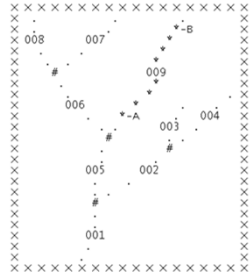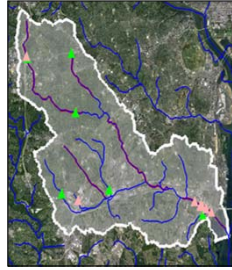*Session #5*

**A Focus on
Geospatial Hydrologic Frameworks**

1987 – Reach File Version 1   2017 - NHD*Plus*

Tatyana DiMascio – USGS, National Geospatial Program
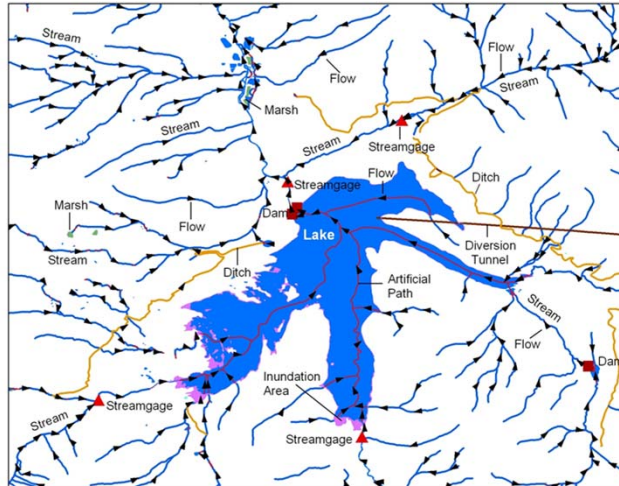Tommy Dewald – EPA, Office of Water

---

Overview

* NHD-NHDPlus Content
* Evolving NHD-NHDPlus
* Stewardship Opportunities
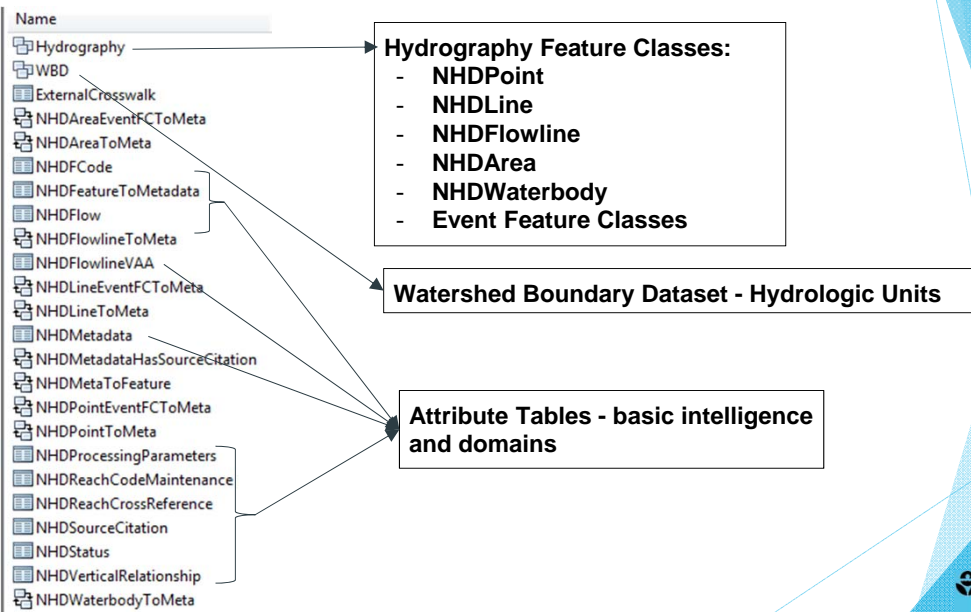* Tools and Services
* The Water User Community
* Oh …

The National Hydrography Dataset is the Foundation

3

- Surface Water Features for the entire nation

- Lakes, rivers, reservoirs, stream gages, etc.

- Spatial Database

NHD Content

4

Hydrography Feature Classes:
- **NHDPoint**
- **NHDLine**
- **NHDFlowline**
- **NHDArea**
- **NHDWaterbody**
- **Event Feature Classes**

Watershed Boundary Dataset - Hydrologic Units

Attribute Tables - basic intelligence and domains

Name
- Hydrography
- WBD
- ExternalCrosswalk
- NHDAreaEventFCToMeta
- NHDAreaToMeta
- NHDFCode
- NHDFeatureToMetadata
- NHDFlow
- NHDFlowlineToMeta
- NHDFlowlineVAA
- NHDLineEventFCToMeta
- NHDLineToMeta
- NHDMetadata
- NHDMetadataHasSourceCitation
- NHDMetaToFeature
- NHDPointEventFCToMeta
- NHDPointToMeta
- NHDProcessingParameters
- NHDReachCodeMaintenance
- NHDReachCrossReference
- NHDSourceCitation
- NHDStatus
- NHDVerticalRelationship
- NHDWaterbodyToMeta

For more details see: https://nhd.usgs.gov/NHDv2.2.1_poster_081216.pdf

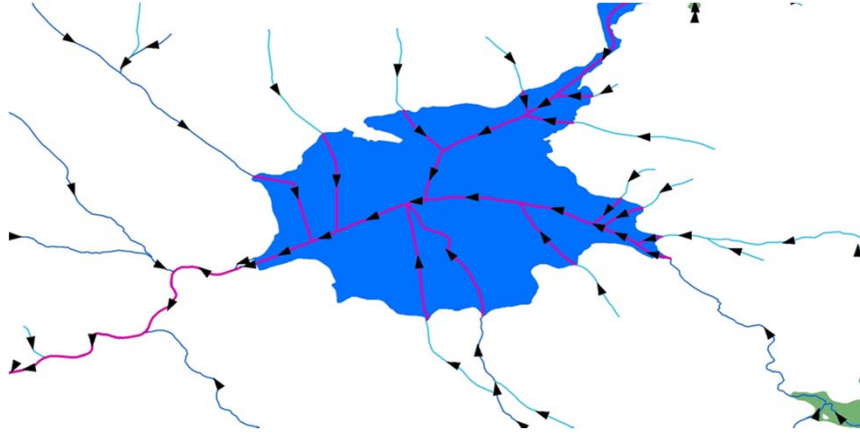NHD - Complete Network with Flow Direction

Image credit: Jeff Simley

Linking Data to Features - Reach Codes
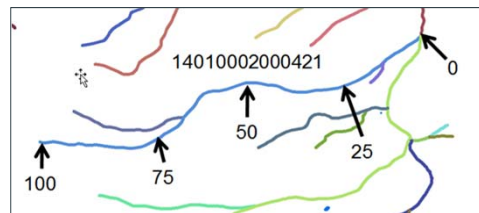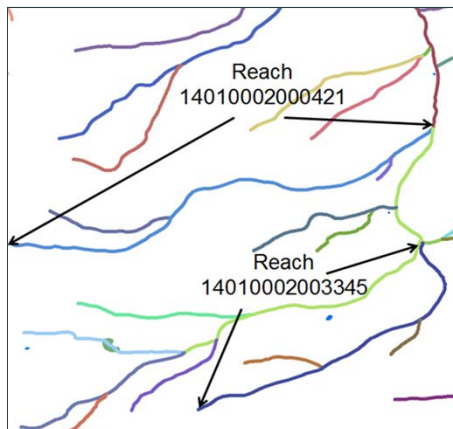
Image credit: Jeff Simley

Linking Data to Features - Events

USGS Streamgage
09050000

Coordinate
106 05 13.955 W
39 32 43.472 N

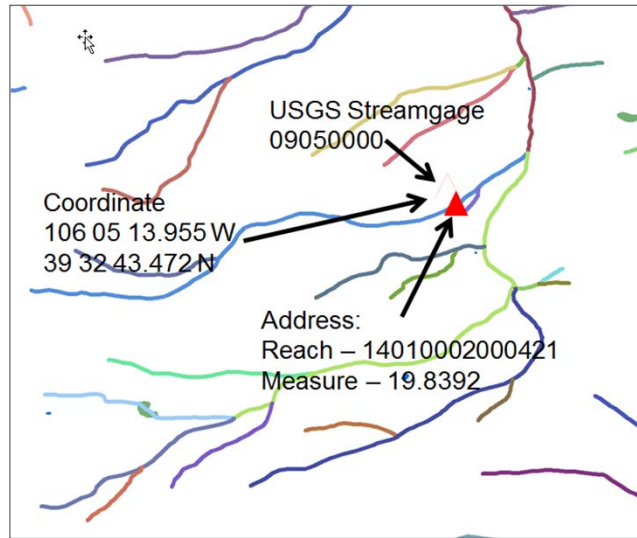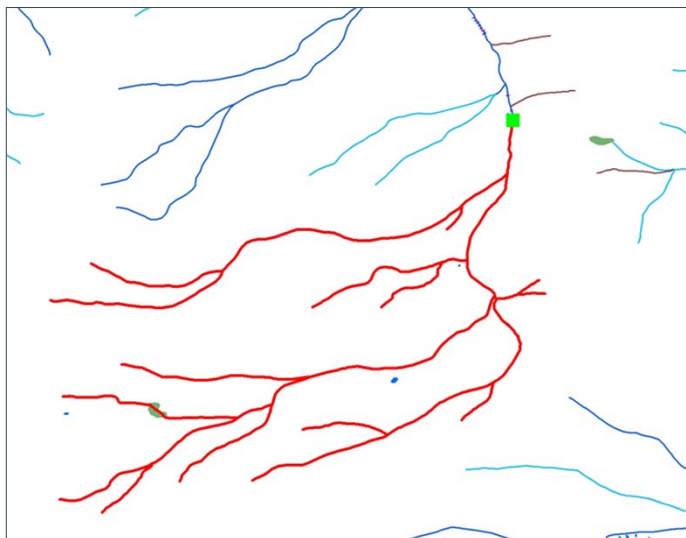Address:
Reach – 14010002000421
Measure – 19.8392

Image credit: Jeff Simley
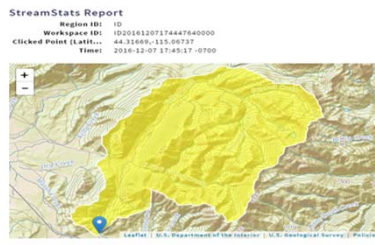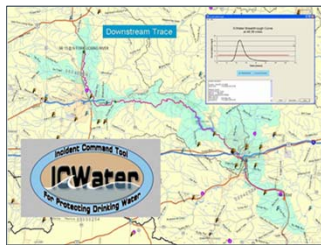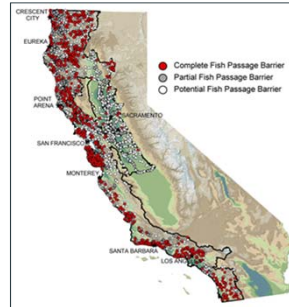
Navigation - The Basis for Analysis
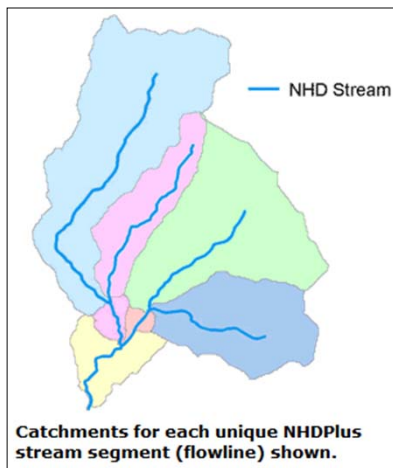
Image credit: Jeff Simley

NHD Uses

- Make maps
- Manage water use
- Environmental protection
- Emergency response

National Hydrography Dataset Plus (NHD*Plus*)

An integrated suite of geospatial products including flow volume and velocity estimates to support modeling

Incorporates -
- Hydrography (streams)
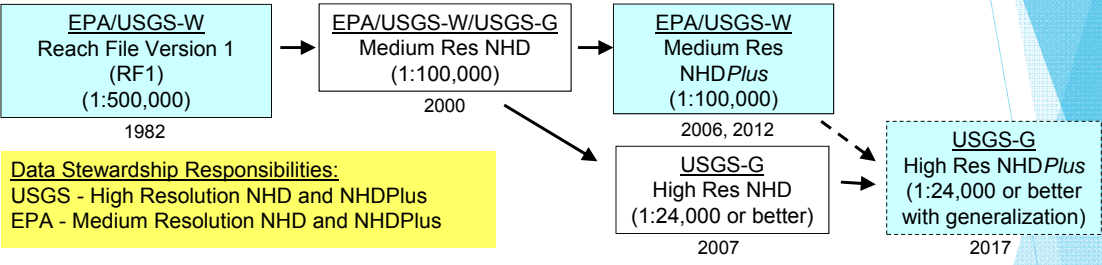- Watershed Boundaries
- Elevation

NHD*Plus* Core Data Components

- Snapshots of primary ingredient datasets
  - National Hydrography Dataset
  - National Elevation Dataset
  - Watershed Boundary Dataset
- Additional stream attributes
  - flow volume and velocity
  - linked USGS gaged flow data
  - stream order and stream level
  - hydrologic sequence number
  - and many others
- Catchments and attributes
- Flow direction and accumulation grids

---

The Evolving NHD and NHD*Plus* Framework

The blue boxes identify the framework versions used to estimate stream flow volume and velocity.

EPA/USGS-W	→	EPA/USGS-W/USGS-G	→	EPA/USGS-W
Reach File Version 1 (RF1) (1:500,000)		Medium Res NHD (1:100,000)		Medium Res NHD*Plus* (1:100,000)
1982		2000		2006, 2012

USGS-G
High Res NHD
(1:24,000 or better)
2007

USGS-G
High Res NHD*Plus*
(1:24,000 or better
with generalization)
2017

Data Stewardship Responsibilities:
USGS - High Resolution NHD and NHDPlus
EPA - Medium Resolution NHD and NHDPlus

What's the Difference between Versions?

Framework Facts	Map Scale	Map Accuracy	Total Stream Miles (mi)	# of Stream Segments	Stream Segment Average Length (mi)	# of Lakes	Catchment Average Area (sq mi)
Reach File Version 1 (RF1)	1:500K	+/- 254m	600,000	60,000	10	4,100	50
Medium Resolution NHD*Plus*	1:100k	+/- 50m	3,200,000	2,600,000	1.2	38,000	1.1
High Resolution NHD*Plus*	1:24K or better	+/- 12m	7,500,000	20,000,000	0.37	537,000	0.11
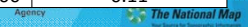
New NHD*Plus* data!

- First national time-of-travel estimates that consider latency in lakes

- NHDPlus for 'priority waters' in Alaska under production

- National seamless flattened File GeoDatabase for simplified data management and direct access to feature attributes

- StreamCat catchment attributes

MR

A Sampling of How NHD*Plus* is Being Used

- EPA reporting on water quality (WQ Framework!)
- EPA National Aquatic Resource Surveys
- USGS SPARROW water quality modeling
- DTRA ICWater spill response
- NOAA National Water Model (flood forecasting)
- OWDI Hydro Network Linked Data Index
- Idaho lake monitoring plan
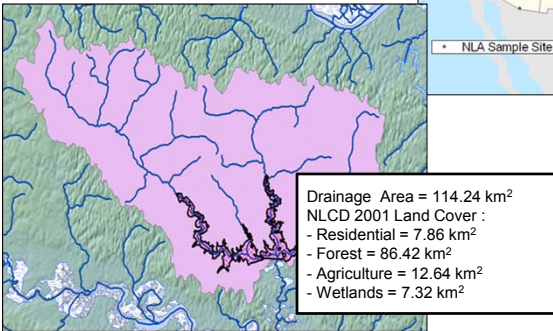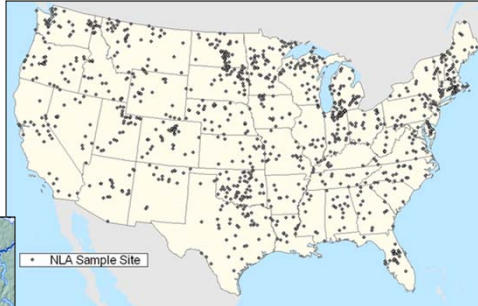- South Carolina stream assessment conservation planning tool

MR

(For more examples, see the Applications Catalog on the NHD*Plus* web site)

EPA National Aquatic Resource Surveys

NHD*Plus* serves as the basis for establishing the river, stream and lake survey sample frames – from which a representative set of sample sites are randomly selected. >>

NLA Sample Site

Drainage Area = 114.24 km^2
NLCD 2001 Land Cover :
- Residential = 7.86 km^2
- Forest = 86.42 km^2
- Agriculture = 12.64 km^2
- Wetlands = 7.32 km^2

<< NHD*Plus* is also used to support data analysis, such as delineating drainage areas and associated attributes for sampled sites.

MR

Developing a Strategic Lake Monitoring Plan
Idaho Department of Environmental Quality

NLCD (2006) Land Use Description	Disturbance Rank
Barren Land (Rock/Sand/Clay)	0
Cultivated Crops	3
Deciduous Forest	0
Developed, High Intensity	4
Developed, Low Intensity	2
Developed, Medium Intensity	3
Developed, Open Space	1
Emergent Herbaceous Wetlands	0
Evergreen Forest	0
Grassland/Herbaceous	0
Mixed Forest	0
Open Water	0
Pasture/Hay	2
Perennial Ice/Snow	0
Shrub/Scrub	0
Woody Wetlands	0

NLCD with Disturbance Rankings

Over 40,000 lakes/ponds and reservoirs contained within approximately 84,000 square miles of mostly rugged terrain. The Landscape Disturbance Index for each lakeshed considered:
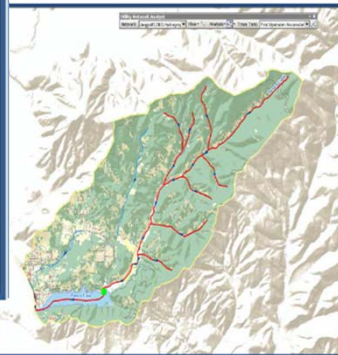
- NLCD (2006)
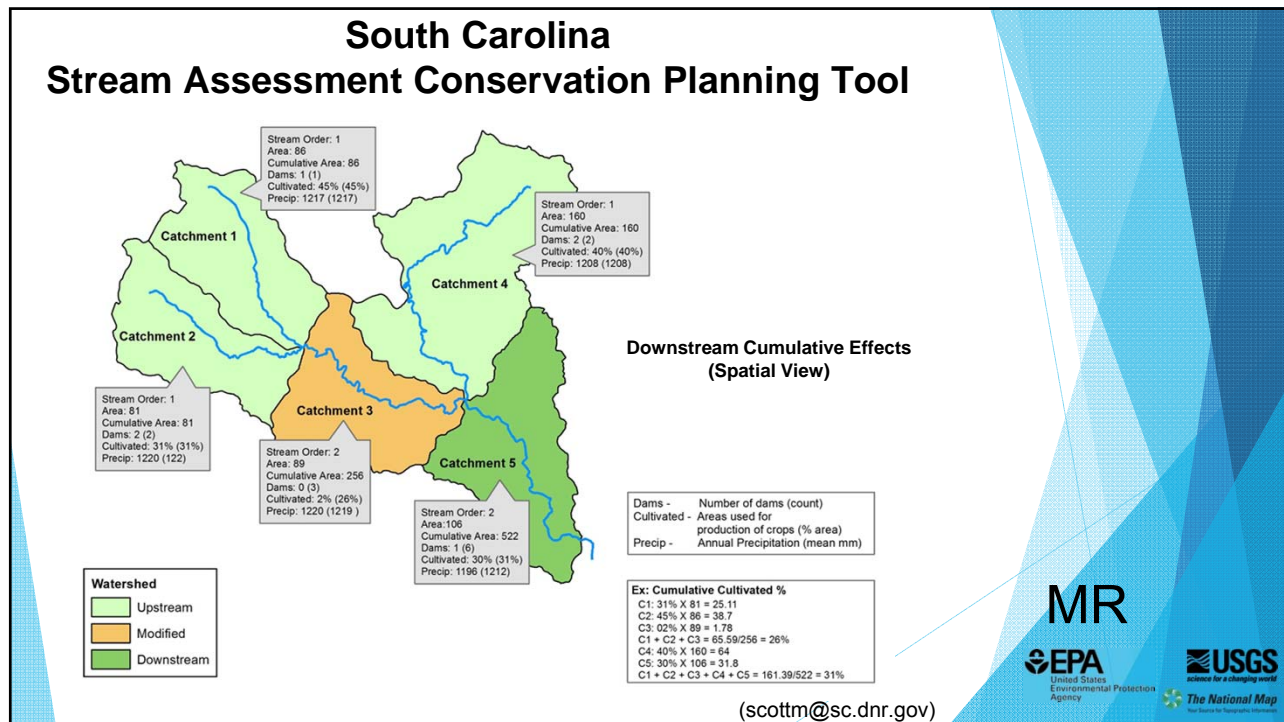- Road Density
- Population Density

Upstream Accumulation of Catchments with NHD Flowlines

(jim.szpara@deq.idaho.gov)

MR

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South Carolina
Stream Assessment Conservation Planning Tool
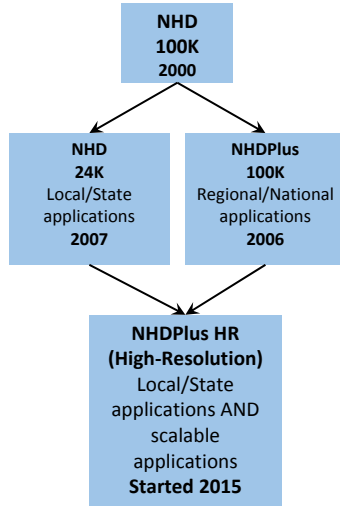

Access to NHD*Plus* Resources

- NHD*Plus* Resources on the NHD*Plus* Web site:
  - Just *Google 'epa water data tools' (hosted by EPA)*
- Technical support and application consultation
  - Email nhdplus-support@epa.gov

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NHDPlus HR in Development

Taking NHDPlus v2 (MedRes) to a new level

NHD
100K
2000

NHD
24K
Local/State
applications
2007

NHDPlus
100K
Regional/National
applications
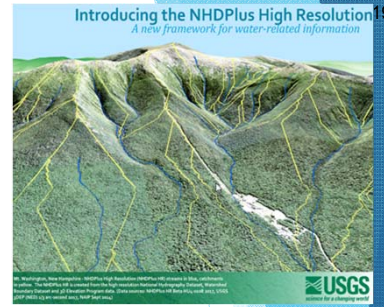2006

NHDPlus HR
(High-Resolution)
Local/State
applications AND
scalable
applications
Started 2015

The best of 24K+ data and NHDPlus

Addresses the need for a single hydrographic frame of reference

Link data to one network and generalize to many different scales

Introducing the NHDPlus High Resolution[19]
A new framework for water-related information

https://nhd.usgs.gov/NHDPlus_HR.html

HR

EPA
United States
Environmental Protection
Agency

USGS
science for a changing world

The National Map
Your Source for Topographic Information

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[20]

Keeping Up with Change: Roles and Responsibilities for Managing NHD and NHDPlus

High Resolution
NHD and NHDPlus HR – USGS

Medium Resolution
NHD and NHDPlus - EPA

What if you find an error or the stream is no longer there?

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USGS
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The National Map
Your Source for Topographic Information

Where Do I Find NHD?

<u>View and Download</u>:
The National Map: https://viewer.nationalmap.gov

Data Download and Visualization Services

Maps
- Download Maps
- Explore Historical Topo Maps and Download
- Buy a Printed Map
- CSV of Map Products

GIS Data
- Download GIS Data
- Cloud Browse
- FTP Access
- Small-scale Data
- Historical Data Archives
- Hazards Events

National or Extract by HU4, HU8, or State

Visualization
- TNM Viewer
- TNM Viewer (legacy)
- List of Map Services
- How to Use Map Services
- Map Service Status
- Advanced Viewers

Applications
- TNM Download Client
- TNM Download Manager
- TNM Mobile
- USGS Streamer
- Application List

Extract by HU4, HU8, or State

Tools
- Elevation Tools
- Metadata Lineage Reporter
- Point Query Service (PQS)
- Raster Conversion Tools
- Topo TNM Style Template
- Other API Example Demos

More Information
- How To Videos
- FAQs
- List of Datasets
- TNMAccess API
- TNM Metrics
- Contact Us

<u>Web Services</u>: https://services.nationalmap.gov

For more details see: https://nhd.usgs.gov/data.html

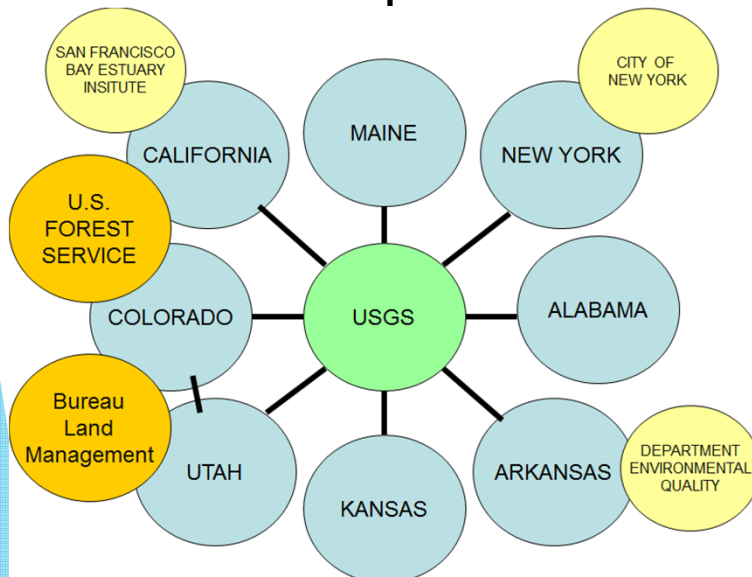
Who Does Create NHD?
NHD Stewardship

Stewardship Agreement (MOU)

<u>State stewards to serve as:</u>
➔ A point of contact for local NHD data questions
➔ A point of contact for local technical editing
➔ A point of contact of local coordination

<u>USGS to provide:</u>
➔ Technical support
➔ Documentation
➔ NHD Tool
➔ Free Training
➔ Program coordination and guidance

Slide 23

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USGS Resources to Support NHD Stewardship

HR

Slide 24

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Found an Error in NHD or NHDPlus HR, or Want to Get Involved?

Options for reporting errors:
1. Contact your state steward
2. Use "Report Data Issue" on https://nhd.usgs.gov/

Options for getting involved in making changes:
1. Contact your state steward to collaborate
2. Become an approved NHD editor - contact the state steward and USGS Technical Point of Contact
3. Participate in NHDPlus HR Beta QC - contact Tatyana Dimascio

HR

Who is My NHD Steward?

1. Go to nhd.usgs.gov
2. Go to Stewardship
3. Go to "Locate your area's stewardship POC"
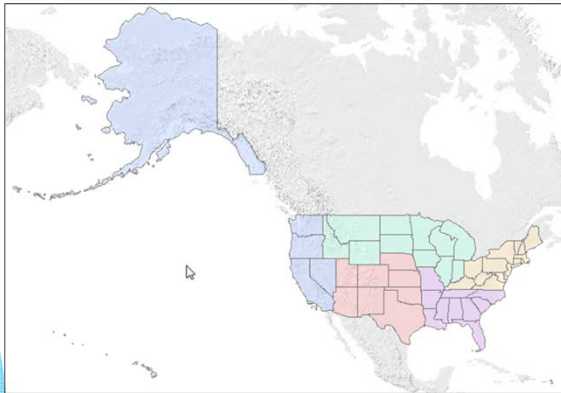
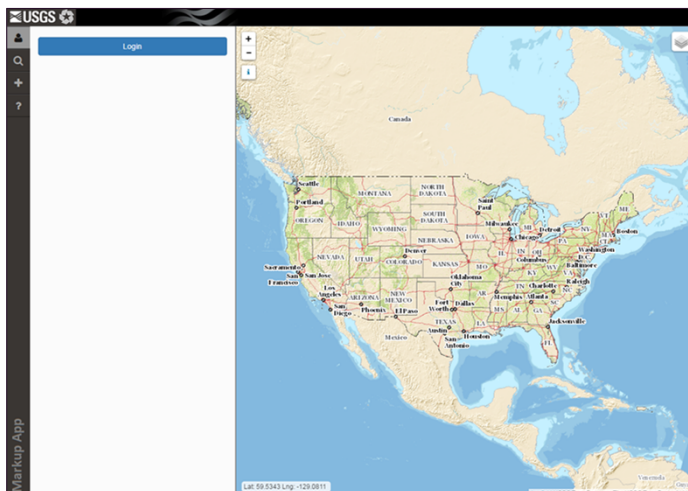**State of New York**

Status: Signed
Signed Document

USGS Region V Point of Contact (NY)
Name: Tatyana DiMascio
E-mail: tdimascio@usgs.gov
Phone: 3032024206
Organization: USGS National Geospatial Technical Operations Center - De

New York NHD Principal Steward
Name: Tim Daly
E-mail: timothy.daly@its.ny.gov
Phone: 518-402-9872
Organization: New York State Department Of Environmental Conservation

Stewardship State Regions
- Region I
- Region II
- Region III
- Region IV
- Region V

HR

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USGS
science for a changing world

The National Map
Your Source for Topographic Information

Another Option for Reporting Errors in NHD is Coming - Markup Application

Users:
Public, non-trained NHD and WBD editors, academia, etc.

Purpose:
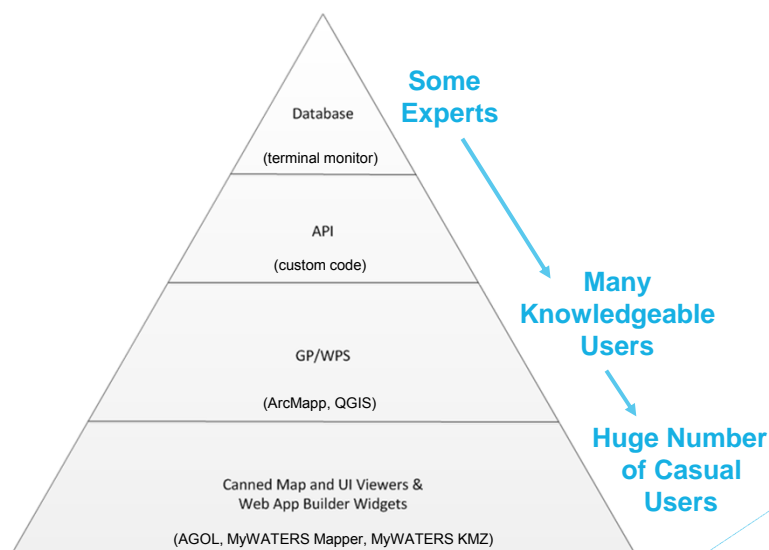- Creating new markups for NHD, NHDPlus HR, WBD layers
- Viewing markups and their status

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The National Map
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Medium Resolution Stewardship
Reporting Updates to NHD in NHD*Plus*

- Users identify and report errors/improvements that can then be applied to NHD by EPA data editors.

- When reporting errors, users provide:
  - a geographic reference for the features that need to be corrected,
  - a description of the error, and
  - an image of how any new geometry should look.

- The NHD edits are integrated into NHD*Plus* during the next refresh - subject to program priorities and funding.

MR

NHD*Plus* Technologies and Users

Database
(terminal monitor)

API
(custom code)

GP/WPS
(ArcMapp, QGIS)

Canned Map and UI Viewers &
Web App Builder Widgets
(AGOL, MyWATERS Mapper, MyWATERS KMZ)

Some Experts

Many Knowledgeable Users

Huge Number of Casual Users

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NHD Tools

Editing Tools:

- NHD Update Tool
    Check out jobs for HU8 or HU10 to start editing immediately.
    Good for processing fewer than several hundred edits at a time
    Built-in QC
    For questions, contact your USGS Technical Point of Contact

- NHD Geoconflation
    Complex process to major editing (several thousand edits) to geometries or attributes
    Replacing complete geometries while maintaining reach codes and GNIS names
    Validation Data without NHD compatibility
    Replacing full information within HU8 or HU10.
    Technical Contact: David Anderson at NHD-GCT@usgs.gov
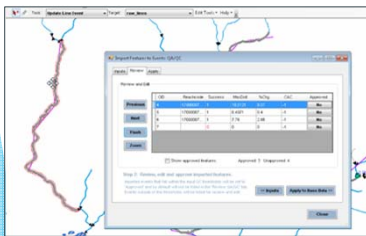
The Hydrography Event Management (HEM) Tool

- Provides full functionality for adding and editing events in the NHD.
- Handles all the linear referencing mechanics to make working with events easy.
- Works on point, line, and area events and allows events to be located interactively, imported, or calculated.
- Has Syncronization Option for changes between versions
- Technical Contact: Michael Tinker at mdtinker@usgs.gov

Other Tools: https://nhd.usgs.gov/tools.html

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NHD Web Tools - Hydrolink Tool
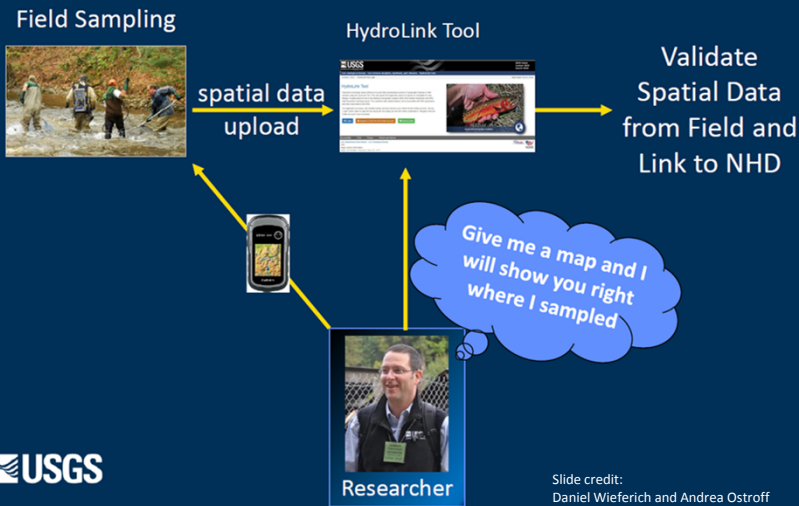
Technical Contacts:

Daniel Wieferich - dwieferich@usgs.gov

Andrea Ostroff - aostroff@usgs.gov

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NHD Web Services

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NHD and WBD services:
- Found at https://services.nationalmap.gov/arcgis/rest/services

HEM (Hydro Event Management) Web services:
- Allow to create, edit, and display "events"
- Found at https://edits.nationalmap.gov/arcgis/rest/services
- Documentation: https://edits.nationalmap.gov/hem-soe-docs/

"USGSHydroCached" service:
- New Hydrography Cached Map Service
- Can be used in overlay
- Improved performance
- Can be found at:
  https://basemap.nationalmap.gov/arcgis/rest/services/USGSHydroCached/MapServer

HR

EPA USGS

NHD*Plus* Core Tools and Services

* Desktop tools (ESRI ArcGIS)
    * Data prep and check-update utilities for your local NHD*Plus* holdings
    * Network navigation
    * Watershed delineation
    * Catchment attribute allocation and accumulation (CA3T)
* Web services (ESRI and Open Source)
    * Mapping and analytical services including -
        * Network navigation with linked data search
        * Watershed delineation
        * Watershed report
        * And others …
    * Accessible by desktop clients (ESRI ArcGIS, Google Earth …) and Web viewers (ESRI ArcGIS Online …)

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EPA USGS

New NHD*Plus* tools!

- Network distance script (desktop)
  - Number of permitted dischargers xx miles upstream of an impaired water
- Watershed report
  - Incorporates StreamCat catchment attributes
- Analytical services as ESRI GP services
  - Upstream/downstream search
  - Watershed delineation
- HydroLink web indexing tool

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Upstream navigation GP service under AGOL

MR

Hydro Network Linked Data Index (NLDI)

https://cida.usgs.gov/nldi/huc12pp/030801011008 …

… navigate/UT/nwissite   … navigate/UT/wqp
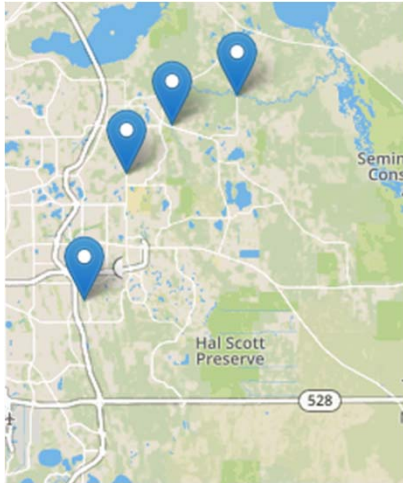
(Slide: Dave Blodgett)

MR
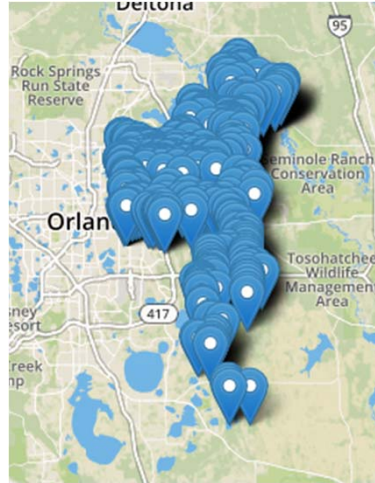
Web Service Performance

We're still feeling the need for more speed!

- **Cloud scalable performance**
- **Database tuning**
- **Dynamic cache**
- **Pre-computing national cache**

MR HR

Oh … there's one more thing …

(Steve Jobs, Apple)

Catchment-based Indexing Approach for Measuring Performance and Tracking Water Quality

EPA is implementing a new approach (using NHD*Plus* catchments) to measure progress under the 303(d) Impaired Waters Program Vision, and in the future will use this new approach for tracking water quality restoration, maintenance, and protection.
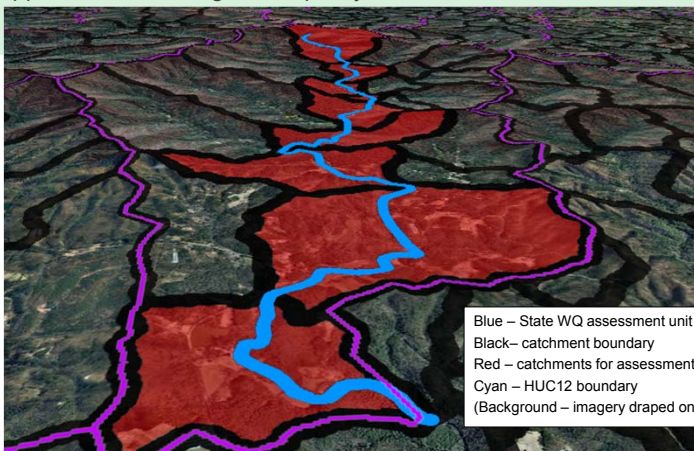
Blue – State WQ assessment unit
Black– catchment boundary
Red – catchments for assessment unit
Cyan – HUC12 boundary
(Background – imagery draped on elevation)
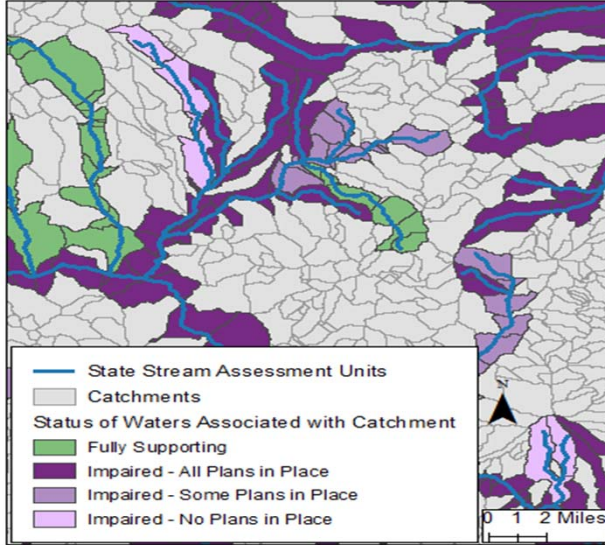
MR

(young.dwane@epa.gov)

Clean Water Act Section 303(d) Performance Measures (draft)

State Stream Assessment Units
Catchments
Status of Waters Associated with Catchment
Fully Supporting
Impaired - All Plans in Place
Impaired - Some Plans in Place
Impaired - No Plans in Place

0   1   2 Miles

MR

(reid.wendy@epa.gov)

Any questions?

The End

Tatyana DiMascio
tdimascio@usgs.gov

Tommy Dewald
dewald.tommy@epa.gov