Appendix B
National Hydrography Requirements and Benefits Study
Federal Agency Summary Reports

Agricultural Research Service (ARS)

Point of Contact: Mark Walbridge, mark.walbridge@ars.usda.gov

The Agricultural Research Service (ARS) is the U.S. Department of Agriculture's (USDA's) chief in-house research agency. **ARS conducts research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination to:**

- **ensure high-quality, safe food and other agricultural products;**
- **assess the nutritional needs of Americans;**
- **sustain a competitive agricultural economy;**
- **enhance the natural resource base and the environment; and**
- **provide economic opportunities for rural citizens, communities, and society as a whole.**

To achieve these objectives, ARS identifies critical problems affecting American agriculture and plans and executes the strategies needed to address these problems by: mobilizing resources (both human and financial); fostering multi-disciplinary research; linking research to program and policy objectives; and communicating and interacting with customers, stakeholders, partners, and beneficiaries to ensure program relevancy. ARS seeks to broaden public understanding of the value of agriculture and agricultural research to ensure the continued primacy of U.S. agriculture in the 21st century.

ARS's Water Availability and Watershed Management National Program provided input into this study. The Water Availability and Watershed Management National Program is composed of four areas as follows:

1. Water Management – This program area includes water availability, precision irrigation, dryland agriculture, drainage management, and non-traditional technologies for alternative sources for agricultural irrigation.
2. Water Quality – This program area also includes erosion and sedimentation.
3. Conservation – This program area focuses its research on watershed-scale conservation efforts and how they can affect and improve water quality. The ARS Conservation Effects Assessment Project (CEAP) Watershed Assessment Study links to the Natural Resources Conservation Service (NRCS) CEAP National Assessment and studies how conservation practices affect water quality.
4. Watershed Management/Ecosystem Services in Agricultural Landscapes – This program area includes hydrologic assessment—regional, continental, and global work linking remote sensing data to ground-based assessments to quantify water budgets, soil moisture, evaporative stress, drought, and ecosystem services. It also includes long-term observation and characterization of agricultural watersheds and landscapes as part of the Long-Term Agro-Ecosystem Research (LTAR)

Network that looks at ways to sustain or enhance productivity, profitability, and ecosystem services in US agro-ecosystems and agricultural landscapes.

Customers, stakeholders, partners, and users of the research conducted by the Water Availability and Watershed Management Program include producers, landowners, consultants, state agencies, the Cooperative Extension Service, the Natural Resources Conservation Service, the U.S. Forest Service, the Farm Service Agency, the Foreign Agricultural Service, the USDA Office of Risk Assessment and Cost-Benefit Analysis, the U.S. Environmental Protection Agency, USGS, the Centers for Disease Control and Prevention, the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the Bureau of Land Management, the Bureau of Reclamation, the U.S. Army Corps of Engineers, the National Park Service, and other action-oriented organizations and centers.

Agency Hydrography Data Requirements and Benefits

The Water Availability and Watershed Management National Program has needs for hydrography data across all of its areas of research. Depending on the project, the data requirements may be for highly detailed data for small watershed-scale (HUC-12) project areas or more generalized data for large river basin studies. Modeling tools used by ARS, including the Automated Geospatial Watershed Assessment (AGWA) tool and the Soil and Water Assessment Tool (SWAT) demand large amounts of data as inputs, much of which is remotely sensed.

ARS currently benefits from the availability of digital hydrographic and hydrologic data. Better data availability and improved hydrography data would mean more expedient watershed modeling, less ambiguity and uncertainty in defining contributing source areas by matching them to National Hydrography Dataset (NHD) headwaters, and less uncertainty with routing when the hydrography data better aligns with higher resolution elevation data. Major environmental benefits could be realized including better water quality as well as improved soil and water sustainability.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User-defined map extent	User-defined irregular area (polygon)	Other	I don't know
✓	✓	✓						✓	✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
	✓	✓	✓	✓		✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Highly Desirable
Services to download standard data products	Required
Services to create and download customized data products	Required
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Highly Desirable
Services to visualize cartographically rendered and symbolized hydrography data	Nice To Have
Services that allow combination of visualizations with other visualization services (mash-ups)	Nice To Have
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Highly Desirable

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Nice To Have
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Nice To Have
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable

Data Type	Elevation Data Integration	Requirement
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Highly Desirable
	Ensure that hydrography and elevation data represent a similar point in time.	Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Required
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Required
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Highly Desirable

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Critically Impactful
In a series of tributary streams, several streams do not connect with the main river.	Highly Impactful
A perennial stream is misnamed.	Critically Impactful
A large reservoir is misnamed.	Critically Impactful
A first order stream flow direction is reversed.	Somewhat Impactful
A second order stream flow direction is reversed.	Little or No Impact
A third order stream flow direction is reversed.	Somewhat Impactful
Two first order streams coded as perennial should be intermittent.	Somewhat Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Somewhat Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Highly Impactful

Quality Issue	Impact
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments.	Within 1% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units.	I don't know
Use of web tool for reporting hydrography data errors.	Probably

Agency Mission Critical Activities

ARS managers identified three major Mission Critical Activities with requirements for hydrography data:

- Watershed Assessments, under Business Use #8, Rangeland Management.
- Grassland Soil and Water Research, under Business Use #4, Water Quality.
- Agro-Ecosystems Research, under Business Use #3, Water Resource Planning and Management.

ARS managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Watershed Assessments, Grassland Soil and Water Research, and Agro-Ecosystems Research. Summarized details are provided in the following pages.

Watershed Assessments

Mission Critical Activity Title:	Watershed Assessments
Mission Critical Activity Description:	Watershed assessments to evaluate the effects of land use changes on water quality
MCA_ID:	3801631266_1
Agency or Department:	Agricultural Research Service (ARS)
Sub-agency or Division:	Water Availability and Watershed Management
Program Name:	Water Availability and Watershed Management
Business Use:	Rangeland Management, BU #8
Area of Interest:	Nationwide

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD):	Yes
National Hydrographic Dataset Plus (NHDPlus):	Yes
Watershed Boundary Dataset (WBD):	Yes
No hydrography data are currently being used:	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$61.3 Million in FY15, across the Water Availability and Watershed Management program under which all of the ARS Mission Critical Activities fall.
Current Annual Benefits ($):	Unable to quantify
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Don't know
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$100,000 for Southwest Watershed Research Center; unable to quantify nationwide
Future Benefits Description:	Less ambiguity and uncertainty in defining contributing source areas by matching them to headwaters of NHD data. Less uncertainty with routing when NHD data match elevation data like NHD Plus (not high enough resolution).
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	

Future Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Major
Future Human Lives Saved:	Don’t know
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	
Floodplain boundary	
Flow periodicity	
Riverine bathymetry	
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	
Wetlands	
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	

Required Analytical Functions	
Find events or features on network	
Preset symbolization	
User defined symbolization	Yes
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Nice to Have	Visual Inspection
Bathymetry	Not Required	None
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Not Required	None
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Highly Desirable	Associate Selected Data Type
Wetlands	Highly Desirable	Associate Selected Data Type
Census (population statistics)	Not Required	None
Aquifers	Not Required	None
Point Discharges	Highly Desirable	Associate Selected Data Type
Water Use: Diversions	Highly Desirable	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Highly Desirable	Associate Selected Data Type
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Associate Selected Data Type
USGS National Water Information Sites (NWIS)	Highly Desirable	Associate Selected Data Type
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

Grassland Soil and Water Research

Mission Critical Activity Title:	Grassland Soil and Water Research
Mission Critical Activity Description:	Grassland soil and water research to increase efficient use of soil and water resources, enhance forage and crop production, and support sustainable agricultural production in healthy ecosystems.
MCA_ID:	3769850261_1
Agency or Department:	Agricultural Research Service (ARS)
Sub-agency or Division:	Grassland Soil and Water Research Lab
Program Name:	Water Availability and Watershed Management
Business Use:	Water Quality, BU #4
Area of Interest:	Nationwide including Hawaii

Requirements	
Update Frequency:	Annually
Post Event Updates:	Highly Desirable

Requirements	
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	5 acres
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Covered under the Water Availability and Watershed Management program budget provided for the ARS Watershed Assessments Mission Critical Activity.
Current Annual Benefits ($):	Unable to quantify
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Don’t know
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify
Future Benefits Description:	Environmental benefits
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate

Future Benefits	
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Major
Future Human Lives Saved:	Don’t know
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	
Diversion lines	
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	
Preset symbolization	

Required Analytical Functions	
User defined symbolization	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Nice to Have	Associate Selected Data Type
Bathymetry	Highly Desirable	Associate Selected Data Type
Climate	Highly Desirable	Associate Selected Data Type
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Highly Desirable	Associate Selected Data Type
Wetlands	Highly Desirable	Perform Geospatial Analysis
Census (population statistics)	Nice to Have	Associate Selected Data Type
Aquifers	Nice to Have	Associate Selected Data Type
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice to Have	Associate Selected Data Type
EPA - STOrage and RETrieval Data Warehouse (STORET)	Nice to Have	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Nice to Have	Associate Selected Data Type
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Associate Selected Data Type
USGS National Water Information Sites (NWIS)	Nice to Have	Associate Selected Data Type
USGS National Water-Quality Assessment Program (NAWQA)	Nice to Have	Associate Selected Data Type
Other (please specify the importance and highest analysis level):	Measured water quality at field, farm scale.	Measured water quality at field, farm scale.

Agro-Ecosystems Research

Mission Critical Activity Title:	Agro-Ecosystems Research
Mission Critical Activity Description:	Agro-ecosystems research on agricultural sustainability, climate change, ecosystem services, and natural resources conservation.
MCA_ID:	3794488258_1
Agency or Department:	Agricultural Research Service (ARS)
Sub-agency or Division:	Hydrology and Remote Sensing Lab
Program Name:	Water Availability and Watershed Management
Business Use:	Water Resource Planning and Management, BU #3
Area of Interest:	Nationwide

Requirements	
Update Frequency:	Annually
Post Event Updates:	Required
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)

Requirements	
Stream Density:	I don't know
Smallest Contributing Area:	100 square miles (64,000 acres)
Smallest Mapped Waterbody:	20 acres
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Covered under the Water Availability and Watershed Management program budget provided for the ARS Watershed Assessments Mission Critical Activity.
Current Annual Benefits ($):	Unable to quantify
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Major
Current Human Lives Saved:	Don’t know
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Benefits would be environmental; unable to quantify
Future Benefits Description:	Environmental benefits would be major, to include better water quality, soil and water sustainability, and other environmental issues.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Major
Future Human Lives Saved:	Don't know
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	
Determine downstream flood area	Yes
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	

Required Analytical Functions	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Nice to Have	Visual Inspection
Bathymetry	Not Required	None
Climate	Required	Associate Selected Data Type
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice to Have	Visual Inspection
Aquifers	Highly Desirable	Associate Selected Data Type
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Highly Desirable	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Nice to Have	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Highly Desirable	Associate Selected Data Type
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Animal and Plant Health Inspection Service (APHIS)

Point of Contact: Fan Wang-Cahill, Fan.Wang-Cahill@aphis.usda.gov and Jim Warren, Jim.E.Warren@aphis.usda.gov

The mission of the Animal and Plant Health Inspection Service (APHIS) is to *protect the health and value of American agriculture and natural resources.*

APHIS is a very diverse and multi-faceted agency with a broad mission area that includes protecting and promoting U.S. agricultural health, regulating genetically engineered organisms, administering the Animal Welfare Act, and carrying out wildlife damage and disease management activities. These efforts support the overall mission of USDA, which is to protect and promote food, agriculture, natural resources, and related issues. To protect agricultural health, APHIS works to defend America's animal and plant resources from agricultural pests and diseases. In the event that a pest or disease of concern is detected, APHIS implements emergency protocols and partners with affected states to quickly manage or eradicate the outbreak.

APHIS currently uses hydrography data for analysis to support its program areas of Plant Protection and Quarantine, Veterinary Services, Wildlife Services, Biotechnology Regulatory Services, and Animal Care to a lesser degree. The data are used as a component of base maps for mapping to support Plant Pest Survey Maps used by field personnel and for outreach. Hydrography data are also used for annual Environmental Analyses and Environmental Impact Statements every two to three years for National Environmental Policy Act (NEPA) compliance, as well as for Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Endangered Species Act (ESA) compliance. Future additional uses of enhanced hydrography data by APHIS would include climate change analysis.

Agency Hydrography Data Requirements and Benefits

APHIS requirements for enhanced hydrography data include up-to-date data and maps of intermittent streams that have constant flow three or more months per year. These data are needed for development of rangeland pesticide treatment buffers. Data that more closely match the base imagery, are more spatially accurate, and include smaller bodies of water would better support APHIS's analyses of aquatic and wetlands invasive species as well as pest control.

Improved hydrographic data (features, consistency, and resolution) and availability will assist APHIS in accomplishing its missions and provide needed service to the agricultural sector and natural resource management (and the overlap thereof). It will allow for greater understanding of patterns and better ability to project likely futures of invasive species, pests, and pathogens of plants and animals. Improved data will save time in performing analyses, and the analyses are likely to be more accurate and of higher quality.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓			✓	✓	✓	✓	✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓	✓	✓	✓	✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Highly Desirable
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Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Highly Desirable
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Services that allow combination of visualizations with other visualization services (mash-ups)	Required
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Highly Desirable

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Nice To Have

Data Type	Elevation Data Integration	Requirement
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Nice To Have
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Highly Desirable
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Nice To Have
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Nice To Have
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Nice To Have
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Nice To Have
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Nice To Have
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Nice To Have

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Somewhat Impactful
In a series of tributary streams, several streams do not connect with the main river.	Highly Impactful
A perennial stream is misnamed.	Somewhat Impactful
A large reservoir is misnamed.	Somewhat Impactful
A first order stream flow direction is reversed.	Somewhat Impactful
A second order stream flow direction is reversed.	Somewhat Impactful
A third order stream flow direction is reversed.	Somewhat Impactful
Two first order streams coded as perennial should be intermittent.	Somewhat Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful

Quality Issue	Impact
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Somewhat Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Somewhat Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	I don’t know
Use of web tool for reporting hydrography data errors	Maybe

Agency Mission Critical Activities

APHIS managers identified five major Mission Critical Activities with requirements for hydrography data:

- Climate Change, primarily under Business Use #10, Agriculture and Precision Farming. Ancillary Business Uses also include Business Use #9, Wildlife and Habitat Management (off-stream).
- Environmental Monitoring and Compliance, primarily under Business Use #10, Agriculture and Precision Farming.
- Plant Pest Survey Maps and Infestation Areas for Survey and Quarantine, primarily under Business Use #2, Natural Resources Conservation.
- Risk Analysis, primarily under Business Use #2, Natural Resources Conservation.
- Environmental Documentation, primarily under Business Use #22, Health and Human Services. Ancillary Business Uses also include Business Use #4, Water Quality; and Business Use #9, Wildlife and Habitat Management (off-stream).

APHIS managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data. Summarized details are provided in the following pages.

Climate Change

Mission Critical Activity Title:	Climate Change
Mission Critical Activity Description:	Evaluate the extent of invasive species, pest, and pathogen projections under climate change and resilience or vulnerability (to invasive species, pests, and/or pathogens) under climate change.
MCA_ID:	3800255165_1
Agency or Department:	Animal and Plant Health Inspection Service (APHIS)
Sub-agency or Division:	Policy and Program Development
Program Name:	Policy and Program Development
Business Use:	Agriculture and Precision Farming, BU #10
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	6-10 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)
Stream Density:	I don't know
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	5 acres
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	Yes
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Total APHIS Policy and Program Development budget is $4.9 Million, which covers Climate Change and Environmental Documentation Mission Critical Activities.
Current Annual Benefits ($):	$478,000
Current Operational Benefits	
Current Time/Cost Savings:	Not Applicable
Current Mission Compliance Benefits:	Not Applicable
Current Customer Service Benefits	
Current Products or Services Benefits:	Not Applicable
Current Response or Timeliness Benefits:	Not Applicable
Current Customer Experience Benefits:	Not Applicable
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Not Applicable
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	Agricultural benefits (Societal Benefits)

Future Benefits	
Future Annual Benefits ($):	$478,000
Future Benefits Description:	Improved data availability (features, consistency, resolution) will assist in accomplishing our missions and provide needed service to the agricultural sector and natural resource management (and the overlap thereof) in allowing us to understand patterns and project likely futures of invasive species, pests, and pathogens of plants and animals.

Future Benefits	
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Major
Future Human Lives Saved:	Moderate
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	Yes
Wetlands	Yes
Badlands	
Other	Yes
	Tidal information where relevant.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	

Required Analytical Functions	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	Yes
Find events or features on network	
Preset symbolization	
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Associate Selected Data Type
Bathymetry	Required	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Highly Desirable	Associate Selected Data Type
Point Discharges	Highly Desirable	Associate Selected Data Type
Water Use: Diversions	Nice to Have	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Associate Selected Data Type
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Other (please specify the importance and highest analysis level):	Tidal information, where relevant, for geospatial analysis in certain locations (coastal, estuarine)	Tidal information, where relevant, for geospatial analysis in certain locations (coastal, estuarine)

Environmental Monitoring and Compliance

Mission Critical Activity Title:	Environmental Monitoring and Compliance
Mission Critical Activity Description:	Environmental monitoring and compliance.
MCA_ID:	3801029333_1
Agency or Department:	Animal and Plant Health Inspection Service (APHIS)
Sub-agency or Division:	Plant Protection and Quarantine
Program Name:	Plant Protection and Quarantine
Business Use:	Agriculture and Precision Farming, BU #10
Area of Interest:	Nationwide including Hawaii, Puerto Rico, Virgin Islands, Guam

Requirements	
Update Frequency:	Annually
Post Event Updates:	Nice to Have
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	National Wetlands Inventory.

Current Benefits	
Total Annual Program Budget:	Total APHIS Plant Pest and Quarantine budget is $50,000,000.
Current Annual Benefits ($):	$500,000
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$500,000
Future Benefits Description:	Benefits would be realized from current data and maps of intermittent streams with constant flow three or more months per year for rangeland pesticide treatment buffers.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate

Future Benefits	
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Major
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	
Left/right bank delineation	Yes
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	Yes
	Intermittent streams with constant flow three or more months per year

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	
Calculate drainage area	
Delineate catchment	
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Highly Desirable	Visual Inspection
Surficial Geology	Nice to Have	Visual Inspection
Bathymetry	Nice to Have	Visual Inspection
Climate	Nice to Have	Associate Selected Data Type
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Nice to Have	Visual Inspection
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice to Have	Associate Selected Data Type
Aquifers	Not Required	None
Point Discharges	Highly Desirable	Perform Geospatial Analysis
Water Use: Diversions	Highly Desirable	Visual Inspection
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Nice to Have	Visual Inspection
USACE - National Inventory of Dams (NID)	Nice to Have	Visual Inspection
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Associate Selected Data Type
Other (please specify the importance and highest analysis level):		

Plant Pest Survey Maps and Infestation Areas for Survey and Quarantine

Mission Critical Activity Title:	Plant Pest Survey Maps and Infestation Areas for Survey and Quarantine
Mission Critical Activity Description:	Plant pest survey maps and infestation areas for survey and quarantine.
MCA_ID:	3796781668_1
Agency or Department:	Animal and Plant Health Inspection Service (APHIS)
Sub-agency or Division:	Plant Protection and Quarantine
Program Name:	Plant Protection
Business Use:	Natural Resources Conservation, BU #2
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico

Requirements	
Update Frequency:	6-10 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	100 square miles (64,000 acres)
Smallest Mapped Waterbody:	5 acres
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Covered under APHIS Plant Pest and Quarantine budget.
Current Annual Benefits ($):	Minimal.
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Major
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Minimal.
Future Benefits Description:	Minor benefits from hydrography data as reference layer for mapping. Flood event data are very useful as well.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Minor
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	
Estuaries	
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	
Delineate catchment	
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	Yes
Preset symbolization	
User defined symbolization	

Required Analytical Functions	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Nice to Have	Visual Inspection
Soils	Nice to Have	Visual Inspection
Surficial Geology	Not Required	None
Bathymetry	Not Required	None
Climate	Highly Desirable	Visual Inspection
Contaminant Sources	Not Required	None
Elevation	Nice to Have	Visual Inspection
Stream Flow	Nice to Have	Visual Inspection
Wetlands	Highly Desirable	Visual Inspection
Census (population statistics)	Highly Desirable	Associate Selected Data Type
Aquifers	Not Required	None
Point Discharges	Not Required	None
Water Use: Diversions	Not Required	None
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Required	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Visual Inspection
USGS National Water Information Sites (NWIS)	Nice to Have	Visual Inspection
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

Risk Analysis

Mission Critical Activity Title:	Risk Analysis
Mission Critical Activity Description:	Generate risk analysis products that inform regulatory policy regarding invasive plant pests.
MCA_ID:	3801011803_1
Agency or Department:	Animal and Plant Health Inspection Service (APHIS)
Sub-agency or Division:	Plant Protection and Quarantine
Program Name:	Plant Protection and Quarantine
Business Use:	Natural Resources Conservation, BU #2
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	Annually
Post Event Updates:	Nice to Have

Requirements	
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	I don't know
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	Yes
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Covered under APHIS Plant Pest and Quarantine Budget.
Current Annual Benefits ($):	Minimal.
Current Operational Benefits	
Current Time/Cost Savings:	Not Applicable
Current Mission Compliance Benefits:	Not Applicable
Current Customer Service Benefits	
Current Products or Services Benefits:	Not Applicable
Current Response or Timeliness Benefits:	Not Applicable
Current Customer Experience Benefits:	Not Applicable
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Not Applicable
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	TBD.
Future Benefits Description:	Minor future benefits to risk analysis products and for informing surveys and pathway analyses.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Minor
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	
Flow periodicity	
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	
Estuaries	Yes
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	
Delineate catchment	
Determine downstream flood area	
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	

Required Analytical Functions	
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Nice to Have	Perform Geospatial Analysis
Surficial Geology	Nice to Have	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Not Required	None
Elevation	Highly Desirable	Perform Geospatial Analysis
Stream Flow	Highly Desirable	Perform Geospatial Analysis
Wetlands	Nice to Have	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Nice to Have	Perform Geospatial Analysis
Point Discharges	Not Required	None
Water Use: Diversions	Nice to Have	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice to Have	Visual Inspection
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Nice to Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Nice to Have	Visual Inspection
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

Environmental Documentation

Mission Critical Activity Title:	Environmental Documentation
Mission Critical Activity Description:	Prepare environmental documentation for APHIS programs including NEPA, ESA and FIFRA.
MCA_ID	3801807989_1
Agency or Department:	Animal and Plant Health Inspection Service (APHIS)
Sub-agency or Division:	Policy and Program Development – Environmental and Risk Analysis Services
Program Name:	Policy and Program Development
Business Use:	Health and Human Services, BU #22
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	Annually
Post Event Updates:	Nice to Have

Requirements	
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Covered under APHIS Policy and Program Development budget.
Current Annual Benefits ($):	Covered under benefits reported for APHIS Climate Change Mission Critical Activity.
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Covered under benefits reported for APHIS Climate Change Mission Critical Activity.
Future Benefits Description:	The hydrographic information currently available allows us to conduct the required environmental analysis in most cases. Improving the information may allow some benefits such as more up-to-date information or easier access.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	Yes
Flow periodicity	
Riverine bathymetry	
Coastlines	
Coastal bathymetry	
Estuaries	Yes
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	
Wetlands	Yes
Badlands	Yes
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	

Required Analytical Functions	
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Highly Desirable	Visual Inspection
Surficial Geology	Not Required	None
Bathymetry	Not Required	None
Climate	Highly Desirable	Visual Inspection
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Highly Desirable	Visual Inspection
Stream Flow	Highly Desirable	Visual Inspection
Wetlands	Highly Desirable	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Associate Selected Data Type
Aquifers	Highly Desirable	Perform Geospatial Analysis
Point Discharges	Highly Desirable	Perform Geospatial Analysis
Water Use: Diversions	Nice to Have	Visual Inspection
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Nice to Have	Visual Inspection
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Highly Desirable	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Bureau of Land Management (BLM)

Point of Contact: Jay Stevens, gstevens@blm.gov

BLM's mission is to manage and conserve the public lands for the use and enjoyment of present and future generations under our mandate of multiple-use and sustained yield.

To accomplish its mission, BLM manages public land resources for a variety of uses, such as energy development, livestock grazing, recreation, and timber harvesting, while protecting a wide array of natural, cultural, and historical resources. BLM administers more public land – over 245 million surface acres – than any other Federal agency in the United States. Most of this land is located in the 12 Western states, including Alaska. BLM also manages 700 million acres of sub-surface mineral estate throughout the nation. BLM's environmental responsibility for these public lands includes managing wildfire, controlling weeds and insect outbreaks, providing for energy development and urban growth, and addressing pervasive impacts from the effects of climate change.

Many activities on BLM land, such as outdoor recreation, livestock grazing, mineral development, and energy production, affect and are affected by water resources. Potential impacts include modification of surface and groundwater flow systems, water contamination resulting from chemical leaks or spills, and water quality degradation by runoff or excessive withdrawals. To ensure that activities do not negatively impact water resources on public lands, BLM conducts management activities to actively manage, maintain, restore and improve resources on public lands, including water.

Recreation — BLM lands offer a variety of diverse recreational opportunities, and many of those activities involve water resources, such as fishing, boating, swimming, and whitewater rafting. Countless other activities can be impacted by the water resources on public lands including camping, hunting, hiking, all types of winter sports, and visiting natural and cultural heritage sites, just to name a few. To ensure water resources are not negatively impacted by recreational activities, BLM may establish thresholds for numbers, types, and duration of visitor use, and when those thresholds are reached, develop facilities to reduce those impacts and/or possibly limit or relocate use.

Livestock Grazing — BLM provides permits that allow ranchers to graze their livestock on public lands. BLM uses some of the money obtained from selling permits for rangeland improvements. BLM may also require permit holders to make improvements and/or to counter the impacts from grazing. Impacts can include erosion, which can impact streams and other water bodies; and water pollution from runoff, which can include animal waste.

Mining and Mineral Development — BLM leases rights to mine minerals and other materials on BLM-managed lands. Water quality and quantity can be impacted by mining and removal of minerals. Some mining operations divert water for various purposes, which could impact the quantity of use for other purposes. Additionally, mining can result in water contamination, especially heavy metals.

Energy Development — Energy and mineral development can require large volumes of water for construction and operation of facilities, and pose a number of potential impacts to surface and groundwater resources. BLM works with industry, other agencies, and stakeholders to mitigate the impacts and to reclaim disturbed lands after the activity ends.

Fisheries — The more than 245 million surface acres managed by BLM contain diverse water bodies, from isolated desert springs harboring populations of rare and unique fish to large Columbia and Yukon River tributaries that provide habitat for Pacific salmon and steelhead as they migrate long distances to breed. BLM conducts aquatic resource inventories and monitoring to help managers make informed decisions and to assist in the design of other BLM program activities to ensure the special habitat needs of aquatic species are adequately considered.

BLM identified one major Mission Critical Activity for Resource Management Planning, which is a broad category that covers multiple programs within the agency and includes many individual activities. Hydrography data are important to each of these programs and activities and the data and analyses performed using them directly inform how BLM manages its lands. BLM's activities that fall under Resource Management Planning include: stormwater management; aquatic and terrestrial habitat management including wetlands and riparian resources; watershed management including hydrologic and hydraulic modeling and floodplain delineation; environmental assessments and environmental impact statement analysis; land use planning and compliance with the National Environmental Policy Act (NEPA); analysis of surface and ground water quality, quantity, distribution, and water rights; recreation; grazing permits; timberlands management; wildland fire management; and permitting for surface mining and oil and gas drilling for energy production.

Agency Hydrography Data Requirements and Benefits

BLM respondents noted the following requirements for enhanced hydrography data:

- BLM would like to better integrate hydrographic data into its NEPA decision-making process about proposed project areas. Highly reliable information about water quality, quantity, and uses is needed. This includes information such as distance to nearest surface water body, depth to groundwater, potable waters in area, existing contamination, etc.
- More accurate representation of stream networks to include intermittent streams from high quality lidar-derived elevation data is needed.
- Greater accuracy in attributing flow periodicity (perennial, intermittent, ephemeral) on hydrographic features is needed.
- Locations of small wetlands are needed.
- Elimination of density disparities within areas of similar geomorphology or in ecoregions would be beneficial.
- Greater accuracy in attribution is needed. For example, major rivers are attributed the same as canals (artificial).
- More detailed data are needed in the heavily forested areas of the Pacific Northwest. Additionally, fish attributes are needed in those areas.

BLM would realize the following benefits from enhanced hydrographic data:

- Better ability to plan field work, reduced field expenses from better up-front planning and mapping for field surveys, less wasted time from finding sites they cannot survey. BLM could perform wetlands surveys on a broad scale if it knew the location of the smaller wetlands on its lands. Having this information would make a big impact on the cost and effectiveness of BLM's programs.
- Reduced time spent searching multiple databases/datasets to build an analysis and share information with partners.
- Hydrologic analyses and watershed assessments could be performed more quickly and with a higher degree of quality, certainty, and accuracy.
- Better ability to model intrinsic potential for fish habitat, and prioritize restoration efforts.
- A more accurate depiction of the wild and scenic rivers would improve the understanding of water-based recreation programs.
- Water is a scarce resource in desert environments. As climate change begins to create conflict over the scarcity of water, access to highly reliable information about water's quality, quantity, and uses will become essential to creating win-win solutions.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓		✓	✓			✓	✓	*	

*10-digit Hydrologic Units, NEPA analysis areas, Geographic Area Coordination Center boundaries

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	**Esri shapefiles**	**Esri file geodatabase**	**NetCDF**	**GeoTIFF**	**NITF**	**Esri Grid**	**Other**
✓	✓	✓		✓		✓	*

*Services, DEMs

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Highly Desirable
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Highly Desirable
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Nice To Have
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Highly Desirable

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Highly Desirable
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Highly Desirable
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Highly Desirable
	Ensure that hydrography and elevation data represent a similar point in time.	Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Highly Desirable
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Highly Desirable

Data Type	Elevation Data Integration	Requirement
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Highly Desirable

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Highly Impactful
In a series of tributary streams, several streams do not connect with the main river.	Highly Impactful
A perennial stream is misnamed.	Critically Impactful
A large reservoir is misnamed.	Critically Impactful
A first order stream flow direction is reversed.	Highly Impactful
A second order stream flow direction is reversed.	Critically Impactful
A third order stream flow direction is reversed.	Critically Impactful
Two first order streams coded as perennial should be intermittent.	Critically Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Highly Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Highly Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	Minor problem, requires some intervention
Use of web tool for reporting hydrography data errors	Probably

Agency Mission Critical Activities

BLM managers identified one major Mission Critical Activity with requirements for hydrography data:

- Resource Management Planning, primarily under Business Use #5, River and Stream Ecosystem Management. Ancillary Business Uses also include Business Use #7, Forest Resources Management and Business Use #8, Rangeland Management.

BLM managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Resource Management Planning. Summarized details are provided in the following pages.

Resource Management Planning

Mission Critical Activity Title:	Resource Management Planning
Mission Critical Activity Description:	Regional scale resource management planning. Includes stormwater management, fisheries management, watershed management, floodplain delineation and management, environmental assessment, environmental impact statement analysis, and hydrologic and hydraulic modeling for analysis and restoration.
MCA_ID:	3798030582_1
Agency or Department:	Bureau of Land Management (BLM)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	River and Stream Ecosystem Management, BU #5
Area of Interest:	HUC4s with BLM land in them

Requirements	
Update Frequency:	Annually
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	NWI, local digitized data, 10m elevation derived stream networks and geomorphology modeling from http://www.terrainworks.com/, state diversion points.

Current Benefits	
Total Annual Program Budget:	$60 million
Current Annual Benefits ($):	$10 million
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Major
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$5 million
Future Benefits Description:	Time and cost savings for field work, reduced time spent searching multiple databases/datasets to build an analysis and share information with partners. Hydrologic analyses, watershed assessments, and fish habitat modeling could be performed more quickly and with a higher degree of quality, certainty, and accuracy. Greater confidence in resulting products.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Major
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	
Wetlands	Yes
Badlands	Yes

Required Characteristics	
Other	Yes
	NWI, depth to groundwater at wells, accurate flowlines.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Nice To Have	Perform Geospatial Analysis
Soils	Nice To Have	Perform Geospatial Analysis
Surficial Geology	Nice To Have	Perform Geospatial Analysis
Bathymetry	Not Required	None
Climate	Nice To Have	Perform Geospatial Analysis
Contaminant Sources	Nice To Have	Visual Inspection
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Highly Desirable	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice to Have	Perform Geospatial Analysis
Aquifers	Nice To Have	Visual Inspection
Point Discharges	Not Required	None
Water Use: Diversions	Nice to Have	Visual Inspection
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Nice to Have	Visual Inspection

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Nice to Have	Visual Inspection
USGS National Water-Quality Assessment Program (NAWQA)	Nice to Have	Visual Inspection
Other (please specify the importance and highest analysis level):	Ownership- Required, Perform Geospatial Analysis; Timber Inventory - Required, Perform Geospatial Analysis; Wildlife Habitat Distribution - Required, Perform Geospatial Analysis; Fish Passage Barriers - Highly Desirable, Perform Geospatial Analysis; Land Use Allocations - Required, Perform Geospatial Analysis; Vegetation Regional Inter-agency Fish Passage Barrier Dataset - Perform Geospatial Analysis; NOAA and FWS Critical Habitat data - Perform Geospatial Analysis; Regional Fish Distribution and population data - Perform Geospatial Analysis; Elevation-derived geomorphological data (e.g. landslide)	Ownership- Required, Perform Geospatial Analysis; Timber Inventory - Required, Perform Geospatial Analysis; Wildlife Habitat Distribution - Required, Perform Geospatial Analysis; Fish Passage Barriers - Highly Desirable, Perform Geospatial Analysis; Land Use Allocations - Required, Perform Geospatial Analysis; Vegetation Regional Inter-agency Fish Passage Barrier Dataset - Perform Geospatial Analysis; NOAA and FWS Critical Habitat data - Perform Geospatial Analysis; Regional Fish Distribution and population data - Perform Geospatial Analysis; Elevation-derived geomorphological data (e.g. landslide)

Bureau of Ocean Energy Management (BOEM)

Point of Contact: Walter Johnson, walter.johnson@boem.gov

BOEM promotes energy independence, environmental protection, and economic development to its stakeholders through responsible, science-based management of offshore conventional and renewable energy and marine mineral resources.

BOEM is responsible for offshore oil, gas, and wind energy management, as well as sand and gravel dredging used for beach nourishment. These activities are mandated by the Outer Continental Shelf Lands Act.

BOEM manages the Federal Government's offshore leasing program under 43 U.S. C. Section 1344. In support of this effort, BOEM performs mathematical offshore boundary location computations and prepares Outer Continental Shelf (OCS) Leasing Maps, OCS Official Protraction Diagrams, and Supplemental Official OCS Block Diagrams depicting OCS Block information, the State Seaward Boundary, Limit of "8(g) Zone", the 200-nautical-mile Exclusive Economic Zone (EEZ Boundary), and corresponding areal measurements.

Agency Hydrography Data Requirements and Benefits

BOEM's use of surface water hydrography data is limited, since its main mission pertains to the oceans; however, riverine inputs do affect the offshore environment, hence BOEM makes some use of hydrography data. In particular, ocean circulation models used for oil spill modeling have a riverine input component in addition to wind and tidal inputs. Additionally, the Mean Lower Low Water (MLLW) shoreline is used to project out three nautical miles offshore to delineate the Submerged Lands Act (SLA) boundary. The area between the SLA boundary and the OCS is the area of primary concern to BOEM and the area within which most of its activities take place. The length of coastal shoreline within a jurisdiction also determines certain oil royalties. Thus any shoreline movement from whatever cause (e.g. climate change, hurricanes, tropical storms, or riverine impacts) is of interest to BOEM and NOAA as they review and update the MLLW baseline.

BOEM delineates nine-square mile OCS Lease Blocks that are used for leasing and other activities. Data about conditions within each block are maintained in databases, to include water depth. Other pertinent data within the lease blocks include well depth, marine protected species areas, and National Monuments.

BOEM relies heavily on water depth data and receives major environmental benefits from having these data available. Any further improvements to coastal bathymetry or integration of bathymetric data with surface hydrology would benefit BOEM.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓			✓		✓				

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
	✓	✓	✓				

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Nice To Have
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Highly Desirable
Services to visualize cartographically rendered and symbolized hydrography data	Nice To Have
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Nice To Have
Services to support online analysis of hydrography information (such as StreamStats)	Not Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Nice To Have
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Nice To Have
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Highly Desirable
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Nice To Have
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Not Required
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Nice To Have
	Ensure that hydrography and elevation data represent a similar point in time.	Not Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Not Required
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Not Required
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Nice To Have
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Nice To Have

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Little or No Impact
In a series of tributary streams, several streams do not connect with the main river.	Little or No Impact
A perennial stream is misnamed.	Highly Impactful
A large reservoir is misnamed.	Somewhat Impactful
A first order stream flow direction is reversed.	Little or No Impact
A second order stream flow direction is reversed.	Little or No Impact
A third order stream flow direction is reversed.	Little or No Impact

Quality Issue	Impact
Two first order streams coded as perennial should be intermittent.	Little or No Impact
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Little or No Impact
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Little or No Impact
Error Resolution	**Time**
Acceptable error resolution time:	Within 1 year

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 10% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	I don’t know
Use of web tool for reporting hydrography data errors	No

Agency Mission Critical Activities

BOEM managers identified a single Mission Critical Activity with requirements for hydrography data:

- Ocean Energy Management, primarily under Business Use #14, Oil and Gas Resources. Ancillary Business Uses also include Business Use #13, Renewable Energy Resources.

BOEM managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Ocean Energy Management. Summarized details are provided in the following pages.

Ocean Energy Management

Mission Critical Activity Title:	Ocean Energy Management
Mission Critical Activity Description:	Ocean energy management includes management of oil and gas as well as wind energy. Additional BOEM activities include offshore sand and gravel dredging for beach nourishment.
MCA_ID:	3783235821_1
Agency or Department:	Bureau of Ocean Energy Management (BOEM)
Sub-agency or Division:	Renewable Energy and Oil and Gas
Program Name:	Natural Resources
Primary Business Use:	Oil and Gas Resources, BU #14
Area of Interest:	Coastal areas of the U.S. including Alaska

Requirements	
Update Frequency:	6-10 years
Post Event Updates:	Nice to Have
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of channel per square mile (1:24,000-scale mapping)
Smallest Contributing Area:	10 square miles (6,400 acres)
Smallest Mapped Waterbody:	20 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Estimated Annual Program Budget:	$20 million
Current Estimated Annual Benefits ($):	$100,000
Current Operational Benefits	
Current Time/Cost Savings:	Not Applicable
Current Mission Compliance Benefits:	Not Applicable
Current Customer Service Benefits	
Current Products or Services Benefits:	Not Applicable
Current Response or Timeliness Benefits:	Not Applicable
Current Customer Experience Benefits:	Not Applicable
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Major
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	We don't presently use hydrographic data much. However, major environmental benefits are received from having water depth data.

Future Benefits	
Future Estimated Annual Benefits ($):	$100,000
Future Benefits Description:	We could use hydrographic data in modeling oil spills and planning responses, and to update water depths in currently used databases.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	
Flood stage	Yes
Floodplain boundary	
Flow periodicity	
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	
Wetlands	
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	Yes
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	
Delineate catchment	
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	
Mash-ups	

Required Analytical Functions	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Not Required	Visual Inspection
Soils	Nice to Have	Visual Inspection
Surficial Geology	Nice to Have	Visual Inspection
Bathymetry	Required	Perform Geospatial Analysis
Climate	Not Required	None
Contaminant Sources	Nice to Have	Visual Inspection
Elevation	Nice to Have	Visual Inspection
Stream Flow	Nice to Have	Perform Geospatial Analysis
Wetlands	Nice to Have	Visual Inspection
Census (population statistics)	Nice to Have	Perform Geospatial Analysis
Aquifers	Nice to Have	Visual Inspection
Point Discharges	Nice to Have	Perform Geospatial Analysis
Water Use: Diversions	Not Required	None
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice to Have	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	Visual Inspection
USACE - National Inventory of Dams (NID)	Not Required	Visual Inspection
USDA - National Agriculture Statistics Service (NASS)	Not Required	Visual Inspection
USFWS - National Wetlands Inventory (NWI)	Nice to Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Nice to Have	Visual Inspection
USGS National Water-Quality Assessment Program (NAWQA)	Nice to Have	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Bureau of Reclamation (USBR)

Point of Contact: David Raff, draff@usbr.gov

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Reclamation is a water management agency with numerous programs, initiatives, and activities that help the Western States, Native American tribes, and others meet new water needs and balance the multitude of competing water uses in the West. Reclamation places great emphasis on fulfilling its obligations in water delivery, water conservation, and water recycling and reuse; developing partnerships with its customers, states, and Native American tribes; and in finding ways to bring together the variety of interests to address the competing needs for our nation's limited water resources.

Figure B-1- USBR Regions

Reclamation is the largest supplier and manager of water in the 17 Western States (see Figure B-1) and the nation's second largest producer of hydroelectric power. Reclamation manages water for agricultural, municipal, and industrial use, and provides flood control risk reduction and recreation for millions of people. The 53 hydroelectric power plants owned and operated by Reclamation account for 15 percent of the hydroelectric generating capacity in the United States. Reclamation owns an additional 23 hydroelectric plants that are operated by other entities, five of which generate hydropower that is marketed by Federal power marketing administrations.

Reclamation manages all aspects of its water resources, including water quality, supply, delivery, and conservation; dam safety; flood risk modeling and management; river restoration; facilities design, construction, maintenance, and management; and fisheries management. In addition to its customers, Reclamation also works closely with USGS regarding streamflows and other water resources conditions, EPA regarding water quality, and is co-lead with FWS in the Western Landscape Conservation Cooperatives (LCCs).

Reclamation operates a network of automated hydrologic and meteorologic monitoring stations (Hydromet) that provide real-time water management capability. These data are then integrated with other data to provide streamflow forecasting and current runoff conditions for river and reservoir operations. These data are in turn used by the power administrations (WAPA, BPA, SEPA, and SWPA). Reclamation, in cooperation with other Federal, state, and local sponsors, also operates AgriMet, a network of more than 90 automated weather stations that collect and telemeter site-specific weather data for use in crop-specific applications such as irrigation management, pest management, frost prediction, and other crop management activities.

Reclamation is also seeking to address climate change in a number of ways, including initiatives to develop basin-wide studies of future water supply and demand, future infrastructure requirements to ensure supply and delivery of adequate water, and LCCs designed to address climate change and inform climate adaptation strategies across an ecological region or "landscape."

Reclamation's use of hydrography data for dam safety includes delineation of watersheds behind dams, as input to hydrologic models, and as input to parameters for hydraulic models. Hydrography data are also used for habitat delineation, river restoration projects and flow studies, and as a base map layer for cartographic products for numerous other Reclamation programs.

Agency Hydrography Data Requirements and Benefits

Reclamation facilities are primarily on streams or waterways. Reclamation's requirements for hydrography data include a critical requirement for integration of hydrography data with elevation data and improved flood data and information at streamflow gaging stations. Additional requirements include canals and other manmade water features, trans-basin features, left/right bank lines, and historic data for change detection. If the hydrography data were enhanced to spatially match the National Agricultural Imagery Program (NAIP) imagery and spatially integrated with the Common Land Unit (CLU) data, Reclamation would realize significant time and cost savings from not having to digitize the stream bank lines.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓			✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	**Esri shapefiles**	**Esri file geodatabase**	**NetCDF**	**GeoTIFF**	**NITF**	**Esri Grid**	**Other**
✓	✓	✓	✓	✓	✓	✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Highly Desirable
Services to download standard data products	Required
Services to create and download customized data products	Required
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Highly Desirable
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Highly Desirable

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Required
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Required
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable

Data Type	Elevation Data Integration	Requirement
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Highly Desirable
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Highly Desirable
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Highly Desirable
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Required
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Highly Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Highly Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Highly Impactful
A large reservoir is misnamed.	Critically Impactful
A first order stream flow direction is reversed.	Critically Impactful
A second order stream flow direction is reversed.	Critically Impactful
A third order stream flow direction is reversed.	Critically Impactful
Two first order streams coded as perennial should be intermittent.	Somewhat Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Highly Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Somewhat Impactful

Quality Issue	Impact
Error Resolution	**Time**
Acceptable error resolution time:	Within 3-6 months

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 1% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	I don't know
Use of web tool for reporting hydrography data errors	Probably

Agency Mission Critical Activities

Reclamation managers identified four major Mission Critical Activities with requirements for hydrography data:

- Dam Safety, primarily under Business Use #15, Flood Risk Management.
- Habitat Assessments, primarily under Business Use #5, River and Stream Ecosystem Management. Ancillary Business Uses also include Business Use #3, Water Resource Planning and Management.
- Water Supply, primarily under Business Use #1, River and Stream Flow Management. Ancillary Business Uses also include Business Use #3, Water Resource Planning and Management; and Business Use #20, Infrastructure and Construction Management.
- Hydro Power, primarily under Business Use #13, Renewable Energy Resources. Ancillary Business Uses also include Business Use #1, River and Stream Flow Management.

Reclamation managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data. Summarized details are provided in the following pages.

Dam Safety

Mission Critical Activity Title:	Dam Safety
Mission Critical Activity Description:	Flood hydrology and hazard analysis for dam safety.
MCA_ID:	3826965891_1
Agency or Department:	Bureau of Reclamation (USBR)
Sub-agency or Division:	Flood Hydrology and Dam Safety
Program Name:	Flood Hydrology and Dam Safety
Business Use:	Flood Risk Management, BU #15
Area of Interest:	USBR region

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Nice To Have
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)

Requirements	
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	20 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	A total of $81.1 million based upon the Budget Justification of the Bureau of Reclamation for FY 2016 (http://www.usbr.gov/budget/2016/FY16_Budget_Justifications.pdf).
Current Annual Benefits ($):	$2 million
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Major
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Major
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$500,000
Future Benefits Description:	Improved data availability would allow faster, better, and more accurate hydrologic and hydraulic modeling and evaluation of dam safety and consequences, supporting better decision making.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Minor
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate

Future Benefits	
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	
Flood stage	Yes
Floodplain boundary	
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	
Deltas	
Wetlands	
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Not Required	None
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Highly Desirable	Associate Selected Data Type
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Nice to Have	Associate Selected Data Type
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Habitat Assessments

Mission Critical Activity Title:	Habitat Assessments
Mission Critical Activity Description:	Assessment of impacts or benefits of Reclamation activities on endangered species habitat and large scale assessments of fish habitat in basins adjacent to Reclamation facilities, such as tributaries to the Columbia Basin.
MCA_ID:	3826293076_1
Agency or Department:	Bureau of Reclamation (USBR)
Sub-agency or Division:	Bureau of Reclamation (USBR)
Program Name:	Numerous
Business Use:	River and Stream Ecosystem Management, BU #5
Area of Interest:	USBR region

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Nice to Have
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	20 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	A total of $173.3 million based upon the Budget Justification of the Bureau of Reclamation for FY 2016. The total is a sum of the following projects: Central Valley Project Restoration Fund ($49.5 million); California Bay-Delta Restoration Fund ($37 million); San Joaquin River Restoration Fund ($35 million); Columbia and Snake River Salmon Recovery ($18 million); Trinity River Restoration ($11.9 million); Upper Colorado and San Juan River Endangered Fish Recovery programs ($4.4 million); and Platte River Endangered Species Recovery Implementation program ($17.5 million).
Current Annual Benefits ($):	$200,000
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$200,000
Future Benefits Description:	More studies could be done, and better studies for the same cost.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Not Applicable
Future Environmental Benefits:	Major
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Highly Desirable	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Not Required	None
Aquifers	Highly Desirable	Perform Geospatial Analysis
Point Discharges	Highly Desirable	Perform Geospatial Analysis
Water Use: Diversions	Highly Desirable	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Highly Desirable	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Highly Desirable	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Water Supply

Mission Critical Activity Title:	Water Supply
Mission Critical Activity Description:	Water resources management.
MCA_ID:	3787498558_1
Agency or Department:	Bureau of Reclamation (USBR)
Sub-agency or Division:	Water Resources Division
Program Name:	Numerous
Business Use:	River and Stream Flow Management, BU #1
Area of Interest:	USBR region

Requirements	
Update Frequency:	Annually
Post Event Updates:	Nice To Have
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)

Requirements	
Smallest Contributing Area:	10 square miles (6,400 acres)
Smallest Mapped Waterbody:	20 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	The total current annual budget of Reclamation is $1098.7 million based on the FY2016 Budget Justification of Reclamation. Of that budget, $805 million is considered to be for Water and Related Resources.
Current Annual Benefits ($):	$2 million
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$500,000
Future Benefits Description:	Improved reservoir operations.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Not Applicable
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Hydro Power

Mission Critical Activity Title:	Hydro Power
Mission Critical Activity Description:	Water delivery to customers and power generation from hydropower facilities.
MCA_ID:	3801440350_1
Agency or Department:	Bureau of Reclamation (USBR)
Sub-agency or Division:	Bureau of Reclamation (USBR)
Program Name:	Streamflow
Business Use:	Renewable Energy Resources, BU #13
Area of Interest:	USBR region

Requirements	
Update Frequency:	Annually
Post Event Updates:	Nice To Have
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	10 square miles (6,400 acres)
Smallest Mapped Waterbody:	20 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Program budget included under Water Supply mission critical activity program budget.
Current Annual Benefits ($):	$2 million
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$500,000
Future Benefits Description:	Improved data provided faster would improve decision making for releases in real-time events.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Not Applicable
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Environmental Protection Agency (EPA)

Point of Contact: Vince Allen, Allen.Vince@epa.gov

The mission of the Environmental Protection Agency (EPA) is to protect human health and the environment.

To accomplish its mission, EPA develops and enforces environmental regulations; gives grants to states, non-profits, educational institutions, and others; studies environmental issues to identify and solve environmental problems, shares information broadly, and sponsors partnerships with businesses, non-profits, and state and local governments; educates the public; and publishes scientific and other information online and in print.

The following EPA Mission Critical Activities rely on hydrography data.

Beaches

The Clean Water Act (CWA) 33 USC 1346 SEC. 406 (e)(1) requires that the EPA maintain and make available to the public a database of coastal and Great Lakes recreational waters accessible by beaches, containing locations of beaches and water quality monitoring locations; monitoring data; and actions to advise the public when water quality creates an increased risk to public health. The online eBEACHES system is this EPA database.

The National Beach Program's spatial focus is coastal and Great Lakes. To address its responsibilities for monitoring, notification, and remediation of water quality at beaches, EPA maintains data on beach locations and monitoring stations for those beaches, issues public advisories when necessary, locates sources of pollution, and identifies remediation measures that can be taken to clean up beaches. EPA needs merged riverine and coastal data to include topobathy data, tidal stage data, wetlands locations, as well as information about shellfish and predicted sea level rise. Annual shoreline information is provided by states, and EPA provides updates to USGS for inclusion in the NHD. Up-to-date shoreline shape is important because state grants are tied to shoreline length.

Enforcement

Enforcing environmental laws is a central part of EPA's Strategic Plan to protect human health and the environment. EPA works to ensure compliance with environmental requirements. When warranted, EPA will take civil or criminal enforcement action against violators of environmental laws. When this is necessary, hydrography data and point discharge data are components of the evidence collection, forensics, and scientific analyses used for criminal and civil enforcement.

Permitting

Section 404 of the CWA establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. EPA and the U.S. Army Corps of Engineers (USACE) have promulgated a number of regulations to implement the permitting program.

EPA and USACE require considerable coordination between the agencies in order to effectively manage the permitting program. They need a consistent definition of hydrographic features and an authoritative map of the Waters of the U.S. The NHD will be the likely starting point for such an authoritative dataset, and once developed it will be “priceless”.

Water Quality and Monitoring

Recent EPA guidance requires states to prioritize watersheds for multiple Safe Drinking Water Act and CWA programs including Healthy Watersheds, CWA 305(b), CWA 303(d)/TMDL, and CWA 319. Water quality data are used to characterize waters, identify trends over time, identify emerging problems, determine whether pollution control programs are working, help direct pollution control efforts to where they are most needed, and respond to emergencies such as floods and spills.

The EPA Watershed Index Online (WSIO) provides data and an approach to watershed prioritization along with an analysis tool. Watershed-level data included in WSIO are based on hydrology and landscape condition. Indicators of ecological condition, stressors, and social aspects are compiled/aggregated by the Watershed Boundary Dataset (WBD) HUC12. Indicators are derived from hydrology, land cover, transportation, and use other related NHDPlus products.

USGS hydrography data are also used to support other water programs at EPA, including Waters of the U.S., wetlands, groundwater, drinking water, and waste water. The data are used for effluent permitting, drinking water protection, underground injection control, watershed protection, wetlands protection and mitigation, enforcement, and inspections authorized by the CWA and its implementing regulations. Without the current NHD these activities would not be possible.

River reach addresses are used as the central index key for water quality and pollutant source locations. USGS, EPA, and USDA all share water quality monitoring data, and the NHD is the common modeling backbone used by these agencies (and others) to share data and see results. Significant time and effort are saved by the currently available data. In addition to the common reference framework provided by NHD for modeling, it also links environmental services and ties both into climate strategies.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA provides for Federal regulation of pesticide distribution, sale, and use. All pesticides distributed or sold in the United States must be registered (licensed) by EPA. Before EPA may register a pesticide under FIFRA, the applicant must show, among other things, that using the pesticide according to specifications "will not generally cause unreasonable adverse effects on the environment.''

As part of its pesticide registration process, EPA is responsible for determining the effect of pesticides on drinking water supplies and on the health of aquatic species, especially endangered species. EPA is also required to understand the causes of pesticide detections on all water supplies from monitoring data to minimize the likelihood of future contamination through modified pesticide use labeling and mitigation measures.

Hydrography data are needed for FIFRA fate transport modeling activities to analyze pesticide concentrations in all waterways. EPA is moving towards a revised risk assessment approach that is spatially explicit, and the availability of the NHDPlus dataset has made this big step forward possible.

In addition to the Mission Critical Activities for which detailed requirements and benefits were collected, EPA also noted that hydrography data are critical to:

- The ability of states, local governments, utilities, and the EPA to identify drinking water intake locations, identify the contributing watershed areas to those locations, monitor them, and identify potential contamination threats.
- Fish advisories, which are provided on state websites and in an online interactive spatial tool by location and identify waterbodies where consumption of fish or other water-dependent species caught in those waters is not advised.
- As authorized by the CWA, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into Waters of the U.S. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. EPA tracks NPDES grants using NHD data.
- The NPDES Stormwater Program, which regulates stormwater discharges from three potential sources: municipal separate storm sewer systems (MS4s), construction activities, and industrial activities. Most stormwater discharges are considered point sources, and operators of these sources may be required to receive an NPDES permit before they can discharge. Most states are authorized to implement the NPDES Stormwater Program and administer their own stormwater permitting programs. EPA remains the permitting authority in a few states, territories, and on most tribal lands. For these areas, EPA provides oversight and issues stormwater permits. Again, EPA tracks NPDES grants using NHD data.

Agency Hydrography Data Requirements and Benefits

Across all of its Mission Critical Activities, EPA requires enhancements to the spatial accuracy, level of detail included, consistency, and currency of the hydrography data. Additional requirements include linkages and geospatial proximity analysis of landscape, soils, and human infrastructure; and integration of bathymetric and coastline data with NOAA products.

EPA estimates that the cost to maintain its own surface water dataset would have been approximately $51,597,015 between 1991 and 2015, or $2,063,881 per year. This cost is avoided by having the NHD surface water framework available.

EPA program managers noted the following benefits from enhanced hydrography data:

- Increases in detail, accuracy, and currency of beach-related spatial information will (1) reduce program costs to both the local and federal levels of government; (2) better inform the recreating public, particularly children, of avoidable increased health risks, thereby avoiding or reducing health-related costs; (3) reduce costs and improve accuracy of pollution source identification; and (4) allow for better targeting and cost-effective remediation of those sources.
- For criminal enforcement, fines and penalties could be more efficiently collected. In the law enforcement/field investigations capacity, other key benefits that could be realized with enhanced hydrography data include: field planning, operations, and visual presentations in technical reports and trial exhibits, and most importantly, recon functions to minimize risks to field personnel. EPA ground-truths case-critical data for projects requiring it, and without hydrography data would struggle to meet its mission.

- Enhanced hydrography data would support more detailed (higher resolution) watershed analysis to support protection and recovery programs. Catchment-level aggregation of linked data is a future goal of the WSIO.
- Improvements to hydrography datasets would save time and cost to develop nationwide data and provide improved determination of CWA jurisdiction; improved water quality and quantity modeling; improved understanding of the relationship between flow modification and water quality, groundwater, and surface water relationships; and improved understanding of sea level rise impacts.
- Improved data would allow for better environmental modeling which in turn would lead to better environmental protection in the context of pesticide regulation. For example, higher resolution data would allow for more accurate endangered species assessments for aquatic species. Other improvements would increase accuracy in determining pesticide effects on public drinking water supplies and improve the ability to restrict pesticide use in vulnerable areas.
- Enhanced hydrography data would increase the accuracy and efficiency of work and decision making, allow better documentation of nationwide trends or statistics, improve the quality and efficiency of analysis and use, and ultimately result in higher quality environmental outcomes.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓	✓	✓				

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓		✓	✓	✓	*

*EPA-endorsed formats used by the National Beach Program

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Highly Desirable
Services to download standard data products	Required
Services to create and download customized data products	Highly Desirable
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Highly Desirable
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Highly Desirable
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Nice To Have
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Required
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Highly Desirable
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Highly Desirable

Data Type	Elevation Data Integration	Requirement
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Highly Desirable

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Critically Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Critically Impactful
A large reservoir is misnamed.	Critically Impactful
A first order stream flow direction is reversed.	Critically Impactful
A second order stream flow direction is reversed.	Critically Impactful
A third order stream flow direction is reversed.	Critically Impactful
Two first order streams coded as perennial should be intermittent.	Somewhat Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Somewhat Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Somewhat Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 1 year

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	I don’t know
Use of web tool for reporting hydrography data errors	Yes

Agency Mission Critical Activities

EPA managers identified five major Mission Critical Activities with requirements for hydrography data:

- Beaches, primarily under Business Use #22, Health and Human Services.
- Enforcement, primarily under Business Use #18, Homeland Security, Law Enforcement, and Disaster Response.
- Permitting, primarily under Business Use #5, River and Stream Ecosystem Management.
- Water Quality and Monitoring, primarily under Business Use #4, Water Quality.
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), primarily under Business Use #22, Health and Human Services. Ancillary Business Uses also include Business Use #4, Water Quality.

EPA managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data. Summarized details are provided in the following pages.

Beaches

Mission Critical Activity Title:	Beaches
Mission Critical Activity Description:	Monitoring, notification, and remediation of water quality at beaches.
MCA_ID:	3804354356_1
Agency or Department:	Environmental Protection Agency (EPA)
Sub-agency or Division:	Office of Water/Office of Science and Technology/Standards and Health Protection Division
Program Name:	National Beach Program - eBEACHES System
Business Use:	Health and Human Services, BU #22
Area of Interest:	Drainages that influence coastal areas

Requirements	
Update Frequency:	Annually
Post Event Updates:	Required
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	60 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Unable to provide.
Current Annual Benefits ($):	Unable to quantify; included in agency-wide cost avoidance of $2,063,880 for not having to maintain own surface water dataset.
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Major
Current Societal Benefits	
Current Education or Public Safety Benefits:	Major
Current Environmental Benefits:	Major
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify
Future Benefits Description:	Increases in detail, accuracy, and currency of beach-related spatial information will (1) reduce program costs to both the local and federal levels of government; (2) better inform the recreating public, particularly children, of avoidable increased health risks, thereby avoiding or reducing health-related costs; (3) reduce costs and improve accuracy of pollution source identification; and (4) allow for better targeting and cost-effective remediation of those sources.

Future Benefits	
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Major
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	Enable web event indexing by non-GIS local government staff.

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	Yes
	Match bathymetry and coastline with NOAA products; enable web event indexing by non-GIS local government staff.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Highly Desirable	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Perform Geospatial Analysis
Bathymetry	Required	Perform Geospatial Analysis
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Highly Desirable	Perform Geospatial Analysis
Stream Flow	Highly Desirable	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Not Required	None
Point Discharges	Highly Desirable	Perform Geospatial Analysis
Water Use: Diversions	Highly Desirable	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Nice To Have	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Highly Desirable	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	Required: match bathymetry and coastline with NOAA products for geospatial analysis; enable web event indexing by non-GIS local government staff	Required: match bathymetry and coastline with NOAA products for geospatial analysis; enable web event indexing by non-GIS local government staff

Enforcement

Mission Critical Activity Title:	Enforcement
Mission Critical Activity Description:	Evidence collection, forensics, and scientific analyses for criminal and civil enforcement.
MCA_ID:	3829260329_1
Agency or Department:	Environmental Protection Agency (EPA)
Sub-agency or Division:	Office of Criminal Enforcement, Forensics, and Training, National Enforcement Investigations Center, Field Branch
Program Name:	Office of Enforcement and Compliance Assurance (OECA)/Office of Criminal Enforcement, Forensics, and Training (OCEFT)
Business Use:	Homeland Security, Law Enforcement, and Disaster Response, BU #18
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Required
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Unable to provide.
Current Annual Benefits ($):	Unable to quantify; included in agency-wide cost avoidance of $2,063,880 for not having to maintain own surface water dataset.
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	For criminal enforcement, fines and penalties collected.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Minor
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor

Future Benefits	
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	Yes
	Reach code.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes

Required Analytical Functions	
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Nice To Have	Visual Inspection
Soils	Highly Desirable	Associate Selected Data Type
Surficial Geology	Highly Desirable	Visual Inspection
Bathymetry	Nice To Have	Visual Inspection
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Associate Selected Data Type
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Visual Inspection
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Highly Desirable	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Permitting

Mission Critical Activity Title:	Permitting
Mission Critical Activity Description:	Management of the Clean Water Act Section 404 Regulatory Program.
MCA_ID:	3836616697_1
Agency or Department:	Environmental Protection Agency (EPA)
Sub-agency or Division:	Office of Water - Wetlands Division
Program Name:	CWA Section 404 Regulatory Program
Business Use:	River and Stream Ecosystem Management, BU #5
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Highly Desirable

Requirements	
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	5 acres
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Unable to provide.
Current Annual Benefits ($):	Unable to quantify; included in agency-wide cost avoidance of $2,063,880 for not having to maintain own surface water dataset.
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	Better information will lead to faster desktop decision making and better documentation of nationwide trends or statistics.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Minor
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor

Future Benefits	
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	
Bridges, culverts	
Diversion lines	Yes
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	
Accumulate upstream or downstream features	Yes

Required Analytical Functions	
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	
User defined symbolization	
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land cover	Highly Desirable	Perform Geospatial Analysis
Soils	Highly Desirable	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Perform Geospatial Analysis
Bathymetry	Nice To Have	Associate Selected Data Type
Climate	Nice To Have	Associate Selected Data Type
Contaminant Sources	Nice To Have	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Nice To Have	Associate Selected Data Type
Point Discharges	Highly Desirable	Perform Geospatial Analysis
Water use: Diversions	Highly Desirable	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Nice To Have	Associate Selected Data Type
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	FEMA Flood Maps and Designations - Highly Desirable, Perform Geospatial Analysis; OSMRE GeoMine Datalayers - Highly Desirable, Perform Geospatial Analysis	FEMA Flood Maps and Designations - Highly Desirable, Perform Geospatial Analysis; OSMRE GeoMine Datalayers - Highly Desirable, Perform Geospatial Analysis

Water Quality and Monitoring

Mission Critical Activity Title:	Water Quality and Monitoring
Mission Critical Activity Description:	Support water programs at EPA including Waters of the U.S., wetlands, groundwater, drinking water, and waste water.
MCA_ID:	3824192351_1
Agency or Department:	Environmental Protection Agency (EPA)
Sub-agency or Division:	Several
Program Name:	Several
Business Use:	Water Quality, BU #4
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Highly Desirable

Requirements	
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	Esri general hydrography layer for small-scale national or regional maps, State-submitted hydrography datasets from a variety of sources.

Current Benefits	
Total Annual Program Budget:	Unable to provide.
Current Annual Benefits ($):	Unable to quantify; included in agency-wide cost avoidance of $2,063,880 for not having to maintain own surface water dataset.
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify
Future Benefits Description:	Improved consistency, accuracy, higher resolution, integrated, hydrology data including linkages and geospatial proximity analysis of landscape, soils, and human infrastructure would support more detailed (higher resolution) watershed analysis to support protection and recovery programs. Catchment-level aggregation of linked data is a future goal of the WSIO. Improvements to hydrography datasets would save time and cost to develop nationwide data and provide improved determination of CWA jurisdiction; improved water quality and quantity modeling; improved understanding of the relationship between flow modification and water quality, groundwater, and surface water relationships; and improved understanding of sea level rise impacts.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Moderate
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes

Required Characteristics	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	Yes
	Leakage/seepage at manmade barriers (levees, berms).

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Associate Selected Data Type
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Associate Selected Data Type
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	Assessed waters - Required, Perform Geospatial Analysis; Impaired waters - Required, Perform Geospatial Analysis	Assessed waters - Required, Perform Geospatial Analysis; Impaired waters - Required, Perform Geospatial Analysis

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

Mission Critical Activity Title:	Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
Mission Critical Activity Description:	Pesticide fate modeling including the effect on drinking water supplies and aquatic species. Special emphasis on endangered species.
MCA_ID:	3829418845_1
Agency or Department:	Environmental Protection Agency (EPA)
Sub-agency or Division:	Office of Pesticide Programs, Environmental Fate and Effects Division
Program Name:	Office of Chemical Safety and Pollution Prevention (OCSPP)
Business Use:	Health and Human Services, BU #22
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Required
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Unable to provide.
Current Annual Benefits ($):	Unable to quantify; included in agency-wide cost avoidance of $2,063,880 for not having to maintain own surface water dataset.
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Not Applicable
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Major
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	Improved data would allow for better environmental modeling which in turn would lead to better environmental protection in the context of pesticide regulation. For example, higher resolution data would allow for more accurate endangered species assessments for aquatic species. Other improvements would increase accuracy in determining pesticide effects on public drinking water supplies and improve the ability to restrict pesticide use in vulnerable areas.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Not Applicable
Future Environmental Benefits:	Major
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	
Floodplain boundary	
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	
Estuaries	Yes
Diversion points	
Bridges, culverts	
Diversion lines	Yes
Deltas	

Required Characteristics	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Not Required	None
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Nice To Have	Visual Inspection
Elevation	Highly Desirable	Associate Selected Data Type
Stream Flow	Highly Desirable	Perform Geospatial Analysis
Wetlands	Highly Desirable	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Highly Desirable	Perform Geospatial Analysis
Point Discharges	Not Required	None
Water Use: Diversions	Highly Desirable	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice To Have	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Highly Desirable	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	EPA SDWIS data - Highly Desirable, Perform Geospatial Analysis	EPA SDWIS data - Highly Desirable, Perform Geospatial Analysis

Farm Service Agency (FSA)

Point of Contact: Shirley Hall, Shirley.Hall@wdc.usda.gov

The Farm Service Agency (FSA) is equitably serving all farmers, ranchers, and agricultural partners through the delivery of effective, efficient agricultural programs for all Americans to achieve an abundant, safe, and affordable food and fiber supply while sustaining quality agricultural communities.

In pursuit of its mission, the FSA oversees a number of voluntary conservation-related programs. These programs work to address a large number of farming- and ranching-related conservation issues, including:

- Drinking water protection
- Reducing soil erosion
- Wildlife habitat preservation
- Preservation and restoration of forests and wetlands
- Aiding farmers whose farms are damaged by natural disasters

FSA accomplishes its goals through conservation programs that protect environmentally sensitive land, restore farmland and privately owned forests damaged by natural disasters, implement emergency water conservation measures in severe drought, restore wetlands and wetland buffer zones and establish plant cover, prevent grazing and pasture land from being converted into cropland or used for urban development, and protect surface and ground water used as drinking water by rural residents.

The Conservation Reserve Program (CRP) pays a yearly rental payment in exchange for farmers removing environmentally sensitive land from agricultural production and planting species that will improve environmental quality. CRP contracts typically extend for 10-15 years, after which the land can be re-enrolled or returned to production. Certain conservation priority areas (e.g. sage grouse habitats, duck nesting habitats in MN) are always eligible, while other CRP land is competitively scored and bid, with areas that have higher scores enrolled. Areas targeted by CRP for protection include riparian areas that contribute to wetland restoration, stormwater management, erosion reduction, stream rehabilitation, and reduced nitrogen loading; specific targeted or endangered species areas; areas that recharge underground aquifers; and areas that would increase wildlife and recreational activities.

The Conservation Reserve Enhancement Program (CREP) targets high-priority conservation areas identified by state and local agencies. The basic CRP framework is used and enhanced with a state and/or local cost share to encourage participation.

Use of hydrography data by the CRP is currently mainly cartographic. CRP offers are delineated on maps for enrollment using National Agriculture Imagery Program (NAIP) imagery, Common Land Unit (CLU) boundaries (farm and field boundaries), streams, soils data, etc. Currently, streams and stream banks are drawn using NAIP imagery and CLUs. Other data used in the CRP process include wetlands, flood zones, NOAA weather services, and impaired waters datasets. If the hydrography data were enhanced to match the NAIP imagery and spatially integrated with the CLU data, FSA would realize time and cost savings from not having to digitize the streams; buffers could be more quickly and easily generated, the data would be more consistent state–to-state, and the data would be considered to be more defensible. Communication between FSA and producers would also be improved, thereby making the producer better informed for land use decision making.

FSA also uses hydrography data in its risk assessment and disaster recovery programs to identify major crops in flood hazard areas, identify post-flood areas for debris removal, restore fences, and help restore land to production after an event. Stream channels are also used for future disaster estimates and mitigation plans. Enhanced hydrography data would provide benefits to FSA from faster disaster assessment and claims evaluations for its clients.

Agency Hydrography Data Requirements and Benefits

FSA uses Hydrography data in numerous ways, with the most benefit realized through its use in administering voluntary conservation programs. An updated layer with improved accuracy would assist offices at the state and county levels in providing higher-quality data and service to landowners, farmers, and ranchers participating in FSA programs. A standardized hydrography dataset could be leveraged by all states rather than relying on state-specific data or nationally-available data that do not meet accuracy requirements for program administration, particularly as conservation partnerships shift toward more focused enrollments in smaller areas.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓				✓	✓	✓		✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓		✓			

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Highly Desirable
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Nice To Have
Services to create generalized versions of hydrography (different scales and level of detail)	Nice To Have
Services to support online analysis of hydrography information (such as StreamStats)	Nice To Have

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Highly Desirable
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Nice To Have
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Nice To Have
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Nice To Have
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Nice To Have
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Nice To Have
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Nice To Have
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Not Required
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Nice To Have

Data Type	Elevation Data Integration	Requirement
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Not Required
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Not Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Highly Impactful
In a series of tributary streams, several streams do not connect with the main river.	Highly Impactful
A perennial stream is misnamed.	Little or No Impact
A large reservoir is misnamed.	Little or No Impact
A first order stream flow direction is reversed.	Somewhat Impactful
A second order stream flow direction is reversed.	Somewhat Impactful
A third order stream flow direction is reversed.	Little or No Impact
Two first order streams coded as perennial should be intermittent.	Somewhat Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Somewhat Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Somewhat Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	No problem at all
Use of web tool for reporting hydrography data errors	Yes

Agency Mission Critical Activities

FSA managers identified one major Mission Critical Activity with requirements for hydrography data:

- Conservation Reserve Program, primarily under Business Use #2, Natural Resources Conservation. Ancillary Business Uses also include Business Use #1, River and Stream Flow Management; Business Use #4, Water Quality; Business Use #5, River and Stream Ecosystem Management; Business Use #9, Wildlife and Habitat Management (off-stream); Business Use #10, Agriculture and Precision Farming; Business Use #15, Flood Risk Management; and Business Use #16, Sea Level Rise and Subsidence.

FSA managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for the Conservation Reserve Program. Summarized details are provided in the following pages.

Conservation Reserve Program

Mission Critical Activity Title:	Conservation Reserve Program
Mission Critical Activity Description:	Enrollment and maintenance of the Conservation Reserve Program (CRP) to target land for environmental benefits including recharge of underground aquifers, establishing habitat for endangered species, and increasing wildlife benefits and recreational activities. Eligibility of land is dependent on soil and hydrologic requirements. Currently our GIS Tools in the Tool for Environmental Resource Results Assessment (TERRA) applications provide that analysis of the land, hydrological features, and eligibility requirements.
MCA_ID:	3793131506_1
Agency or Department:	Farm Service Agency (FSA)
Sub-agency or Division:	Nationwide perspective, National Office
Program Name:	Conservation Reserve Program
Business Use:	Natural Resources Conservation, BU #2

Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, Northern Mariana Islands

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	Varies by state based on available higher resolution state hydrography datasets.

Current Benefits	
Total Annual Program Budget:	$1.8 billion
Current Annual Benefits ($):	Not available for the survey.
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Major
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Not available for the survey.
Future Benefits Description:	Improved hydrography datasets will facilitate major benefits to customers as it will allow staff to improve outreach and marketing of available voluntary conservation programs for agricultural producers and landowners. Increased enrollment will accelerate implementation of conservation practices and will provide greater environmental benefits, particularly to water quality and wildlife habitat.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Not Applicable
Future Environmental Benefits:	Major
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	
Flow periodicity	
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	
Estuaries	Yes
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	
Delineate catchment	
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Highly Desirable	Perform Geospatial Analysis
Surficial Geology	Not Required	None
Bathymetry	Not Required	None
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Not Required	None
Elevation	Nice To Have	Visual Inspection
Stream Flow	Not Required	None
Wetlands	Highly Desirable	Perform Geospatial Analysis
Census (population statistics)	Not Required	None
Aquifers	Nice To Have	Visual Inspection
Point Discharges	Not Required	None
Water Use: Diversions	Not Required	None
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Not Required	None
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Other (please specify the importance and highest analysis level):	Yes; Must be integrated with FSA National Common Land Unit (CLU) layer; Required; Perform Geospatial Analysis	Yes; Must be integrated with FSA National Common Land Unit (CLU) layer; Required; Perform Geospatial Analysis

Federal Emergency Management Agency (FEMA)

Point of Contact: Paul Rooney, paul.rooney@fema.dhs.gov

FEMA's mission is to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards.

FEMA is the Federal agency charged with building and supporting the nation's emergency management system. The range of FEMA's activities is broad and spans the life cycle of disasters. The disaster life cycle describes the process through which emergency managers prepare for emergencies and disasters, respond to them when they occur, help people and institutions recover from them, mitigate their effects, reduce the risk of loss, and prevent disasters from occurring.

The National Flood Insurance Program (NFIP) was established in 1968 to reduce future flood damage through hazard identification and mapping, effective community floodplain management, and insurance protection for property owners. FEMA's management of the NFIP has evolved to best manage mounting flood losses and escalating costs of disaster relief. As originally conceived, the NFIP was the means to get communities and citizens to understand their risk from flooding and to mitigate against future flood damage. Congress provided the incentives to do this by encouraging community participation through floodplain building standards, discounting premiums for structures built prior to the publication of a Flood Insurance Rate Map (FIRM) for their community, mandating the purchase of flood insurance, and authorizing grant programs to mitigate repetitively damaged structures. The NFIP's flood risk identification and floodplain management land use and building standards save the country more than $1 billion in prevented damages each year.

FEMA also manages multiple programs for disaster preparedness, response, and recovery operations, to include the Hazard Mitigation Assistance Program, Individual Assistance Program, and Public Assistance Program.

Agency Hydrography Data Requirements and Benefits

FEMA flood mapping studies and databases frequently use NHD datasets and would use NHD datasets more extensively if the currency and resolution were improved nationally. FEMA also uses NHD datasets to manage the flood mapping inventory.

FEMA has requirements for NHD flowlines and waterbodies that match recent orthoimagery and terrain data, stream lines that drain one square mile or greater, and Watershed Boundary Dataset (WBD) boundaries that match recent terrain data. These data are needed to support hydrologic and hydraulic modeling, flood mapping, and flood hazard data visualization and dissemination. Having higher quality or more granular data in the base NHD data would reduce the cost to acquire and standardize data, and to delineate catchments and flowpaths.

FEMA also uses NHD flowlines as the basis for its Coordinated Needs Management Strategy (CNMS). The CNMS organizes, stores, and analyzes nationwide flood hazard mapping needs information by river reach and allows FEMA to document where the inventory of its currently published flood studies meet FEMA's validity standards and where FIRM updates are needed. The validity of flood studies is based on critical and secondary change indicators of physical environment, climate patterns, and engineering methods since the date of the effective hydrologic and hydraulic analyses.

FEMA, USGS, and USACE need updated hydrography as soon as possible after a flood or hurricane event for collecting high water marks and other survey purposes and to identify changes to watercourse locations.

FEMA's disaster response activities also make use of NHD datasets; however, these activities are not explicitly included in the responses outlined under the Flood Risk Mapping, Assessment, and Planning (Risk MAP) activity described below.

FEMA's flood mapping studies and databases would benefit from higher quality or more granular data in the base NHD data. These benefits would be realized from reduced costs to acquire and standardize data and to delineate catchments and flowpaths.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓				✓	✓		✓	✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
	✓	✓		✓		✓	*

*LAS

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Nice To Have
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required

Data or Service Access Method	Requirement
Services to visualize cartographically rendered and symbolized hydrography data	Required
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Nice To Have

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Highly Desirable
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Required
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Required
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Required
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Required
	Ensure that hydrography and elevation data represent a similar point in time.	Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Required
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Required
	Determine <u>feature</u> on the hydrographic network to which a point (with elevation value) is connected.	Required
	Determine the actual <u>point location</u> (within a DEM cell) on the hydrographic network to which a point is connected.	Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Little or No Impact
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Little or No Impact
In a series of tributary streams, several streams do not connect with the main river.	Little or No Impact
A perennial stream is misnamed.	Little or No Impact
A large reservoir is misnamed.	Little or No Impact
A first order stream flow direction is reversed.	Critically Impactful
A second order stream flow direction is reversed.	Critically Impactful
A third order stream flow direction is reversed.	Critically Impactful
Two first order streams coded as perennial should be intermittent.	Little or No Impact
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Critically Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Highly Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Little or No Impact
Error Resolution	**Time**
Acceptable error resolution time:	Within 3-6 months

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	Significant problem, but we have workarounds
Use of web tool for reporting hydrography data errors	Yes

Agency Mission Critical Activities

FEMA managers identified one major Mission Critical Activity with requirements for hydrography data:

- Flood Risk Mapping, Assessment, and Planning (Risk MAP), primarily under Business Use #15, Flood Risk Management. Ancillary Business Uses also include Business Use #1, River and Stream Flow Management; Business Use #6, Coastal Zone Management; Business Use #16, Sea Level

Rise and Subsidence; Business Use #18, Homeland Security, Law Enforcement, and Disaster Response; Business Use #19, Marine and Riverine Navigation and Safety; Business Use #21, Urban and Regional Planning; and Business Use #23, Real Estate, Banking, Mortgage, and Insurance.

FEMA managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Flood Risk Mapping, Assessment, and Planning (Risk MAP). Summarized details are provided in the following pages.

Flood Risk Mapping, Assessment, and Planning (Risk MAP)

Mission Critical Activity Title:	Flood Risk Mapping, Assessment, and Planning (Risk MAP)
Mission Critical Activity Description:	FEMA's Risk MAP program combines flood hazard mapping, risk assessment tools, and Hazard Mitigation Planning into one seamless program. The intent of this integrated program is to encourage beneficial partnerships and innovative uses of flood hazard and risk assessment data in order to build more resilient communities.
MCA_ID:	3809522145_1
Agency or Department:	Federal Emergency Management Agency (FEMA)
Sub-agency or Division:	Federal Insurance and Mitigation Administration
Program Name:	National Flood Insurance Program
Primary Business Use:	Flood Risk Management, BU #15
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Required
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Estimated Annual Program Budget:	$90 million
Current Estimated Annual Benefits ($):	$1.8 million
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Major
Current Societal Benefits	
Current Education or Public Safety Benefits:	Major
Current Environmental Benefits:	Major
Current Human Lives Saved:	Moderate
Current Other Benefits:	

Future Benefits	
Future Estimated Annual Benefits ($):	$9 million
Future Benefits Description:	FEMA flood mapping studies and databases are built from NHD data sets. Having higher quality or more granular data in the base NHD data would reduce the cost to acquire and standardize data, and to delineate catchments and flowpaths. We have labeled these benefits as moderate because many studies start from existing data, rather than requiring brand new data to be created.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Minor

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	
Flow periodicity	
Riverine bathymetry	
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	
Wetlands	
Badlands	
Other	Yes
	GNIS names (better reconciled with FEMA, GIS streams).

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	
Delineate catchment	
Determine downstream flood area	
Accumulate upstream or downstream features	

Required Analytical Functions	
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	
Preset symbolization	
User defined symbolization	
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Required	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Not Required	None
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Associate Selected Data Type
Aquifers	Not Required	None
Point Discharges	Not Required	None
Water Use: Diversions	Not Required	None
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Nice To Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

Federal Energy Regulatory Commission (FERC)

Point of Contact: Steven Sachs, steven.sachs@ferc.gov

The Federal Energy Regulatory Commission (FERC) is an independent agency that regulates the interstate transmission of electricity, natural gas, and oil. FERC also reviews proposals to build liquefied natural gas (LNG) terminals and interstate natural gas pipelines as well as licensing hydropower projects. **FERC's Mission is to assist consumers in obtaining reliable, efficient, and sustainable energy services at a reasonable cost through appropriate regulatory and market means.** Fulfilling this mission involves pursuing three primary goals:

1. Ensure just and reasonable rates, terms, and conditions
2. Promote safe, reliable, secure, and efficient infrastructure
3. Mission support through organizational excellence

As it relates to this study of hydrography data requirements and benefits, FERC's activities include the following:

Dam Safety – FERC's dam safety program ensures that its dams are safe through review and approval of designs, plans, specifications, and construction of new dams, as well as inspections of ongoing operations. Dam inspection frequency is dictated by the hazard potential classification of the dam. FERC publishes dam safety engineering guidelines, including procedures and criteria for the engineering evaluation and analysis of hydropower projects. Emergency Action Plans are required for all dams under FERC's jurisdiction. FERC also requires comprehensive inspections and engineering evaluations of high and significant hazard potential dams to be conducted by independent consultants every five years. Each is reviewed and evaluated by FERC staff to determine if additional studies or remedial actions are required.

Hydropower Licensing and Compliance – FERC reviews all new licenses, renewals of licenses, and exemptions for hydropower projects, working with the project owner throughout the license application process. FERC staff prepares either an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) and bases recommended license conditions on the these reviews. FERC staff ensures compliance with the numerous terms and conditions contained in each of the licenses and exemptions issued. Section 10(a)(2)(A) of the Federal Power Act (FPA) requires FERC to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project.

Additional FERC activities that may make use of hydrography data include reviews of gas pipeline and electric transmission line siting studies that include analysis of stream crossings. Additionally, all FERC-regulated project owners are required to conduct EAs and EISs that document potential environmental issues, including water quality and quantity, associated with the project.

Agency Hydrography Data Requirements and Benefits

FERC performs dam safety reviews to ensure that the dam and its spillway are designed to withstand flood conditions and/or overtopping to the point where flood flows are discharged safely and dam failure would not constitute a hazard to downstream life or property. Field investigations, terrain data, existing flood studies, and detailed engineering analyses including dam break analyses are used to determine the hazard potential of a dam.

For its dam safety reviews, FERC uses hydrography data provided by USGS and others, to include gage data, high water marks, precipitation and other storm data, existing flood studies and data, terrain data and bathymetry to evaluate the potential for dam failure and resulting flood hazards. Watershed modeling to include collection of storm data, rainfall runoff modeling, and hydraulic modeling are performed. Depth to groundwater is an additional consideration, particularly in the Midwest.

Considerable data gathering is required to conduct dam safety reviews and FERC currently benefits from the availability of digital hydrographic and hydrologic data. Better data availability and improved hydrography data would mean more expedient hydrologic and hydraulic (H&H) modeling, more reliable dam safety evaluation results, and improved decision making for FERC and its customers (licensees and exemptees). Properly sized dam spillways would reduce dam failures due to inadequate spillway capacity, which would save lives and environmental damage, improving downstream economies. Additionally, dam owners could potentially realize savings in the costs of dam construction and/or upgrades that result from the over-engineering of structures to accommodate modeling uncertainties if better data were available.

For its hydropower license and compliance reviews, FERC reviews H&H studies performed by dam owners and ensures that minimum flow requirements and water surface elevations are maintained and that environmental protection measures are enforced. Additionally, FERC determines headwater benefits realized by downstream hydropower projects from any regulation of river flows by upstream storage reservoirs and assesses charges to the downstream beneficiaries.

Again, FERC and its contractors currently benefit from the availability of digital hydrographic and hydrologic data for H&H studies. Future improvements to the amount and quality of hydrography data would result in less time spent locating external data and better analyses. Additionally, improved hydrography data would result in future environmental benefits from the ability to consider climate change in the flood frequency analyses for the 50-year life of a project's license.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	**Esri shapefiles**	**Esri file geodatabase**	**NetCDF**	**GeoTIFF**	**NITF**	**Esri Grid**	**Other**
✓	✓	✓		✓		✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Required
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required
Services to visualize cartographically rendered and symbolized hydrography data	Nice To Have
Services that allow combination of visualizations with other visualization services (mash-ups)	Nice To Have
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Highly Desirable
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Highly Desirable
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Required
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Required
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable

Data Type	Elevation Data Integration	Requirement
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Highly Desirable
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Highly Desirable
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Highly Desirable
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Highly Desirable

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Highly Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Highly Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Somewhat Impactful
A large reservoir is misnamed.	Somewhat Impactful
A first order stream flow direction is reversed.	Highly Impactful
A second order stream flow direction is reversed.	Highly Impactful
A third order stream flow direction is reversed.	Highly Impactful
Two first order streams coded as perennial should be intermittent.	Somewhat Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Highly Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Somewhat Impactful

Quality Issue	Impact
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	Major problem – data can not be used for Mission Critical Activity
Use of web tool for reporting hydrography data errors	Maybe

Agency Mission Critical Activities

FERC managers identified two major Mission Critical Activities with requirements for hydrography data:

- Dam Safety, under Business Use #15, Flood Risk Management.
- Hydropower Compliance and License Reviews under Business Use #13, Renewable Energy Resources.

FERC managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Dam Safety and Hydropower Compliance and License Reviews. Summarized details are provided in the following pages.

Dam Safety

Mission Critical Activity Title:	Dam Safety
Mission Critical Activity Description:	Inspection and evaluation of the safety of hydropower dams under FERC's jurisdiction.
MCA_ID:	3787830272_1
Agency or Department:	Federal Energy Regulatory Commission (FERC)
Sub-agency or Division:	Division of Dam Safety and Inspections
Program Name:	Dam Safety
Business Use:	Flood Risk Management, BU #15
Area of Interest:	Nationwide including Alaska and Puerto Rico

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Required
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$12.88 million
Current Annual Benefits ($):	$3.22 million
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Major
Current Societal Benefits	
Current Education or Public Safety Benefits:	Major
Current Environmental Benefits:	Major
Current Human Lives Saved:	Major
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$322,000 - $805,000
Future Benefits Description:	Improved data availability would allow better, more reliable, and more expedient hydrologic modeling and evaluation of dam safety and consequences, which supports decision making. The dam owner and consultant can do more accurate engineering analysis as needed. Properly sized spillways at dams would reduce the probability of dam failures due to having inadequate spillway capacity. This would save lives and environmental damage.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Major
Future Human Lives Saved:	Major
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	
Deltas	
Wetlands	
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	
Find upstream or downstream points	

Required Analytical Functions	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Perform Geospatial Analysis
Bathymetry	Required	Perform Geospatial Analysis
Climate	Nice to Have	Visual Inspection
Contaminant Sources	Not Required	None
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Required	Perform Geospatial Analysis
Aquifers	Highly Desirable	Associate Selected Data Type
Point Discharges	Highly Desirable	Associate Selected Data Type
Water Use: Diversions	Nice to Have	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Highly Desirable	Associate Selected Data Type
USDA - National Agriculture Statistics Service (NASS)	Nice to Have	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Nice to Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Nice to Have	Associate Selected Data Type
USGS National Water-Quality Assessment Program (NAWQA)	Nice to Have	Visual Inspection
Other (please specify the importance and highest analysis level):		

Hydropower License and Compliance Reviews

Mission Critical Activity Title:	Hydropower License and Compliance Reviews
Mission Critical Activity Description:	Hydropower license and compliance reviews to include environmental assessments of project effects, development and assessment of mitigation measures of project effects, assessment of benefits and costs of mitigation measures, preparation of license orders, and administration of headwater benefits.
MCA_ID:	3772430552_1
Agency or Department:	Federal Energy Regulatory Commission (FERC)
Sub-agency or Division:	Office of Energy Projects, Division of Hydropower Administration and Compliance
Program Name:	Hydropower Licensing and Headwater Benefits
Business Use:	Renewable Energy Resources, BU #13
Area of Interest:	Nationwide including Alaska, Hawaii, and Puerto Rico

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Nice to Have
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$5,350,000
Current Annual Benefits ($):	$802,500
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Don’t know
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Don’t know
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$80,250
Future Benefits Description:	Less time spent locating external data and better analyses. Future environmental benefits from the ability to consider climate change in the flood frequency analyses for the 50-year life of a project’s license.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Don’t know
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Don’t know
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	Yes
Flow periodicity	
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	
Diversion lines	Yes
Deltas	
Wetlands	
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes

Required Analytical Functions	
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	
User defined symbolization	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Nice to Have	Visual Inspection
Soils	Nice to Have	Visual Inspection
Surficial Geology	Not Required	None
Bathymetry	Nice to Have	Visual Inspection
Climate	Nice to Have	Visual Inspection
Contaminant Sources	Not Required	None
Elevation	Highly Desirable	Associate Selected Data Type
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Nice to Have	Visual Inspection
Census (population statistics)	Nice to Have	Visual Inspection
Aquifers	Nice to Have	Visual Inspection
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice to Have	Visual Inspection
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Nice to Have	Visual Inspection
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Nice to Have	Visual Inspection
Other (please specify the importance and highest analysis level):		

International Joint Commission (IJC)

Point of Contact: Mike Laitta, LaittaM@washington.ijc.org l

The International Joint Commission (IJC) prevents and resolves disputes between the United States of America and Canada under the 1909 Boundary Waters Treaty and pursues the common good of both countries as an independent and objective advisor to the two governments.

In particular, IJC rules on applications for approval of projects affecting boundary or transboundary waters and may regulate the operation of these projects; it assists the two countries in the protection of the transboundary environment, including the implementation of the Great Lakes Water Quality Agreement and the improvement of transboundary air quality; and it alerts the governments to emerging issues along the boundary that may give rise to bilateral disputes.

IJC is responsible for regulating water levels and monitoring the water quality of rivers and lakes along the international border between Canada and the United States. IJC's activities include regulating shared water uses to include making decisions on applications for projects such as dams and diversions that affect the natural level and flow of waters across the boundary. Changes to water levels can affect drinking water intakes, commercial shipping, hydroelectric power generation, agriculture, shoreline property, recreation, fisheries, wildlife, wetlands, and other interests. IJC is also responsible for maintaining emergency water levels in the Lake of the Woods basin and for apportioning water among various uses in several other basins.

Figure B-2 - Shared U.S.-Canada Watersheds

Under the International Watersheds Initiative, a strategic initiative for IJC is the Transboundary Data Harmonization Task Force, which is working with Federal, provincial, state, and local agencies to integrate and standardize hydrographic data along the 5,000-mile U.S.-Canada border. This Task Force is addressing the harmonization and long-term stewardship of Canada's National Hydrographic Network (NHN) and Fundamental Drainage Areas (FDAs) and the U.S. National Hydrography Dataset (NHD) and the National Watershed Boundary Dataset (WBD). For the hydrography data, the respective datasets (NHN and NHD) are compared along a 100-meter strip on either side of the border. Any features that do not align are connected and redigitized following agreed-upon guidelines. The revised features are sent back to their responsible agencies in each country for verification and inclusion into the national data structures.

For the watershed boundaries, a similar approach is being taken, beginning with the WBD 8-digit codes and FDA 4-digit codes. Again, areas of congruence and areas with substantial interpretive disconnects are identified (see Figure B-3 below), agreed-upon protocols for merging drainage areas are applied within the border swath, and the harmonized areas are reported back to their respective agencies for update in the national datasets. Once the US8-CAN4 level data are reconciled and the hydrographic features within them are harmonized, more detailed work will be undertaken to refine the higher-resolution drainage areas.

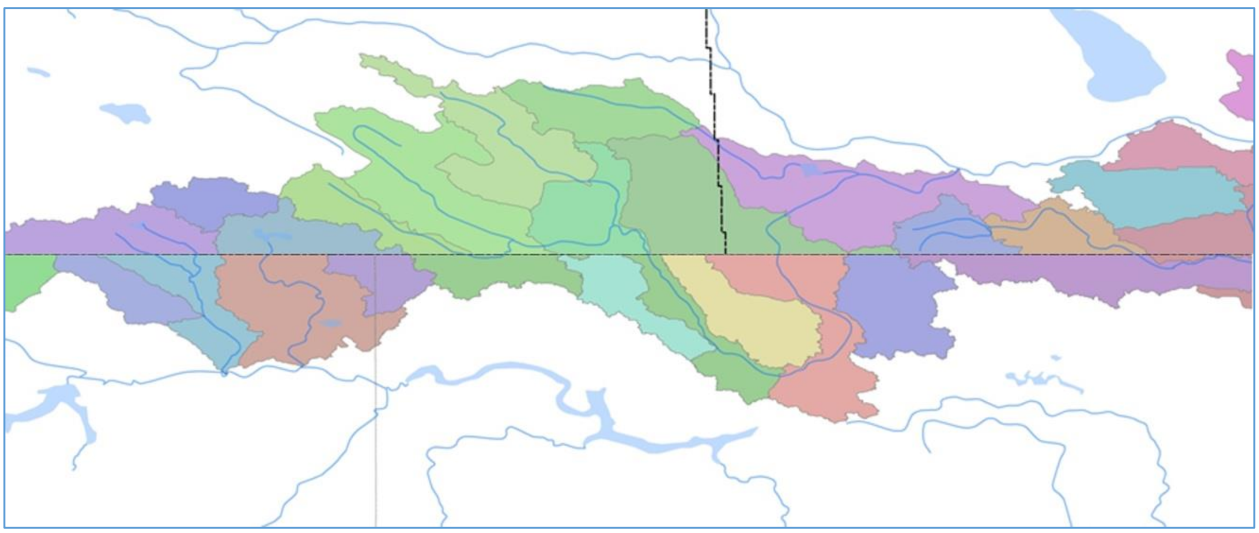


Figure B-3 - Pre-harmonized Watershed Boundaries

Agency Hydrography Data Requirements and Benefits

Well-integrated hydrography and watershed data across the border with Canada are mission critical to IJC in order to maintain the health and well-being of shared waters and areas. The hydrography data are the backbone of numerous coordinated water quality monitoring and modeling activities performed both in the U.S. and Canada that use tools such as Hydrological Simulation Program – Fortran (HSPF), Soil and Water Assessment Tool (SWAT), Generalized Watershed Loading Function (GWLF), StreamStats, SPAtially Referenced Regressions on Watershed attributes (SPARROW), etc. that depend on standardized hydrography data inputs.

The hydrography data harmonization activities completed across the U.S.-Canada border to date have changed the behavior and expectations across the two nations. Both countries are benefiting from the use of the harmonized data across the landscape. The data harmonization could not have been accomplished without the NHD and WBD datasets as the starting point, and the harmonized data could not be maintained without the data framework and delivery mechanisms that are currently in place. Seamless data are now the expected norm across the border and having seamless data is providing large benefits to both nations. Completion of the data harmonization to the HUC-12 level and future enhancements to the hydrography data will enable more efficient studies across the U.S.-Canada boundary at all scales. Continued and sustained relationships between U.S. states and Canadian provinces will be critical for maintenance of the harmonized NHD and WBD data.

A future enhancement to the hydrography data that would benefit IJC would be the ability to view the drainage network at different densities suitable for cartographic representation at different scales. The Canadian NHN has a tool that allows this, and similar functionality for the NHD would be helpful. Additionally, differences between the WBD hydrologic units and NHDPlus catchments causes confusion to users and duplication of effort. Future efforts to reconcile these differences would benefit IJC.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓			✓			✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓	✓	✓		✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Highly Desirable
Services to download standard data products	Required
Services to create and download customized data products	Required
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required
Services to visualize cartographically rendered and symbolized hydrography data	Required
Services that allow combination of visualizations with other visualization services (mash-ups)	Required
Services to create generalized versions of hydrography (different scales and level of detail)	Required

Data or Service Access Method	Requirement
Services to support online analysis of hydrography information (such as StreamStats)	Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Required
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Required
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Required
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Required
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Required
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Required
	Ensure that hydrography and elevation data represent a similar point in time.	Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Required
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Required
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Critically Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Critically Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Somewhat Impactful

Quality Issue	Impact
A large reservoir is misnamed.	Little or No Impact
A first order stream flow direction is reversed.	Highly Impactful
A second order stream flow direction is reversed.	Highly Impactful
A third order stream flow direction is reversed.	Highly Impactful
Two first order streams coded as perennial should be intermittent.	Highly Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Somewhat Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Critically Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	Major problem – data cannot be used for Mission Critical Activity
Use of web tool for reporting hydrography data errors	Yes

Agency Mission Critical Activities

IJC managers identified one major Mission Critical Activity with requirements for hydrography data:

- Bi-National Cooperation, primarily under Business Use #1, River and Stream Flow Management.

IJC managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Bi-National Cooperation. Summarized details are provided in the following pages.

Bi-National Cooperation

Mission Critical Activity Title:	Bi-National Cooperation
Mission Critical Activity Description:	Bi-national cooperation between the U.S. and Canada to protect shared waters.
MCA_ID:	3794821295_1
Agency or Department:	International Joint Commission (IJC)
Sub-agency or Division:	N/A
Program Name:	Transboundary Waters
Business Use:	River and Stream Flow Management, BU #1
Area of Interest:	Shared watersheds across the U.S.-Canada boundary

Requirements	
Update Frequency:	Annually
Post Event Updates:	Required
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)

Requirements	
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	5 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$2 million
Current Annual Benefits ($):	Unable to quantify; could not harmonize data without current datasets.
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Major
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Major
Current Human Lives Saved:	Moderate
Current Other Benefits:	Bi-national communication

Future Benefits	
Future Annual Benefits ($):	$1 million
Future Benefits Description:	Our mission is unique in that we have to deal with hydrographic (quantity and quality) issues along the transboundary. One improvement to the existing NHD: create a drainage density grouping that provides easy visualization.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Major
Future Human Lives Saved:	Moderate
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Associate Selected Data Type
Bathymetry	Required	Perform Geospatial Analysis
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Highly Desirable	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Nice To Have	Associate Selected Data Type
Point Discharges	Highly Desirable	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

National Oceanic and Atmospheric Administration (NOAA)

Point of Contact: Ed Clark, Edward.Clark@noaa.gov

The National Oceanic and Atmospheric Administration's (NOAA's) mission is to understand and predict changes in climate, weather, oceans, and coasts; to share that knowledge and information with others; and to conserve and manage coastal and marine ecosystems and resources. NOAA works to achieve healthy and resilient ecosystems, communities, and economies through science, service, and stewardship.

NOAA was formed in 1970, but the agencies that came together at that time date back to 1807, when the United States Coast and Geodetic Survey was formed, followed by the Weather Bureau in 1870, and the Bureau of Commercial Fisheries in 1871. NOAA's products and services affect more than one-third of America's gross domestic product. NOAA's scientists provide citizens, planners, emergency managers, and other decision makers with reliable information including accurate weather forecasts and the data needed to protect and manage the nation's coastal and ocean resources and to enable society to plan and respond to climate change.

The following offices within NOAA are represented with hydrography requirements and benefits:

- Through the *National Weather Service*, NOAA provides local and regional forecasts and emergency alerts for severe storms, tornadoes, hurricanes, floods, extreme heat, winter storms, fire threats, tsunamis, and solar flares. This is accomplished through its national center, 122 Weather Forecast Offices, and 13 River Forecast centers. In addition to forecasts, NOAA archives the data used in weather forecasting as well as historic climate records.
- Under the *National Ocean Service*, NOAA operates the national Integrated Ocean Observing System that includes sustained monitoring of the ocean and Great Lakes through a network of buoys, tidal stations, and satellite data. NOAA also tracks estuarine water quality, meteorology, and nutrient data. Additionally, NOAA maintains detailed, accurate, and up-to-date maps and nautical charts for 3.4 million square nautical miles. These charts are used by the maritime carriers responsible for 80 percent of the U.S. overseas trade that goes through our nation's 400 ports.

Agency Hydrography Data Requirements and Benefits

As noted above, NOAA's unique role in federal water resources information is forecasting, and its new business paradigm is to develop a spatially continuous "national water model" at the 250 kilometer scale that will result in high-resolution hydrologic and hydraulic (H&H) simulations and forecasts. NOAA plans to couple this model with coastal and estuarine process models and produce "total water prediction" data. In the future, these models could be linked to atmospheric data to capture the return to the atmosphere to model the full hydrologic cycle. This is a leap forward from the approach used for the past 30-40 years that was based on highly calibrated engineering based hydrologic simulations modeled on 100-1000 kilometer basins.

Ultimately, the new model data will be tied to improved hydrography data by reach and will be able to be conflated with other data sets such as EPA water quality data, regulation data from USACE and USBR, and in the future, agricultural information. The forecast data will be able to be communicated more readily to its users, by leveraging authoritative hydrography data as the underlying geospatial framework. Moreover, FEMA and other emergency response groups will be able to see what specific reaches are predicted to flood, as opposed to the current situation where flooding can only be predicted at specific point locations or more generally by county. In order to realize NOAA's vision of a "total water model," more detailed hydrography data are needed. This would result in improved flow data in urban and rural areas, even allowing rural users to determine whose field water is coming from.

Additionally, NOAA's future vision is to fully couple the riverine forecasts with coastal forecasts. In the coastal environment, the boundary between riverine and tidal areas is extremely important. NOAA's future vision is to include ADCIRC modeling in its "total water model." The coastal component of the future hydrography dataset needs to be well-coordinated with NOAA so that there is consistency between Federal products.

NOAA's National Operational Hydrologic Remote Sensing Center (NOHRSC) snow models use lake extents for parameter typing. Waterbodies are much more important now due to the need to account for water movement and storage across the landscape. Waterbodies in the future hydrography dataset also need to be conflated with dams (e.g. the USACE National Inventory of Dams) for regulated waterbodies.

NOAA's shoreline mapping activities use hydrography data mainly as a reference layer and to verify/validate other sources. Hydrography data that were more spatially accurate and up to date would be more useful for these activities.

NOAA's nautical charts are updated every six months; currently, however, USGS hydrography data are not used for nautical charting; NOAA relies on its own shoreline data.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	*	

*Canada, especially watersheds draining into Alaska

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓	✓	✓		✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Required
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Required
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Required
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Required
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Required

Data Type	Elevation Data Integration	Requirement
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Required
	Ensure that hydrography and elevation data represent a similar point in time.	Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Required
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Required
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Required
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Highly Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Highly Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Critically Impactful
A large reservoir is misnamed.	Critically Impactful
A first order stream flow direction is reversed.	Critically Impactful
A second order stream flow direction is reversed.	Critically Impactful
A third order stream flow direction is reversed.	Critically Impactful
Two first order streams coded as perennial should be intermittent.	Highly Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Critically Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Critically Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Critically Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Critically Impactful

Quality Issue	Impact
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 1% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	No problem at all
Use of web tool for reporting hydrography data errors	Probably

Agency Mission Critical Activities

NOAA managers identified three major Mission Critical Activities with requirements for hydrography data:

- Water Resources Forecasting, primarily under Business Use #1, River and Stream Flow Management. Ancillary Business Uses also include Business Use #15, Flood Risk Management.
- Shoreline Mapping, primarily under Business Use #19, Marine and Riverine Navigation and Safety. Ancillary Business Uses also include Business Use #6, Coastal Zone Management.
- Nautical Charting, primarily under Business Use #19, Marine and Riverine Navigation and Safety.

NOAA managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography. Summarized details are provided in the following pages.

Water Resources Forecasting

Mission Critical Activity Title:	Water Resources Forecasting
Mission Critical Activity Description:	Comprehensive Water Resources Forecasting: The NWS is responsible for forecasting the future conditions of fresh water resources by operating deterministic and probabilistic H&H models. The models simulate the run-off process at over 4,000 forecast locations and provide base information for forecast that range from low-flow conditions during periods of drought to flood forecasts, and include volumetric water supply projections.
MCA_ID:	3804383728_1
Agency or Department:	National Oceanic and Atmospheric Administration (NOAA)
Sub-agency or Division:	National Weather Service
Program Name:	National Water Center
Business Use:	River and Stream Flow Management, BU #1
Area of Interest:	North America

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	10 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$100 million
Current Annual Benefits ($):	$2.5 million
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Major
Current Societal Benefits	
Current Education or Public Safety Benefits:	Major
Current Environmental Benefits:	Major
Current Human Lives Saved:	Moderate
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$2 million
Future Benefits Description:	Provision of enhanced Hydrographic data would directly impact the development the proposed national water resources modeling framework slated for implementation and operation at the National Water Center. In particular, enhanced hydrographic data would facilitate the parameterization of key H&H models within the framework.
Future Operational Benefits	
Future Time/Cost Savings:	Major

Future Benefits	
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Major
Future Human Lives Saved:	Moderate
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	
Diversion lines	Yes
Deltas	
Wetlands	
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes

Required Analytical Functions	
Delineate catchment	Yes
Determine downstream flood area	
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Required	Perform Geospatial Analysis
Climate	Nice to Have	Perform Geospatial Analysis
Contaminant Sources	Nice to Have	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Nice to Have	Associate Selected Data Type
Wetlands	Nice to Have	Perform Geospatial Analysis
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Highly Desirable	Perform Geospatial Analysis
Point Discharges	Required	Associate Selected Data Type
Water Use: Diversions	Required	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Associate Selected Data Type
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Highly Desirable	Associate Selected Data Type
USDA - National Agriculture Statistics Service (NASS)	Not Required	Visual Inspection
USFWS - National Wetlands Inventory (NWI)	Nice to Have	Visual Inspection
USGS National Water Information Sites (NWIS)	Highly Desirable	Associate Selected Data Type
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Associate Selected Data Type
Other (please specify the importance and highest analysis level):		

Shoreline Mapping

Mission Critical Activity Title:	Shoreline Mapping
Mission Critical Activity Description:	Shoreline mapping (coastal mapping program).
MCA_ID:	3787385812_1
Agency or Department:	National Oceanic and Atmospheric Administration (NOAA)
Sub-agency or Division:	National Ocean Service, National Geodetic Survey, Remote Sensing Division
Program Name:	Coastal Mapping Program
Business Use:	Marine and Riverine Navigation and Safety, BU #19
Area of Interest:	Coastal states including outlying islands not shown on this map

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	10 square miles (6,400 acres)
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$3 million
Current Annual Benefits ($):	Unable to quantify.
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Not Applicable
Current Customer Experience Benefits:	Not Applicable
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Not Applicable
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	NHD provides supplemental support to the Coastal Mapping Program.

Future Benefits	
Future Annual Benefits ($):	$100,000
Future Benefits Description:	Highly accurate data could be a source to provide or verify geographic positioning of satellite imagery.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Minor
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Minor

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	
Delineate catchment	
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	

Required Analytical Functions	
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Visual Inspection
Soils	Not Required	None
Surficial Geology	Not Required	None
Bathymetry	Required	Visual Inspection
Climate	Not Required	None
Contaminant Sources	Not Required	None
Elevation	Required	Visual Inspection
Stream Flow	Highly Desirable	Visual Inspection
Wetlands	Required	Visual Inspection
Census (population statistics)	Not Required	None
Aquifers	Not Required	None
Point Discharges	Not Required	None
Water Use: Diversions	Required	Visual Inspection
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Required	Visual Inspection
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Required	Visual Inspection
USGS National Water Information Sites (NWIS)	Not Required	None
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

Nautical Charting

Mission Critical Activity Title:	Nautical Charting
Mission Critical Activity Description:	Nautical charting.
MCA_ID:	3795135327_1
Agency or Department:	National Oceanic and Atmospheric Administration (NOAA)
Sub-agency or Division:	Office of Coast Survey
Program Name:	Hydrographic Surveys Division
Business Use:	Marine and Riverine Navigation and Safety, BU #19
Area of Interest:	Coastal states including outlying islands not shown on this map

Requirements	
Update Frequency:	Annually
Post Event Updates:	Required
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)
Stream Density:	I don't know

Requirements	
Smallest Contributing Area:	100 square miles (64,000 acres)
Smallest Mapped Waterbody:	5 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	Yes
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$40 million
Current Annual Benefits ($):	$0
Current Operational Benefits	
Current Time/Cost Savings:	Not Applicable
Current Mission Compliance Benefits:	Not Applicable
Current Customer Service Benefits	
Current Products or Services Benefits:	Not Applicable
Current Response or Timeliness Benefits:	Not Applicable
Current Customer Experience Benefits:	Not Applicable
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Not Applicable
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	Highly accurate data could reduce time and cost spent maintaining own shoreline data.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Minor
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor

Future Benefits	
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	
Flow periodicity	
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	
Bridges, culverts	Yes
Diversion lines	
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	
Delineate catchment	
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Not Required	None
Soils	Not Required	None
Surficial Geology	Not Required	None
Bathymetry	Required	Visual Inspection
Climate	Not Required	None
Contaminant Sources	Not Required	None
Elevation	Required	Visual Inspection
Stream Flow	Not Required	None
Wetlands	Required	Visual Inspection
Census (population statistics)	Not Required	None
Aquifers	Not Required	None
Point Discharges	Not Required	None
Water Use: Diversions	Not Required	None
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Not Required	None
USGS National Water Information Sites (NWIS)	Not Required	None
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

National Park Service (NPS)

Point of Contact: Dean Tucker, Dean_Tucker@nps.gov

The National Park Service (NPS) preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.

Figure B-4 – NPS Regions

NPS manages over 400 parks nationwide, including units in the U.S. territories (Puerto Rico, U.S. Virgin Islands, Guam, and American Samoa) within its seven regions (see Figure B-4). Over 292 million people visited a unit of the National Park System in 2014.

Hydrography data are used in all of the NPS regions, for park GIS activities, for varied applications including inventory and monitoring, river and trail mapping and maintenance, water resource management, and geologic and biologic assessments. Hydrography data are critical to NPS's management of threatened and endangered species, flood hazard mitigation, monitoring aquatic ecosystem health, watershed protection, water quality monitoring, fisheries science and research, habitat assessment, park planning, and maintenance of cultural resources for park visitors.

Agency Hydrography Data Requirements and Benefits

NPS's requirements for hydrography data include a critical requirement for integration of hydrography data with elevation data, updates to reflect changes in watercourse locations over time, and correct flow direction. Better integration of hydrography data with NPS river inventories, wild and scenic rivers, fisheries, and water quality databases and products is also needed.

Better information (larger scale, more up-to-date, enhanced functionality) made more widely available will save time and improve NPS mission fulfillment and customer support. More detailed modeling and analyses would be possible. Improved scientific information would allow better decision making to solve environmental issues.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓	✓	✓		✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Required
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required
Services to visualize cartographically rendered and symbolized hydrography data	Required
Services that allow combination of visualizations with other visualization services (mash-ups)	Required
Services to create generalized versions of hydrography (different scales and level of detail)	Required
Services to support online analysis of hydrography information (such as StreamStats)	Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Required
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Highly Desirable
	Hydrography data (streams, streamgages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Required
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Required
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Required
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Required
	Ensure that hydrography and elevation data represent a similar point in time.	Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Required
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Required
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Required
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Critically Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Critically Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Critically Impactful
A large reservoir is misnamed.	Critically Impactful
A first order stream flow direction is reversed.	Critically Impactful
A second order stream flow direction is reversed.	Critically Impactful
A third order stream flow direction is reversed.	Critically Impactful

Quality Issue	Impact
Two first order streams coded as perennial should be intermittent.	Critically Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Critically Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Critically Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Critically Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Critically Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 1% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	I don't know
Use of web tool for reporting hydrography data errors	Probably

Agency Mission Critical Activities

Although most NPS natural resource management activities require hydrographic data, NPS managers identified one major Mission Critical Activity with requirements for hydrography data:

- Inventory and Monitoring, primarily under Business Use #2, Natural Resources Conservation. Ancillary Business Uses also include Business Use #1, River and Stream Flow Management; Business Use #3, Water Resource Planning and Management; Business Use #5, River and Stream Ecosystem Management; Business Use #16, Sea Level Rise and Subsidence; and Business Use #25, Recreation.

NPS managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Inventory and Monitoring. Summarized details are provided in the following pages.

Inventory and Monitoring

Mission Critical Activity Title:	Inventory and Monitoring
Mission Critical Activity Description:	Inventory, monitoring, assessing, and managing park aquatic resources.
MCA_ID:	3778409594_1
Agency or Department:	National Park Service (NPS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	Natural Resources Conservation, BU #2
Area of Interest:	HUC8s with NPS land in them

Requirements	
Update Frequency:	Annually
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)

Requirements	
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	Aquarius for continuous water resource data. EQuIS and the STORET Data Warehouse for discrete water resource data.

Current Benefits	
Total Annual Program Budget:	$25 million
Current Annual Benefits ($):	Difficult to estimate.
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Major
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Difficult to estimate - $500,000?
Future Benefits Description:	Better information (larger scale, more up-to-date, enhanced functionality) made more widely available will save time and improve mission fulfillment and customer support. More detailed modeling and analyses would be possible. Improved scientific information would allow better decision making to solve environmental issues. Better integration of hydrography data with NPS river inventories, wild and scenic rivers, fisheries, and water quality databases and products is needed.
Future Operational Benefits	
Future Time/Cost Savings:	Major

Future Benefits	
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes

Required Analytical Functions	
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	Park vegetation mapping: Required; Perform Geospatial Analysis	Park vegetation mapping: Required; Perform Geospatial Analysis

Natural Resources Conservation Service (NRCS)

Point of Contact: Steve Nechero, Steven.Nechero@ftw.usda.govl

The Natural Resources Conservation Service (NRCS) helps America's farmers, ranchers, and forest landowners conserve the nation's soil, water, air, and other natural resources through voluntary programs that offer science-based solutions that benefit both the landowner and the environment.

Seventy percent of the land in the U.S. is privately owned, making stewardship by private landowners absolutely critical to the health of our nation's environment. Working at the local level in field offices at over 3,000 U.S. Department of Agriculture (USDA) Service Centers in nearly every county in the nation, NRCS works with landowners through conservation planning and assistance to benefit the soil, water, air, plants, and animals for productive lands and healthy ecosystems.

NRCS's broad mission includes programs to provide support to landowners to protect and improve the water quality and quantity, wildlife and fish habitat, recreational opportunities, aesthetic character, agricultural operations, and sustainable agricultural practices on their lands. NRCS provides technical and financial assistance to producers who implement conservation practices and management strategies, including the restoration and protection of wetlands that benefit water quality and improve water management.

Working with its clients, NRCS provides conservation planning and technical assistance to address resource concerns. A conservation plan, which typically includes a map of the unit of land, is developed to record the decisions and supporting information for treatment of a unit of land. The plan describes the schedule of implementation for practices and activities needed to solve identified natural resource concerns and takes into account the client's concerns, interests, and abilities.

NRCS is continually developing new tools to, among other things, improve current conservation practice technology; improve models to track nutrients; improve snowmelt prediction capabilities; and improve irrigation efficiency so that agricultural producers can more efficiently use water, increase water storage, and protect water quality. This will be achieved by minimizing the potential loss of sediment and nutrients from their operations through the application of science-based conservation practices.

Hydrography data are used in all of these NRCS programs in concert with numerous other datasets including lidar data, high resolution imagery, farm field boundaries, land use, and soils inventories. Hydrography data support modeling and analysis as well as the preparation of cartographic products.

NRCS also supports emergency watershed protection after a natural disaster. Hydrography data are invaluable for operations to clear debris from waterways before it causes flooding.

Agency Hydrography Data Requirements and Benefits

NRCS identified as its primary requirement for enhancement that the hydrography data be more representative of farm field networks and more closely align with newer high-resolution imagery and elevation data. NRCS has been exploring opportunities for automation of stream capture from QL2 lidar data to help achieve this goal.

Agency vision for the integration of vector and raster data

NRCS's vision for the integration of vector and raster data to support the Conservation Planner and putting conservation on the ground is the vertical and horizontal integration of our National Agricultural Imagery Program (NAIP) at 1- and 0.5-meter resolution and the high resolution specialty imagery to support the National Resources Inventory (NRI) and the Land Stewardship Program, which uses imagery products ordered from the Aerial Photography Field Office (APFO) at 1-foot and 6-inch resolution on 9x9 photography. The NRCS Enterprise Elevation Program (NEEP) is publishing bare-earth rasters at 1- and 2-meter resolution from lidar based on the nominal point spacing and vertical accuracy to provision shaded relief products that are mashed up with the high resolution imagery. The vector datasets including the hydrography would need to line up and integrate at the NRCS Conservation Planning Scale of 1:7920 or 1 inch equals 660 feet. At a minimum NRCS wants to hydro-flatten the water bodies and streams using the USGS Lidar Base Specification version 1.1 (http://pubs.usgs.gov/tm/11b4/) and hydro-enforce the bare earth DEM to show where the water flows (http://pubs.usgs.gov/fs/2014/3051/pdf/fs2014-3051.pdf). The Area of Interest for NRCS is all 50 states plus the US Territories in the Pacific Basin, Puerto Rico, and the Virgin Islands. The Alaska integration would be the exception for the majority of the state based in the IFSAR 5-meter and 20-foot contour product; however, Alaska would have specialty areas that would adhere to the 1-meter bare earth DEM where QL2 or higher lidar exists.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	*	

*Farm or ranch boundary

NRCS requirements for geographic extents for data provisioning are the same as the options implemented in the Geospatial Data Gateway http://datagateway.nrcs.usda.gov

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
	✓	✓		✓			

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Highly Desirable
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Highly Desirable
Services to visualize cartographically rendered and symbolized hydrography data	Nice To Have
Services that allow combination of visualizations with other visualization services (mash-ups)	Nice To Have
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Nice To Have

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Nice To Have
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Nice To Have
	Hydrography data (streams, streamgages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Nice to Have
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Nice To Have
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Highly Desirable
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Required

Data Type	Elevation Data Integration	Requirement
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Highly Desirable

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Somewhat Impactful
In a series of tributary streams, several streams do not connect with the main river.	Highly Impactful
A perennial stream is misnamed.	Somewhat Impactful
A large reservoir is misnamed.	Somewhat Impactful
A first order stream flow direction is reversed.	Somewhat Impactful
A second order stream flow direction is reversed.	Somewhat Impactful
A third order stream flow direction is reversed.	Somewhat Impactful
Two first order streams coded as perennial should be intermittent.	Critically Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Somewhat Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Somewhat Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 1-2 months

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 1% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	I don’t know
Use of web tool for reporting hydrography data errors	Yes

Agency Mission Critical Activities

NRCS managers identified three major Mission Critical Activities with requirements for hydrography data:

- Conservation Planning, primarily under Business Use #2, Natural Resources Conservation.
- Conservation Planning in Alaska, primarily under Business Use #2, Natural Resources Conservation.
- Conservation Planning in the Pacific Islands, primarily under Business Use #2, Natural Resources Conservation.

NRCS managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Conservation Planning. Summarized details are provided in the following pages.

Conservation Planning

Mission Critical Activity Title:	Conservation Planning
Mission Critical Activity Description:	Conservation planning support for private agricultural operations to include floodplain and other hazard mapping, watershed protection, and soils surveys.
MCA_ID:	3795516784_1
Agency or Department:	Natural Resources Conservation Service (NRCS)
Sub-agency or Division:	Natural Resources Conservation Service (NRCS)
Program Name:	Numerous
Business Use:	Natural Resources Conservation, BU #2
Area of Interest:	Nationwide (CONUS 48)

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)

Requirements	
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	2 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	Elevation data (lidar, DEMs), local hydrography data, protected waters inventory, impaired waters, DOT ditches.

Current Benefits	
Total Annual Program Budget:	Overall NRCS budget is $4.2 billion; all NRCS programs benefit from hydrography data.
Current Annual Benefits ($):	Unable to quantify.
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Major
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	Better quality analysis, time savings in data analysis and product preparation.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major

Future Benefits	
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	Yes
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	Yes

Required Analytical Functions	
User defined symbolization	Yes
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Nice to Have	Perform Geospatial Analysis
Bathymetry	Not Required	None
Climate	Nice To Have	Visual Inspection
Contaminant Sources	Not Required	None
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Not Required	None
Aquifers	Highly Desirable	Perform Geospatial Analysis
Point Discharges	Nice To Have	Visual Inspection
Water Use: Diversions	Nice To Have	Visual Inspection
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Nice To Have	Visual Inspection
USGS National Water Information Sites (NWIS)	Nice To Have	Visual Inspection
USGS National Water-Quality Assessment Program (NAWQA)	Nice To Have	Visual Inspection
Other (please specify the importance and highest analysis level):		

Conservation Planning in Alaska

Mission Critical Activity Title:	Conservation Planning in Alaska
Mission Critical Activity Description:	Conservation planning support for private agricultural operations to include floodplain and other hazard mapping, watershed protection, and soils surveys.
MCA_ID:	3795382299_1
Agency or Department:	Natural Resources Conservation Service (NRCS)
Sub-agency or Division:	GIS (Soils and Conservation Planning)
Program Name:	Soils and Conservation Planning
Business Use:	Natural Resources Conservation, BU #2
Area of Interest:	Alaska

Requirements	
Update Frequency:	Annually
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Covered under NRCS program budget reported for Conservation Mission Critical Activity.
Current Annual Benefits ($):	Unable to quantify.
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	Our products would be more accurate and would limit the amount of repeat work we would need to do. Additionally, our field work data would better match up with web services using hydrologic data and would create less confusion for our customers and conservation planning staff.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major

Future Benefits	
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	
Left/right bank delineation	Yes
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	Yes
Flow periodicity	
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	
Estuaries	
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	

Required Analytical Functions	
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Associate Selected Data Type
Surficial Geology	Nice To Have	Visual Inspection
Bathymetry	Not Required	None
Climate	Not Required	None
Contaminant Sources	Not Required	None
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Nice To Have	Visual Inspection
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Not Required	None
Aquifers	Not Required	None
Point Discharges	Not Required	None
Water Use: Diversions	Not Required	None
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Visual Inspection
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Nice To Have	Visual Inspection
Other (please specify the importance and highest analysis level):		

Conservation Planning in the Pacific Islands

Mission Critical Activity Title:	Conservation Planning in the Pacific Islands
Mission Critical Activity Description:	Conservation planning support for private agricultural operations to include floodplain and other hazard mapping, watershed protection, and soils surveys.
MCA_ID:	3829706969_1
Agency or Department:	Natural Resources Conservation Service (NRCS)
Sub-agency or Division:	Pacific Islands Area (Hawaii and Pacific Basin)
Program Name:	Numerous
Business Use:	Natural Resources Conservation, BU #2
Area of Interest:	Pacific Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Nice To Have
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	I don't know
Smallest Mapped Waterbody:	5 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Covered under NRCS program budget reported for Conservation Mission Critical Activity.
Current Annual Benefits ($):	Unable to quantify.
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Major
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	Better quality analysis, time savings in data analysis and product preparation.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	
Estuaries	Yes
Diversion points	
Bridges, culverts	
Diversion lines	
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	

Required Analytical Functions	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Visual Inspection
Soils	Required	Visual Inspection
Surficial Geology	Nice To Have	Visual Inspection
Bathymetry	Not Required	None
Climate	Required	Visual Inspection
Contaminant Sources	Not Required	None
Elevation	Highly Desirable	Visual Inspection
Stream Flow	Nice To Have	Visual Inspection
Wetlands	Required	Visual Inspection
Census (population statistics)	Nice To Have	Visual Inspection
Aquifers	Highly Desirable	Visual Inspection
Point Discharges	Nice To Have	Visual Inspection
Water Use: Diversions	Highly Desirable	Visual Inspection
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice To Have	Visual Inspection
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Visual Inspection
USFWS - National Wetlands Inventory (NWI)	Required	Visual Inspection
USGS National Water Information Sites (NWIS)	Not Required	None
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

Nuclear Regulatory Commission (NRC)

Points of Contact: Thomas Nicholson, Thomas.Nicholson@nrc.gov and Allen Gross, Allen.Gross@nrc.gov

The U.S. Nuclear Regulatory Commission (NRC) was created as an independent agency by Congress in 1974 to ensure the safe use of radioactive materials for beneficial civilian purposes while protecting people and the environment. **Its mission is to license and regulate the civilian use of radioactive materials in the United States, to protect public health and safety, promote the common defense and security, and protect the environment.**

NRC regulates commercial nuclear power plants; research, test, and training reactors; nuclear fuel cycle facilities; and radioactive materials used in medicine, academia, and industry. NRC also regulates the transport, storage, and disposal of radioactive materials and waste; most Federal agencies' use and possession of radioactive materials; and licenses the export and import of radioactive materials. NRC regulates industries in the U.S. and works with agencies around the world to enhance global nuclear safety and security.

To fulfill its responsibilities, NRC develops regulations and guidance for applicants and licensees; licenses or certifies applicants to use nuclear materials and operate nuclear facilities and decommissioning facilities; inspects and assesses licensee operations and facilities to ensure licensees comply with NRC regulations, responds to incidents, investigates allegations of wrongdoing, and takes appropriate follow-up or enforcement actions when necessary; evaluates operational experience of licensed facilities and activities; and conducts research, holds hearings, and obtains independent reviews to support regulatory decisions.

Agency Hydrography Data Requirements and Benefits

NRC uses hydrography data throughout the lifecycle of a nuclear facility for licensing, regulation during operations, license amendments, and facility decommissioning. Additionally, hydrography data would be used for incident response if a problem were to occur at a site or during transport. Publicly-available data such as the USGS NHD data are used in conjunction with data provided by licensees.

Because of the potential hazard of nuclear materials, NRC performs extensive analysis of nuclear facility sites including use of hydrography and other data for flood risk analysis; riverine and coastal flooding such as tsunami, storm surge, and wave run-up modeling; erosion modeling; radionuclide transport pathway analysis; rainfall-runoff modelling; and ground-water assessments. Hydrography data are used in conjunction with high-water marks, nearshore and offshore bathymetry, water intake locations, wetlands, gage locations, soil and water chemistry, and precipitation data for these and other analyses.

Connectivity between groundwater and surface water is important to NRC for spill and infiltration modeling. Contaminants in soil and water can also affect radionuclide transport, so pH, reduction/oxidation conditions, turbidity, and presence of volatile organic compounds and heavy metals in water and soil are also important factors.

Additionally, because public education and outreach is so important when nuclear sites are concerned, NRC prepares maps and other documents that communicate plans for reviewing and assessing all significant safety-related and environmental activities. Hydrography data are used in the preparation of these public outreach materials as well.

NRC guidelines require all data to be downloadable by geographic region or quadrangle, as opposed to using data via web services. Notifications of data updates would be useful to NRC staff. Complete metadata including attribute definitions for all datasets is also required. Integration of soil, surface-water, and ground-water datasets would also greatly benefit NRC staff licensing review activities.

Improved hydrography data and better integration of hydrography data with other required datasets would benefit NRC by allowing modeling and analysis to be performed more quickly. In addition to the benefits to NRC staff, this would reduce the costs of NRC staff reviews to its licensees.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓					✓			✓	✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
	✓	✓	✓	✓		✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Highly Desirable
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Not Required
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Nice to Have

Data or Service Access Method	Requirement
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Nice to Have

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Required
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Highly Desirable
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Required
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Required
	Ensure that hydrography and elevation data represent a similar point in time.	Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Required
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Highly Desirable
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Required
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Critically Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Critically Impactful

Quality Issue	Impact
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Somewhat Impactful
A large reservoir is misnamed.	Somewhat Impactful
A first order stream flow direction is reversed.	Highly Impactful
A second order stream flow direction is reversed.	Highly Impactful
A third order stream flow direction is reversed.	Highly Impactful
Two first order streams coded as perennial should be intermittent.	Highly Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Critically Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Highly Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Critically Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	No problem at all
Use of web tool for reporting hydrography data errors	Probably

Agency Mission Critical Activities

NRC staff identified one major Mission Critical Activity with requirements for hydrography data:

- Regulate and License Commercial Nuclear Facilities, primarily under Business Use #4, Water Quality. Ancillary Business Uses also include Business Use #22, Health and Human Services.

NRC staff provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Regulate and License Commercial Nuclear Facilities. Summarized details are provided in the following pages.

Regulate and License Commercial Nuclear Facilities

Mission Critical Activity Title:	Regulate and License Commercial Nuclear Facilities
Mission Critical Activity Description:	Regulate and protect public health, safety, and environment for licensed commercial nuclear facilities. Licensing reviews include site characterization, environmental assessments, emergency response, and monitoring and modeling normal effluent releases and accidental releases.
MCA_ID:	3783413182_1
Agency or Department:	Nuclear Regulatory Commission (NRC)
Sub-agency or Division:	Decommissioning, Uranium Recovery, and Waste Programs, Research, Incident Response, Intergovernmental Liaison, New Reactors
Program Name:	Various Offices of NRC, particularly licensing
Business Use:	Water Quality, BU #4
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	Annually
Post Event Updates:	Required
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	Other (please specify): Site specific and contaminant specific
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	FEMA floodplain data; groundwater data.

Current Benefits	
Total Annual Program Budget:	Not able to release.
Current Annual Benefits ($):	Not able to release.
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Not Applicable
Current Societal Benefits	
Current Education or Public Safety Benefits:	Major
Current Environmental Benefits:	Major
Current Human Lives Saved:	Don’t Know
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Not able to release.
Future Benefits Description:	Better integration between datasets would result in major time savings. Higher accuracy and resolution would result in greater confidence and lower uncertainty in analysis.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Major
Future Human Lives Saved:	Don’t Know
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	
Wetlands	Yes
Badlands	
Other	Yes
	Meteorological data such as NWS Hydro Meteorological Reports (HMRs) for estimating Probable Maximum Precipitation (PMPs) and historical events.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes

Required Analytical Functions	
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	
User defined symbolization	Yes
Mash-ups	
Animation of time-series	Yes

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Highly Desirable	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Associate Selected Data Type
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Nice to Have	Visual Inspection
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Associate Selected Data Type
Census (population statistics)	Required	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Highly Desirable	Visual Inspection
USDA - National Agriculture Statistics Service (NASS)	Nice to Have	Visual Inspection
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	Radiological baseline data for geology, soil, ground and surface water	Radiological baseline data for geology, soil, ground and surface water

Office of Surface Mining Reclamation and Enforcement (OSMRE)

Point of Contact: Cecil Slaughter, cslaughter@osmre.gov

OSMRE's mission is to carry out the requirements of the Surface Mining Control and Reclamation Act (SMCRA) in cooperation with States and Tribes. Its primary objectives are to ensure that coal mines are operated in a manner that protects citizens and the environment during mining and ensures that the land is restored to beneficial use following mining, and to mitigate the effects of past mining by aggressively pursuing reclamation of abandoned coal mines.

OSMRE is a bureau within the United States Department of the Interior. It is responsible for establishing a nationwide program to protect society and the environment from the adverse effects of surface coal mining operations, under which OSMRE is charged with balancing the nation's need for continued domestic coal production with protection of the environment. In its beginning, OSMRE directly enforced mining laws and arranged cleanup of abandoned mine lands. Today, most coal states have developed their own programs to do those jobs themselves, as Congress envisioned. OSMRE focuses on overseeing the state programs and developing new tools to help the states and tribes get the job done.

OSMRE has three major programs:

Reclaiming Abandoned Mine Lands

The Abandoned Mine Land (AML) Reclamation Program is OSMRE's largest program and one of its primary responsibilities under SMCRA. Millions of Americans live less than a mile from abandoned coal mines. OSMRE and its state and tribal partners oversee reclamation of land and waters damaged by coal mining prior to the 1977 enactment of SMCRA. In the early years, the AML program focused on the physical reclamation of hazards affecting coalfield communities. More recently, the program has begun working to reclaim the vitality of communities left impoverished and degraded by past coal mining.

Regulating Coal Mines

SMCRA ensures that coal mining operations are conducted in an environmentally responsible manner and that the land is adequately reclaimed during and following the mining process. Most coal-mining states now have the primary responsibility to regulate surface coal mining on lands within their jurisdiction, with OSMRE performing an oversight role. OSMRE also partners with states and Indian tribes to regulate mining on Federal lands and to support states' regulatory programs with grants and technical assistance.

Technology Development and Transfer

OSMRE provides resources for technical assistance, training, and technology development. These activities support and enhance the technical skills that states and tribes need to operate their regulatory and reclamation programs in order to effectively implement the SMCRA.

Agency Hydrography Data Requirements and Benefits

OSMRE and the coal mining states it oversees use hydrography data during permit review, as a part of monitoring during mining operations, and during reclamation. As a part of the permit review process, hydrography data are used as a baseline prior to mining to determine what needs to be protected outside the permit area and what condition the permit area needs to be returned to once mining operations are completed. During mining operations, monthly inspections are performed and changes resulting from mining activities are assessed to ensure that the mining plan is being followed. Once mining operations are finished, reclamation of the permit area is monitored for five or more years. Reclamation efforts typically may include re-vegetation, among other activities, to return the land to its pre-mine conditions. Once the State Regulatory Authority or OSMRE (for Federal lands or in areas we regulate) confirm that the reclamation activities have been completed, bond monies can be released.

Similarly, for pre-SMCRA AML sites, hydrography data are used to help evaluate what needs to be reclaimed and to what condition it should be returned. Additionally, surface waters in and near AMLs are monitored for the effects of acid mine drainage.

OSMRE's benefits are mainly derived from time savings during permit reviews from being able to review the hydrography data in the office to help solve problems and avoid some field work. Future activities resulting from the proposed stream protection rule would increase the use of hydrography data but also require the data to be more detailed and more accurately coded regarding whether the water feature is perennial, intermittent, or ephemeral.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓			✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓	✓	✓	✓	✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Required
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Required
Services to support online analysis of hydrography information (such as StreamStats)	Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Required
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Required
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Required
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Required
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Required
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Required
	Ensure that hydrography and elevation data represent a similar point in time.	Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Highly Desirable
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Required

Data Type	Elevation Data Integration	Requirement
	Determine <u>feature</u> on the hydrographic network to which a point (with elevation value) is connected.	Required
	Determine the actual <u>point location</u> (within a DEM cell) on the hydrographic network to which a point is connected.	Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Critically Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Critically Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Critically Impactful
A large reservoir is misnamed.	Critically Impactful
A first order stream flow direction is reversed.	Critically Impactful
A second order stream flow direction is reversed.	Critically Impactful
A third order stream flow direction is reversed.	Critically Impactful
Two first order streams coded as perennial should be intermittent.	Critically Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Critically Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Critically Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Critically Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Critically Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 1% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	Major problem – data cannot be used for Mission Critical Activity
Use of web tool for reporting hydrography data errors	Yes

Agency Mission Critical Activities

OSMRE managers identified one major Mission Critical Activity with requirements for hydrography data:

- Regulation and Reclamation of Surface Coal Mining Areas, primarily under Business Use #12, Resource Mining.

OSMRE managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Regulation and Reclamation of Surface Coal Mining Areas. Summarized details are provided in the following pages.

Regulation and Reclamation of Surface Coal Mining Areas

Mission Critical Activity Title:	Regulation and Reclamation of Surface Coal Mining Areas
Mission Critical Activity Description:	Regulation and reclamation of surface coal mining areas and activities; monitoring and assessment of stream impacts due to surface coal mining activities.
MCA_ID:	3777338001_1
Agency or Department:	Office of Surface Mining Reclamation and Enforcement (OSMRE)
Sub-agency or Division:	Regulatory Division
Program Name:	Regulatory Division
Business Use:	Resource Mining, BU #12
Area of Interest:	OSMRE regulated states

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Not Required
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)

Requirements	
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	National Inventory of Dams.

Current Benefits	
Total Annual Program Budget:	$500 million
Current Annual Benefits ($):	$1 million
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Major
Current Societal Benefits	
Current Education or Public Safety Benefits:	Major
Current Environmental Benefits:	Major
Current Human Lives Saved:	Moderate
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$1 million
Future Benefits Description:	Continuity of normal operations; possible addition of intermittent streams due to proposed rule-making.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Major
Future Human Lives Saved:	Moderate
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	
Floodplain boundary	
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	Yes
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	Yes
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Highly Desirable	Associate Selected Data Type
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Nice to Have	Visual Inspection
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Highly Desirable	Associate Selected Data Type
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice to Have	Visual Inspection
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Associate Selected Data Type
USDA - National Agriculture Statistics Service (NASS)	Required	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Highly Desirable	Associate Selected Data Type
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Associate Selected Data Type
Other (please specify the importance and highest analysis level):		

U.S. Army Corps of Engineers (USACE)

Point of Contact: Nancy Blyler, Nancy.J.Blyler@usace.army.mil

The mission of the U.S. Army Corps of Engineers (USACE) is to deliver vital public and military engineering services; partnering in peace and war to strengthen our Nation's security, energize the economy and reduce risks from disasters.

USACE's responsibilities include Federal water management, flood risk reduction, water supply, and hydropower. USACE supports the nation in its water resources management responsibilities through the Institute for Water Resources (IWR), the Engineer Research and Development Center (ERDC), and the Hydrologic Engineering Center (HEC). The IWR is the USACE center of expertise for integrated water resources management, focusing on planning analysis and hydrologic engineering and on the collection, management, and dissemination of Civil Works and navigation information, including the nation's waterborne commerce data. The ERDC conducts research in civil and military engineering, geospatial sciences, water resources, and environmental sciences for the Army, Department of Defense, civilian agencies, and the public at its seven laboratories. The HEC provides technical methods and guidance, water resources models and associated utilities, training and workshops, research and development, and performs technical assistance and special projects. The hydrologic and hydraulic (H&H) models developed and made available to the public by the USACE are used by engineers at USACE and throughout the country for flood risk studies, dam and levee breach modeling, FEMA flood hazard analyses, etc.

The following USACE Mission Critical Activities rely on hydrography data.

Flood Risk Management

The USACE supports its water control mission and reduces disaster risks through modeling and analysis of flood risk, inundation mapping and consequence analysis, analysis for water supply and navigation during droughts, assessment of levee risks, characterization of critical infrastructure, and preparation of Emergency Action Plans and maps for dams and levees.

H&H Modeling

USACE water resources engineers perform H&H modeling in support of flood risk studies, flood hazard analyses, and special projects. The USGS hydrography data are currently used for some pre-modeling data development activities, and the USACE especially finds the linear referencing to be useful. They are also used for hydrology studies and some dam breach modeling; however, hydrography data with greater spatial accuracy and that match the terrain data are needed for hydraulic modeling. Additionally, post-event-updates are required. USACE currently obtains locally-created datasets or creates its own hydrography data that match lidar for hydraulic modeling.

Permit Reviews and Jurisdiction Determinations

USACE, through the regulatory program, administers and enforces Section 10 of the Rivers and Harbors Act of 1899 (RHA) and Section 404 of the Clean Water Act (CWA). Under RHA Section 10, a permit is required for work or structures in, over, or under navigable waters of the United States (WOUS). Under CWA Section 404, a permit is required for the discharge of dredged or fill material into WOUS. Many waterbodies and wetlands in the nation are WOUS and are subject to USACE's regulatory authority. USACE evaluates permit applications and requests for jurisdictional determinations for essentially all construction activities that occur in WOUS, including wetlands. USACE's mission is to balance strong environmental protection of the nation's aquatic resources while allowing reasonable and necessary development to proceed, through a fair and flexible Regulatory Program. This mission is carried out in 38 districts and eight divisions across the country. These data are used in jurisdictional determinations (about 59,000 annually) and permit reviews (about 60,000 annually)

Agency Hydrography Data Requirements and Benefits

The USACE information was collected from seven questionnaire respondents representing the Regulatory Division, the Modeling, Mapping, and Consequences Center, the H&H Technical Services section, and Planning. Additional information was provided by eight other USACE representatives in follow-up discussions.

USACE respondents noted the following required enhancements for hydrography data:

- Engineering scale (1:5,000-scale, 1:10,000-scale) hydrography data that reflect post-event updates are needed for hydraulic modeling
- Stream centerlines that could be used for dam breach analysis of the approximately 700 dams USACE operates and maintains would save time currently spent developing these centerlines
- Additional flow line attributes including Jurisdiction, Section 10, Section 404, isolated, not regulated, etc.
- Toolbar(s) to make selections/comparisons easier for endangered species presence, soil types, connectivity to navigable water
- Allow users to designate canal type (i.e. drainage vs. irrigation; jurisdictional vs. non-jurisdictional)

USACE identified Mission Critical Activities (MCAs) that would benefit from enhanced hydrography data in the following ways:

- USACE would realize benefits from having more accurate and consistent hydrography data through reduced time to produce analytical products supporting flood risk assessments. The quality of the products would also improve using a stable baseline data source.
- USACE would save time and costs and improve mission compliance by being able to obtain all of its needed water related information from a single source.
- USACE would realize significant benefits from having hydrography data that were spatially accurate enough for hydraulic modeling by not having to find locally-developed data or create its own datasets.
- Accurate datasets that can be both modified by the end-user and incorporate released updates from a single source would save time, aid the wetland delineation and permit verification process, and improve mission compliance. Easier interpretation of the data would result in more educated decisions.
- Future benefits to USACE include the ability to streamline the permit review process with spatially-enhanced hydrography data to conduct fewer site visits, and improved ability to compare older and current data.

Additionally, navigation and navigation charting is a significant activity for USACE, but does not currently use USGS hydrography data products (instead it requires riverine bathymetry and channel definition); however, one program manager noted that a navigable waterways dataset that could be used to support these activities would be "awesome".

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓			✓	✓		✓	✓	✓		

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓	✓	✓	✓	✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Nice To Have
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Highly Desirable
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Highly Desirable

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Highly Desirable
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Highly Desirable
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Highly Desirable
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Nice To Have
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Nice To Have
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Nice To Have
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Highly Desirable
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Nice To Have
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Nice To Have

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Somewhat Impactful
In a series of tributary streams, several streams do not connect with the main river.	Highly Impactful
A perennial stream is misnamed.	Highly Impactful
A large reservoir is misnamed.	Highly Impactful
A first order stream flow direction is reversed.	Highly Impactful
A second order stream flow direction is reversed.	Highly Impactful
A third order stream flow direction is reversed.	Somewhat Impactful

Quality Issue	Impact
Two first order streams coded as perennial should be intermittent.	Highly Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Highly Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Somewhat Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 1 year

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	I don’t know
Use of web tool for reporting hydrography data errors	Probably

Agency Mission Critical Activities

USACE managers identified three major MCAs with requirements for hydrography data:

- Flood Risk Management, primarily under Business Use (BU) #15, Flood Risk Management. Ancillary BUs include BU #20, Infrastructure and Construction Management.
- Hydraulic Modeling, primarily under BU #15, Flood Risk Management.
- Permit Reviews and Jurisdiction Determinations, primarily under BU #2, Natural Resources Conservation. Ancillary BUs include BU #1, River and Stream Flow Management; and BU #5, River and Stream Ecosystem Management.

USACE managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data. Summarized details are provided in the following pages.

Flood Risk Management

Mission Critical Activity Title:	Flood Risk Management
Mission Critical Activity Description:	Hydrologic modeling, water management, background data, dam break modeling, and preparation of Emergency Action Plans (EAPs).
MCA_ID:	3776565165_1
Agency or Department:	U.S. Army Corps of Engineers (USACE)
Sub-agency or Division:	Modeling, Mapping, and Consequences Center
Program Name:	Modeling, Mapping, and Consequences
Business Use:	Flood Risk Management, BU #15
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Required

Requirements	
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	10 square miles (6,400 acres)
Smallest Mapped Waterbody:	10 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	Local data.

Current Benefits	
Total Annual Program Budget:	$5 million
Current Annual Benefits ($):	$150,000 - $200,000
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$300,000 - $500,000
Future Benefits Description:	By having more accurate and consistent hydrography data it would greatly reduce time to produce analytical products supporting flood risk assessments. The quality of the products would also improve.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate

Future Benefits	
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Nice To Have	Visual Inspection
Surficial Geology	Nice To Have	Visual Inspection
Bathymetry	Required	Perform Geospatial Analysis
Climate	Highly Desirable	Associate Selected Data Type
Contaminant Sources	Not Required	None
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Not Required	None
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Not Required	None
Point Discharges	Not Required	None
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Highly Desirable	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Not Required	None
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

Hydraulic Modeling

Mission Critical Activity Title:	Hydraulic Modeling
Mission Critical Activity Description:	Hydraulic modeling.
MCA_ID:	3803726397_1
Agency or Department:	U.S. Army Corps of Engineers (USACE)
Sub-agency or Division:	Modeling, Mapping, and Consequences Center
Program Name:	Modeling, Mapping, and Consequences
Business Use:	Flood Risk Management, BU #15
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Required
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)

Requirements	
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	10 square miles (6,400 acres)
Smallest Mapped Waterbody:	10 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	Local data or USACE-created data.

Current Benefits	
Total Annual Program Budget:	Included in the USACE program budget for the Flood Risk Management Mission Critical Activity.
Current Annual Benefits ($):	Minimal.
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$100,000. May not account for agency-wide use for hydraulic modeling.
Future Benefits Description:	Benefits would be from not having to create own datasets for hydraulic modeling.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes

Required Analytical Functions	
Preset symbolization	Yes
User defined symbolization	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Nice to Have	Visual Inspection
Surficial Geology	Nice to Have	Visual Inspection
Bathymetry	Required	Perform Geospatial Analysis
Climate	Highly Desirable	Associate Selected Data Type
Contaminant Sources	Not Required	None
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Not Required	None
Census (population statistics)	Highly Desirable	Perform Geospatial Analysis
Aquifers	Not Required	None
Point Discharges	Not Required	None
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Highly Desirable	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Not Required	None
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

Permit Reviews and Jurisdiction Determinations

Mission Critical Activity Title:	Permit Reviews and Jurisdiction Determinations
Mission Critical Activity Description:	USACE permit reviews for essentially all construction activities that occur in the Nation's waters, including wetlands.
MCA_ID:	3813261215_1
Agency or Department:	U.S. Army Corps of Engineers (USACE)
Sub-agency or Division:	Regulatory Division
Program Name:	Regulatory and Permitting Program
Business Use:	Flood Risk Management, BU #15
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	Annually
Post Event Updates:	Highly Desirable

Requirements	
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	National Elevation Dataset (NED), available lidar.

Current Benefits	
Total Annual Program Budget:	$200 million
Current Annual Benefits ($):	2 days/permit x 60,000 = 461 FTEs = $46 million
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	1 hour/permit saved = 28 FTEs = $2.8 million
Future Benefits Description:	Accurate datasets that can be both modified by the end user and incorporate released updates from a single source would save time, aid the wetland delineation and permit verification process, and improve mission compliance. Easier interpretation of the data would result in more educated decisions.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	
Estuaries	Yes
Diversion points	
Bridges, culverts	Yes
Diversion lines	
Deltas	Yes
Wetlands	Yes
Badlands	
Other	Yes
	Ordinary high water marks.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes

Required Analytical Functions	
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	
Calculate distance on network	Yes
Find events or features on network	
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Nice to Have	Visual Inspection
Soils	Required	Associate Selected Data Type
Surficial Geology	Nice To Have	Visual Inspection
Bathymetry	Highly Desirable	Associate Selected Data Type
Climate	Nice To Have	Visual Inspection
Contaminant Sources	Nice to Have	Visual Inspection
Elevation	Highly Desirable	Associate Selected Data Type
Stream Flow	Required	Associate Selected Data Type
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Not Required	None
Aquifers	Not Required	None
Point Discharges	Nice to Have	Visual Inspection
Water Use: Diversions	Highly Desirable	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice to Have	Visual Inspection
EPA - STOrage and RETrieval Data Warehouse (STORET)	Nice To Have	Visual Inspection
USACE - National Inventory of Dams (NID)	Nice To Have	Visual Inspection
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Visual Inspection
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Nice to Have	Visual Inspection
USGS National Water-Quality Assessment Program (NAWQA)	Nice To Have	Visual Inspection
Other (please specify the importance and highest analysis level):		

U.S. Census Bureau

Point of Contact: Lynda Liptrap, Lynda.A.Liptrap@census.gov

The Census Bureau's mission is to serve as the leading source of quality data about the nation's people and economy. We honor privacy, protect confidentiality, share our expertise globally, and conduct our work openly.

Geography is central to the work of the Census Bureau, providing the framework for survey design, sample selection, data collection, tabulation, and dissemination. Geography provides meaning and context to statistical data and geospatial data are critical to the Census Bureau's ability to accomplish its mission. Additionally, reference and thematic maps support the Bureau's censuses and surveys.

To that end, Census Bureau geographers, cartographers, statisticians, and information technology specialists collect and maintain large spatial databases with spatial data for the United States, Puerto Rico, and the Island Areas. Much of the data used to define the boundaries and features in these spatial databases come from Census Bureau partners.

The Census Bureau maintains the MAF/TIGER Database (MTDB), which consists of two components: the Master Address File (MAF), which includes millions of geocoded addresses, and the Topologically Integrated Geographic Encoding and Referencing (TIGER) component, which includes street centerlines, rail lines, rivers and streams, jurisdiction boundaries, and Census boundaries. Prior to 2000, the TIGER database had a spatial accuracy generally consistent with USGS 1:100,000-scale source maps. In the early 2000s the Census Bureau first integrated the MAF data with the TIGER database, and significantly improved the spatial accuracy of the dataset through incorporation of data from local sources. The current MAF/TIGER data are derived from various sources depending on the locale, including local data sources, historic data, USGS NHD, imagery, and others. The accuracy requirement for data used in the MAF/TIGER database (MTDB) is 7.6 meters.

Agency Hydrography Data Requirements and Benefits

The Census Bureau's use of hydrography data is mainly as a component of the MTDB. As noted above, hydrography data from USGS NHD datasets were incorporated into the MTDB in the early 2000s and the Census Bureau is not actively updating the hydrography in the MTDB. Because of the MTDB topology, future NHD enhancements would be difficult to import directly into the MTDB. The Census Bureau does not make significant use of hydrography data for analysis. It does use hydrography to locate both statistical and administrative boundaries, and also to define the land and water area extent for various levels of geography as presented in the Statistical Abstract of the United States. Additionally, hydrography defines the national coastline used in small-scale maps of the United States.

Watershed boundaries could aid the Census Bureau in redistricting activities. Recently, the Census Bureau has been looking to improve the representation of persistence (perennial and intermittent) for linear and area features for use in the systematic exclusion of hydrographic features from some data products; the NHD is an authoritative source of persistence information for these updates. The NHD could also provide the means for adding official Geographic Names Information System (GNIS) names to hydrography features. Ongoing support for these data would be highly beneficial for these efforts.

Future improvements to the spatial accuracy of hydrography data products would benefit the Census Bureau through improved efficiency in tabulating population. Improved representation of hydrography in Census products would also increase public confidence in those products. Financial benefits to the Census Bureau would be minimal.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
						✓	✓	✓	✓		*	

*County data

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	**Esri shapefiles**	**Esri file geodatabase**	**NetCDF**	**GeoTIFF**	**NITF**	**Esri Grid**	**Other**
		✓					

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Nice To Have
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Nice To Have
Services to support online analysis of hydrography information (such as StreamStats)	Not Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Not Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Not Required
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Not Required
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Not Required
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Not Required
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Not Required
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Not Required
	Ensure that hydrography and elevation data represent a similar point in time.	Not Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Not Required
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Not Required
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Not Required
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Not Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Somewhat Impactful
In a series of tributary streams, several streams do not connect with the main river.	Somewhat Impactful
A perennial stream is misnamed.	Somewhat Impactful
A large reservoir is misnamed.	Somewhat Impactful
A first order stream flow direction is reversed.	Little or No Impact
A second order stream flow direction is reversed.	Little or No Impact
A third order stream flow direction is reversed.	Little or No Impact

Quality Issue	Impact
Two first order streams coded as perennial should be intermittent.	Somewhat Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Little or No Impact
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Little or No Impact
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Little or No Impact
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Little or No Impact
Error Resolution	**Time**
Acceptable error resolution time:	Within 1 year

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 10% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	I don’t know
Use of web tool for reporting hydrography data errors	Maybe

Agency Mission Critical Activities

Census Bureau managers identified one major Mission Critical Activity with requirements for hydrography data:

- Census Reference Data Layer, primarily under Business Use #21, Urban and Regional Planning.

Census Bureau managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Census Reference Data Layer. Summarized details are provided in the following pages.

Census Reference Data Layer

Mission Critical Activity Title:	Census Reference Data Layer
Mission Critical Activity Description:	Demographic, economic data collection, tabulation, and dissemination; related spatial data to carry out censuses and surveys. Improving and maintaining the MAF/TIGER Database (including linear and areal hydrography) to support Census operations.
MCA_ID:	3833149078_1
Agency or Department:	U.S. Census Bureau (USCB)
Sub-agency or Division:	Geography Division
Program Name:	Geographic Support System
Business Use:	Urban and Regional Planning, BU #21
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	>10 years
Post Event Updates:	Nice to Have
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	I don't know
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$55.613 million
Current Annual Benefits ($):	Minimal value; unable to quantify.
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Not Applicable
Current Environmental Benefits:	Not Applicable
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Minimal value; unable to quantify.
Future Benefits Description:	Improved ability and efficiency in tabulating population. Improved representation of hydrography in public products produced from the MAF/TIGER database, which could increase public confidence in these products.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Minor

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Not Applicable
Future Environmental Benefits:	Not Applicable
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	
Left/right bank delineation	Yes
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	
Estuaries	Yes
Diversion points	
Bridges, culverts	
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	
Delineate catchment	

Required Analytical Functions	
Determine downstream flood area	
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	Yes
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Not Required	None
Surficial Geology	Not Required	None
Bathymetry	Not Required	None
Climate	Not Required	None
Contaminant Sources	Not Required	None
Elevation	Not Required	None
Stream Flow	Not Required	None
Wetlands	Highly Desirable	Perform Geospatial Analysis
Census (population statistics)	Required	Perform Geospatial Analysis
Aquifers	Not Required	None
Point Discharges	Not Required	None
Water Use: Diversions	Not Required	None
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Not Required	None
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

U.S. Fish and Wildlife Service (USFWS)

Point of Contact: Paul Souza, Paul_Souza@fws.gov

The U.S. Fish and Wildlife Service's (USFWS's) mission is to work with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

The USFWS works to meet its mission by conducting the following activities:

- Operate 70 National Fish Hatcheries, 65 fishery resource offices, 86 ecological services field stations, and 550 refuges
- Enforce federal wildlife laws
- Protect endangered species
- Manage migratory birds
- Restore nationally significant fisheries
- Conserve and restore wildlife habitat such as wetlands
- Help foreign governments with their international conservation efforts
- Distribute hundreds of millions of dollars, through the Wildlife Sport Fish and Restoration program, in excise taxes on fishing and hunting equipment to State fish and wildlife agencies.

Figure B-5– USFWS Regions

USFWS is divided into Regions (see Figure B-5). Central to the mission of USFWS, along with state and tribal natural resource agencies, its private land partners, and other stakeholders, is providing and protecting a healthy environment for fish, wildlife, and people. Long-term goals include stewardship of the National Wildlife Refuge System (NWRS) and the National Fish Hatchery System (NFHS); recovery of threatened and endangered species; protection and conservation of trust species; and support for international conservation, habitat conservation, and migratory birds.

Although most responsibilities are distributed, USFWS has several national-level programs including Endangered Species, Fisheries and Habitat Conservation, Migratory Birds, and Landscape Conservation

Cooperatives (LCCs). The LCCs are partnerships of governmental (Federal, state, tribal, and local) and non-governmental entities. The primary goal of the LCCs is to bring together science and resource management to inform climate adaptation strategies to address climate change and other stressors within an ecological region, or "landscape".

Use of hydrography data in USFWS is as varied as the agency itself. The data are used in all USFWS regions, by many of its programs, and by a wide variety of staff (e.g., engineers, hydrologists, biologists). USFWS programs that benefit from the use of hydrography data include:

- The National Wildlife Refuge System, including its refuges and small wetlands and other special management areas, which uses the data in conjunction with property boundaries and ownership lines to map refuges and to assess water supply and quantity within the refuges.
- The Coastal Barrier Resources System which uses the data to help manage the identification and mapping of coastal areas in which Federal expenditures and incentives (including flood insurance) are restricted in order to encourage conservation of these coastal barriers.
- The National Wetlands Inventory, for which hydrography data are one of the three primary parameters used to identify and map wetland habitats.
- The Endangered Species program, which uses hydrography data for identification and prioritization of endangered species' habitats including aquatic habitats.
- Various ecological services activities that include review of Federal water resources projects (e.g., dams, harbor development, flood control, water storage), transportation projects, and energy development projects to ensure conservation of fish, wildlife, and plants and their habitats.

Agency Hydrography Data Requirements and Benefits

USFWS respondents noted the following requirements for enhanced hydrography data:

- USFWS and its international, state, tribal, and local partners need hydrography data (including wetlands) for at least all of North America for management of migratory birds. USFWS needs to know 24/7/365 water quantity and quality for this area down to a less-than-an-acre pothole for many species.
- Integration of hydrography data with the National Levee Database; better integration with gage and water quality datasets, diversions, dams, etc.; a more comprehensive and reliable inventory of barriers to flow; spatial metadata (at least the date) which reference the source material on which the delineation is based; integration with elevation data (lidar); accurate representation of the floodplain elevation; downloadable data that can be selected from an interactive display; and a means for seamless updates that will minimize impacts to ongoing work if possible would all greatly benefit USFWS.
- Hydrography data updated to a finer spatial scale than is currently available for Alaska and with network functionality is critical to natural resource work in Alaska. The effects of climate change are a major driver for expediting better hydrology data for Alaska to better understand and mitigate the impacts of a changing climate for the arctic.
- A simple means for users to provide input on corrections and improvements to the dataset to correct network errors such as saddles and reversed flowlines is needed.

- Greater consistency in the level of detail collected between watersheds would benefit USFWS. It was noted that there are some areas where significantly denser stream networks exist in some watersheds, with large additional numbers of identified intermittent streams, which imbalances some analyses that cross these boundaries.

All of the USFWS identified Mission Critical Activities would benefit greatly from enhanced hydrography data, and USFWS considers enhanced hydrography data to be critical to achieving its fundamental program goals as well as specific individual program management objectives.

- Improved accuracy and currency of hydrography data would improve its use for aquatic habitat identification and prioritization. It could drastically reduce the field time to survey or verify stream locations relative to property boundaries; increase the speed and efficiency of analyses used to set priorities and plan for restoration of aquatic habitat, including replacement of stream crossings and fishery sustainability; modeling could be performed at a proper scale for habitat impacts and the ability to document fish (primarily brook trout) in small catchments would be improved; and more accurate maps would better convey potential project impacts to the public, cooperators, and staff.
- Improved data would result in less time spent aggregating data from multiple sources and adding value to hydrography data to meet local needs, improve compliance reviews, and improve stream barrier prioritization to improve aquatic organism passage and enhance public safety. Better quality maps could be made for public education of water resources, and for evaluating potential impacts from development project proposals.
- Enhanced hydrography data would mean quicker and more efficient access to the required information to assess water supply and water quality for Federal refuge lands; less time spent mapping hydrographic property boundaries and improved accuracy of the ownership lines; less time spent manipulating data for refuge map and evaluation creation and publication; and more detailed, complete, and accurate flowline/waterbody locations, classifications, and flow directions could be produced. Improved data would result in greatly improved quality of information informing ecological decisions, better ability to use GIS and ecological modeling tools, and improved ability to produce detailed hydrologic analyses at a landscape scale, resulting in better decision making.
- The inclusion of hydrology data is considered one of the three parameters inherent to and critical for determining, classifying, and delineating wetland habitats. Enhanced hydrography data would increase wetland determination accuracy, improve response time for data users, and improve wetland conservation due to better understanding of wetland critical functions.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	*	

*10-digit HUCs

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓	✓	✓	✓	✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Highly Desirable
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Highly Desirable
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Highly Desirable

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Highly Desirable
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Required
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Highly Desirable
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Highly Desirable
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Highly Desirable
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Highly Desirable
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Highly Desirable

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Highly Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Highly Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Somewhat Impactful
A large reservoir is misnamed.	Somewhat Impactful
A first order stream flow direction is reversed.	Highly Impactful
A second order stream flow direction is reversed.	Highly Impactful
A third order stream flow direction is reversed.	Highly Impactful

Quality Issue	Impact
Two first order streams coded as perennial should be intermittent.	Somewhat Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Critically Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Highly Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Highly Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 3-6 months

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	Major problem – data can not be used for Mission Critical Activity
Use of web tool for reporting hydrography data errors	Probably

Agency Mission Critical Activities

USFWS managers identified four major Mission Critical Activities with requirements for hydrography data:

- Aquatic Species and Habitat Conservation, primarily under Business Use (BU) #5 River and Stream Ecosystem Management. Ancillary BUs include BU #9, Wildlife and Habitat Management (off stream).
- Landscape Level Aquatic and Terrestrial Trust Resources, primarily under BU #9, Wildlife and Habitat Management (off stream). Ancillary BUs include Business Use #2, Natural Resources Conservation.
- Refuges, primarily under BU #9, Wildlife and Habitat Management (off stream). Ancillary BUs include BU #3, Water Resource Planning and Management; BU # 5, River and Stream Ecosystem Management; and BU #23, Real Estate, Banking, Mortgage, and Insurance.
- Wetlands, primarily under BU #2, Natural Resources Conservation.

USFWS managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data. Summarized details are provided in the following pages.

Aquatic Species and Habitat Conservation

Mission Critical Activity Title:	Aquatic Species and Habitat Conservation
Mission Critical Activity Description:	Aquatic habitat restoration, hydrologic and hydraulic modeling for habitat restoration.
MCA_ID:	3777687390_1
Agency or Department:	U.S. Fish and Wildlife Service (USFWS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	River and Stream Ecosystem Management, BU #5
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico

Requirements	
Update Frequency:	6-10 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	State HUC14s; state hydrography data; wetlands; surface waters.

Current Benefits	
Total Annual Program Budget:	Overall USFWS program budget is $1.5 billion; unable to split by Mission Critical Activity.
Current Annual Benefits ($):	Unable to quantify.
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	More accurate hydrography information is critical to achieving fundamental FWS program goals as well as more specific fisheries management objectives. Improved hydrography accuracy and currency of data would improve their use for habitat identification and prioritization. It could drastically reduce the field time to survey or verify stream locations relative to property boundaries. Enhanced hydrography data would increase the speed and efficiency of analyses used to set priorities and plan for restoration of aquatic habitat, including replacement of stream crossings and fisheries' sustainability. Modeling could also be performed at a proper scale for habitat impacts and the ability to document fish (primarily brook trout) in small catchments would be improved. More accurate maps would better convey potential project impacts to the public.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Major
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes

Required Characteristics	
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	Yes
	1D and 2D line sets of streams and rivers; waterbody names.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Required	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Required	Associate Selected Data Type
Aquifers	Required	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	Road Crossings - Highly Desirable, Perform Geospatial Analysis; National Bridge Inventory - Highly Desirable, Perform Geospatial Analysis	Road Crossings - Highly Desirable, Perform Geospatial Analysis; National Bridge Inventory - Highly Desirable, Perform Geospatial Analysis

Landscape Level Aquatic and Terrestrial Trust Resources

Mission Critical Activity Title:	Landscape Level Aquatic and Terrestrial Trust Resources
Mission Critical Activity Description:	Habitat restoration and protection for Trust species.
MCA_ID:	3790402684_1
Agency or Department:	U.S. Fish and Wildlife Service (USFWS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	Wildlife and Habitat Management (off-stream), BU #9
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)

Requirements	
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Overall USFWS program budget is $1.5 billion; unable to split by Mission Critical Activity.
Current Annual Benefits ($):	Unable to quantify.
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	Improved data would result in less time spent aggregating data from multiple sources and adding value to NHD data to meet local needs. Hydrography data with improved accuracy and better attribution would improve the final product - improved reliability and utility for the customer; better support to modelling needs; improved compliance reviews; and better, more accurate maps for the public, cooperators, and staff. Enhanced data would also improve stream barrier prioritization to improve aquatic organism passage and enhance public safety. Better quality maps could be made for public education of water resources, and for evaluating potential impacts from development project proposals.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes

Required Characteristics	
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Required	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Highly Desirable	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Refuges

Mission Critical Activity Title:	Refuges
Mission Critical Activity Description:	Water resource inventorying and monitoring for National Wildlife Refuges.
MCA_ID:	3795195932_1
Agency or Department:	U.S. Fish and Wildlife Service (USFWS)
Sub-agency or Division:	National Wildlife Refuge System
Program Name:	Division of Refuges
Business Use:	Wildlife and Habitat Management (off-stream), BU #9
Area of Interest:	HUC8 watersheds with Refuges in them

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	10 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$472.202 million
Current Annual Benefits ($):	Unable to quantify.
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	Enhanced hydrography data would mean quicker and more efficient access to the required information to assess water supply and water quality for Federal refuge lands. It would also mean less time spent mapping hydrographic property boundaries and improved accuracy of the ownership lines. Less time would be spent manipulating data for refuge map and evaluation creation and publication. More detailed, complete, and accurate flowline/waterbody locations, classifications, and flow directions could be produced. Improved data would result in greatly improved quality of information informing ecological decisions, better ability to use GIS and ecological modeling tools, and improved ability to produce detailed hydrologic analyses at a landscape scale, resulting in better decision making.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Major
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	
Estuaries	Yes

Required Characteristics	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	
Find events or features on network	Yes
Preset symbolization	
User defined symbolization	Yes
Mash-ups	
Animation of time-series	Yes

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Visual Inspection
Aquifers	Required	Associate Selected Data Type
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Associate Selected Data Type
USGS National Water-Quality Assessment Program (NAWQA)	Required	Associate Selected Data Type
Other (please specify the importance and highest analysis level):		

Wetlands

Mission Critical Activity Title:	Wetlands
Mission Critical Activity Description:	Wetland habitat identification, protection, and conservation.
MCA_ID:	3790364996_1
Agency or Department:	U.S. Fish and Wildlife Service (USFWS)
Sub-agency or Division:	Fisheries and Ecological Services
Program Name:	National Wetlands Inventory (NWI)
Business Use:	Natural Resources Conservation, BU #2
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	Annually
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	Surface water inventory - identify surface water bodies to include lakes, streams, rivers; also NWI.

Current Benefits	
Total Annual Program Budget:	Overall USFWS program budget is $1.5 billion; unable to split by Mission Critical Activity.
Current Annual Benefits ($):	Unable to quantify
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Major
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify.
Future Benefits Description:	The inclusion of hydrology data is considered one of the three parameters inherent to and critical for determining, classifying, and delineating wetland habitats. Updated hydrology would greatly increase determination accuracy. Customer service would improve due to enhanced products and overall accuracy in mapping products. Digital data would significantly increase response time for data users. Societal benefits would include overall environmental benefits associated with wetland conservation due to better understanding of wetland critical functions.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Major
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes

Required Characteristics	
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Associate Selected Data Type
Bathymetry	Required	Perform Geospatial Analysis
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Associate Selected Data Type
Aquifers	Nice to Have	Associate Selected Data Type
Point Discharges	Highly Desirable	Perform Geospatial Analysis
Water Use: Diversions	Highly Desirable	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice To Have	Visual Inspection

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Nice to Have	Visual Inspection
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Highly Desirable	Associate Selected Data Type
USGS National Water-Quality Assessment Program (NAWQA)	Nice To Have	Visual Inspection
Other (please specify the importance and highest analysis level):	Daily water elevation change in wetlands which can be done with interferometry radar - Required	Daily water elevation change in wetlands which can be done with interferometry radar - Required

U.S. Forest Service (USFS)

Point of Contact: Mike Eberle, mbeberle@fs.fed.us

The U.S. Forest Service's (USFS) mission is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations.

The USFS is a multi-faceted agency that manages and protects 154 national forests and 20 grasslands in 44 states and Puerto Rico. The agency accomplishes its mission through numerous activities that include water use, aquatic habitat management, fire and fuels management, soil management, vegetation management, infrastructure planning, range management, and recreation, among others. It is also active outside of the National Forests across the U.S. and internationally within the state and private, research, climate, and international programs.

USFS manages its National Forest Lands through the development of Forest Plans, among others, as well as though environmental impact assessment activities/response. These plans are used in the management of forest lands for the protection and enhancement of watersheds, streams, lakes, wetlands, seep, springs, and other water resources features. Having accurate data is essential in planning and project-level analysis for water quality, stream condition, aquatic habitat, facility upgrades monitoring, and condition assessments.

Tasks performed by USFS forest land management program managers include: forest inventories, forest resource management, watershed protection, flood calculation, bridge designs, aquatic passage, water diversion upgrades, stream and wetland restoration, riparian management, stream and habitat surveys, watershed condition classification, water quality monitoring, phosphate mining, protection of drinking water sources, grazing management, and recreational facility/management, among other activities.

USFS's responsibilities also include aquatic habitat management. Aquatic habitat relies on properly functioning stream channels that facilitate channel and flow stability and good water quality. USFS aquatic habitat program mangers rely on hydrography data to document and map the distribution of aquatic species and the condition of their habitats.

Agency Hydrography Data Requirements and Benefits

USFS respondents noted requirements that include enhanced hydrography data; enhanced spatial accuracy; updates to flow lines more frequently than annually; accurate attribution of flow direction, flow duration, stream classification, presence of species, and connection to municipal watersheds; and unique identifiers for unnamed streams. Additionally, users requested simple tools for editing hydrography data to include tools to add, delete, or move stream lines, and reattribute streams and other features, as well as easier ways for USFS to submit higher accuracy data into USGS for revisions of the NHD.

USFS would benefit from having enhanced hydrography data in the following ways:

- If the data were more spatially accurate, USFS would save time and resources that are currently spent editing and improving the hydrography data that fall in USFS lands. USFS would also be better able to meet its mission.

- USFS would realize cost savings in the reduced time it would take to conduct analysis; the improved level of accuracy would improve resource management and resource benefits as well as allowing USFS to better educate the public.
- USFS would be better able to predict the effects of its actions on stream channels regarding water quality and quantity, and especially damage from floods.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	*	

*Including watershed extents in international boundary areas

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓	✓	✓	✓	✓	

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Highly Desirable
Services to download standard data products	Required
Services to create and download customized data products	Highly Desirable
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Highly Desirable
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Required

Data or Service Access Method	Requirement
Services to support online analysis of hydrography information (such as StreamStats)	Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Highly Desirable
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Highly Desirable
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Required
	Ensure that hydrography and elevation data represent a similar point in time.	Required
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Highly Desirable
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Highly Desirable
	Determine <u>feature</u> on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual <u>point location</u> (within a DEM cell) on the hydrographic network to which a point is connected.	Highly Desirable

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Highly Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Highly Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Critically Impactful

Quality Issue	Impact
A large reservoir is misnamed.	Critically Impactful
A first order stream flow direction is reversed.	Critically Impactful
A second order stream flow direction is reversed.	Highly Impactful
A third order stream flow direction is reversed.	Highly Impactful
Two first order streams coded as perennial should be intermittent.	Critically Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Highly Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Somewhat Impactful
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Highly Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	Major problem – data can not be used for Mission Critical Activity
Use of web tool for reporting hydrography data errors	Probably

Agency Mission Critical Activities

USFS managers identified two major Mission Critical Activities (MCAs) with requirements for hydrography data:

- Land Management, primarily under Business Use (BU) #7, Forest Resources Management. Ancillary BUs include BU #3, Water Resource Planning and Management; and BU #5, River and Stream Ecosystem Management.
- Aquatic Habitat Management, primarily under BU #5, River and Stream Ecosystem Management. Ancillary BUs include BU #4, Water Quality; BU #15, Flood Risk Management; and BU #17, Wildfire Management, Planning, and Response.

USFS managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data. Summarized details are provided in the following pages.

Land Management

Mission Critical Activity Title:	Land Management
Mission Critical Activity Description:	Land management planning and project-level analysis for water quality, stream condition, aquatic habitat, facility upgrades monitoring, and condition assessments.
MCA_ID:	3824419155_1
Agency or Department:	U.S. Forest Service (IUSFS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	Forest Resources Management, BU #7
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico and Virgin Islands with an emphasis within National Forest, station, and area boundaries

Requirements	
Update Frequency:	Annually
Post Event Updates:	Highly Desirable

Requirements	
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Estimated at $7 million.
Current Annual Benefits ($):	Estimated at $1.5 million.
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Major
Current Societal Benefits	
Current Education or Public Safety Benefits:	Major
Current Environmental Benefits:	Major
Current Human Lives Saved:	Major
Current Other Benefits:	Consistency

Future Benefits	
Future Annual Benefits ($):	Estimated at $2 million.
Future Benefits Description:	Improved accuracy of hydrography data would reduce time spent by USFS refining and maintaining their own geospatial layers of stream network. Cost savings would also be realized for reduced time to conduct analyses. The improved level of accuracy would improve resource management and resource benefits, and improve use in meeting the USFS mission.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Moderate
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	Yes
	Gage data, presence of fish in reach.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes

Required Analytical Functions	
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Highly Desirable	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Nice to Have	Perform Geospatial Analysis
Bathymetry	Nice To Have	Perform Geospatial Analysis
Climate	Nice To Have	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Associate Selected Data Type
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Highly Desirable	Perform Geospatial Analysis
Point Discharges	Highly Desirable	Associate Selected Data Type
Water Use: Diversions	Highly Desirable	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Highly Desirable	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Aquatic Habitat Management

Mission Critical Activity Title:	Aquatic Habitat Management
Mission Critical Activity Description:	Watershed protection, water quality and quantity, fisheries habitat management.
MCA_ID:	3827154934_1
Agency or Department:	U.S. Forest Service (USFS)
Sub-agency or Division:	Several
Program Name:	Several
Business Use:	River and Stream Ecosystem Management, BU #5
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, and Virgin Islands with an emphasis within National Forest, station, and area boundaries

Requirements	
Update Frequency:	Annually
Post Event Updates:	Required

Requirements	
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	Estimated at $5 million.
Current Annual Benefits ($):	Estimated at $1 million.
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Estimated at $1.2 million.
Future Benefits Description:	Enhanced hydrography data would greatly reduce the time spent updating data and the time needed for data analysis. It would greatly improve the accuracy of the analysis, better predict the effects of actions on water quality and quantity particularly damage from floods, and it would help USFS to better educate the public.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major

Future Benefits	
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Major
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes

Required Analytical Functions	
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Nice to Have	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Required	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Not Required	None
Aquifers	Highly Desirable	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Highly Desirable	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	Being able to map stream classes as defined by the Northwest forest plan.	Being able to map stream classes as defined by the Northwest forest plan.

U.S. Geological Survey (USGS)

Point of Contact: Nate Booth, nlbooth@usgs.gov and Sue Buto, sbuto@usgs.gov

The U.S. Geological Survey (USGS) serves the nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. To support this mission, USGS collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems. The diversity of our scientific expertise enables us to carry out large-scale, multi-disciplinary investigations and provide impartial scientific information to resource managers, planners, and other customers.

USGS is focused on some of the most significant issues society faces, in which natural science can make a substantial contribution to the well-being of the nation and the world:

- Climate and Land Use Change
- Core Science Systems
- Ecosystems
- Energy and Minerals, and Environmental Health
- Natural Hazards
- Water

The following USGS Mission Critical Activities rely on hydrography data.

Hydrologic Modeling and Water Budgets

Streamflow statistics, flood stage and frequency, tide stage and coastal flood data, and groundwater levels are used in conducting hydrologic investigations to help understand and solve water-resource problems. Data are used for bridge and culvert design, to manage water supplies, hydroelectric power development and generation, wildlife management, pollution abatement, mapping floodplains, and water resources development. Estimation of daily mean flows is used to promote healthy in-stream ecology and support water management decisions.

Habitat and Ecosystem Health / Watershed Studies

USGS assesses water quantity and quality in the nation's rivers and aquifers, including analysis of trends in water quality and estimation of water quantity at unmonitored locations. This information is used for watershed modeling, aquatic habitat mapping, watershed management and protection, climate change studies, and ecosystem health projects. Studying the past, monitoring the present, and simulating the future quantity and quality of water resources can help protect and enhance water resources for human health, aquatic health, and environmental quality; and contribute to the wise physical and economic development of our nation's resources for the benefit of present and future generations.

Water Availability and Use

Hydrography data are used to develop water availability assessments that describe components of the water budget including consumptive use from irrigated agricultural lands, diversion-point locations, and their impact throughout the network, including river depletion. These information products are then delivered to those with a need for information to inform a decision related to water availability and use.

Groundwater Modeling and Studies

Groundwater and coupled groundwater/surface-water assessment and management are conducted through surface water/groundwater modeling studies. Groundwater pumpage impacts on surface water, and losing stream contributions to groundwater are two critical considerations when using a water budget approach to estimate water availability. Information that facilitates the connection between surface water and groundwater information and models is critical to understanding these interactions.

Streamflow Networks and Flood/Coastal Modeling and Studies

Collection and dissemination of information related to streamflow and water quality studies supports a variety of water management activities. Flood risk mapping, flood inundation mapping, coastal modeling, and analysis of flood/coastal surge response for management of flood-prone areas aids emergency managers in making public safety decisions in their communities. USGS operates over 8,000 stream gages.

Agency Hydrography Data Requirements and Benefits

USGS's overarching requirements for improvements to the hydrography datasets include:

- Improved spatial resolution and accuracy of stream channels, surface-water bodies, and wetlands; better alignment with high-resolution elevation data and orthoimagery; and more current data.
- Improved continuity and connectivity of the hydrographic network, including stability of stream identifiers, clean topology, linkages between reaches, navigable networks for up and downstream tracing, and better indexing of features to the network (e.g. NPDES sites, NID dams, diversions).
- Scalable data that can be used at scales ranging from watershed or regional to very local and urban.
- Better integration of watershed and catchment information with hydrography data, as well as better integration between NHDPlus and high-resolution NHD data, and vice versa. Having both translated to any new products is needed.
- A better synchronized data maintenance and release process is needed. It should include more frequent updates to address reported errors as well as allow for major upgrades to items such as the overall data model on a less frequent but predictable schedule. This would allow modelers to import error corrections without having to revise their models but provide advance notification of major releases so software dependencies could be addressed in a timely fashion.
- Consolidated data that are readily available in an online web service or web viewer.
- Improved flow lines with no ambiguity in flowpaths and corrected attribution of flow direction and flow duration.
- Additional linkages to related water data (e.g. water quality observations, stream-stage information). In a geospatial context this would be approached through "event" management (point and linear events on the network such as dams, divergences, and sampling locations on streams).

Additional specific USGS requirements for enhancements to hydrography data include:

- River miles stored in points along the stream network
- Inclusion of time of travel information.
- Embedded datasets, such as the NASS cropland data layer
- Ability to geoprocess related watershed attributes
- Connectivity between surface water and groundwater
- Consistency with other datasets (e.g. USGS stream gages)
- Transboundary data into Mexico and Canada
- Stormwater outlets
- Stream channel characteristics
- Canal-lining information
- Contaminant information
- Sediment transport attributes (e.g. sediment size, suspended solid concentration, particle velocity)
- Additional water quality attributes (e.g. chlorophyll, biochemical oxygen demand, dissolved oxygen)
- Metadata such as the date of the data used to establish a reach address for a feature

USGS respondents overwhelmingly replied that enhanced hydrography data would reduce time spent discovering data sources, pre-processing data, and performing QA/QC on data; increase efficiency in computations and modeling; allow additional automation of processes; improve the accuracy of modeling results allowing model scale to be more flexible (i.e. watershed to local scale); and thereby improve decision making and delivery of products and services.

Specific benefits would be realized for streamflow monitoring activities; wildlife habitat modeling; flood inundation mapping; modeling efforts for surface water and ground water; water use and availability assessments; and ecosystem modeling of the responses of coastal wetlands to climate change, water management, restoration, and protection.

Benefits would also be realized by having improved transboundary data extending into and integrated with data for Mexico and Canada. Agreements for common data standards and maintenance of these shared datasets is also needed between neighboring countries.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
✓	✓	✓	✓	✓	✓	✓	✓	✓				

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
✓	✓	✓	✓	✓	✓	✓	*

* TIN, PNG, GeoPDF, KML, KMZ

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Required
Services to download standard data products	Required
Services to create and download customized data products	Required
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Required
Services to visualize cartographically rendered and symbolized hydrography data	Highly Desirable
Services that allow combination of visualizations with other visualization services (mash-ups)	Highly Desirable
Services to create generalized versions of hydrography (different scales and level of detail)	Highly Desirable
Services to support online analysis of hydrography information (such as StreamStats)	Required

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Required
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Highly Desirable
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Highly Desirable
	Hydrography data (streams, streamgages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Highly Desirable

Data Type	Elevation Data Integration	Requirement
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Highly Desirable
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Highly Desirable
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Highly Desirable
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Required
	Determine <u>feature</u> on the hydrographic network to which a point (with elevation value) is connected.	Highly Desirable
	Determine the actual <u>point location</u> (within a DEM cell) on the hydrographic network to which a point is connected.	Required

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Somewhat Impactful
In a series of tributary streams, several streams do not connect with the main river.	Critically Impactful
A perennial stream is misnamed.	Highly Impactful
A large reservoir is misnamed.	Highly Impactful
A first order stream flow direction is reversed.	Critically Impactful
A second order stream flow direction is reversed.	Critically Impactful
A third order stream flow direction is reversed.	Critically Impactful
Two first order streams coded as perennial should be intermittent.	Somewhat Impactful
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Somewhat Impactful

Quality Issue	Impact
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Somewhat Impactful
Error Resolution	**Time**
Acceptable error resolution time:	Within 2-30 days

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 5% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	Major problem – data can not be used for Mission Critical Activity
Use of web tool for reporting hydrography data errors	Probably

Agency Mission Critical Activities

USGS managers identified nine major Mission Critical Activities (MCAs) with requirements for hydrography data:

- Hydrologic Modeling and Water Budgets (National Scale), primarily under Business Use (BU) #1, River and Stream Flow Management. Ancillary BUs include BU #3, Water Resource Planning and Management; BU #4, Water Quality; and BU #5, River and Stream Ecosystem Management.
- Hydrologic Modeling and Water Budgets (Local Scale), primarily under BU #1, River and Stream Flow Management. Ancillary BUs include Business Use #3, Water Resource Planning and Management; BU #4, Water Quality; and BU #5, River and Stream Ecosystem Management.
- Habitat and Ecosystem Health/Watershed Studies (National Scale), primarily under BU #4, Water Quality. Ancillary BUs also include BU #1, River and Stream Flow Management; BU #3, Water Resource Planning and Management; BU #5, River and Stream Ecosystem Management; BU #9, Wildlife and Habitat Management; and BU #15, Flood Risk Management.
- Habitat and Ecosystem Health/Watershed Studies (Local Scale), primarily under BU #4, Water Quality. Ancillary BUs also include BU #1, River and Stream Flow Management; BU #3, Water Resource Planning and Management; BU #5, River and Stream Ecosystem Management; BU #9, Wildlife and Habitat Management; and BU #15, Flood Risk Management.
- Water Availability and Use, primarily under BU #3, Water Resource Planning and Management. Ancillary BUs include BU #1, River and Stream Flow Management; BU #4, Water Quality; and BU #10, Agriculture and Precision Farming.
- Groundwater Modeling and Studies (National Scale), primarily under BU #3, Water Resource Planning and Management. Ancillary BUs include BU #1, River and Stream Flow Management; and BU #4, Water Quality.
- Groundwater Modeling and Studies (Local Scale), primarily under BU #3, Water Resource Planning and Management. Ancillary BUs include BU #1, River and Stream Flow Management; and BU #4, Water Quality.

- Streamflow Networks and Flood/Coastal Modeling and Studies (National Scale), primarily under BU #1, River and Stream Flow Management. Ancillary BUs include BU #3, Water Resource Planning and Management; BU #4, Water Quality; BU #15, Flood Risk Management; and BU #6, Coastal Zone Management.
- Streamflow Networks and Flood / Coastal Modeling and Studies (Local Scale), primarily under BU #1, River and Stream Flow Management. Ancillary BU include BU #3, Water Resource Planning and Management; BU #4, Water Quality; BU #15, Flood Risk Management; and BU #6, Coastal Zone Management.

USGS managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data. Summarized details are provided in the following pages.

Hydrologic Modeling and Water Budgets (National Scale)

Mission Critical Activity Title:	Hydrologic Modeling and Water Budgets (National Scale)
Mission Critical Activity Description:	Hydrologic modeling and water budgets (national scale).
MCA_ID:	3776047668_1
Agency or Department:	U.S. Geological Survey (USGS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	River and Stream Flow Management, BU #1
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Nice To Have
Positional Accuracy:	+/- 170 feet, 90% (1:100,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	2 acres
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$40 million
Current Annual Benefits ($):	$20 million
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Major
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$30 million
Future Benefits Description:	With more functionality, can better integrate water cycle components with network; models improved with more frequent network updates.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Perform Geospatial Analysis
Bathymetry	Not Required	None
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Highly Desirable	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Nice To Have	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Highly Desirable	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice To Have	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Nice To Have	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Nice To Have	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Nice To Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Hydrologic Modeling and Water Budgets (Local Scale)

Mission Critical Activity Title:	Hydrologic Modeling and Water Budgets (Local Scale)
Mission Critical Activity Description:	Hydrologic modeling and water budgets (local scale).
MCA_ID:	3782060293_2
Agency or Department:	U.S. Geological Survey (USGS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	River and Stream Flow Management, BU #1
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Highly Desirable
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$20 million
Current Annual Benefits ($):	$20 million
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$50 million
Future Benefits Description:	With more functionality, can better integrate water cycle components with network; models improved with more frequent network updates. Better resolution yields ability to link in local components.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Perform Geospatial Analysis
Bathymetry	Not Required	None
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Highly Desirable	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Nice To Have	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Highly Desirable	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice To Have	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Nice To Have	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Nice To Have	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Nice To Have	Associate Selected Data Type
USFWS - National Wetlands Inventory (NWI)	Nice To Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Habitat and Ecosystem Health/Watershed Studies (National Scale)

Mission Critical Activity Title:	Habitat and Ecosystem Health/Watershed Studies (National Scale)
Mission Critical Activity Description:	Habitat and ecosystem health/watershed studies (national scale).
MCA_ID:	3777850608_1
Agency or Department:	U.S. Geological Survey (USGS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	Water Quality, BU #4
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Nice To Have

Requirements	
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	10 acres
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	NWIS, locally derived streams and watersheds, RF1, EPA river reach files for smaller scale modeling and visualization.

Current Benefits	
Total Annual Program Budget:	$10 million
Current Annual Benefits ($):	$20 million
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$50 million
Future Benefits Description:	Better flow estimates introduced with improved functionality; network improvements yield better water quality estimates; better integration of water quality data and landscape variables allows for model development efficiency and currency.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Moderate

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	Yes
	Stormwater outlets, linkages to water quality observations.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes

Required Analytical Functions	
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Nice To Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Other (please specify the importance and highest analysis level):	River miles in points along stream network - highly desirable; atmospheric deposition - required, perform geospatial analysis; fertilizer and manure - required, perform geospatial analysis	River miles in points along stream network - highly desirable; atmospheric deposition - required, perform geospatial analysis; fertilizer and manure - required, perform geospatial analysis

Habitat and Ecosystem Health/Watershed Studies (Local Scale)

Mission Critical Activity Title:	Habitat and Ecosystem Health/Watershed Studies (Local Scale)
Mission Critical Activity Description:	Habitat and ecosystem health/watershed studies (local scale).
MCA_ID:	3783622692_1
Agency or Department:	U.S. Geological Survey (USGS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	Water Quality, BU #4
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Highly Desirable

Requirements	
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	NWIS, locally-derived streams and watersheds, RF1, EPA river reach files for smaller scale modeling and visualization.

Current Benefits	
Total Annual Program Budget:	$1 million
Current Annual Benefits ($):	$2 million
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$10 million
Future Benefits Description:	Better flow estimates introduced with improved functionality; network improvements yield better water quality estimates; better integration of water quality data and landscape variables allows for model development efficiency and currency.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Major

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Major
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	Yes
	Stormwater outlets, linkages to water quality observations.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes

Required Analytical Functions	
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Nice To Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Other (please specify the importance and highest analysis level):	River miles in points along stream network - highly desirable; atmospheric deposition - required, perform geospatial analysis; fertilizer and manure - required, perform geospatial analysis	River miles in points along stream network - highly desirable; atmospheric deposition - required, perform geospatial analysis; fertilizer and manure - required, perform geospatial analysis

Water Availability and Use

Mission Critical Activity Title:	Water Availability and Use
Mission Critical Activity Description:	Water availability and use.
MCA_ID:	3792119529_2
Agency or Department:	U.S. Geological Survey (USGS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	Water Resource Planning and Management, BU #3
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Not Required
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	5 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	

Current Benefits	
Total Annual Program Budget:	$10 million
Current Annual Benefits ($):	$20 million
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$40 million
Future Benefits Description:	Better functionality allows for water use components to be better integrated with network which allows for more automated water budget estimates.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes

Required Analytical Functions	
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Not Required	None
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Nice To Have	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Required	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Required	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Nice To Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Nice To Have	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Groundwater Modeling and Studies (National Scale)

Mission Critical Activity Title:	Groundwater Modeling and Studies (National Scale)
Mission Critical Activity Description:	Groundwater modeling and studies (national scale).
MCA_ID:	3792119529_3
Agency or Department:	U.S. Geological Survey (USGS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	Water Resource Planning and Management, BU #3
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Nice To Have
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)

Requirements	
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	60 acres
Smallest Mapped Waterbody:	20 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	NWIS, local watershed boundaries.

Current Benefits	
Total Annual Program Budget:	$30 million
Current Annual Benefits ($):	$10 million
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$20 million
Future Benefits Description:	Quantum leap of linked surface water hydrography with subsurface hydrostratigraphy would yield integrated ground water/surface water processes nationwide.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Major
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	Yes
	Canal-lining information, linkages to stream-stage information.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes

Required Analytical Functions	
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Required	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Highly Desirable	Perform Geospatial Analysis
Water Use: Diversions	Required	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Groundwater Modeling and Studies (Local Scale)

Mission Critical Activity Title:	Groundwater Modeling and Studies (Local Scale)
Mission Critical Activity Description:	Groundwater modeling and studies (local scale).
MCA_ID:	3799790376_1
Agency or Department:	U.S. Geological Survey (USGS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	Water Resource Planning and Management, BU #3
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Nice To Have
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)

Requirements	
Stream Density:	5.0 miles of channel per square mile (1:5,000-scale mapping)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	NWIS, local watershed boundaries.

Current Benefits	
Total Annual Program Budget:	$20 million
Current Annual Benefits ($):	$10 million
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$20 million
Future Benefits Description:	Quantum leap of linked surface water hydrography with subsurface hydrostratigraphy would yield integrated ground water/surface water processes nationwide.
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Moderate
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Moderate

Future Benefits	
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	Yes
Other	Yes
	Canal-lining information, linkages to stream-stage information.

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes

Required Analytical Functions	
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Required	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Highly Desirable	Perform Geospatial Analysis
Water Use: Diversions	Required	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Associate Selected Data Type
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		

Streamflow Networks and Flood/Coastal Modeling and Studies (National Scale)

Mission Critical Activity Title:	Streamflow Networks and Flood/Coastal Modeling and Studies (National Scale)
Mission Critical Activity Description:	Streamflow networks and flood/coastal modeling and studies (national scale).
MCA_ID:	3787067638_2
Agency or Department:	U.S. Geological Survey (USGS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	River and Stream Flow Management, BU #1
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Required

Requirements	
Positional Accuracy:	+/- 40 feet, 90% (1:24,000-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	2 acres
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	NWIS, NAWQA, NCLD, lidar.

Current Benefits	
Total Annual Program Budget:	$20 million
Current Annual Benefits ($):	$30 million
Current Operational Benefits	
Current Time/Cost Savings:	Major
Current Mission Compliance Benefits:	Major
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$40 million
Future Benefits Description:	Hydrography dataset allows for more robust flow routing down network to improve models and downstream estimates; integrating supporting data into one network improves our ability to develop statistical models including regressions (StreamStats).
Future Operational Benefits	
Future Time/Cost Savings:	Major
Future Mission Compliance Benefits:	Major

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Major
Future Response or Timeliness Benefits:	Major
Future Customer Experience Benefits:	Major
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Major
Future Human Lives Saved:	Moderate
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes

Required Analytical Functions	
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Nice To Have	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Nice To Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	Sediment size, distribution, and concentration - required, perform geospatial analysis	Sediment size, distribution, and concentration - required, perform geospatial analysis

Streamflow Networks and Flood/Coastal Modeling and Studies (Local Scale)

Mission Critical Activity Title:	Streamflow Networks and Flood/Coastal Modeling and Studies (Local Scale)
Mission Critical Activity Description:	Streamflow networks and flood/coastal modeling and studies (local scale).
MCA_ID:	3787751171_2
Agency or Department:	U.S. Geological Survey (USGS)
Sub-agency or Division:	Several
Program Name:	Numerous
Business Use:	River and Stream Flow Management, BU #1
Area of Interest:	Nationwide including Alaska, Hawaii, Puerto Rico, Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands

Requirements	
Update Frequency:	4-5 years
Post Event Updates:	Required

Requirements	
Positional Accuracy:	+/- 7 feet, 90% (1:2,400-scale)
Stream Density:	2.5 miles of surface water channel per square mile (1:24,000-scale)
Smallest Contributing Area:	6 acres
Smallest Mapped Waterbody:	Less than an acre
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	Yes
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	NWIS, NAWQA, NCLD, lidar.

Current Benefits	
Total Annual Program Budget:	$10 million
Current Annual Benefits ($):	$5 million
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Moderate
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$20 million
Future Benefits Description:	Ability to quickly leverage lidar data to build 3-D hydrography and stream morphometry in an automated way - linked to broader hydrography upstream would greatly improve local hydraulic models.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Minor

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	Yes
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	Yes
Leakage at points	Yes
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	Yes
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	Yes
Diversion points	Yes
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	Yes
Calculate stream distance to points	Yes
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	Yes
Calculate drainage area	Yes
Delineate catchment	Yes

Required Analytical Functions	
Determine downstream flood area	Yes
Accumulate upstream or downstream features	Yes
Find upstream or downstream points	Yes
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	Yes
Mash-ups	Yes
Animation of time-series	Yes

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Required	Perform Geospatial Analysis
Soils	Required	Perform Geospatial Analysis
Surficial Geology	Required	Perform Geospatial Analysis
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Highly Desirable	Perform Geospatial Analysis
Elevation	Required	Perform Geospatial Analysis
Stream Flow	Required	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Nice To Have	Perform Geospatial Analysis
Aquifers	Required	Perform Geospatial Analysis
Point Discharges	Required	Perform Geospatial Analysis
Water Use: Diversions	Nice To Have	Perform Geospatial Analysis
EPA - National Pollutant Discharge Elimination System (NPDES)	Highly Desirable	Perform Geospatial Analysis
EPA - STOrage and RETrieval Data Warehouse (STORET)	Highly Desirable	Perform Geospatial Analysis
USACE - National Inventory of Dams (NID)	Required	Perform Geospatial Analysis
USDA - National Agriculture Statistics Service (NASS)	Highly Desirable	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Nice To Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Required	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Required	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):	Sediment size, distribution, and concentration - required, perform geospatial analysis	Sediment size, distribution, and concentration - required, perform geospatial analysis

Western Area Power Administration (WAPA)

Point of Contact: Robert Kennedy, rkennedy@wapa.gov

The Western Area Power Administration's (WAPA's) mission is to market and deliver clean, renewable, reliable, cost-based Federal hydroelectric power and related services.

WAPA is one of four power marketing administrations in the U.S. Department of Energy, whose role is to market and transmit wholesale electricity from multi-use water projects. Its service area encompasses a 15-state region of the central and western U.S. (see Figure B-6) where its more than 17,000 circuit-mile transmission system carries electricity from 56 hydropower plants operated by the Bureau of Reclamation (USBR), U.S. Army Corps of Engineers (USACE), and the International Boundary and Water Commission. WAPA also markets power from the Navajo Generating Station coal-fired plant near Page, AZ. WAPA sells its power to preference customers such as Federal and state agencies, cities and towns, rural electric cooperatives, public utility districts, irrigation districts, and Native American tribes. They, in turn, provide retail electric service to millions of consumers in the West.

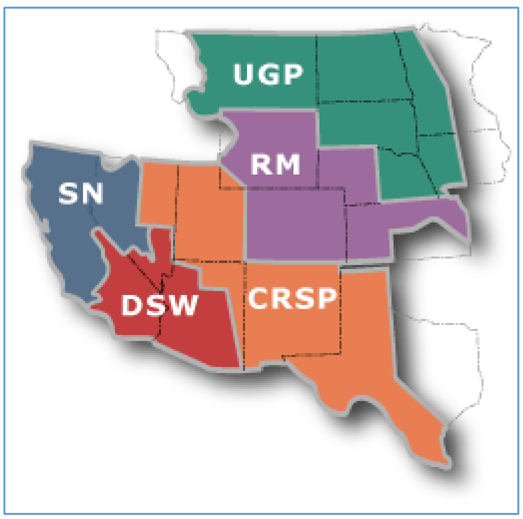


Figure B-6 – WAPA Service Area

Agency Hydrography Data Requirements and Benefits

WAPA uses hydrography data for long term planning and reservoir operations including reservoir inflow forecasts, streamflow, snow melt, regression modelling, hydrologic forecasting, and weather and climate forecasting. Daily reservoir operations are greatly influenced by weather predictions and reservoir inflow; however, the hydrography data used by WAPA for hydro power management are primarily provided by their reservoir owners (USBR and USACE).

Beyond its reservoir operations, WAPA uses hydrography data for National Environmental Policy Act (NEPA) and General Services Administration (GSA) assessments of reservoirs. Data used for these activities include soil moisture, terrain, flow regression equations, MODFLOW, and stream gages. Water quality data are also used for habitat modeling in support of the Colorado River Basin Salinity Control Program and WAPA's Transmission Infrastructure Program under the American Recovery and Reinvestment Act.

WAPA's environmental compliance activities include stormwater management plans, groundwater testing at electrical substations, and environmental evaluation of properties under consideration for purchase. Additionally, future compliance with the recently enacted Waters of the U.S. rules will require WAPA to make additional use of hydrography data for oil Spill, Prevention, Control, and Countermeasure (SPCC) plans, to include pollution prevention and downstream oil spill modeling.

As noted above, WAPA relies primarily on hydrography data provided by USBR and USACE for its hydro power management activities. Improvements to hydrography datasets would provide WAPA with minor benefits, primarily from improved streamflow and weather forecasts. Enhanced data would lead to improved forecasts which would improve decisions, potentially lowering operation expenses and reducing the cost of electricity to its customers. The ability to map depth to groundwater in wells near substations would be very helpful.

Future benefits to WAPA environmental compliance activities would be realized from wetland delineations that could be used for evaluation of new transmission lines and substations, as well as ephemeral streams data which would make field visits more efficient.

WAPA's activities are similar to those of the three other power administrations: Bonneville Power Administration (BPA), South Eastern Power Administration (SEPA), and South West Power Administration (SWPA). Because of its location, BPA also has a larger fish conservation mission and would likely have additional hydrography data requirements (including coastal requirements) for that activity. It is not clear if the requirements and benefits for the other power administrations would be similar to those reported by WAPA or not.

Geographic Extents Required for Hydrography Data Access

12-digit Hydrologic Units	8-digit Hydrologic Units	6-digit Hydrologic Units	4-digit Hydrologic Units	2-digit Hydrologic Units	NHDPlus Catchments	State or Territory	Conterminous United States	Nationwide including Alaska and Hawaii	User defined map extent	User defined irregular area (polygon)	Other	I don't know
									✓		*	

* Data provided by U.S. Bureau of Reclamation and U.S. Army Corps of Engineers

Data Types Required for Hydrography Data Access

Vector Data			Raster Data				
OGC conformant (e.g. WaterML, GeoJSON)	Esri shapefiles	Esri file geodatabase	NetCDF	GeoTIFF	NITF	Esri Grid	Other
	✓						*

*Surface flow records provided by U.S. Bureau of Reclamation

Data or Service Access Requirements for Hydrography Data

Data or Service Access Method	Requirement
Services to discover standard data products	Highly Desirable
Services to download standard data products	Highly Desirable
Services to create and download customized data products	Nice To Have
Services to dynamically use data with client-based software (like a browser, GIS, or to feed other services)	Nice To Have
Services to visualize cartographically rendered and symbolized hydrography data	Nice To Have
Services that allow combination of visualizations with other visualization services (mash-ups)	Nice To Have
Services to create generalized versions of hydrography (different scales and level of detail)	Nice To Have
Services to support online analysis of hydrography information (such as StreamStats)	Nice To Have

Requirements for Integration of Hydrography Data with Elevation Data

Data Type	Elevation Data Integration	Requirement
Vector Data	Rivers and streams in the hydrography dataset align with channels as defined from the elevation data at 1:12,000-scale or larger (3-meter DEM).	Highly Desirable
	Objects defined by elevation, such as a levees, are linked to a particular river in the hydrography dataset.	Highly Desirable
	Hydrography and elevation data are packaged in a single product such as a TIN or a 3-D dataset.	Nice to Have
	Hydrography data (streams, stream gages, dams, hydrologic units) along with elevation data (elevations, catchments, levees, floodplains) coexist within a common data model.	Nice to Have
	Perform synthesis such that streamflow can be estimated from elevation-based drainage area and other factors.	Highly Desirable

Data Type	Elevation Data Integration	Requirement
	Produce data derivatives such that gradient can be calculated on a stream using elevation data.	Nice to Have
	Manage hydrography and elevation data as a unified activity always keeping both datasets synchronized with one another.	Nice To Have
	Ensure that hydrography and elevation data represent a similar point in time.	Highly Desirable
	Both hydrography and elevation data are delivered in unison rather than two separate operations.	Nice To Have
Raster Data	Determine new flow paths across the land surface into existing stream channels.	Nice To Have
	Determine feature on the hydrographic network to which a point (with elevation value) is connected.	Nice To Have
	Determine the actual point location (within a DEM cell) on the hydrographic network to which a point is connected.	Nice To Have

Hydrography Data Quality Impacts

Quality Issue	Impact
In a series of lakes formed at gravel pits, one lake is missing from the NHD.	Somewhat Impactful
In a series of lakes formed at gravel pits, all lakes are missing from the NHD.	Somewhat Impactful
In a series of tributary streams, several streams do not connect with the main river.	Somewhat Impactful
A perennial stream is misnamed.	Somewhat Impactful
A large reservoir is misnamed.	Somewhat Impactful
A first order stream flow direction is reversed.	Little or No Impact
A second order stream flow direction is reversed.	Little or No Impact
A third order stream flow direction is reversed.	Little or No Impact
Two first order streams coded as perennial should be intermittent.	Little or No Impact
A meandering river represented in the NHD is overlaid over a contemporary image of the river. The position of the meanders has deviated over time with a mean error of 100 feet and a maximum error of 200 feet.	Somewhat Impactful
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 175 feet.	Little or No Impact
An intermittent stream represented in the NHD is portrayed along with contours and shaded terrain. The stream appears to be misaligned with the terrain by a mean of 75 feet.	Little or No Impact
A ridge line in the WBD is portrayed along with contours and shaded terrain. The ridge line appears to be misaligned with the terrain by a mean of 70 feet.	Little or No Impact

Quality Issue	Impact
Error Resolution	**Time**
Acceptable error resolution time:	Within 1 year

Other Requirements

Requirement	Response
Accuracy requirements for elevation derived catchments	Within 10% of actual area
Categorization of differences in definition of NHDPlus catchments vs. Hydrologic Units	I don't know
Use of web tool for reporting hydrography data errors	Maybe

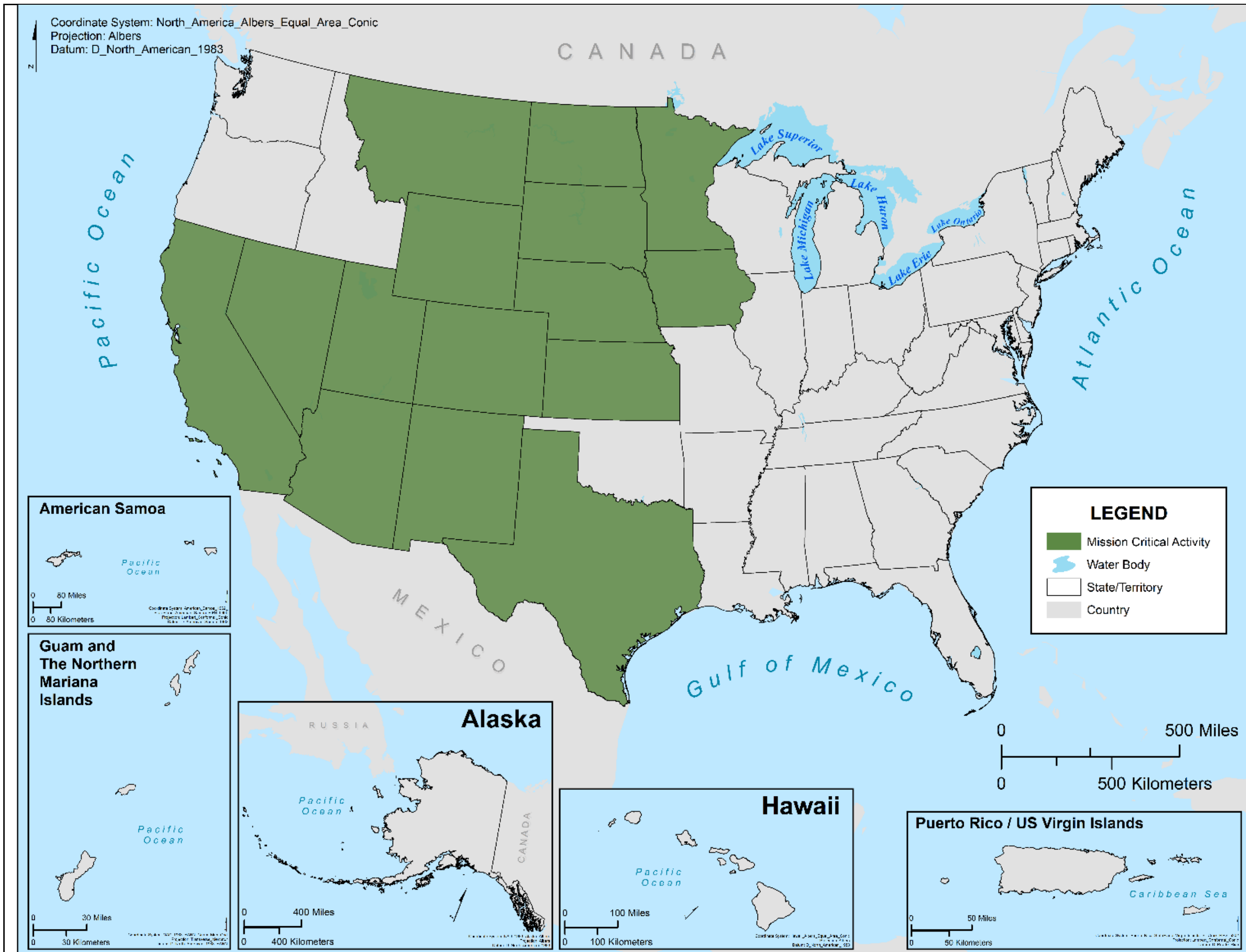
Agency Mission Critical Activities

WAPA managers identified two Mission Critical Activities (MCAs) with requirements for hydrography data:

- Marketing, Scheduling, and Transmitting Hydro Power, under Business Use (BU) #13, Renewable Energy Resources.
- Environmental Compliance, under BU #4, Water Quality.

WAPA managers provided the following assessments of hydrography data requirements and benefits received from enhanced hydrography data for Marketing, Scheduling, and Transmitting Hydro Power and Environmental Compliance. Summarized details are provided in the following pages.

Marketing, Scheduling, and Transmitting Hydro Power



Mission Critical Activity Title:	Marketing, Scheduling, and Transmitting Hydro Power
Mission Critical Activity Description:	Marketing, scheduling, and transmitting hydro power includes hydropower generation forecasting and scheduling as well as transmission line and substation planning and mapping.
MCA_ID:	3792632591_1
Agency or Department:	Western Area Power Administration (WAPA)
Sub-agency or Division:	Power Marketing, Natural Resources
Program Name:	Power Marketing, Natural Resources
Primary Business Use:	Renewable Energy Resources, BU #13
Area of Interest:	WAPA 15-state service area

Requirements	
Update Frequency:	Annually
Post Event Updates:	Nice To Have

Requirements	
Positional Accuracy:	+/- 420 feet, 90% (1:250,000-scale)
Stream Density:	1.0 mile of surface water channel per square mile (1:100,000 -scale)
Smallest Contributing Area:	I don't know
Smallest Mapped Waterbody:	5 acres
Level of Detail:	Best Available

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	Yes
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	Data provided by USBR and USACE.

Current Benefits	
Total Estimated Annual Program Budget:	$1.14 billion
Current Estimated Annual Benefits ($):	Unable to quantify.
Current Operational Benefits	
Current Time/Cost Savings:	Minor
Current Mission Compliance Benefits:	Minor
Current Customer Service Benefits	
Current Products or Services Benefits:	Minor
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Minor
Current Societal Benefits	
Current Education or Public Safety Benefits:	Minor
Current Environmental Benefits:	Minor
Current Human Lives Saved:	Not Applicable
Current Other Benefits:	

Future Benefits	
Future Estimated Annual Benefits ($):	Unable to quantify
Future Benefits Description:	Most benefits would accrue to USBR or USACE. Future benefits would include improved customer coordination with hydropower scheduling as well as improved mapping. Mapping depth to groundwater in wells near substations would be very helpful.
Future Operational Benefits	
Future Time/Cost Savings:	Minor
Future Mission Compliance Benefits:	Minor

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Minor
Future Response or Timeliness Benefits:	Minor
Future Customer Experience Benefits:	Minor
Future Societal Benefits	
Future Education or Public Safety Benefits:	Minor
Future Environmental Benefits:	Minor
Future Human Lives Saved:	Not Applicable
Future Other Benefits:	

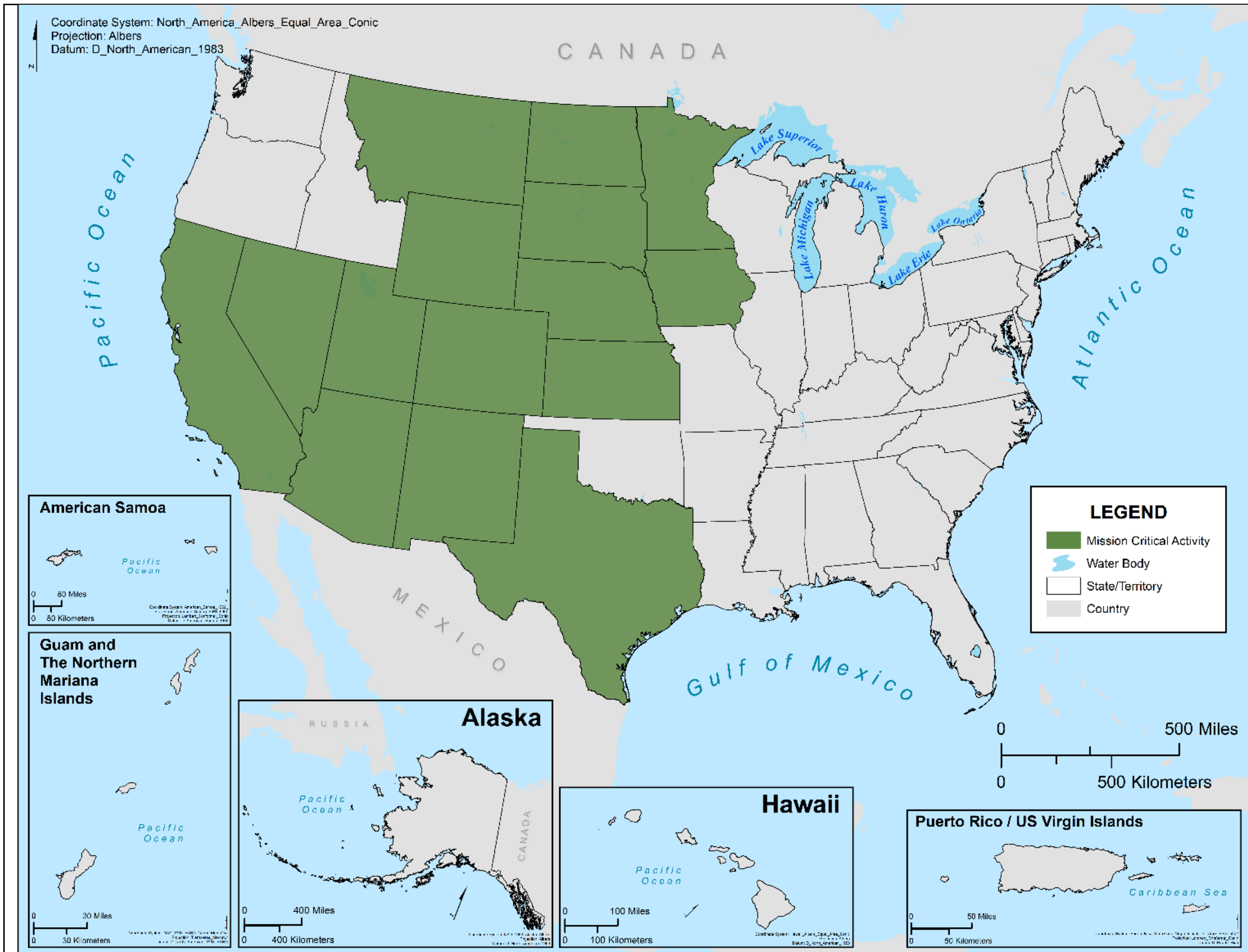
Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	
Left/right bank delineation	
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	
Floodplain boundary	
Flow periodicity	
Riverine bathymetry	
Coastlines	
Coastal bathymetry	
Estuaries	Yes
Diversion points	
Bridges, culverts	Yes
Diversion lines	Yes
Deltas	Yes
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	
Delineate catchment	
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	

Required Analytical Functions	
Calculate distance on network	Yes
Find events or features on network	Yes
Preset symbolization	Yes
User defined symbolization	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	**Importance**	**Highest Level of Analysis**
Land Cover	Not Required	None
Soils	Not Required	None
Surficial Geology	Not Required	None
Bathymetry	Not Required	None
Climate	Required	Perform Geospatial Analysis
Contaminant Sources	Not Required	None
Elevation	Required	Associate Selected Data Type
Stream Flow	Required	Visual Inspection
Wetlands	Nice To Have	Visual Inspection
Census (population statistics)	Not Required	None
Aquifers	Highly Desirable	Visual Inspection
Point Discharges	Nice to Have	Visual Inspection
Water Use: Diversions	Highly Desirable	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Not Required	None
EPA - STOrage and RETrieval Data Warehouse (STORET)	Not Required	None
USACE - National Inventory of Dams (NID)	Nice to Have	Visual Inspection
USDA - National Agriculture Statistics Service (NASS)	Not Required	None
USFWS - National Wetlands Inventory (NWI)	Not Required	None
USGS National Water Information Sites (NWIS)	Nice to Have	Visual Inspection
USGS National Water-Quality Assessment Program (NAWQA)	Not Required	None
Other (please specify the importance and highest analysis level):		

Environmental Compliance



Mission Critical Activity Title:	Environmental Compliance
Mission Critical Activity Description:	Environmental compliance includes development of Stormwater Management Plans, evaluation of depth to groundwater at electrical substations for planning geotechnical testing information, and environmental remediation for oil/fuel spill cleanups. Defining watersheds could be useful for determining construction impacts on a more regional basis.
MCA_ID:	3797556345_1
Agency or Department:	Western Area Power Administration (WAPA)
Sub-agency or Division:	
Program Name:	Environmental compliance at electrical substations and maintenance facilities/operations centers
Primary Business Use:	Water Quality, BU #4
Area of Interest:	WAPA 15-state service area

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Nice to Have
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)
Stream Density:	I don't know
Smallest Contributing Area:	10 square miles (6,400 acres)
Smallest Mapped Waterbody:	1 acre
Level of Detail:	Consistent Level of Detail

Hydrography Datasets Currently Used	
National Hydrography Dataset (NHD)	
National Hydrographic Dataset Plus (NHDPlus)	
Watershed Boundary Dataset (WBD)	
No hydrography data are currently being used	Yes
Other dataset (please provide name and brief description):	

Current Benefits	
Total Estimated Annual Program Budget:	$5 million-$10 million (varies from year to year).
Current Estimated Annual Benefits ($):	$100,000
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Moderate
Current Response or Timeliness Benefits:	Moderate
Current Customer Experience Benefits:	Moderate
Current Societal Benefits	
Current Education or Public Safety Benefits:	Moderate
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Estimated Annual Benefits ($):	$200,000
Future Benefits Description:	Improved wetland delineation maps would help WAPA more efficiently conduct environmental assessments, assessments of waterways, and water basin impacts. Ephemeral streams would make field visits more efficient.
Future Operational Benefits	
Future Time/Cost Savings:	Moderate
Future Mission Compliance Benefits:	Moderate

Future Benefits	
Future Customer Service Benefits	
Future Products or Services Benefits:	Moderate
Future Response or Timeliness Benefits:	Moderate
Future Customer Experience Benefits:	Moderate
Future Societal Benefits	
Future Education or Public Safety Benefits:	Moderate
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Minor
Future Other Benefits:	

Required Characteristics	
Linkages to stream gage observations	
Linkages to cross section geometry	Yes
Left/right bank delineation	Yes
Velocity or time of travel	Yes
Leakage along lines	
Leakage at points	
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	
Coastal bathymetry	
Estuaries	
Diversion points	
Bridges, culverts	Yes
Diversion lines	
Deltas	
Wetlands	Yes
Badlands	
Other	

Required Analytical Functions	
Navigate up or downstream on network	
Calculate stream distance to points	
Calculate time of travel to points	Yes
Find upstream or downstream feature within watershed	
Calculate drainage area	Yes
Delineate catchment	Yes

Required Analytical Functions	
Determine downstream flood area	
Accumulate upstream or downstream features	
Find upstream or downstream points	
Calculate distance on network	
Find events or features on network	
Preset symbolization	
User defined symbolization	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Nice to Have	Visual Inspection
Soils	Nice to Have	Visual Inspection
Surficial Geology	Nice to Have	Visual Inspection
Bathymetry	Not Required	None
Climate	Nice To Have	Visual Inspection
Contaminant Sources	Nice To Have	Perform Geospatial Analysis
Elevation	Highly Desirable	Perform Geospatial Analysis
Stream Flow	Highly Desirable	Perform Geospatial Analysis
Wetlands	Required	Perform Geospatial Analysis
Census (population statistics)	Not Required	None
Aquifers	Nice to Have	Associate Selected Data Type
Point Discharges	Highly Desirable	Associate Selected Data Type
Water Use: Diversions	Not Required	None
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice to Have	Associate Selected Data Type
EPA - STOrage and RETrieval Data Warehouse (STORET)	Nice to Have	Visual Inspection
USACE - National Inventory of Dams (NID)	Not Required	None
USDA - National Agriculture Statistics Service (NASS)	Nice to Have	Visual Inspection
USFWS - National Wetlands Inventory (NWI)	Required	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Nice to Have	Visual Inspection
USGS National Water-Quality Assessment Program (NAWQA)	Nice to Have	Visual Inspection
Other (please specify the importance and highest analysis level):	Ephemeral streams; Nice to Have, Perform Geospatial Analysis	Ephemeral streams; Nice to Have, Perform Geospatial Analysis