AGENDA

- **NHDPlusHR Value Added Attributes Demo.**
  - LevelPathID
  - TerminalPath
- **National Stream Internet Project**
- **Updates**
  - WBD/NHD
  - NHDPlusHR
  - NHD/WBD Tool Status
- **Other Business**
- **Upcoming Events**
- **Next TWG**
  Sept. 10, 2020
NHDPlusHR Value Added Attributes Demonstration

• Ariel Doumbouya, USGS
NHDPlus High Resolution Value Added Attributes: LevelPathID and TerminalPath
Presentation Overview

- NHDPlus High Resolution (NHDPlus HR)
- NHDPlus HR Flowline VAA Basics
- LevelPathID & Terminal Path
- Where to Find More Information
USGS National Hydrography Datasets

Hydrologic networks, units, catchments, and more…

**Watershed Boundary Dataset (WBD)**
- The drainage basins at 8 scales of a nested hierarchy; defines the areal extent of surface water drainage to a point

**National Hydrography Dataset (NHD)**
- The drainage network with features such as rivers, streams, canals, lakes, ponds, and stream gages

**NHDPlus**
- Incorporates features of the NHD, WBD and 3DEP elevation data to create a networked hydrography framework that incorporates the entire landscape
NHDPlus Completes the Framework

- Brings together NHD, WBD and elevation data to incorporate the landscape as a part of the stream network
- Creates a national framework for water-related information and enhance modeling capabilities
- Medium Resolution completed for CONUS (1:100,000), High Resolution in work (1:24,000)
NHDPlus 101

NHDPlus is a digital stream network for hydrologic modeling with catchments and a suite of related geospatial data

- Includes:
  - Value Added Attributes that enhance stream network navigation, analysis and display
  - An elevation-based catchment area for each flowline in the stream network
  - Catchment characteristics, including mean annual precipitation, mean annual temperature, mean annual runoff, and mean latitude
  - Cumulative drainage area characteristics
  - Mean annual flow (1971-2000) and velocity estimates for each flowline with 10 years of continuous data for the above period
  - Flow direction, flow accumulation, elevation, and hydro-enforced elevation rasters
  - Headwater node areas
  - Flowline min/max elevations and slopes
NHDPlus Develops More Detail
Accessing NHDPlus HR Data

- **National Map Downloader**

![Map Downloader Screenshot]

1. Select Hydrography (NHDPlus HR, NHD, WBD)
2. Expand Product Search Filter
3. Choose Data Extent and File Format
4. Click "Find Products"
Accessing NHDPlus HR Data

- National Map Downloader

Download 1: Vectors (gdb)

Download 2: Rasters (folder)
Accessing NHDPlus HR Data

National Hydrography Website

The National Geospatial Program manages the National Hydrography Dataset (NHD), Watershed Boundary Dataset (WBD), and NHDPlus High Resolution (NHDPlus HR). These geospatial datasets represent the surface water of the United States for mapping and modeling applications.

Update National Hydrography with the Markup App
Have a correction or update for the NHD, WBD, or NHDPlus High Resolution? Visit the Markup App!

NHDPlus HR - the Next Generation of National Hydrography
Check out the NHDPlus High Resolution (NHDPlus HR) framework - a new, integrated hydrography and elevation dataset

Get the NHD Newsletter to keep up with the latest Hydrography info
Sign up to receive the National Hydrography Dataset newsletters for updates, information, and the hydro quiz!

The National Hydrography Dataset (NHD) and Watershed Boundary Dataset (WBD) form a rich geospatial data suite that maps the Nation's surface water network and hydrologic drainage areas. The NHD, at 1:24,000-scale or larger, represents the Nation's rivers, streams, canals, lakes, ponds, glaciers, coastlines, dams, and streamgages, and related features. The WBD represents drainage areas of the country as eight nested levels of hydrologic units. The NHD and WBD are the most up-to-date and geographically inclusive hydrography datasets for the Nation.

Together, the NHD and WBD act as an addressing system similar to streets (NHD) and ZIP Codes (WBD), creating an indexing and reporting system for water resources studies and information. Hydrographic addressing tools, such as the Hydrography Event Management (HEM) Tool and Hydrolink Tool, provide mechanisms to reference data to this surface water network. However, using the NHD and WBD alone, this addressing system does not have the ability to connect information about the surrounding landscape to the stream network.
Accessing NHDPlus HR Data

National Hydrography Website

Download by Link

NHDPlus High Resolution (NHDPlus HR) Direct Download Links

Please note: The NHDPlus High Resolution is being released for download in Beta version (NHDPlus HR Beta) by 4-digit Hydrologic Unit (HU4) as it is built. Please see the NHDPlus High Resolution (NHDPlus HR) page for more information about this building process, to find out the current availability by 2-digit Hydrologic Unit (HU2), and to learn about participating in reviews of the Beta version data.

The NHDPlus HR data includes both vector and raster components for each geographic area mapped. NHDPlus HR Beta vector data is available in file geodatabase (GDB) format, zipped (.zip) to reduce the file size. NHDPlus HR raster data files are available for download as zipped (.zip) files.

- Download the NHDPlus HR by 4-digit Hydrologic Unit (HU4)
- Download the NHDPlus HR by 8-digit Hydrologic Unit (HU8) - Alaska Only

NHD High Resolution Dataset (NHD) Direct Download Links

The NHD High Resolution can be directly downloaded in shapefile or file geodatabase (GDB) format by Hydrologic Unit (HU), state, or the entire nation. Also, an extract containing only streamgages and dams is available.

- Download the NHD by 4-digit Hydrologic Unit (HU4)
- Download the NHD by 8-digit Hydrologic Unit (HU8)
- Download the NHD by State
- Download the NHD by the Entire Nation
- Download streamgages and Dams only

Watershed Boundary Dataset (WBD) Direct Download Links

The WBD can be directly downloaded in shapefile or file geodatabase format by 2-digit Hydrologic Unit (HU2) or as a file geodatabase for the entire nation.

- Download the WBD by 2-digit Hydrologic Unit (HU2)
- Download the WBD by the Entire Nation

National data are refreshed monthly.
- Download the WBD from the NRC's Geospatial Data Gateway

Watershed Boundaries can also be downloaded from the Natural Resources Conservation Service. Data on the Geospatial Data Gateway are refreshed every six months (March and September).

Map Services

Hydrography web-based map services are available from The National Map Service Endpoints page as cached
# Accessing NHDPlus HR Data

- 4 downloads per unit (HU/VPU)

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NHDPlus Value Added Attributes (VAAs)

- The result of building NHDPlus HR is a set of value added geospatial layers and hundreds of attributes.
- Many of the attributes are computed from the analysis of the NHD network.
- These attributes are designed to make the NHD network more powerful and easier to use.
NHDPlus HR VAAs

- A set of value added attributes (VAAs) to enhance stream network navigation, analysis and display (inc. stream order)
- Catchment characteristics
- Cumulative drainage area characteristics
- Flowline min/max elevations and slopes (in meters)
- Flow volume (Q) & velocity (V) estimates for each flowline in the stream network

- File: NHDPlus_H_0903_GDB.gdb
  - Hydrography
    - HYDRO_NET
    - HYDRO_NET_Junctions
    - NHDArea
    - NHDFlowline
    - NHDLIne
    - NHDPoint
    - NHDWaterbody
  - NHDPlus
    - NHDPlusBurnLineEvent
    - NHDPlusBurnWaterbody
    - NHDPlusCatchment
    - NHDPlusLandSea
    - NHDPlusSink
    - NHDPlusWall
  - WBD
    - NonContributingDrainageArea
    - NonContributingDrainageLine
    - NWISDrainageArea
    - NWISDrainageLine
    - WBDHU10
    - WBDHU12
    - WBDHU14
    - WBDHU16
    - WBDHU2
    - WBDHU4
    - WBDHU6
    - WBDHU8
    - WBDLine

- Files: NHDPlusDivFracMP, NHDPlusEROMMA, NHDPlusEROMQAMA, NHDPlusEROMQAPT, NHDPlusFlow, NHDPlusFlowlineVAA, NHDPlusIncrClat
NHDPlus HR VAAs

Categories

1. NHDFlowline Attributes
2. Navigation Attributes
3. Analysis Attributes

NHDPlus HR Beta 1704
Weighted symbology based on NHDPlus
HR VAA: StreamOrder
NHDPlus HR VAAs

Analysis Attributes

Designed to support network analysis

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NHDPlus HR VAAs

Join NHDFlowline FC with NHDPlusFlowlineVAA table

- NHDPlusID is the join field
- These are the only 2 feature classes/tables required for this demonstration.
NHDPlus HR VAAs

Analysis Attributes: LevelPathIdentifier

- The identifier for all the flowlines on a level path from mouth to headwaters

- River Main Stem

- HydrologicSequence number of the most downstream flowline of a specific river

NHDPlus HR Beta 19020505

LevelPathIdentifier = 22

HydrologicSequence = 22
NHDPlus HR VAAs

Dissolve: LevelPathIdentifier

- Input: Joined NHDFlowline and NHDPlusFlowlineVAA
- Optional Step: Statistics Fields
NHDPlus HR VAAs

InNetwork = No

- Currently corresponds to FlowDir = Uninitialized
- No NHDPlus HR VAAs computed for these features
NHDPlus HR VAAs

Analysis Attributes: LevelPathIdentifier

- LevelPathID in combination with LengthKM (from NHDFlowline)
NHDPlus HR VAAs

Analysis Attributes: TerminalPathIdentifier

- The identifier for all connected and flowline flowlines from mouth to headwaters
- River Main Stem plus all tributaries
- HydrologicSequence number of the most downstream flowline of all connected flowlines
NHDPlus HR VAAs

Dissolve: TerminalPathIdentifier

- Input: Joined NHDFlowline and NHDPlusFlowlineVAA
- Optional Step: Statistics Fields
Putting it all together

VPUOut = 1/Yes

- One or more downstream VPU/HU
Putting it all together

Examine LevelPathIdentifier at VPUOut

- Select from joined NHDFlowline/NHDPlusFlowlineVAA where LevelPathID = value at outflow (VPUOut)
Putting it all together

LevelPathIdentifier and GNIS

■ Select from joined NHDFlowline/NHDPlusFlowlineVAA where GNIS_Name = ‘Snake River’
Putting it all together

Examine LevelPathIdentifier in relation to GNIS

- Missing GNIS_ID caused LevelPathID to change
Putting it all together

Examine TerminalPathIdentifier at VPUOut

- Select from joined NHDFlowline/NHDPlusFlowlineVAA where LevelPathID = value at outflow (VPUOut)
Putting it all together

How is the data connected?

- VPUOut will correspond to VPUIn in next downstream VPU/HU
- **LevelPathIdentifier** continues through hydrologically connected VPU
Putting it all together

How is the data connected?

- VPUOut will correspond to VPUIn in next downstream VPU/HU
- TerminalPathIdentifier continues through hydrologically connected VPUs
NHDPlus HR VAAs

- A set of value added attributes (VAAs) to enhance stream network navigation, analysis and display (inc. stream order)
- Catchment characteristics
- Cumulative drainage area characteristics
- Flowline min/max elevations and slopes (in meters)
- Flow volume (Q) & velocity (V) estimates for each flowline in the stream network
More Information: NHDPlus HR
National Hydrography Website
Questions/Comments

- Ariel Doumbouya (atdoumbouya@usgs.gov)

- National Hydrography Website: usgs.gov/NatHydro
National Stream Internet Project

- David Nagel, USFS
U.S. Forest Service
Aquatic Resources Data for the Western U.S.

David E. Nagel, Daniel J. Isaak, John M. Buffington, Charles H. Luce, and Michael K. Young

U.S. Forest Service, Rocky Mountain Research Station; Air, Water and Aquatic Environments Program

IDWR Hydrography Technical Working Group Meeting
March 12, 2020
Boise Aquatic Sciences Lab

Air, Water, and Aquatic Environments Program

Idaho Water Center

Fish and watershed research
Principal Investigator
Dr. Daniel Isaak

Boise Spatial Streams Group

- Gwynne Chandler – Database
- Dona Horan – SAS and GIS
- David Nagel – GIS
- Sharon Payne – Web and GIS
- Sherry Wollrab – Database and GIS
Research conducted at landscape or regional scales

100s kilometers

1,000+ kilometers
Built on a Common Framework
100K Medium Scale NHDPlus

NHDPlus Version 2

NHDPlusV2 consists of the following components:

- Greatly improved 1:100K National Hydrography Dataset (NHD)
- Greatly improved 1 arc-second (approximately 30 meter ground spacing) National Elevation Dataset (NED)
- Nationally complete Watershed Boundary Dataset (WBD)
- A set of value added attributes to enhance stream network navigation, analysis and display
- An elevation-based catchment for each flowline in the stream network
- Catchment characteristics
- Headwater node areas
- Cumulative drainage area characteristics
- Flow direction, flow accumulation and elevation grids
- Flowline min/max elevations and slopes
- Flow volume & velocity estimates for each flowline in the stream
- Catchment attributes and network accumulated attributes
- Various grids from the hydro-enforcement process including the
AWAE provides impartial information on the health of our ecosystems and environments, the natural resources we rely on, the impacts of climate and land-use change, and the core science systems that help us provide timely, relevant, and usable information. To learn more, access publications written by our scientists in a variety of formats.

PUBLICATIONS

PROJECTS, TOOLS, & DATA

RESEARCH TOPICS

AWAE

RMRS AWAE scientists cover a wealth of different subject areas, with much collaboration between specialties. Scientists have extensive experience and expertise within the Rocky Mountain Research Station’s Strategic Research Priorities and associated Sub-Elements, including:

- Disturbance Ecology
- Fire Sciences
- Human-Landscape Interactions
- Inventory & Monitoring
- Species Endangerment
- Resilient Landscapes
- Water & Watersheds
Data are peer reviewed, quality assured, and documented

Stream Internet Quality Assurance Protocol
D. Nagel, January 31, 2015

Before Merging QA Procedure

Display the reconditioned stream lines in blue 1.5 width. Display the original stream lines (NHDFlowline.shp) underneath in in red 1.0 width in the same viewer. Look at the streams that were deleted. See if they meet the criteria of being uninitialized flow, or braids or diversions.
Datasets

- Stream temperature
- Fish habitat patches
- Stream flow metrics
- Valley confinement
- Edited NHDPlus flowlines (NSI)
- Environmental DNA (eDNA)
- Stream gradient
1) NorWeST Stream Temperature

Modeled stream temperature at 1 km resolution for the Western U.S.

Regional Database and Modeled Stream Temperatures

STARS and SSN
NorWeST Model Inputs

Observed Temperatures

Predictors

- Elevation
- Canopy percent
- Stream gradient
- Precipitation
- Catchment area
- Latitude
- Lake influence
- Base flow index
- Tailwater flag
- Air temperature
- Flow
Example Data

1993

Air = 11.9 °C  Flow = 50.1 cms

2003

Air = 15.8 °C  Flow = 26.7 cms
NorWeST Products

1) Summarized stream temperature observation data (database)

2) Modeled stream temperature scenarios

Excel and Esri shapefile format

Salmon Basin

Daily metrics

Annual August means
Google: Norwest stream temperature
2) Cold-Water Climate Shield

Mapped, thermally suitable habitat patches for juvenile cutthroat and bull trout
Thermally Suitable Habitat Patches

**Patch 1**
Total length: 124 km
Mean: 9.6° C

**Patch 2**
Total length: 25 km
Mean: 9.1° C
Distributing shapefiles and PDF maps
Google:
Cold water climate shield
3) Western U.S. Stream Flow Metrics

Western U.S. Stream Flow Metrics - A dataset of modeled flow metrics for streams in major river basins of the Western US for historical and future climate change scenarios.

Dr. Charles Luce and Abby Lute

- Derived from Variable Infiltration Capacity (VIC) model
- Distributing tables linked to NHDPlusV2 COMID
- Historic and future flows

- Metrics
  - Mean annual flow
  - Mean August flow
  - Winter 95th percentile
  - Winter 99th percentile
  - 1.5 year flood
  - Center of flow mass
Network Thinning

Full NHDPlus network

Mean annual flow > 0.5 cfs

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Google:
Western U.S. streamflow
4) Valley Bottom Confinement

GIS algorithm uses NHDPlus and elevation data to identify unconfined valley bottoms

Brook trout, Chinook, steelhead
Algorithm uses a flooding approach based on bankfull depth.
Valley Bottom Data Distribution

Portions of NHDPlus regions 17 and 10

Download Shapefiles

Forest Service lands of the Interior Columbia Basin in Region 17

Forest Service lands in the northwestern portion of Region 10

View Metadata (PDF)
Google: Valley confinement algorithm
5) National Stream Internet

The National Stream Internet Project

National edited NHDPlus flow lines for use with Spatial Stream-network Models

STARS and SSN
Uninitialized flow

Multi-confluence

Braids

Convergence

Edits
Redistributing edited NHDPlus flow lines with a User Guide

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Google:
National stream internet
6) eDNA Bull Trout Status Assessment

A spatial framework for water sampling, to detect free DNA and assess bull trout distribution.
eDNA Bull Trout Project Scope

- 117 8-digit HUCs in historical range of BT
- 41,000+ sample sites at 1 km interval
- 6,600 samples contributed to date
- Collected by FS field crews and numerous cooperators
- Three year timeframe
- Sample results posted as available
Bull Trout AGOL Tool
Google: Bull trout edna
7) eDNAAtlas

The Aquatic eDNAAtlas Project

A spatial framework for water sampling, to detect free DNA and assess distribution of most cold-water
eDNAAtlas Project Scope

- 1km sampling grid along all streams in the Western and Eastern U.S.
- Unique site IDs
- Sampling kits available on loan
- Results posted when available
- 11,000+ samples contributed to date
eDNAAtlas AGOL Tool
Google:
edna atlas
8) West-wide Stream Gradient
Coming Soon
Gradient Calculations

NHD gradient

5%

Ideal gradient

7%

2%
Our solution is a variable interval spacing, which varies by slope class and approximates the original quad map contour spacing.

High gradient = short intervals

Low gradient = longer intervals
Variable intervals approximating original contours
High Slope Streams
(Cascade - Slope > 7.5%)

Low Slope Streams
(Pool-riffle - Slope < 1.5%)

Mean error = ABS(contour slope – interval slope)

Denotes minimum error

36% improvement over 810 m

40% improvement over 160 m
Final Channel Gradient
AWAE provides impartial information on the health of our ecosystems and environments, the natural resources we rely on, the impacts of climate and land use change, and the core science systems that help us provide timely, relevant, and useful information. To learn more, access publications written by our scientists in a variety of formats.

PUBLICATIONS

PROJECTS, TOOLS, & DATA

RESEARCH TOPICS

RMRS AWAE scientists cover a wealth of different subject areas, with much collaboration between specialties. Scientists have extensive experience and expertise within the Rocky Mountain Research Station’s Strategic Research Priorities and associated Sub-Elements, including:

- Disturbance Ecology
- Human-Landscape Interactions
- Resilient Landscapes
- Fire Sciences
- Inventory & Monitoring
- Species Endangerment
- Water & Watersheds
Thank you
Updates

• **NHD**
  - VisFilter Attribute is complete. Please update your NHD to take advantage of it.
  - New feature – Drainageway: Will be added soon. Will have more at next TWG.

• **WBD**
  - Some model changes coming. More to come at the Sept. TWG.

• **NHDPlus HR**
  - Region 16 & 17 in beta. Working on refresh of 1601.
  - If you want to submit QC edits, see IDWR website.
  - Refresh cycle starting with Regions 6, 1, & 2.
  - [VAA Webpage](#)

• **Markup Reviewer**
  - For submitting small edits to all 3 datasets.

• **IDWR**
Updates

NHD/WBD Tools Status

Editor Tools: All require ArcGIS 10.5.1
- NHD: version 6.7.1.0
- WBD: version 2.9.1.31
- GeoConflation: 3.4.1.0

Tools available from nhd.usgs.gov
- HEM: version 2.10.0.1
- Utilities: version 3.1.1.0
  - Network Builder Requires ArcGIS Standard or Advanced License

Training: Will begin again in May. Email NHD.WBD@idwr.Idaho.gov if interested.

• IDWR
Other Business?
Upcoming Events

- **IWUA Water Law & Resource Issues Seminar**
  - June 8-9, 2020  Sun Valley, ID

- **URISA GIS-Pro**
  - Sept. 27 – Oct. 1, 2020  Baltimore, MD

- **Northwest GIS Conference**
  - Sept. 27-Oct. 2, 2020  Boise, ID
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Website Information: http://idwr.idaho.gov/GIS/NHD/

NEXT TWG MEETING: Sept. 10, 2020