

DIGITAL MAPPING TECHNIQUES 2023

The following was presented at DMT'23

May 21 - 24, 2023

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2023)

<http://ngmdb.usgs.gov/info/dmt/>

Major mapping initiatives at the Pennsylvania Geological Survey include producing GeMS- compliant map submissions and generating elevation-derived hydrography. This presentation details a case study in which elevation-derived hydrography was included in a GeMS package and discusses necessary considerations of the relationship between surficial lithologic contacts and hydrography.

Integrating Elevation-Derived Hydrography with Mapping at the Pennsylvania Geological Survey

Ellen Fehrs, Senior Geoscientist

Pennsylvania Geological Survey

efehrs@pa.gov

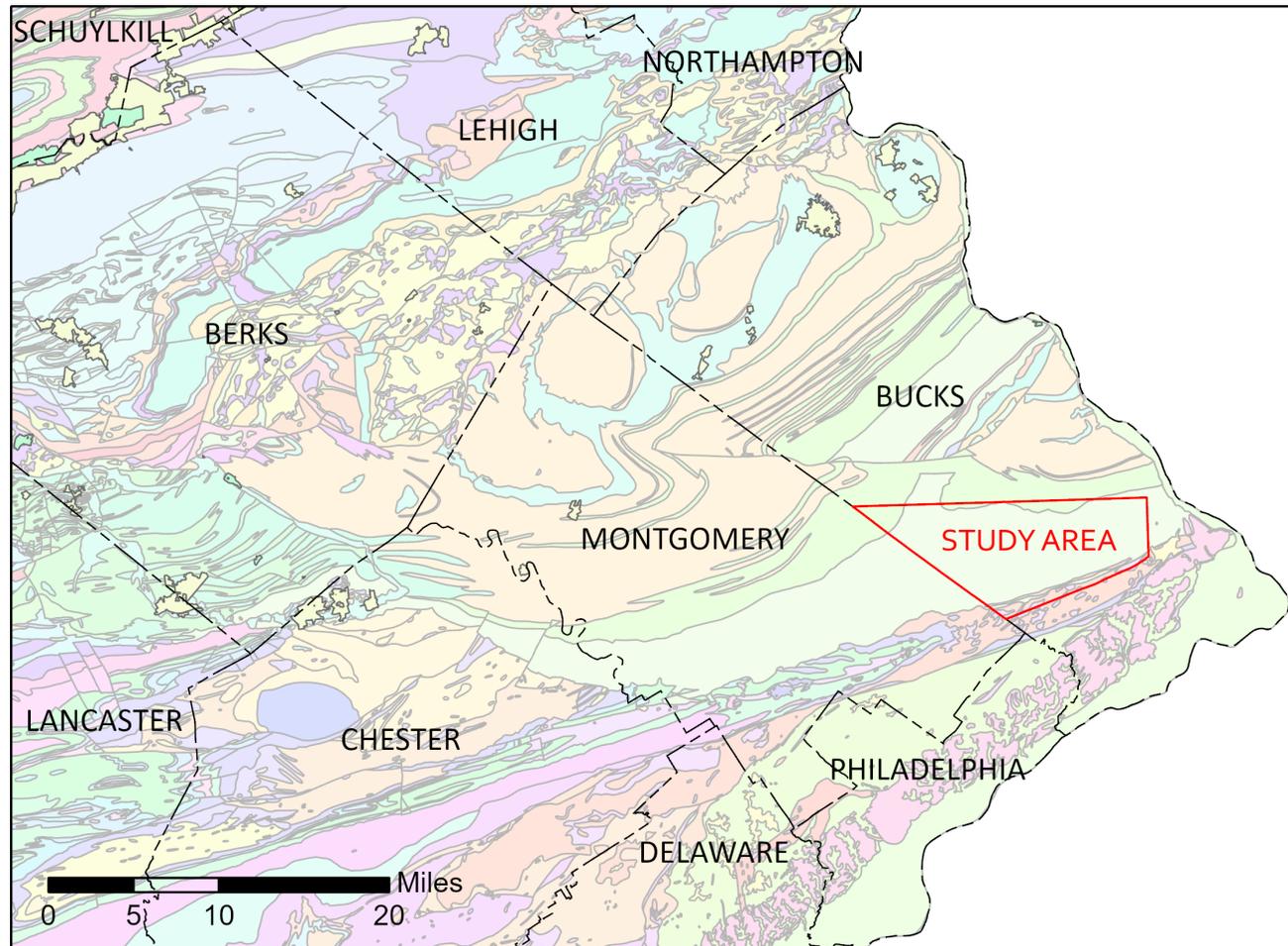


Contents

- Bucks County Project
- Hydrography
- Lessons Learned

Bucks County Project

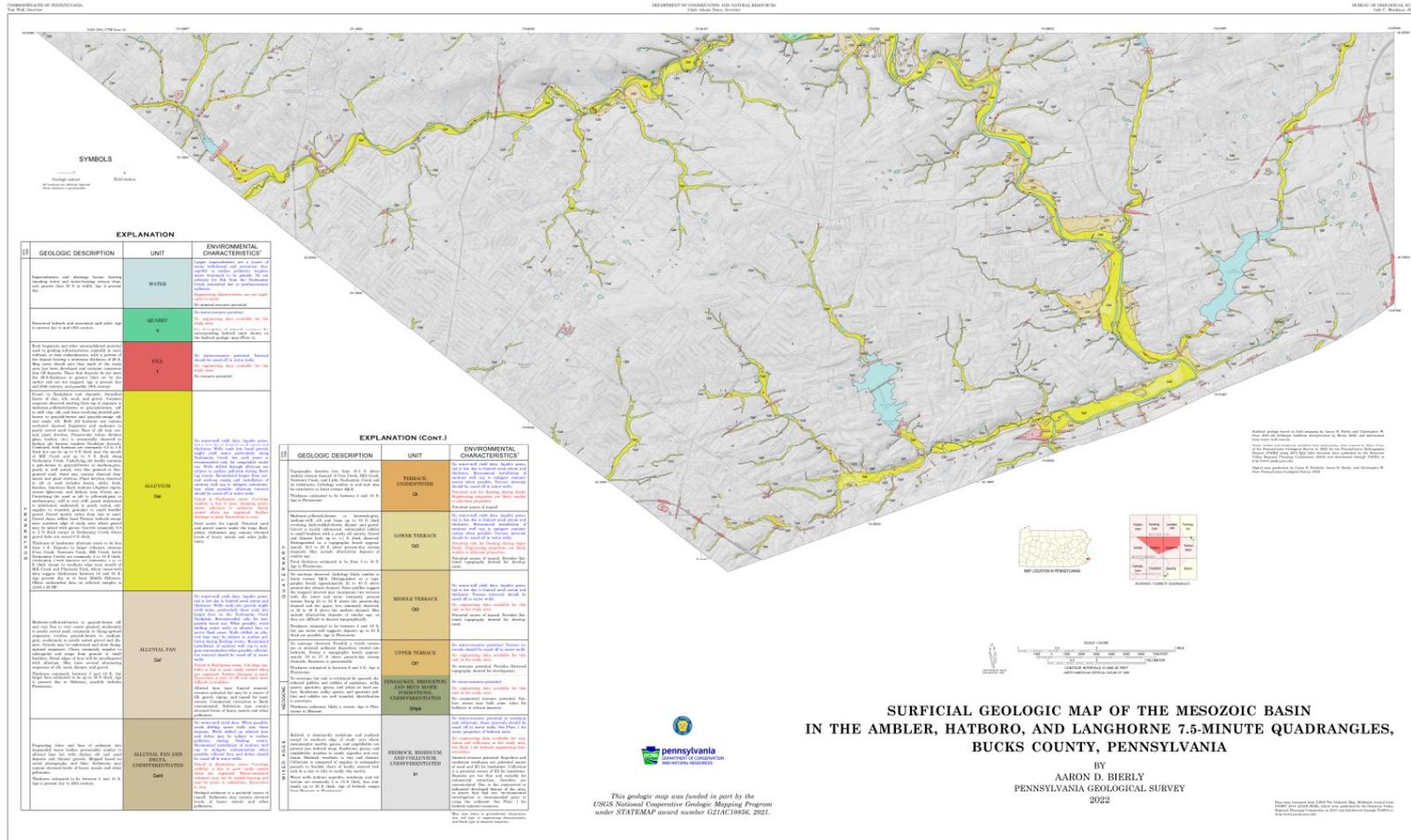
Area



SURFICIAL GEOLOGIC MAP OF THE MESOZOIC BASIN IN THE AMBLER, HATBORO, AND LANGHORNE 7.5-MINUTE QUADRANGLES, BUCKS COUNTY, PENNSYLVANIA

BY
AARON D. BIERLY
PENNSYLVANIA GEOLOGICAL SURVEY
2022

This map was prepared from USGS Topographic Maps, 7.5-minute scale (from USGS 1:25,000 7.5-MINUTE BOM, which was published by the Delaware Valley Regional Planning Commission in 2007 and distributed through FORTIS, et al.)



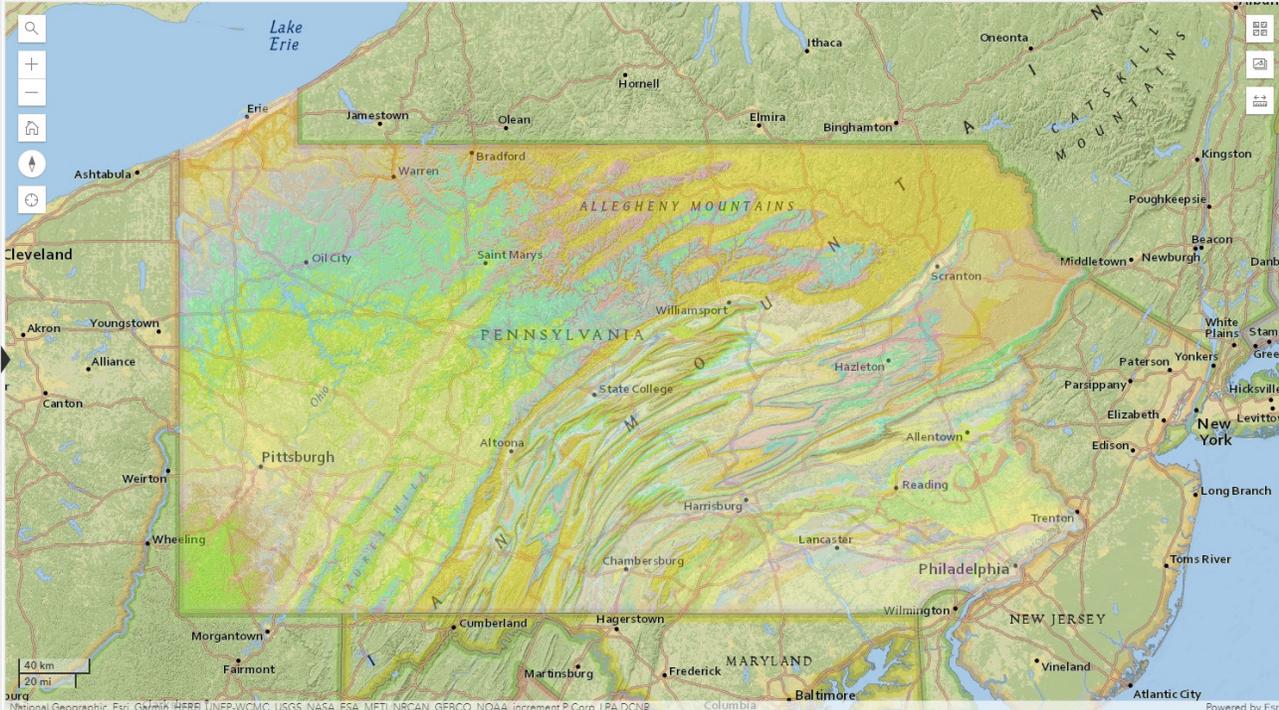
PaGEODE

 PaGEODE - Pennsylvania GEOlogic Data Exploration
Geological Survey

Josh Shapiro, Governor | Cindy Adams Dunn, Secretary

Links - About Help  

- Publication Search >
- Surficial Geology Search >
- Bedrock Geology Search >
- Elevation Profile >
- Identify Results >
- Layers >
- Legend >
- Print >
- Download Data >



40 km
20 mi

Feedback



www.gis.dcnr.state.pa.us/pageode/

GeMS Requirements

1. Hydrography and surficial units/contacts go into the same feature classes

Spoiler: We talked to Evan Thoms.

MapUnitPolys (Polygon Feature Class)

The MapUnitPolys polygon feature class contains all the units within the mapped area: geologic map units, areas of open water, permanent snowfields, or glaciers, as well as any unmapped areas. Table 12 describes the fields (and their values) in MapUnitPolys.

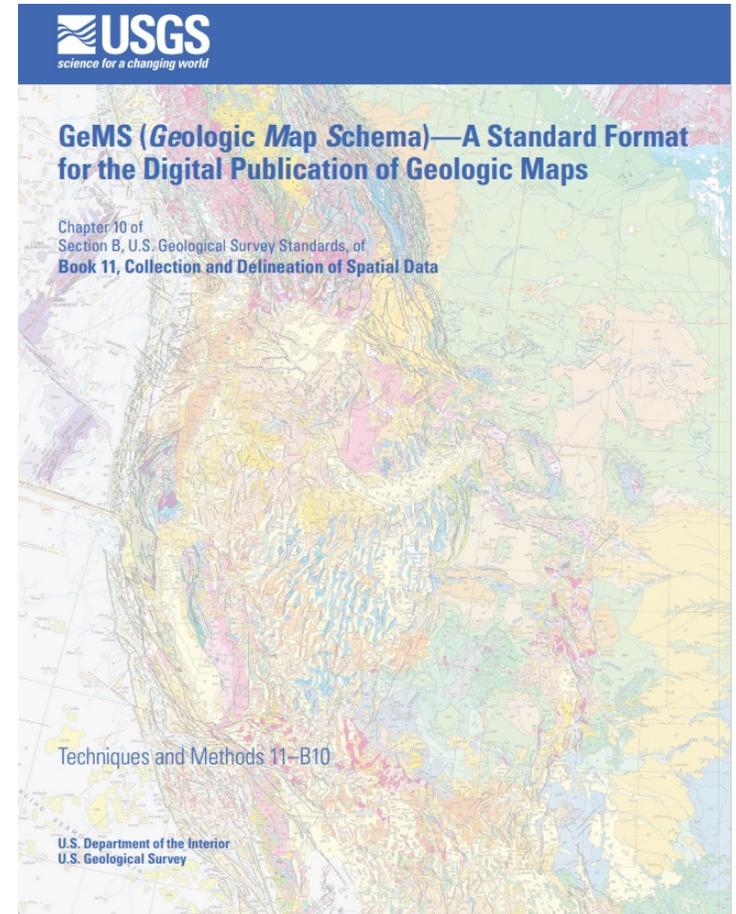
Note that areas of open water (for example, lakes, wide rivers), glaciers, snowfields, and unmapped areas must be included in MapUnitPolys, and they must have non-null MapUnit values (examples would be MapUnit = "water", "glacier", "unmapped"); however, such areas commonly are not labeled with their MapUnit values (therefore, Label = <null>).

(Page 18)

ContactsAndFaults (Line Feature Class)

The ContactsAndFaults line feature class contains the types of lines that bound map-unit polygons; common types are contacts, faults, waterlines, and map boundaries. Table 13 describes the fields (and their values) in ContactsAndFaults.

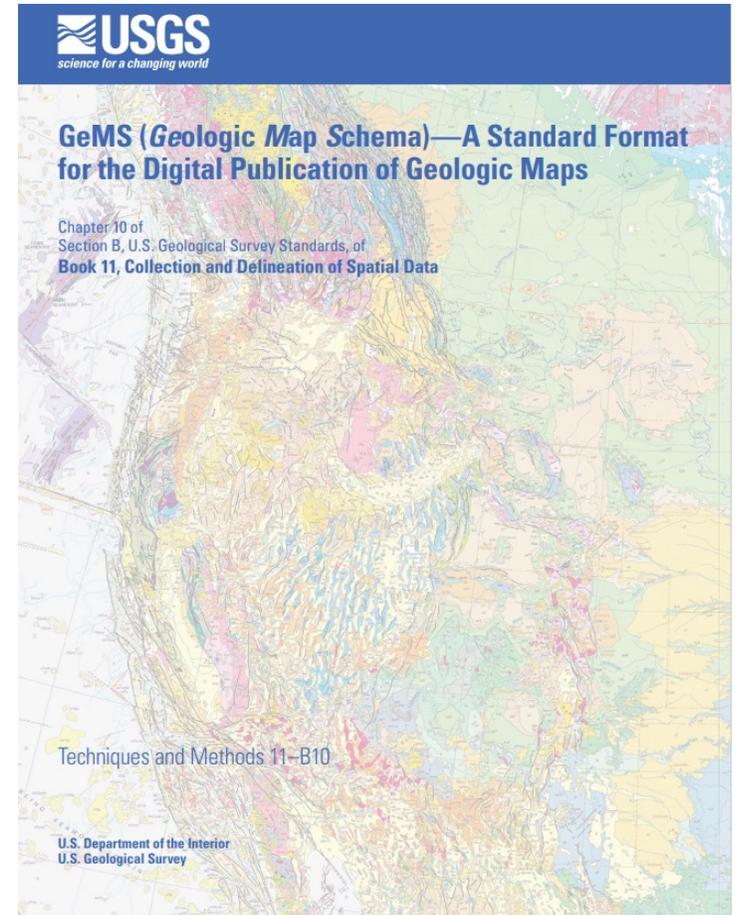
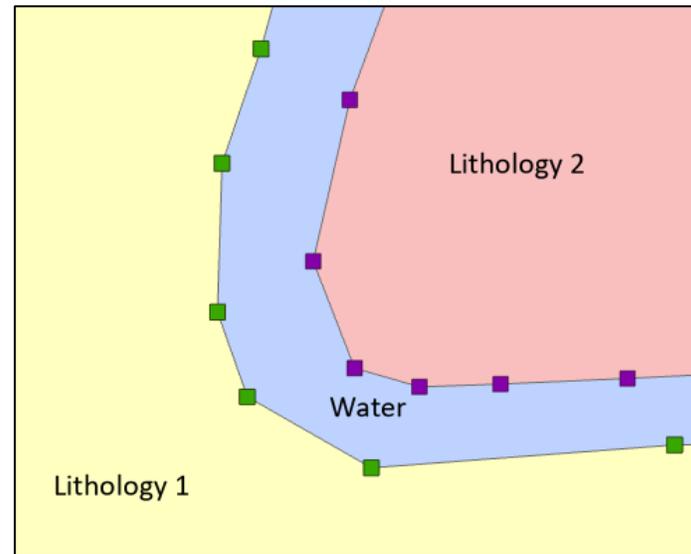
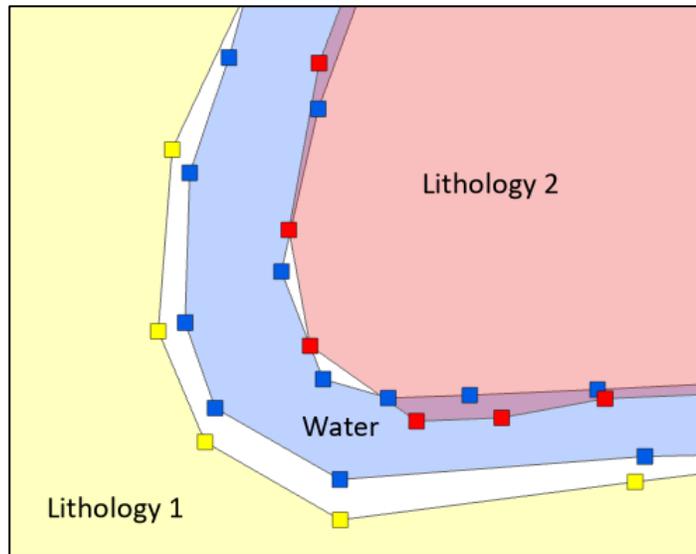
Map boundaries, open-water boundaries, and snowfield and glacier boundaries delineate the edge of certain map-unit polygons. In this sense, they are contacts, and, therefore, they are included in this feature class.



(Above) U.S. Geological Survey National Cooperative Geologic Mapping Program, 2020, GeMS (Geologic Map Schema)—A standard format for the digital publication of geologic maps: U.S. Geological Survey Techniques and Methods, book 11, chap. B10, 74 p., <https://doi.org/10.3133/tm11B10>.

GeMS Requirements

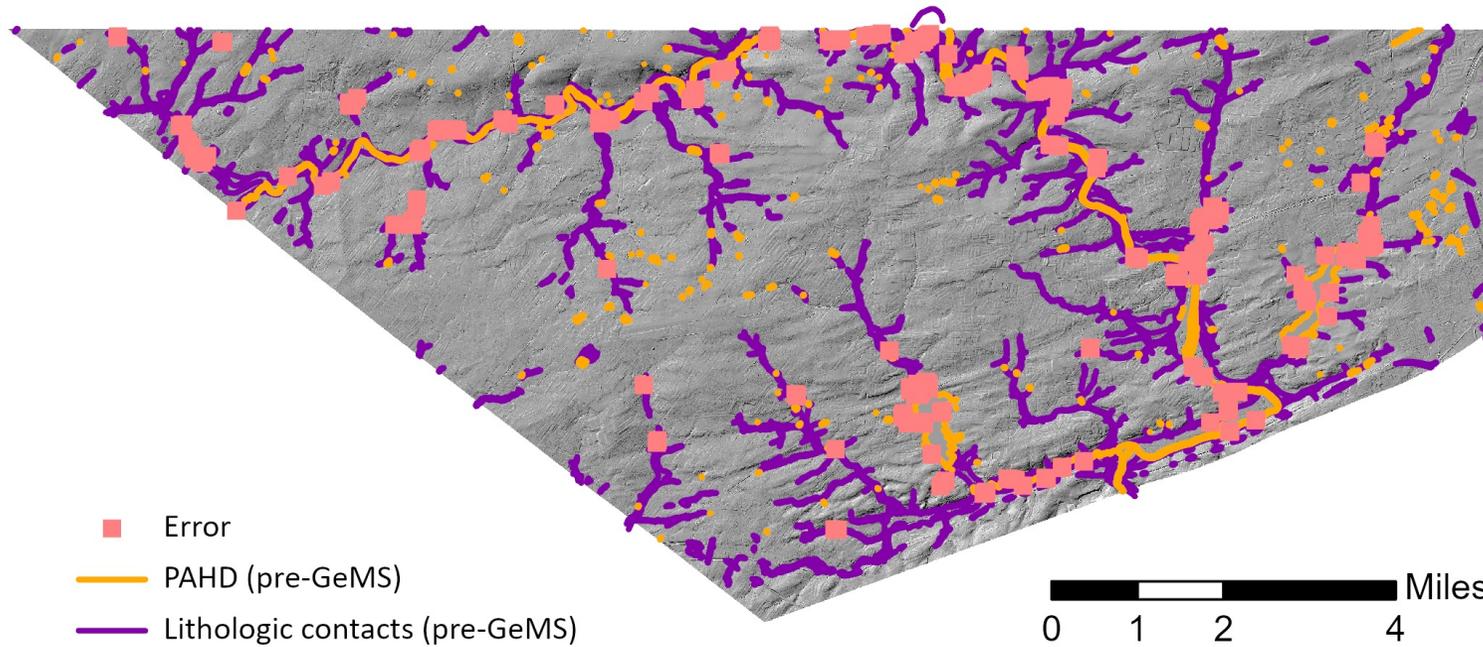
1. Hydrography and surficial units/contacts go into the same feature classes
2. Topology rules for those feature classes



(Above) U.S. Geological Survey National Cooperative Geologic Mapping Program, 2020, GeMS (Geologic Map Schema)—A standard format for the digital publication of geologic maps: U.S. Geological Survey Techniques and Methods, book 11, chap. B10, 74 p., <https://doi.org/10.3133/tm11B10>.

Topology Errors

437 topology errors



Hydrography

PAHD Background

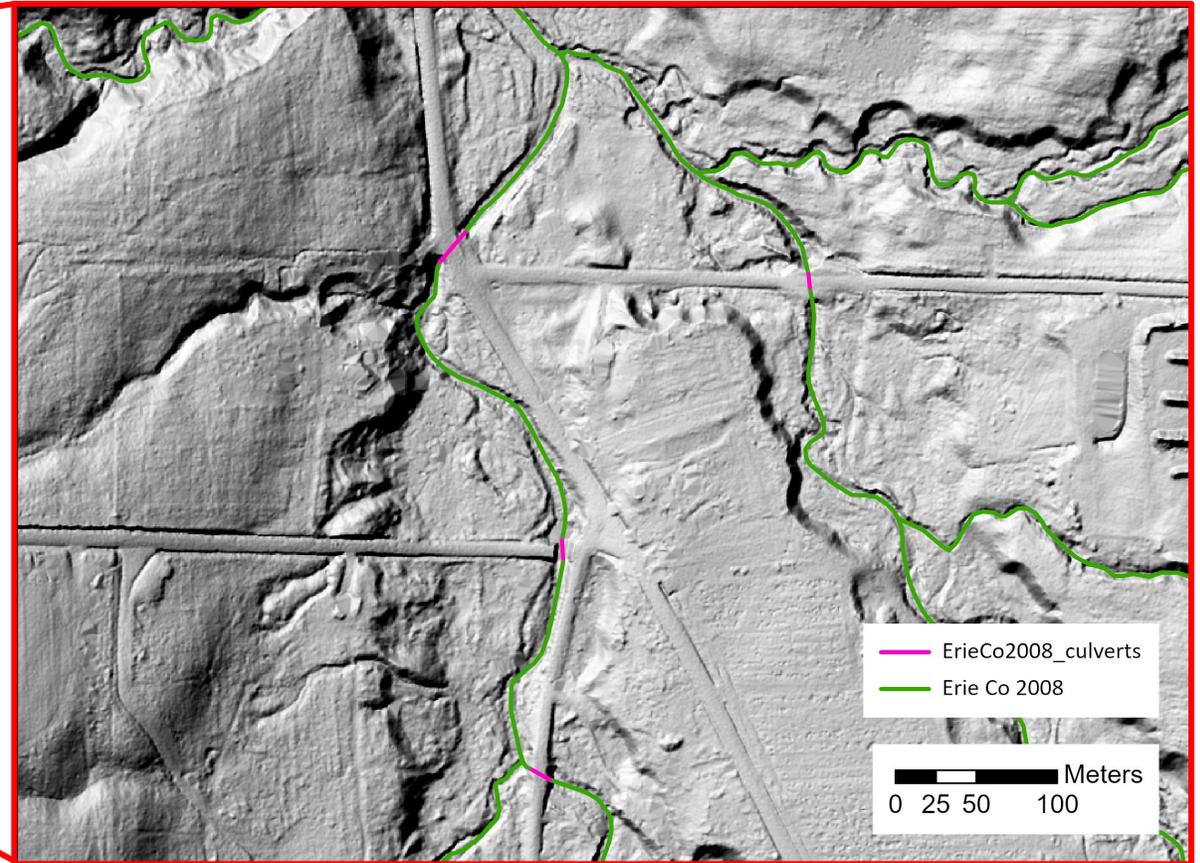
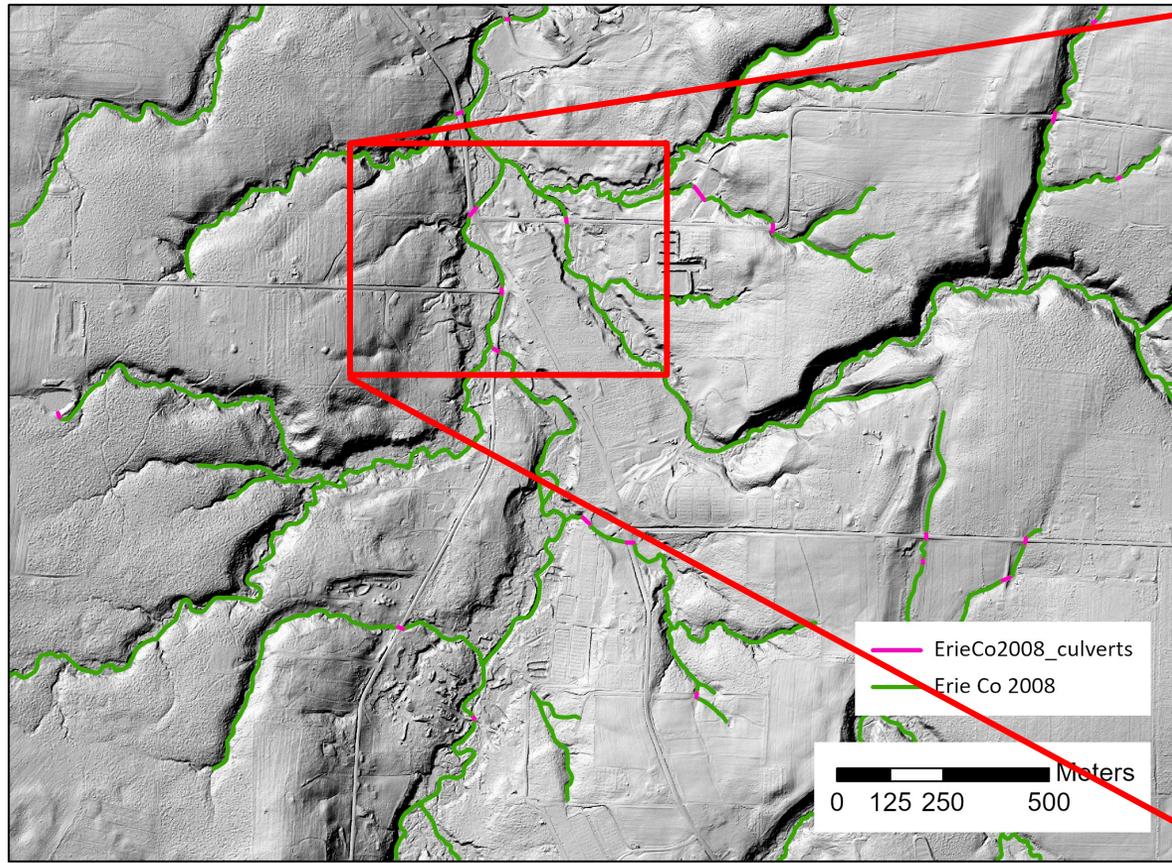
- Began in 2019
- The goal was/is to create and curate a dataset of elevation-derived hydrography
- As new cycles of lidar are flown, this data is to be updated to reflect spatial and temporal changes



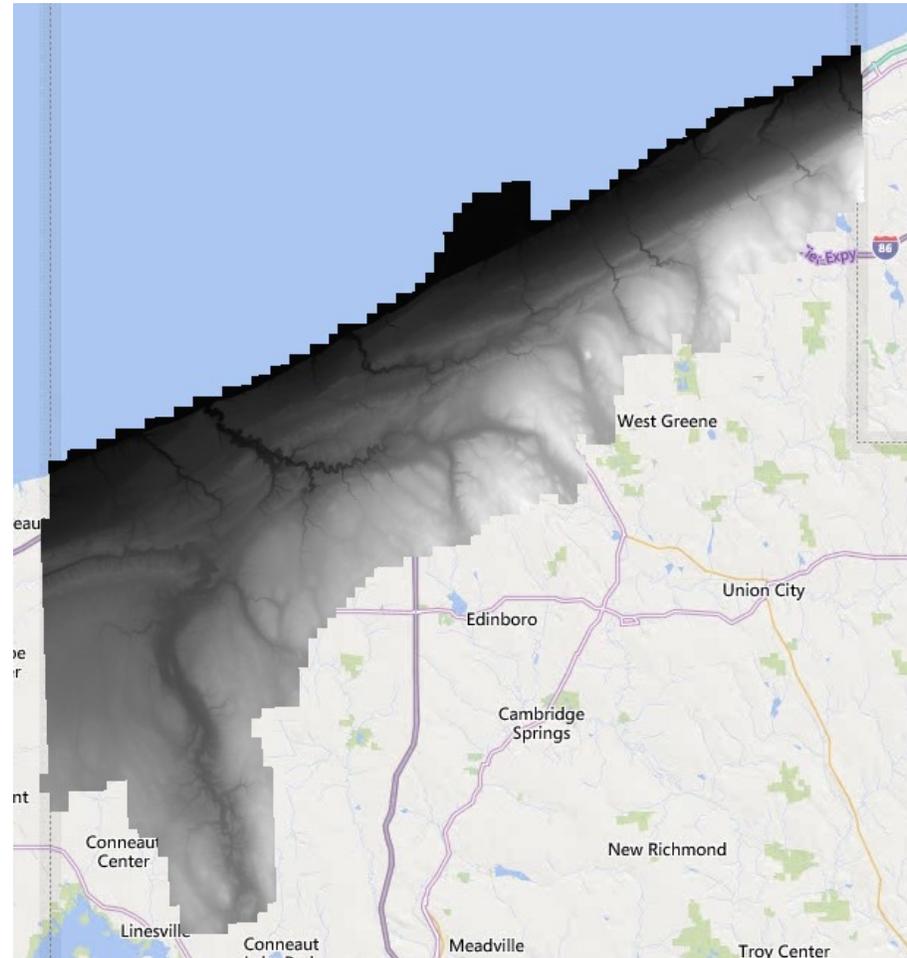
Why PAHD?

- National Hydrography Dataset Plus High-Res (NHDPlus HR) is not accurate enough to suit our needs
- When I was hired, there were no formal plans for a national elevation-derived hydrography project
- Now that there are plans for 3DHP, the PA Geological Survey still wants the control and accessibility of a statewide equivalent
- Organizations have been producing elevation-derived hydrography in Pennsylvania for years

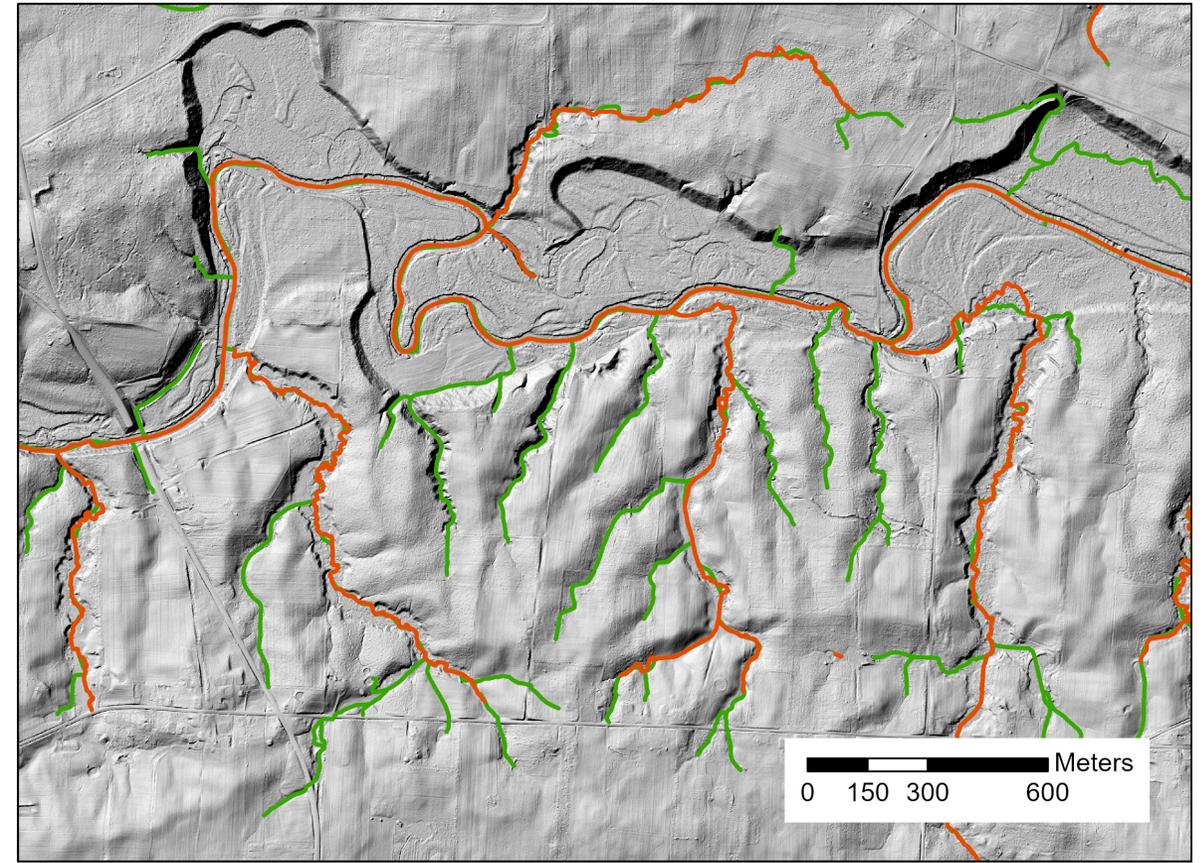
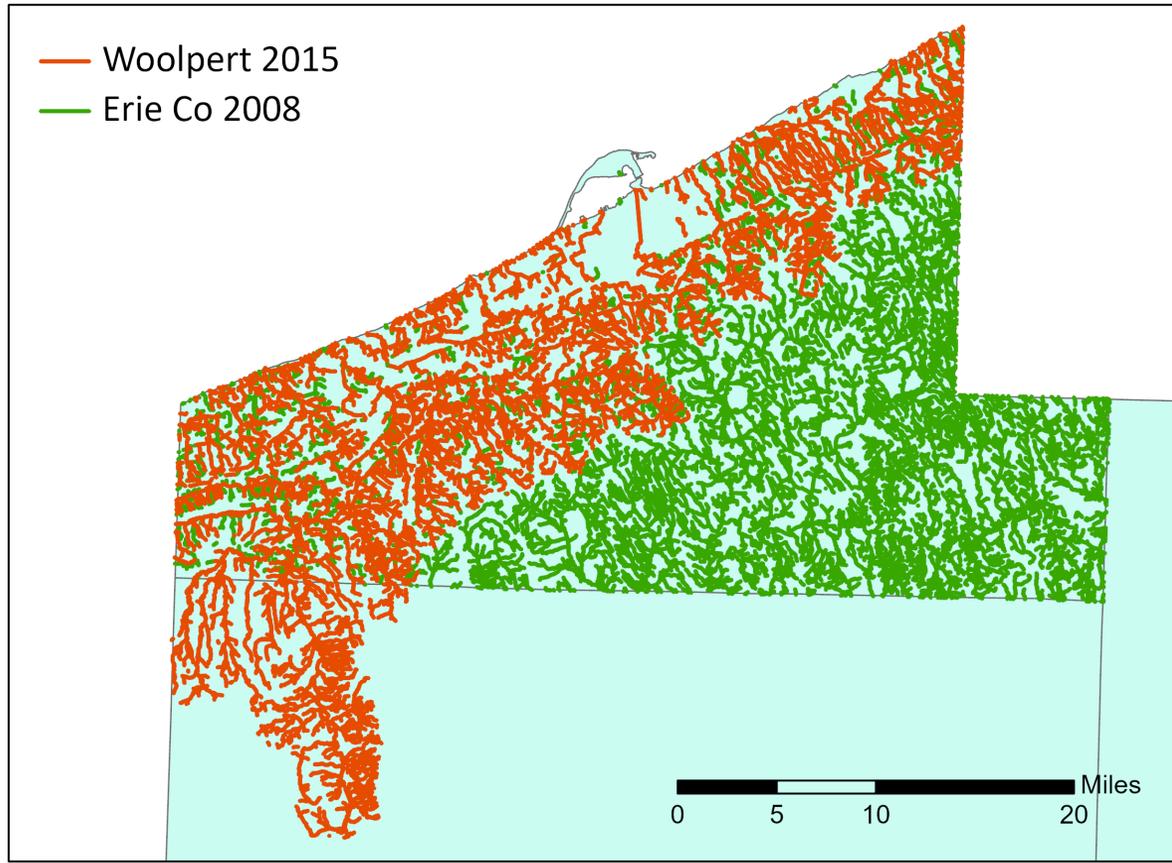
Erie County Hydrography (2008)



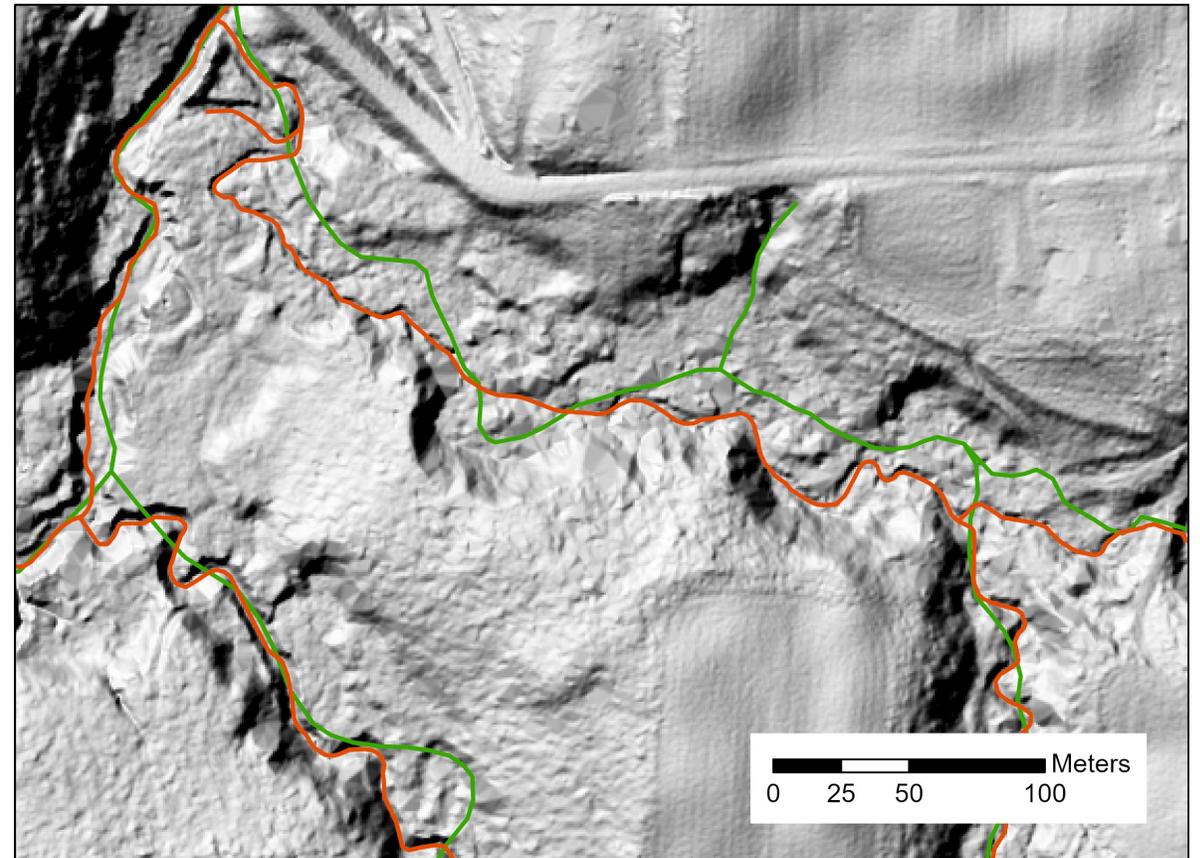
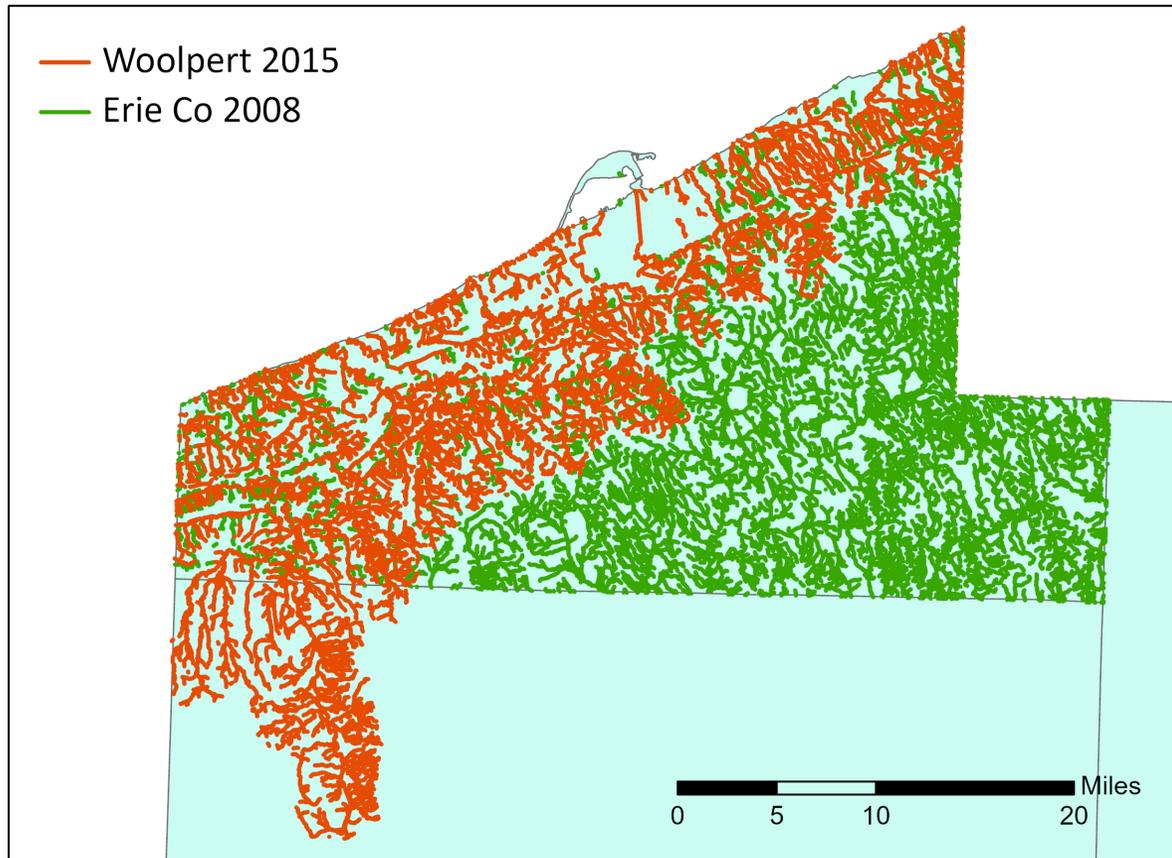
Erie County QL2 Lidar (2015)



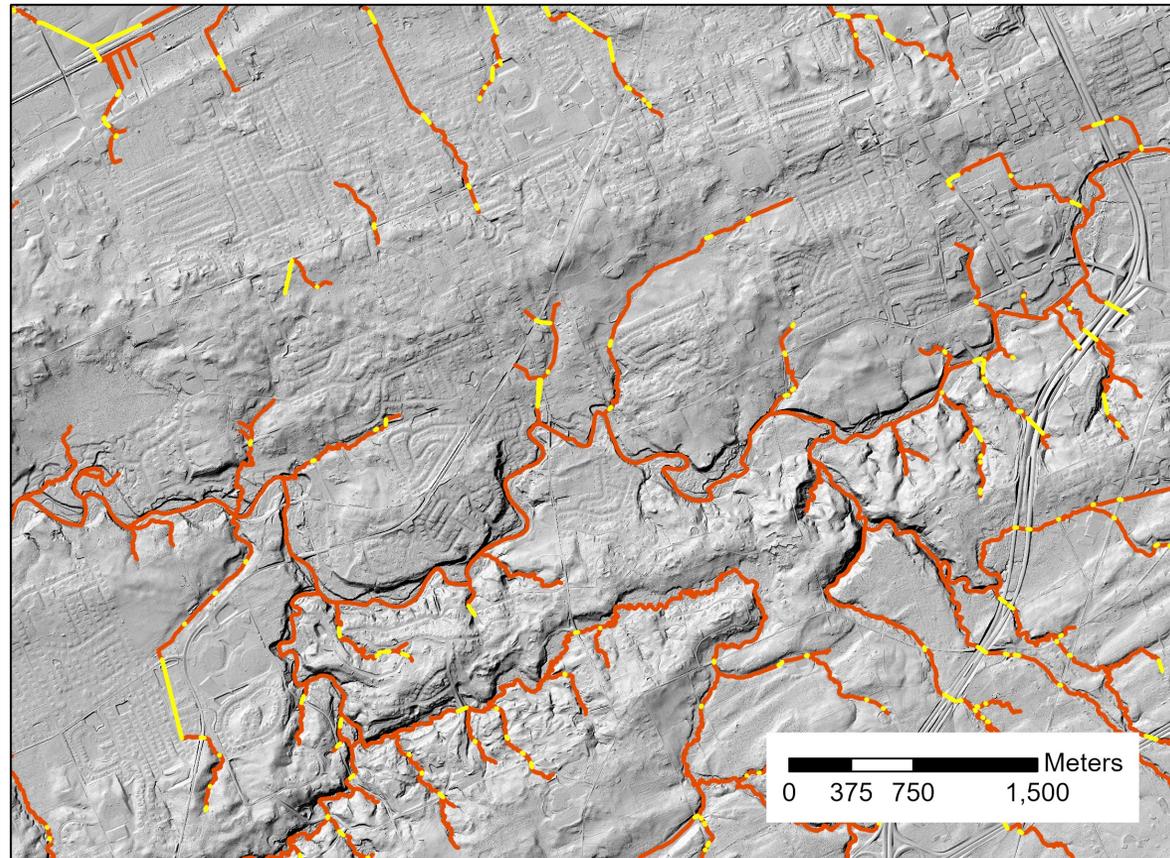
Erie County Hydrography (2008 & 2015)



Erie County Hydrography (2008 & 2015)

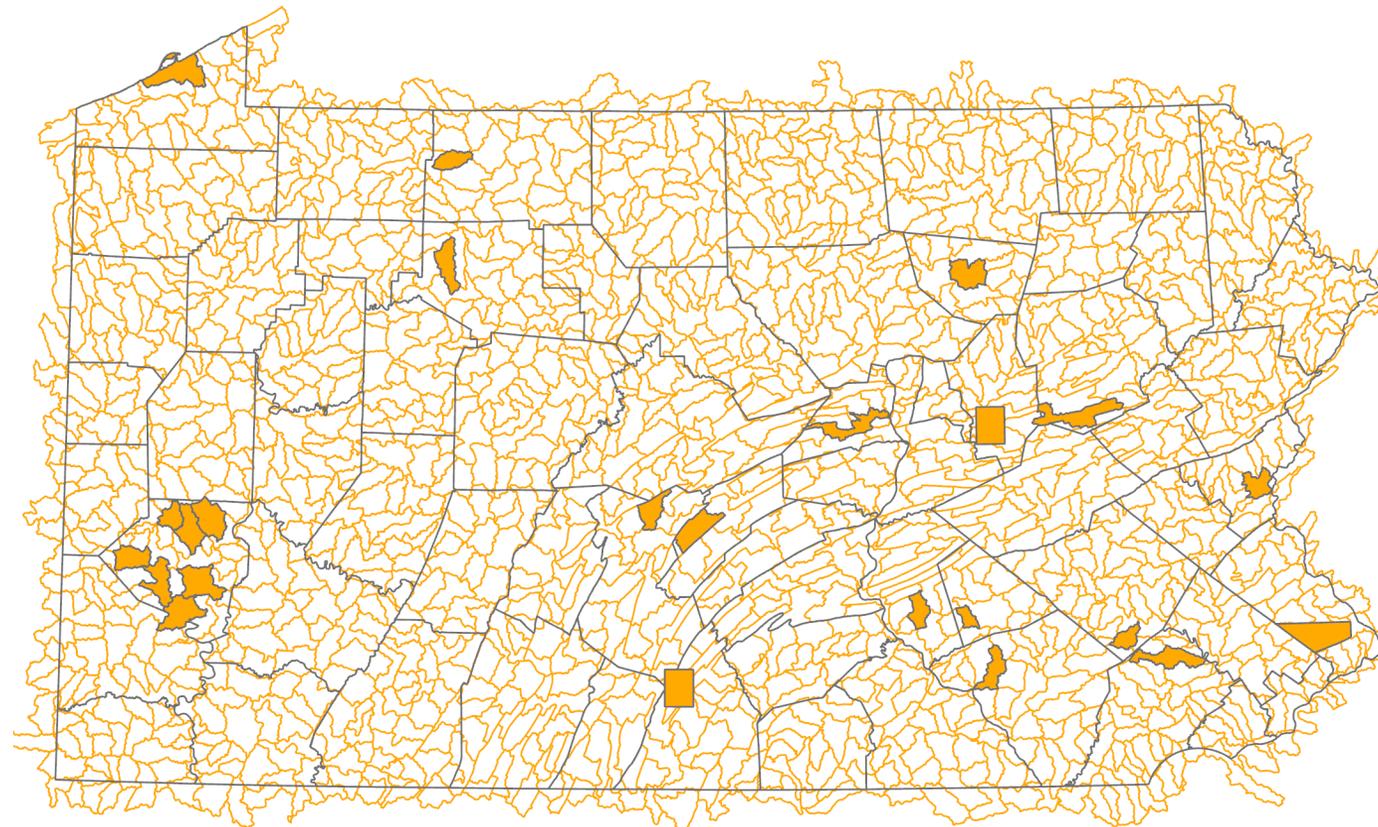


Erie County Hydrography (2015)



- 2015 Hydrography
- 2015 Culverts

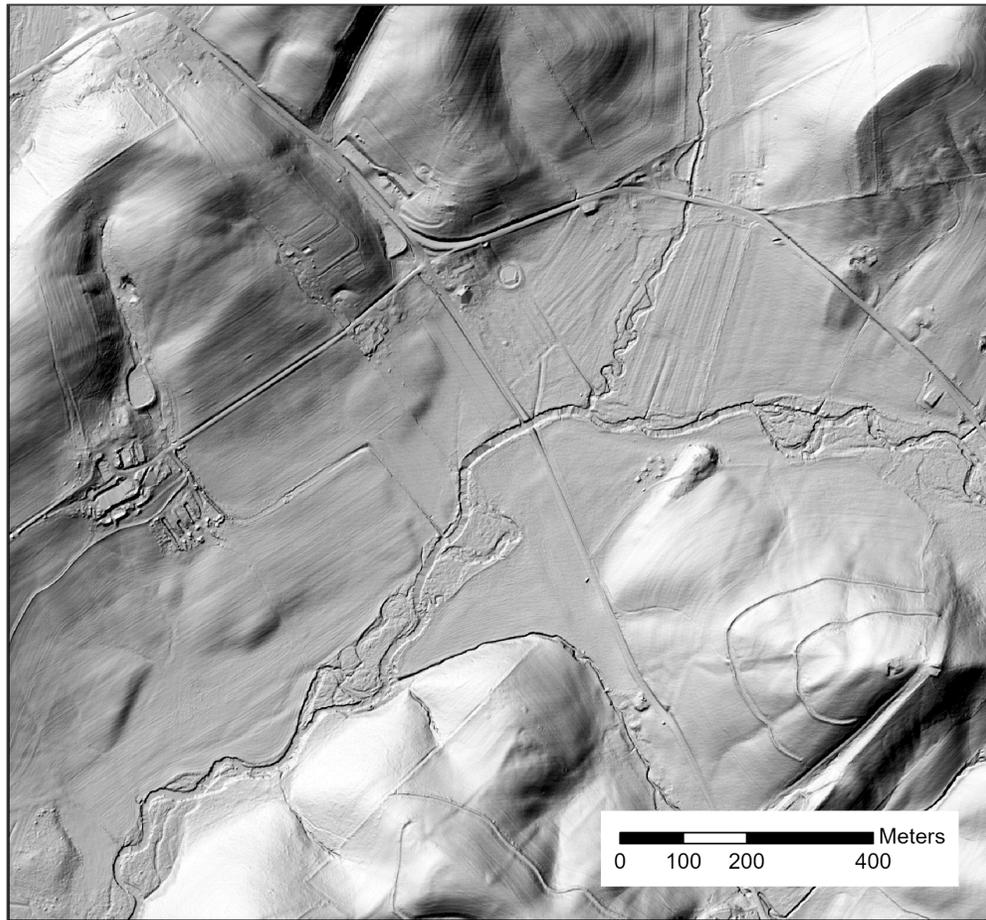
Production



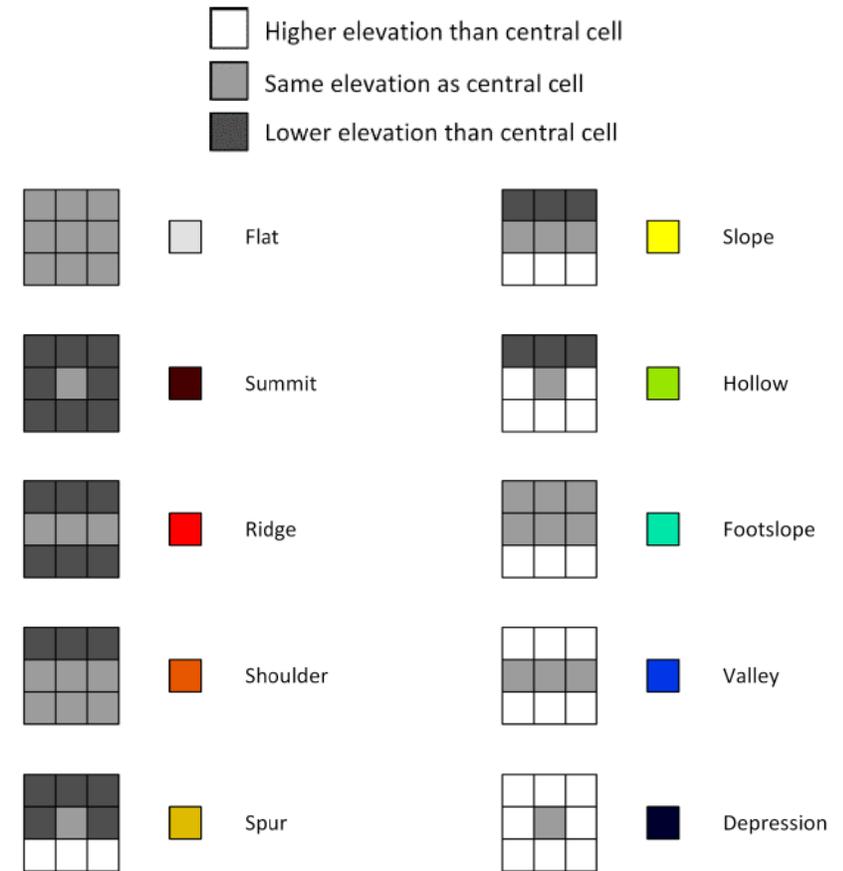
■ PAHD geometries



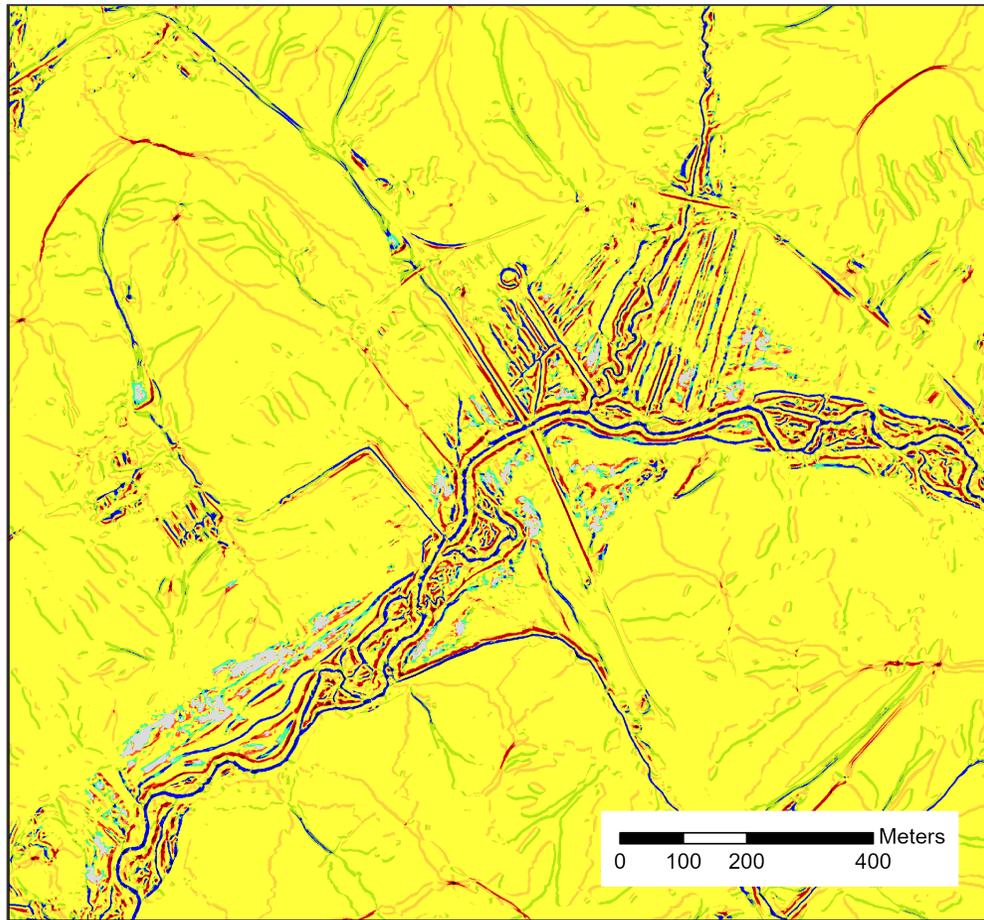
Geomorphons



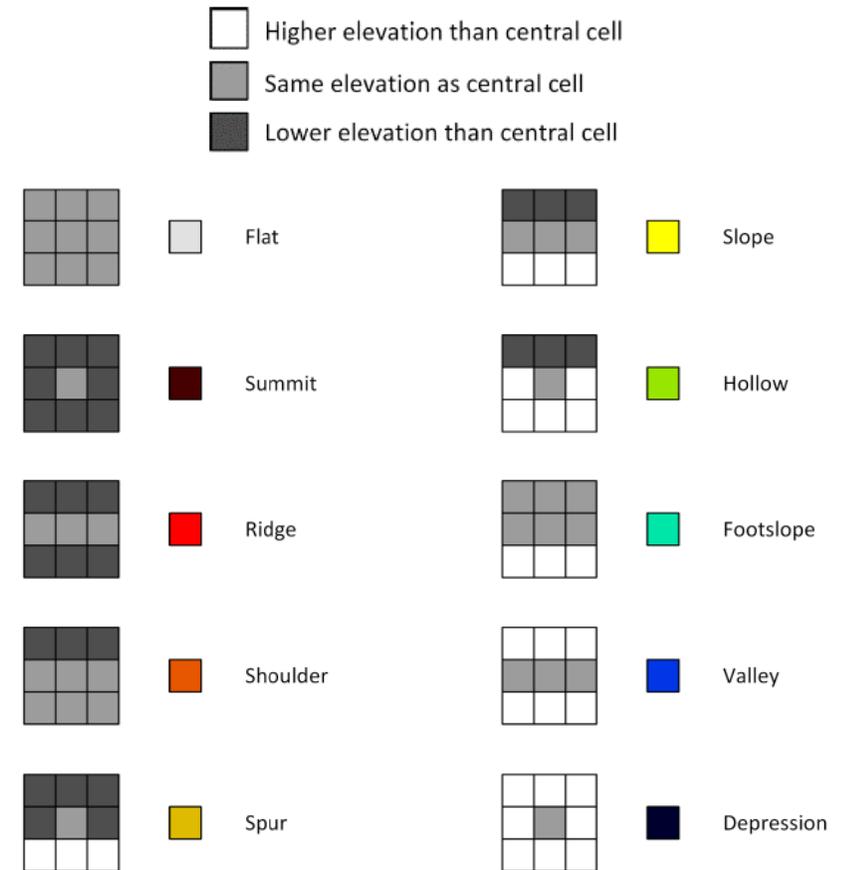
USGS LiDAR 2019 delivery



Geomorphons

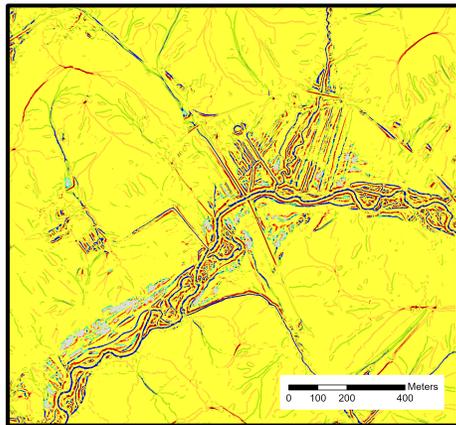


Geomorphon output

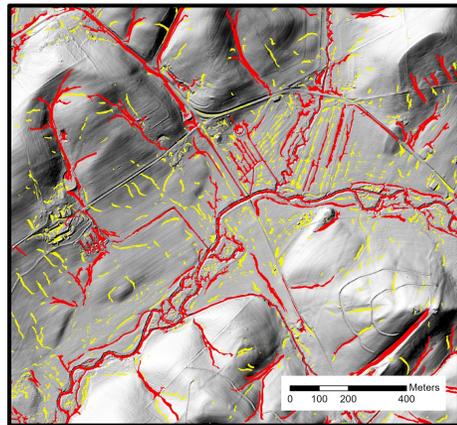


Method

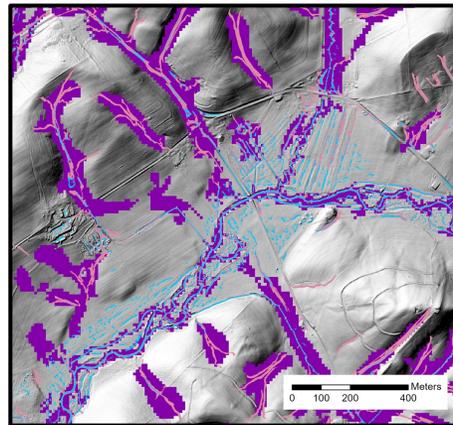
Geomorphons



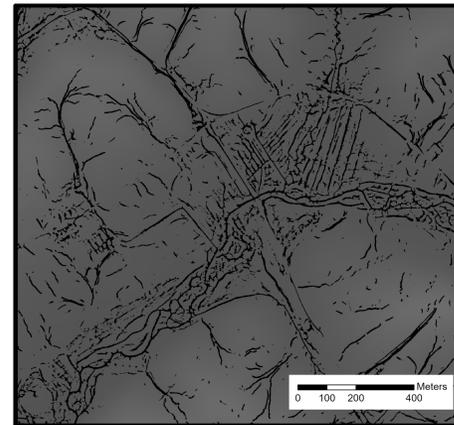
Connectivity



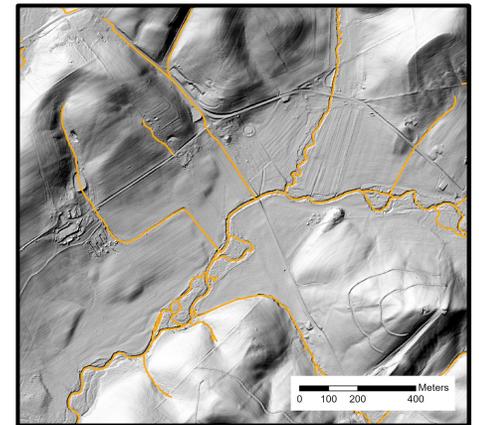
Masking



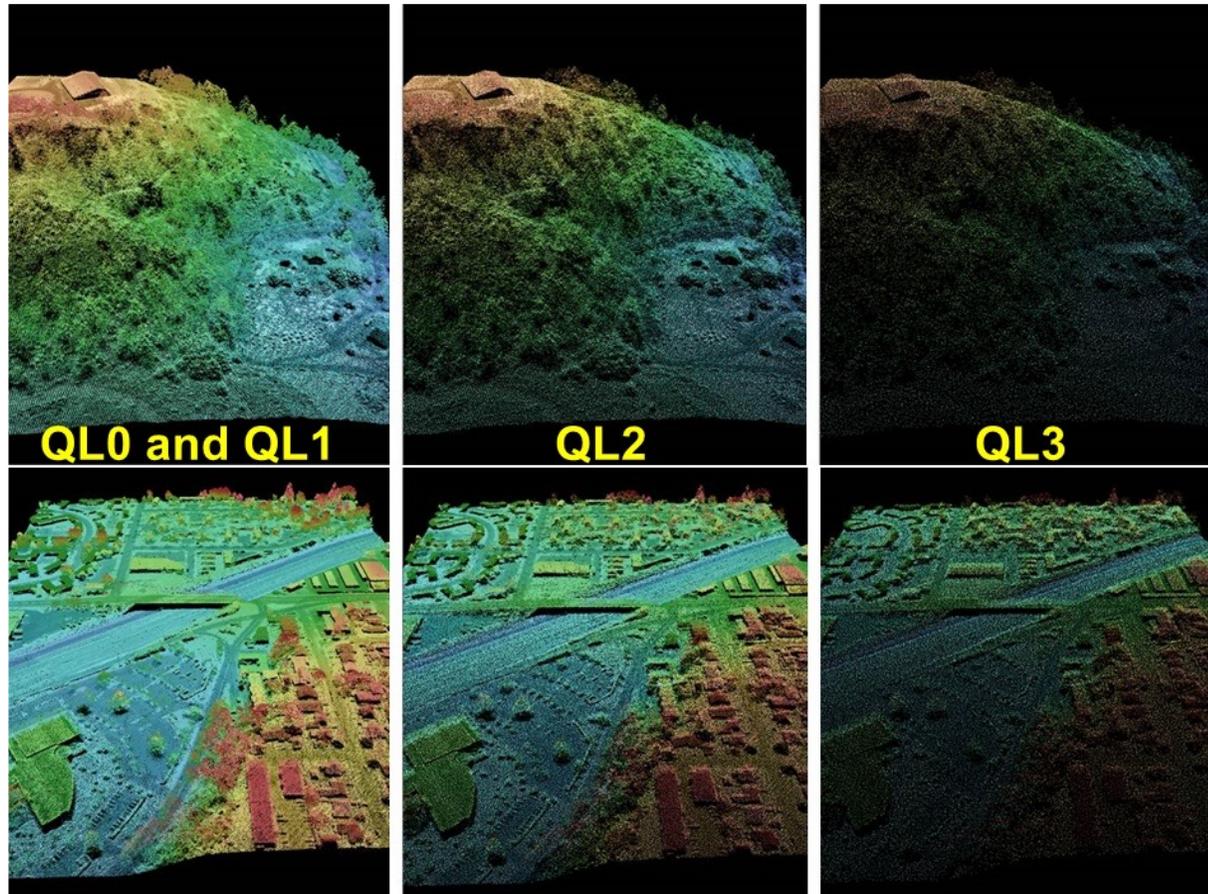
Least-Cost Analysis



Manual Edits



Resolution and Scale



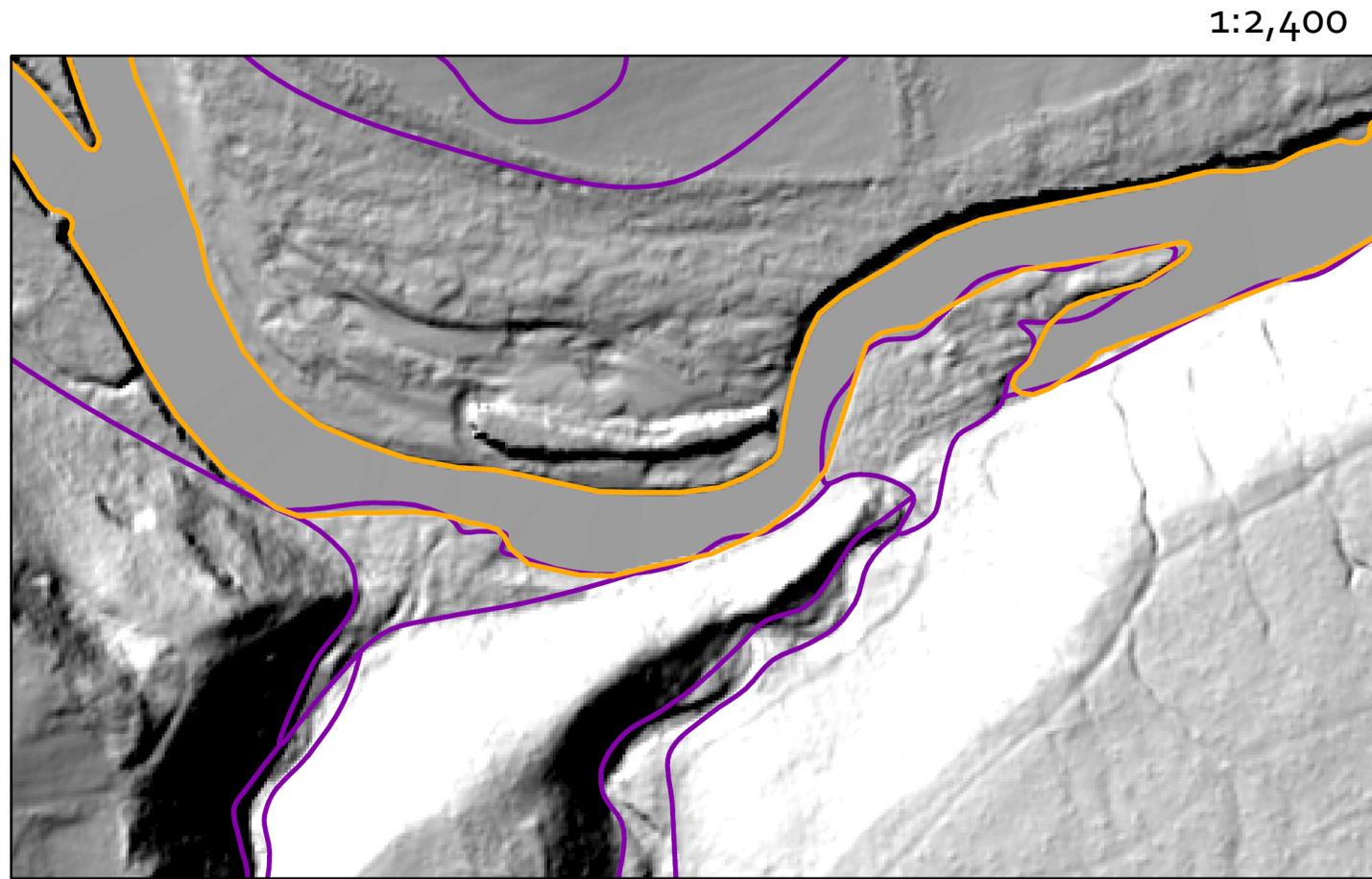
Derivative (DEM) Accuracy

Quality level	Minimum cell size (m)	Minimum cell size (ft)
QL0	0.5	1
QL1	0.5	1
QL2	1	2
QL3	2	5

USGS Lidar Base Specifications, 2018, p. 24, accessed from <https://doi.org/10.3133/tm11b4>.

U.S. Geological Survey 3D Elevation Program, 11 August 2021, 3D view of lidar point clouds demonstrating QLs, accessed from <https://www.usgs.gov/media/images/figure-1-3d-view-lidar-point-clouds-demonstrating-qls> on October 12, 2022.

Resolution and Scale

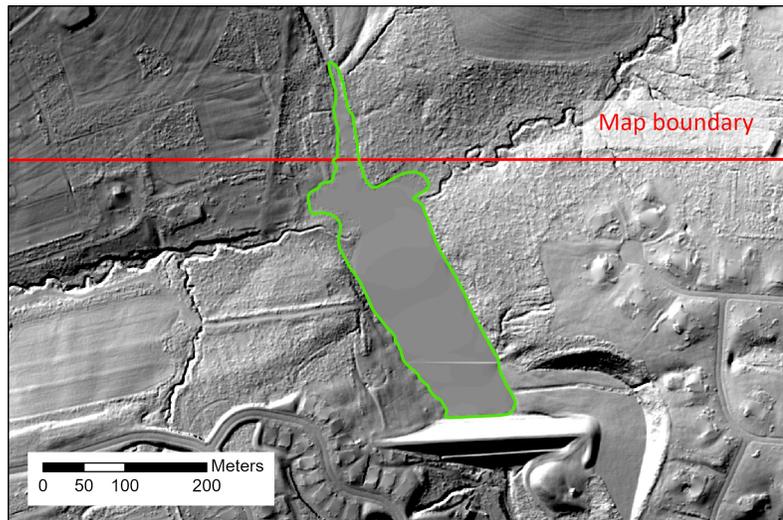


- PAHD (pre-GeMS)
- Lithologic contacts (pre-GeMS)

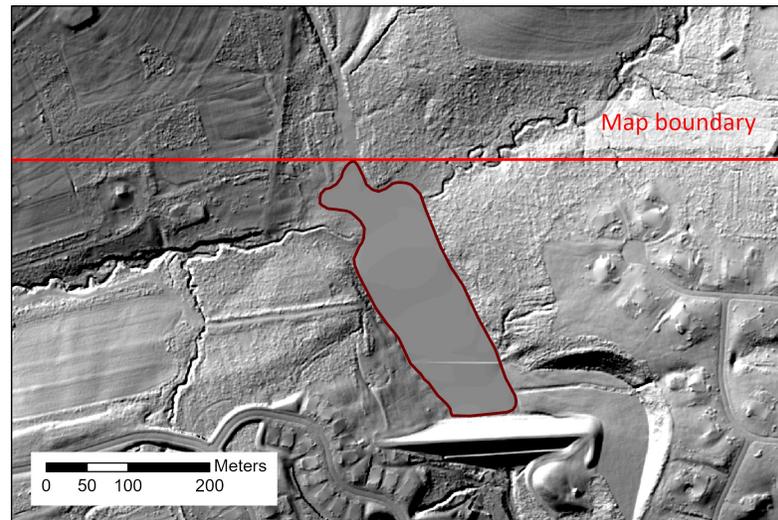
0 25 50 100 Meters

Source Data

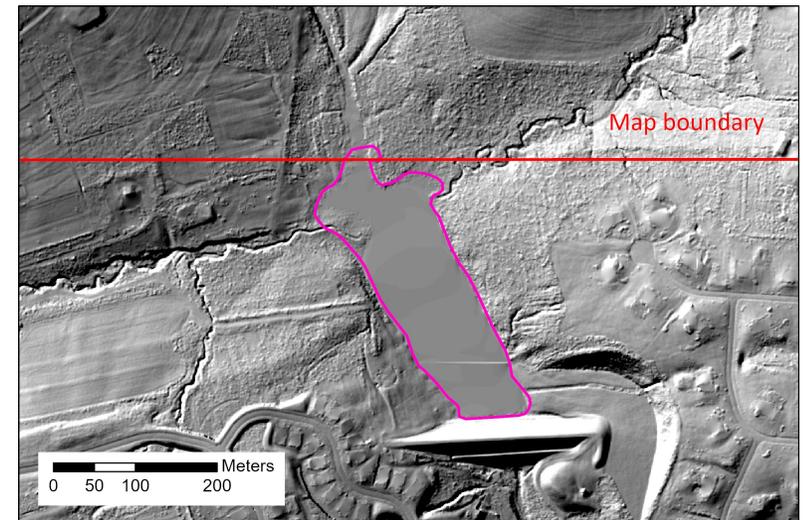
PAMAP 2008 Breaklines



DCRPC 2015 Breaklines



NHD Plus High Res



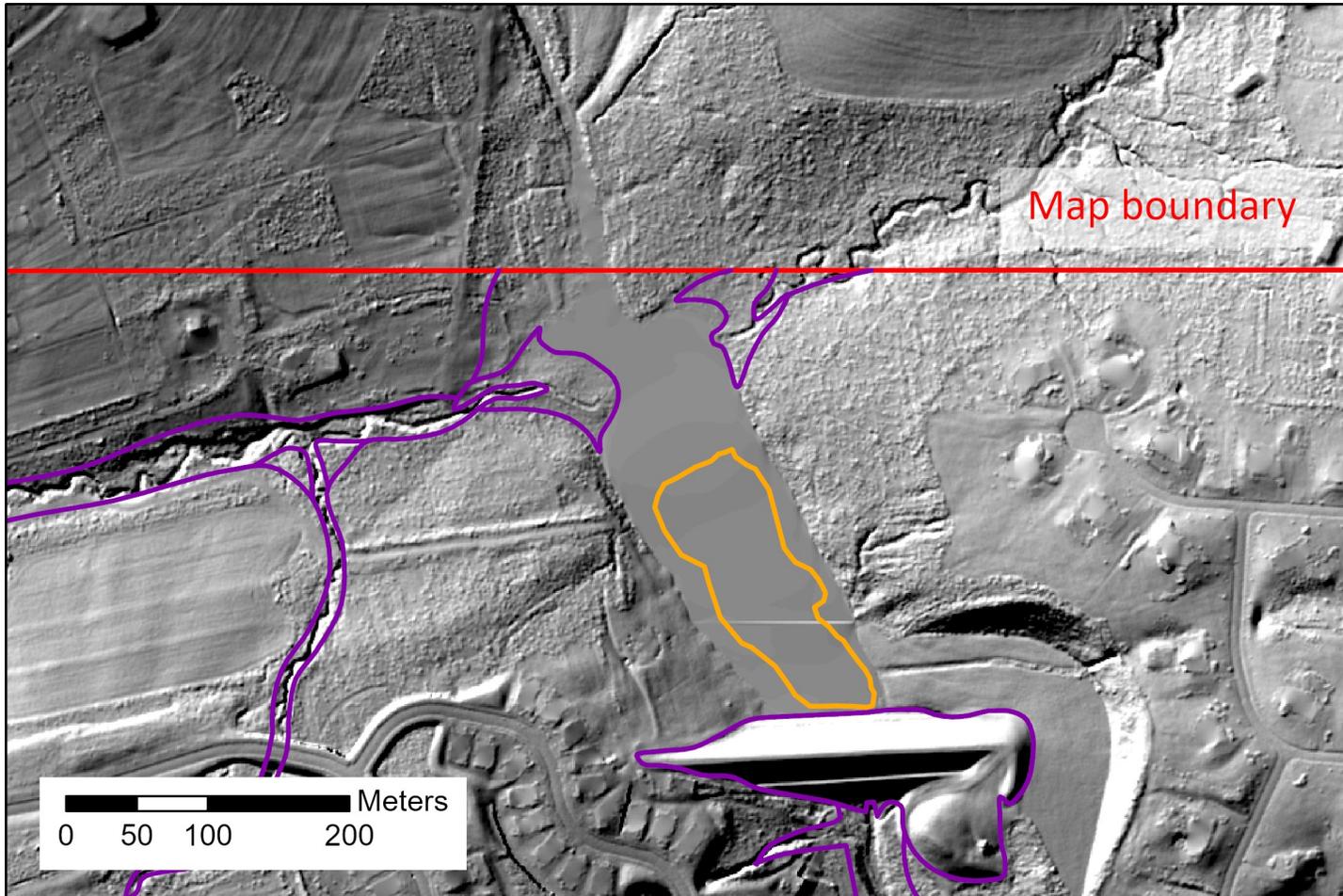
Temporal Resolution



Photo by Aaron Bierly, Pennsylvania Geological Survey, taken in Bucks County, PA.

Temporal Resolution

2015 BE-DEM

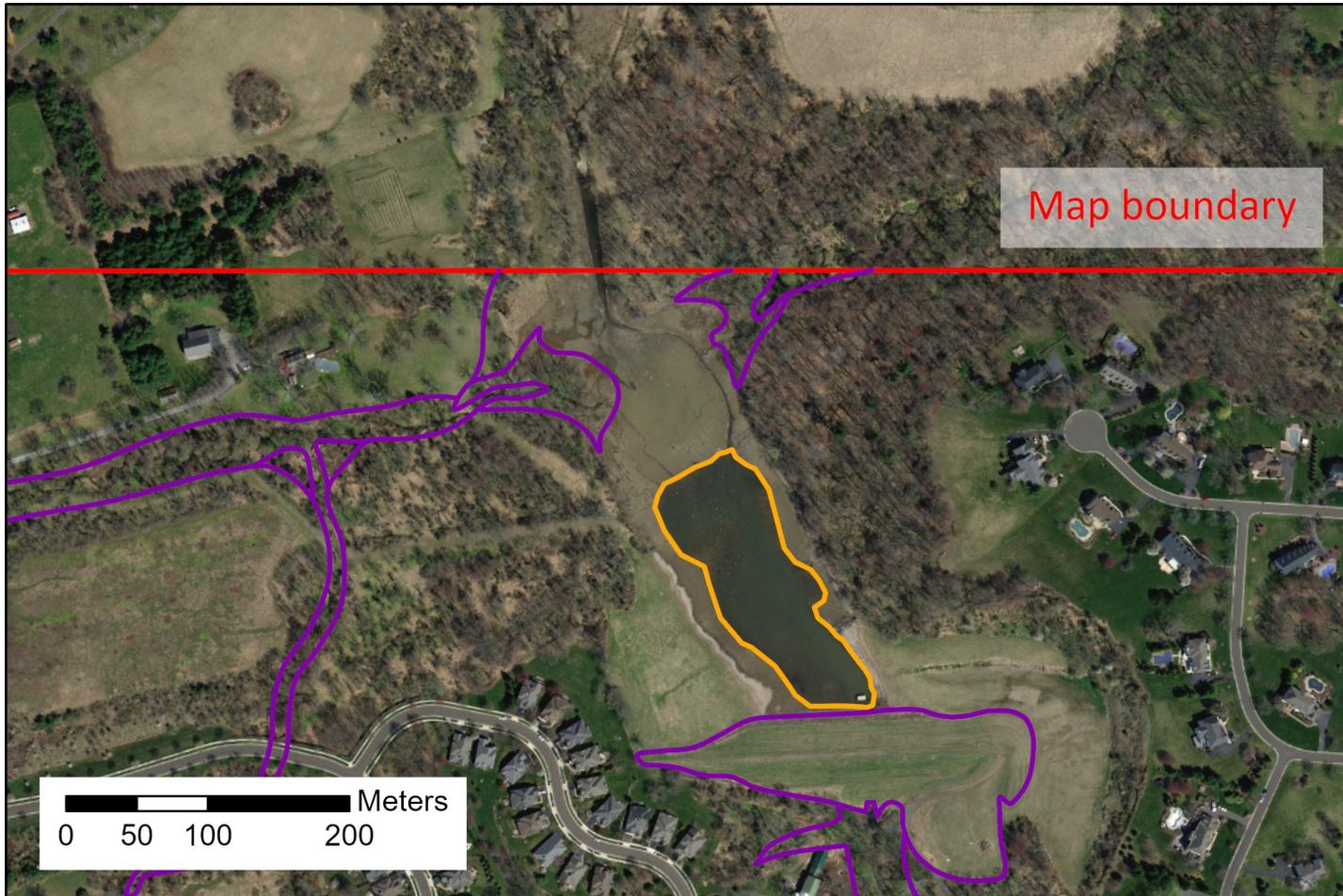


PAHD (pre-edits)

Lithologic contacts (pre-edits)

Temporal Resolution

2018 orthoimagery



PAHD (pre-edits)

Lithologic contacts (pre-edits)

Field Validation

- Guide field geologists through data collection
- Force them to take pictures

The screenshot displays a GIS application interface with three main panels:

- Map Panel (Left):** Shows a map of a region with various towns and roads. A purple location pin is placed on the map. The map is titled "PAHD" and includes a "Layers" panel on the left with a "Route" layer and a "FieldNotesandPhotos_PAHD" layer. A "Zoom to" dialog box is open over the map, showing a photo of a bridge over a stream.
- Properties Panel (Middle):** Displays the "FieldNotesandPhotos_PAHD" layer properties. It includes sections for "Information", "Symbology", "Appearance", and "Visible range". The "Visible range" section shows a slider set to "World" and "Room".
- Data Entry Panel (Right):** Shows the "HydroType" data entry form. It includes a search bar, a "Description" field, and a "Field Value Type" dropdown menu. The "Settings" section contains a table with the following data:

Setting	Value	Action
Allows Null Values	Yes	
Editable	Yes	Edit
Default Value	None	
Length	100	
Unique	No	Edit

The "List of Values (Domain)" section contains a list of options: Stream/River, Lake/Pond, Sink, Culvert, Reservoir, and Other (describe in notes).

Lessons Learned

Why didn't this work well?

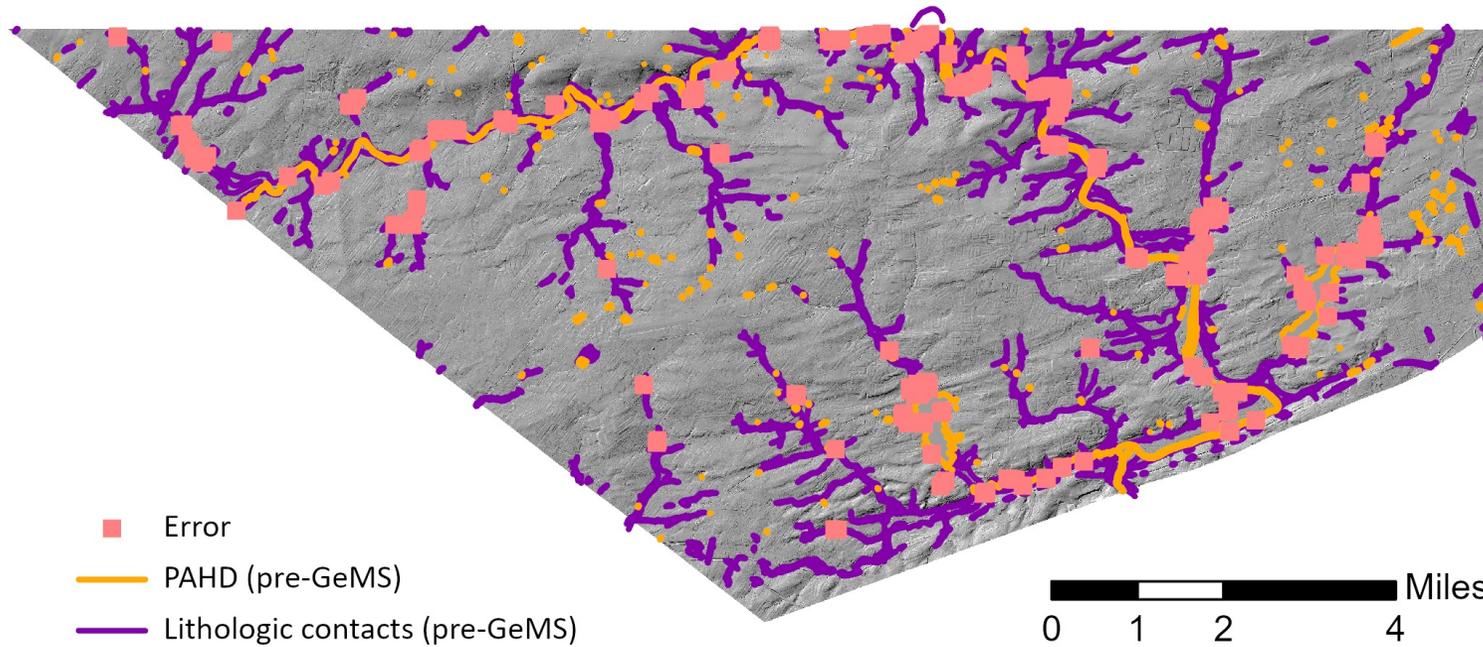
1. Different data scales
2. Different source data
3. Temporal resolution



Photo by Chris Oest, Pennsylvania Geological Survey, taken in Bucks County, PA.

Topology Errors

437 topology errors



GeMS Requirements

1. Hydrography and surficial contacts go into the same feature classes
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U.S. Geological Survey National Cooperative Geologic Mapping Program, 2020, GeMS (Geologic Map Schema)—A standard format for the digital publication of geologic maps: U.S. Geological Survey Techniques and Methods, book 11, chap. B10, p. 18, <https://doi.org/10.3133/tm11B10>.

GeMS (post-project)

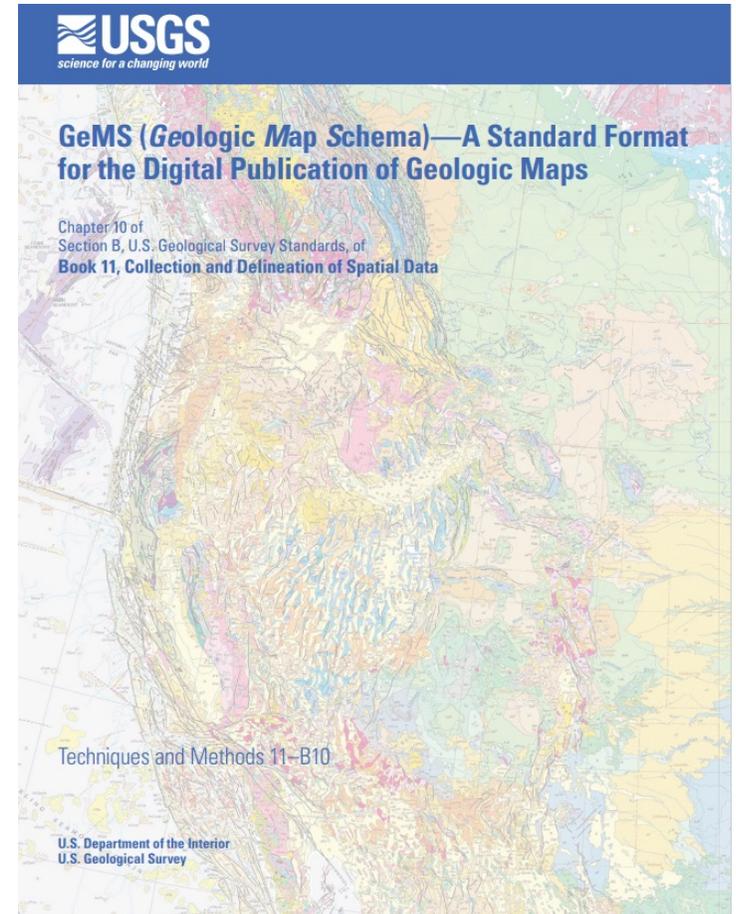
(Possible) Solution: Create a new, separate feature class for hydrography features that is NOT tied to any topology rules.

“I like the modularity of [putting hydrography in a separate feature class] and **the acknowledgement of the authority of the expertise in a different domain to make a best-available map from different sources.”**

- Evan Thoms, USGS, personal comm. March 27, 2023

GeMS

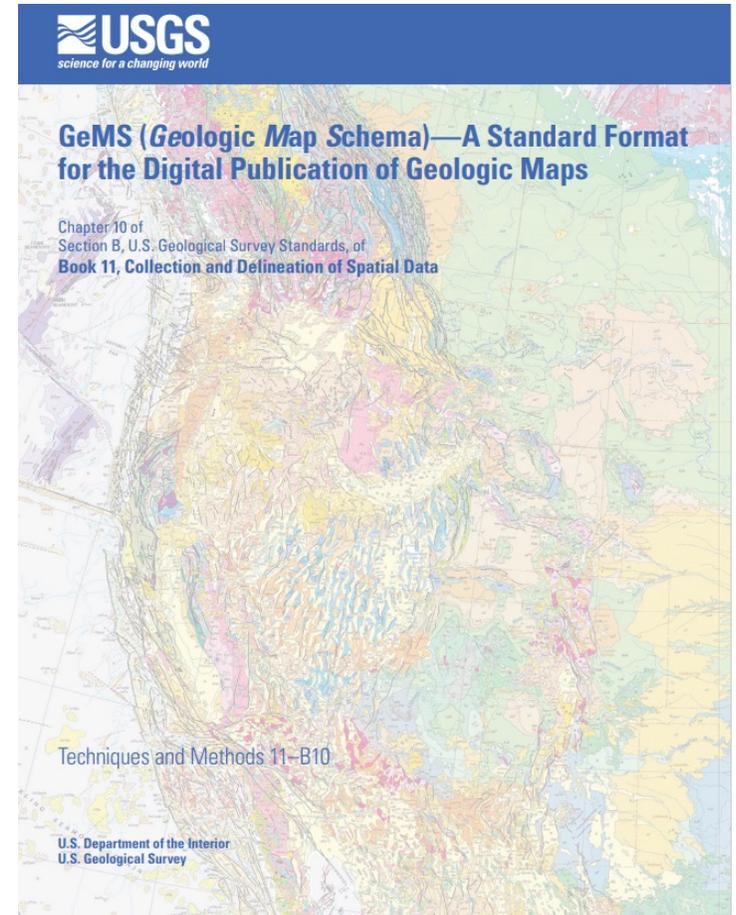
- Does not account for the resolution of modern elevation-derived hydrography



(Above) U.S. Geological Survey National Cooperative Geologic Mapping Program, 2020, GeMS (Geologic Map Schema)—A standard format for the digital publication of geologic maps: U.S. Geological Survey Techniques and Methods, book 11, chap. B10, 74 p., <https://doi.org/10.3133/tm11B10>.

GeMS

- Does not account for the resolution of modern elevation-derived hydrography
- Does not account for surveys who are producing their own hydrography

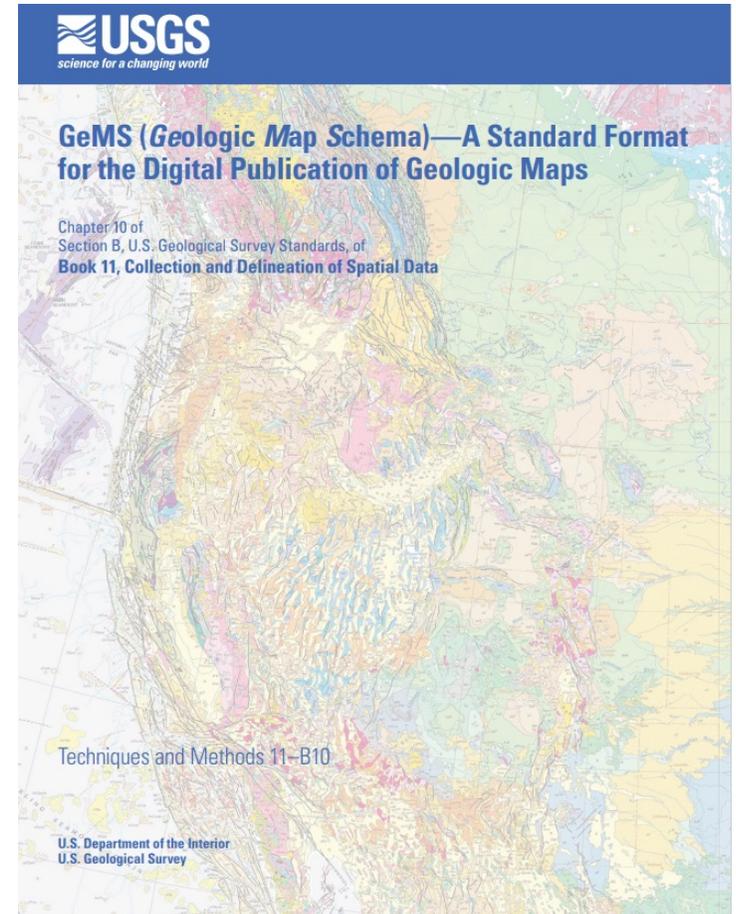


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GeMS

- Does not account for the resolution of modern elevation-derived hydrography
- Does not account for surveys who are producing their own hydrography
- Does not account for 3DHP

...Maybe this is okay?



(Above) U.S. Geological Survey National Cooperative Geologic Mapping Program, 2020, GeMS (Geologic Map Schema)—A standard format for the digital publication of geologic maps: U.S. Geological Survey Techniques and Methods, book 11, chap. B10, 74 p., <https://doi.org/10.3133/tm11B10>.

A Suggestion...



Links to the LBS

For information on revisions being considered for the next LBS release, please see the [LBS Revisions Status](#) page.

The revision history of the LBS can be found on the [Lidar Base Specification Revision History](#) page. Dates of publication are given in parentheses after the title. During the transition from print publication to online publication, versions 1.3 and 2.0 were in effect concurrently. This ended with the publication of version 2.1.

[Lidar Base Specification 2022 rev. A \(APR 2022\)](#)

[Lidar Base Specification 2021 rev. A \(JUN 2021\) \(pdf\)](#)

[Lidar Base Specification 2020 rev. A \(AUG 2020\) \(pdf\)](#)

[Lidar Base Specification Version 2.1 \(OCT 2019\) \(pdf\)](#)

[Lidar Base Specification Version 2.0 \(JUL 2018 in Spec-X, available online JUL 2019\) \(pdf\)](#)

The following links are to pdf versions of previous versions of the LBS

[Lidar Base Specification Version 1.3 \(FEB 2018\)](#)

[Lidar Base Specification Version 1.2 \(OCT 2014\)](#)

[Lidar Base Specification Version 1.0 \(AUG 2012\)](#)

Version 1.0, August 2012

Questions



Photo by Chris Oest, Pennsylvania Geological Survey, taken in Bucks County, PA.