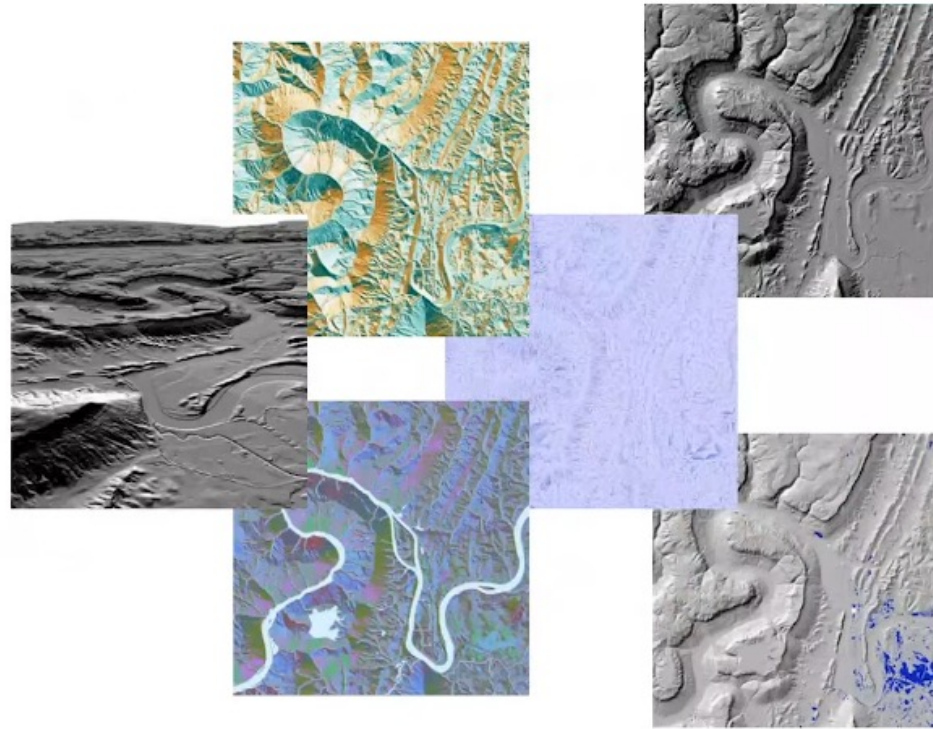
When fully implemented, 3DHP is estimated to provide more than **$1 billion in benefits every year**, in addition to myriad societal benefits. Additionally, decisions that directly affect water would be better informed. The next generation of surface water mapping under the new 3DHP will incorporate 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

Sources/Usage: Public Domain.

Figure 2: The 3D Hydrography Program aims to align hydrography and elevation data.

Thank you!

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