Aquatic Resource Mapping

WESTERN STATES WATER COUNCIL FALL MEETING

OCTOBER 14, 2020

Aquatic Resource Mapping - Overview

Dwane Young, Chief Water Data Integration Branch

U.S. EPA, Office of Water

Outline for Our Discussion

- Overview
  - Vision
  - Interagency Workgroup
  - Outcomes and Process
  - Case Study Areas
- Enhancements to the National Frameworks
  - National Hydrography Dataset (Jason Stoker, USGS)
  - National Wetlands Inventory (Megan Lang, U.S. FWS)
- Research and Modeling Efforts (Jay Christensen, U.S. EPA/ORD)
- Open Discussion / Questions

Vision

Strive to improve our understanding of the nation's aquatic resources as they relate to the Clean Water Act. The effort will also provide a visual, geospatial representation building upon existing frameworks (National Hydrography Dataset and National Wetlands Inventory) to improve the regulatory understanding for landowners and water resource managers about the potential Clean Water Act jurisdictional status of aquatic resources nationwide.

Interagency Workgroup

Organization:

Executive Communication Group: Reviews and communicates products for senior agency leadership

Planning Group: Project planning and coordination

Georeferencing and Data Interoperability Group: Identifies approaches for connecting data to the frameworks and evaluates approaches for integrating federal, state, and other data

Modeling Group: Evaluates available modeling capability for improving understanding of flow permanence (i.e., perennial, intermittent, ephemeral) and connectivity (e.g., adjacency, direct hydrologic surface connection, inundation by flooding)

Modernized Frameworks Group: Evaluates existing plans for NHD and NWI modernization and identifies requirements for future modernization efforts

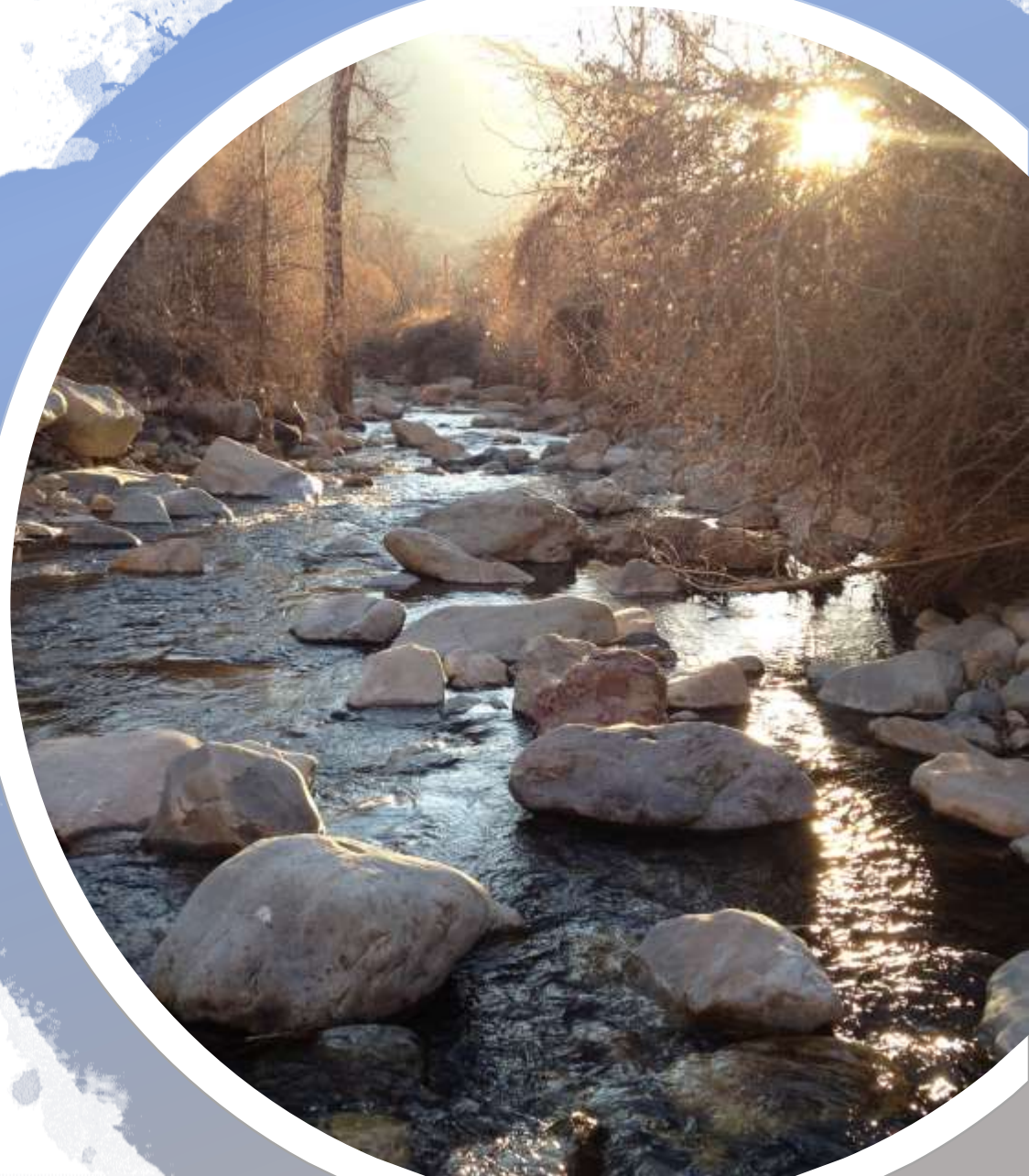
EPA United States Environmental Protection Agency

USGS science for a changing world

U.S. Fish & Wildlife Service

Planned Outcomes: Short-Term and Long-Term

- Short-Term: Requirements, Options, and Resource Estimates that achieve the vision that has been described
- Long-Term: Develop a Decision Support System (DSS) that is built upon existing frameworks that steadily improves over time as more data become available
- Interagency Workgroup and sub-workgroups are engaging in two-week ‘Sprints’ with specific goals for each sprint



Use of Case Studies

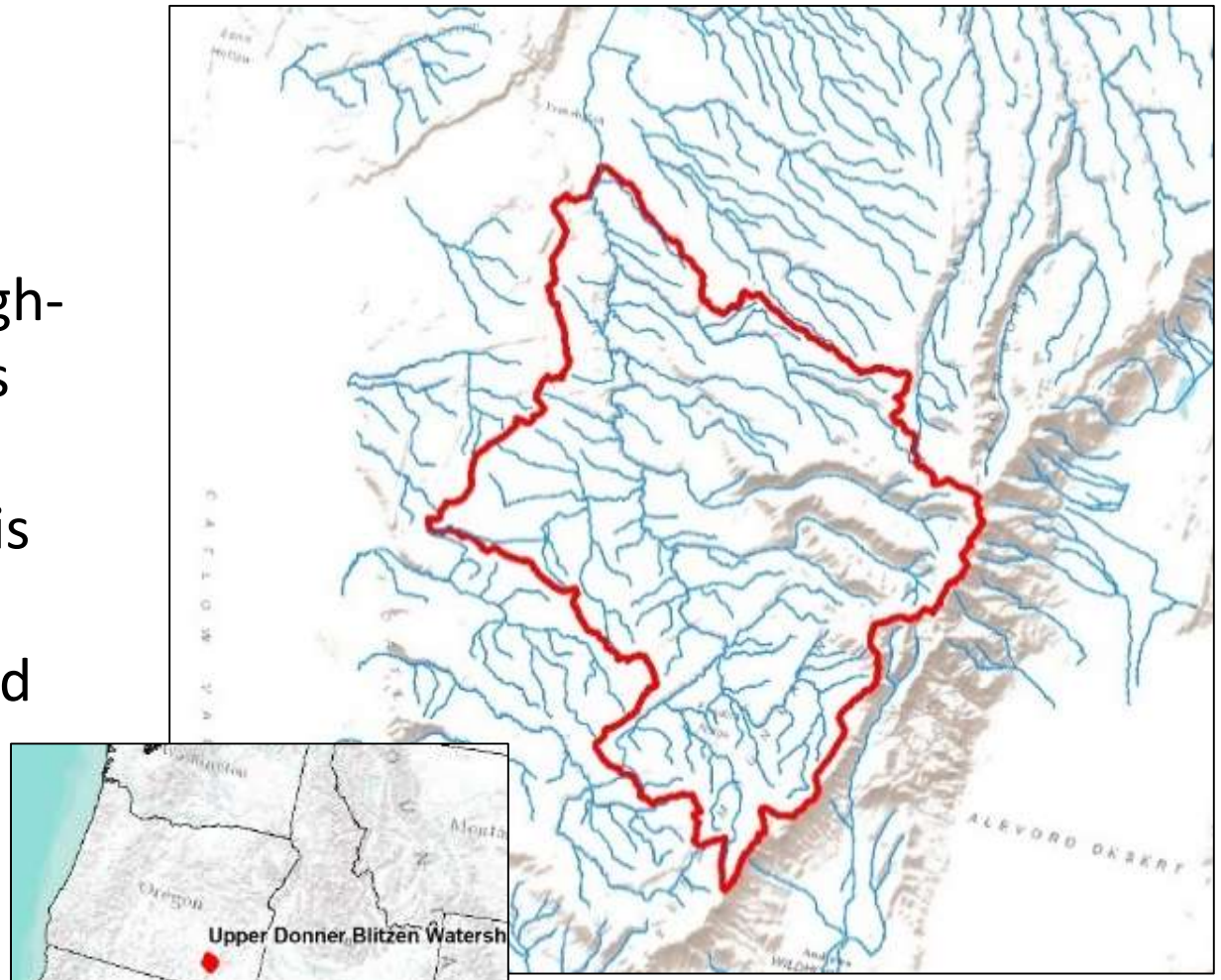
- The workgroups are using Case Study areas to help focus the activities and to provide a diverse set of challenges to evaluate as we identify requirements, options, and resource needs
- Identified four Case Study areas (three HUC10s and one HUC8):
  - Upper Donner Blitzen in Eastern Oregon
  - Roaring Fork in Colorado (in the upper Colorado River Basin)
  - Cedar Creek in Northern Indiana
  - Upper Choptank in Maryland and Delaware

Case Study 1: Upper Donner Blitzen

HUC10: 1712000301

Size: ~209 Square Miles

Characteristics of Interest: Arid, high-desert environment with numerous wetlands downstream. USGS has conducted extensive research in this watershed which may help in characterizing flow permanence and surface hydrologic connectivity. Availability of high-resolution data in the northern part of the basin.



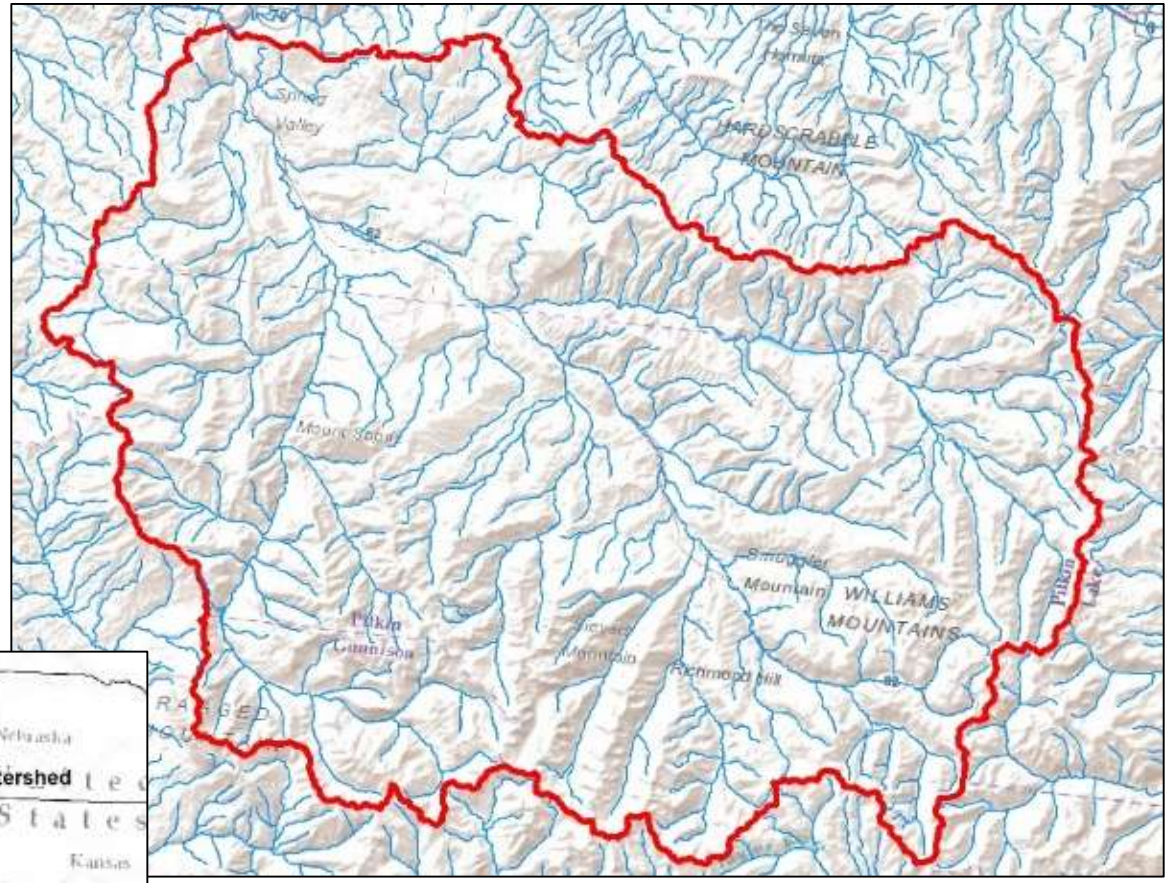
Medium-resolution NHD shown – Higher resolution available

Case Study 2: Roaring Fork

HUC8: 14010004

Size: ~1,455 Square Miles

Characteristics of Interest: Arid, alpine environment with significant snowpack and the need to evaluate cross-basin transfers. Tributary to the Colorado River. High-resolution Lidar available in the northern part of the watershed.



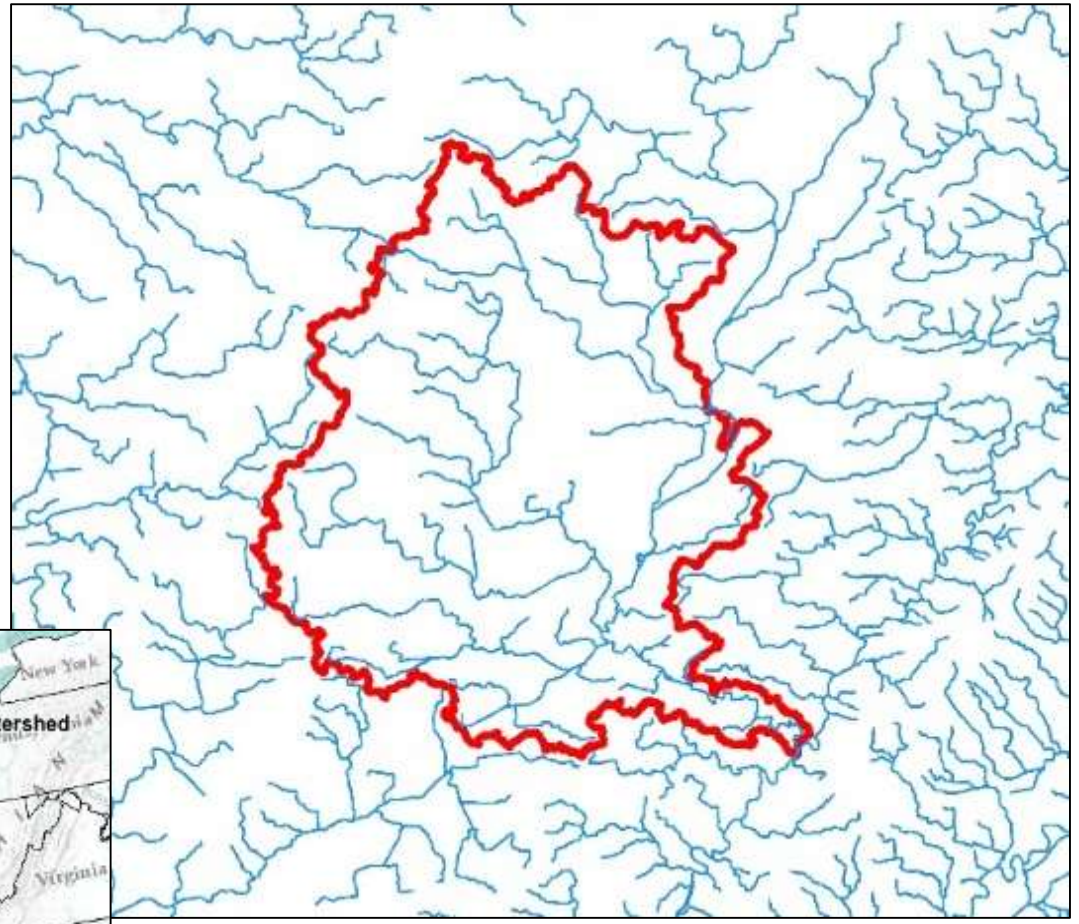
Medium-resolution NHD shown – Higher resolution available

Case Study 3: Cedar Creek

HUC10: 0410000307

Size: ~181 Square Miles

Characteristics of Interest: Agricultural landscape with ditching and water diversions. High resolution NHD and NWI are available for the entire area.



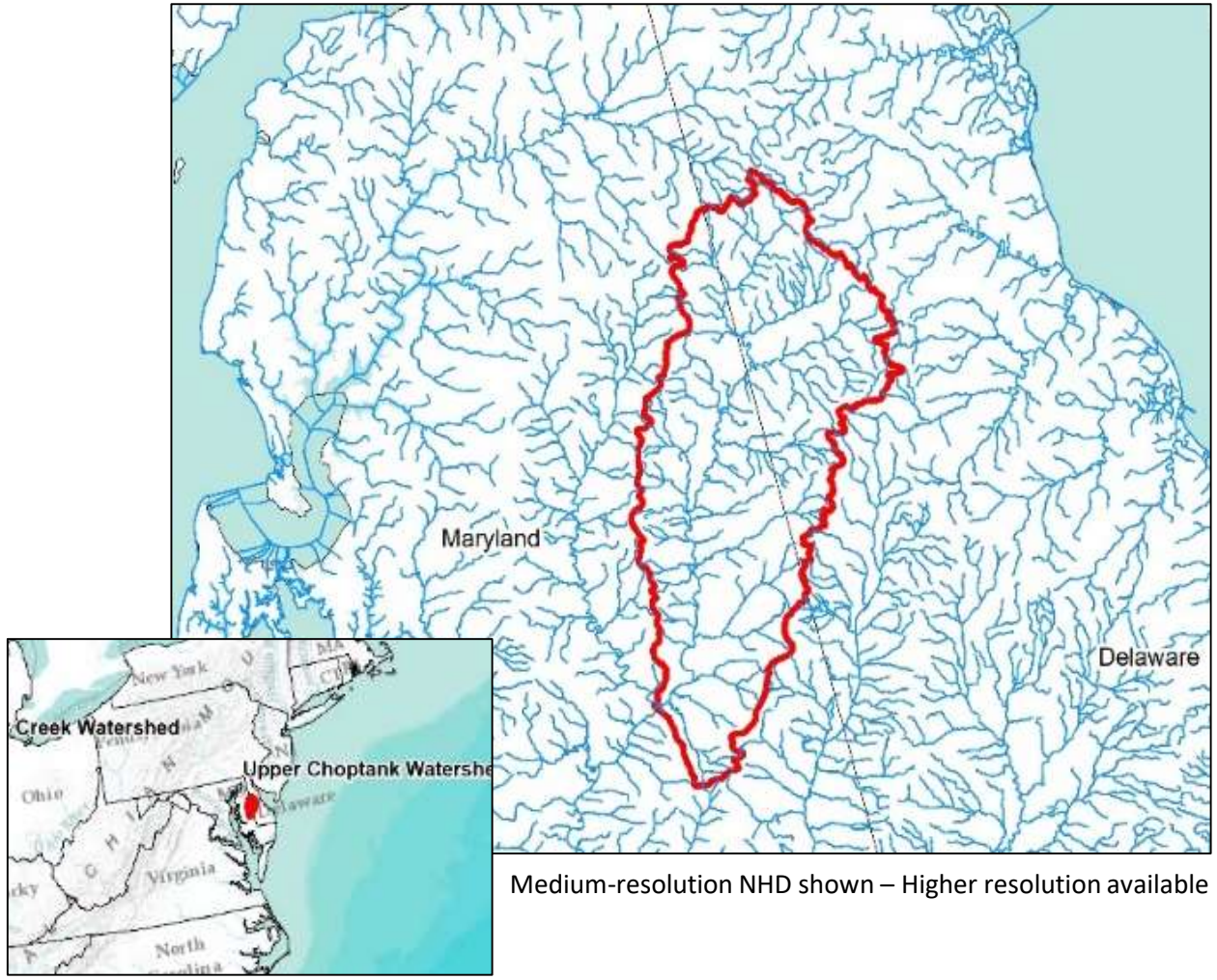
Medium-resolution NHD shown – Higher resolution available

Case Study 4: Choptank

HUC10: 0206000502

Size: ~259 Square Miles

Characteristics of Interest: Partially tidally-influenced area with low topographic relief. Large agricultural influence with ditching and other diversions. High resolution data is available in the northern parts of the watershed with numerous studies having also been conducted in this watershed that will provide valuable insight.



Medium-resolution NHD shown – Higher resolution available

Next Topics

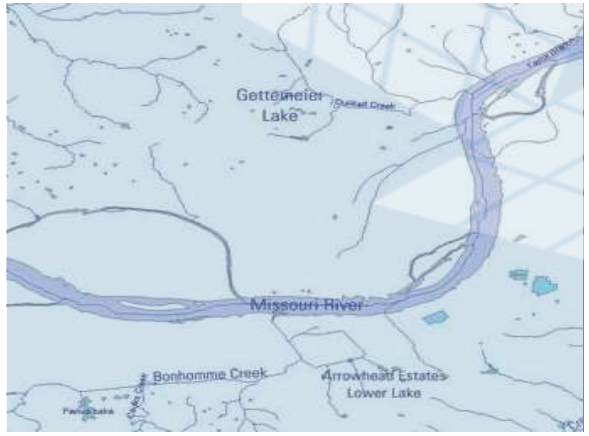
National Frameworks

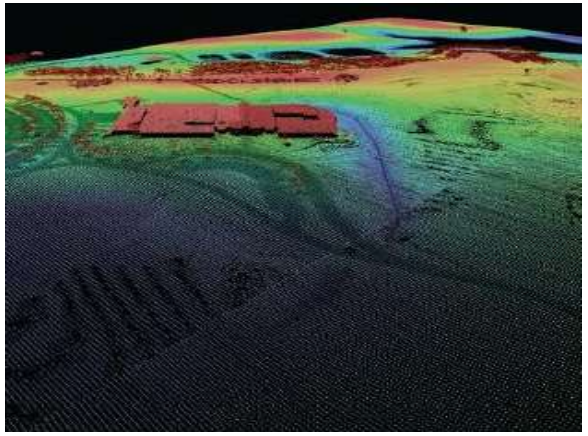
- National Hydrography Dataset: Jason Stoker, Chief, Topographic Data Services; U.S. Geological Survey
- National Wetlands Inventory: Megan Lang, Chief Scientist, National Wetlands Inventory, U.S. Fish and Wildlife Service

Research and Modeling Efforts: Jay Christensen, Research Ecologist, U.S. EPA Office of Research and Development

Open Discussion / Questions

National Hydrography Datasets





Jason Stoker, PhD
Acting Chief, Topographic Data Services
USGS National Geospatial Program

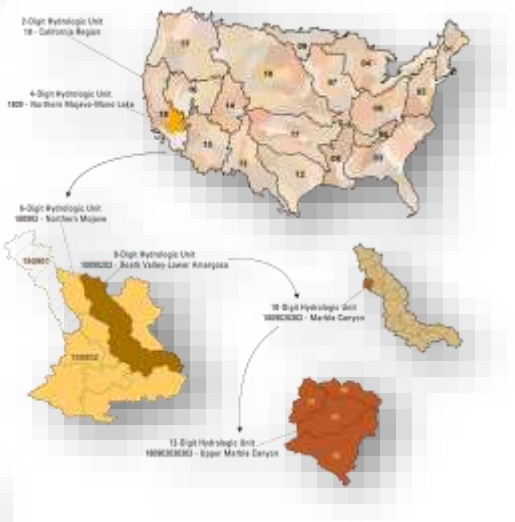
October 2020

National Hydrography Datasets Support Critical Applications

- **Hydrography Requirements and Benefits Study** documented 420 mission critical business uses with 23 Federal agencies, 50 states, 8 Tribal governments and 3 national associations
  - Ecological flows
  - Drought
  - Flooding
  - Spill response
  - Infrastructure engineering
  - Modeling and prediction
  - Watershed condition reporting and analysis
  - Resource reporting and analysis
  - Many more…
- Current Annual Benefits - $538M
  Total Potential Annual Benefits - $1.14B
- A few primary findings - the need for high resolution NHDPlus and integration of hydrography and elevation data

National Hydrography Dataset (NHD)

Most up-to-date national drainage network with features such as rivers, streams, canals, lakes, ponds, and stream gages



Watershed Boundary Dataset (WBD)

Drainage basins at eight scales in a nested hierarchy for the entire Nation

NHDPlus High Resolution

Combines the NHD, WBD and 3D Elevation Program (3DEP) elevation data to create a networked hydrography framework that models the flow of water from the ridgelines down to and through the stream network

USGS science for a changing world

The National Map
Your Source for Topographic Information

USGS National Hydrography Datasets

The most up-to-date and complete hydrography datasets for the Nation

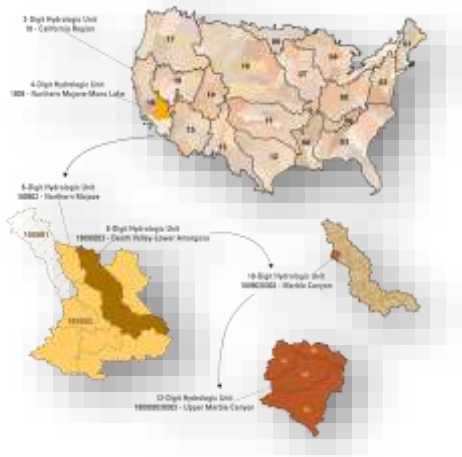
National Hydrography Dataset (NHD)

- Drainage network with features such as rivers, streams, canals, lakes, ponds, and stream gages

National Hydrography Dataset

Watershed Boundary Dataset (WBD)

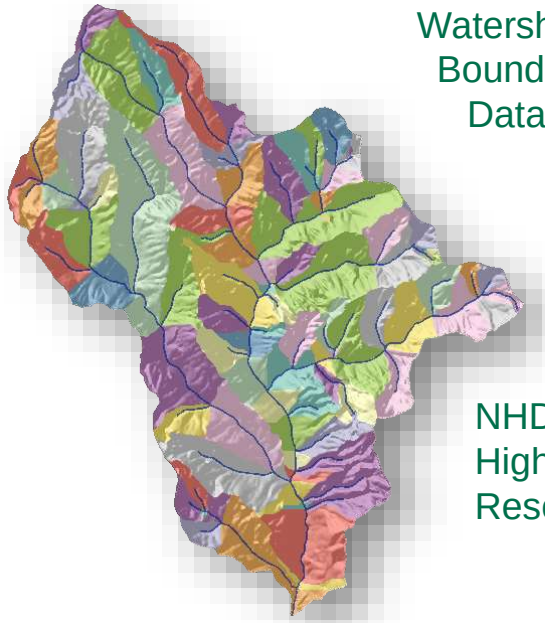
- Drainage basins at eight scales in a nested hierarchy



Watershed Boundary Dataset

NHDPlus High Resolution (NHDPlus HR)

- Combines the NHD, WBD and 3DEP elevation data to create a networked hydrography framework



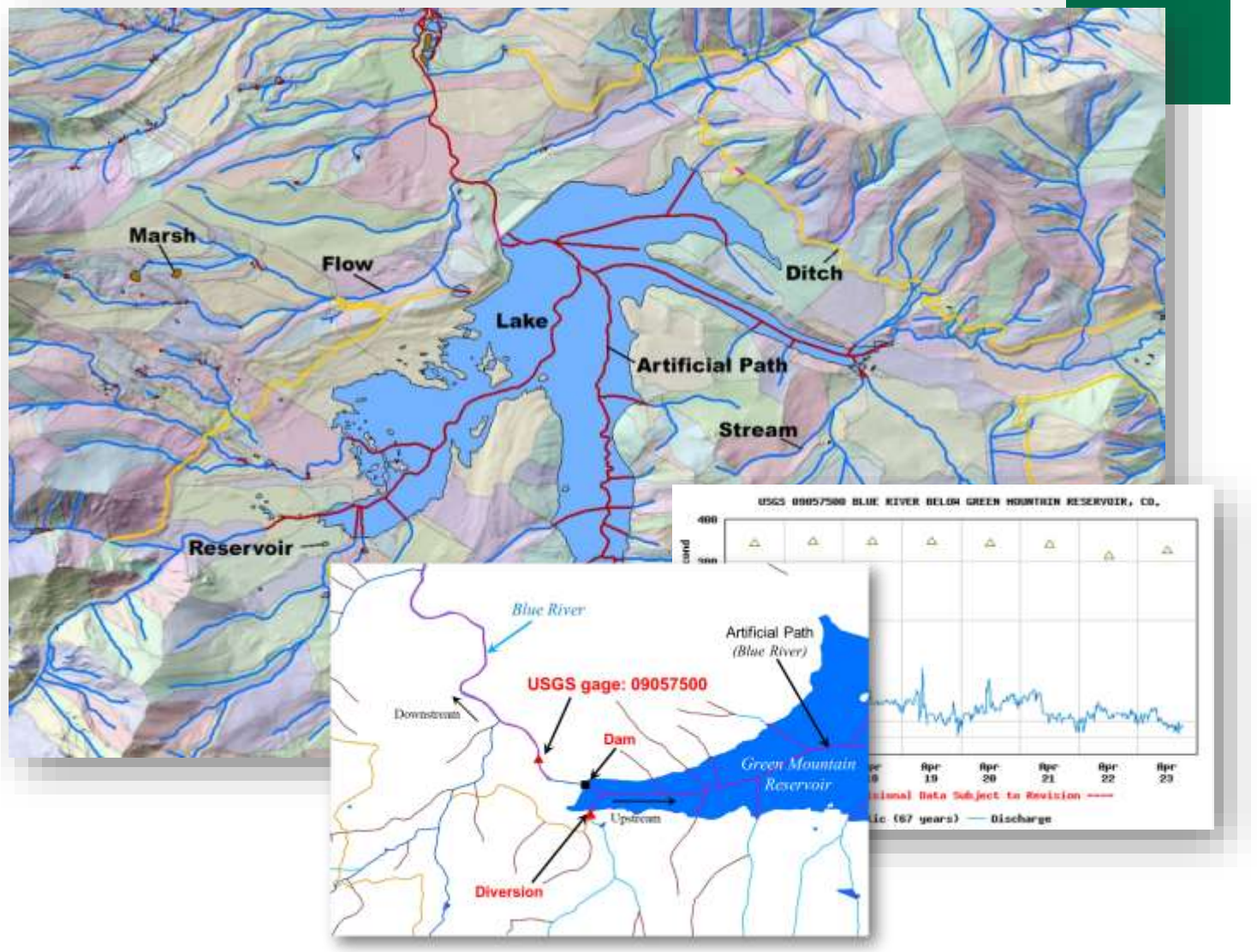
NHDPlus High Resolution

USGS science for a changing world

The National Map
Your Source for Topographic Information

National Hydrography Dataset

- National drainage network of streams and lakes, plus other hydro info, in a GIS format
- 1:24K or more detailed (1:63K – 1:24K in AK)
- Addressing system similar to street addresses (reach codes and measures)
  - Can be used to link external datasets
- Flow direction, network navigation - location adds context

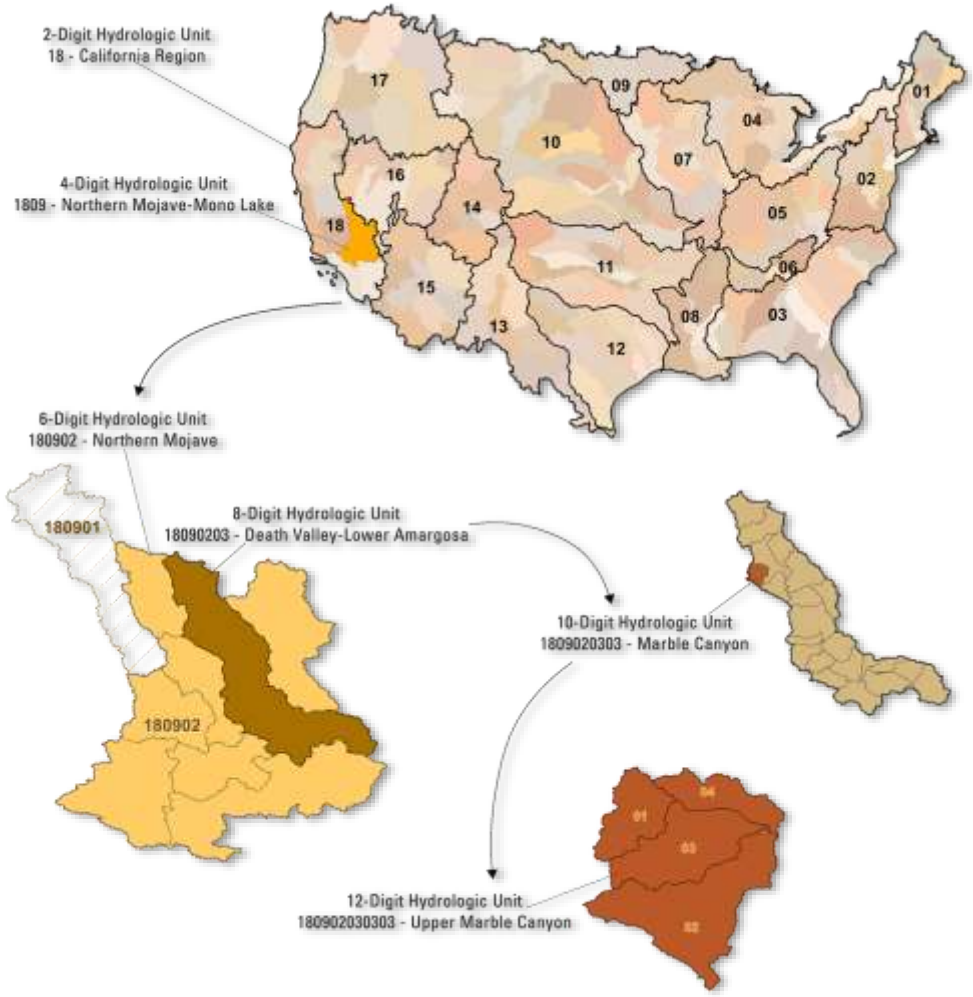


USGS science for a changing world

The National Map
Your Source for Topographic Information

Watershed Boundary Dataset

- Represent **all or part** of the **drainage area** to the outlet of the unit
- Boundaries defined by hydrographic and topographic criteria with no regard for administrative boundaries
- Delineated in a nested multi-level, hierarchical drainage system
- Each level assigned a progressive 2-digit Hydrologic Unit Code (HUC) which describes where the unit is in the country and the “level” of the unit
- Similar to ZIP codes
- Complete for the US to HUC12



USGS science for a changing world

The National Map
Your Source for Topographic Information

NHDPlus High Resolution

Rivers reflect their watersheds

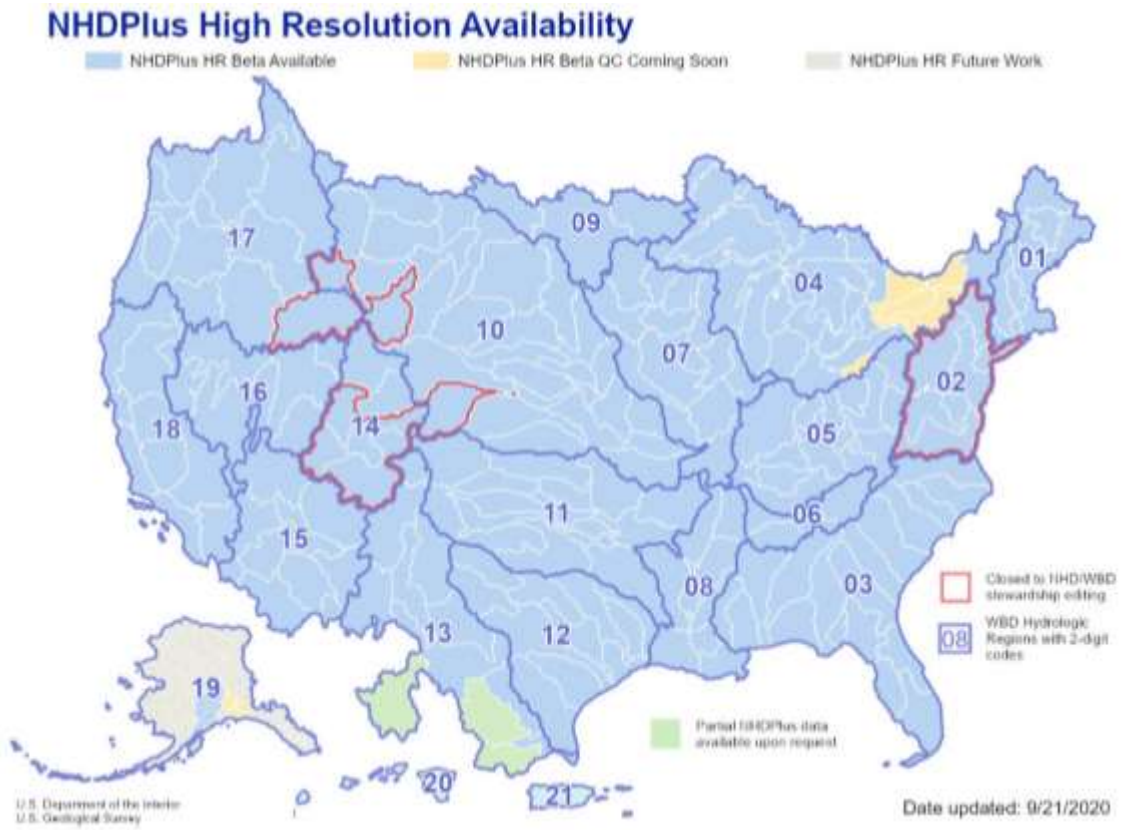
- Integrates hydrography (NHD and WBD) and digital elevation models (DEMs) into a dataset that enables water flow to be modeled across the landscape
- Built using 1:24,000-scale NHD and WBD data, and 3D Elevation Program (3DEP) 10m DEM data
- Used for environmental modeling, including water quality research and bridge and culvert infrastructure planning, because it connects terrestrial characteristics to the stream network
- Supports development of consistent and repeatable modeling results
- Plan to complete Beta version for CONUS, HI and territories in 2020, followed by AK in later years
- Provides the framework for linking data to landscape and stream network, which enables the discovery and sharing of limitless sources of information, and supports consistent and repeatable modeling results

USGS science for a changing world

The National Map
Your Source for Topographic Information

NHDPlus High Resolution (NHDPlus HR)

- Will complete Beta version for CONUS, HI and territories in 2020
- Alaska NHD and WBD update underway, some NHDPlus HR production completed with more scheduled
- Users are invited to provide feedback to the Beta version datasets - feedback will be used to improve subsequent dataset releases



	COMPLETED: NHDPlus Medium Resolution	IN PROGRESS: NHDPlus High Resolution
Hydrography source	1:100,000-scale NHD	1:24,000-scale or more detailed NHD
Elevation source	30 meter	10 meter
Number of features nationwide	2.7 million	26 million

USGS science for a changing world

The National Map
Your Source for Topographic Information

Stewardship

Collaborating to build and maintain datasets

- Robust hydrography datasets
  - NHD maps 8.4 million miles of stream network, including 7.8 million waterbodies
  - WBD contains over 130,000 nested hydrologic units
- Local user knowledge and expertise is crucial to accurate mapping
- NHD and WBD gain this local knowledge through a stewardship program
- Many states participate in the stewardship program –
  41 states and District of Columbia

Photo credit: Bill Anderson

USGS science for a changing world

The National Map
Your Source for Topographic Information

6 STRATEGIES

The 3D National Terrain Model (3D NTM) Vision for the Future Generations of USGS Hydrography and Elevation

1 COMPLETE NATIONWIDE BASELINE DATA

- Unifies observations and measurements onto one multiscale hydrography framework
- Realizes the benefits and ROI of nationwide lidar

3DEP & NHDPlus HR

2 ESTABLISH THE NATIONAL HYDROGRAPHY INFRASTRUCTURE

Implement the NHI as the authoritative, universal source for sharing and discovering water information

3 INTEGRATE HYDROGRAPHY AND ELEVATION

3DEP & 3D NHD

Derive hydrography with Z-values from lidar to move from the neighborhood to the street-level in accuracy of features

4 INTEGRATE GROUNDWATER AND ENGINEERED HYDROLOGIC SYSTEMS

Integrate connection points to groundwater and engineered hydrologic systems to allow better accounting of the hydrologic cycle

5 INTEGRATE INLAND BATHYMETRY

3D National Terrain Model

- Extend elevation surface under water bodies
- Replace estimated flow volume with volume calculated from the mapped surface

6 REPEAT COVERAGE

4D National Terrain Model

- Enable monitoring and change detection
- Analytical capabilities increase exponentially with the availability of multiple data vintages

Enables 3D topographic maps and links with 3D geologic models to visualize data in new and unimagined ways ★★★★★

Supports the National Water Model, National Water Census, drought, water availability and use ★★★★★

Supports the 3D Nation vision of elevation data from the depths of the oceans to the peaks of the mountains ★★★★★

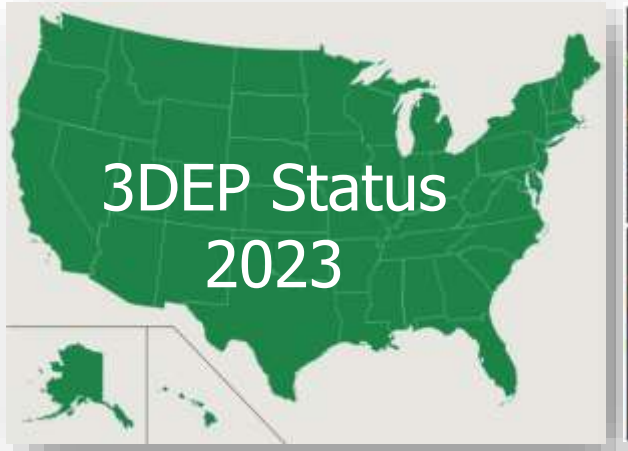
Provides a mapping foundation for the Clean Water Act* ★★★★★

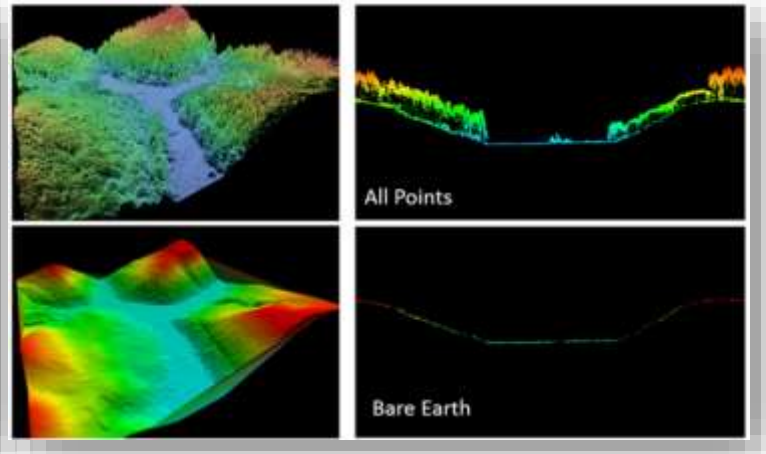
* NHD is not a regulatory dataset

8/20/20

3D Elevation Program (3DEP) Goal

- Complete acquisition of nationwide lidar (IfSAR in AK) by 2023 to provide the **first-ever national baseline of consistent high-resolution elevation data – both bare earth and 3D point clouds – collected in a timeframe of less than a decade**
- Address Federal, state and other mission-critical requirements
- Realize ROI 5:1 and potential to generate $13 billion/year
- Leverage the expertise and capacity of private mapping firms
- Achieve a 25% cost efficiency gain
- Completely refresh national data holdings



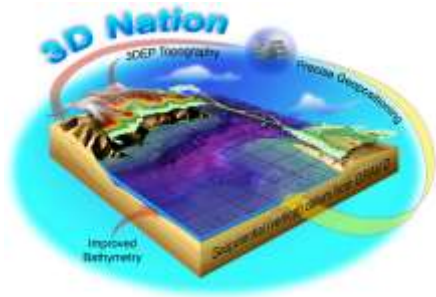


USGS science for a changing world

The National Map
Your Source for Topographic Information

		Annual Benefits	
Rank	Business Use	Conservative	Potential
1	Flood Risk Management	$295M	$502M
2	Infrastructure and Construction Management	$206M	$942M
3	Natural Resources Conservation	$159M	$335M
4	Agriculture and Precision Farming	$122M	$2,011M
5	Water Supply and Quality	$85M	$156M
6	Wildfire Management, Planning and Response	$76M	$159M
7	Geologic Resource Assessment and Hazard Mitigation	$52M	$1,067M
8	Forest Resources Management	$44M	$62M
9	River and Stream Resource Management	$38M	$87M
10	Aviation Navigation and Safety	$35M	$56M
:			
20	Land Navigation and Safety	$0.2M	$7,125M
	Total for all Business Uses (1 – 27)	**$1.2B**	**$13B**

Next Generation – 3D National Terrain Model

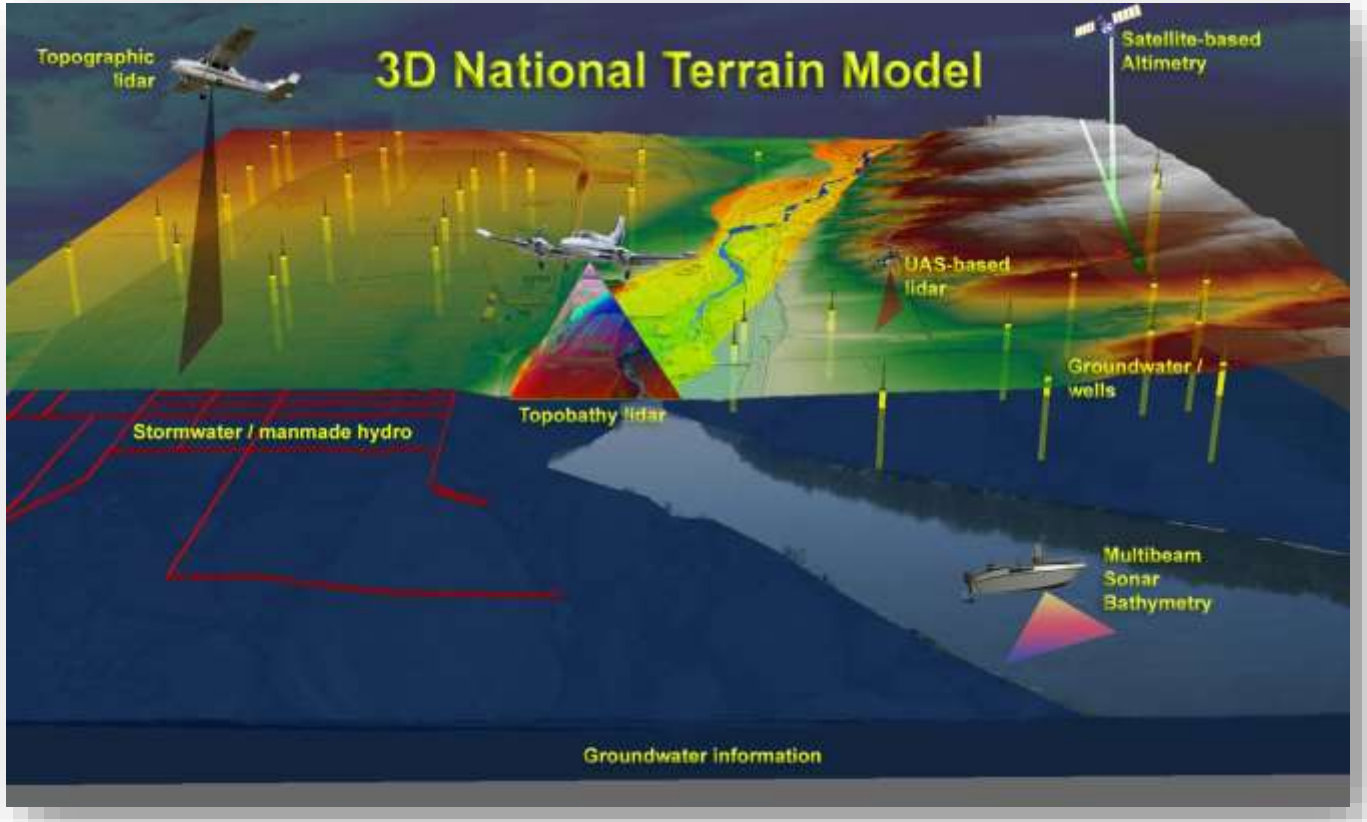


Implement the USGS-NOAA 3D Nation concept of building a modern elevation foundation – from the peaks of our mountains to the depths of our waters – for stronger, more resilient communities and U.S. economy

A continuous, integrated 3D elevation and hydrography surface

To improve and enable critical applications

- Flood forecasting in 3D, at the street level
- Hydrologic observing systems and models that account for water from the atmosphere to the oceans
- Support Clean Water Act Implementation
- 3D Geologic models
- New and unimagined 3D applications



USGS science for a changing world

The National Map
Your Source for Topographic Information

3DEP & 3D NHD

3 INTEGRATE HYDROGRAPHY AND ELEVATION

Simulates conditions for 2.7 million stream reaches, representing *the biggest improvement in flood forecasting ever*

Forecasting at neighborhood level

Forecasting at street level

	IN USE TODAY: NHDPlus Medium Resolution	IN PROGRESS: NHDPlus High Resolution	FUTURE: Hydrography Derived from Lidar
Elevation source	30 meter	10 meter	1 meter
Hydrography source	1:100,000-scale NHD	1:24,000-scale or better NHD	1:5,000-scale or better derived from lidar
Number of features nationally	2.7 million	26 million	200-300 million

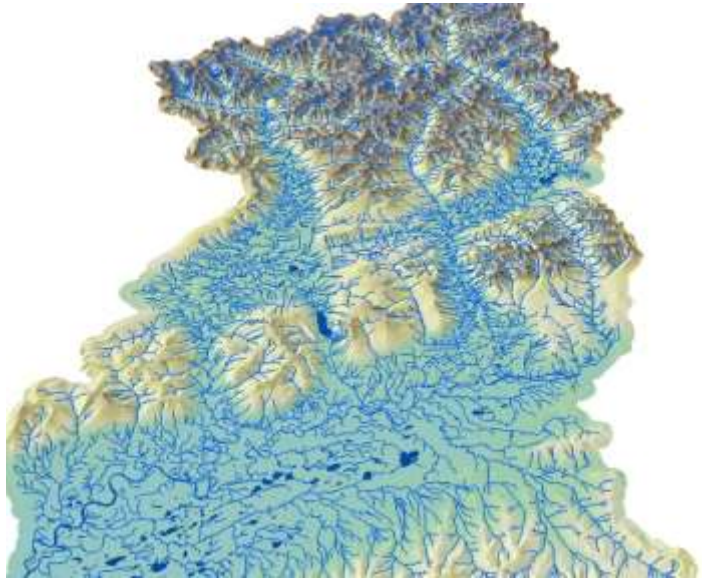
USGS science for a changing world

The National Map
Your Source for Topographic Information

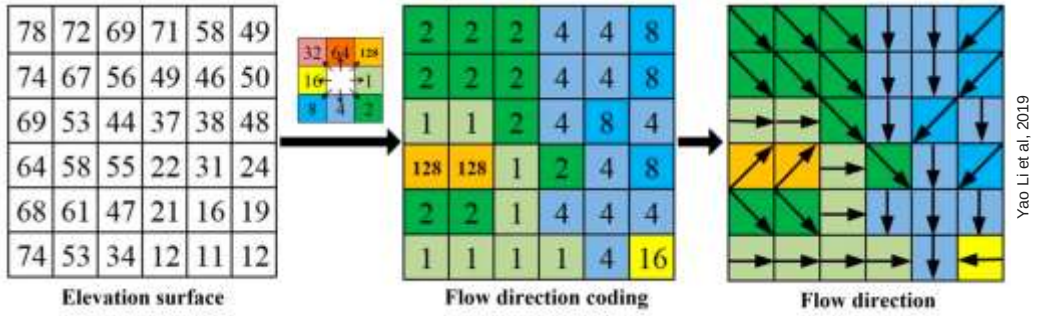
3DEP & 3D NHD

3 INTEGRATE HYDROGRAPHY AND ELEVATION

- Elevation-derived hydrography (EDH) is synthetically derived from elevation data using algorithms to process to identify channels / depressions that may carry surface flow
- Deriving hydrography from elevation ensures necessary data integration for modeling and analysis
- Modeled from 3DEP lidar (and IfSAR)
- Recent NHD EDH pilot projects in several areas are helping to understand products and processes
  - CONUS (2017), AK (2020), SE Texas (2021), potential other CONUS pilots
- Once the synthetically derived streams are created, NHD attributes must be mapped to the features and the data moved into the national NHD database



Courtesy of Quantum Spatial



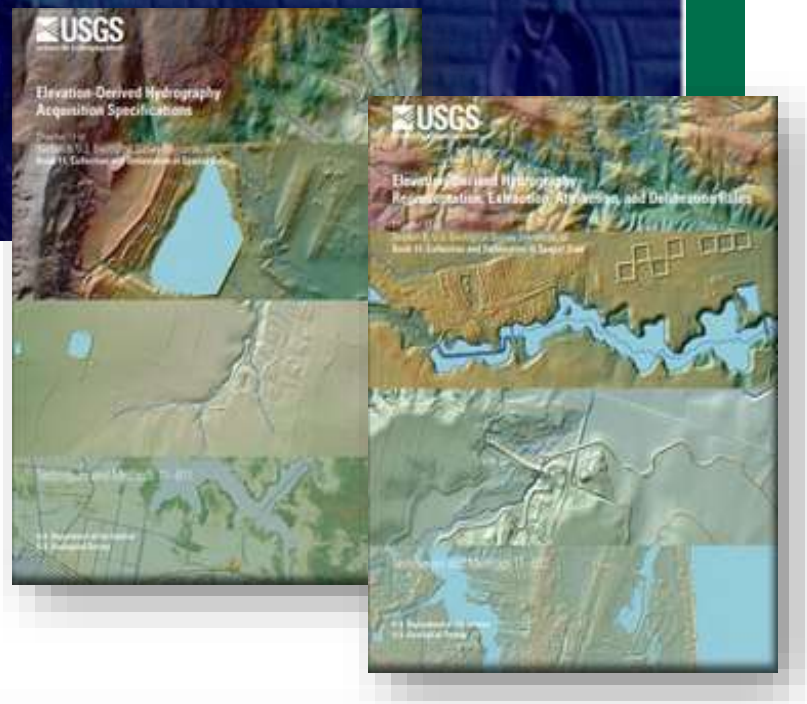
Yao Li et al, 2019

USGS science for a changing world

The National Map Your Source for Topographic Information

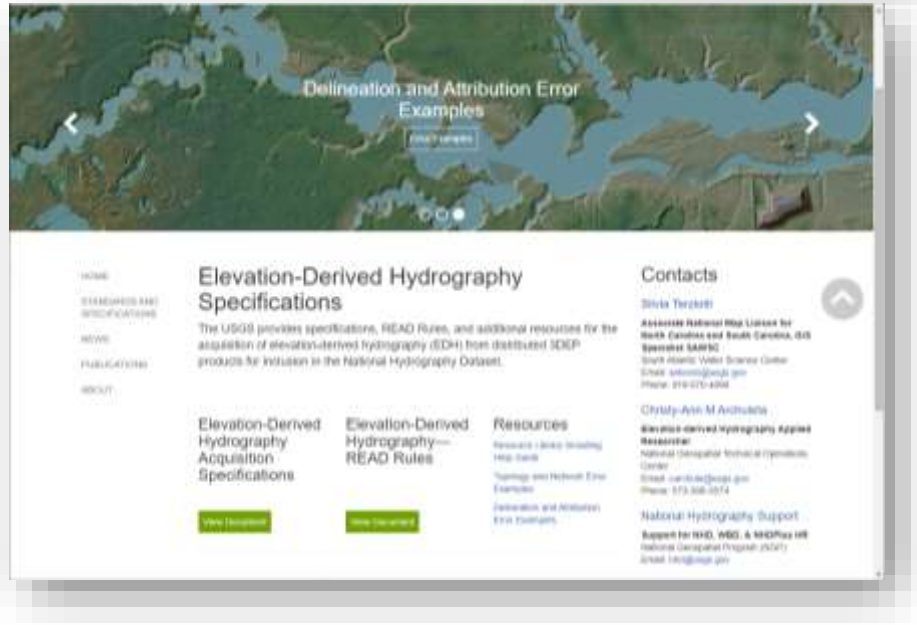
3DEP & 3D NHD

3 INTEGRATE HYDROGRAPHY AND ELEVATION



EDH Specifications, published July 2020

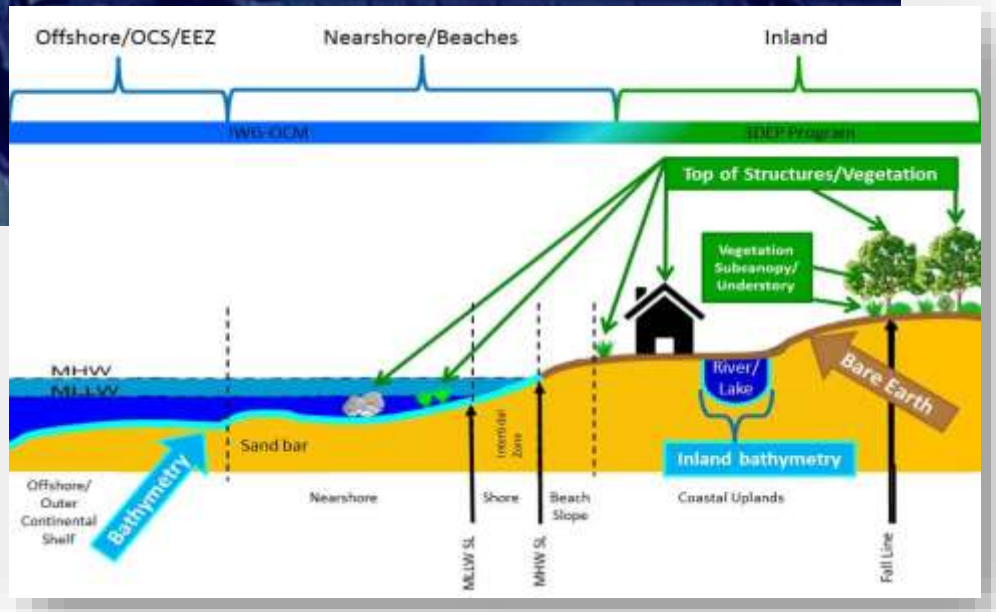
- USGS Techniques and Methods 11–B11: Elevation-Derived Hydrography Acquisition Specifications
  - Terziotti, S., and Archuleta, C.M., 2020, Elevation-Derived Hydrography Acquisition Specifications: U.S. Geological Survey Techniques and Methods, book 11, chap. B11, 74 p., https://doi.org/10.3133/tm11B11.
- USGS Techniques and Methods 11–B12: Elevation-Derived Hydrography—Representation, Extraction, Attribution, and Delineation Rules
  - Archuleta, C.M, and Terziotti, S., 2020, Elevation-Derived Hydrography—Representation, Extraction, Attribution, and Delineation Rules: U.S. Geological Survey Techniques and Methods, book 11, chap. B12, 60 p., https://doi.org/10.3133/tm11B12.
- EDH specifications resources online
  - https://www.usgs.gov/core-science-systems/ngp/ss/elevation-derived-hydrography-specifications



USGS science for a changing world

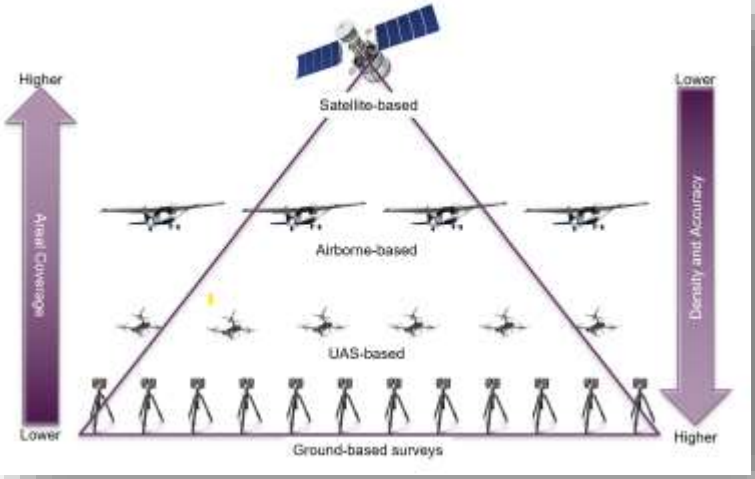
The National Map Your Source for Topographic Information

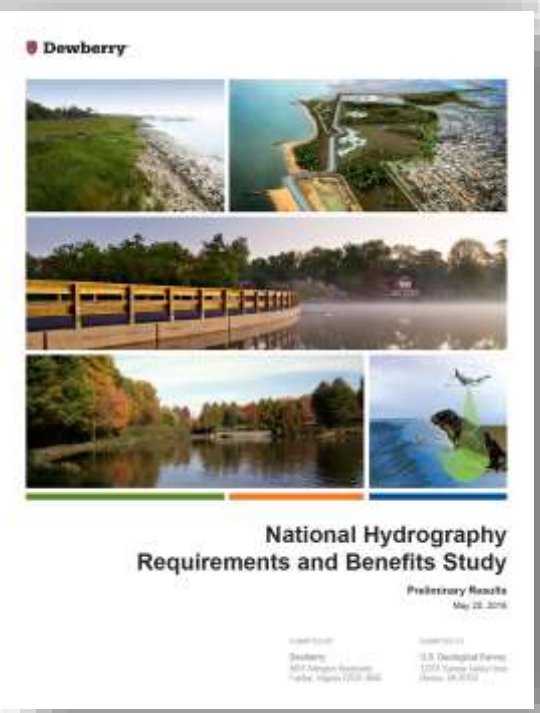
4D National Terrain Model 6 REPEAT COVERAGE



- 3D Nation Elevation Requirements and Benefits Study
  - Working with NOAA to understand inland, nearshore and offshore bathymetric data requirements and benefits
  - Gather technology-agnostic user information to be able to assess new technologies against requirements and identify the tradeoffs between different approaches
  - **Plan for the next generation of 3DEP - Results will lead to a completely new approach regarding Quality Levels, refresh frequency by geography, products offered, and other changes**

- Hydrography Requirements and Benefits Study
  - Use results to help define the optimal refresh cycle and new data accuracies and qualities





USGS science for a changing world

The National Map
Your Source for Topographic Information


THANK YOU!

THE USFWS NATIONAL WETLANDS INVENTORY

Megan Lang
Chief Scientist
National Wetlands Inventory

THE NATIONAL WETLANDS INVENTORY PROGRAM

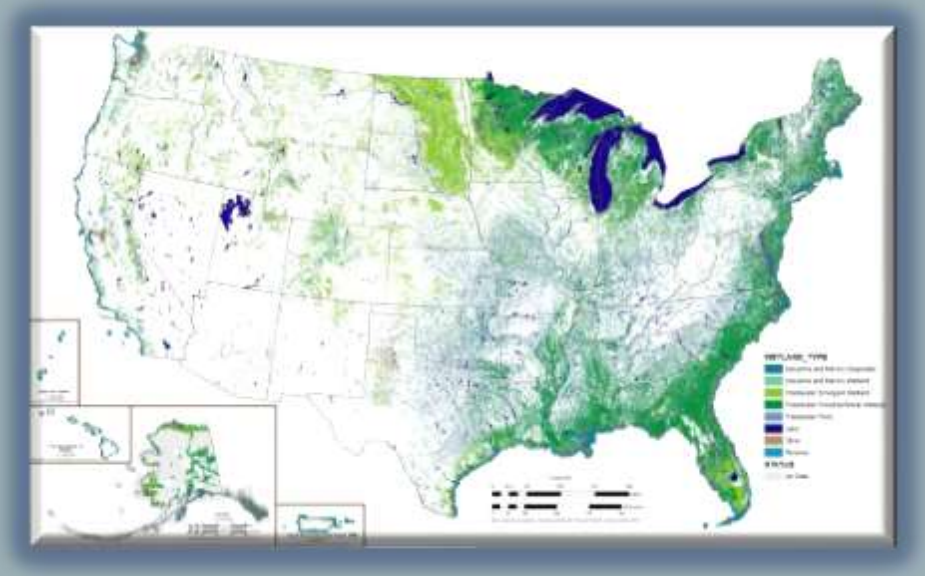
Science-based information on wetlands and deepwater habitats to promote the understanding and conservation of the Nation's wetland resources through research, education, resource management and policy development.

Who Are We?

Principle U.S. federal agency tasked with providing information to the American public on the extent and trends of U.S. wetlands

- **Emergency Wetlands Resources Act of 1986**
  - Map U.S. wetlands – NWI Wetlands Geospatial Dataset
  - Provide 10 year reports – Wetland Status and Trends Reports
- Wetlands Geospatial Dataset identified as a **National Geospatial Data Asset (NGDA)**
- OMB Circular A-16 identifies the NWI Geospatial Dataset as the **Wetlands Layer** of the **National Spatial Data Infrastructure**.
- Stewards of the Federal Geographic Data Committee (FGDC) **Wetland Mapping and Classification Standards**
  - Federally funded wetland mapping must use FGDC standards

WETLANDS DATA LAYER

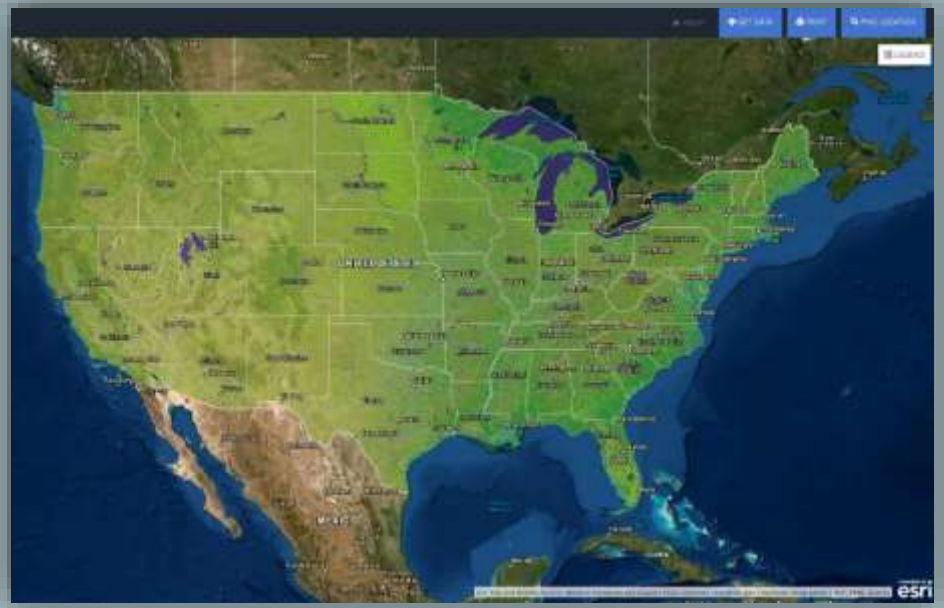


Data Layer Facts

- America's only wetland data layer
  - Most spatially and categorically detailed land cover data on U.S. wetlands
- Complete for the conterminous U.S., Puerto Rico, U.S. Virgin Islands, Hawaii, Pacific Trust Territories and over 40% of AK
- 40+ years and $220+ million invested
- Over 165 data contributors
- Between 50 and100M acres updated annually
- Rigorous quality control maintains FGDC mandated standards

THE WETLANDS MAPPER

Delivering easy-to-use, map like views of America's wetland resources



https://www.fws.gov/wetlands/data/mapper

How can I use the online Wetlands Mapper and other NWI Resources?

- **Explore** by manually panning or use the location tool to view your area of interest
- **Print** a .pdf to share with others
- **View** mapping information, wetland descriptions and related documents through pop-up windows
- **Download** by watershed or state
- **Integrate** NWI data with web mapping services
- **Analyze** data using tools developed by NWI

* *The Wetlands Mapper is also accessible on mobile devices.*

THE WETLANDS MAPPER

Delivering easy-to-use, map like views of America's wetland resources

https://www.fws.gov/wetlands/data/mapper

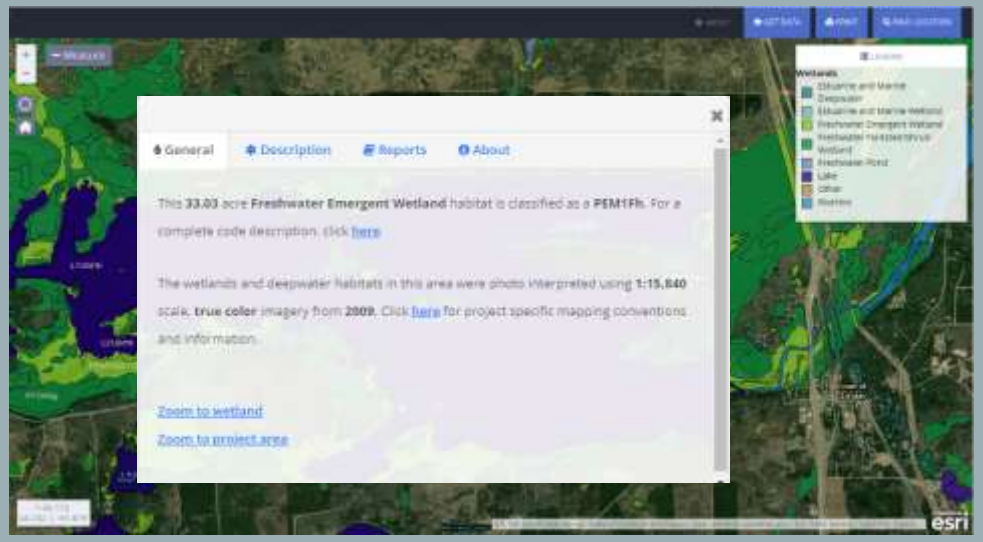
How can I use the online Wetlands Mapper and other NWI Resources?

- **Explore** by manually panning or use the location tool to view your area of interest
- **Print** a .pdf to share with others
- **View** mapping information, wetland descriptions and related documents through pop-up windows
- **Download** by watershed or state
- **Integrate** NWI data with web mapping services
- **Analyze** data using tools developed by NWI

* *The Wetlands Mapper is also accessible on mobile devices.*

THE WETLANDS MAPPER

Delivering easy-to-use, map like views of America's wetland resources



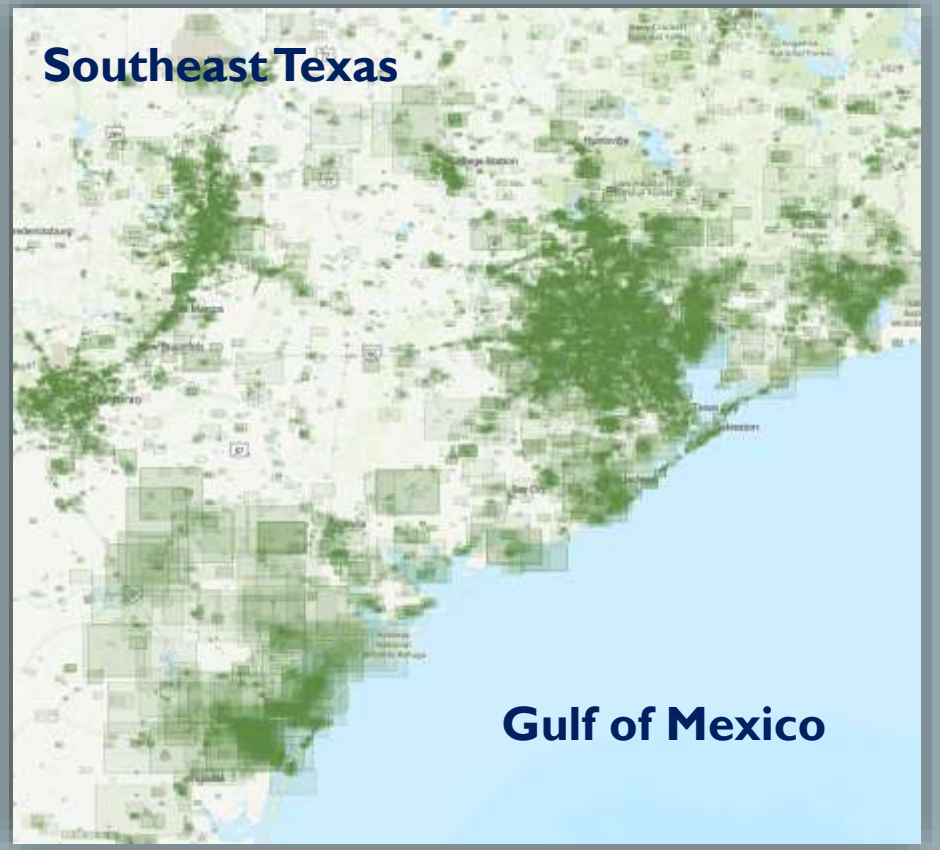
https://www.fws.gov/wetlands/data/mapper

How can I use the online Wetlands Mapper and other NWI Resources?

- **Explore** by manually panning or use the location tool to view your area of interest
- **Print** a .pdf to share with others
- **View** mapping information, wetland descriptions and related documents through pop-up windows
- **Download** by watershed or state
- **Integrate** NWI data with web mapping services
- **Analyze** data using tools developed by NWI

* *The Wetlands Mapper is also accessible on mobile devices.*

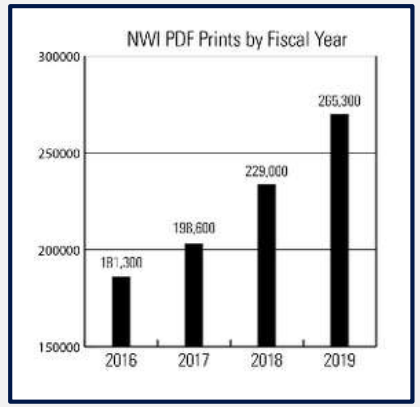
NWI WETLANDS GEOSPATIAL DATASET

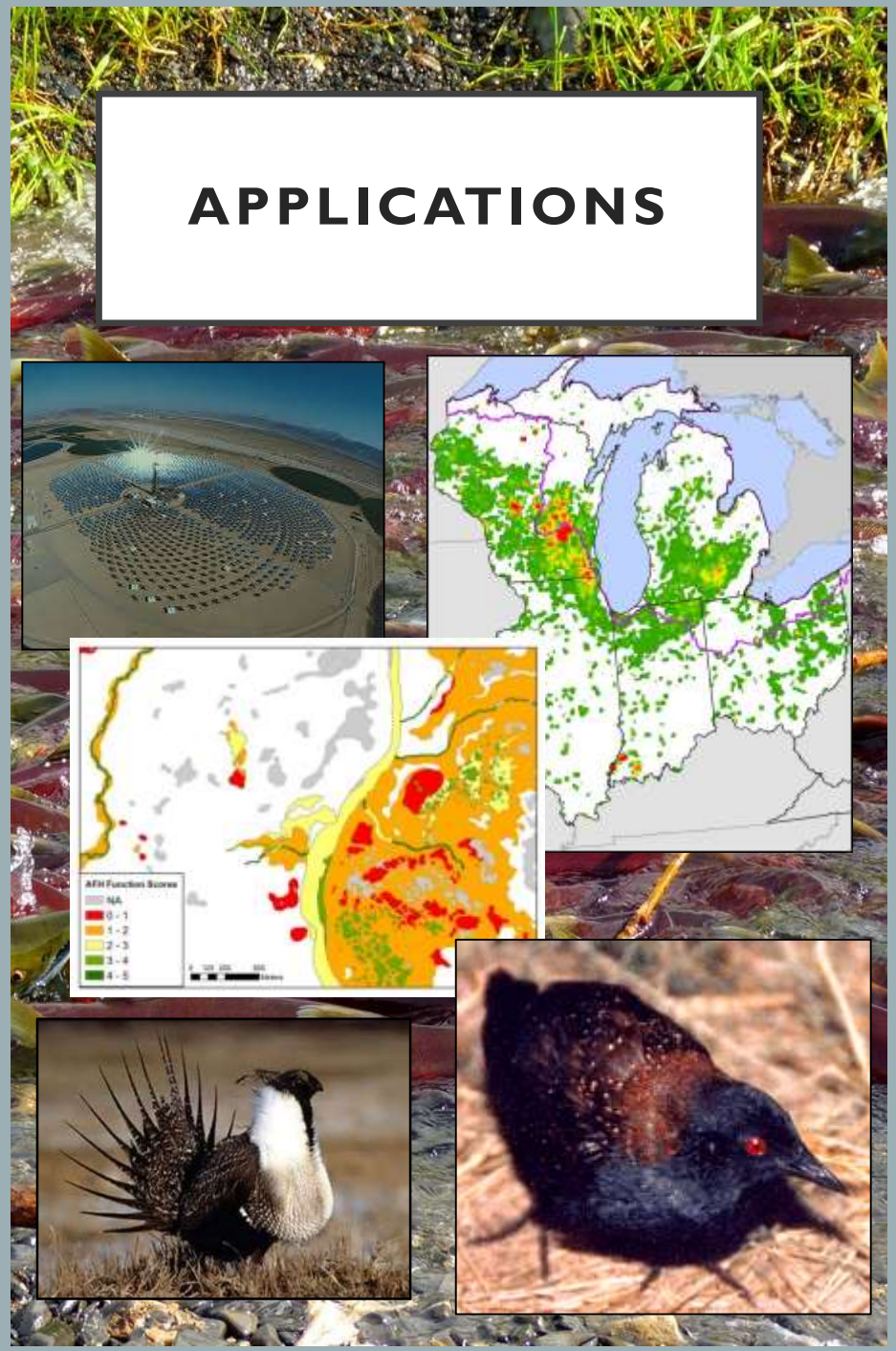


From October 2015 to September 2019, over 874,000 maps were printed from the NWI Wetlands Mapper.

The NWI dataset is frequently relied upon by the American public.

- Nearly one million website views annually
- Over 525,000 annual Mapper views
- Over 40,000 data downloads annually
- About 260,000 maps printed last year
- Data use has increased through time

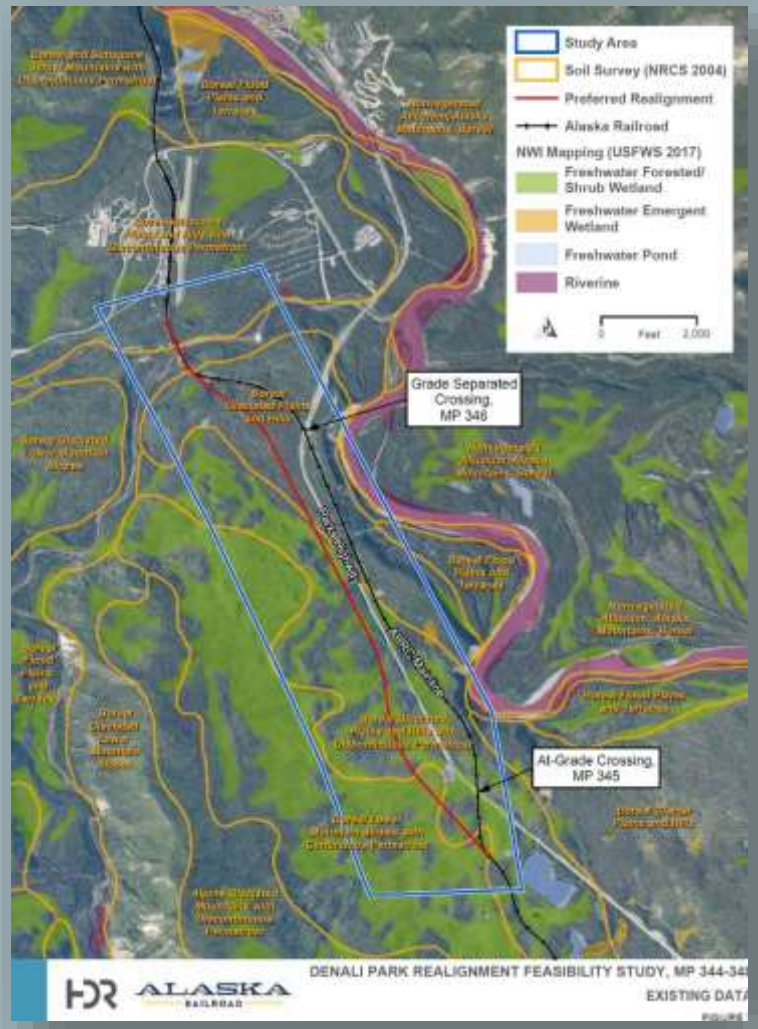




NWI's robust classification system supports a wide variety of applications.

- Over 5,000 codes in the dataset (800 common)
- Applications of NWI include:
  - Assessment of ecological functions and services, including mitigation of natural disasters and provision of clean water
  - Habitat assessment and species population modeling
  - Support for cost-effective, conservation-oriented infrastructure development

ALASKA RAILROAD PLANNING

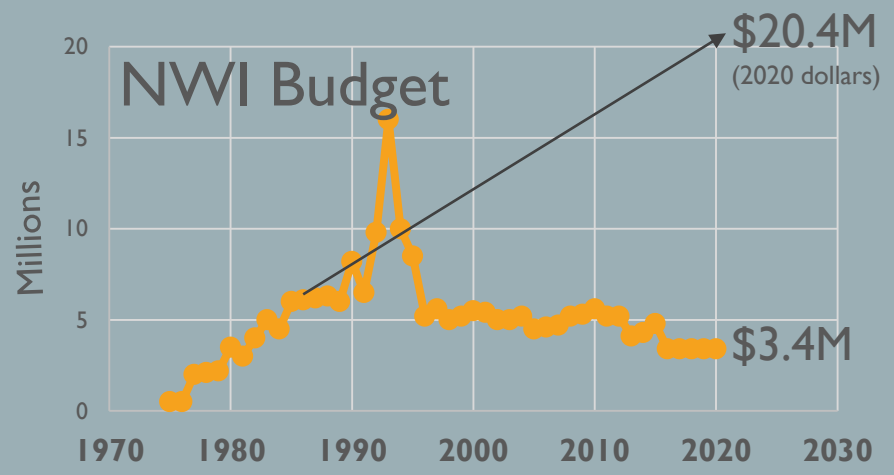


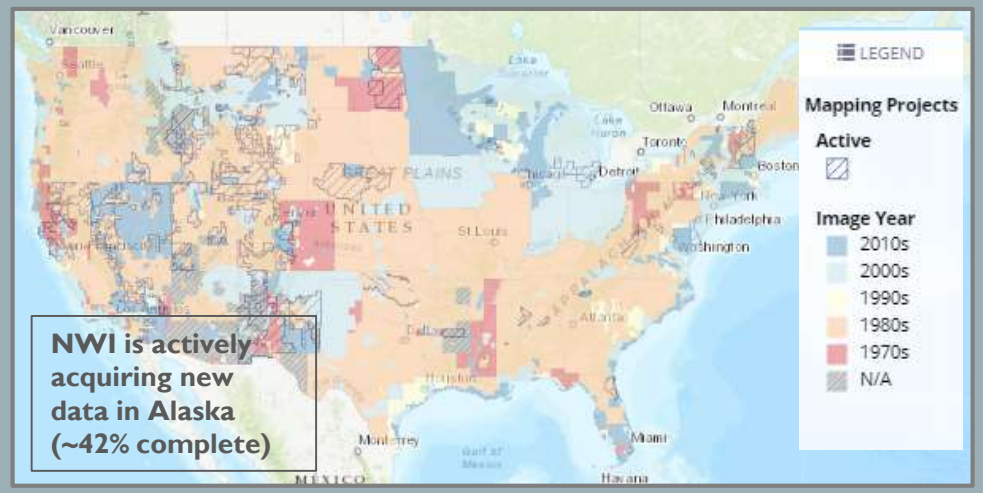
NWI data are used to streamline planning, permitting and mitigation, while conserving wetlands and their environmental benefits.

- NWI dataset is used by states to efficiently implement planning and regulatory programs.
  - Minnesota and Michigan estimate that they save $1M and $750K annually, respectively.
- NWI dataset allows Washington state to more efficiently meet state policy requirements.
- The state of Alaska commonly uses NWI to support infrastructure development planning.
  - NWI data were used to support planning for realignment of the Alaska railroad.
  - The Alaska Geospatial Council has developed a plan to support completion of the NWI dataset in Alaska.

The NWI Program does not map the proprietary jurisdiction of local, state or federal governments, or establish the geographic scope of government regulatory programs. (NWI uses a biological, rather than a regulatory, wetland definition.)

STATUS OF THE NWI WETLANDS LAYER



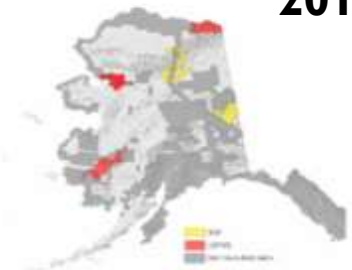


NWI's primary challenge is to support a contemporary dataset with a historically flat budget.

- After accounting for inflation, NWI's current budget is 1/6th of its 1986 budget (the year NWI mapping was mandated).
- We are working towards meeting this challenge by leveraging partnerships and advanced mapping technologies.

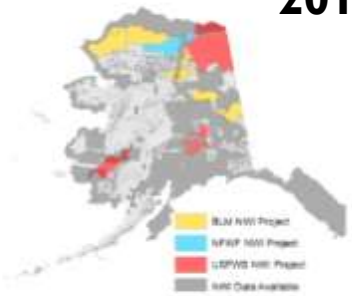
RECENT PROGRESS IN ALASKA

2018



20M acres

2019

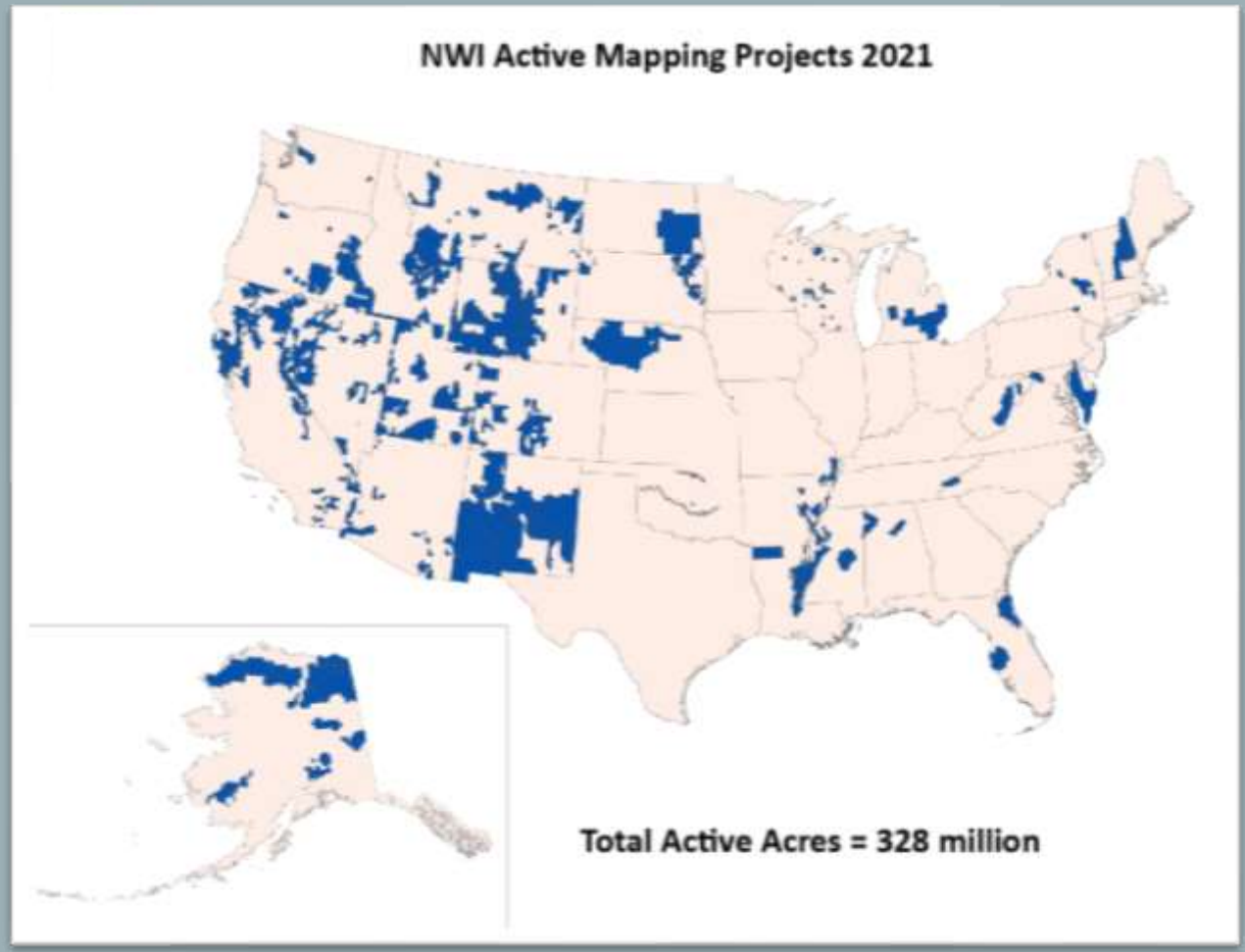


65M acres

2020

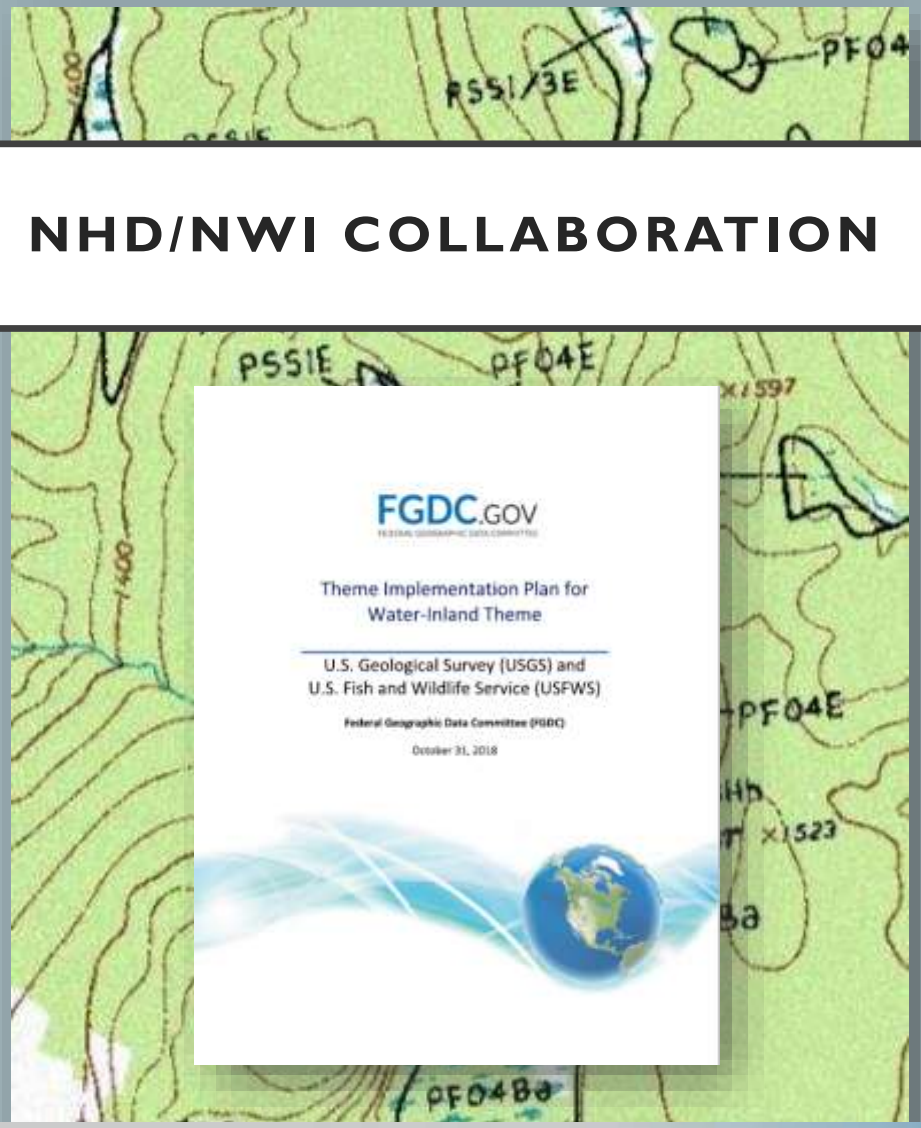
165M acres

LEVERAGING PARTNERSHIPS



The majority of mapping is funded by other federal agencies, including BLM, EPA, NRCS and FS, and states.

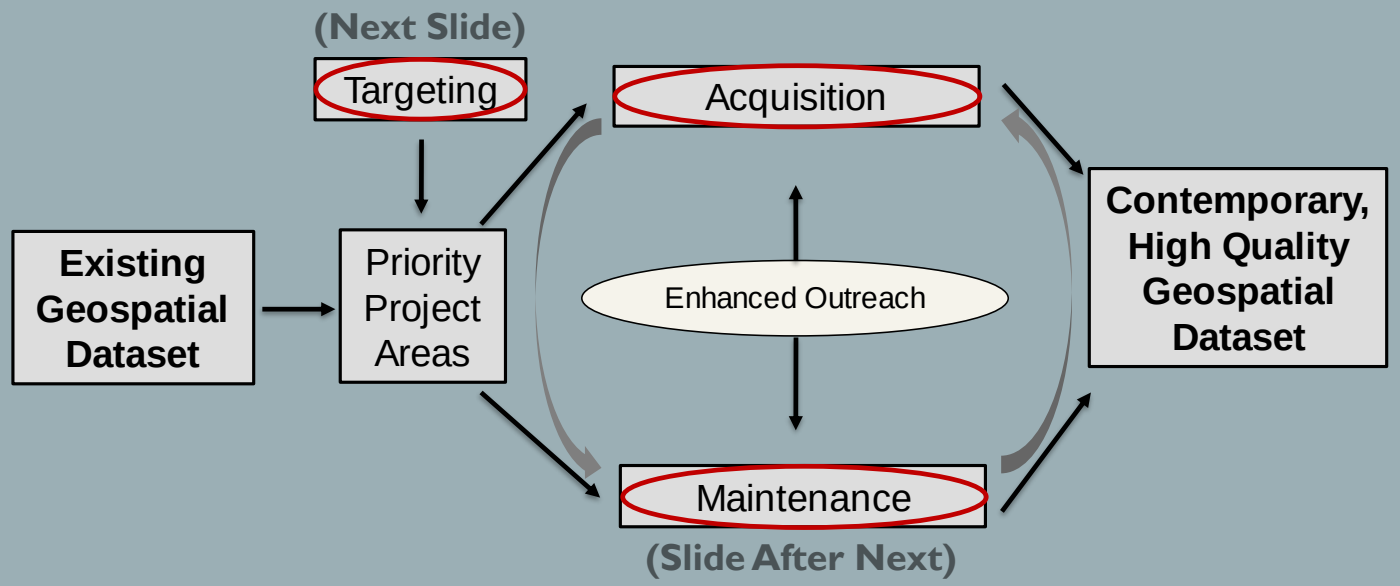
NHD/NWI COLLABORATION



NWI and NHD have a long history of collaboration that continues today.

- NWI features were originally created to compliment USGS topographic maps.
  - Blue lines from topographic maps eventually became the foundation of NHD.
- USGS and USFWS co-lead the FGDC's Water-Inland theme, which serves to enhance coordination between geospatial datasets that pertain to inland hydrologic features.
  - Through this shared governance NHD and NWI are working to identify opportunities to strengthen their partnership.
    - Example: Identification of opportunities to enhance efficiencies that will best meet the needs of stakeholders
- USFWS and USGS also coordinate as members of the National Hydrography Infrastructure Working Group.

LEVERAGING NEW TECHNOLOGIES



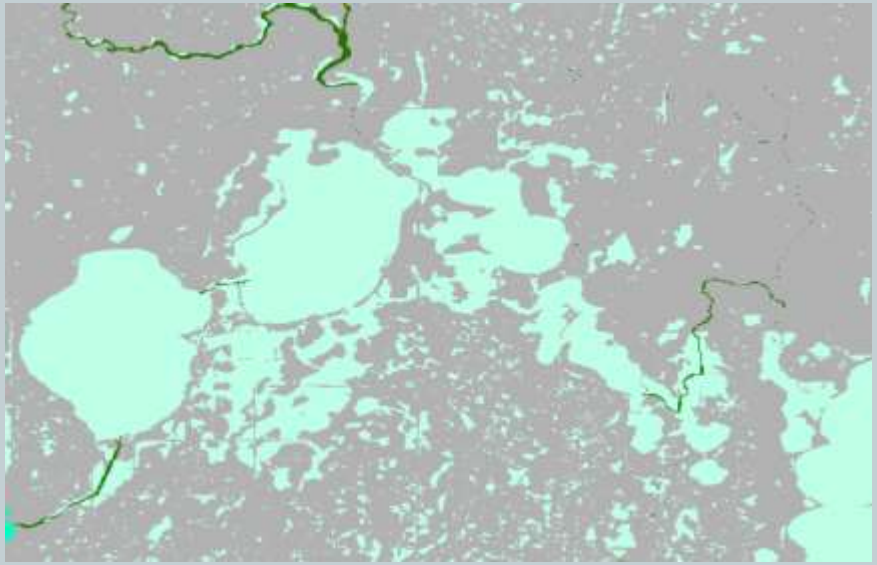
Challenge: Although technology is developing rapidly, it is still very difficult to accurately map wetlands nationally, especially at fine spatial and categorical resolutions.

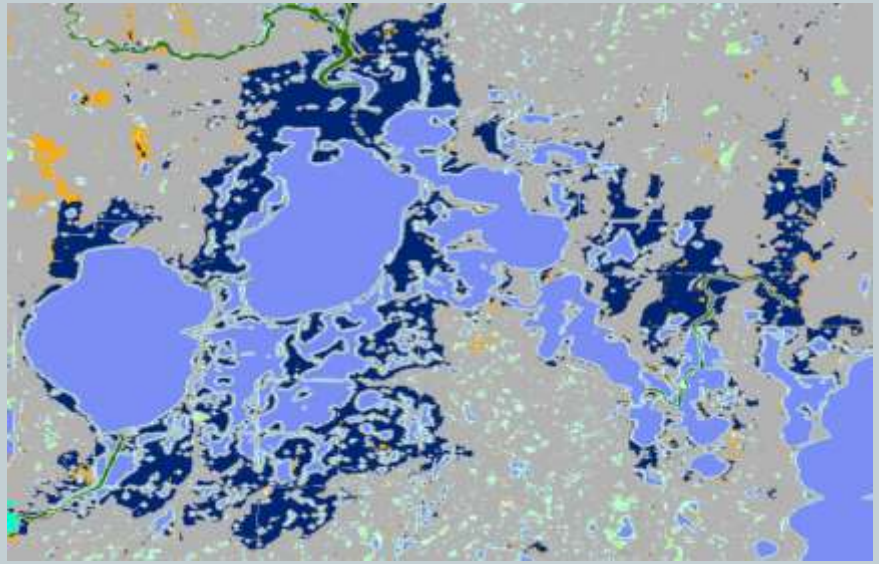
Solution: Adaptively manage NWI's targeting, acquisition and maintenance procedures to **leverage the best of all datasets and techniques/processes**

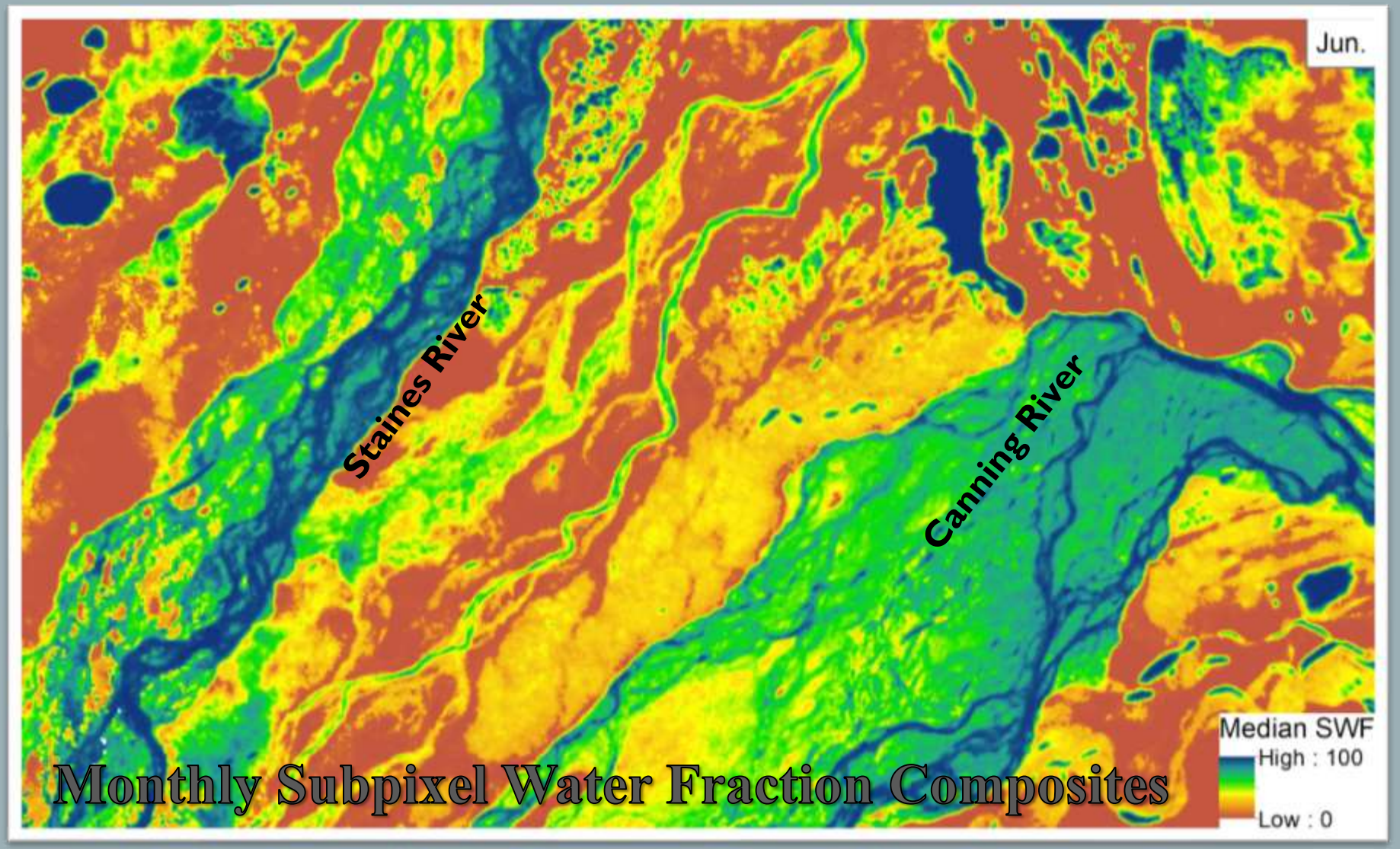
Key: A semi-automated approach – where automated processes are used to strategically improve efficiency and quality within a robust, time-tested manual foundation

Upland
Wetland
Marine
Estuarine Subtidal
Lacustrine Limnetic
Riverine
Wetland to NLCD Open water
Wetland to NLCD Open space
Wetland to NLCD Low intensity urban
Wetland to NLCD Medium intensity urban
Wetland to NLCD High intensity urban
Wetland to NLCD Cultivated crops
Upland to NLCD Woody wetland
Upland to NLCD Emergent wetland
Upland to NLCD Open water

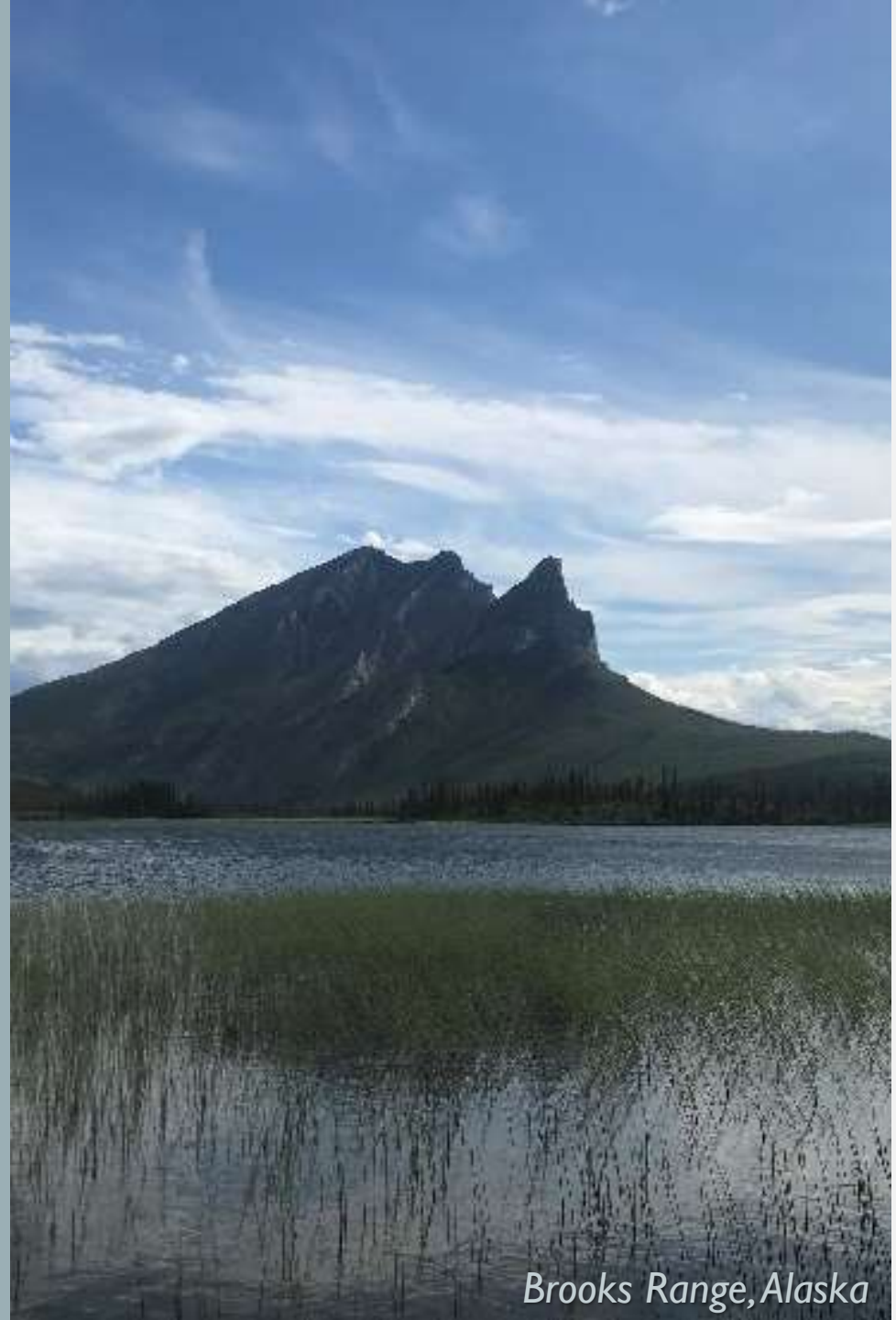
Lake Alice, Ramsey County, North Dakota







Information on inundation dynamics allows for more rapid and accurate determination of wetland boundaries and type. This information is especially critical in Alaska, where it has been difficult to obtain.


Brooks Range, Alaska

SUMMARY

- NWI is the Wetlands Layer of the National Spatial Data Infrastructure, and is freely available as a resource to the American public.
- NWI data are used for a variety of applications, including supporting cost-effective, conservation-oriented development.
- Our primary challenge is supporting a contemporary dataset with a declining budget (after inflation).
- To address this challenge we work closely with partners to leverage resources, and to build a more efficient workflow.
- We look forward to working with you to best meet your wetland information needs.

THANK YOU






Improved Aquatic Resource Mapping

- OW need:
  - Existing geospatial datasets of streams and wetlands are often limited in the degree of accuracy and at the resolution needed to support federal, state, tribal, and local water management decisions, including identifying “waters of the United States” subject to Clean Water Act jurisdiction
- ORD charge:
  - Engage in interagency workplan and research
  - Explore methods for improved characterization and mapping of streams and wetlands
    - Modeling and Remote Sensing methods
    - Field-based methods

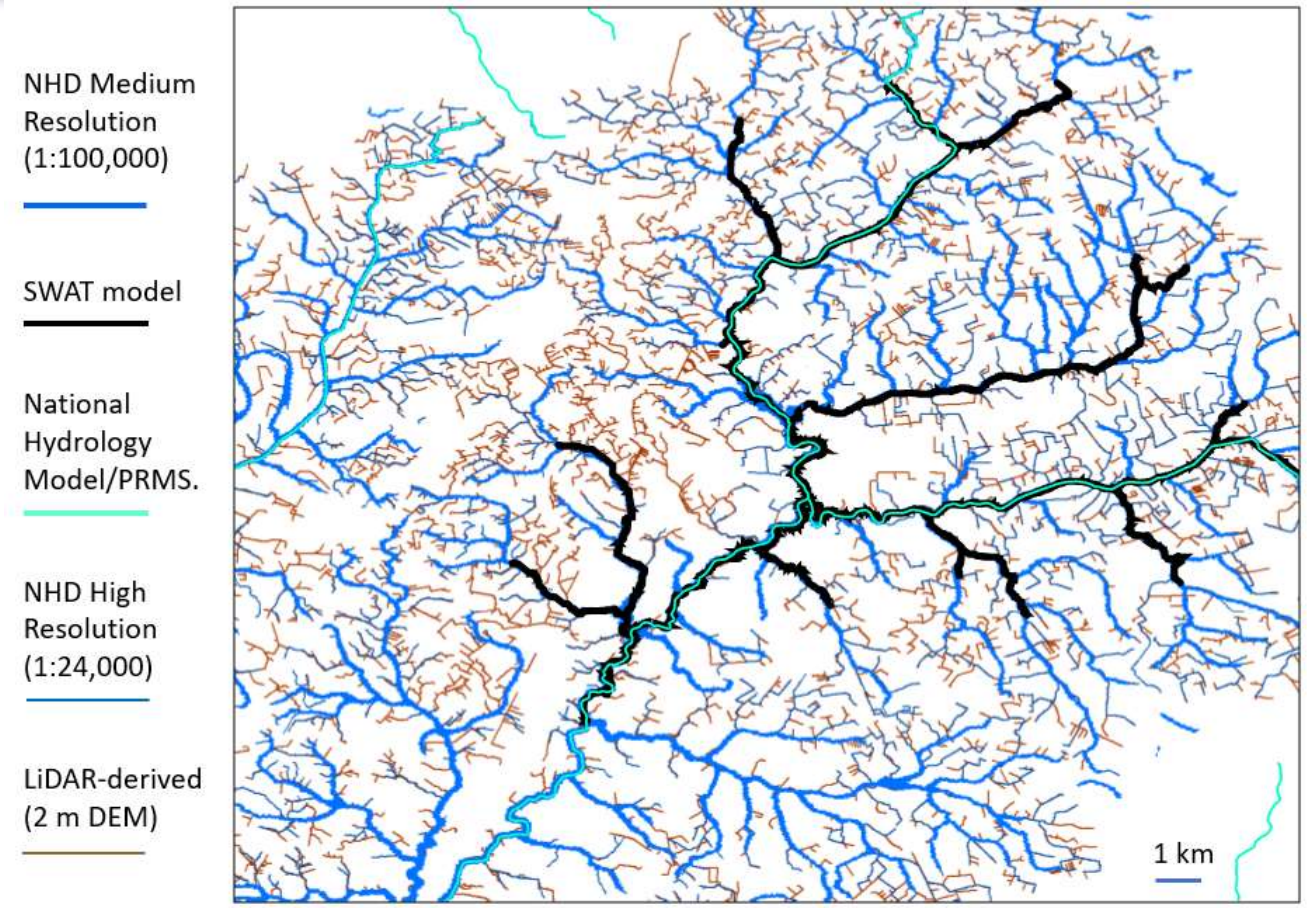
Jay Christensen – Research Ecologist christensen.jay@epa.gov

Improved Aquatic Resource Mapping

- Collaborative research effort with federal, state and academic partners
  - Interagency workgroup – modeling subgroup
    - USGS, USFWS, USACE, EPA-OW, EPA-ORD
  - ORD-led efforts – OW, USGS, UKentucky, UMaryland, UAlabama, UTennessee, Virginia Tech, TNC
  - Support of Field-based OW efforts – Streamflow Duration Assessment Methods (SDAMs)

Interagency Workgroup

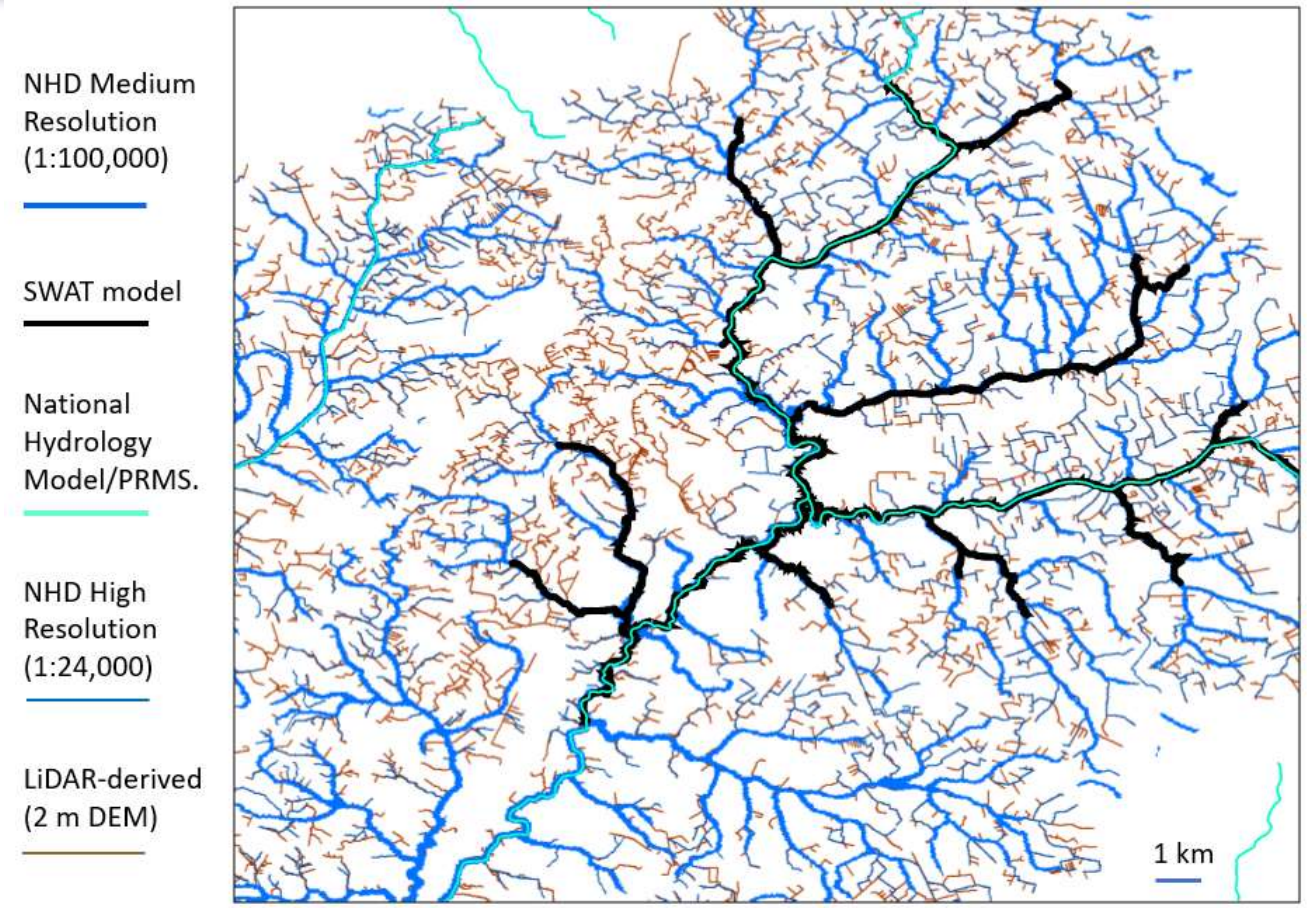
- **Modeling subgroup**
  - Developing list of applicable model outputs
    - National models (teal line)
    - Regional/Local models (black line)
    - Statistical models – e.g StreamStats
    - Probabilistic models – e.g PROSPER
  - Comparisons to existing stream networks (Dark, light blue, tan lines)



Upper Choptank River, MD/DE

Interagency Workgroup

- **Modeling subgroup**
  - Overlay the various models with existing data in case study areas
    - Translation of model outputs – e.g. Monthly streamflow to permanence class
    - Identify degrees of certainty in case study areas
  - Identify gaps and requirements for improvement



Upper Choptank River, MD/DE

ORD-led Aquatic Mapping Efforts

Product 1 **Review of current mapping approaches and geodatabases**

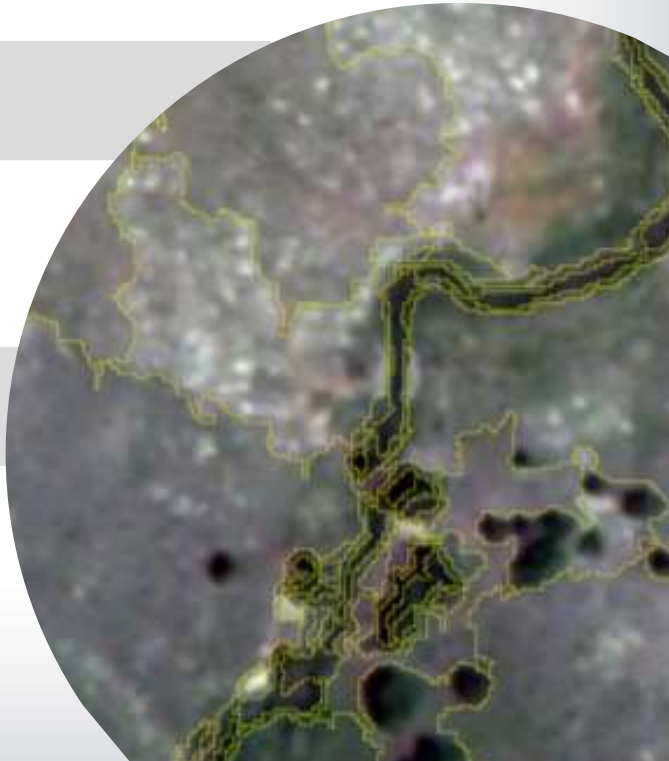
- What is the current state of mapping and what are emerging methods?

Product 2 **Geospatial mapping and analysis case-studies**

- Where can we test a variety of mapping and modeling methods?

Product 3 **Field-based tools/indicators to validate maps**

- How can we validate methods and improve field assessments?



ORD Review of current mapping approaches and geodatabases

Problem/Issue: Scattered geospatial datasets and numerous methods for mapping streams, streamflow permanence and wetland extent in the literature need to be summarized.

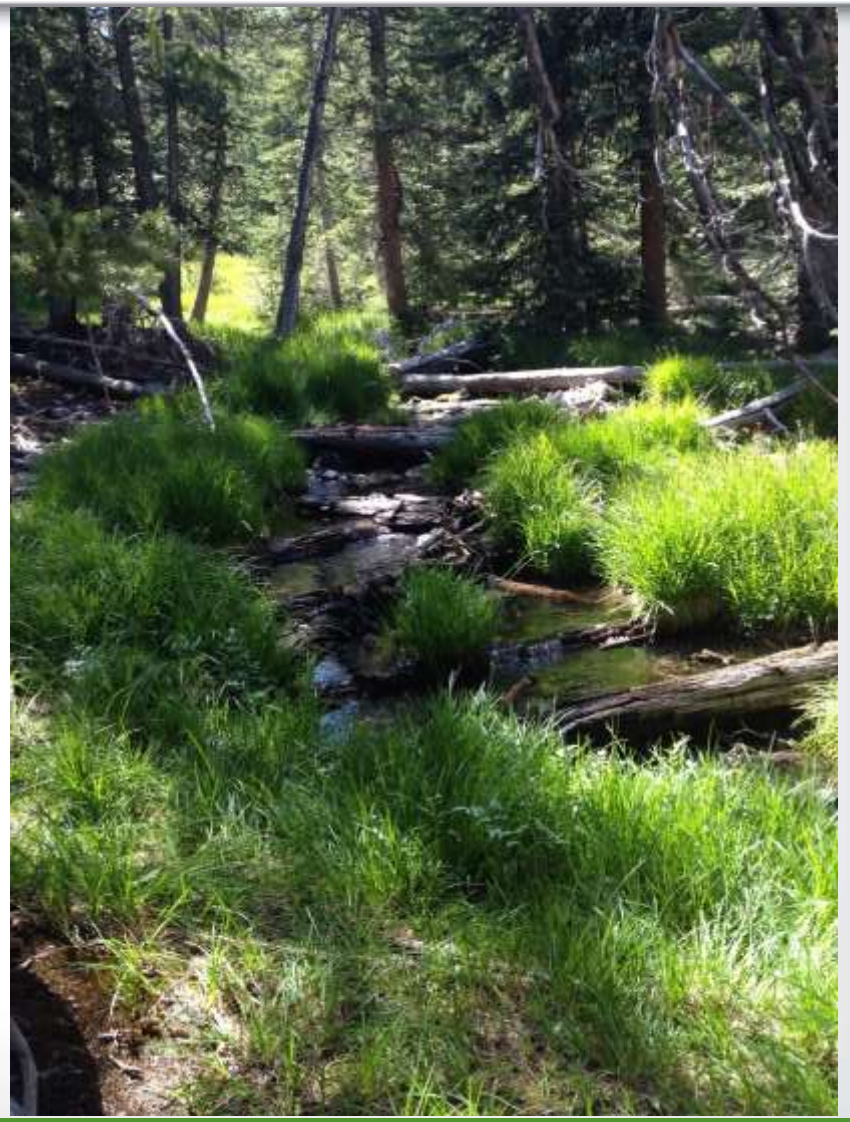
Action: Conduct a technical review of existing and potential approaches for mapping aquatic resources

Product: FY 21 - Report/manuscript describing the results of a thorough review which includes:

- Federal, State, and Tribal geospatial extent and permanence data
- Stream and wetland mapping literature/methods with a deep dive on 260+ publications

Inform the Interagency Workgroup workplan, data, gaps and model lists

External Collaborators: TetraTech, USGS and USFWS



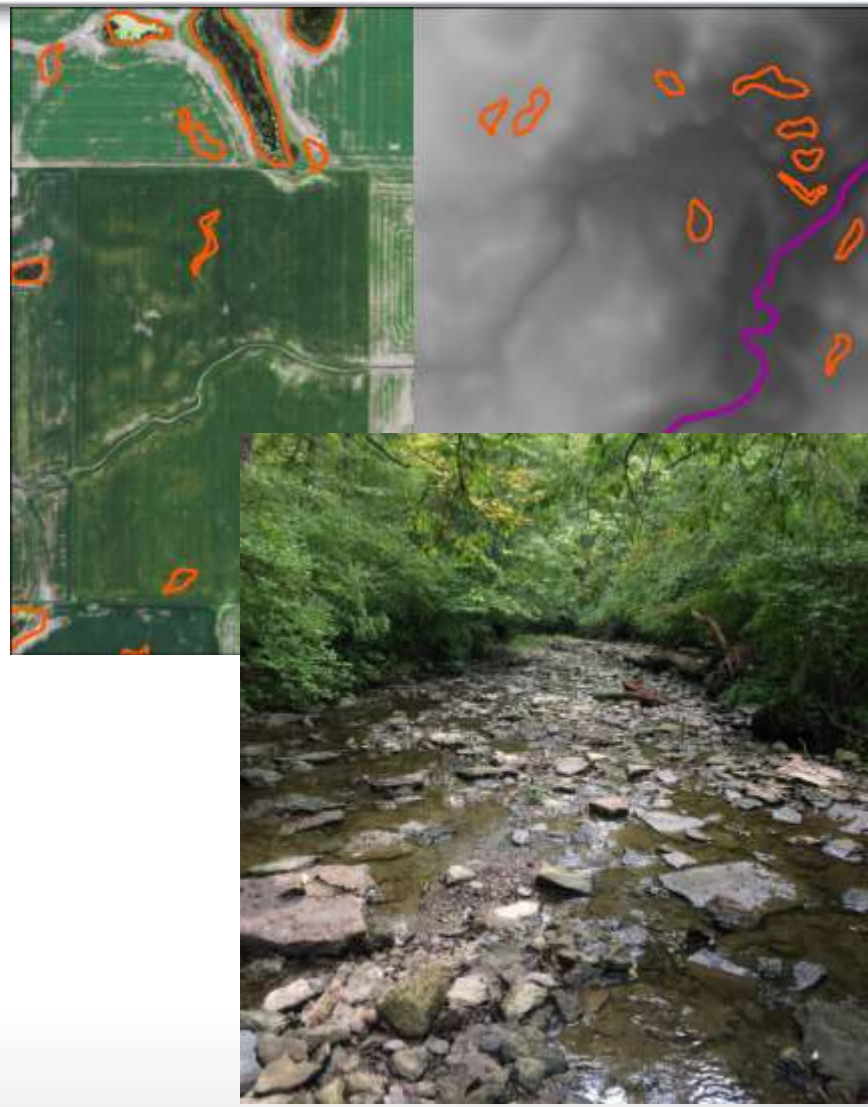
Geospatial mapping and analysis ORD case-studies

Problem/Issue: The varying geographies, dynamics and types of aquatic resources requires careful consideration of approaches in mapping streams and wetlands

Action: Conduct stream and wetland mapping in chosen case study areas using an ensemble of topographic analyses, multiple models, remote sensing platforms and field-based sensors.

Product: FY22 - Synthesis of lessons learned from one or more ORD case study areas. Phased approach

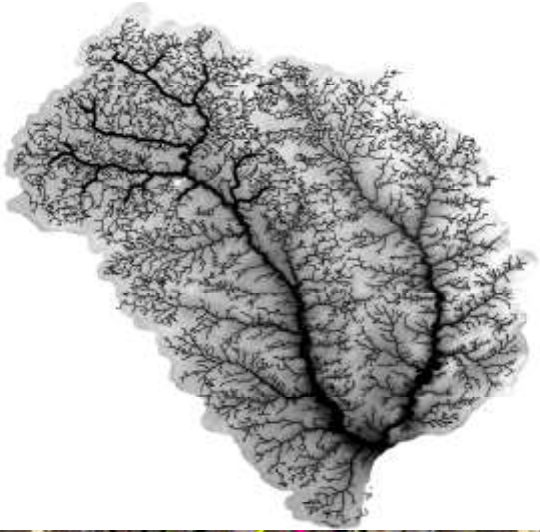
External Collaborators: USGS, USFWS, UKentucky, UMaryland, UAlabama, UTennessee, Virginia Tech, TNC



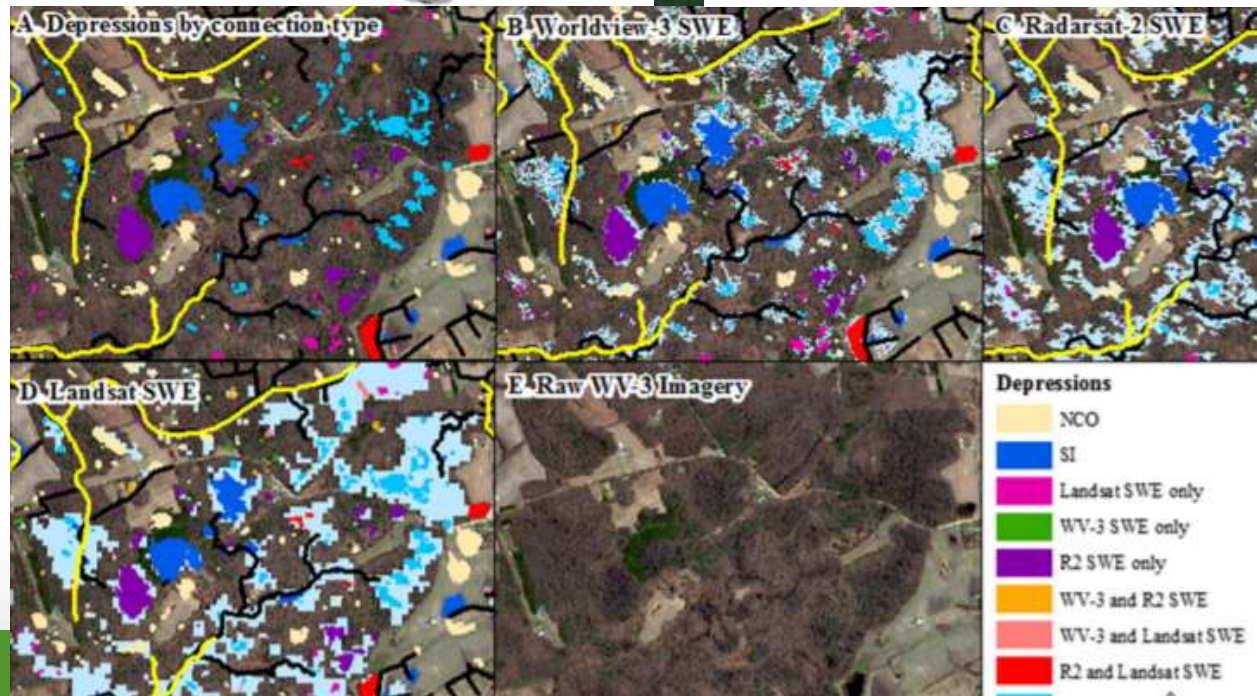
Geospatial mapping and analysis ORD case-studies

Phase 1 example: Choptank River, MD

- Flat forested wetlands in ditched ag lands with sandy soils and shallow subsurface flows where wetlands and streams wet in spring and dry in summer
- Existing LiDAR, models and imagery
- **Included as an Interagency case study**
- Ongoing work
  - Logger deployment into non-perennial streams
  - Acquisition of Sentinel and fine-scale imagery
- Future work
  - Saturation hydrology model
  - Loggers to support the validation of models and remote sensing

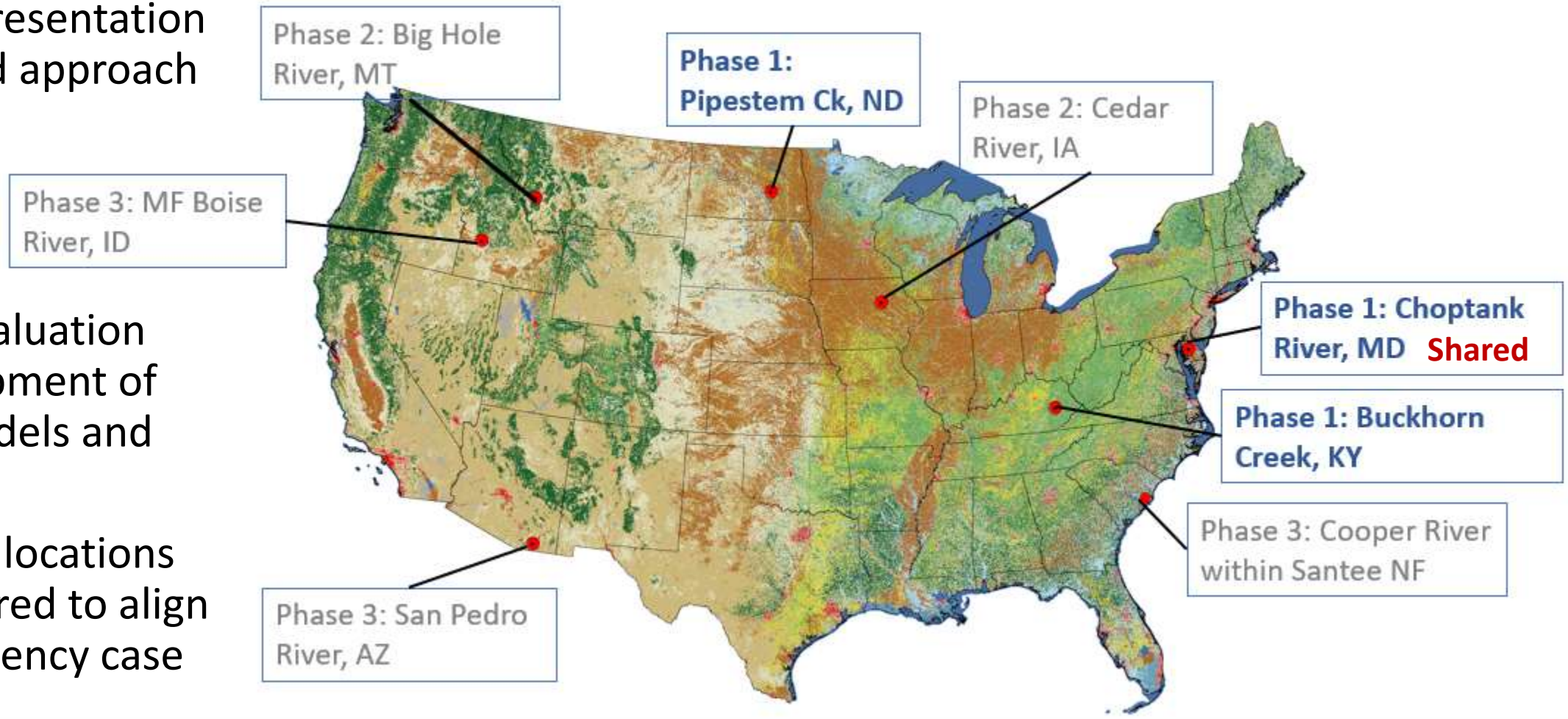


Vanderhoof et al. 2017



Geospatial mapping and analysis ORD case-studies

- Diverse representation via a phased approach
- In-depth evaluation and development of loggers, models and imagery
- Later phase locations may be altered to align with interagency case studies



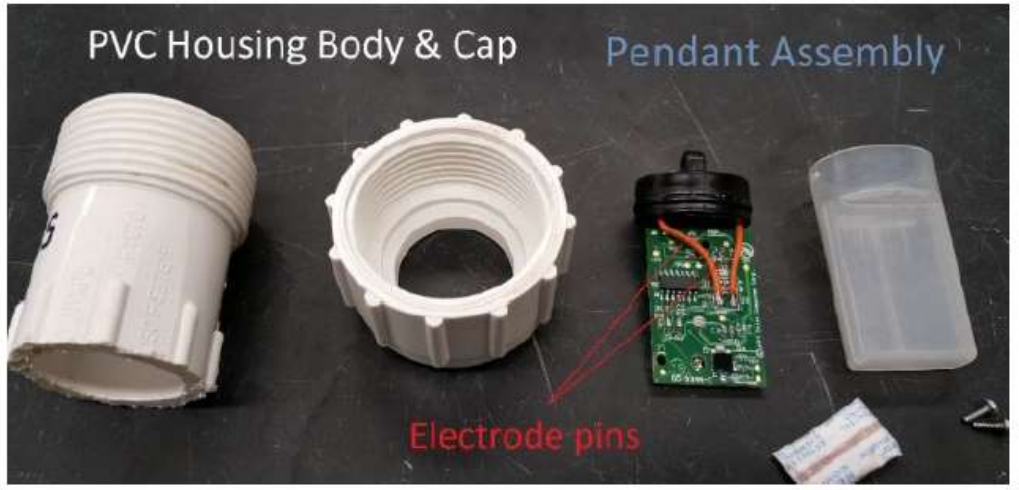
ORD Field-based tools/indicators to validate maps

Problem/Issue: Field data are needed to validate models and additional rapid assessment methodologies are needed to determine streamflow permanence.

Action: Deploy conductivity loggers in case study areas and support ongoing OW-led efforts on stream assessments

Product: FY22 - Synthesis of geospatial methodologies & maps with metadata relating to validation efforts and OW stream assessments

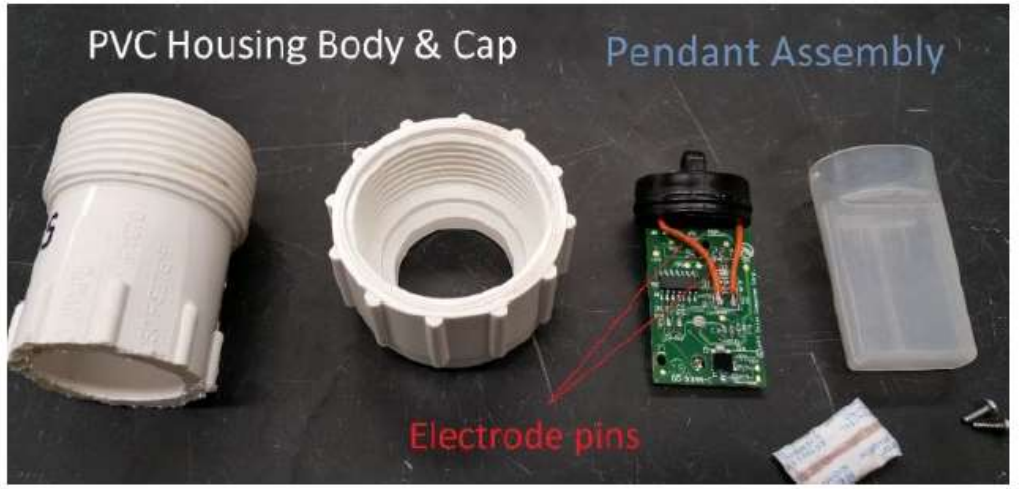
External Collaborators: EPA-OW,USGS, VA DNR, UKentucky, UMaryland, UAlabama, Virginia Tech, TNC



Images: Ken Fritz

ORD Field-based tools/indicators to validate maps

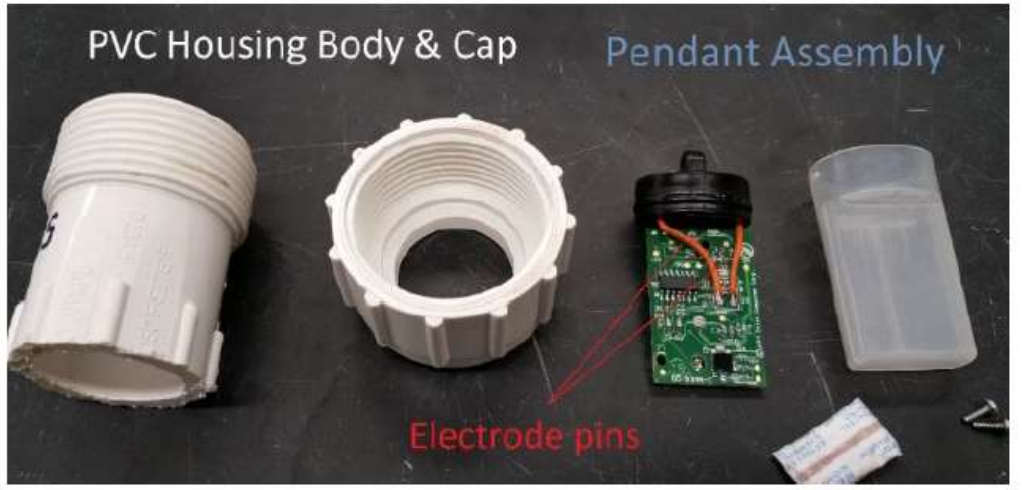
- Field validation efforts to support remote sensing and modeling work
  - Ongoing – deployment of loggers at the case study locations
    - ND loggers – Summer/Fall 2020
    - MD loggers – planned for Fall 2020
    - KY loggers – planned for Fall 2020/Spring 2021
  - Planned development of logger datasets to support model/remote sensing
  - Included in interagency case study in MD



Images: Ken Fritz

Support of Field-based OW efforts

- OW development of regional **Streamflow Duration Assessment Methods** (SDAMs)
  - Rapid field-based assessment tool
  - Uses machine learning approaches to identify best sets of reach-scale physical and biological indicators that most accurately predict flow duration class for stream reaches
    - Pacific Northwest - completed 2015
    - Arid West – tool in dev 2020
    - Western Mountains – sampling 2020
    - Great Plains – sampling 2020
    - Northeast – initial sampling 2020
    - Southeast – initial sampling 2020



Logger Images: Ken Fritz

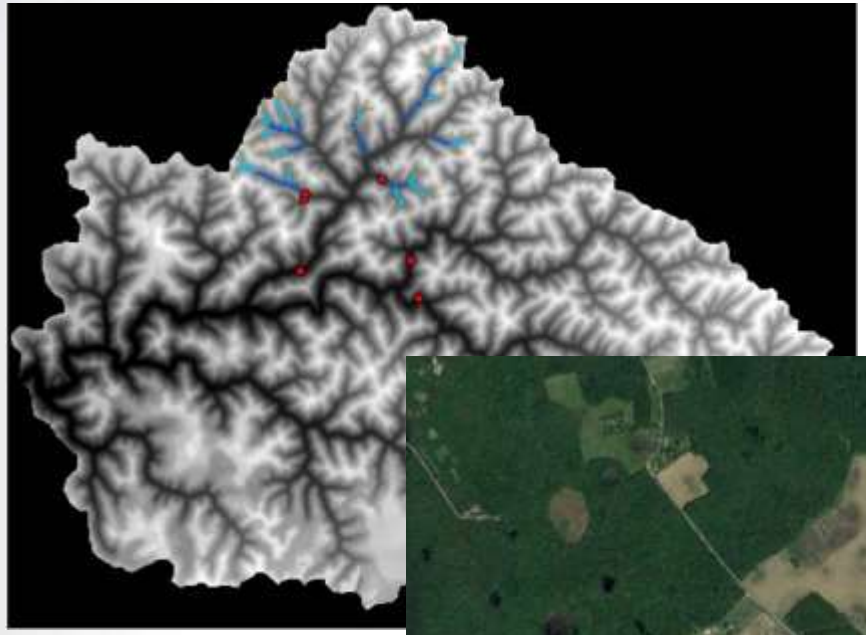
Support of Field-based OW efforts

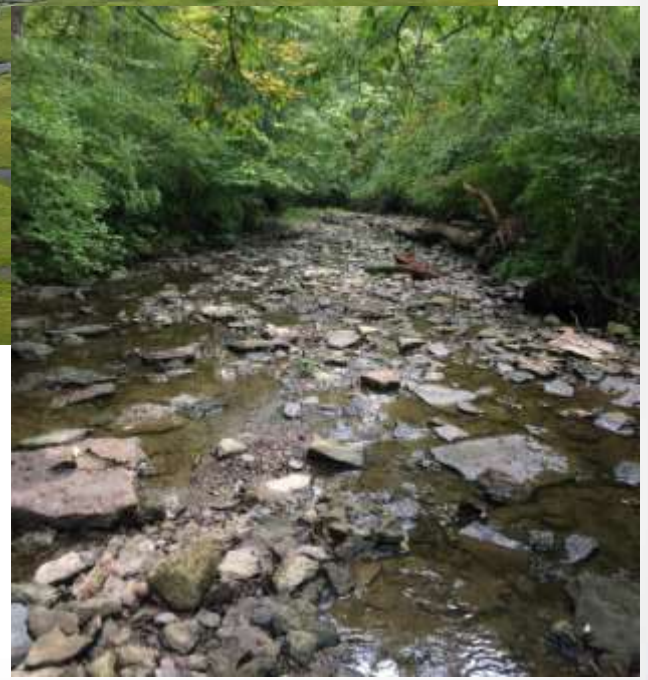
ORD support of SDAMs

- All ORD Phase 1 case studies included as intensive studies for SDAM
- Fritz et al. *Classifying Streamflow Duration: The Scientific Basis and an Operational Framework for Method Development*. Water. 2020 https://doi.org/10.3390/w12092545
- ORD effort to improve methodologies
  - Compiled biological and physical dataset to inform SDAMs with a focus in the Northeast, Southeast and Northern Great Plains regions

Images: Ken Fritz

Thank you





Jay Christensen – Research Ecologist christensen.jay@epa.gov

Questions and Discussion

Please contact Rose Kwok at kwok.rose@epa.gov if your state agency is interested in being involved in mapping.