

USGS Report to SMAC

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Introduction

Current Efforts – Elevation-Derived Hydrography

- **Goal:**
 - To create hydrographic features that are horizontally and vertically integrated with a 3DEP bare-earth digital-elevation model.
 - Elevation-Derived Hydrography will be suitable for:
 - use as breaklines to hydro-flatten digital elevation models,
 - processing for pre-conflation of features to the National Hydrography Dataset, and
 - hydro-enforcement of digital elevation models.
- ✓ **Publish requirements for EDH:**
 - Elevation-derived Hydrography - Acquisition Specifications
 - Elevation-derived Hydrography - Representation, Extraction, Attribution, and Delineation (READ Rules)

Elevation-Derived Hydrography Acquisition Specifications

Chapter 11 of
Section B, U.S. Geological Survey Standards, of
Book 11, Collection and Delineation of Spatial Data

Techniques and Methods 11-B11

Acquisition Specifications

Specifications

List of Specification Categories

- **Collection Area**
 - Concurrent with lidar BAA or other new lidar collection
 - From previously collected elevation data
- **Spatial Reference System**
- **Attribute Table Structure**
- **Feature Codes and values**
- **Delineation of hydrographic features**
 - LBS Hydro-flattening
 - Elevation-derived Hydrography
 - Minimum features
 - Additional features
 - Ancillary data sources
 - Special Cases
- **Topology**
 - Topology rules
 - Z-Values
- **Positional Assessment**
 - Positional assessment and reporting
 - Vertical
 - Horizontal
 - Alignment
 - Completeness
- **Metadata**
- **Delivery products and formats**

Specifications

Feature Types - Elevation-derived Hydrography and Hydro-flattening

- Features are limited to those that can be identified from a lidar-derived elevation surface.
- Codes allow for elevation and hydrography treatments.
- Each of these features is defined in detail within the READ Rules Document.

Domain value	Feature description
FClass	
1	NHD feature (will be used for conflation).
2	Non-NHD feature (outside of collection criteria).
9	Nonhydrography feature (elevation dataset limitation).
EClass	
0	Not used for elevation derivatives.
1	Used for hydroflattening (3D polygon).
2	Hydrographic feature used for elevation purposes, other than culverts or those used for hydroflattening.
3	Culvert—used for hydroenforcement.
9	Elevation dataset limitation.

FCode	Desc
0	User-defined feature ¹
33400	Connector
33600	Canal/ditch
34300	Dam/weir
36100	Playa
37800	Ice mass
39000	Lake/pond
42800	Pipeline
43600	Reservoir
44500	Sea/ocean
45000	Sink/rise
46000	Stream/river
46800	Drainageway ¹
53700	Area of complex channels
55800	Artificial path
Assigned based on adjacent features ²	
991	Low-confidence area (predetermined)
992	Low-confidence area (sparse bare earth)
993	Low-confidence area (snow covered)

Elevation source data	Source
Hydrography delineation method	Method
User-defined code	UserCode
Free-text space for user comments	Comments

Features required for hydro-flattening	
Description	FCODE
Lake/Pond	39000
Reservoir	43600
Sea/Ocean	44500
Stream/River	46000

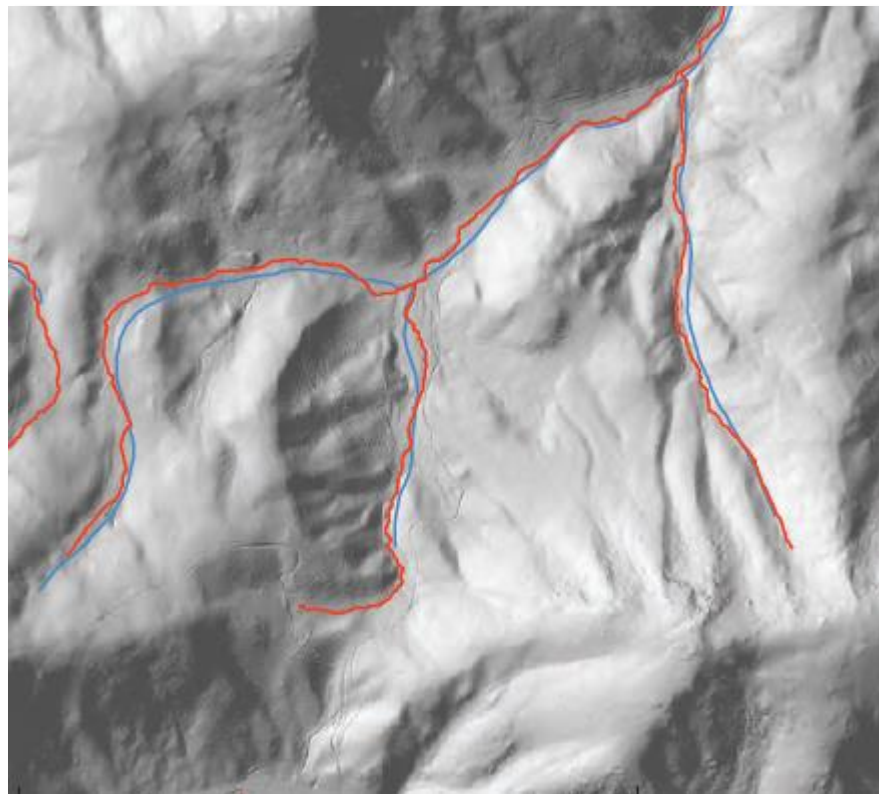


Specifications

Delineation of Features - Minimum

- Minimum Set of Features:
 - The minimum required set of **hydrographic features will match the density of existing NHD HR** following “Standards for National Hydrography Dataset” (converted to real world measurements)
 - Removal of features that are no longer present.
 - Addition of visible features should follow the ‘READ Rules’ for connectivity and attribution.

Using NHD as a guide (in blue), better geometry is added, new features added, others deleted if appropriate



Specifications

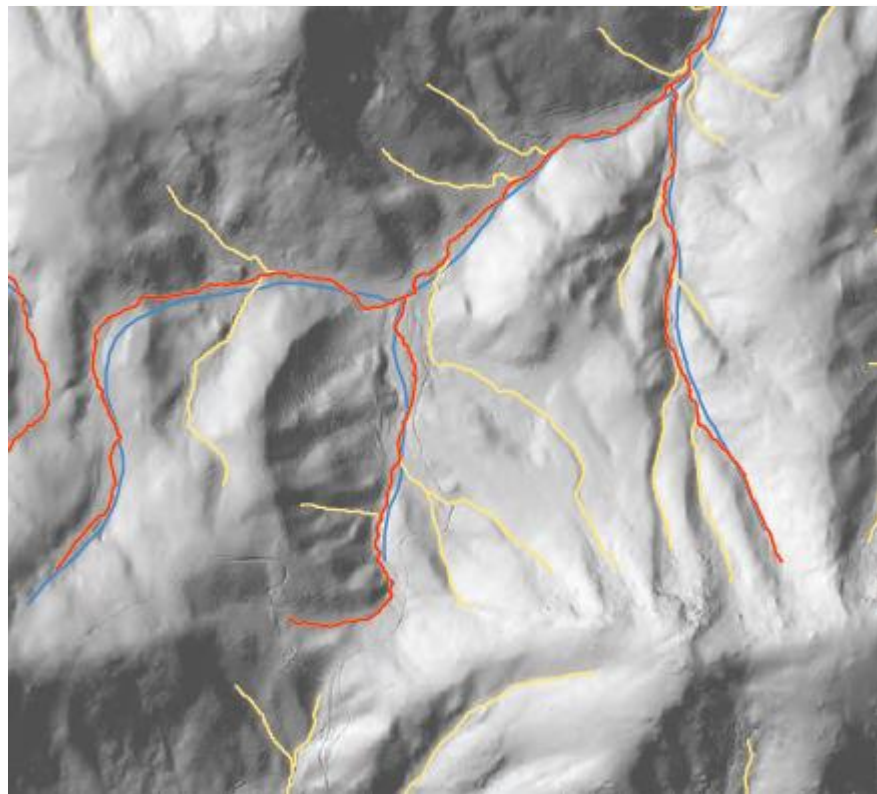
Delineation of Features - Additional

Additional features must meet these requirements:

OR it should be present in an accepted ancillary data source,
OR it is necessary to provide valid network connectivity.

- The method used to define feature extents must be identified in the Method field.
 - Examples: a regression model to determine headwaters, curvature (or other geomorphic algorithm) to delineate stream reaches, or flow direction and accumulation of a drainage path.
- The features should be compared to the 3DEP bare-earth elevation surface to check the accuracy of the method used.

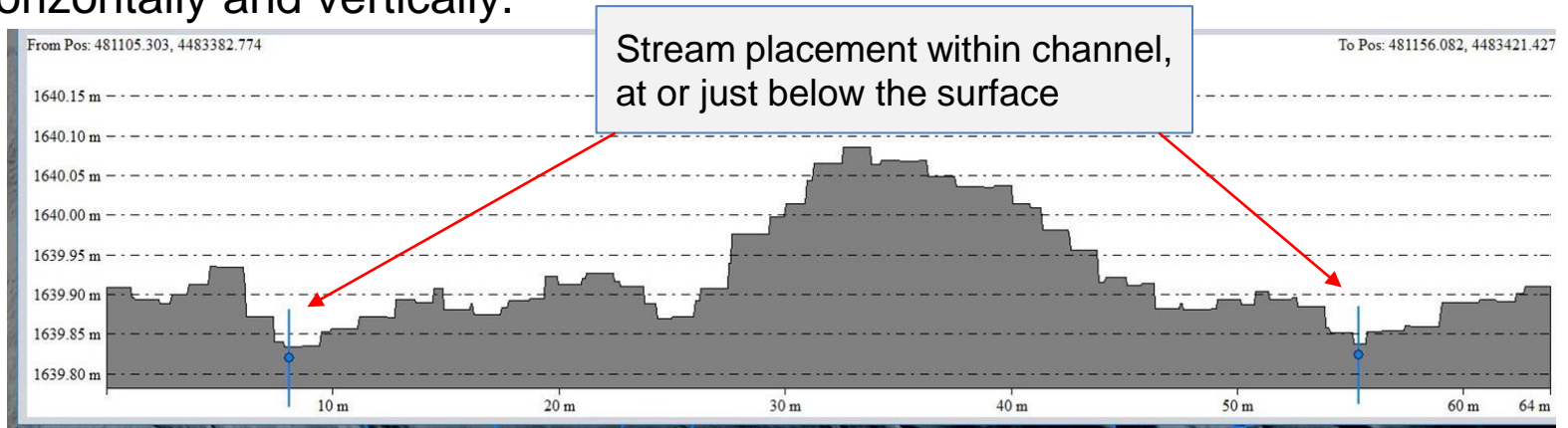
New linework follows visible channels in the elevation. Z-values and FCODES are added. Drainageway used if needed.



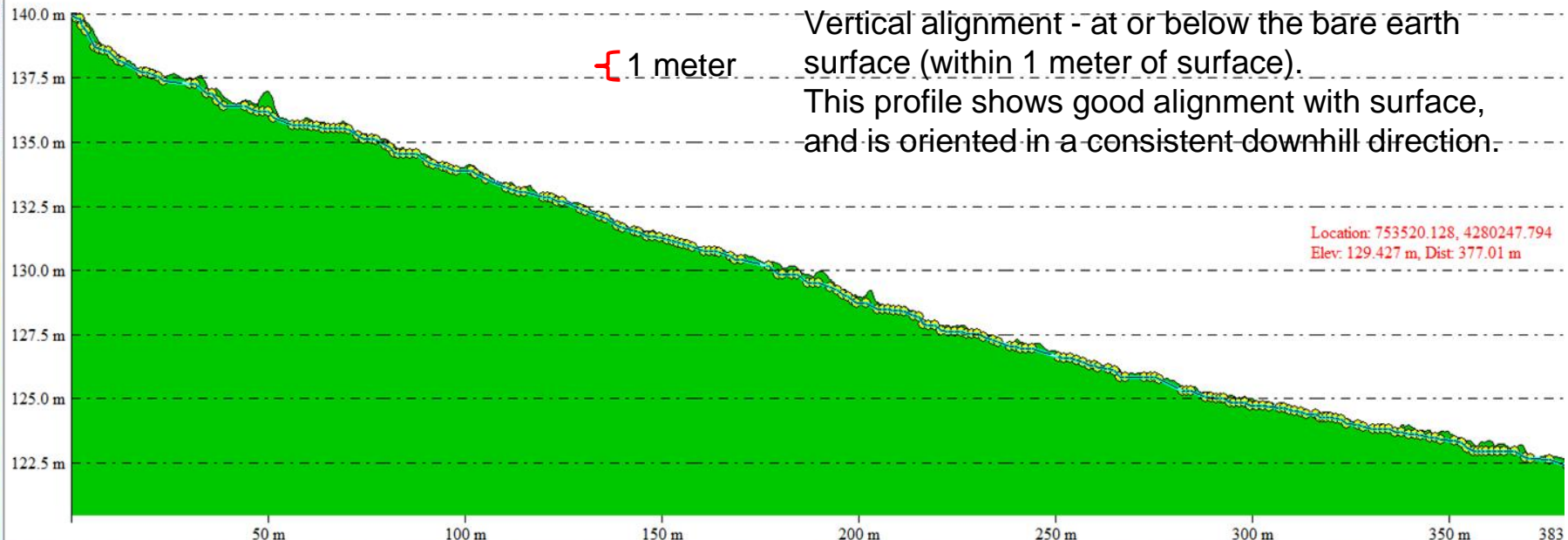
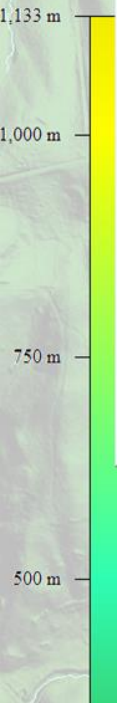
Specifications

Alignment Requirements

- All features shall
 - align with DEM and current NHD where appropriate,
 - have a downstream orientation,
 - edge match between project areas, and
 - be logically and spatially consistent with the elevation data, both horizontally and vertically.



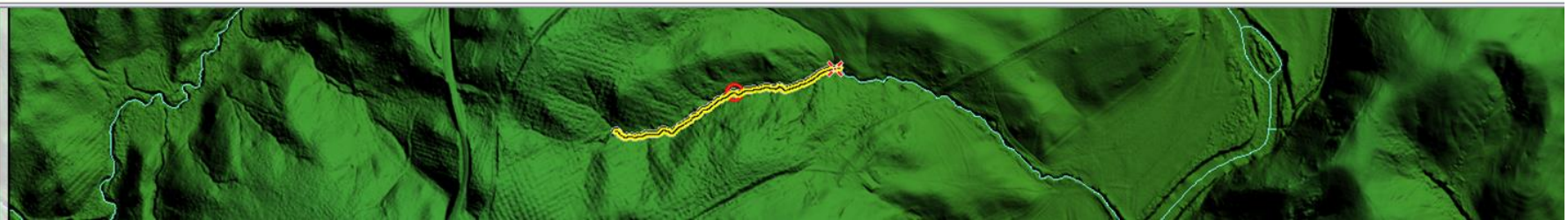
Layer Search



1 meter

Vertical alignment - at or below the bare earth surface (within 1 meter of surface).
This profile shows good alignment with surface, and is oriented in a consistent downhill direction.

Location: 753520.128, 4280247.794
Elev: 129.427 m, Dist: 377.01 m





Elevation-Derived Hydrography
Representation, Extraction, Attribution, and Delineation Rules

Chapter 12 of
Section B, U.S. Geological Survey Standards, of
Book 11, Collection and Delineation of Spatial Data



Techniques and Methods 11-B12

Representation , Extraction, Attribution, and Delineation Rules

Artificial Path

An abstraction to facilitate hydrologic modeling through open waterbodies (figs. 4 and 5).

Attribute/Attribute Value

Each feature requires domain codes to be entered into the attribute table for the feature class (table 4). See "Field Definitions and Domain Values for Attributes" section for more information on EDH code definitions.

Delineation

The limit of artificial path is the connection between the inflow and outflow points of an in-line polygon, the line through a head or terminal open waterbody that connects to the inflow (for terminal), or the outflow point (for head) (fig. 4).

Representation Rules

When delineating a feature, it must be created with the appropriate geometry, either point, line, or polygon, which is determined by the size of the feature or the length along different axes of the feature (table 5).

Special conditions: none.

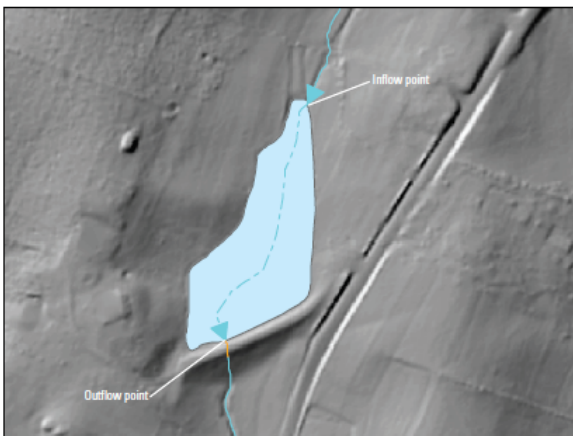


Figure 4. Diagram showing inflow and outflow points of a lake/pond feature.

Data Extraction

Data extraction rules fall into three categories: capture conditions, attribute information, and source interpretation guidelines. The capture conditions explain the requirements for a feature to be collected, and other pertinent information about acquisition. The attribute information explains the definitions of the codes and attributes that must be applied to a feature if acquired, and the source interpretation guidelines give additional information for special circumstances to help determine whether a feature should be acquired or not. Not all features have source interpretation guidelines, and if this is the case, this will be indicated with "None."

Capture Conditions

Artificial paths shall be placed in all polygons except isolated reservoirs, isolated lake/ponds, and isolated basins (reservoirs, lake/ponds, and basins not connected to the stream network). Artificial paths shall represent the shortest path from the inflow to the outflow without crossing through banks or islands.

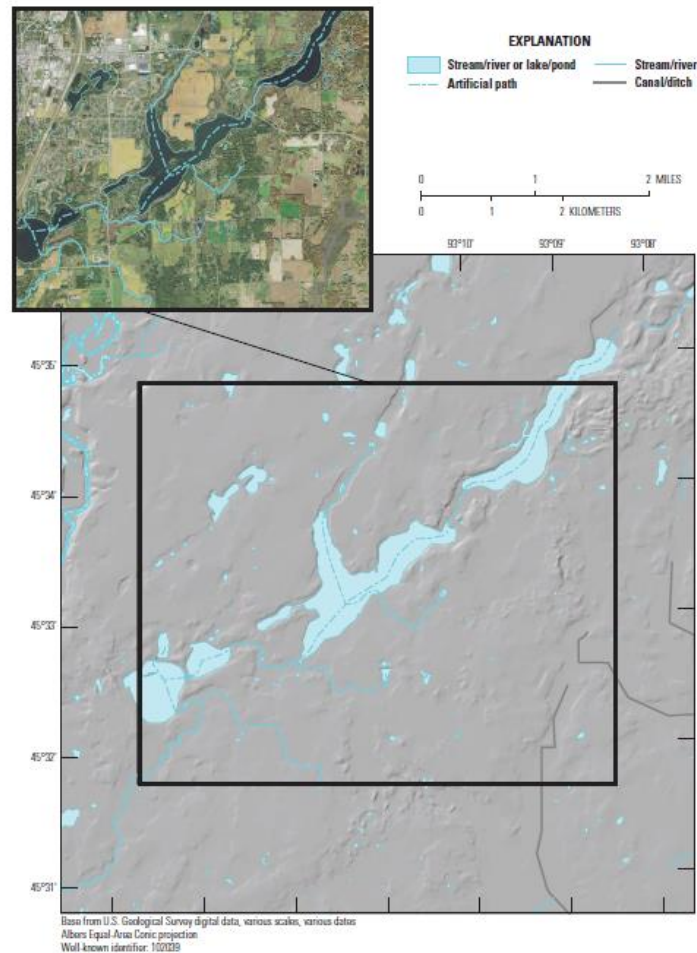


Figure 5. Example of artificial path features in Lake Fannie in Minnesota. Source data are from the National Hydrography Dataset (U.S. Geological Survey, 2020), which is used to provide examples of hydrographic feature types but may not have the same density and other characteristics of elevation-derived hydrography.



Elevation- Derived Hydrography Website

Delineation and Attribution Error Examples

Error Examples

HOME

STANDARDS AND SPECIFICATIONS

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ABOUT

Elevation-Derived Hydrography Specifications

The USGS provides specifications, READ Rules, and additional resources for the acquisition of elevation-derived hydrography (EDH) from distributed 3DEP products for inclusion in the National Hydrography Dataset.

Elevation-Derived Hydrography Acquisition Specifications

[View Document](#)

Elevation-Derived Hydrography—READ Rules

[View Document](#)

Resources

Help Guides and Checklists
Document Library

Topology and Network Error Examples

Delineation and Attribution Error Examples

Contacts

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Support for NHD, WBD, & NHDPlus HR
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Email: nhd@usgs.gov

Elevation-Derived Hydrography Website

<https://www.usgs.gov/core-science-systems/ngp/ss/elevation-derived-hydrography-specifications>

Error: Dam connector length

Issue: Connectors through dams or berms that extend too far in one or both directions across the obstruction.

Solution: If a connector feature is required through a dam or berm, it should only extend the distance across the dam structure, and no further (but be sure to connect low points on both sides).

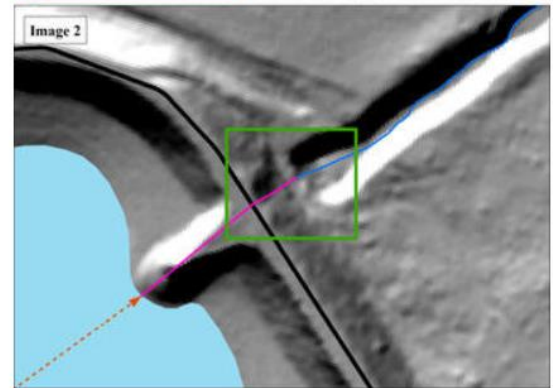
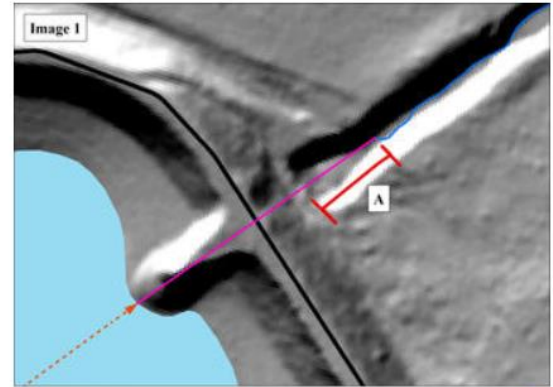


Image 1 is an example of a dam connector that is too long, ending past the edge of the dam. Image 2 is an example of a correctly delineated dam connector, ending at the edge of the dam.

(Public domain.)

Future Direction

- Tools and QC procedures are being developed now for Alaska and a couple of pilot areas.
- No formal funding to support the capture of EDH with lidar right now.
- 3DEP BAA process is constrained by congressional earmarks for funding.
- Currently the 3DEP funding is specifically targeted to lidar collection.
- The USGS would like to encourage the collection of hydrography with lidar in the future – currently working towards a mechanism to do this.
- We are hoping that the conflation of EDH to NHD is simpler and cleaner because topology and features match what is required in NHD.
- We hope to initiate additional pilot projects to continue to test and refine the process.

Other NGP topics:

- Trails – local/county/state
- Lidar QL 1 data

