

**Open Water Data Initiative**  
**USGS Commitments and FY16 Accomplishments**  
October 14, 2016

**Purpose** – The purpose of this document is to communicate USGS FY16 accomplishments towards commitments to establish the Open Water Data Initiative (OWDI). The accomplishments and high level of participation generated since its inception demonstrate a successful proof of concept for the OWDI. Because the effort builds on and synthesizes its long-term mission strategies, the USGS as a managing partner, is proposing to further institutionalize OWDI across the broader community by developing a National Water Data Infrastructure.

**Background** - The United States faces increasing pressures on the nation’s water supply from shifting demographics, aging infrastructure and increasing complexities from climate change. This is further complicated by the various roles that over 26 Federal agencies, and countless state and local entities play in collecting, reporting and synthesizing water information. Quantifying the availability, use, and risks to our national water resources is a strategic and security issue for the present and the foreseeable future. Improving access to data across the Federal enterprise, and enabling open exchange of water information is foundational to understanding existing water resources issues and developing sustainable future solutions. To address this challenge, the Federal Geographic Data Committee (FGDC) and the Advisory Committee on Water Information (ACWI) launched the OWDI in the summer of 2014. The goal of the OWDI is to integrate currently fragmented water information into a connected, national water data framework by leveraging existing systems, infrastructure and tools to underpin innovation, modeling, data sharing, and solution development. Moreover, the adoption of community data standards, protocols, and common vocabularies is critical to this effort.

The OWDI was initiated and has been managed by the Department of the Interior (DOI) U.S. Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) in partnership with other agencies and organizations, such as the University of Texas, the U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE) and the U.S. Bureau of Reclamation (BOR) and through the grassroots support of numerous organizations participating in OWDI use cases and activities.

**COMMITMENT 1: LEADERSHIP/GOVERNANCE**

**OBJECTIVE 1.1:** Align OWDI and A-16 Inland Waters Theme objectives – Work with OWDI managing agencies, partners and A-16 Inland Waters agency dataset managers USFWS and USACE, to rescope the FGDC-defined theme to align with OWDI and to engage additional agencies in supporting the theme.

**1.1 STATUS – ONGOING:** An A-16 Inland Waters Theme Strategic Plan has been drafted to align with OWDI (available in the user resources section at <http://nhd.usgs.gov/>). This strategy aligns the theme goals with those of the OWDI, and improves the synergy between these closely related programs.

**OBJECTIVE 1.2:** Develop additional grant and partnership opportunities to support community engagement in OWDI.

**1.2 STATUS – ONGOING:** The USGS is partnering with Federal and NGOs to promote engagement in OWDI, primarily through prize challenge competitions. Specific activities include:

- Visualizing open nutrient data - In January 2016, U.S. Geological Survey, U.S. Environmental Protection Agency, Esri, and National Geographic challenged high school students in 13 states to create compelling and innovative visualizations of nutrient data from open government data sources. A press release including links to winning submissions is here: [https://www2.usgs.gov/newsroom/article\\_pf.asp?ID=4518](https://www2.usgs.gov/newsroom/article_pf.asp?ID=4518).
- USGS is partnering with U.S. Bureau of Reclamation to develop a challenge prize competition for an open source app for field data collection that will support data interoperability.

**OBJECTIVE 1.3:** Enhance the outreach strategy to the executive level of partner and user organizations through forums including AWRA, AGU, SWAQ and others.

**1.3 STATUS – ONGOING:** The USGS and its partners have been representing OWDI in relevant scientific journals and through international water forums. Specific activities include:

- American Water Resources Association (AWRA) November 2015 meeting included three Special Sessions on the OWDI.
- Journal of the American Water Resources Association (JAWRA) Featured Collection on Open Water Data Initiative: August 2016, Volume 52: Issue 4, including 16 peer reviewed technical papers and technical notes relevant to OWDI.
- OWDI was featured in an Open Water Panel at the National Conversation on Integrated Water Information for the 21st Century. DOI co-sponsored the event.
- Colorado River Water Users Association Meeting, December 2015, Las Vegas, Nevada: Presentation on ACWI Subcommittee on Spatial Water Data Drought Use Case, talking points provided for Deputy Secretary Michael Connor on OWDI.
- USGS has been working with Canadian counterparts in Natural Resources Canada and Environment and Climate Change Canada to harmonize the core hydrography and watershed datasets along the shared border. Discussions are underway to develop transboundary NHDPlusHR joint pilot projects, and long-term development of a common hydrography data model.
- World Water Day summary (March 2016) notable commitments:
  - The Water Funder Initiative is launching Project Water Data, an effort to work with Federal, state, and local governments, as well as private- and social-sector partners, to modernize data systems that support healthy communities, thriving agricultural systems, and clean waterways for our wildlife.
  - Esri and KISTERS North America, Inc., in collaboration with the academic community and NOAA, will build on the National Water Model and the

recent success of the OWDI National Flood Interoperability Experiment to develop a National Flood Model that enhances flood forecasting for the Nation.

- o Imagine H2O, a water-innovation accelerator, has launched a multiyear initiative to develop data solutions in the water industry. Today, the non-profit organization is announcing that it will expand its portfolio to source, launch, and scale 30 new water-data businesses, from monitoring and sensing to software and analytics.

**OBJECTIVE 1.4:** By co-chairing Subcommittee on Spatial Water Data, provide leadership and coordinate the OWDI community through high-value pilot projects.

**1.4 STATUS – ONGOING:** Since reinventing the FGDC/ACWI Subcommittee on Spatial Water Data (SSWD) as the home of OWDI, the subcommittee has grown its participants to over 90 representatives of more than 30 organizations that span Federal, state, and local governments and includes participation from industry leaders, nonprofits, and academia. Specific activities include:

- NOAA's [National Water Model](#) was built on spatial framework datasets reformulated by SSWD work groups. The National Water Model became operational in August 2016, and the greatly improved spatial detail of forecasts will provide better information to emergency responders, enabling them to improve flood response and save lives.
- Develop Drought Data Catalog to support Goal 1 of the National Drought Resilience Partnership Federal Action Plan. Work has been focused on making U.S. Bureau of Reclamation water datasets open and accessible; considering several options for hosting data and a hackathon timed with the catalog release.
- Spanish-language version of the Colorado River Basin Drought Visualization: Translation of record completed by International Boundary and Water Commission, approved by U.S. and Mexico sections. On target to release concurrent with finalization of Minute 32X (likely late CY2016).
- Water use data catalog: Complete. A folder on USGS Sciencebase contains a brief report that documents existing water use datasets and their primary characteristics, identifies important water use data gaps and current efforts to address those gaps, and provides recommendations on how to incorporate water use datasets into the OWDI framework. It will also serve as a repository for a water use dataset inventory and support an interface that details the current status of national, regional, state and local water use datasets, and provides access back to the online data sources. An application is available at <http://viewer.nationalmap.gov/apps/owdi/>.

#### **NEXT STEPS for Leadership/Governance**

**OBJECTIVE 1.5 (Proposed):** Integrate the distributed leadership and governance efforts with input from stakeholders to design and implement a National Water Data Infrastructure.

- Engage in National Conversation on Integrated Water Information follow up activities, including integrating stakeholder input into requirements for NWDI.

- Establish NWDI identity and visibility through timely web content and links to the broad range of related activities and resources, including water data and model services.
- Coordinate with USGS Office of Communication on press releases and social media campaigns.
- Develop a challenge for NHDPlusHR applications to spur innovation.
- Develop an implementation plan for the A-16 Inland Waters Theme (due Dec 31, 2016).
- Support the National Drought Resilience Partnership Federal Action Plan Goal 1: Integrate Data from Key Platforms; through continued efforts under the SSWD data working groups.

## **COMMITMENT 2: FOUNDATIONAL DATASETS**

**OBJECTIVE 2.1:** Complete the National Hydrography Data Requirements and Benefits Study to identify user requirements, and the associated benefits, for improved hydrographic data. The results of the analysis is providing a guide to investment in USGS hydrographic data by identifying which features and functionality would be of most value to the user community.

**2.1 STATUS – DATA COMPILATION COMPLETE, ANALYSIS ONGOING:** The preliminary report of the National Hydrography Requirements and Benefits Study has been completed and is available online at <http://nationalmap.gov/HRBS.html>. The Study includes user requirements from 23 Federal agencies, all 50 states, 8 Tribal governments, and several National associations. The study includes documentation of 420 Mission Critical Activities, and over \$600 million in additional potential future benefits to users if their requirements are met. USGS has begun pilot projects to understand the costs associated with meeting these requirements and will develop a program recommendation during FY17.

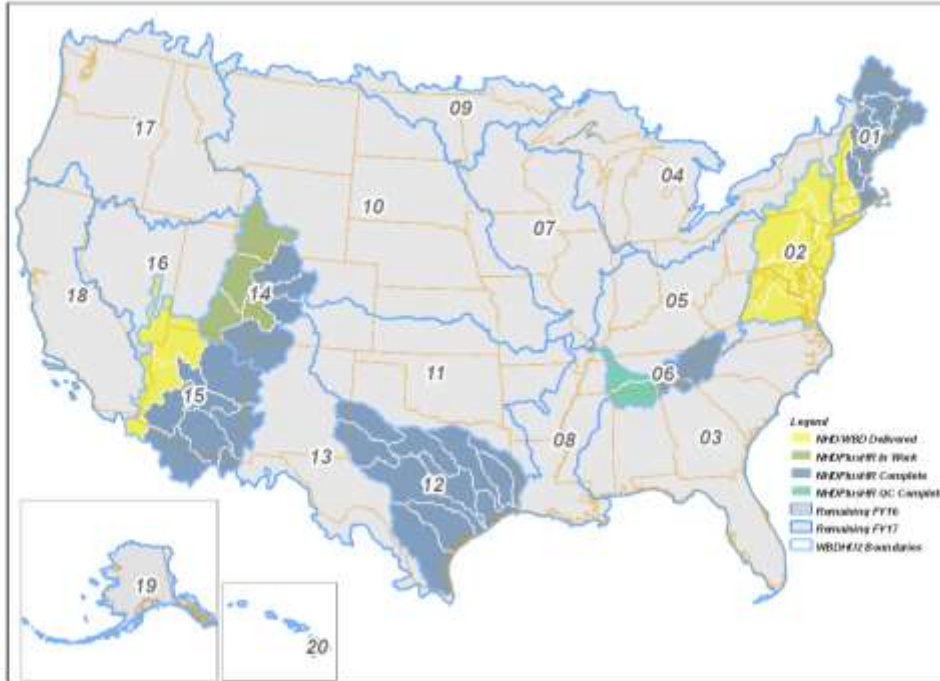
**OBJECTIVE 2.2:** Build a High Resolution National Hydrography Dataset PLUS (NHD+HR) as a unified, scalable geospatial framework will underpin OWDI and form the basis for many advances in the hydrologic sciences for years to come.

Currently, multiple geospatial surface-water frameworks are in use, so observations and model results must be referenced separately to each framework and cannot be easily shared. In the [Hydrography Requirements and Benefits Study](#), as well as an earlier DOI-only study, around 80% of users indicated a need for functionality present in the [NHDPlus](#), but with higher resolution. The NHD+HR is a first step to addressing these needs.

**2.1 STATUS – IN PROGRESS:** The USGS has begun building NHD+HR, a unified framework composed of the highest available resolution data and generalizable to many different scales. The results will be more accurate, better maintained. Significant progress has been made with Beta datasets complete for one fourth of CONUS (see map below). The goal is to complete the Beta version for CONUS by the end of FY18. Next steps will include fully web-enabling this framework to make it more accessible and interoperable with other programs. This framework

eventually will replace the NHDPlus V2.1, which currently is the spatial framework underpinning the National Water Model, and Hydrography Network-Linked Data Index. As the NHD+HR is built, the USGS will seek community engagement in using and improving the initial release of the data. The USGS will continue to support existing foundational datasets through the transition towards implementing NHD+HR.

**NHDPlusHR Status 9/30/16**





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.

**OBJECTIVE 2.3:** Manage the 3D Elevation Program (3DEP) to acquire high quality lidar data and ifsar for Alaska, and to integrate high-resolution elevation with hydrography to improve hydrologic modeling and other applications.

**2.3 STATUS – ONGOING:** Increasing data coverage has been a major outcome of 3DEP in 2016.

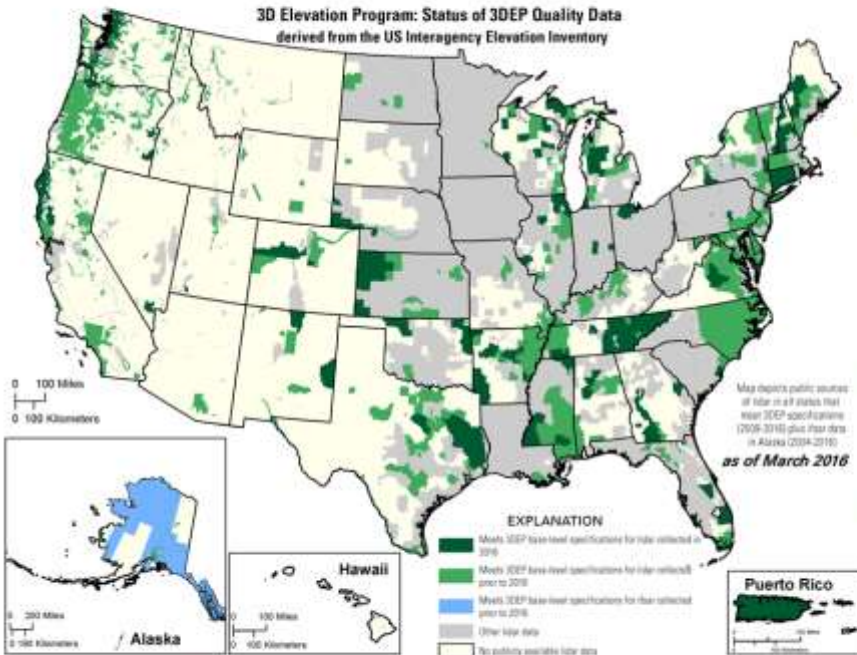
Specific activities include:

- Preliminary results of the US Interagency Elevation Inventory show that in FY16 publicly available lidar increased from 14% to about 19% of the lower 49 (see map below).
- Over FY16, IfSAR coverage in Alaska has increased to 75% of the State.
- Pilot projects are in progress and will determine costs and approaches for extracting hydrography data from lidar.



# U.S. Interagency Elevation Inventory

2016 PRELIMINARY Projections – Subject to Revision



- 5.1% of entire US will be acquired to 3DEP quality in FY16 - includes complete, in progress, and planned/funded
- 19.1% of Lower 49 Meets 3DEP quality (2009-2017 only)
- 64.2% of AK Meets 3DEP quality (QL5 – IfSAR)



## NEXT STEPS for Foundational Datasets:

OBJECTIVE 2.4 (New) Using results from the requirements and benefits study, define and plan for the next generation of integrated foundational data to support the National Water Data Infrastructure in the longer term.

- While the development of NHD+HR will meet more near term user requirements and will unify users on a single, scalable framework, it is clear from early analysis of HRBS that the most medium to long-term requirements will be met best by deriving hydrographic data from 3DEP elevation data so that the Elevation and Hydrography products are fully integrated. Further research and development are necessary to bring this about. Based on more detailed analysis of the HRBS, USGS will develop a program recommendation during FY17 to address these needs. The following table highlights the improvements in the foundational datasets based on current and future plans:

	IN USE TODAY:	IN PROGRESS:	FUTURE:
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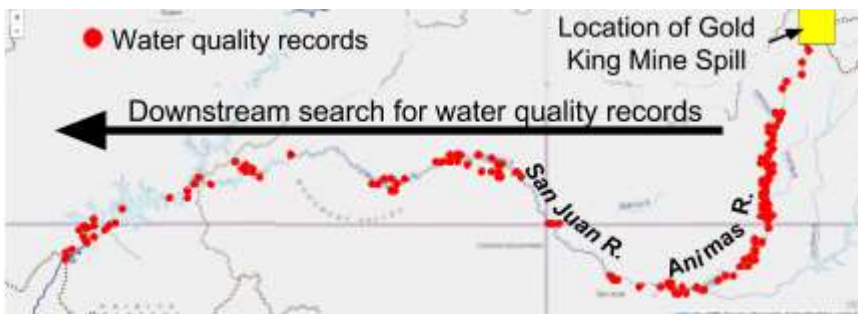
	Medium Resolution NHDPlus	High Resolution NHDPlus	Hydrography Derived from Lidar
<b>Number of features nationally</b>	3 million	34.5 million	300 million
<b>Elevation source</b>	30 meter	10 meter	1 meter
<b>Hydrography source</b>	1:100,000-scale NHD	1:24,000-scale or better (local) resolution NHD	1:5,000-scale 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>	HUC-2	HUC-4	HUC-8 to HUC-12

- 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 planned for FY17.

### COMMITMENT 3: TOOLS AND WEB SERVICES FOR HIGH-PRIORITY APPLICATIONS

**OBJECTIVE 3.1:** Link water data to NHDPlus stream reaches through a Network Linked Data Index – Leverage the Geospatial Platform within the Federal Geographic Data Committee to develop a catalog of data that are linked to the NHDPlus.

**3.1 STATUS – COMPLETE:** An operational Network Linked Data Index (NLDI) has been developed based on NHDPlus V2 and deployed as a proof-of-concept on the Water Quality Portal. Data retrievals that previously took a few experts days to complete using GIS and database software (e.g. retrieving background water-quality data in response to the Gold King Mine incident) now take a couple minutes in a user-friendly web interface. This system is designed to be extended to support *any* kind of data linked to the surface-water network.



An example Water Quality Portal NHDPlus query for water-quality observations along the Animas and San Juan Rivers, downstream of the Silverton, Colorado Gold King Mine spill.



**OBJECTIVE 3.2:** Promote and expand existing interagency water and climate information systems. The US Water Quality Data Portal disseminates over 250 million water quality sample results collected at over 1.5 million sites by USGS, USDA, EPA and dozens of state and local governments and organizations (see [www.waterqualitydata.us](http://www.waterqualitydata.us)). The National Groundwater Monitoring Network is a platform for relaying current groundwater conditions from disparate USGS and state partners into a common format and integrated service, authorized by the SECURE Water Act (see [cida.usgs.gov/ngwmn](http://cida.usgs.gov/ngwmn)). The National Soil Moisture Network Pilot integrates several regional and national soil moisture sensor platforms for understanding current and historic soil moisture at various depths. The GeoData Portal climate data delivery system provides authoritative historical and projected atmospheric model forcings for water resource assessments (see [cida.usgs.gov/gdp](http://cida.usgs.gov/gdp)). Finally, the National Water Information System web services provide a comprehensive set of baseline information for the nation in line with ideals of OWDI goals.

**3.2 STATUS – ONGOING:** Specific activities include:

- The National Groundwater Monitoring Network added data from 5 new states (SC, NC, UT, KS and OR) and is expanding data available from existing cooperators in 3 states.
- The Open Geospatial Consortium accepted the GroundWater Markup Language version 2 (GWML2) as a standard in September 2016. USGS has been an active participant in this effort since the beginning in 2012.
- A team of federal and academic partners held a requirements gathering workshop for an Operational National Soil Moisture Network in June 2016 (agenda: <https://www.drought.gov/drought/calendar/events/national-soil-moisture-network-workshop>). Based on the results, future activities could include integration with NASA's Soil Moisture Active Passive (SMAP) mission and the incorporation of citizen science and crowd sourced soil moisture data. A publication on the National Soil Moisture Pilot is in preparation.
- The National Water Information System internal data management infrastructure and public facing data distribution services are undergoing a modernization and enhancement to better serve the community in the coming years, anticipated to be released for public use in 2017.

**OBJECTIVE 3.3:** Develop open source statistical tools for water data integration and analysis – The USGS Office of Water Information is fostering a community of scientists and developers to build the next generation of water data analysis software in an open source community, using web-service oriented techniques. This community will continue to be a nexus for value adding software for the OWDI (see <https://github.com/USGS-R>).

**3.3 STATUS – COMPLETE.** Specific activities include:

- More than 70 open-source software repositories for water related analysis and workflows now are curated on the USGS-R github site.
- Additionally, an ACWI-OWDI repository has been established on GitHub (<https://github.com/ACWI-SSWD>), and is actively being used to share source code for OWDI development projects.

**NEXT STEPS for Tools and Web Services for High-Priority Applications.** In order to expedite innovation in the water domain, the NWDI seeks to promote a marketplace for open source water tools and services based on consensus standards that private sector technologists and the next generation of scientists demand.

- Expand NLDI to additional foundational water datasets, such as the National Water Information System and EPA water information systems. Encouraging other entities to share their data in a manner that can utilize these advanced capabilities.
- Work with 18F, US Digital Services, EPA and others, to develop *water.api.gov*, a catalog of hydrography-linked observational and model data services. Provide high-performing web services for these data using GeoPlatform.gov cloud resources, and publish open-source code and documentation to support community adoption.
- Prototype incorporation of high frequency sensor data into the Water Quality Portal.
- Develop visualization capabilities for the Open Water Data Initiative tools and web services.
- Upgrade the underlying NLDI geospatial framework from NHDPlus V2 to the NHDPlus High Resolution when HR version becomes available.