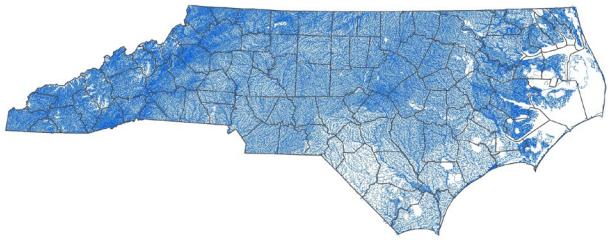
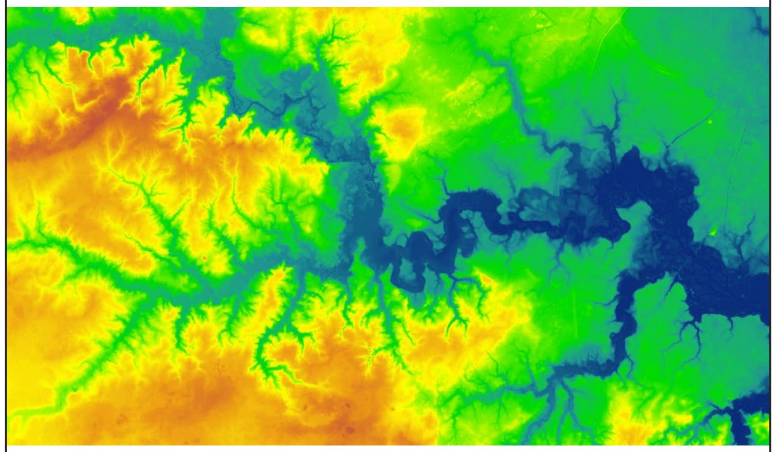
Digital Hydrography and Project ATLAS



North Carolina Hydrography Working Group



Gap Analysis and

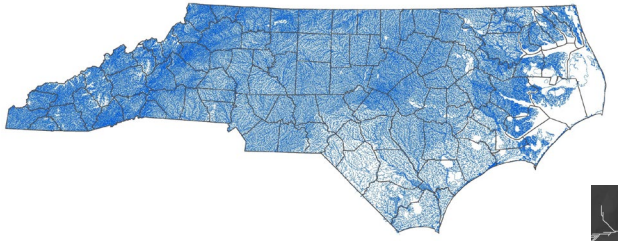
Unfunded Needs

Presented to:
The Statewide Mapping Advisory Committee
of the
North Carolina Geographic Information Coordinating Council

September 2023

NC HYDROGRAPHY

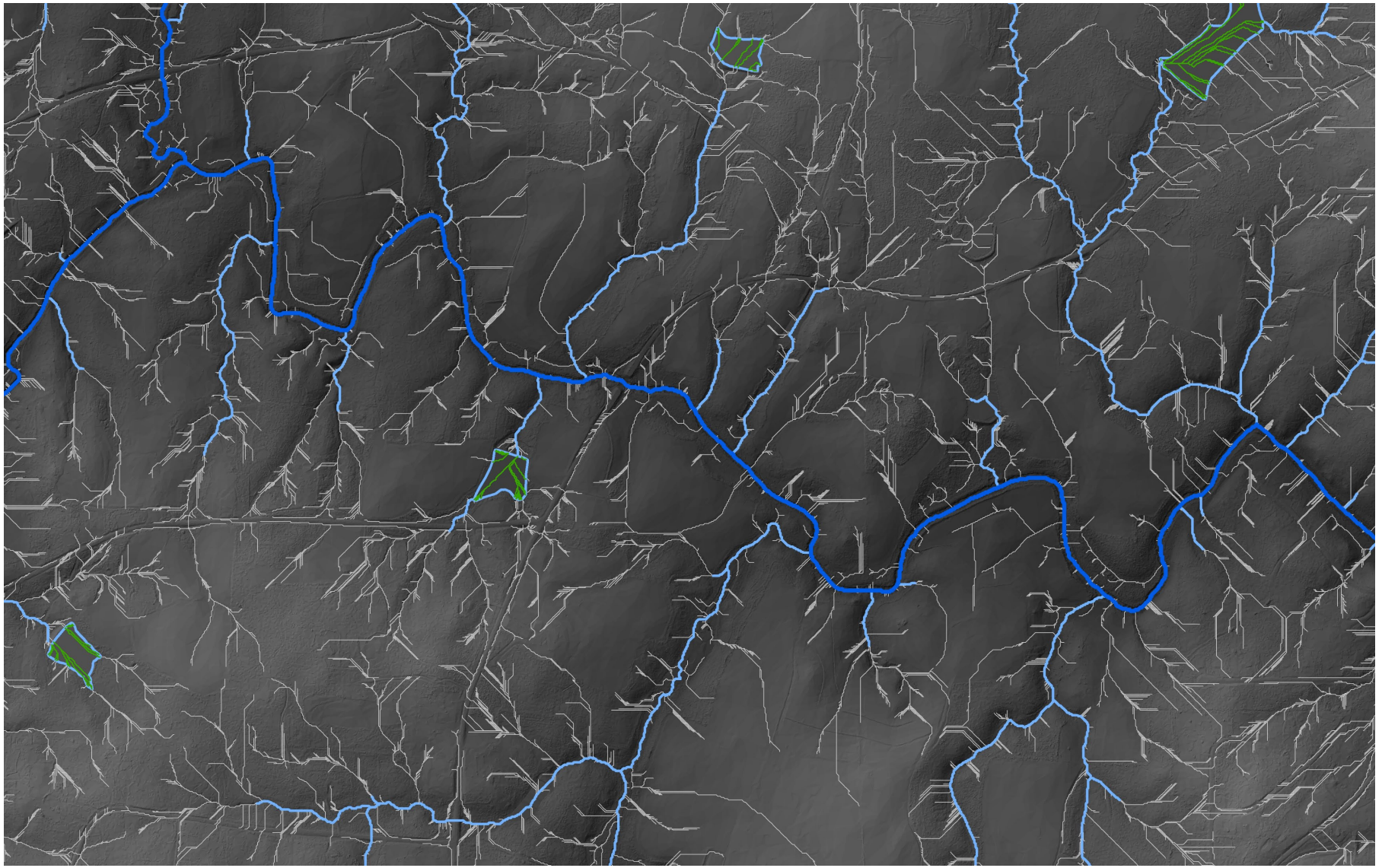
Digital Hydrography and Project ATLAS



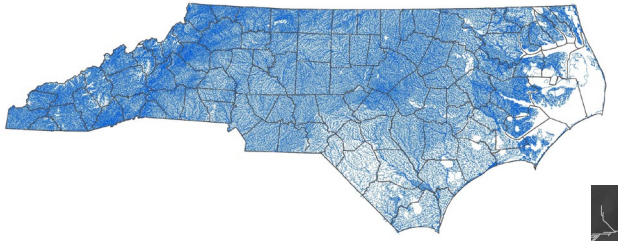
ATLAS HYDROGRAPHY v2.1

WHAT IT IS

- Elevation-Derived Hydrography for the State of North Carolina,
- Geometry from NC DEQ HSSD Program 10-foot LiDAR surfaces and NCEM LiDAR-derived waterbody break lines,
- Modeled stream origins,
- Relational Database Management System uses unique identifiers to link to data in tables,
- Designed to accommodate NCDEQ data structure and changes,
- Flexible for changes and intended for regular updates.



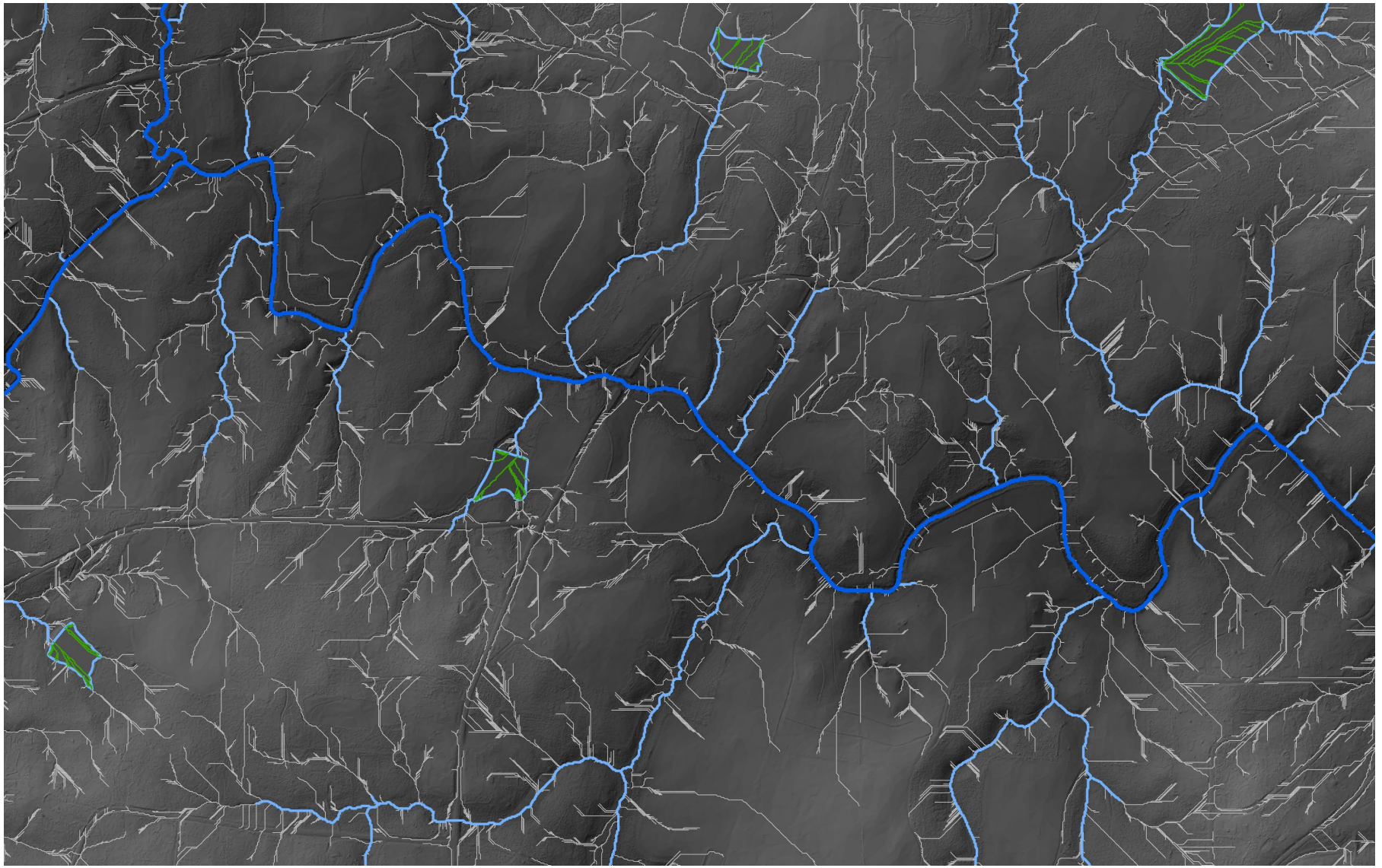
Digital Hydrography and Project ATLAS



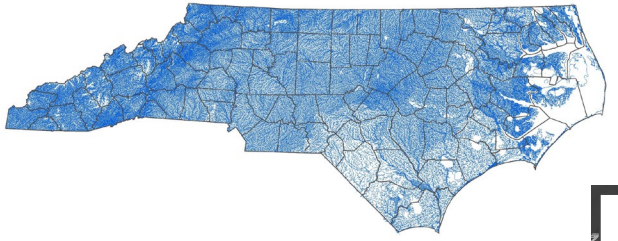
ATLAS HYDROGRAPHY v2.1

WHAT IT DOES

- Incorporates newly mapped stream features, jurisdictional extents, and their receiving waters,
- Leverages Enterprise Database and Relational Database Systems,
- Provides a system to analyze drainage and incorporate infrastructure on the network,
- Provides a framework for improved planning models, including
  - transportation planning,
  - disaster management,
  - resilience and flooding,
  - protected species habitat,
  - tidal and riparian areas,
  - water quality modeling...



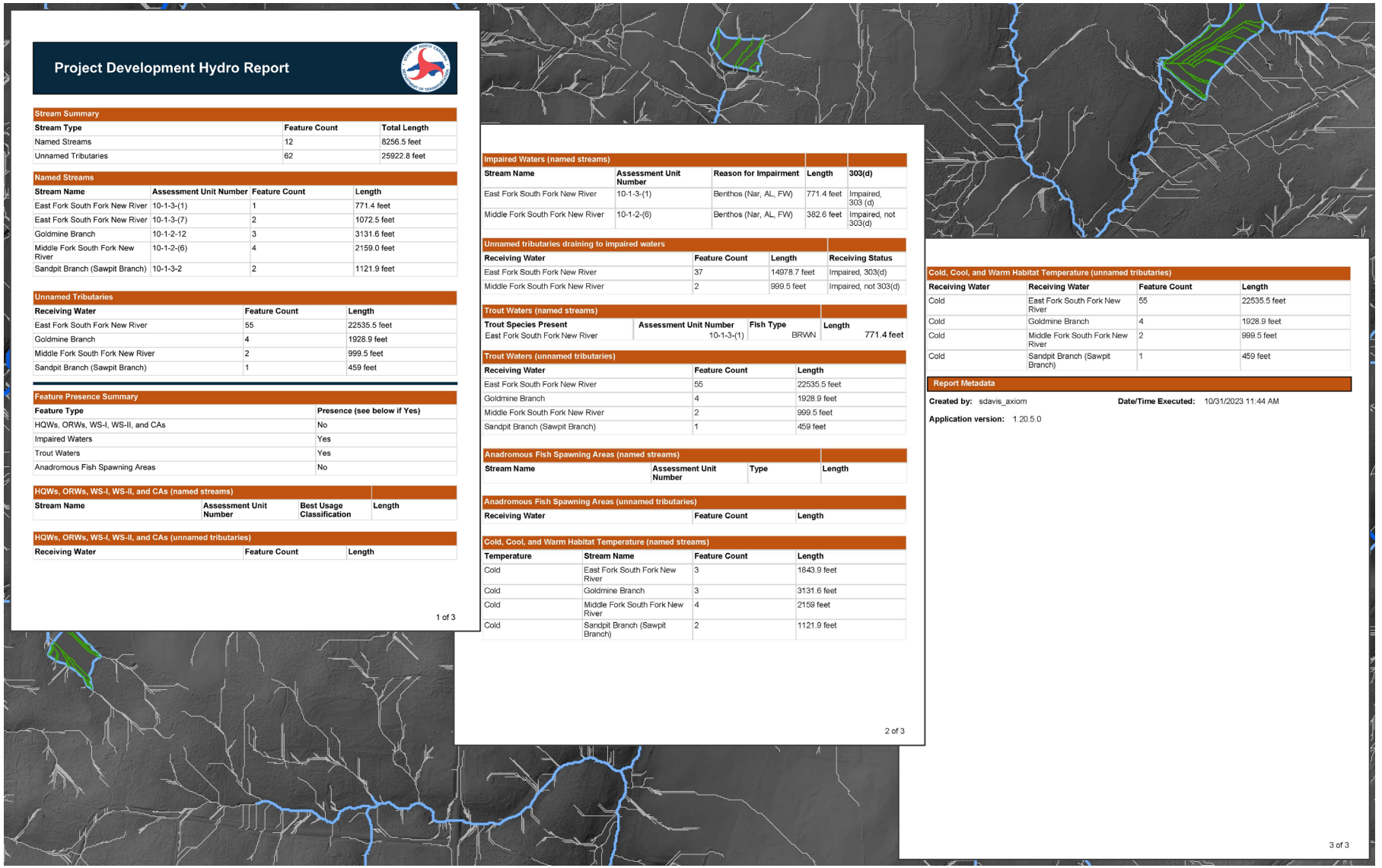
Digital Hydrography and Project ATLAS



ATLAS HYDROGRAPHY v2.1

HOW IT IS USED

- The NCDOT has developed an automated Project Development Hydro Report to summarize potential hydrography issues.
- Early identification of potential water resource data improves planning efficiencies for:
  - field investigation requirements and cost estimates
  - water protection requirements
  - seasonal (moratoria) requirements
  - NEPA, permitting, and mitigation requirements
  - Coordination and collaborative needs
- Improved economic and environmental outcomes are realized through project alternative comparisons and selection approvals



Project Development Hydro Report

Stream Summary

Stream Type	Feature Count	Total Length
Named Streams	12	8256.5 feet
Unnamed Tributaries	62	25922.8 feet

Named Streams

Stream Name	Assessment Unit Number	Feature Count	Length
East Fork South Fork New River	10-1-3-(1)	1	771.4 feet
East Fork South Fork New River	10-1-3-(7)	2	1072.5 feet
Goldmine Branch	10-1-2-12	3	3131.6 feet
Middle Fork South Fork New River	10-1-2-(6)	4	2159.0 feet
Sandpit Branch (Sawpit Branch)	10-1-3-2	2	1121.9 feet

Unnamed Tributaries

Receiving Water	Feature Count	Length
East Fork South Fork New River	55	22535.5 feet
Goldmine Branch	4	1928.9 feet
Middle Fork South Fork New River	2	999.5 feet
Sandpit Branch (Sawpit Branch)	1	459 feet

Feature Presence Summary

Feature Type	Presence (see below if Yes)
HQWs, ORWs, WS-I, WS-II, and CAs	No
Impaired Waters	Yes
Trout Waters	Yes
Anadromous Fish Spawning Areas	No

HQWs, ORWs, WS-I, WS-II, and CAs (named streams)

Stream Name	Assessment Unit Number	Best Usage Classification	Length

HQWs, ORWs, WS-I, WS-II, and CAs (unnamed tributaries)

Receiving Water	Feature Count	Length

1 of 3

Impaired Waters (named streams)

Stream Name	Assessment Unit Number	Reason for Impairment	Length	303(d)
East Fork South Fork New River	10-1-3-(1)	Benthos (Nar, AL, FW)	771.4 feet	Impaired, 303 (d)
Middle Fork South Fork New River	10-1-2-(6)	Benthos (Nar, AL, FW)	382.6 feet	Impaired, not 303(d)

Unnamed tributaries draining to impaired waters

Receiving Water	Feature Count	Length	Receiving Status
East Fork South Fork New River	37	14978.7 feet	Impaired, 303(d)
Middle Fork South Fork New River	2	999.5 feet	Impaired, not 303(d)

Trout Waters (named streams)

Trout Species Present	Assessment Unit Number	Fish Type	Length
East Fork South Fork New River	10-1-3-(1)	BRWN	771.4 feet

Trout Waters (unnamed tributaries)

Receiving Water	Feature Count	Length
East Fork South Fork New River	55	22535.5 feet
Goldmine Branch	4	1928.9 feet
Middle Fork South Fork New River	2	999.5 feet
Sandpit Branch (Sawpit Branch)	1	459 feet

Anadromous Fish Spawning Areas (named streams)

Stream Name	Assessment Unit Number	Type	Length

Anadromous Fish Spawning Areas (unnamed tributaries)

Receiving Water	Feature Count	Length

Cold, Cool, and Warm Habitat Temperature (named streams)

Temperature	Stream Name	Feature Count	Length
Cold	East Fork South Fork New River	3	1843.9 feet
Cold	Goldmine Branch	3	3131.6 feet
Cold	Middle Fork South Fork New River	4	2159 feet
Cold	Sandpit Branch (Sawpit Branch)	2	1121.9 feet

2 of 3

Cold, Cool, and Warm Habitat Temperature (unnamed tributaries)

Receiving Water	Receiving Water	Feature Count	Length
Cold	East Fork South Fork New River	55	22535.5 feet
Cold	Goldmine Branch	4	1928.9 feet
Cold	Middle Fork South Fork New River	2	999.5 feet
Cold	Sandpit Branch (Sawpit Branch)	1	459 feet

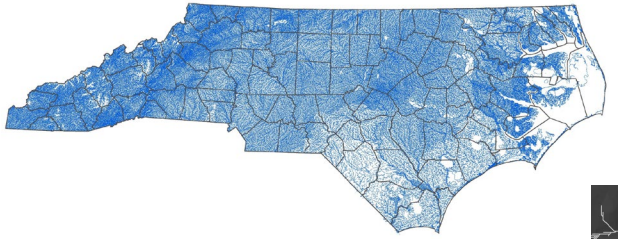
Report Metadata

Created by: sdavis_axiom **Date/Time Executed:** 10/31/2023 11:44 AM

Application version: 1.20.5.0

3 of 3

Digital Hydrography and Project ATLAS



ATLAS HYDROGRAPHY v2.1

HOW IT IS STRUCTURED

FULL DATASET

~287 Million Features
~1.4 Billion Records with tables
~307 GB Dataset

HSSD geometry
NCEM geometry

HSSD data
ATLAS data
NCDEQ data

All Waterbody Types

Changes to geometry only occur in the FULL DATASET

SMALL DATASET

INTERMITTENT OR BETTER

~29 Million Features
~140 Million Records with tables
~31 GB Dataset

HSSD data
ATLAS data
NCDEQ data

Mainstems, Tributaries, and Artificial Paths

Three NCDEQ Tables linked by AUID

NCDEQ Assessment Unit Information

AU Name	BIMS Index Number
AU Number	Water Quality Classification
AU ID	AU Type (i.e., Estuary, Stream)
AU Description	AU Units (i.e., feet, acres)
AU Number	Hydrologically ordered BIMS list
HUC 8 Basin	Retired AU prior to current no.
Subbasin (HUC 8 Basin Name)	Year AU was created or activated
Indicator of feature in 24k data	Active or Retired status

NCDEQ Assessment Unit Ratings (WRAPS)

2020 Rating	Active in 2020	2012 Rating	Active in 2012
2018 Rating	Active in 2018	2010 Rating	Active in 2010
2016 Rating	Active in 2016	2008 Rating	Active in 2008
2014 Rating	Active in 2014		

NCDEQ Water Quality Assessments

Integrated Reporting Category (includes 303(d) list)	Parameter of Interest
	Assessment Criteria Status
First year parameter is category 5	Reason For Rating

AUID

HYDROID

HUC10AIDX

Five ATLAS Tables linked by HYDROID

- Anadromous Fish Spawning Areas
- Cold, Cool, Warm Habitat Temperatures
- Descriptive Boundaries of Coastal, Joint, and Inland Waters
- Eastern Brook Trout Joint Venture Trout Waters
- Flow regime – Identifies at least intermittent streams

Additional Tables can be linked as needed

Feature Attributes

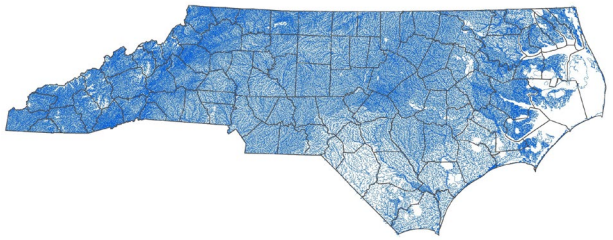
- HYDROID, AUID, HUC10AIDX
- Waterbody Type (*Mainstem, Tributary, Artificial Path, Drainage Way*)
- Feature Type (*Stream/River- Single, Stream/River- Double, Lake/Pond*)
- Object ID, Shape Type, Shape Length, Impact, In State

HSSD Geometry Table linked by HUC10AIDX

HSSD Reach Point Data

Unique AIDX Number for HUC10	Elevation based on DEM
Reference Raster Value	Number of adjacent contributing cells
Unique HUC10 Array Index	Has Inflow (0: Channel head; 1: Junction or Outlet)
Basin Type	Has Outflow (0: Outlet; 1: Non-outlet)
Source - 1	Position Type (0: Reach Interior, 1: Head, 2: Junction, 3: Outlet)
D8 Flow To (AIDX of receiving cell)	HSSD HUC10 ID
D8 Flow Accumulation (number of 100 sq. ft. cells)	HSSD Model ID
D8 Distance to Outlet	HSSD RCHPT ID unique across all HUC10s

Digital Hydrography and Project ATLAS



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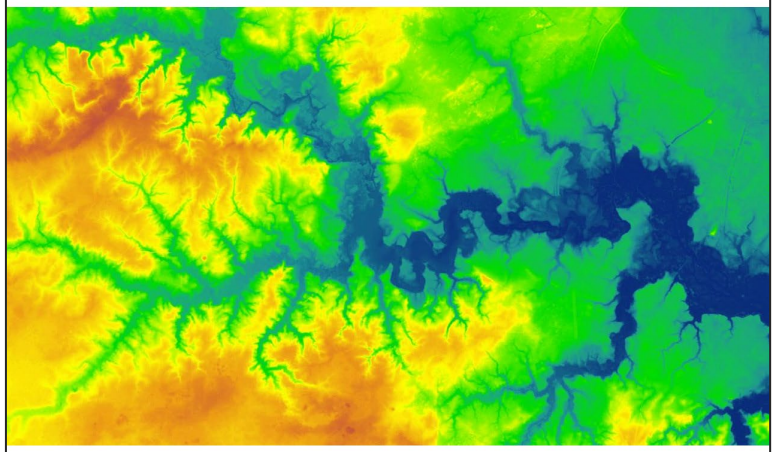

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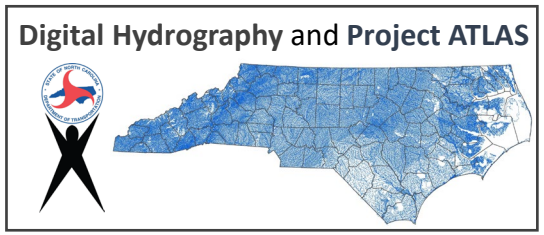
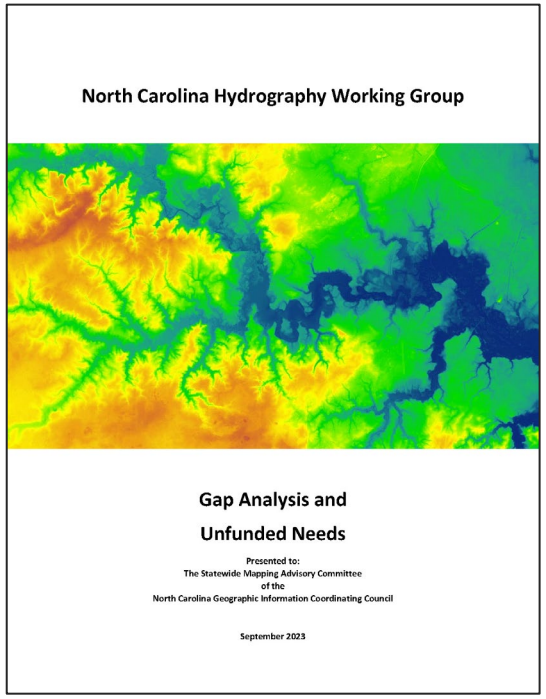
NC HYDROGRAPHY





Gap Analysis Summary

The following table summarizes the current gaps between ATLAS Hydrography, NC Hydro and EDH. The left column lists gaps, and the right two columns indicate whether the gap is necessary for NC Hydro or EDH.	NC Hydro	EDH
ATLAS Hydrography Gaps		
Polyline Issues		
Stream Segmentation		
Combine segments between confluences.	☒	☒
Reaches will be split where needed to represent breaks in DWR Assessment Units.	☒	☐
Smoothing		
Smooth rasterized lines for a cartographic appearance while maintaining accuracy within EDH specifications when possible.	☒	☒
Shorelines		
Develop both a shoreline feature in the polyline dataset (or a separate shoreline dataset)	☒	☐
Add polygon waterbody feature in the polygon dataset	☒	☒
Topology must be maintained between the two features	☒	☐
Waterbody Issues		
Waterbody size		
Add waterbodies that meet the minimum ¼ acre size to the dataset.	☒	☒
2D Rivers		
Add streams and rivers represented as polygons to match current EDH and Western NC Hydrography specifications.	☒	☒
Stewardship and Maintenance		
Roles		
Continue partnership between DWR and DOT.	☒	☐
Formalize roles and responsibilities.	☒	☐
Update and Maintenance		
Implement Enterprise GIS to serve data and formalize relationships with potential editors outside of DWR and DOT	☒	☐
Stewardship		
Maintain communication with USGS and look for opportunities to push NC Hydro to the national dataset.	☒	☐
NHD Specific Issues		
Data must match underlying 3DEP 1-meter DEM	☐	☒
Hydroflattened waterbodies	☐	☒
EDH attributes	☐	☒
Point feature class	☐	☒
Feature attributes and network connectivity		
Hanging Waterbodies		
Where preferential flow paths exist, connect hanging lake/ponds to the stream network with an attribution of modeled connector.	☒	☒
New waterbody must be mapped in between a hanging waterbody and the start of the network.		
Add waterbodies that meet the minimum ¼ acre size to the polygon dataset.	☒	☒
Add waterbody shorelines that meet the minimum ¼ acre size to the polyline/shoreline dataset.	☒	☐
Connect hanging lake/ponds to the stream network with an attribution of modeled connector.	☒	☒
Add artificial paths through the waterbody.	☒	☒
New waterbody is added upstream of most upstream feature in the network. This could be upstream of a pond or of the stream origin point.		
Add waterbodies that meet the minimum ¼ acre size to the polygon dataset.	☒	☒
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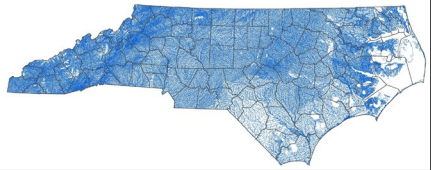
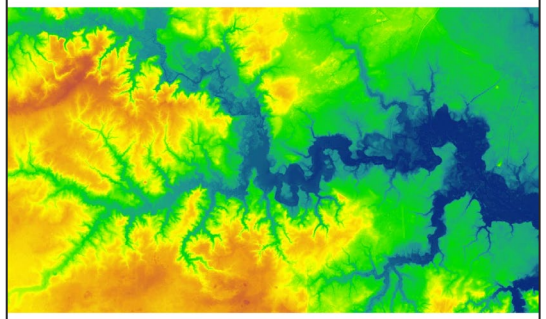
Add waterbodies that meet the minimum ¼ acre size to the polygon dataset.	☒	☒
Add waterbody shorelines that meet the minimum ¼ acre size to the polyline/shoreline dataset.	☒	☐
Attribute stream segment as artificial path where it flows through the waterbody.	☒	☒
New waterbody is added that has no discernable overland connection to the network.		
Add waterbodies that meet the minimum ¼ acre size to the polygon dataset.	☒	☐
Add waterbody shorelines that meet the minimum ¼ acre size to the polyline/shoreline dataset.	☒	☐
A connector will not be added to the stream network unless a connection is confirmed through field or additional investigation.	☒	☐
Waterbody differentiation		
Split waterbody features to represent distinct rivers and lake features, and split complex lake features with multiple shoreline assessment units into distinct units.	☒	☐
Z Enabled Features		
Add Z values according to EDH READ rules	☐	☒
Water Boundary Dataset		
Stream connectivity		
Edit network to ensure stream network connectivity between 10-digit HUCS	☒	☒
Watershed Boundaries		
Create watershed boundaries to meet USGS WBD specifications	☒	☒
Attribute watershed boundaries and coordinate with USGS for attribution	☒	☒

Digital Hydrography and Project ATLAS



North Carolina Hydrography Working Group



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Combine segments between confluences.	☒	☒
Reaches will be split where needed to represent breaks in DWR Assessment Units.	☒	☐
Smoothing		
Smooth rasterized lines for a cartographic appearance while maintaining accuracy within EDH specifications when possible.	☒	☒
Shorelines		
Develop both a shoreline feature in the polyline dataset (or a separate shoreline dataset)	☒	☐
Add polygon waterbody feature in the polygon dataset	☒	☒
Topology must be maintained between the two features	☒	☐
Waterbody Issues		
Waterbody size		
Add waterbodies that meet the minimum ¼ acre size to the dataset.	☒	☒
2D Rivers		
Add streams and rivers represented as polygons to match current EDH and Western NC Hydrography specifications.	☒	☒

- WaterBody Issues — ***GEOMETRY UPDATES***
  - Waterbody size
  - 2D rivers
- Shorelines
- Feature Attributes and Network Connectivity
  - Hanging Waterbodies
  - New Waterbody additions
  - Waterbody differentiation
- Z Enabled Features
- Watershed Boundary Dataset
  - Stream Connectivity
  - Watershed Boundaries
- Stream Segmentation
- Stream Smoothing

Feature attributes and network connectivity		
Hanging Waterbodies		
Where preferential flow paths exist, connect hanging lake/ponds to the stream network with an attribution of modeled connector.	☒	☒
New waterbody must be mapped in between a hanging waterbody and the start of the network.		
Add waterbodies that meet the minimum ¼ acre size to the polygon dataset.	☒	☒
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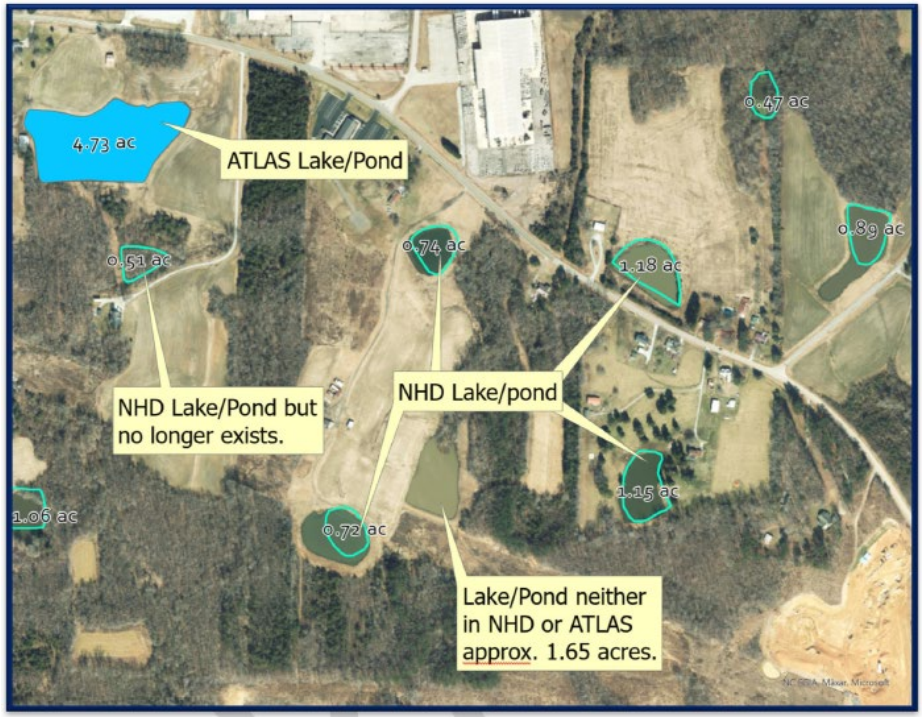
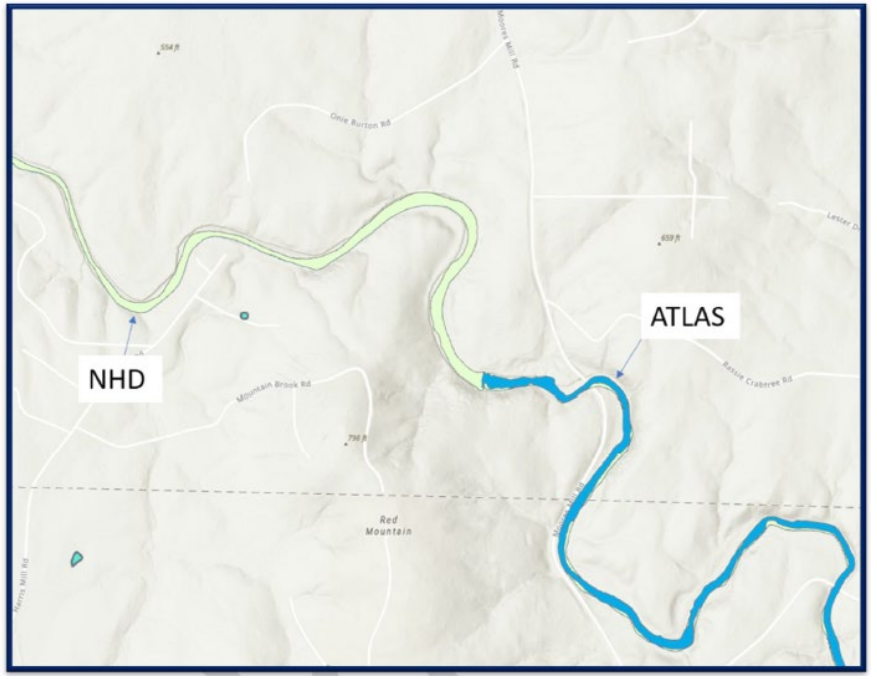
Add Z values according to EDH READ rules	☐	☒
Water Boundary Dataset		
Stream connectivity		
Edit network to ensure stream network connectivity between 10-digit HUCS	☒	☒
Watershed Boundaries		
Create watershed boundaries to meet USGS WBD specifications	☒	☒
Attribute watershed boundaries and coordinate with USGS for attribution	☒	☒

Waterbody Issues	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
• Add waterbodies that meet ¼-acre size to dataset.	Yes	Yes	Yes
• Add streams and rivers represented as polygons to match current EDH and Western NC Hydrography specifications.	Yes	Yes	Yes





Waterbody Issues	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
• Add waterbodies that meet ¼-acre size to dataset.	Yes	Yes	Yes
• Add streams and rivers represented as polygons to match current EDH and Western NC Hydrography specifications.	Yes	Yes	Yes

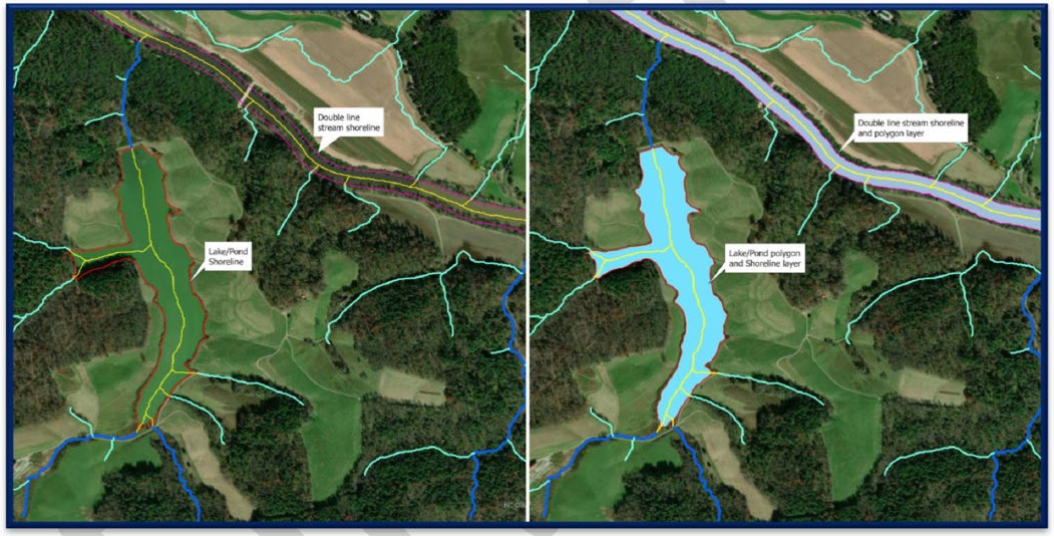
CAPTURE
REVIEW
DEPICTION
ATTRIBUTION

- ATLAS was designed to be representative of best existing data, using data published by NC Emergency Management with specifications of 2+ acre waterbodies and rivers > 100 feet.
- For ATLAS incorporation, collection of waterbodies must be automated and consistent across the state.
- Small waterbody features were identified during ATLAS Hydro v2 generation to assist modeling.
  - Areas 0.2 to 3.0 acres were identified using 20-foot QL1 / QL2 DEMs with slopes from 0 to 1%.
  - Candidates were reviewed with aerial photography and NHD data.
  - 2 million+ candidates resulted in more than **99,000** waterbody polygons (aggregates of DEM cells).
- A review of existing ATLAS data indicates more than **5000 miles** of river polygons/double-line streams are needed.

Methods for capture:
- LiDAR point density assessment,
- Elevation / Imagery review,
- Funding for EM Contractors to revisit breakline extraction and/or generate lines with specified requirements in future LiDAR captures

Considerations:
- Future review and capture/removal,
- Resolution/smoothing,
-
-

Shorelines	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
Develop a shoreline feature in the polyline dataset or separate shoreline dataset.	Yes	Yes	Yes
Add polygon waterbody feature in the polygon dataset.	Yes	Yes	Yes
Maintain topology between the two features.	Yes	Yes	Yes

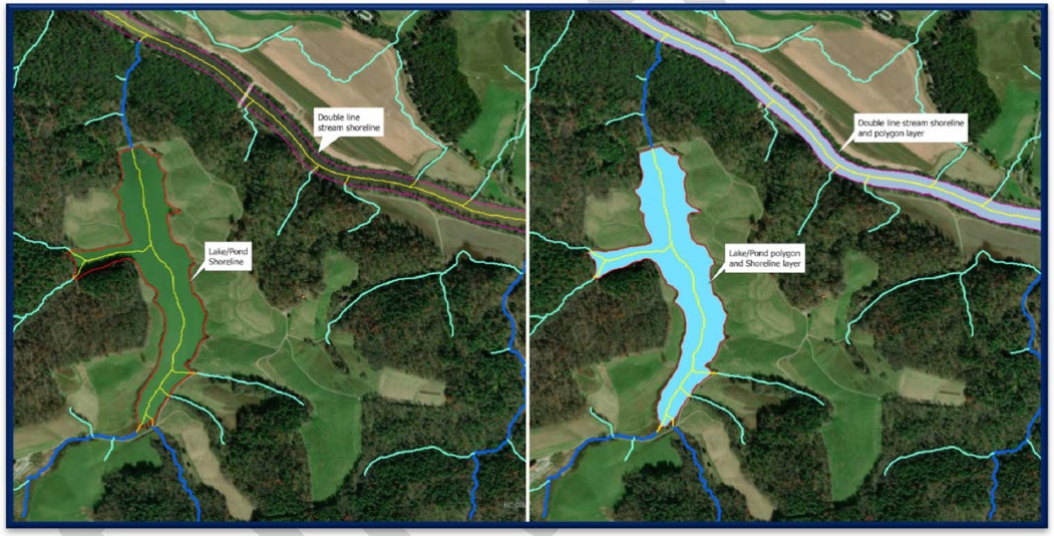


Shorelines	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
Develop a shoreline feature in the polyline dataset or separate shoreline dataset.	Yes	Yes	Yes
Add polygon waterbody feature in the polygon dataset.	Yes	Yes	Yes
Maintain topology between the two features.	Yes	Yes	Yes
2D polygons exist for all 2+ acre waterbodies and rivers > 100 feet.			
2D polygons for ¼ to 2-acre ponds and waterbodies 40-100 feet will be included.			

Existing waterbody outlines (= shorelines) are differentiated from streams and artificial paths through attribution:

'HYDROTYPE' = "Lake/Pond" and
'HYDROTYPE' = "Stream/River-Double"

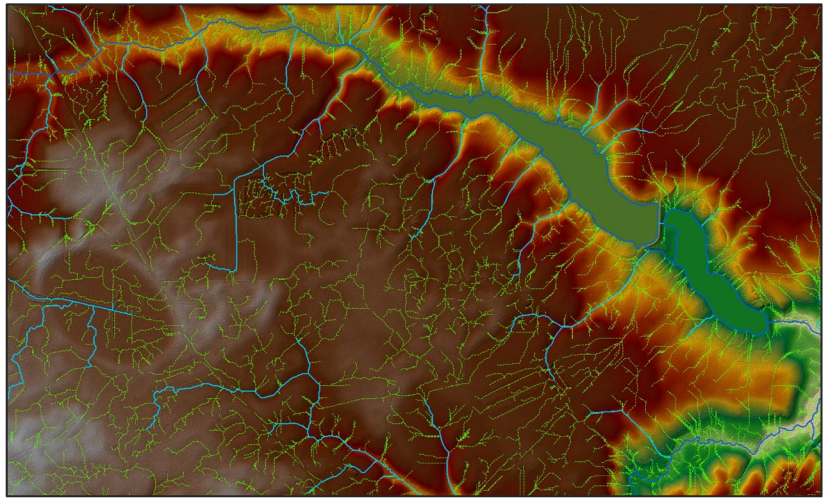
All existing waterbody outlines (= shorelines) will be attributed the same way.



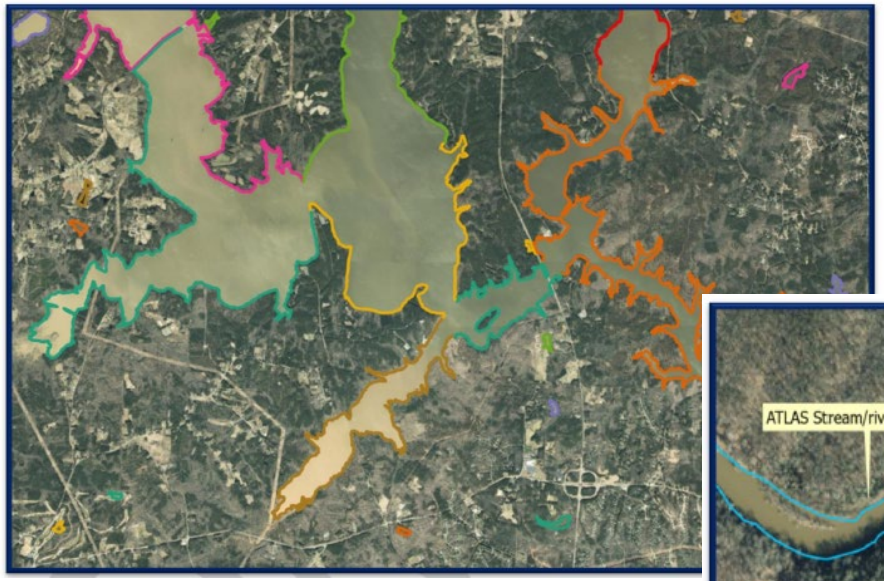
Feature Attributes and Connectivity		Drainage Path Present	Process
Existing	Hanging Waterbodies (Waterbodies upslope of modeled stream origins / not connected the network)	No	No action.
		Yes	Attribute downstream preferential flow paths as 'Connectors.'
New		No	Add ¼+ acre waterbody polygon features. Add shoreline polyline features.
		Yes	Add ¼+ acre waterbody polygon. Create shoreline polyline feature. Attribute downstream preferential flow paths as 'Connectors.'
	Between Hanging Waterbody and Start of Network	No	Add ¼+ acre waterbody polygon. Add shoreline polyline feature.
		Yes	Add ¼+ acre waterbody polygon features. Add shoreline polyline feature. Create artificial paths. - If Drainage Way is present, attribute downstream preferential flow paths as 'Connectors.' - If Mainstem or Tributary is present, no further action.
	On existing stream line	Yes	

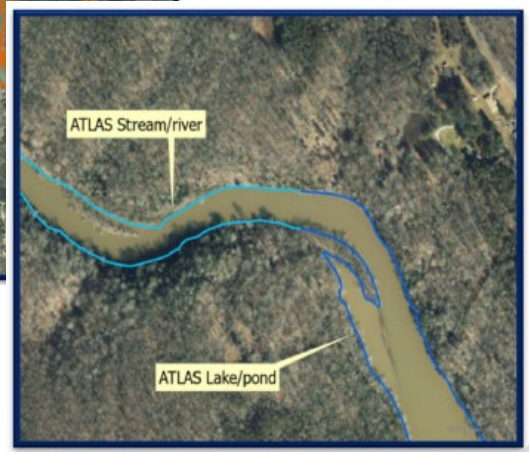
Inclusion of drainage paths from waterbodies that are not connected to a stream feature.

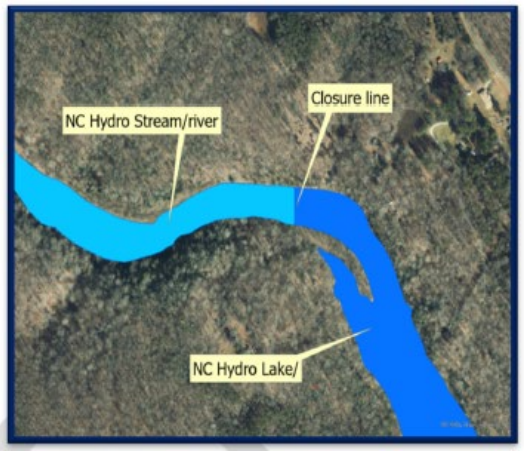
Z-enabled features	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
Add Z values according to EDH READ Rules	Yes	Yes	Yes



Waterbody Differentiation	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
Split waterbody features to represent distinct rivers and lake features	Yes	Yes	Yes
Split complex lake features with multiple shoreline assessment units into distinct units	Yes	Yes	Yes

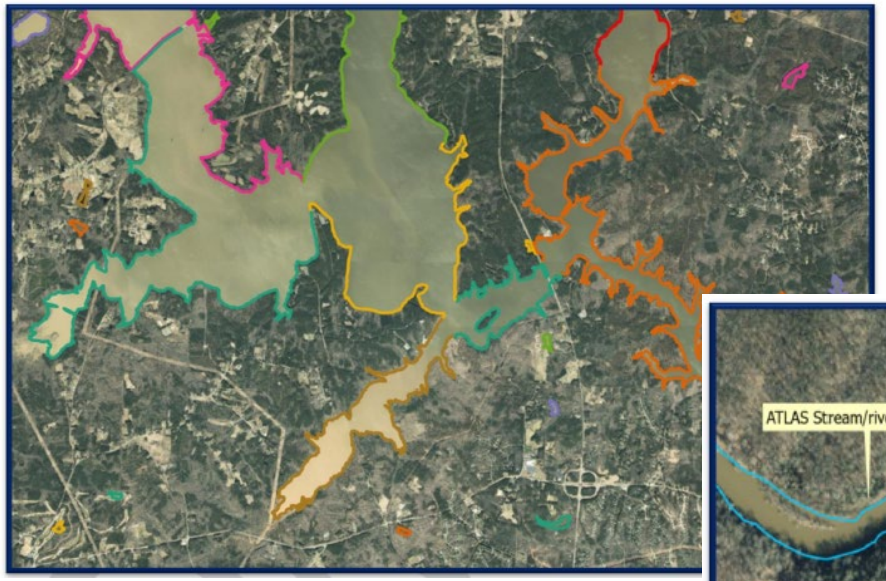


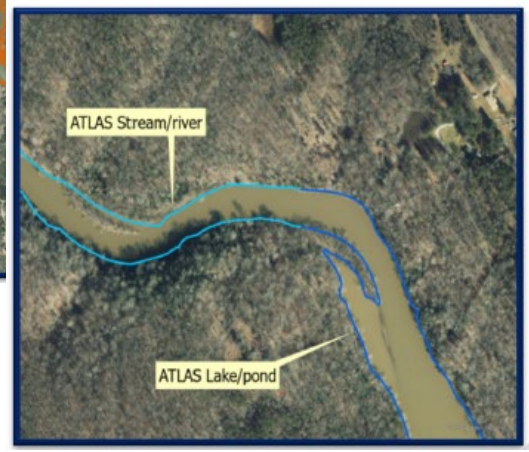


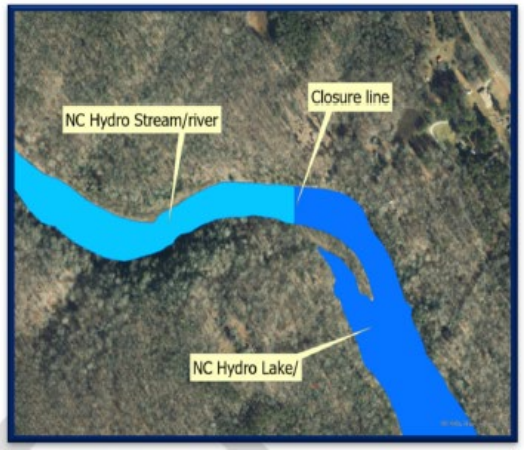


Waterbody Differentiation	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
Split waterbody features to represent distinct rivers and lake features	Yes	Yes	Yes
Split complex lake features with multiple shoreline assessment units into distinct units	Yes	Yes	Yes
Existing polyline shorelines are split.			
Polygons can be split along artificial paths or centerlines.			

Domains within ‘HydroType’ attribute in existing polyline (shoreline) schema make these distinctions.



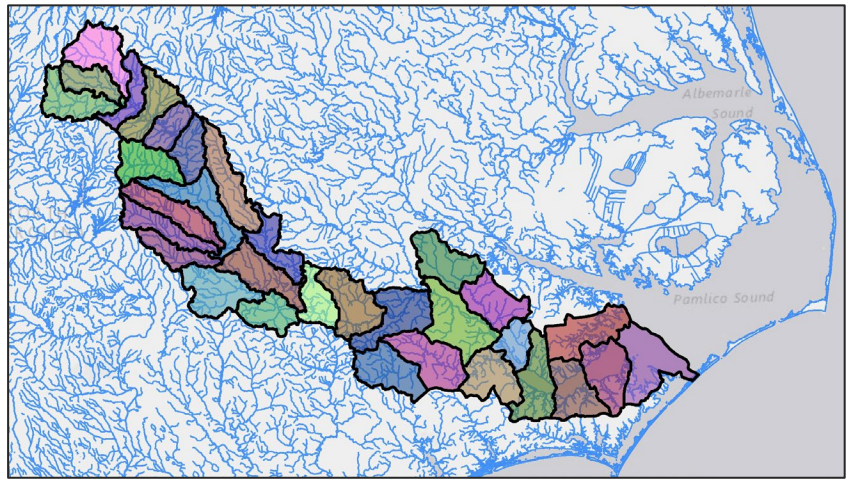




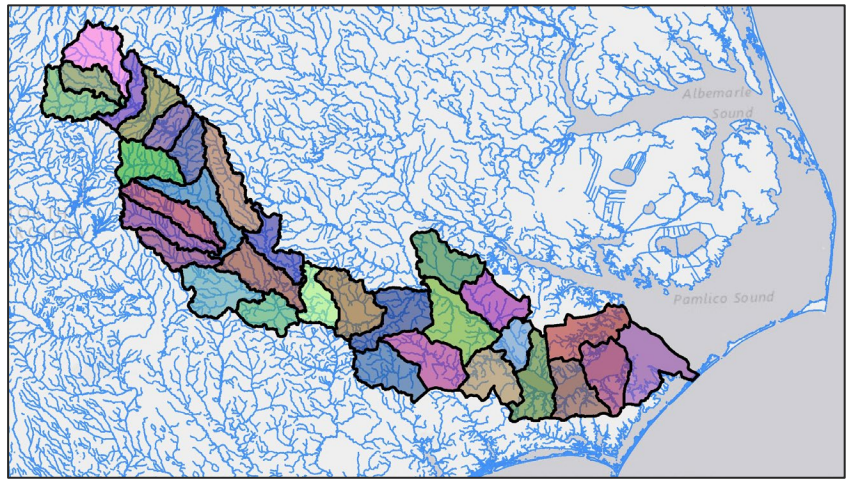
Distinctions between existing ‘HydroType’ = “Lake/Pond” and ‘HydroType’ = “Stream/River-Double” polylines occur at splits in NC Emergency Management breaklines. Polygons will be split here.

Distinctions between **new** ‘HydroType’ = “*Lake/Pond*” and ‘HydroType’ = “*Stream/River-Double*” Polylines and polygons are anticipated to be split at existing NHD breaks (where applicable).

Water Boundary Dataset	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
Edit network to ensure stream connectivity between 10-digit HUCs.	Yes	Yes	Yes
Attribute watershed boundaries and coordinate with USGS for attribution.	Yes	Yes	Yes

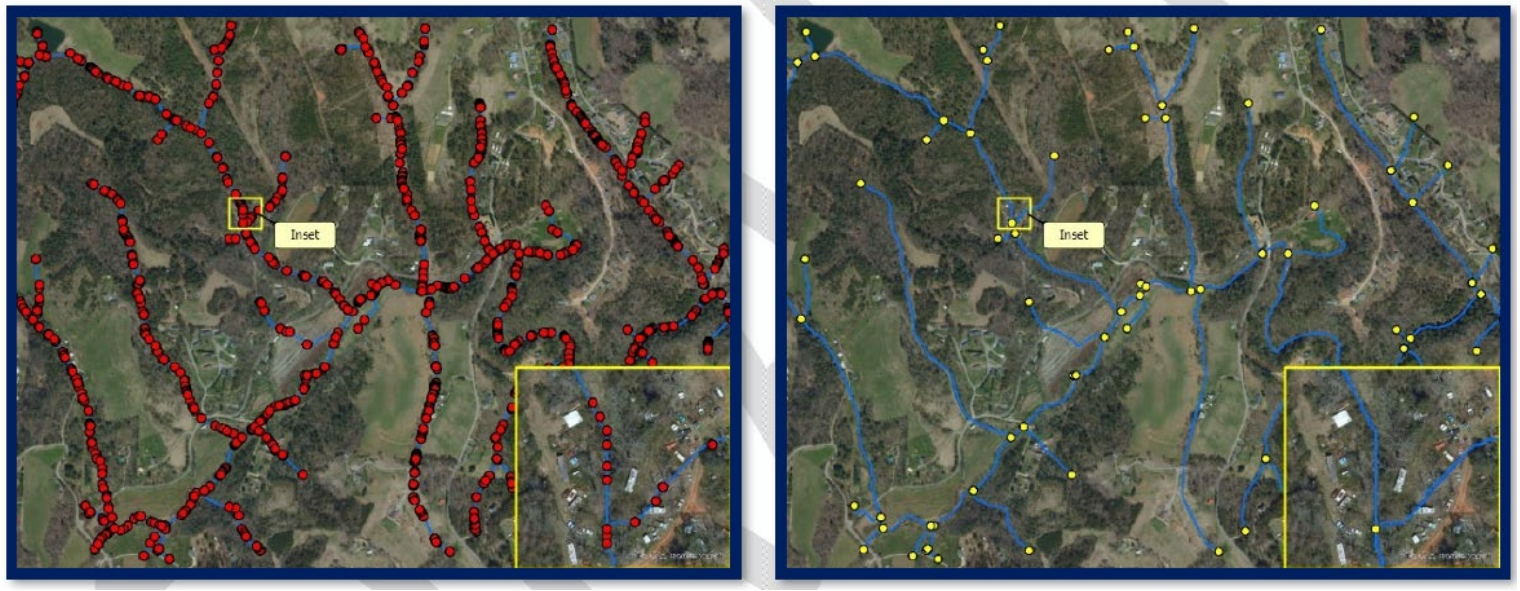


Water Boundary Dataset	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates	
Edit network to ensure stream connectivity between 10-digit HUCs.	Yes	Yes	Yes	Completed in ATLAS Hydrography v2.1
Attribute watershed boundaries and coordinate with USGS for attribution	Yes	Yes	Yes	



Stream Segmentation	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
Combine segments between confluences	Yes	n/a	Yes
Reaches split where needed to represent breaks in DWR AUs	**No**	n/a	Yes

Segment splits represent vertices of Drainage Ways that are not included in the Small Dataset. These vertices can be removed from the Small Dataset but are integral to the Full Dataset.

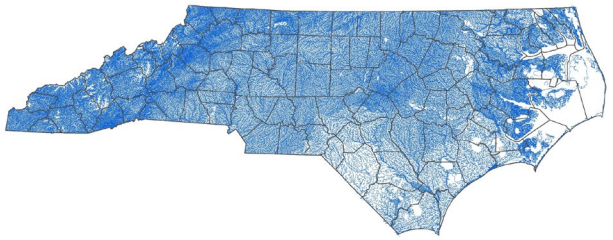


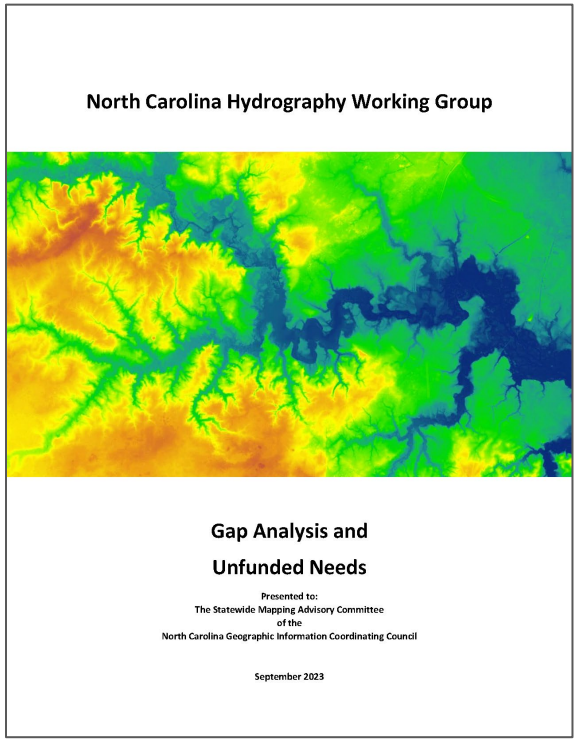
Smoothing	USGS 3DHP	Retained in ATLAS Hydrography	Refreshed on updates
Smooth rasterized lines for cartographic appearance	Yes	**No**	n/a
Maintain accuracy within EDH specifications	Yes	**No**	n/a

The NCDEQ has suggested use of a tool for on-the fly smoothing and display. Rules will be needed for deflection limits.

The NCDOT recommends that smoothed features be generated for depictions only -without data that could be shifted during the smoothing process.

Digital Hydrography and Project ATLAS

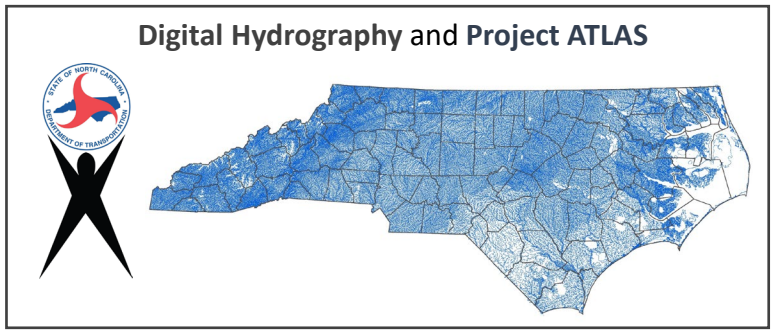


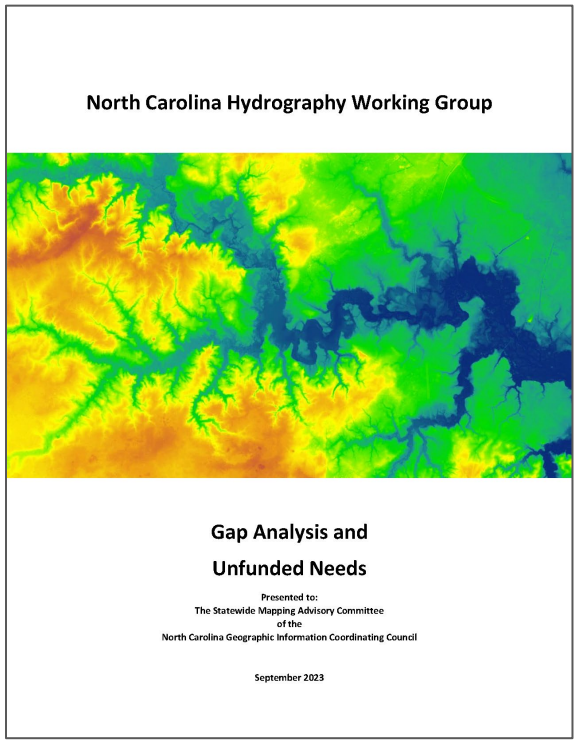


UPDATE SUMMARY

	Existing Data / Process	Retained in ATLAS	Effort Initial/ Recurring
Waterbody Issues ⟵ *KEYSTONE ISSUE*			
Collect waterbodies that meet ¼-acre size to dataset.	No	Yes	High/Med
Collect stream and river polygons to match current EDH and Western NC Hydro specifications	No	Yes	High/Med
Add stream and river polygons to dataset.	Yes	Yes	Med/Med
Shorelines			
Develop a shoreline feature in the polyline dataset or separate shoreline dataset.	Yes	Yes	None/Low
Add polygon waterbody feature in the polygon dataset.	Requires small waterbody collection	Yes	Med/Low
Maintain topology between the two features.		Yes	Low/Low
Feature Attributes and Connectivity			
Hanging Waterbodies	Requires small waterbody collection	Yes	Med/Low
New Waterbody Additions		Yes	Med/Med
Waterbody Differentiation – split features to represent distinct river/lake features	Yes	Yes	Med/Low
Waterbody Differentiation – split complex lake polygon features	No	Yes	Med/Low
Z-enabled features			
Add Z values according to EDH READ Rules*	No	Yes	Low/Low
Water Boundary Dataset			
Edit network to ensure stream connectivity between 10-digit HUCs.	Yes, complete	Yes	None/Low
Attribute watershed boundaries and coordinate with USGS for attribution.	Yes	Yes	Low/Low
Stream Segmentation	No	n/a	Low/Low
Stream Smoothing	No	No	High/High

Add Z values according to EDH READ Rules* = addition of Z values to existing data only; creation of all z-enabled features according to EDH READ rules is anticipated to be High/High





THANK YOU!

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