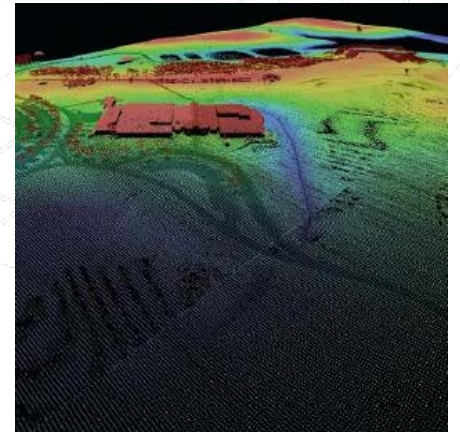
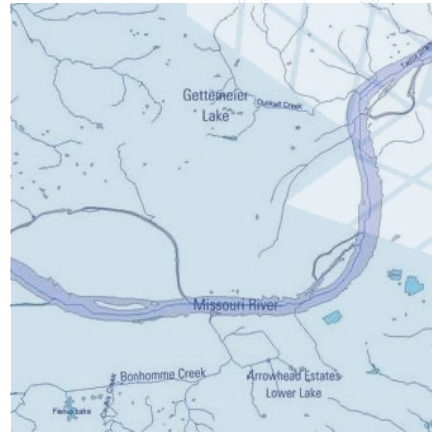
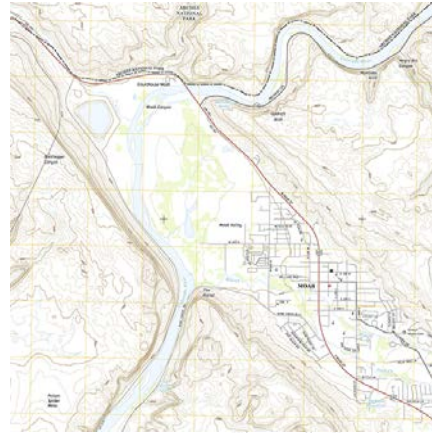




# USGS National Hydrography

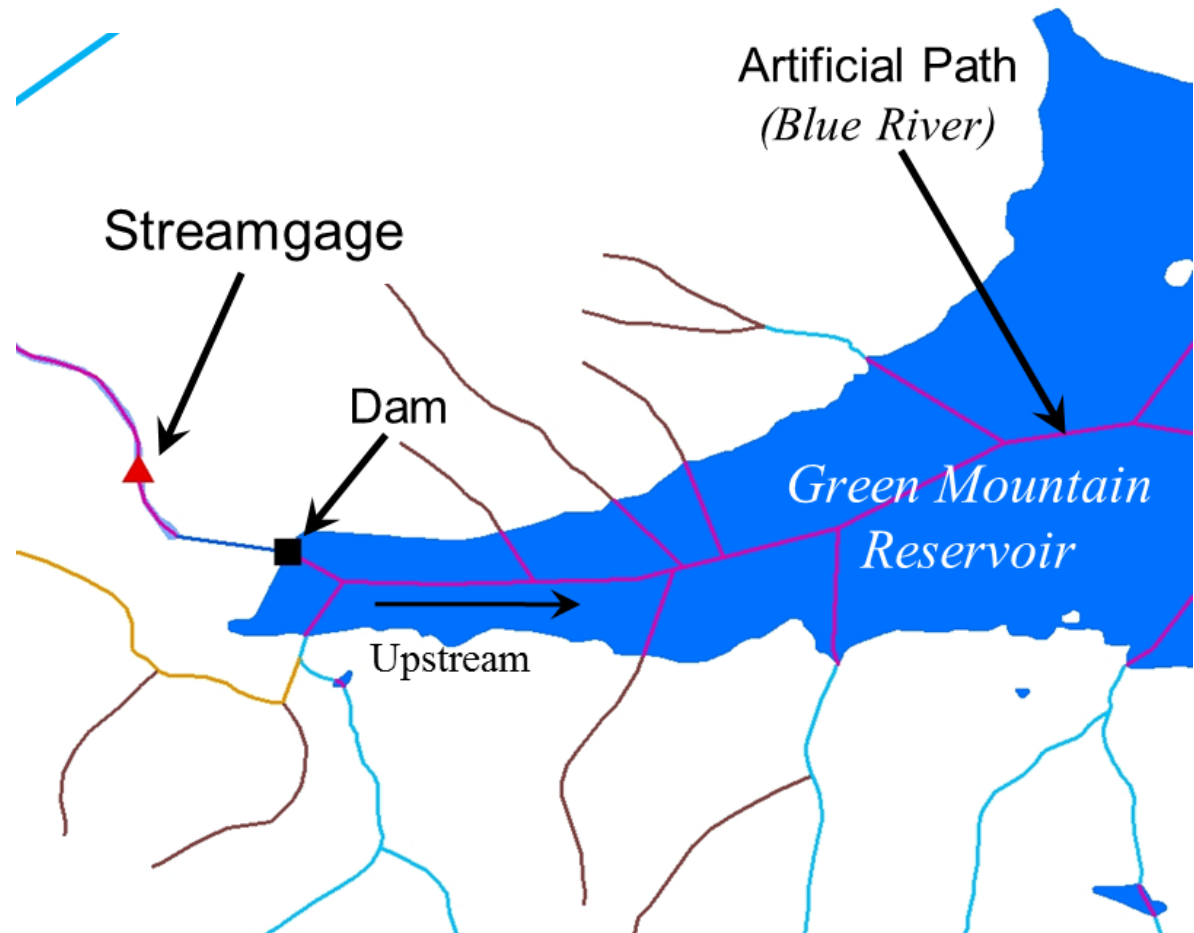




# + National Hydrography Dataset

## Water network for mapping and modeling

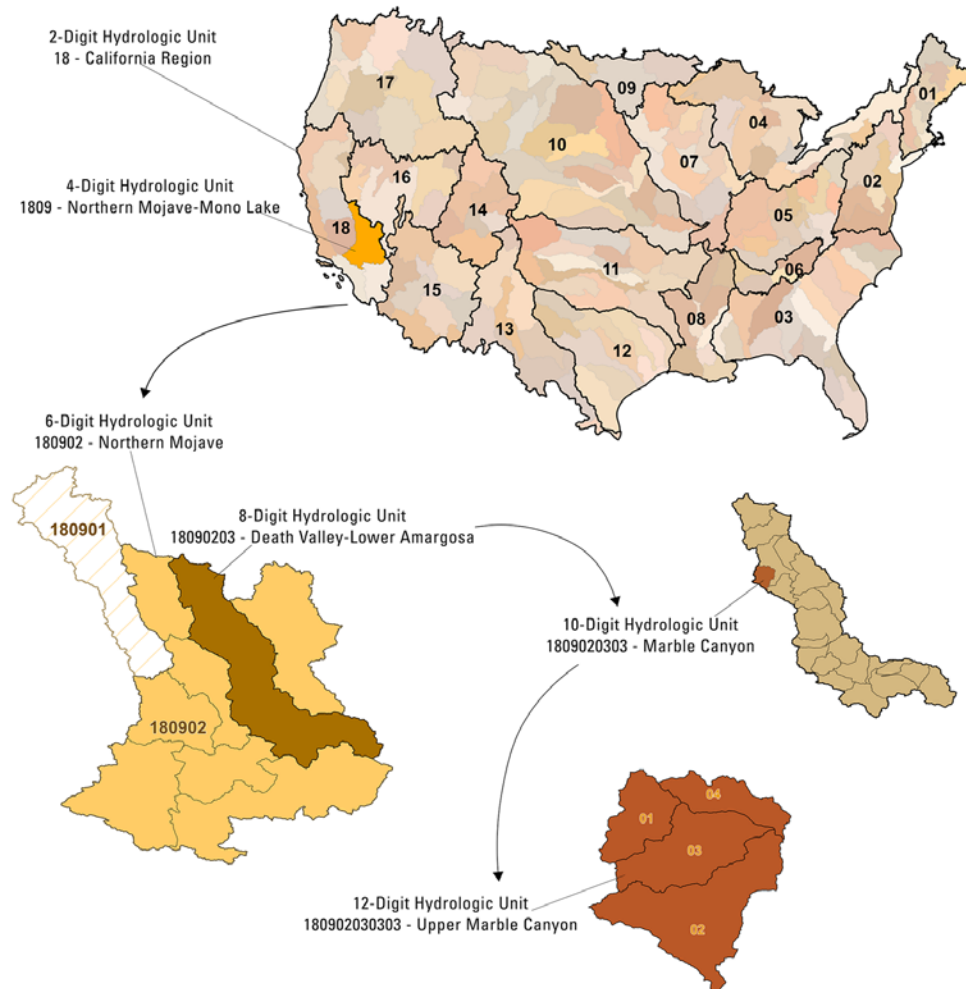
- National drainage network of streams and lakes, plus other hydro info, in a GIS format
- Currently 1:24K or better (1:63K – 1:24K in AK)
- Flow direction, navigation, linear referencing
- Shapefile and GDB downloads, plus web-based map services



# + Watershed Boundary Dataset

## Seamless baseline drainage area dataset for the Nation

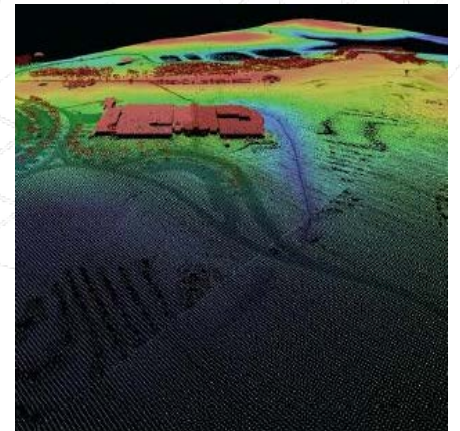
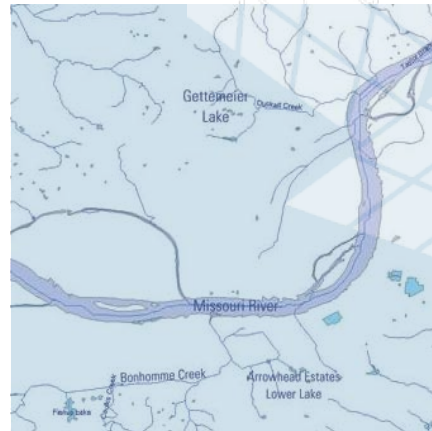
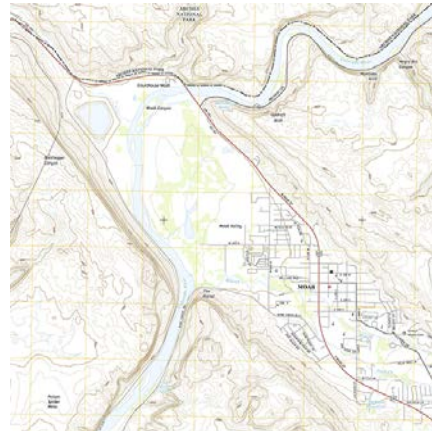
- Boundaries defined by hydrographic and topographic criteria with no regard for administrative boundaries
- Delineated in a nested multi-level, hierarchical drainage system.
- Each level assigned a progressive 2-digit Hydrologic Unit Code (HUC) which describes where the unit is in the country and the “level” of the unit
- Complete for the US to HU12
- Shapefile and GDB downloads, plus web-based map services





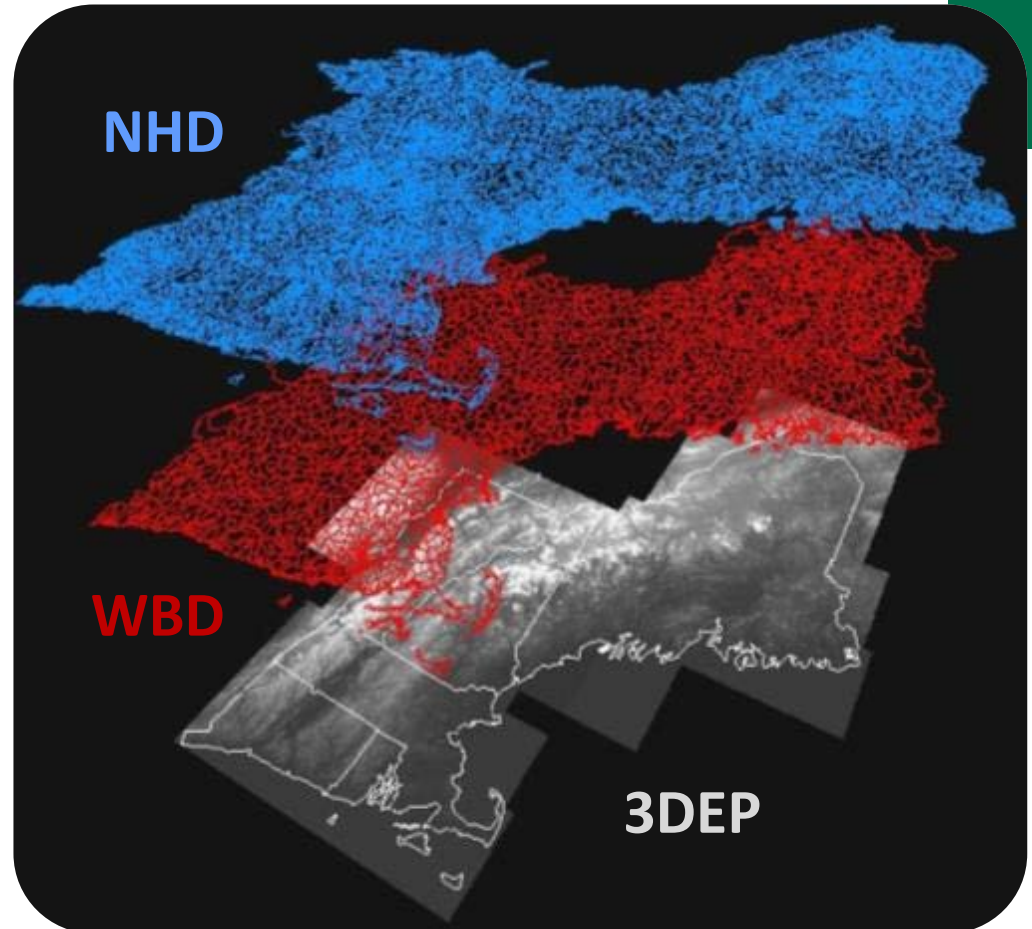
# USGS National Hydrography

*NHDPlus HR*



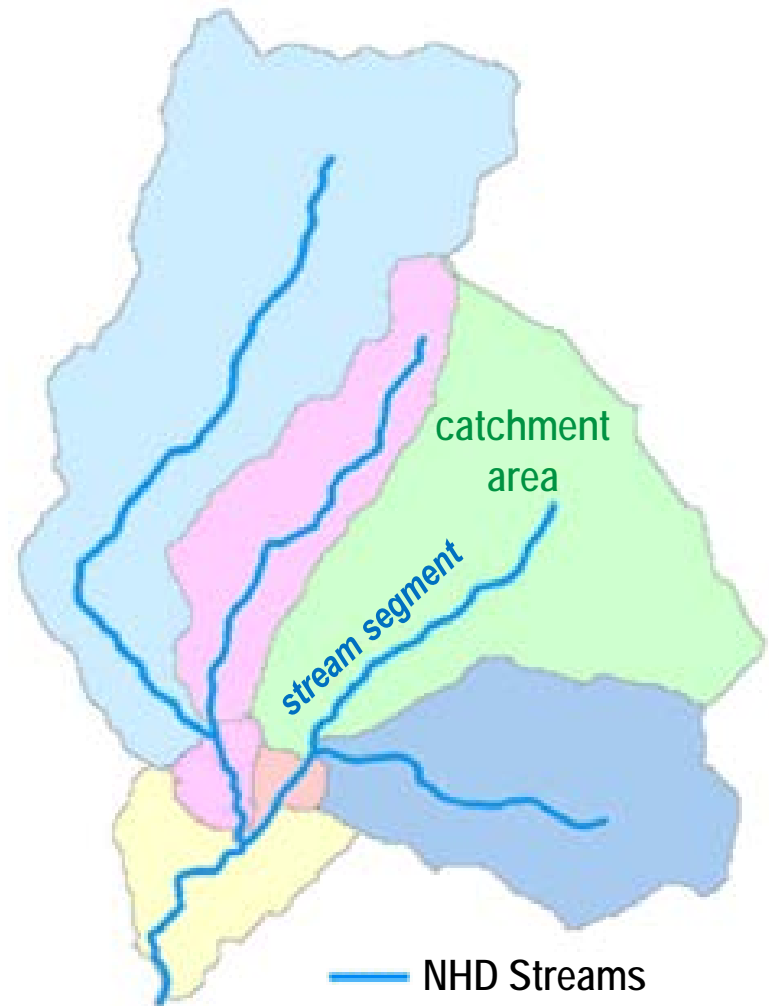
# + NHDPlus

- Medium Resolution completed for CONUS (1:100,000)
- High Resolution in work for CONUS and AK (1:24,000)
- Incorporates NHD, WBD and 3DEP data



# + NHDPlus includes...

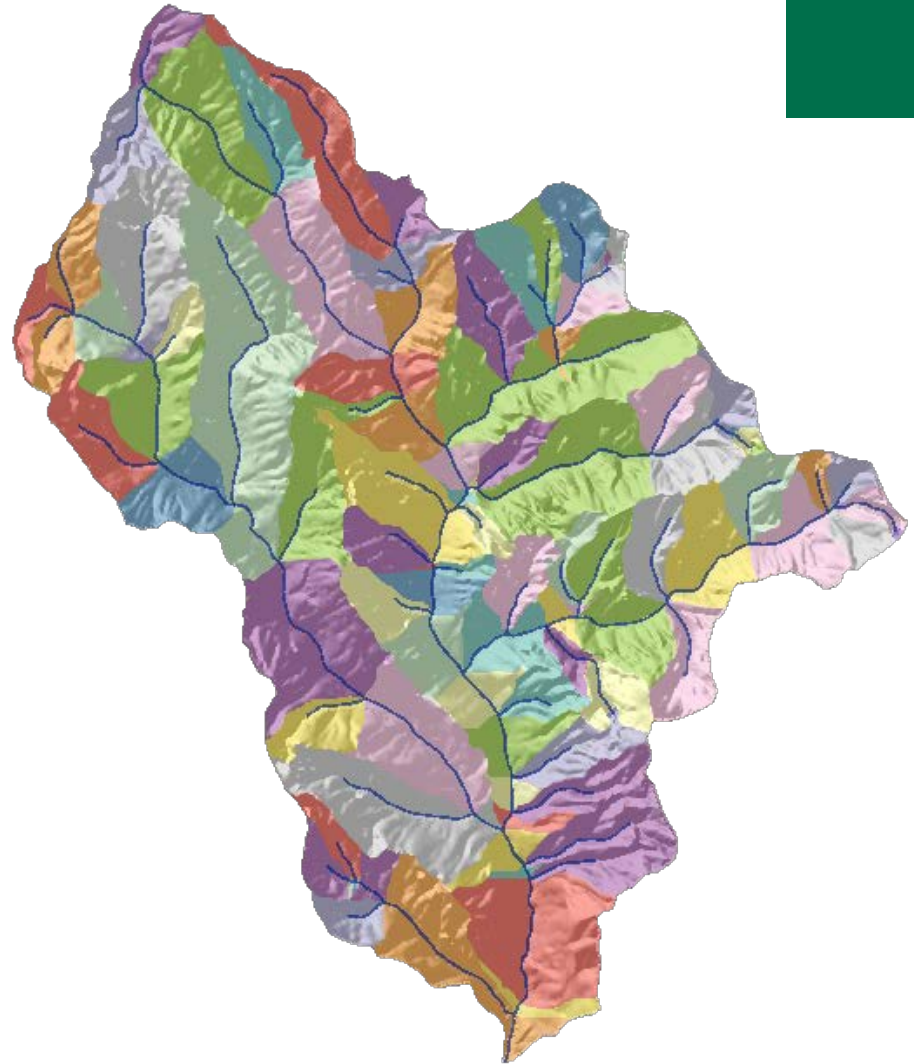
- A nationally seamless network of stream reaches
- Value-added attributes for stream network navigation and analysis
- Flow surfaces in raster format
- Elevation-based catchment areas for each stream segment that
  - Create a seamless, scalable hydrologic framework
  - Enable modeling of water flow across the landscape, linking terrestrial characteristics to the stream network



# + NHDPlus High Resolution

## NHD Plus HR

- The Hydrography Requirements and Benefits Study: ~ 80% of users need the functionality of NHDPlus but ***at a higher resolution***
- USGS is building NHDPlus HR from the highest available resolution NHD and WBD data, and 10m 3DEP data
- The results are more accurate and better maintained than the current, medium resolution NHDPlus
- NHDPlus HR will have multi-scale representation capabilities with the new VisibilityFilter attribute





# + NHDPlus Data Comparison

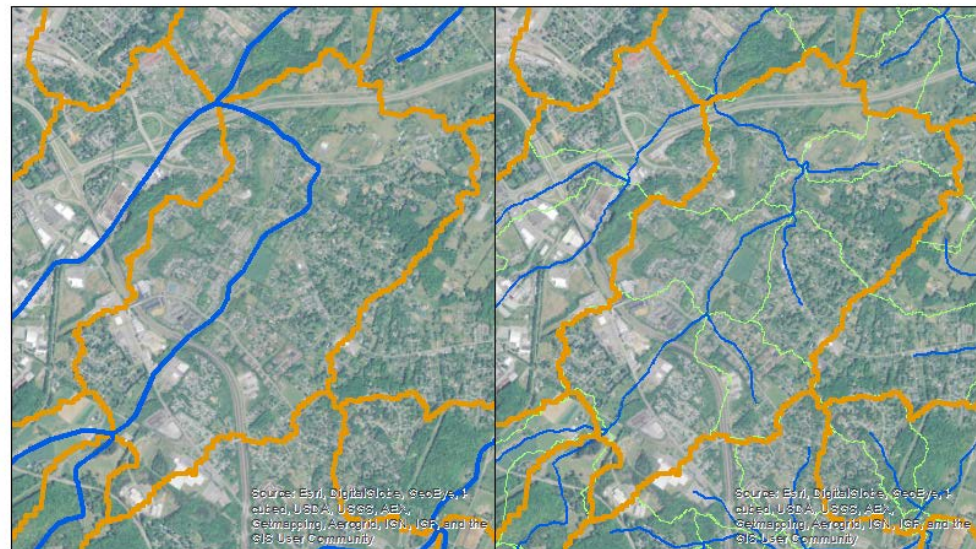
## Medium Resolution versus High Resolution

	NHDPlus Medium Resolution (V2)	NHDPlus High Resolution
<b>Number of catchments</b>	~2.7 Million nationally	~26 Million nationally
<b>Elevation Input</b>	National 1 Arc-Second Seamless DEM (30 meters)	National 1/3 Arc-Second Seamless DEM from 3DEP (10 meters)
<b>NHD Input</b>	Medium Resolution NHD 1:100K	High Resolution NHD 1:24K or better
<b>WBD Input</b>	Composite 2010-2012	Updated WBD
<b>Catchment size</b>	Avg. 1.2 square miles	Avg. ~0.2 square miles
<b>Flow estimates</b>	Mean annual, mean monthly	Mean annual

# + NHDPlus HR Applications

## The power of a common hydrography framework

- Enables complex models such as the National Water Model to bring flood forecasting down to the neighborhood level
- Observational data can be linked to NHDPlus HR to supporting limitless applications such as:



Comparison of medium (1:100,000, left) and high (1:24,000, right) resolution NHDPlus. Blue lines represent the stream network. Orange lines delineate medium-resolution catchments and green lines are catchments of the streams added at the higher resolution.

- Predicting the risk, timing, and magnitude of flood events
- Estimating when and where an event such as a toxic spill will affect downstream populations and ecosystems
- Enabling property owners to better understand upstream water availability impacts

# + NHDPlus HR Workflow - Build/Refresh

11

## Prep Components

USGS preps and QC's component datasets (NHD & WBD) and delivers them to the contractor

## Build and Deliver NHDPlus HR Beta

Contractor builds NHDPlus HR Beta using NHD, WBD and 3DEP elevation data, and delivers NHDPlus HR Beta to USGS

## Beta Distribution and QC

USGS distributes NHDPlus HR Beta to the public while concurrently coordinating a QC of the data with reviewers

## Implement Revisions

USGS incorporates the NHDPlus HR QC results into the component datasets, Beta data remains available to the public throughout this process

## Refresh and Distribute – Repeat Over Time

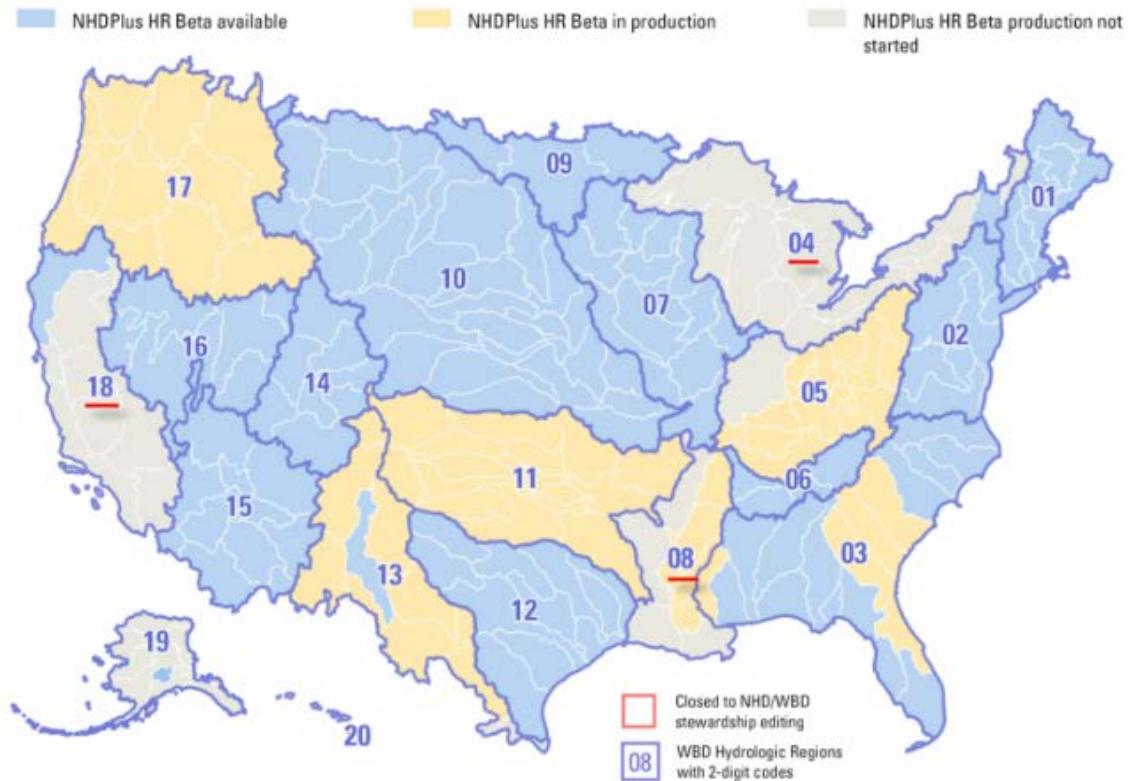
USGS refreshes the data by rerunning build tools with corrected component datasets to create a post-Beta version, the data are refreshed as needed in the future

# + NHDPlus HR Status

First datasets released in April, 2017

- NHDPlus HR Beta will be completed in 2018 for the conterminous U.S., followed by AK, HI, and territories in later years
- Users are invited to review and provide feedback to the Beta version datasets
- Feedback will be used to update and improve the refreshed data release, beginning in 2018

## NHDPlus High Resolution Availability



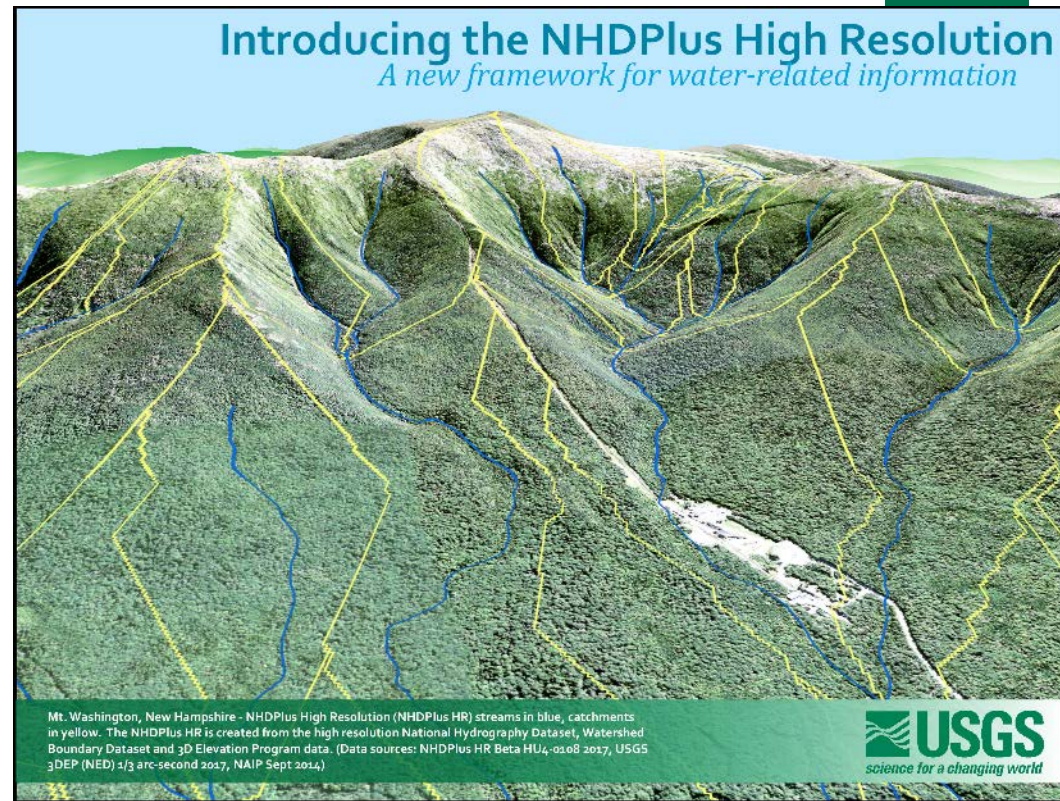
U.S. Department of the Interior  
U.S. Geological Survey

Date updated: 6/25/2018

# + NHDPlus HR Beta QC

## Quality Control Volunteers needed

- We are seeking local experts to participate in Beta QC review
- Beta QC improves *not only* the NHDPlus HR, *but also* the NHD/WBD
- Please spread the word!
- For information about NHDPlus HR Beta QC and how to volunteer, see [nhd.usgs.gov/NHDPlus\\_HR.html](http://nhd.usgs.gov/NHDPlus_HR.html)



# + A few words about NHDPlus HR "Beta"

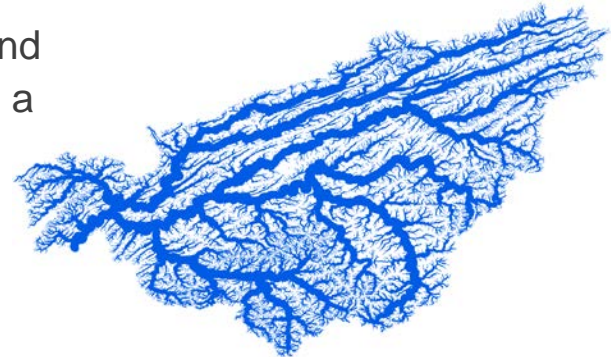
- Beta is the first iteration in a cycle of continuous improvement
- Improvements based on user Beta Review/QC
- Corrections from reviews improve the NHD/WBD and are used in building the next version of NHDPlus HR (Refresh process)
- User community engagement is critical!
- To sign up to participate and to learn more, visit [nhd.usgs.gov/NHDPlus\\_HR.html](http://nhd.usgs.gov/NHDPlus_HR.html)

# + Foundational Hydrography Datasets

## Future

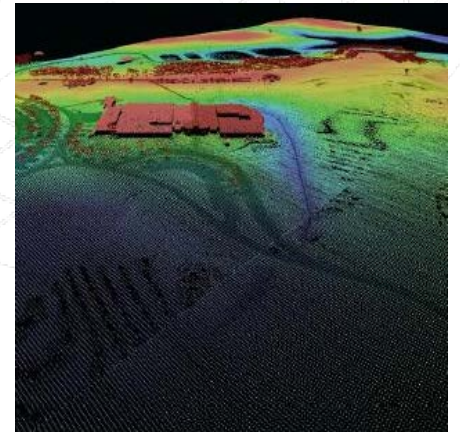
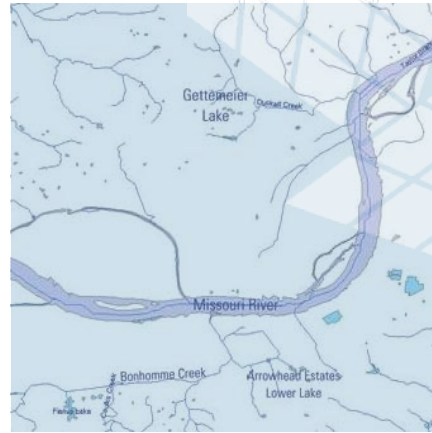
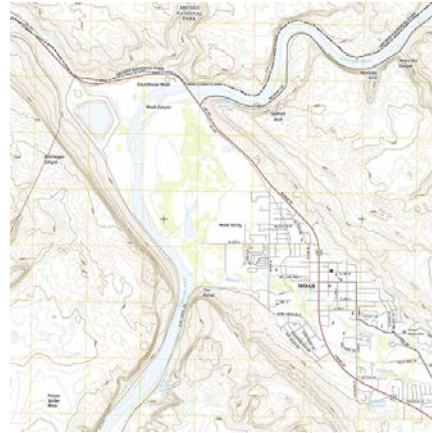
- HRBS indicates that the best way to meet most medium to long-term requirements is through fully integrating hydrography and elevation data by deriving hydrographic data from 3DEP data
- Pilot projects are underway to determine approaches and associated costs
- In the longer term, develop a plan to operationalize inland topo-bathymetric data acquisition to eventually produce a continuous elevation surface to support a range of 3D applications - pilot project is underway in FY17

	IN USE TODAY: NHDPlus Medium Resolution	IN PROGRESS: NHDPlus High Resolution	FUTURE: Hydrography Derived from Lidar
<b>Number of features nationally</b>	2.7 million	26 million	200-300 million
<b>Elevation source</b>	30 meter	10 meter	1 meter
<b>Hydrography source</b>	1:100,000-scale NHD	1:24,000-scale or better NHD	1:5,000-scale or better derived from lidar
<b>Watershed boundaries source</b>	Composite WBD snapshot of 2010-2012	Updated WBD	Catchments derived from lidar
<b>Tile size</b>	HU2	HU4	HU8 to HU12





# 3D Elevation Program- General Presentation

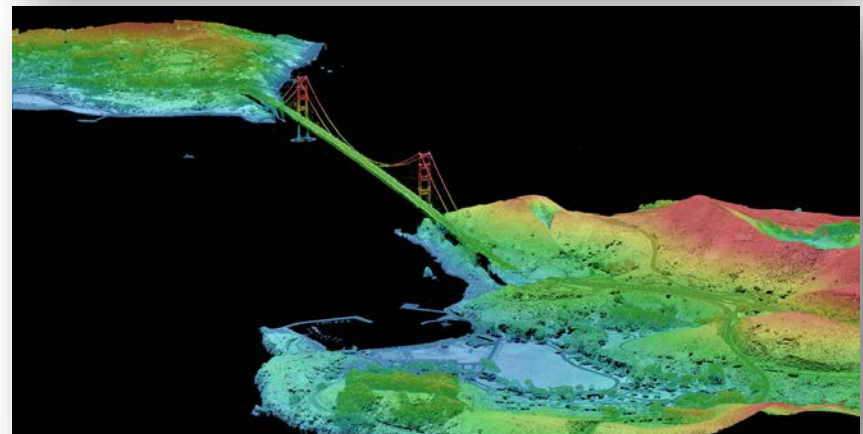


**The National Map**  
Your Source for Topographic Information



# + 3D Elevation Program (3DEP)

- Apply ground-breaking lidar technology to map bare earth surface elevations and 3D data of natural and constructed features
- Increases the data quality level to enable more accurate understanding, modeling, and prediction
- Goal to complete acquisition of national lidar coverage at Quality Level 2 with IfSAR in Alaska in 8 years
- Address the mission-critical requirements of 34 Federal agencies, 50 states, and other organizations documented in the National Enhanced Elevation Assessment
- ROI 5:1, conservative benefits of \$690 million/year with potential to generate \$13 billion/year
- Leverage the capability and capacity of private industry mapping firms
- Achieve a 25% cost efficiency gain by collecting data in larger projects
- Completely refresh national elevation data holdings with new products and services

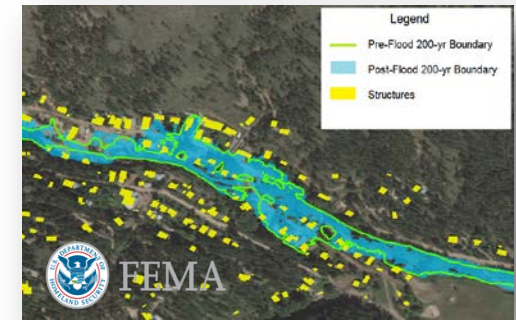


# + 3D Elevation Program

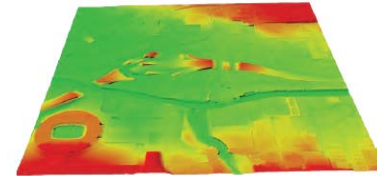
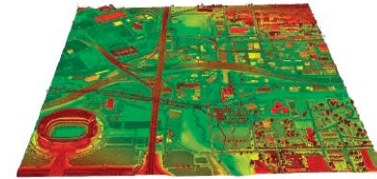
## Mission Critical Applications

Documented in the National Enhanced Elevation Assessment (NEEA) of 2012

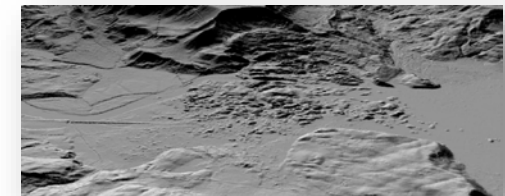
Rank	Business Use	Annual Benefits	
		Conservative	Potential
1	Flood Risk Management	\$295M	\$502M
2	Infrastructure and Construction Management	\$206M	\$942M
3	Natural Resources Conservation	\$159M	\$335M
4	Agriculture and Precision Farming	\$122M	\$2,011M
5	Water Supply and Quality	\$85M	\$156M
6	Wildfire 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
<b>Total for all Business Uses (1 – 27)</b>		<b>\$1.2B</b>	<b>\$13B</b>



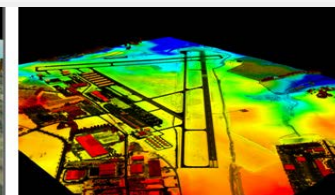
**Flood Risk Management**



**Infrastructure**



**Geologic Hazards**

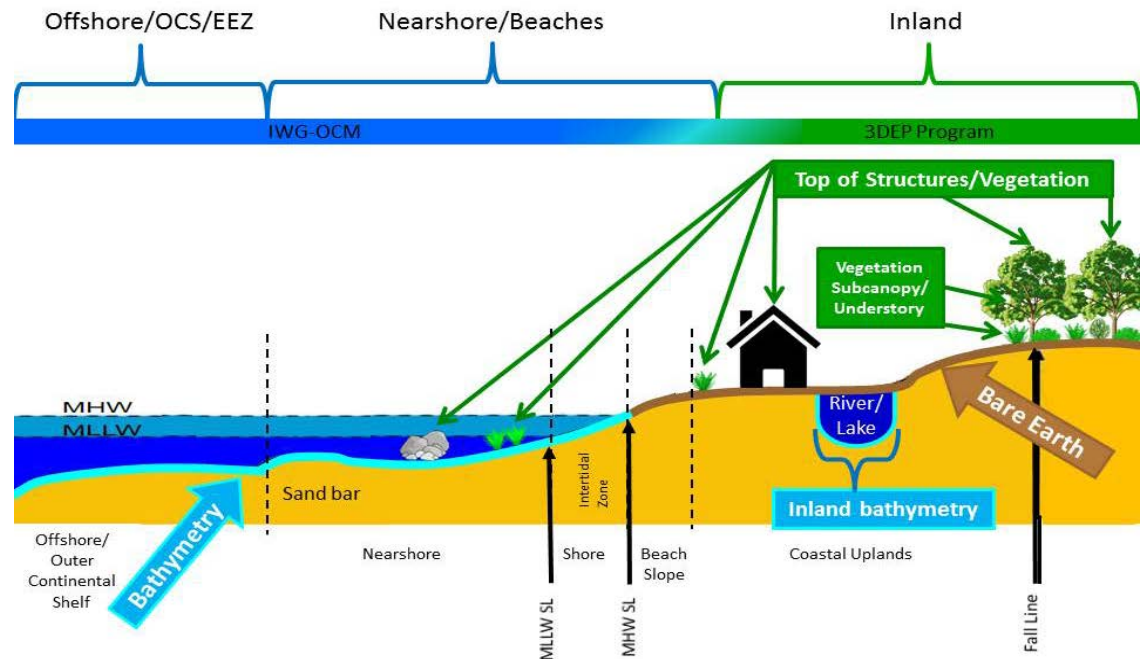


**Aviation Safety**

# + 3D Nation Elevation

## Requirements and Benefits Study - Goals

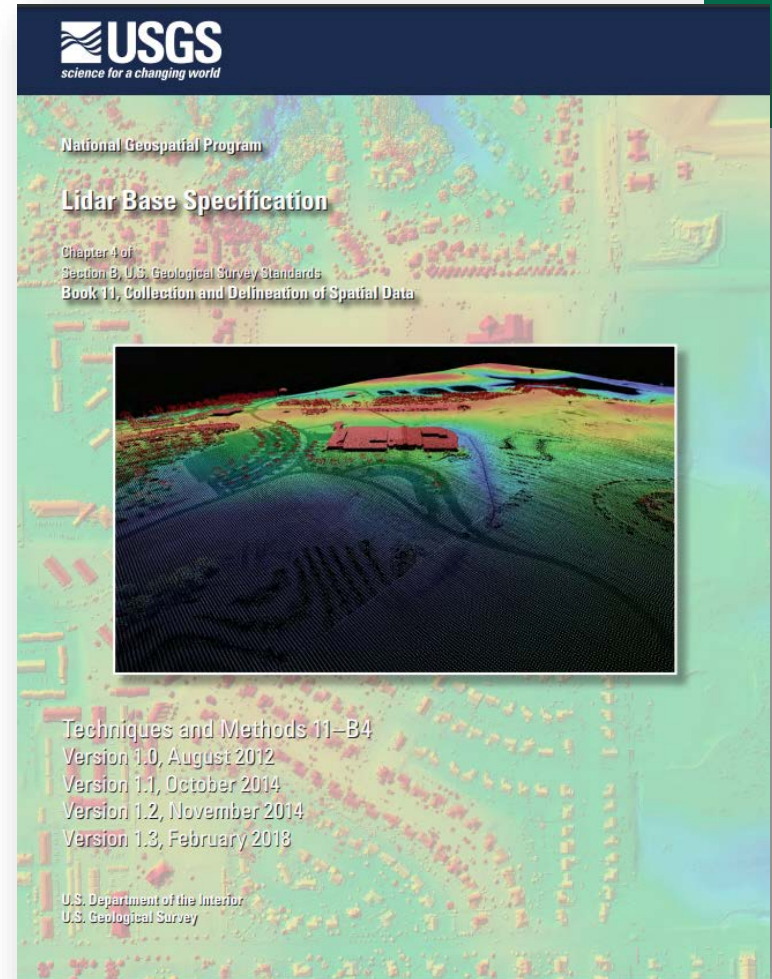
- Understand inland, nearshore and offshore bathymetric data requirements and benefits
- Understand how requirements and benefits dovetail in the nearshore coastal zone
- Plan for the next round of 3DEP after completion of nationwide coverage
- Gather technology-agnostic user information to be able to assess new technologies against requirements and identify the tradeoffs between different approaches
- Improve our understanding of needs to guide development of the next generation of 3DEP products and services





# USGS Lidar Base Specification v1.3

- Version 1.3 published in February
- Notable changes:
  - Dropping the requirement for raw, unclassified swath data
  - Clarification on how to represent coordinate reference information
  - Changes to a few classification codes
  - Inclusion of a new guideline for breakline collections
  - New GIS data dictionary to provide a consistent data structure for hydrologic breaklines



[nationalmap.gov/3dep](https://nationalmap.gov/3dep)

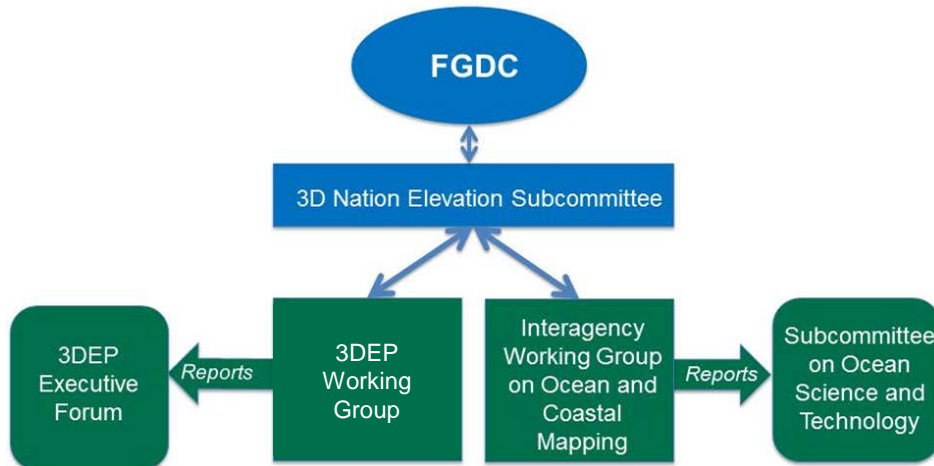
Look in “Resources” on the left navigation bar

# + 3DEP Quality

Quality Level 2 or better

Quality Level	Data Source	Vertical Accuracy RMSEz (cm)	Nominal Pulse Spacing (NPS) (meters)	Nominal Pulse Density (NPD) (points per square meter)	Digital elevation mode (DEM) cell size (meters)
QL0	Lidar	5 cm	$\leq 0.35$ m	$\geq 8$ pts/meter <sup>2</sup>	0.5 m
QL1	Lidar	10 cm	$\leq 0.35$ m	$\geq 8$ pts/meter <sup>2</sup>	0.5 m
QL2	Lidar	10 cm	$\leq 0.7$ m	$\geq 2$ pts/meter <sup>2</sup>	1 m
QL3	Lidar	20 cm	$\leq 1.4$ m	$\geq 0.5$ pts/meter <sup>2</sup>	2 m
QL4	Imagery	139 cm	N/A	N/A	5 m
QL5	Ifsar	185 cm	N/A	N/A	5 m

# + 3DEP Governance

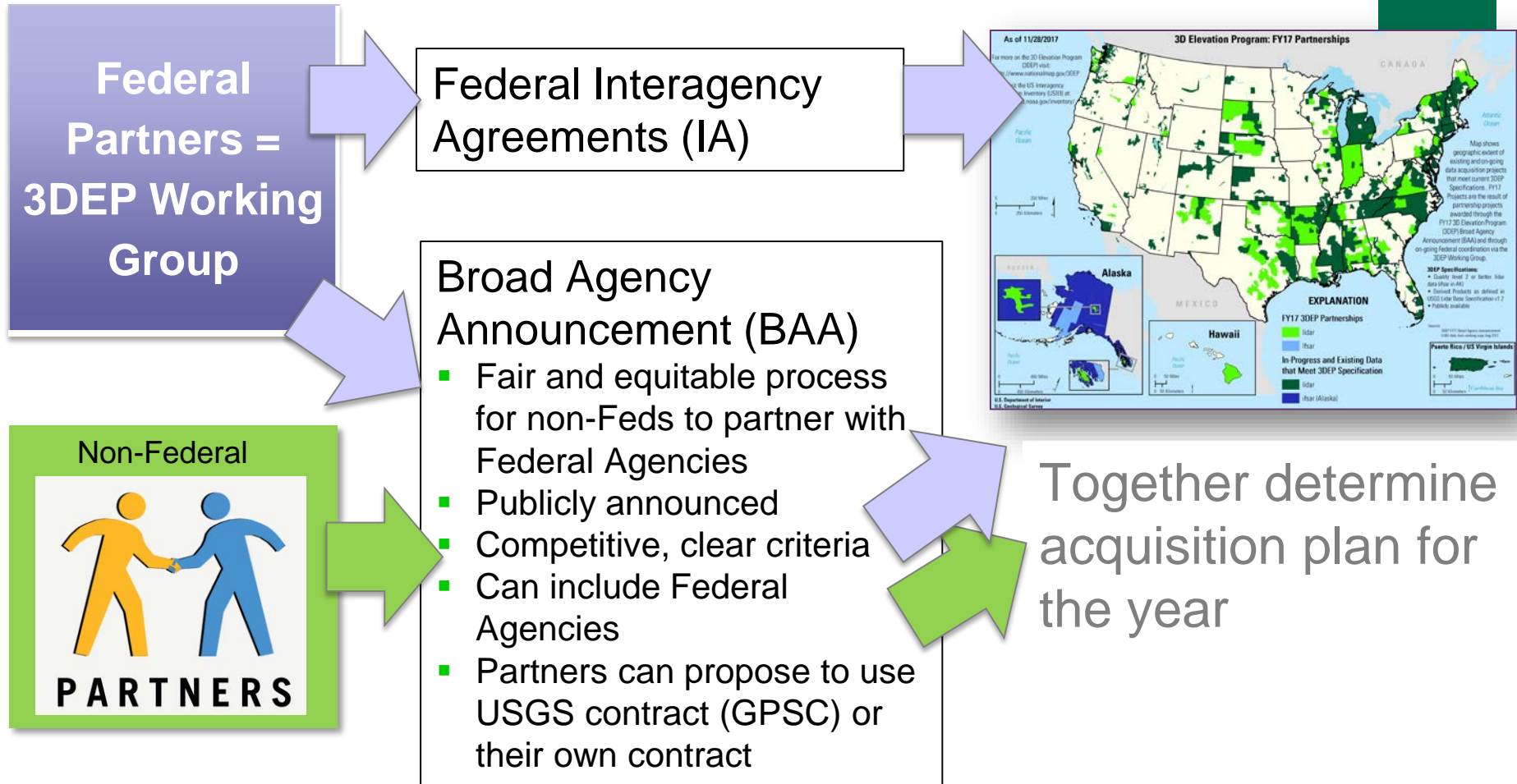


- 3DEP Executive Forum
  - Facilitates executive collaboration on strategies to fund and implement 3DEP for the benefit of all its stakeholders
  - Provides direction to 3DEP Working Group
- 3DEP Working Group
  - Coordinates implementation of 3DEP

Member Agencies
Bureau of Land Management
Department of Homeland Security
Department of Transportation
Environmental Protection Agency
Federal Aviation Administration
Federal Communications Commission
Federal Emergency Management Agency
US Forest Service
US Fish and Wildlife Service
National Oceanic and Atmospheric Administration
National Park Service
Natural Resources Conservation Service
Office of Surface Mining Reclamation and Enforcement
US Department of Agriculture
US Army Corps of Engineers
US Geological Survey
American Association of State Geologists
National States Geographic Information Council

# + 3DEP Data Acquisition

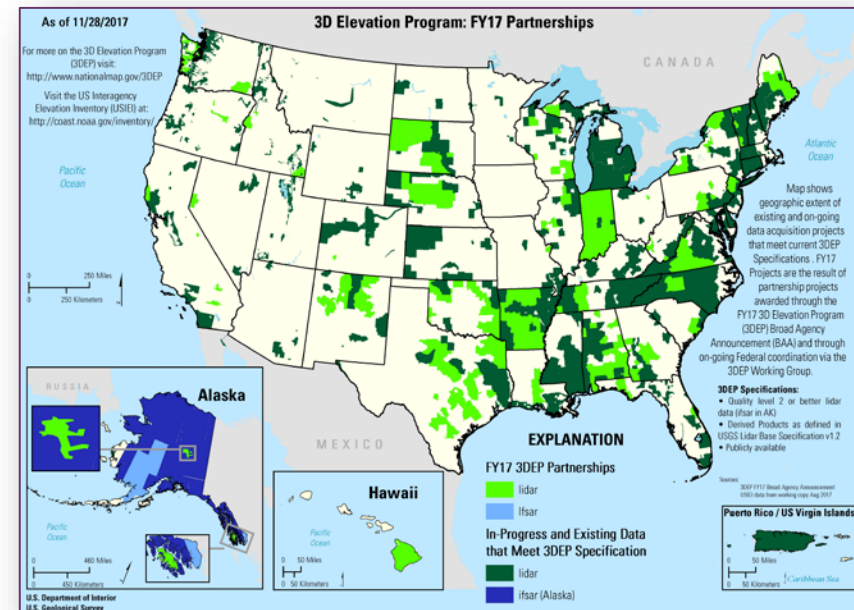
3DEP is built on partnerships



# + 3DEP Broad Agency Announcement

## Partnerships to acquire high-quality 3D elevation data

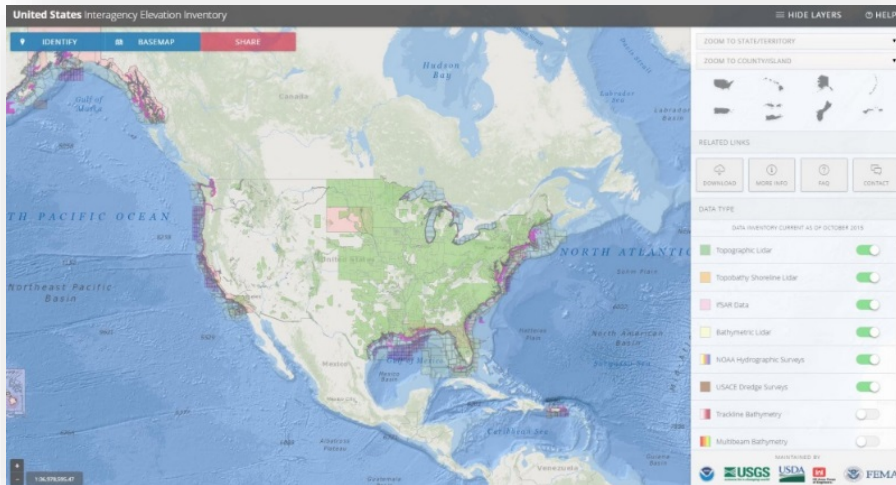
- Provides visibility and opportunity to the broadest stakeholder community possible through FedBizOpps.gov and grants.gov
- Federal, state and local governments, tribes, academic institutions, and private sector are eligible
- Partners may propose to use the USGS Geospatial Product and Services Contracts (GPSC) or their own contracting vehicles
- National Map Liaisons can assist partners with the process and coordinating partnerships
- AK IfSAR projects are not included in BAA



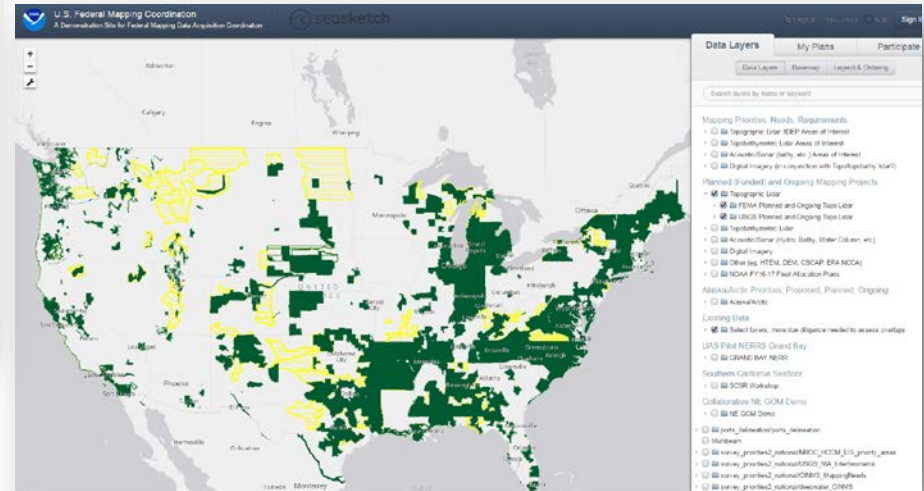
<https://nationalmap.gov/3DEP/index.html>



# + U.S. Interagency Elevation Inventory and Seasketch: Find data and partners



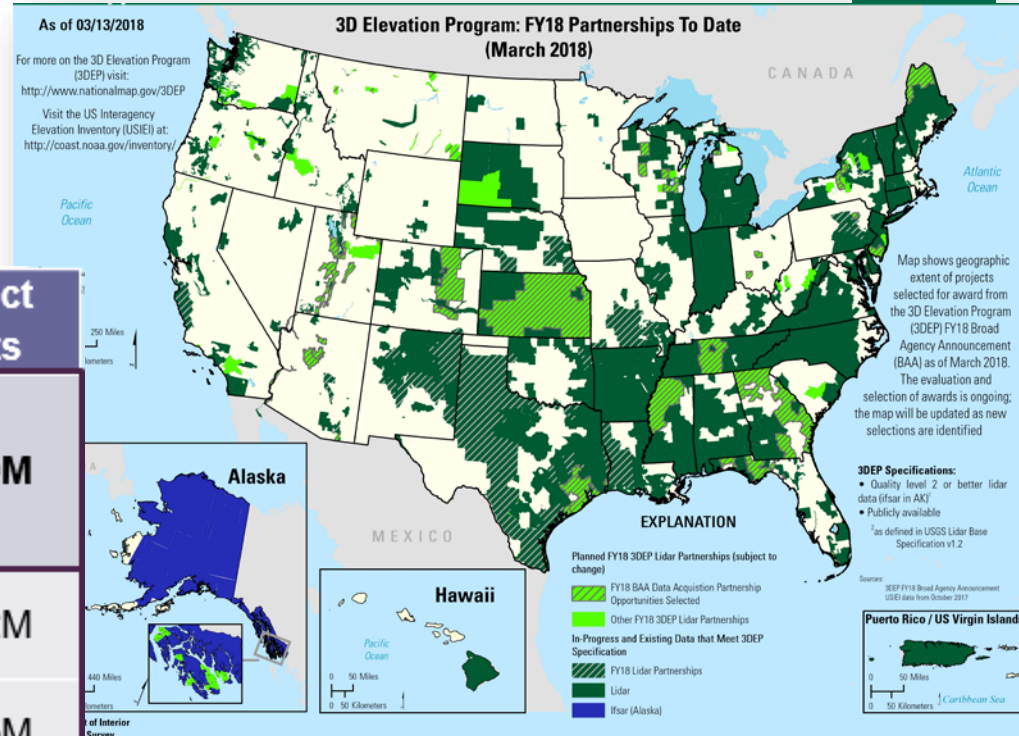
USIEI  
[coast.noaa.gov/inventory](https://coast.noaa.gov/inventory)



NOAA sponsored Seasketch site  
[fedmap.seasketch.org](https://fedmap.seasketch.org)

# + FY18 3DEP Partnerships to Date

Oct 2017– March 2018



Status	Description	Sq Miles	Project Costs
<b>Awarded</b>	<b>FY17 Federal investments to support FY18 projects</b>	<b>205K</b>	<b>\$40.0M</b>
<b>Planned / Funded</b>	BAA – 22 projects in 18 states	175K	\$27.2M
	Federal partnerships	50K	\$10.5M
	<b>Total planned</b>	<b>225K</b>	<b>\$37.7M</b>
<b>TOTAL</b>		<b>430K</b>	<b>\$77.7M</b>

# + 3DEP National Tiling Scheme for Lower 49

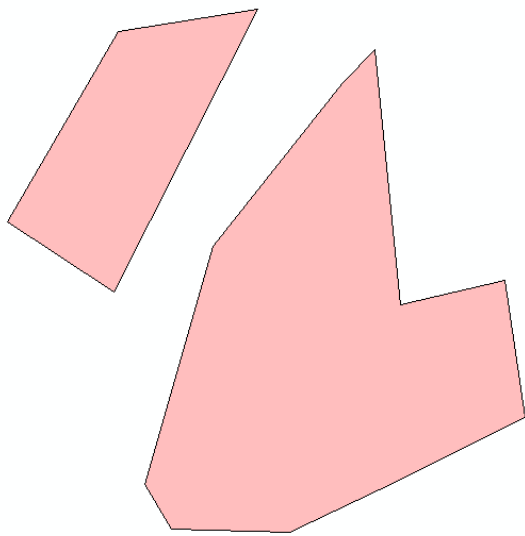
- **Albers Equal Area projection (EPSG:6350), XYZ units in meters**
- Each tile is **1 square km in area**
- A standard national tiling **naming convention** that represents the XY location for each tile
- Tiles can be **grouped or block nested** by various attributes (counties/states/HUCs), but each tile should be part of one and only one group (1:1 relationship)
- Hawaii and territories use 1 km tile on whatever projection makes sense
- Alaska continues to use 1-degree cells
- Implementing in BAA GPSC projects FY18 and cooperative projects in FY19

## Benefits

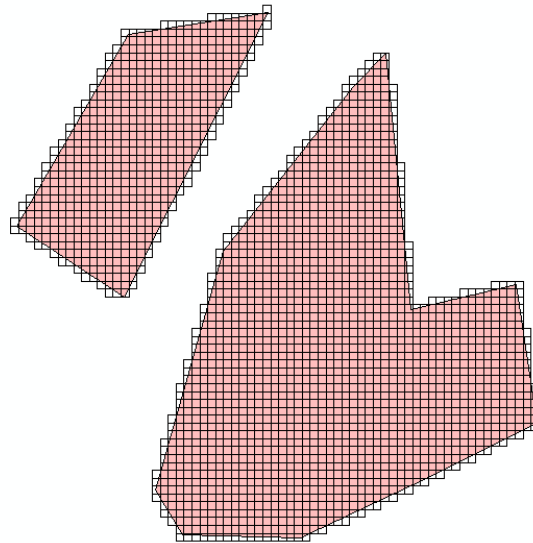
- 1 square km is small enough to approximate watersheds, county and state boundaries, etc., without adding a lot of area to projects
- Tile sizes are equal in area no matter their location in latitude or longitude
- Avoids slivers and unnecessary overlap between projects
- More orderly approach to nationwide coverage
- The MASTER 1k x 1k tile scheme will be provided online for public use and download
- Conversion services to be developed in the future

+

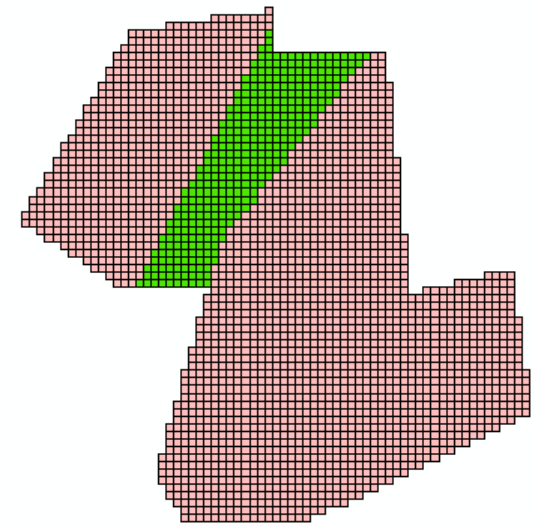
# 3DEP National Tiling Scheme for Lower 49



Original project area  
of interest



Expand to complete the  
nearest 1-km tile



Add tiles to fill in gap  
between polygons

# + Access 3DEP Data: <https://nationalmap.gov/3dep/>



## 3D Elevation Program (3DEP)

[The National Map Home](#) >> 3D Elevation Program (3DEP)

- About
- News
- Get Data
- Data Partnership Opportunities
- Benefits
- Resources
- Contact Us

### Introduction and Goals

The 3D Elevation Program (3DEP) initiative is being developed to respond to growing needs for high-quality topographic data and for a wide range of other three-dimensional representations of the Nation's natural and constructed features. The primary goal of 3DEP is to systematically collect enhanced elevation data in the form of high-quality light detection and ranging (lidar) data over the conterminous United States, Hawaii, and the U.S. territories, with data acquired over an 8-year period. Interferometric synthetic aperture radar (IFSAR) data will be collected over Alaska, where cloud cover and remote locations preclude the use of lidar over much of the State. The 3DEP initiative is based on the results of the [National Enhanced Elevation Assessment](#).

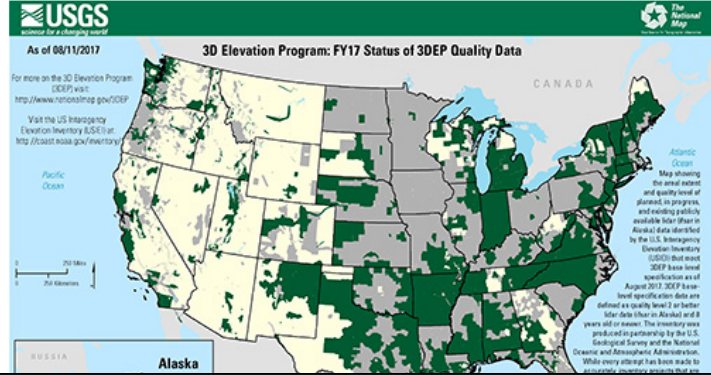
Lidar is used to detect potential obstacles that present hazards to air navigation.

## 3DEP Data Acquisition Partnership Opportunities

### FY18 USGS Broad Agency Announcement (BAA) for the 3D Elevation Program (3DEP)

#### Partnership Opportunities

The FY17/FY18 Broad Agency Announcement (BAA) for the 3D Elevation Program (3DEP) was released on August 16, 2017. The BAA provides detailed information on how to partner with the USGS and other Federal agencies to acquire high-quality 3D Elevation data. Information and contacts are available at Fed Biz Opps (Search for Reference Number: G17PS00746) and Grants.gov (Funding Opportunity Number: G17AS00116). Applicants may contribute funds toward a USGS lidar data acquisition



# + 3DEP Products

## ■ Standard DEMs

### ■ Nationally Seamless

- 2 Arc Second

- 1 Arc Second

- 1/3 Arc Second

} Previously referred to as  
the National Elevation  
Dataset (NED)

### ■ Project-based (seamless within projects)

- 1/9 Arc Second (legacy)

- 1-meter

- 5-meter (IfSAR - Alaska)

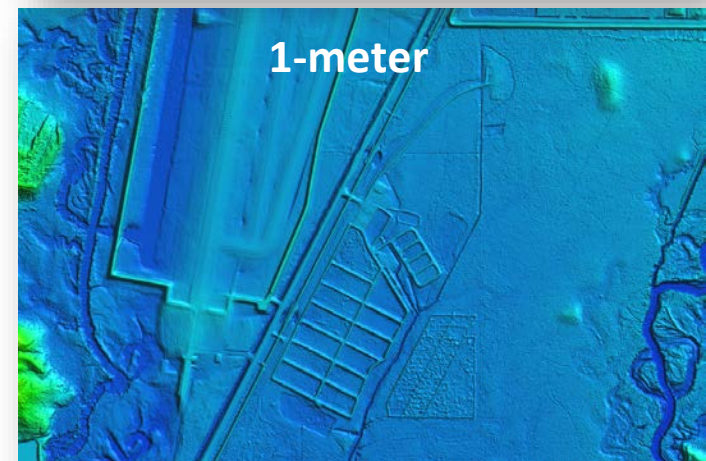
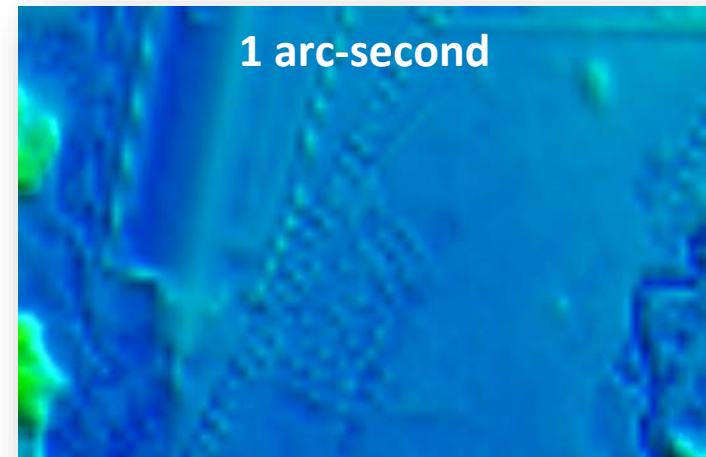
## ■ Source Data

- Lidar Point Clouds

- Source DEMs (original product resolution)

- Digital Surface Model (IfSAR - Alaska)

- Orthorectified Radar Intensity Imagery (IfSAR - Alaska)

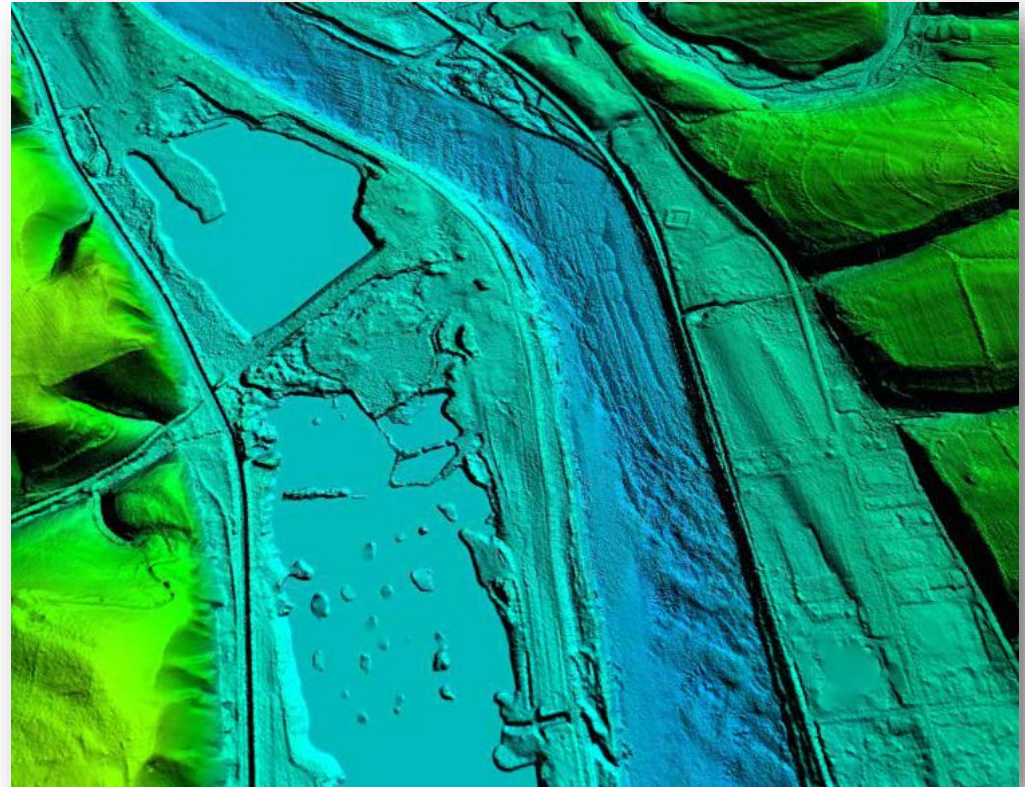


# + Emerging Technology

- Geiger mode and single photon lidar test
  - Potential to increase quality and/or bring down costs
  - Pilots in NC, SD, IL and HI
- Inland bathymetry
  - Technology proven in coastal areas
  - EAARL-B topobathy lidar survey of Delaware River was promising
  - Commercial sensors are available through GPSC
  - Began assessments of commercial capabilities in FY17



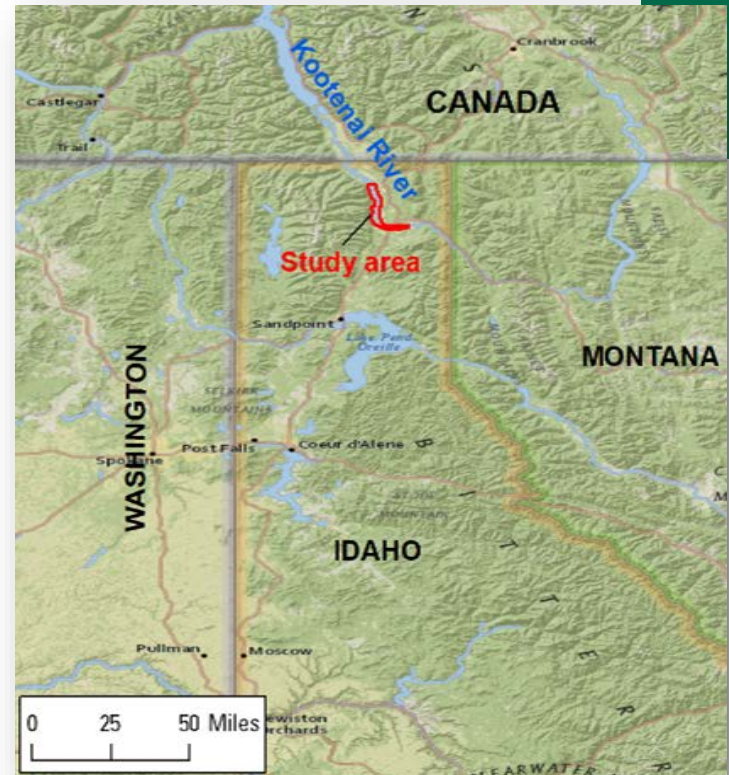
31



Frenchtown Subregion of the Delaware River, integrated EAARL-B and topographic lidar

# + Inland Topo-Bathy Lidar

- Commercial sensors are now in use for mapping both coastal and inland bathymetry
- Collections will help inform future specifications and topo-bathy lidar collection criteria
- 3DEP pilot project to assess commercial capabilities in FY17: study area is the Kootenai River in Idaho; survey conducted in Sept. 2017
- USGS scientists collected field data during lidar survey for assessing instrument performance and data quality
- Bathymetry lidar also recently collected through the GPSC on Elwha River in WA and in FL Everglades







# Path ahead

## Foster maturation of new technologies for 3DEP

- Receipt of approved projects have been slower than expected
  - While data collection may be faster, processing/delivering acceptable data has been slower
- Ongoing/additional review and testing
  - Use the test projects to better understand how the data is processed through our existing workflows, review the data throughout the lifecycle
  - Check calibration between collections (i.e., point-to-plane comparison)
  - Begin better understanding the non-bare earth and noise components of these data
  - Assess costs associated with storage and hosting of higher density collections
- For FY18, will continue with limited investments in GML / SPL data acquisition, depending on proposals and budget
  - Set a total funding and/or total square mile investment by 3DEP WG
  - Allow for growth and incremental acceptance of the new technologies
  - Provide flexibility to continue to work with partners interested in Geiger/SPL



# + 3DEP Resources

*USGS 3DEP Web Pages*

<http://nationalmap.gov/3DEP>

*3D Elevation Program (3DEP) FY16/17 Broad Agency Announcement (BAA) Information Sharing Site* <https://cms.geoplatform.gov/elevation/3DEP>

*BAA Reference Materials Page*

<http://nationalmap.gov/3DEP/BAAReferenceMaterials.html>

*NOAA sponsored Seasketch site: U.S. Federal Mapping Coordination, A Demonstration Site for Federal Mapping Data Acquisition*

<http://fedmap.seasketch.org>

*NOAA sponsored US Interagency Elevation Inventory (USIEI) site*

<http://www.coast.noaa.gov/inventory>

*The 3D Elevation Program Initiative – A Call for Action*

<http://pubs.usgs.gov/circ/1399/>

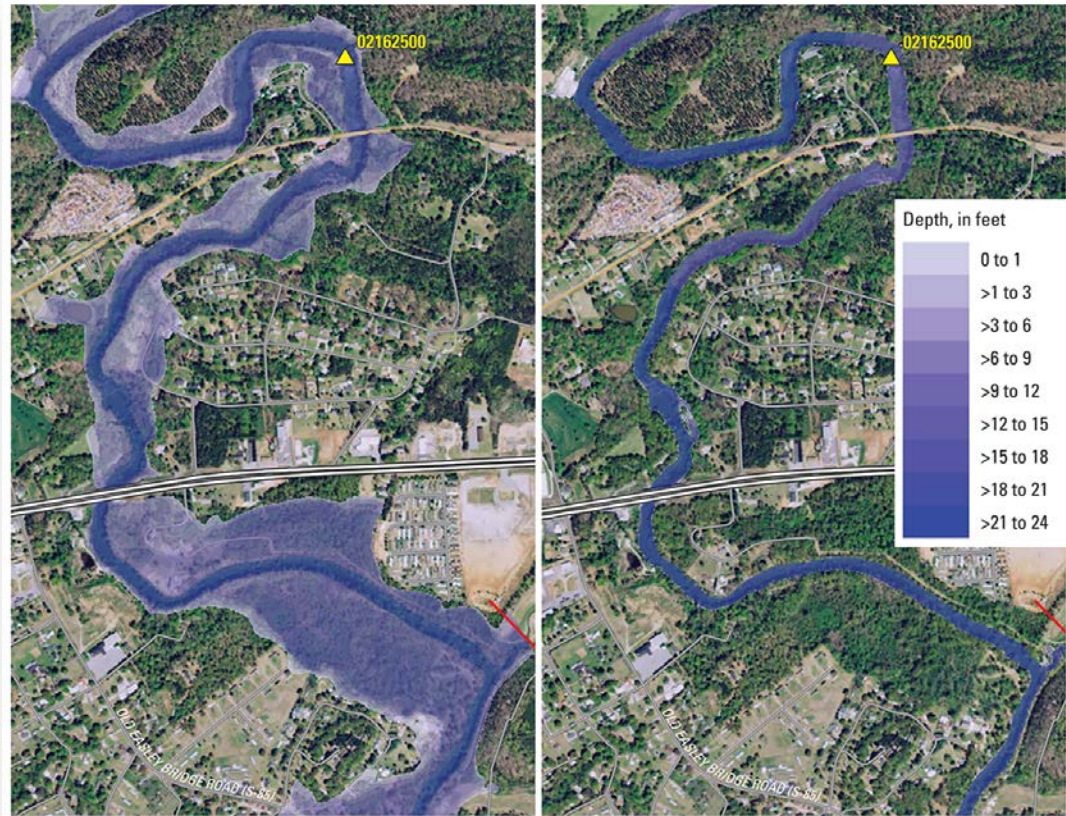
*USGS NGP Lidar Base Specification V1.3*

<http://pubs.usgs.gov/tm/11b4/pdf/tm11-B4.pdf>

# + 3DEP for Flood Risk Management

Conservative annual benefits estimated at \$502M

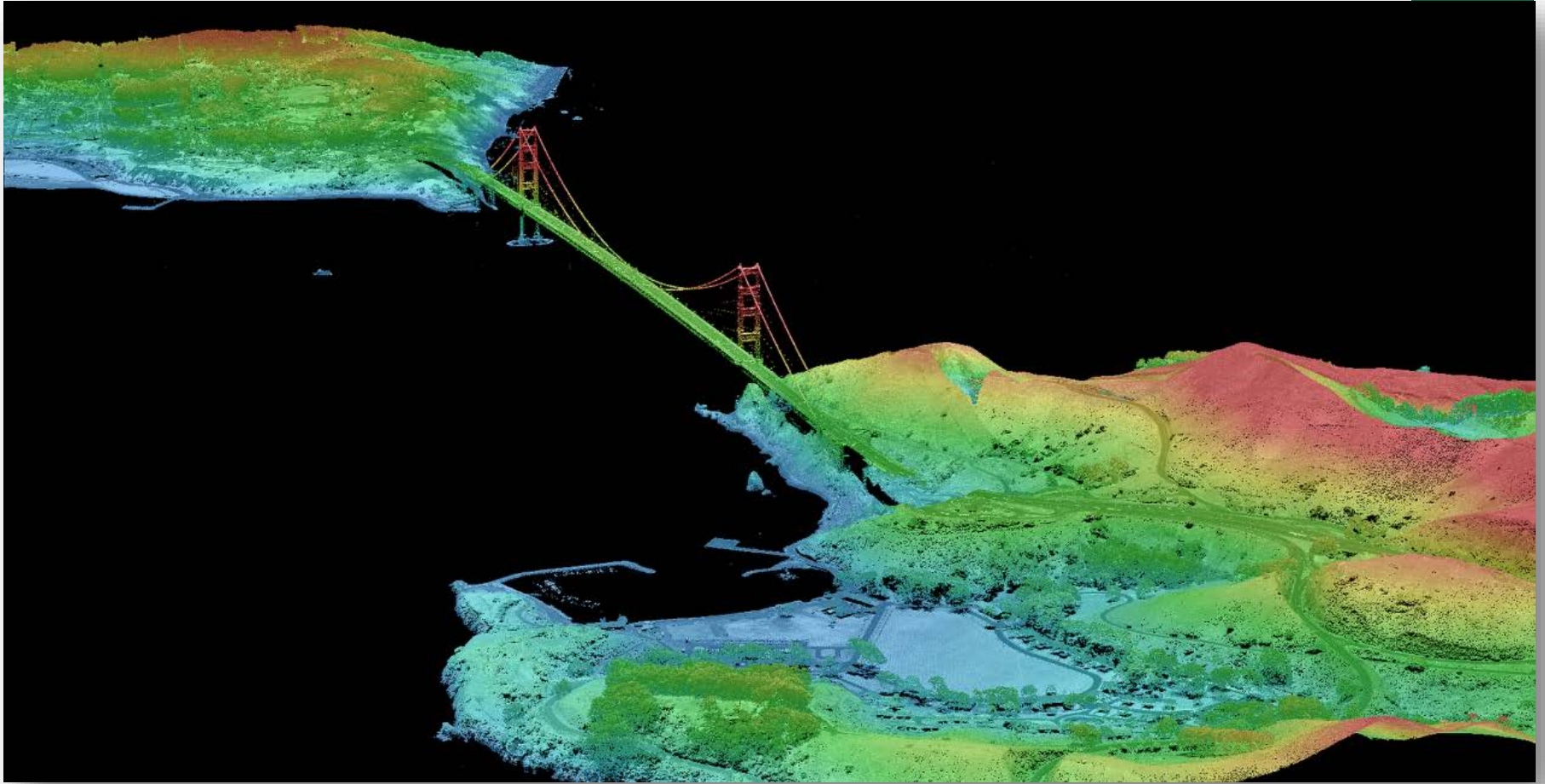
- Produce higher quality flood maps, including Flood Insurance Rate Maps
- Manage dam and levee safety programs to reduce flood risks
- Improve hydrologic modeling and flood forecasting
- Improve State and local flood risk management and response
- Improve storm water facilities and dam design
- Extract building footprints and identify the finished floor elevation to quantify potential damages based on flooding depths



Lidar aids hydraulic modeling to determine flood-inundation on the Saluda River, near Greenville, SC

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# Thank you!



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