Appendix D
National Hydrography Requirements and Benefits Study
Association Summary Reports

Association of State Floodplain Managers (ASFPM)

The Association of State Floodplain Managers' (ASFPM's) mission is to promote education, policies, and activities that mitigate current and future losses, costs, and human suffering caused by flooding, and to protect the natural and beneficial functions of floodplains - all without causing adverse impacts.

ASFPM began in 1977 as the supporting organization of professionals involved in floodplain management, flood hazard mitigation, flood preparedness, and flood warning and recovery. The association aims to mitigate the losses, costs, and human suffering caused by flooding and to promote wise use of the natural and beneficial functions of floodplains. Today, ASFPM is the premier voice in floodplain management practice and policy throughout the nation. Its 6,500 national and chapter members represent local, state, and Federal government agencies, citizen groups, private consulting firms, academia, the insurance industry, and lenders. ASFPM's influence is expressed through policy and practice changes that impact floodplain management in the U.S. and internationally. Its goals are simple – help the public and private sectors:

- Reduce the loss of human life and property damage resulting from flooding;
- Preserve the natural and cultural values of floodplains;
- Promote flood mitigation for the prevention of loss and the wise use of floodplains; and
- Avoid actions that exacerbate flooding.

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	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	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.	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.	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 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.	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.	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.	Highly 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.	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.	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

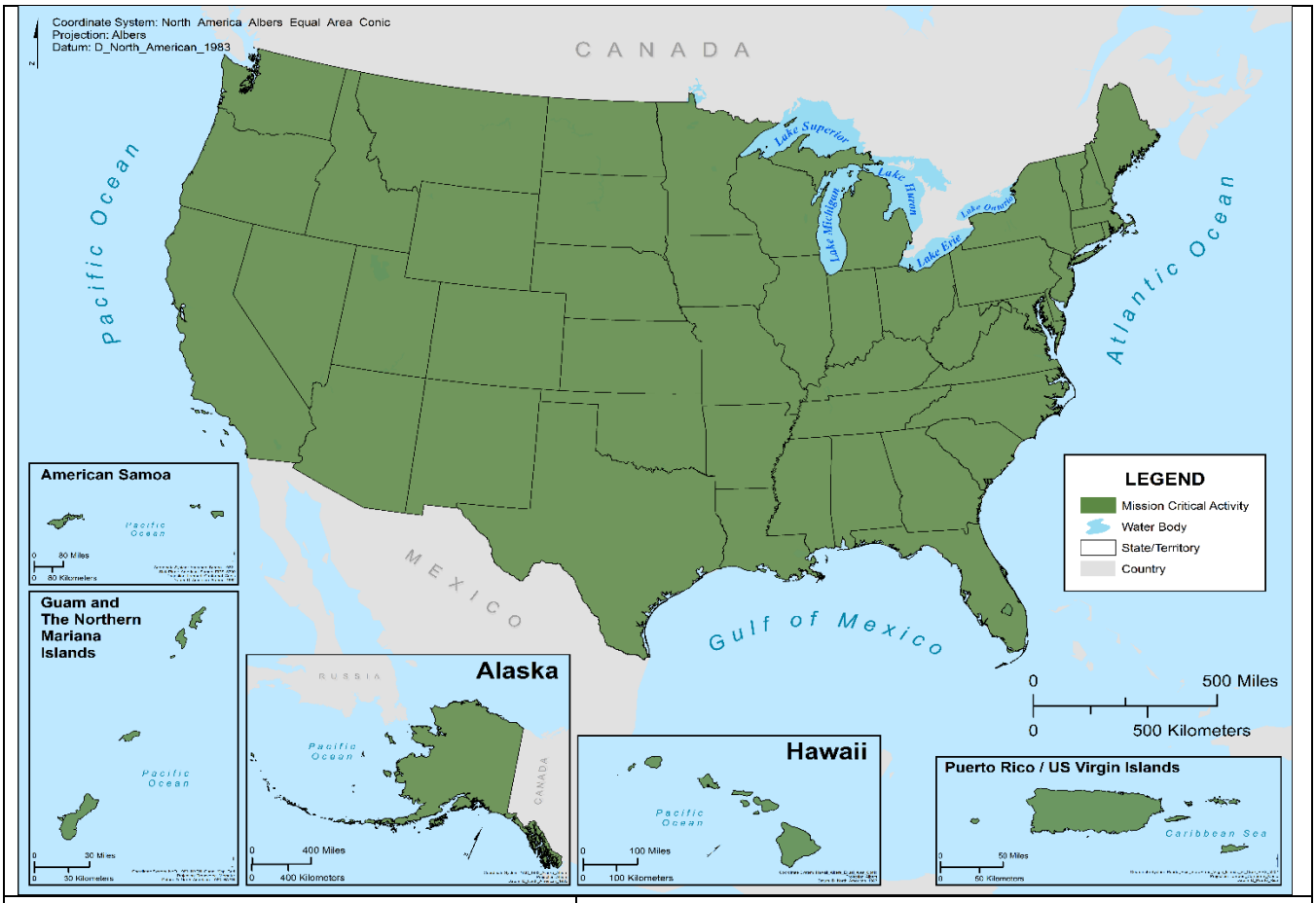
Other Requirements

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

Mission Critical Activities

ASFPM 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 Hazard



Mission Critical Activity Title:	Flood Hazard
Mission Critical Activity Description:	ASFPM gives FEMA input on how to best provide accurate comprehensive flood hazard mapping for the U.S.
MCA_ID:	3817493553_1
Organization Type:	Not for Profit
Organization Name:	Association of State Floodplain Managers
Business Use:	Flood Risk Management
Area of Interest:	Nationwide

Requirements	
Update Frequency:	6-10 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:	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:	$1 million
Current Annual Benefits ($):	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:	Don't Know
Current Response or Timeliness Benefits:	Major
Current Customer Experience Benefits:	Don't Know
Current Societal Benefits	
Current Education or Public Safety Benefits:	Major
Current Environmental Benefits:	Moderate
Current Human Lives Saved:	Major
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	Unable to quantify
Future Benefits Description:	Our Mission Critical Activity (MCA) is getting FEMA to develop flood hazard maps for the nation. To date, FEMA has mapped 1 million miles of the 3 million miles of streams in the NHD. The only way this will be effectively be completed is using automated H&H tools built on the NHD.
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:	Don't Know
Future Societal Benefits	
Future Education or Public Safety Benefits:	Major
Future Environmental Benefits:	Moderate
Future Human Lives Saved:	Major
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	
Leakage along lines	
Leakage at points	
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	Yes
Riverine bathymetry	
Coastlines	Yes
Coastal bathymetry	Yes
Estuaries	
Diversion points	
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	
Find upstream or downstream feature within watershed	
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	
Mash-ups	
Animation of time-series	

Level of Integration with Other Datasets	Importance	Highest Level of Analysis
Land Cover	Highly Desirable	None
Soils	Highly Desirable	Perform Geospatial Analysis
Surficial Geology	Highly Desirable	Associate Selected Data Type
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	Highly Desirable	Perform Geospatial Analysis
Census (population statistics)	Required	Perform Geospatial Analysis
Aquifers	Not Required	None
Point Discharges	Not Required	None
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)	Required	Associate Selected Data Type
USDA - National Agriculture Statistics Service (NASS)	Required	Perform Geospatial Analysis
USFWS - National Wetlands Inventory (NWI)	Highly Desirable	Associate Selected Data Type
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):		

Ducks Unlimited (DU)

Ducks Unlimited (DU) is the world's leader in wetlands and waterfowl conservation. DU got its start in 1937 during the Dust Bowl when North America's drought-plagued waterfowl populations had plunged to unprecedented lows. Determined not to sit idly by as the continent's waterfowl dwindled beyond recovery, a small group of sportsmen joined together to form an organization that became known as Ducks Unlimited. Thanks to decades of abiding by that single mission, DU is now the world's largest and most effective private waterfowl and wetlands conservation organization. DU is able to multilaterally deliver its work through a series of partnerships with private individuals, landowners, agencies, scientific communities, and other entities. DU conserves, restores, and manages wetlands and associated habitats for North America's waterfowl. These habitats also benefit other wildlife and people.

In some parts of the United States, over 90 percent of the original wetlands have been drained. This drainage was done though changing the hydrology of the landscape (mostly drain tiles). Understanding the hydrology at the regional, watershed, and site-specific scales is extremely important to the mission of DU. At the regional scale, we use hydrology to plan conservation activities (determining the most important areas for wetland restoration to occur). At the watershed scale, we use hydrology to estimate flow, accumulation, and benefits for restoration activities. At the site-specific scale, we use hydrology to plan the restoration activity (where to place ditch plugs, berms, etc.). All of the work that DU does in restoring wetlands is tied to the hydrology of the landscape. The more accurate and detailed the hydrology data, the less work DU has to do in creating this data for its restoration efforts.

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)	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)	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).	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.	Required
	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.	Nice to Have
	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 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.	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.	Little or No Impact
A large reservoir is misnamed.	Somewhat 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.	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.	Little or No 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	Minor problem, requires some intervention
Use of web tool for reporting hydrography data errors	No

Mission Critical Activities

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

Wetland Restoration

Mission Critical Activity Title:	Wetland Restoration
Mission Critical Activity Description:	The primary Mission Critical Activity (MCA) for DU is wetland restoration. Effective wetland restoration requires gathering information on hydrology, including water flow, catchment size, watershed size, elevation, etc. Information is mostly very detailed and specific to the location.
MCA_ID:	3798673309_1
Organization Type:	Not for Profit
Organization Name:	Ducks Unlimited, Inc.
Business Use:	Wildlife and Habitat Management
Area of Interest:	Nationwide plus, Canada and, Mexico

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Nice to Have
Positional Accuracy:	+/- 3 feet, 90% (1:1,200-scale)
Stream Density:	1.0 mile of surface water channel per square mile (1:100,000 -scale)
Smallest Contributing Area:	6 acres

Requirements	
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)	
Watershed Boundary Dataset (WBD)	Yes
No hydrography data are currently being used	
Other dataset (please provide name and brief description):	Yes
	Note: most of what DU does is very site-specific, so the NHD is not detailed enough for our purposes. We collect our own survey-level information for wetland restoration activities. NHD and watersheds are used in the initial planning phase.

Current Benefits	
Total Annual Program Budget:	$45 million
Current Annual Benefits ($):	$100,000
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:	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:	Spend less time in the field collecting field information.
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 Benefits	
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	
Velocity or time of travel	
Leakage along lines	
Leakage at points	
Flood stage	Yes
Floodplain boundary	Yes
Flow periodicity	
Riverine bathymetry	Yes
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	Yes
Calculate time of travel to points	
Find upstream or downstream feature within watershed	
Calculate drainage area	Yes
Delineate catchment	
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	
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	Associate Selected Data Type
Bathymetry	Highly Desirable	Perform Geospatial Analysis
Climate	Highly Desirable	Perform Geospatial Analysis
Contaminant Sources	Nice to Have	Visual Inspection
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	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)	Nice to Have	Visual Inspection
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)	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):		

The Nature Conservancy (TNC)

The mission of The Nature Conservancy (TNC) is to conserve the lands and waters on which all life depends. Our vision is a world in which the diversity of life thrives, and people act to conserve nature for its own sake and its ability to fulfill our needs and enrich our lives.

TNC has requirements for hydrography data to support its conservation and restoration programs for coastal and freshwater ecosystems. TNC is interested in tools to model river flooding and to support resiliency programs associated with flood impacts. TNC would like to see more gage stations that report discharge, which will be used to build hydrography flow models.

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, 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
	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.	Highly Impactful
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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.	Highly 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.	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

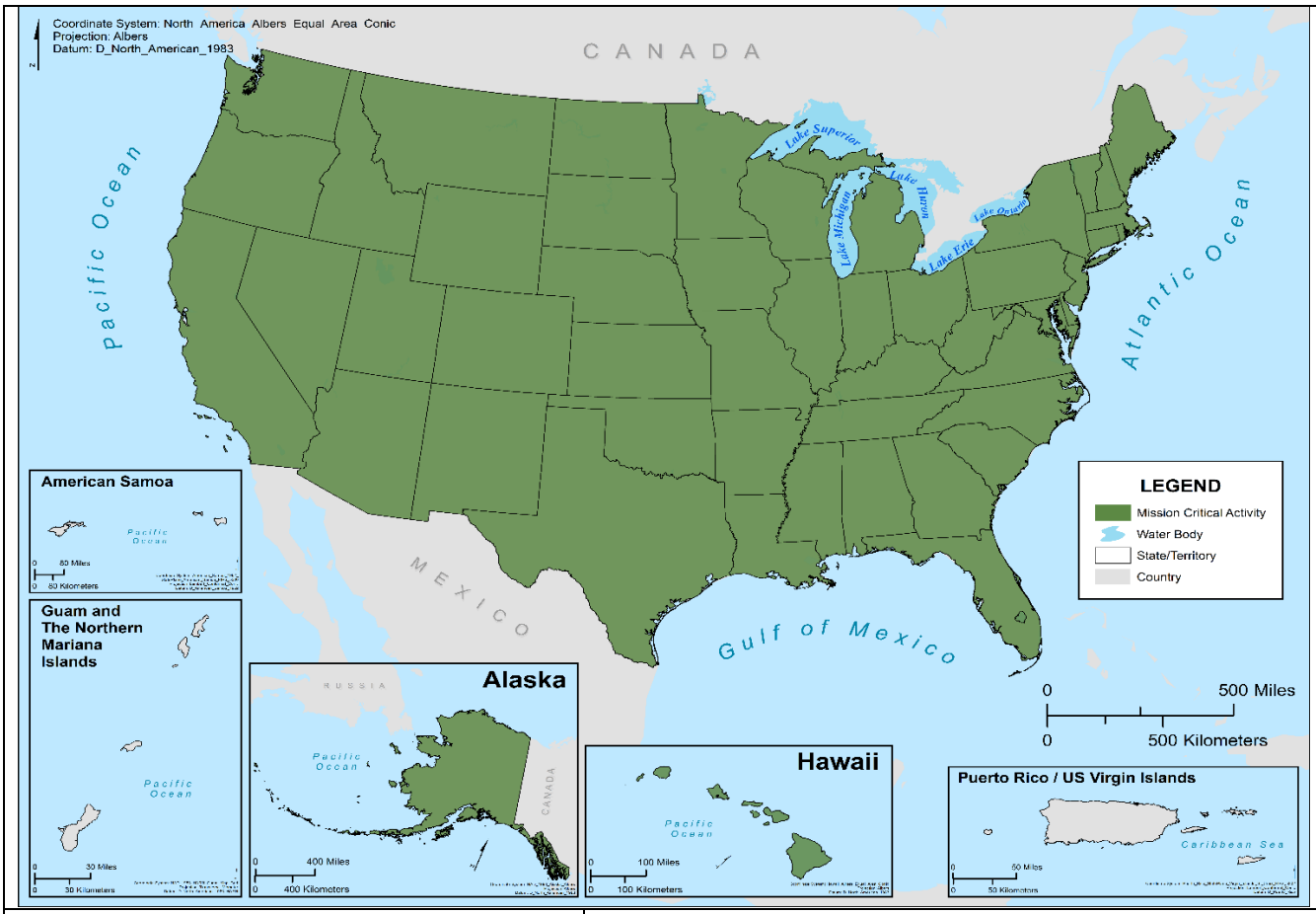
Other Requirements

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

Mission Critical Activities

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

Conservation and Restoration of Freshwater and Coastal Ecosystems



Mission Critical Activity Title:	Conservation and Restoration of Freshwater and Coastal Ecosystems
Mission Critical Activity Description:	Conservation and restoration of Freshwater and Coastal ecosystems.
MCA_ID:	3834133145_1
Organization Type:	Not for Profit
Organization Name:	The Nature Conservancy
Business Use:	Natural Resources Conservation
Area of Interest:	Nationwide

Requirements	
Update Frequency:	2-3 years
Post Event Updates:	Required
Positional Accuracy:	+/- 33 feet, 90% (1:12,000-scale)
Stream Density:	1.0 mile of surface water channel per square mile (1:100,000 -scale)
Smallest Contributing Area:	1 square mile (640 acres)
Smallest Mapped Waterbody:	1 acre

Requirements	
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:	$10 million
Current Annual Benefits ($):	$2 million
Current Operational Benefits	
Current Time/Cost Savings:	Moderate
Current Mission Compliance Benefits:	Moderate
Current Customer Service Benefits	
Current Products or Services Benefits:	Major
Current Response or Timeliness Benefits:	Minor
Current Customer Experience Benefits:	Moderate
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 ($):	$5 million
Future Benefits Description:	Better data and access to those data would help us generate science-based products and tools to meet our conservation mission more cheaply and efficiently.
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:	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	
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	
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	
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	Associate Selected Data Type
Soils	Highly Desirable	Associate Selected Data Type
Surficial Geology	Highly Desirable	Associate Selected Data Type
Bathymetry	Highly Desirable	Associate Selected Data Type
Climate	Highly Desirable	Associate Selected Data Type
Contaminant Sources	Nice to Have	Visual Inspection
Elevation	Highly Desirable	Associate Selected Data Type
Stream Flow	Required	Associate Selected Data Type
Wetlands	Required	Associate Selected Data Type
Census (population statistics)	Highly Desirable	Associate Selected Data Type
Aquifers	Required	Associate Selected Data Type
Point Discharges	Highly Desirable	Associate Selected Data Type
Water Use: Diversions	Highly Desirable	Associate Selected Data Type
EPA - National Pollutant Discharge Elimination System (NPDES)	Nice to Have	Associate Selected Data Type
EPA - STOrage and RETrieval Data Warehouse (STORET)	Required	Associate Selected Data Type
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	Associate Selected Data Type
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):		

Trout Unlimited (TU)

The mission of Trout Unlimited (TU) is to conserve, protect, and restore North America's cold water fisheries and their watersheds. TU is a national organization with more than 150,000 members organized into about 400 chapters from Maine to Montana to Alaska. This dedicated grassroots army is matched by a respected staff of lawyers, policy experts, and scientists, who work out of more than 30 offices nationwide. These conservation professionals ensure that TU is at the forefront of fisheries restoration work at the local, state, and national levels.

The organization remains committed to applying "the very best information and thinking available" in its conservation work and has developed cutting-edge tools such as the Conservation Success Index (CSI), a sophisticated framework for assessing the health of cold water fish species throughout their native range. Whether this range encompasses a few hundred miles or multiple states, the CSI helps the organization target its efforts toward those populations most in need of protection or restoration.

The CSI also enables TU to measure its progress in achieving the bold goals laid out in its mission and vision. These goals require the organization to work at increasingly larger scales, and to collaborate with other conservation interests, local communities, and state and Federal partners to begin to rebuild the natural resiliency of watersheds. Such efforts are crucial if North America's trout and salmon are to survive climate change and the host of threats facing them at the start of the 21st century.

TU uses the NHD as a key component of its conservation planning, science, on-the-ground restoration, and advocacy work. It uses the data to make high-resolution stream maps describing freshwater resources and fish habitat distribution; to quantify the pattern of those resources within jurisdictions including counties, states, national forest boundaries, and other public lands; to identify important conservation and restoration opportunities based on key stream attributes such as periodicity (perennial vs. intermittent), stream flow, stream order, and slope; for conducting hydrological and stream connectivity modelling; and for performing scientific research related to the habitat requirements and distributional patterns of trout and salmon. Increased spatial resolution and additional attributes for stream reaches in the NHD – especially improvement in stream flow information at multiple temporal scales and additional stream temperature information – will allow TU to further apply the data towards its mission.

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	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.	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.	Required
	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.	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.	Nice to Have

Data Type	Elevation Data Integration	Requirement
	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.	Little or No Impact
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.	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.	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.	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	Significant problem, but we have workarounds
Use of web tool for reporting hydrography data errors	Probably

Mission Critical Activities

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

Conservation and Restoration for Trout and Salmon

Mission Critical Activity Title:	Conservation and Restoration for Trout and Salmon
Mission Critical Activity Description:	Informing conservation and restoration activities for trout and salmon. Mapping fish distribution and aquatic resources related to streams. Where streams are. Use NHDPlus. Quantify how many stream miles are in areas.
MCA_ID:	3790685644_1
Organization Type:	Not for Profit
Organization Name:	Trout Unlimited
Business Use:	River and Stream Ecosystem Management
Area of Interest:	Nationwide

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:	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:	$1 million
Current Annual Benefits ($):	$25,000
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:	Moderate
Current Environmental Benefits:	Major
Current Human Lives Saved:	Minor
Current Other Benefits:	

Future Benefits	
Future Annual Benefits ($):	$25,000
Future Benefits Description:	Increased resolution of mapped features and feature attributes would allow us to be more efficient in articulating conservation needs for trout and salmon and prioritizing organizational focus.
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:	Minor

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

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Required Analytical Functions	
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Animation of time-series	

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Bathymetry	Nice to Have	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	Nice to Have	Perform Geospatial Analysis
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USFWS - National Wetlands Inventory (NWI)	Nice to Have	Perform Geospatial Analysis
USGS National Water Information Sites (NWIS)	Highly Desirable	Perform Geospatial Analysis
USGS National Water-Quality Assessment Program (NAWQA)	Highly Desirable	Perform Geospatial Analysis
Other (please specify the importance and highest analysis level):		