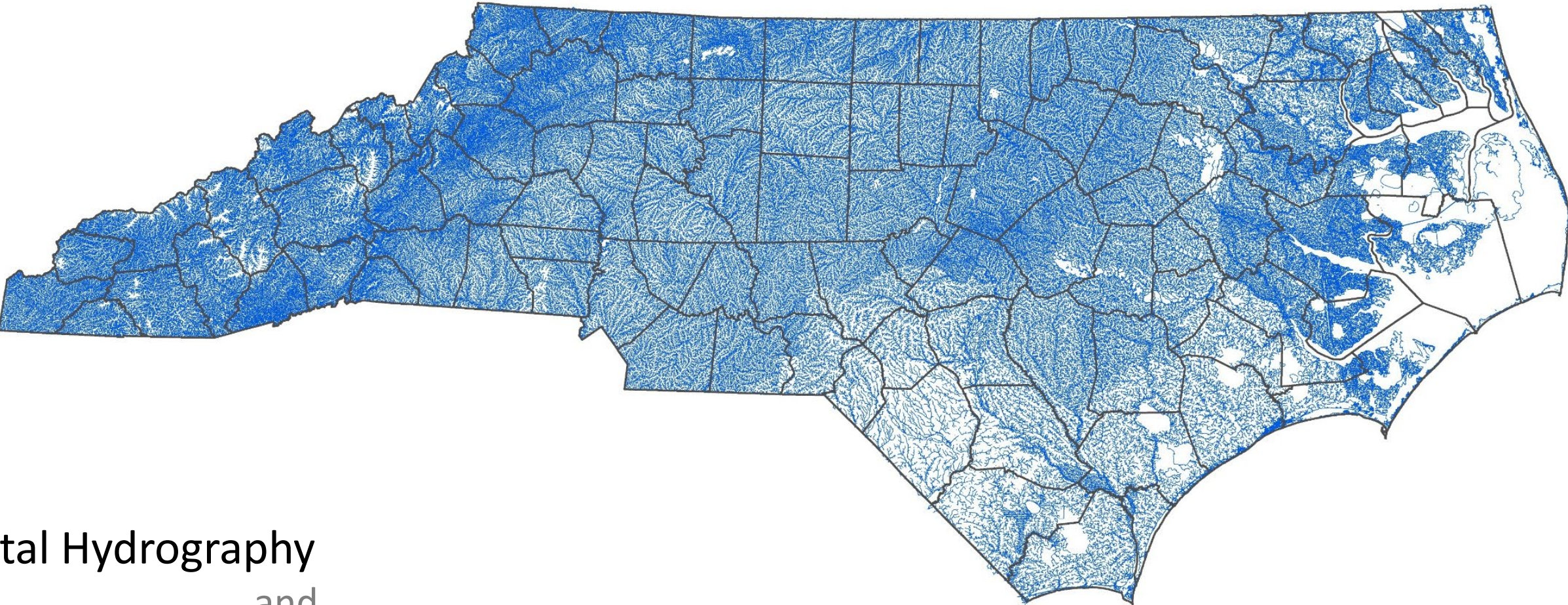


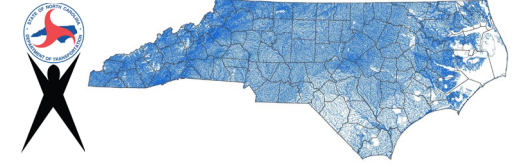
# Surface Waters of North Carolina



Digital Hydrography  
and

## NCDOT Project ATLAS

# The History of Digital Hydrography in North Carolina 1984 - 2021



- 1984 – 1st USGS 24K Quad Hydrography Digitized (DLG)
- 1989 – 194 NC USGS 24k Hydrography Quads, Completed (DLG)
- 1990 – USGS 100K Hydrography Completed (DLG)
- 1990 – EPA develops Reach File 1 model (RF1)
- 1993 – NRCS/USGS develop Watershed Boundary Dataset (WBD)
- 1993 – EPA and USGS create National Hydrography Model (NHD)
- 2000 – NC USGS 24k Hydrography Completed Statewide (DLG)
- 2003 – NHD 100K Completed Nationwide (NHD)
- 2004 – NC initiates Headwater Stream Spatial Data program (HSSD)
- 2005 – NC completed 24K NHD statewide (NHD)
- 2005 – NC Completed 1st Generation LiDAR Statewide (Lidar)
- 2006 – NCDEQ releases statewide attributed 24k hydrography, Western 19 Counties, NC
- 2007 – 24K NHD (Hi-Res) completed nationwide, 19 West included (NHDHR)
- 2015 – NHDPlus using 24K NHD begun (NHDPlus HR)
- 2015 – NHDPlus completed nationwide using 100K (NHDPlus)
- 2017 – USGS 3DEP NC 2nd Gen Lidar program begins, completed 2021
- 2019 – NCDOT ATLAS Hydro begins
- 2021 – NCDOT ATLAS Hydro Version 1.4

1984

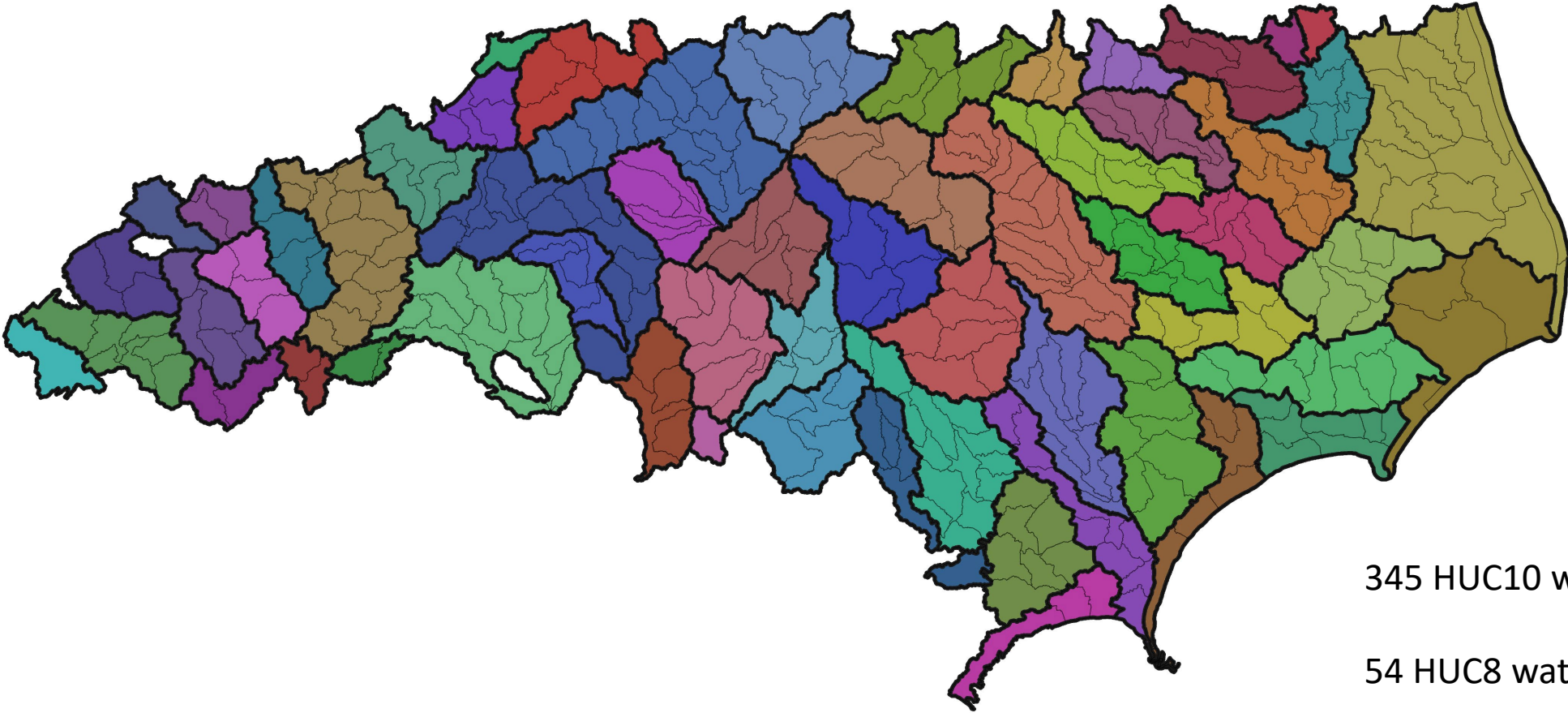
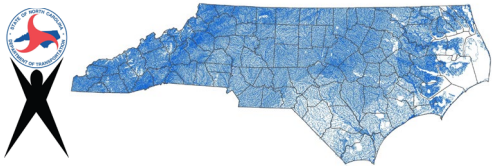
DLG – TIGER – RF1 – RF2 – RF3 – WBD – NHD – HSSD – LiDAR – LR – NHD HR – NHDPlus – 3DEP – NHDPlus HR – ATLAS 1.X

2021



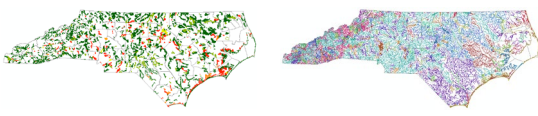
\* - Denotes NCDOT Project or Cost Share

# Current Digital Hydrography in North Carolina

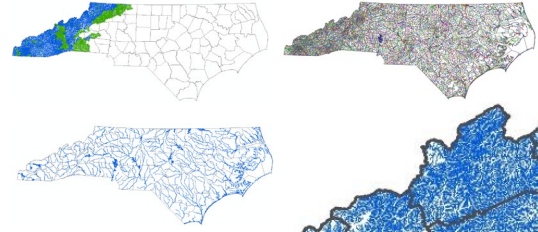


345 HUC10 watersheds

54 HUC8 watersheds



**ATTRIBUTES from MULTIPLE DATASETS**  
Including more than 13,000 NCDEQ Assessment Units and associated data



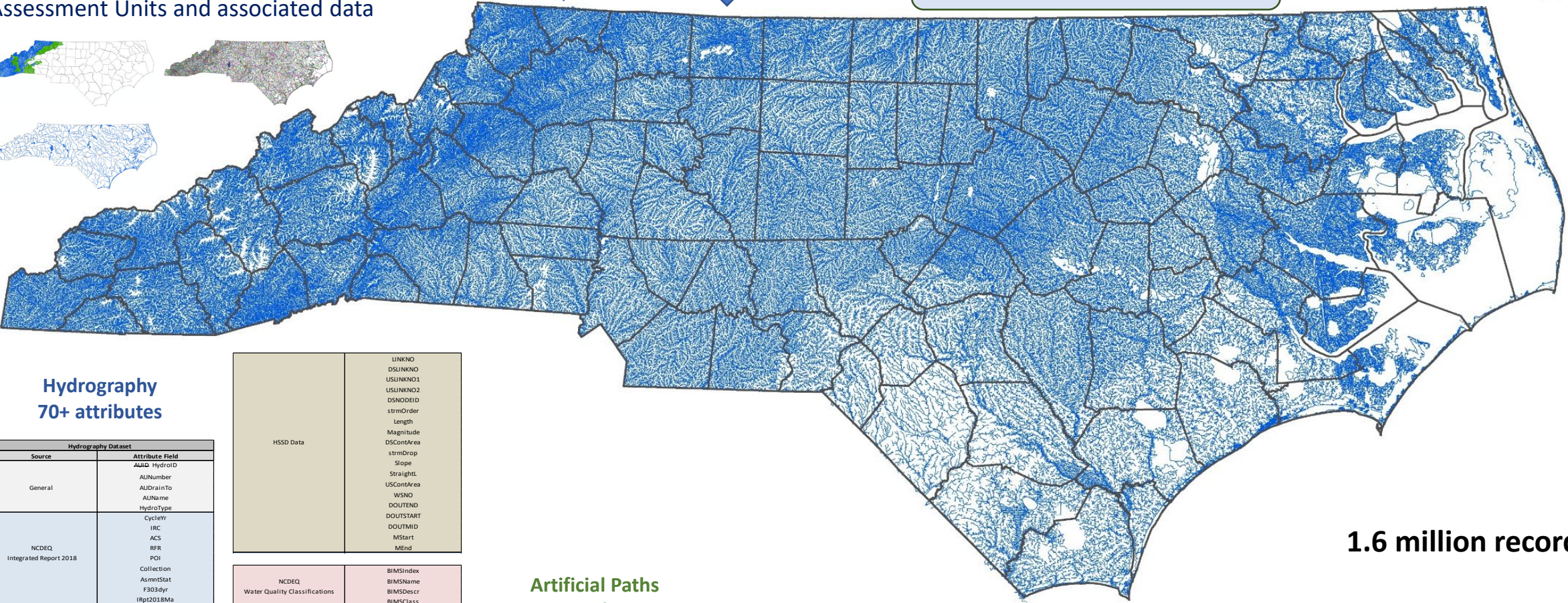
NC Floodplain Mapping surfaces

Headwater Streams Spatial Dataset  
Surface data Hydrography lines Origin data

QL2 LiDAR-derived shorelines  
Waterbodies 2+ acres / 100+ feet width



ATLAS Hydrography v1



**Hydrography  
70+ attributes**

Hydrography Dataset	
Source	Attribute Field
General	AUID, Hydroid, ALNNumber, AUDrainTo, AUName, HydroType
NCDEQ Integrated Report 2018	CycleYr, IRC, ACS, RFR, POI, Collection, AsmntStat, F303dyr, IRpt2018Ma, IRpt2018Cm
NCDEQ Water Quality Assessments	NCBasin, AULengthA, USRLong, USCLongVe, RFRLong, POPLong, Dyear, WQAsmtOneM, WQAsmtCmt
NCDEQ WRAPS_AU_Rating	F2018, WrapsRatin, WrapsRat_1
Additional ATLAS data	EBTJVTR, CCWHab, DBCJW, Impact

Source	Attribute Field
HSSD Data	LINKNO, DSLINKNO, USLINKNO1, USLINKNO2, DSNODEID, strmOrder, Length, Magnitude, DSContArea, strmDrop, Slope, Straighgt, USContArea, WSNO, DOUTEND, DOUTSTART, DOUTMID, MStart, MEnd

Source	Attribute Field
NCDEQ Water Quality Classifications	BIMSindex, BIMName, BIMSDescr, BIMSClass, BIMSDate, ShapeSTLe

Source	Attribute Field
NCDEQ Water Quality Ratings	OIRCat, OUSR

Source	Attribute Field
NCDEQ WRAPS_AU_Classifications	AUDescrip, Subbasin, HUC8, AULengthA1, AUUnits, hydrOrder, Creatdty, PreviousA, Status, Magnitude, GISFeatur, ALType, markupands, Markupan1, ClassOneMa, ClassComme

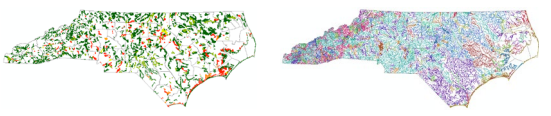
**Artificial Paths  
12 attributes**

ArtificialPath Dataset	
Source	Attribute Field
General	HydroType, LINKNO, DOUTEND, strmOrder, DSContArea, DSLINKNO, Magnitude, USContArea, USLINKNO2, USLINKNO1, MEnd, MStart
HSSD Data	

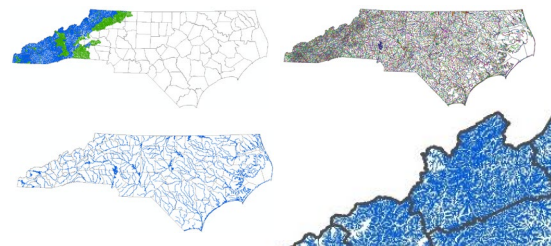
**1.6 million records**

**336k records for streams with designated Assessment Units**

**ATLAS HYDROGRAPHY v1**

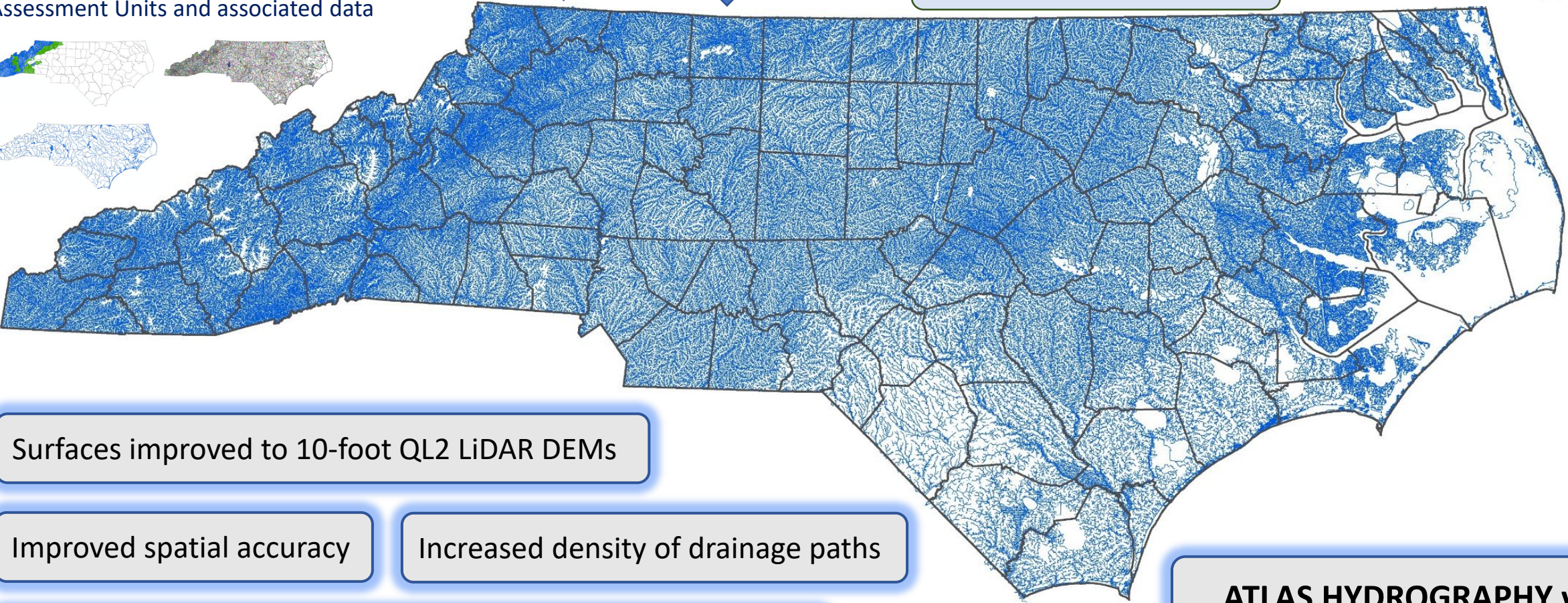
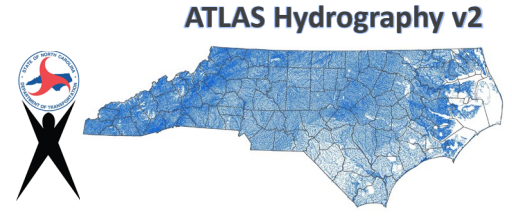


**ATTRIBUTES from MULTIPLE DATASETS**  
Including more than 13,000 NCDEQ  
Assessment Units and associated data



**Headwater Streams Spatial Dataset**  
Surface data Hydrography lines Origin data

QL2 LiDAR-derived shorelines  
Waterbodies 2+ acres / 100+ feet width



Surfaces improved to 10-foot QL2 LiDAR DEMs

Improved spatial accuracy

Increased density of drainage paths

Relational Database Management System (RDBMS) structure

Updated models

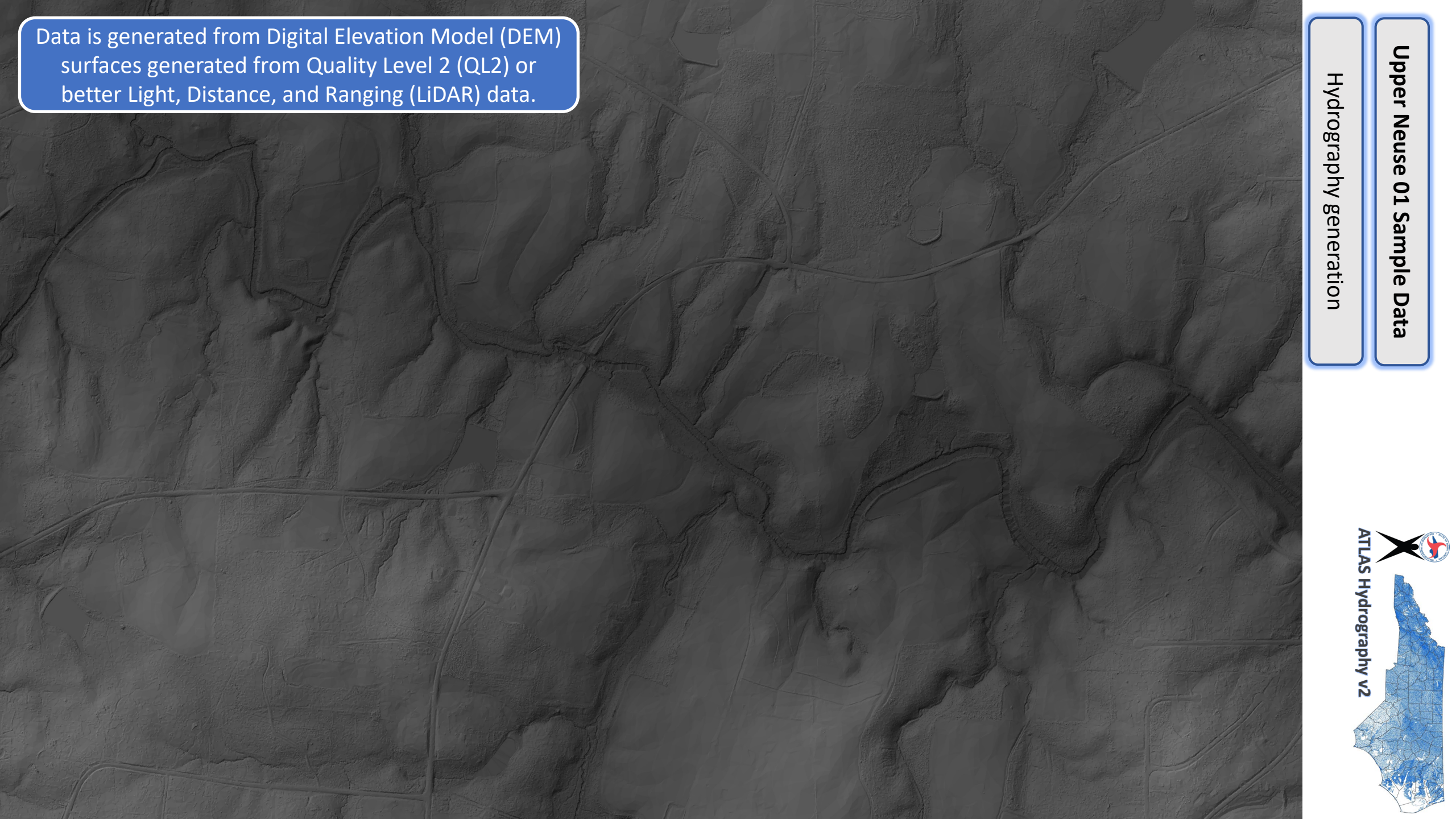
Unique identifiers

ATLAS HYDROGRAPHY v1

**ATLAS HYDROGRAPHY v2**

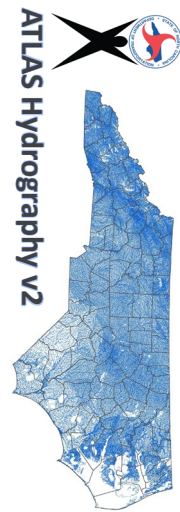


Data is generated from Digital Elevation Model (DEM) surfaces generated from Quality Level 2 (QL2) or better Light, Distance, and Ranging (LiDAR) data.



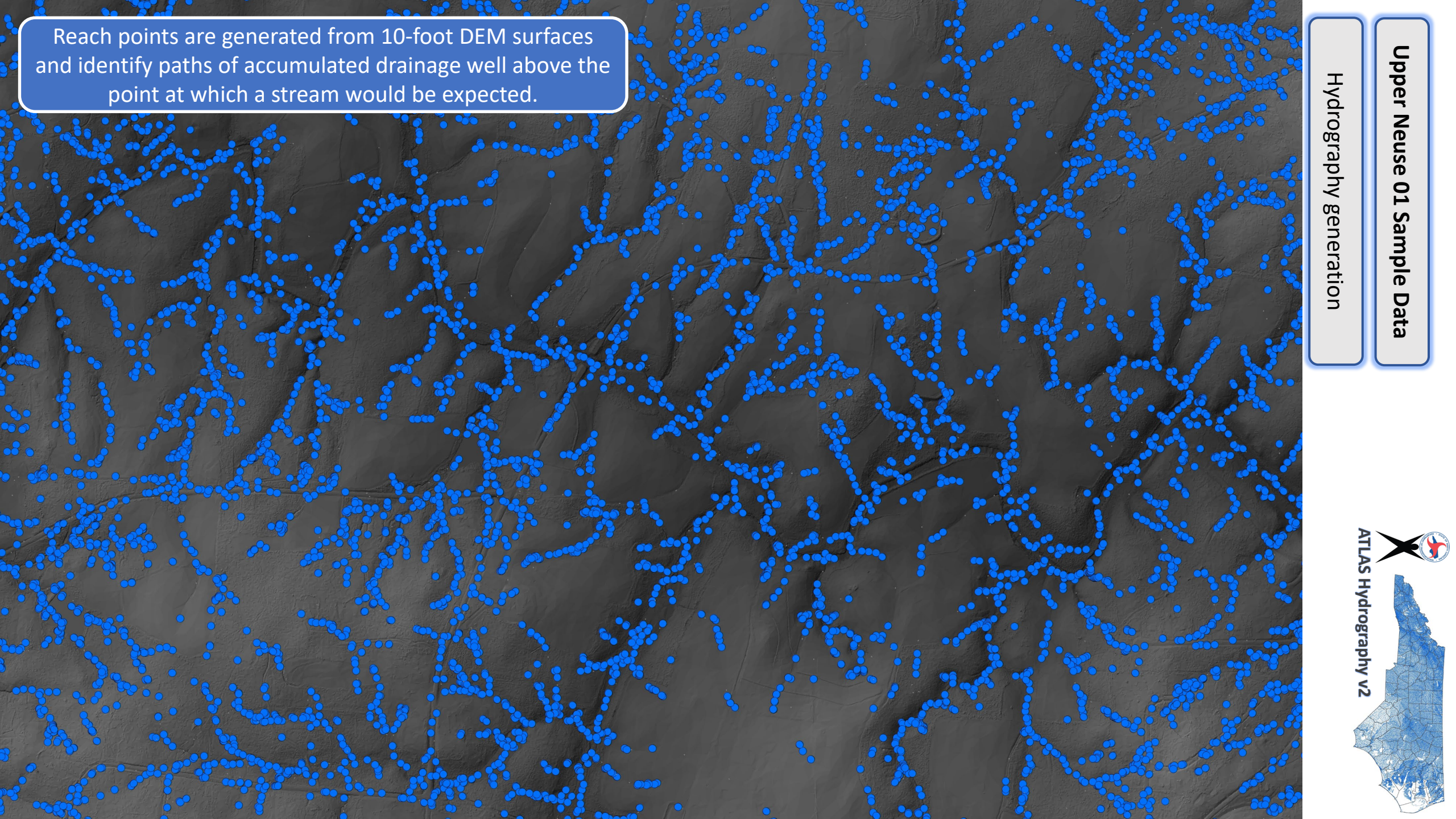
Upper Neuse 01 Sample Data

Hydrography generation



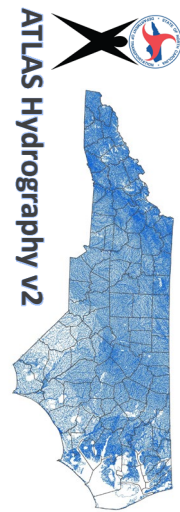
ATLAS Hydrography v2

Reach points are generated from 10-foot DEM surfaces and identify paths of accumulated drainage well above the point at which a stream would be expected.



Hydrography generation

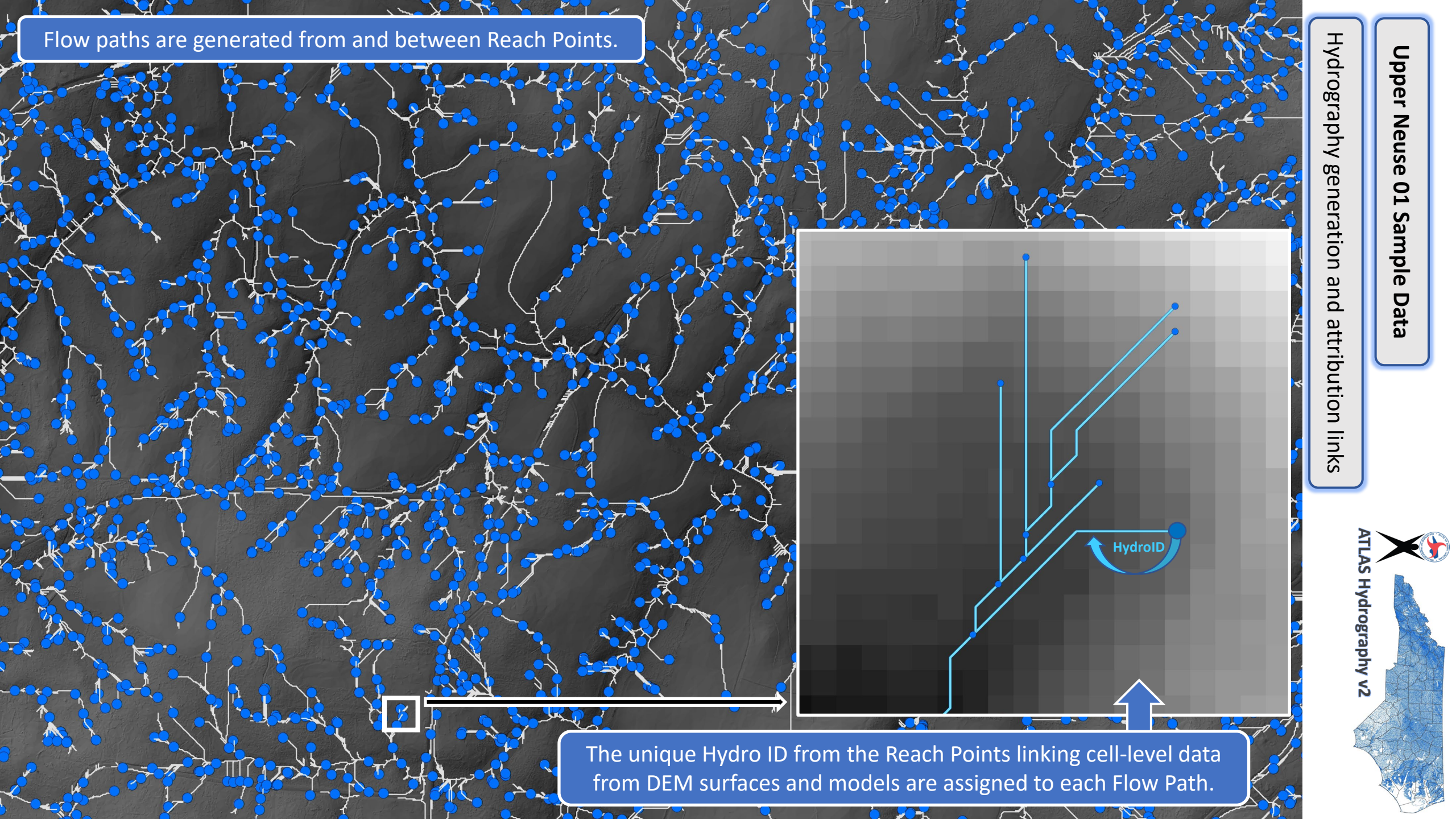
Upper Neuse 01 Sample Data



Flow paths are generated from and between Reach Points.

Upper Neuse 01 Sample Data

Hydrography generation and attribution links



The unique Hydro ID from the Reach Points linking cell-level data from DEM surfaces and models are assigned to each Flow Path.



ATLAS Hydrography v2

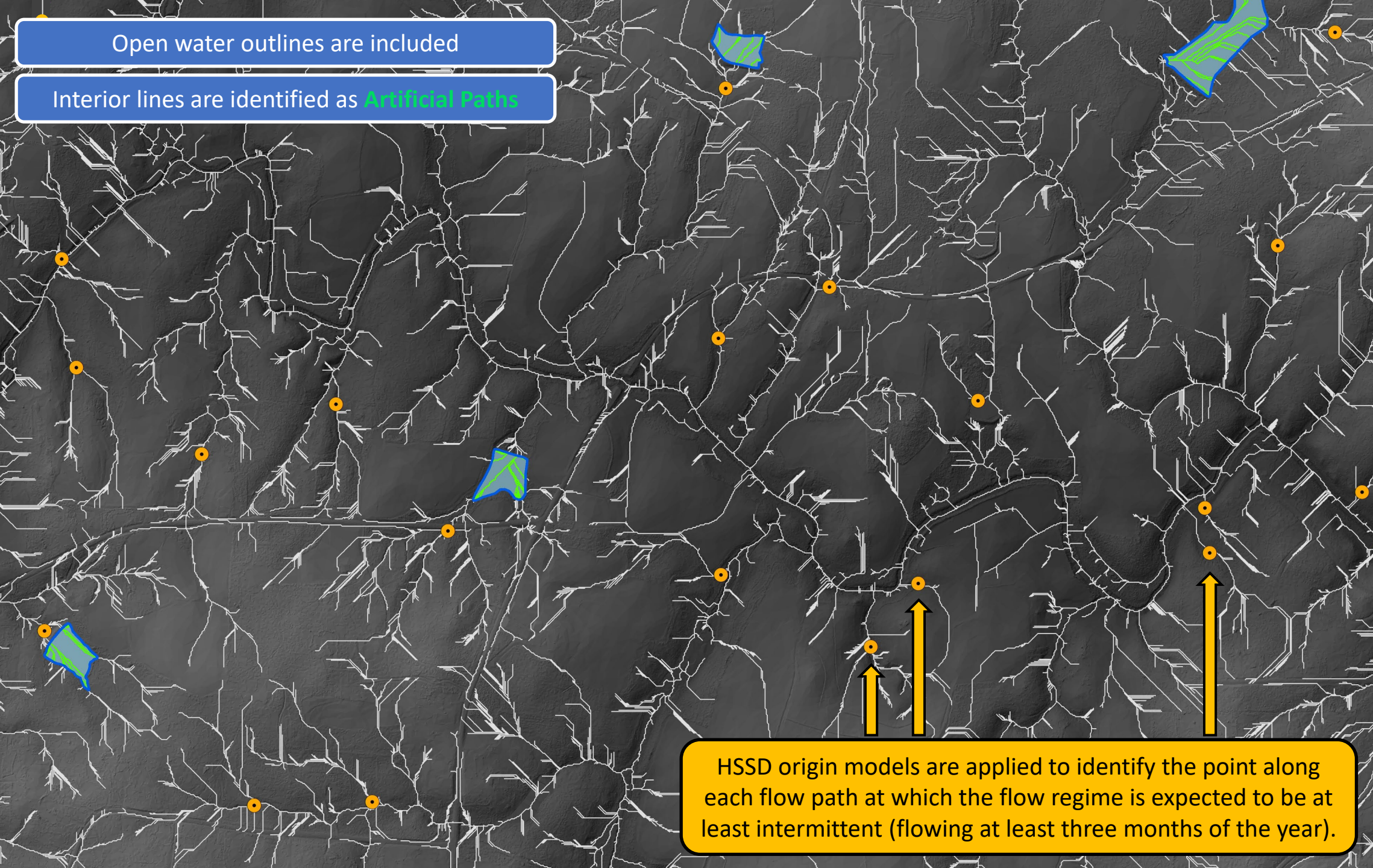


Open water outlines are included

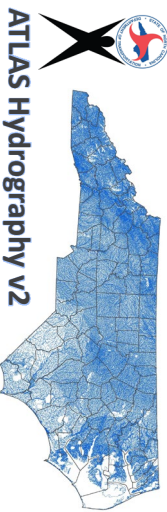
Interior lines are identified as **Artificial Paths**

Identification of likely jurisdictional features

Upper Neuse 01 Sample Data



HSSD origin models are applied to identify the point along each flow path at which the flow regime is expected to be at least intermittent (flowing at least three months of the year).



Feature type = Artificial Path

Feature type = Mainstem

AUIDs linking NCDEQ water data to Assessment Unit streams (AUs) are assigned to appropriate Flow Paths.

Feature type = Tributary

Features without AUID numbers that are identified as at least intermittent are labeled as Unnamed Tributaries (UTs) to AUs.

Each Unnamed Tributary is identified with a unique identification number and the waters to which it drains.

Feature type = Drainage Way

Features that are identified as less than intermittent are labeled as Drainage Ways and assigned a non-unique name that reflects the waters to which it drains.

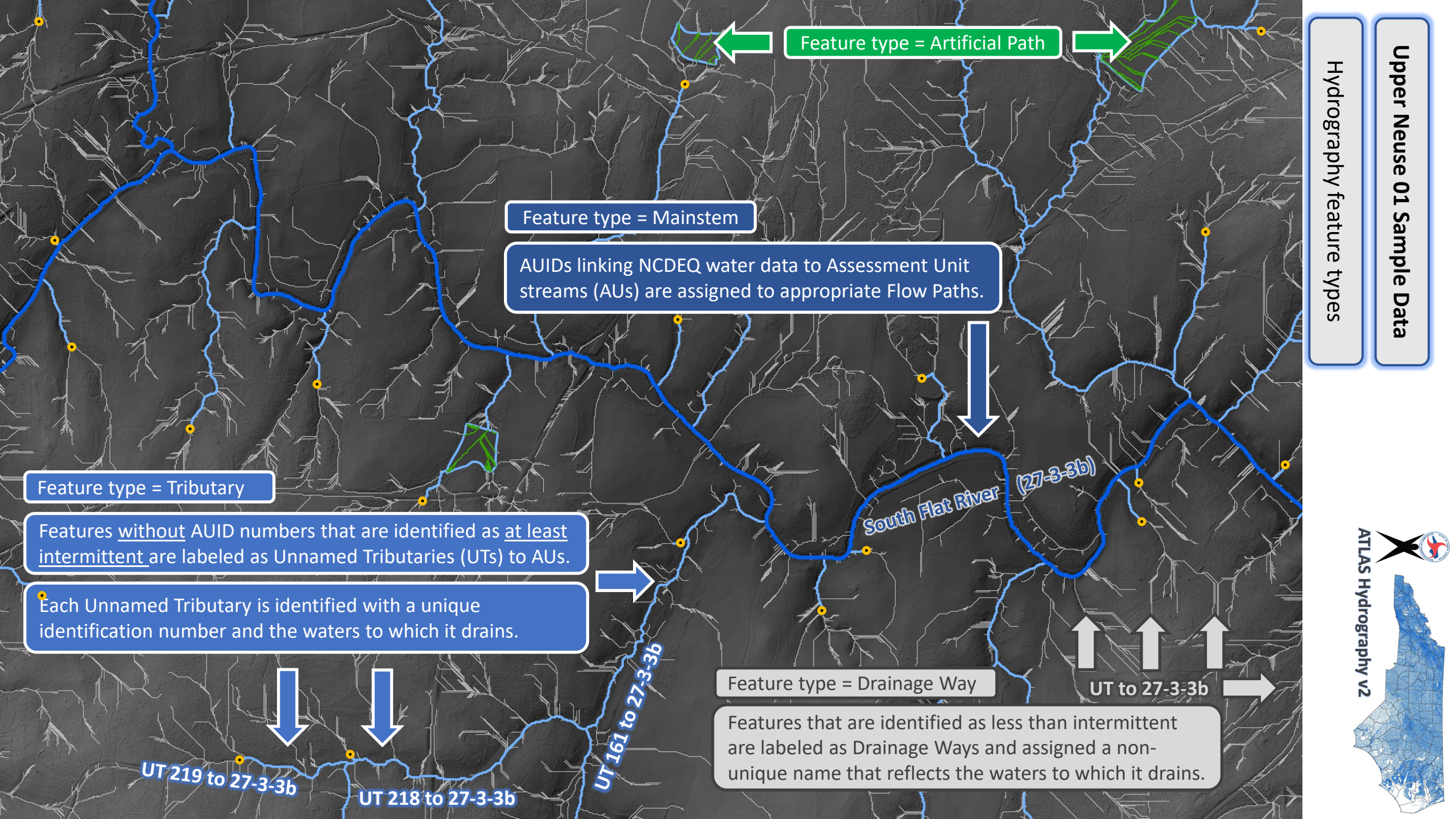
UT to 27-3-3b

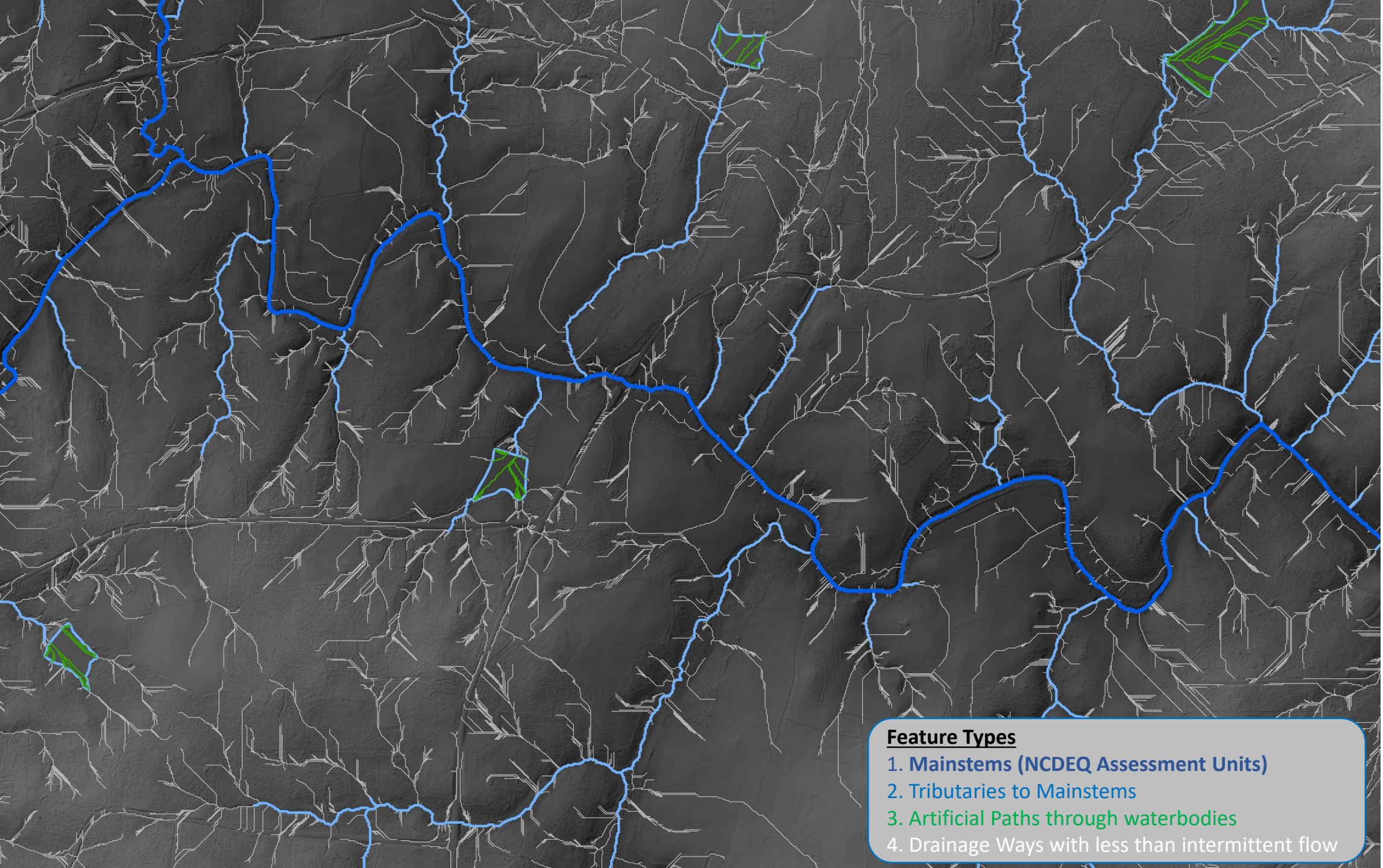
UT 219 to 27-3-3b

UT 218 to 27-3-3b

UT 161 to 27-3-3b

South Flat River (27-3-3b)

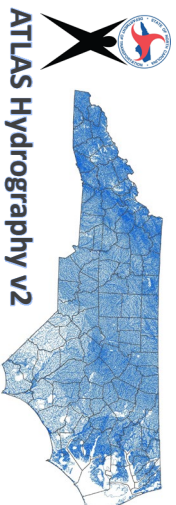
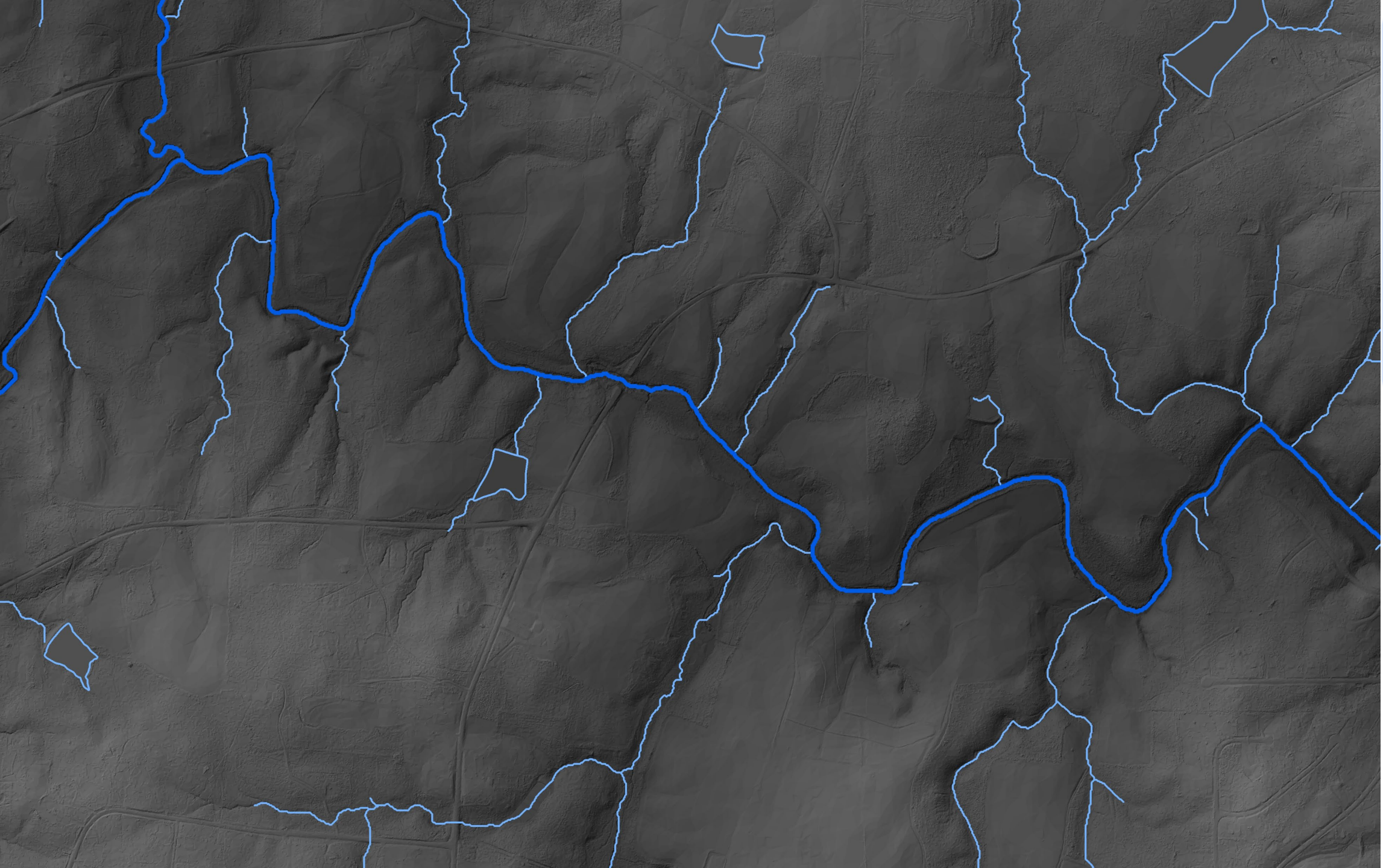




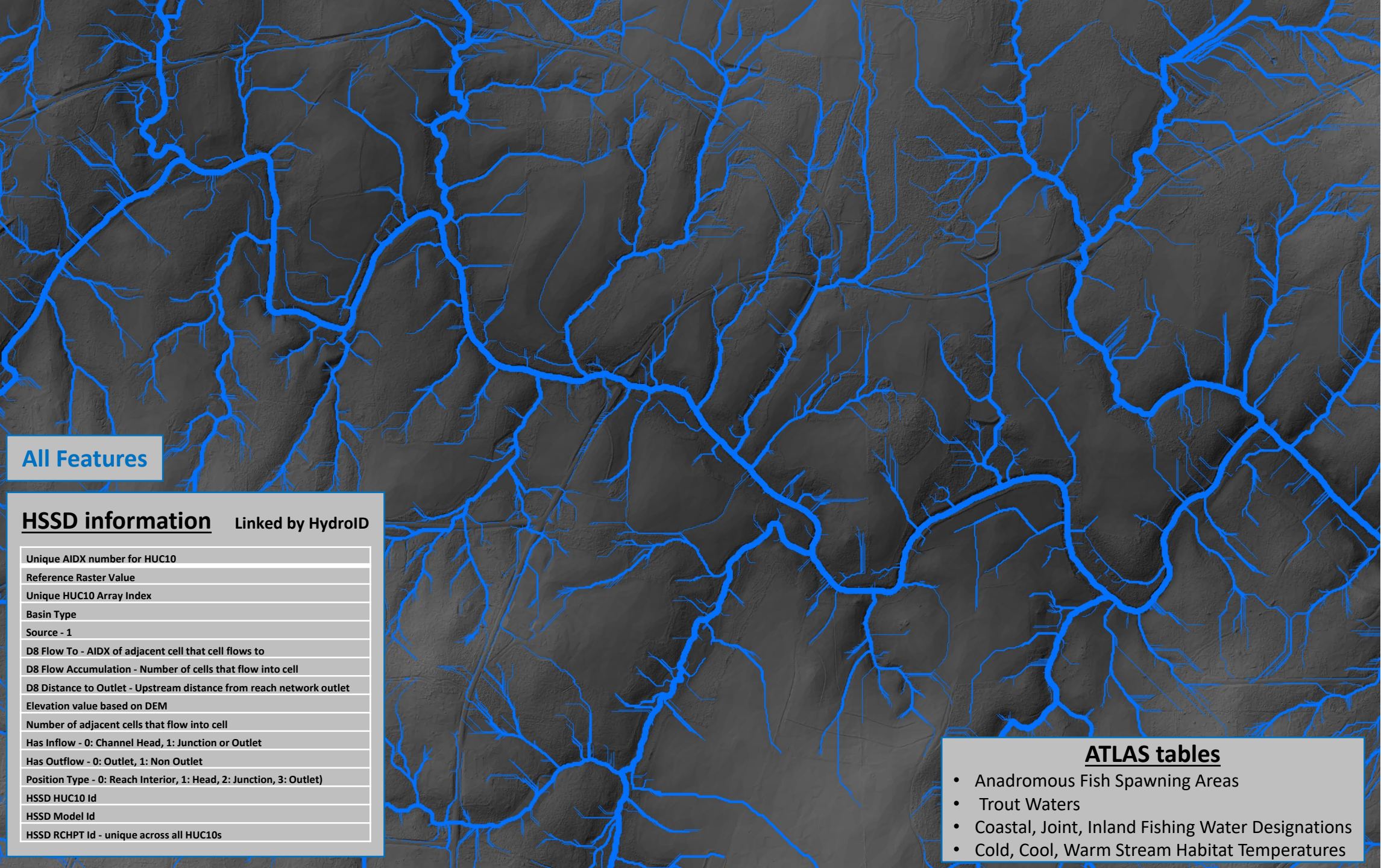
- Feature Types**
1. Mainstems (NCDEQ Assessment Units)
  2. Tributaries to Mainstems
  3. Artificial Paths through waterbodies
  4. Drainage Ways with less than intermittent flow

**Upper Neuse 01 Sample Data**

Predicted jurisdictional features



ATLAS Hydrography v2



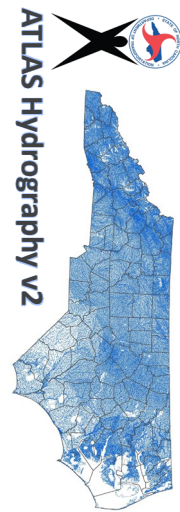
All Features

**HSSD information**    Linked by HydrolD

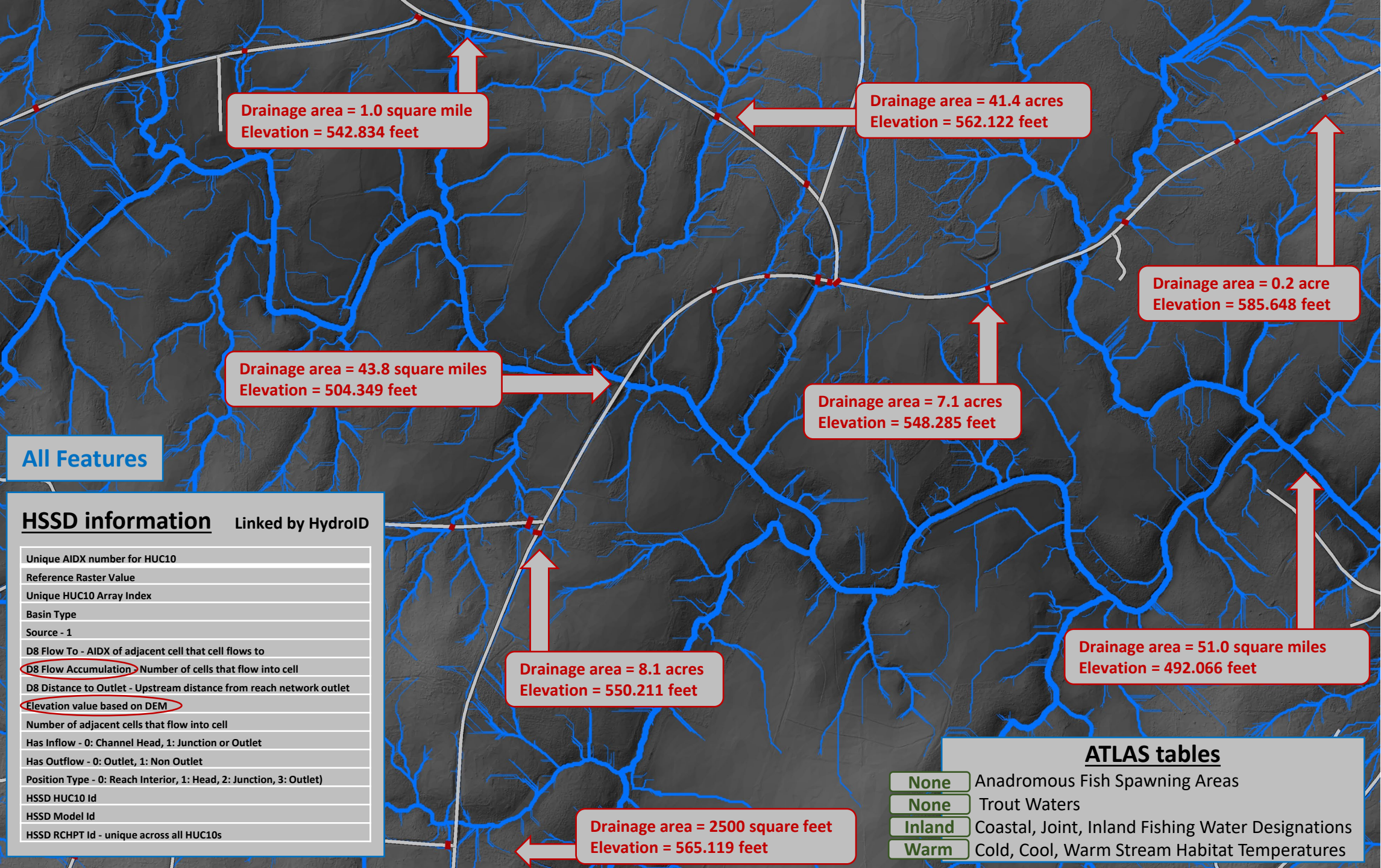
Unique AIDX number for HUC10
Reference Raster Value
Unique HUC10 Array Index
Basin Type
Source - 1
D8 Flow To - AIDX of adjacent cell that cell flows to
D8 Flow Accumulation - Number of cells that flow into cell
D8 Distance to Outlet - Upstream distance from reach network outlet
Elevation value based on DEM
Number of adjacent cells that flow into cell
Has Inflow - 0: Channel Head, 1: Junction or Outlet
Has Outflow - 0: Outlet, 1: Non Outlet
Position Type - 0: Reach Interior, 1: Head, 2: Junction, 3: Outlet)
HSSD HUC10 Id
HSSD Model Id
HSSD RCHPT Id - unique across all HUC10s

**ATLAS tables**

- Anadromous Fish Spawning Areas
- Trout Waters
- Coastal, Joint, Inland Fishing Water Designations
- Cold, Cool, Warm Stream Habitat Temperatures



ATLAS Hydrography v2



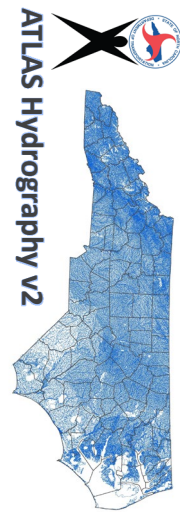
All Features

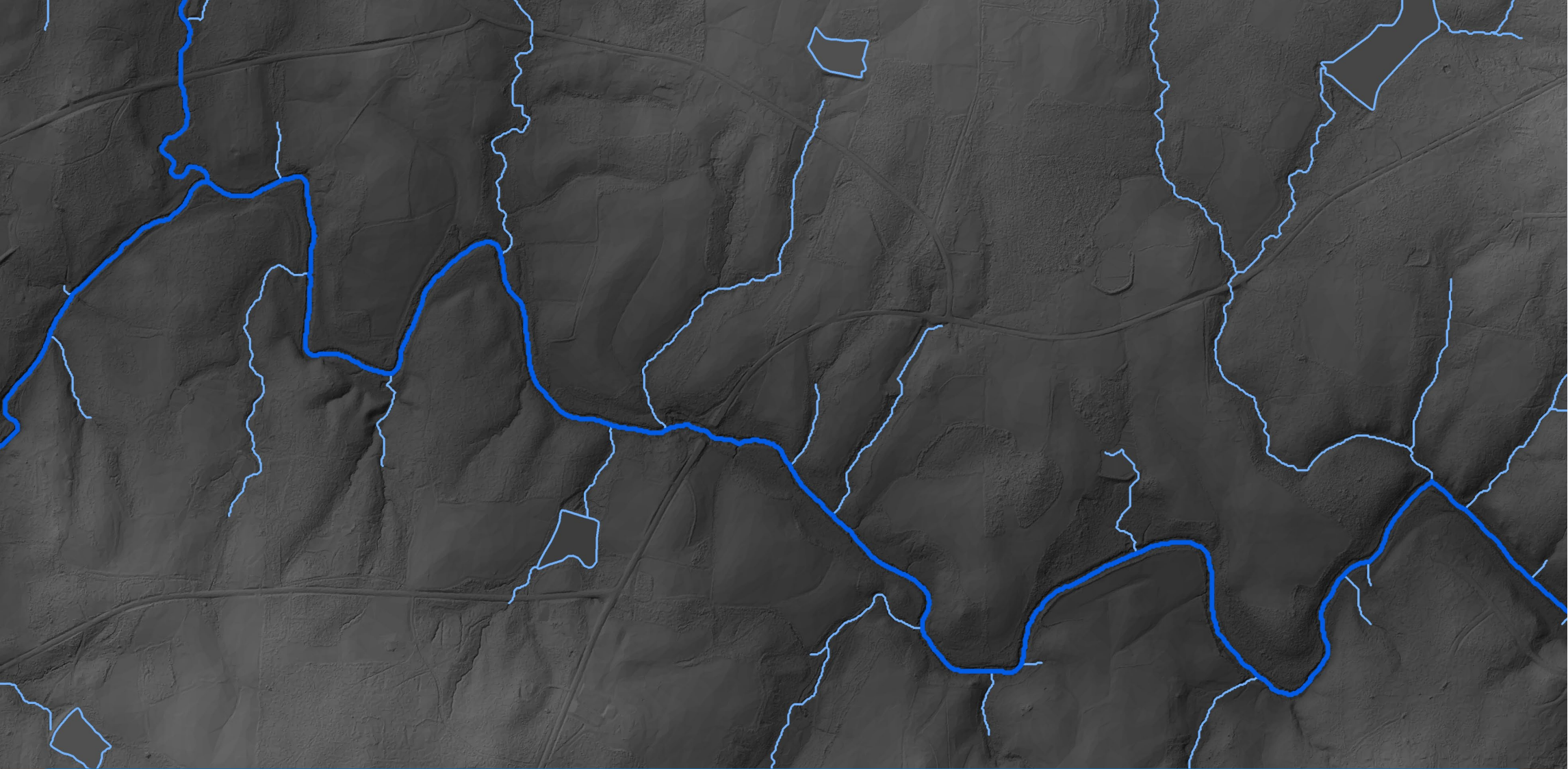
HSSD information Linked by HydroID

Unique AIDX number for HUC10
Reference Raster Value
Unique HUC10 Array Index
Basin Type
Source - 1
D8 Flow To - AIDX of adjacent cell that cell flows to
<u>D8 Flow Accumulation</u> - Number of cells that flow into cell
D8 Distance to Outlet - Upstream distance from reach network outlet
<u>Elevation value based on DEM</u>
Number of adjacent cells that flow into cell
Has Inflow - 0: Channel Head, 1: Junction or Outlet
Has Outflow - 0: Outlet, 1: Non Outlet
Position Type - 0: Reach Interior, 1: Head, 2: Junction, 3: Outlet)
HSSD HUC10 Id
HSSD Model Id
HSSD RCHPT Id - unique across all HUC10s

ATLAS tables

None	Anadromous Fish Spawning Areas
None	Trout Waters
Inland	Coastal, Joint, Inland Fishing Water Designations
Warm	Cold, Cool, Warm Stream Habitat Temperatures





Upper Neuse 01 Sample Data

NCDEQ data application

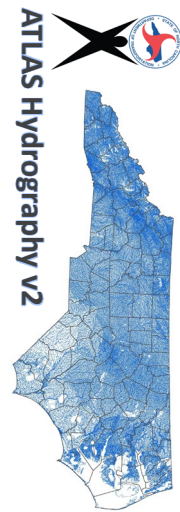
**Feature Types**

**1. Mainstems    2. Tributaries**

**NCDEQ data**  
Linked by AUID

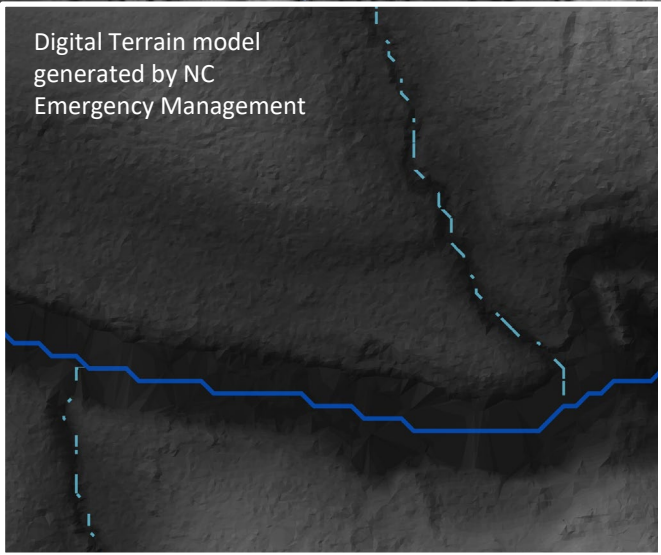
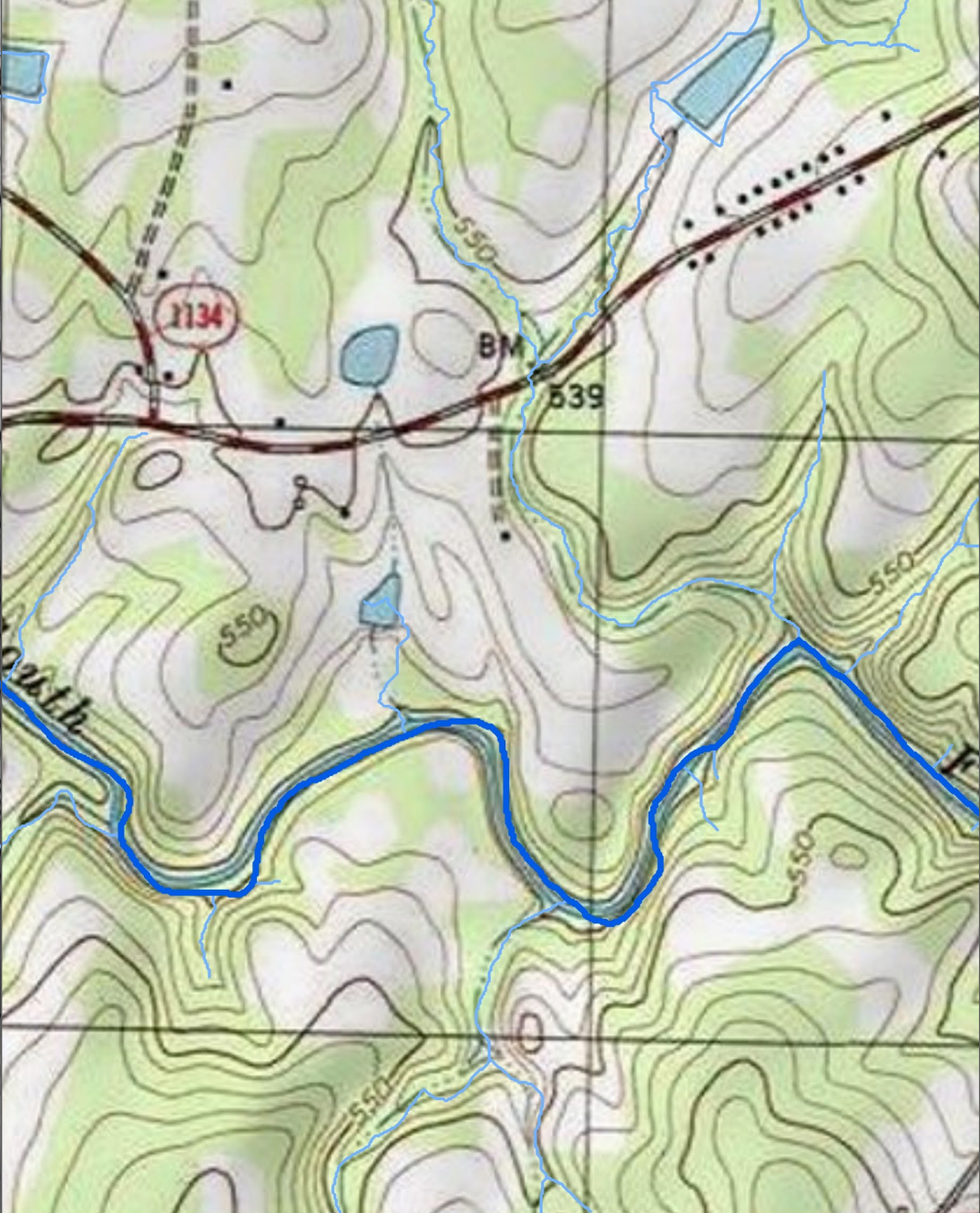
- AU Name
- AU Number
- AU Description
- Integrated Reporting Category
- Assessment Criteria Status
- Reason for Rating
- Parameter of interest
- NC River Basin
- Watershed HUC8 Basin
- Watershed subbasin
- AU type (domain value)
- AU units (domain value)
- AU length based on 24k hydrography
- BIMS Index Number
- BIMS Water Quality Classification
- Hydrologically ordered BIMS list
- Year AU was created or became active
- Retired AU number before current AU
- Active or retired status
- Indicator of GIS feature in 24k data
- WRAPS Ratings

- 2020
- 2018
- 2016
- 2014
- 2012
- 2010
- 2008

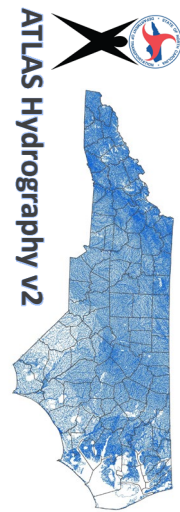


Upper Neuse 01 Sample Data

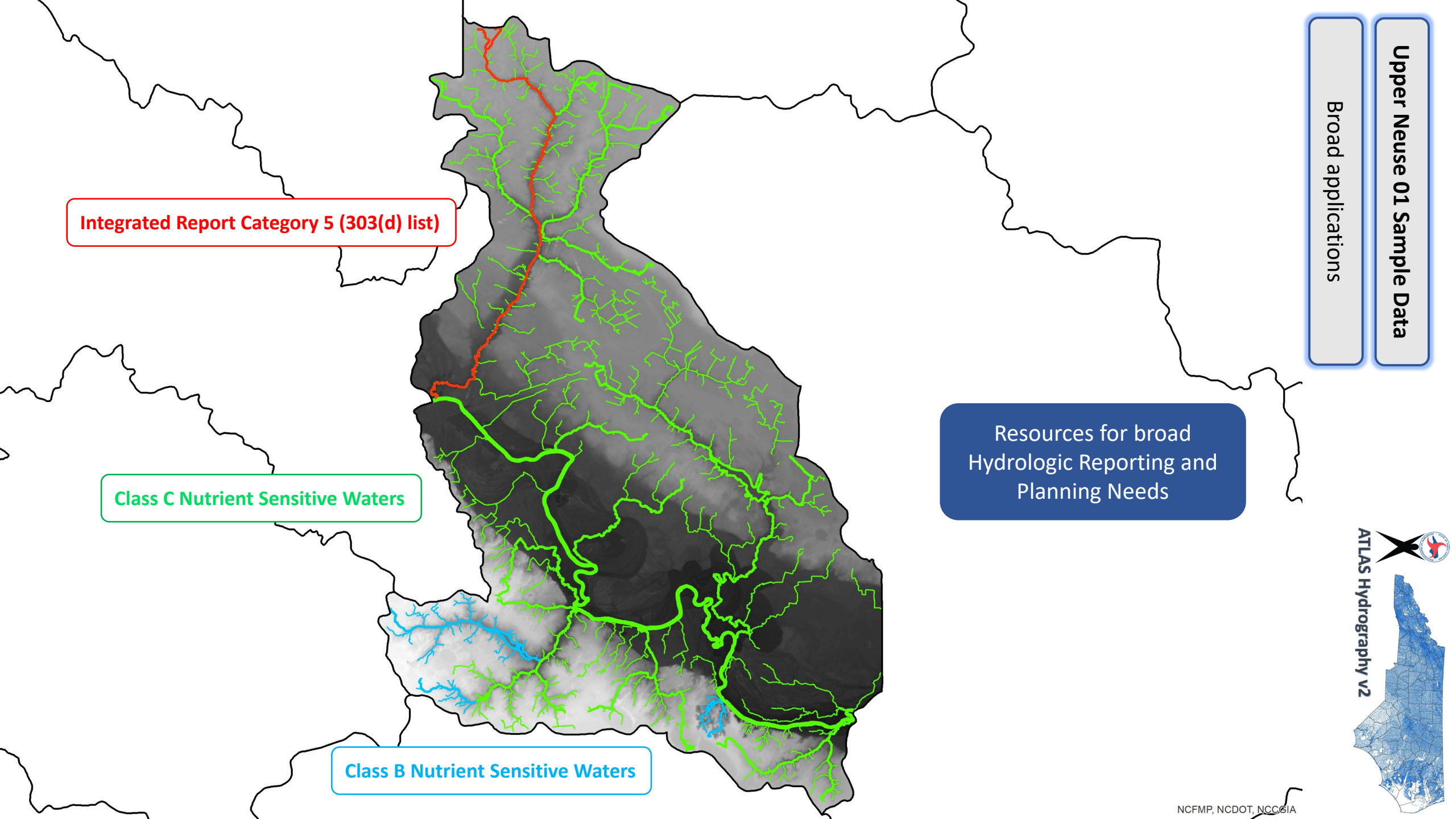
Comparison with existing statewide mapping



NRCS Soil Survey Mapping      SPATIAL ACCURACY is refined significantly.      USGS 1:24,000 topographic quadrangle  
UPSTREAM ORIGINS fall between those depicted by mapping that tends to over-represent and under-represent stream features.







**Integrated Report Category 5 (303(d) list)**

**Class C Nutrient Sensitive Waters**

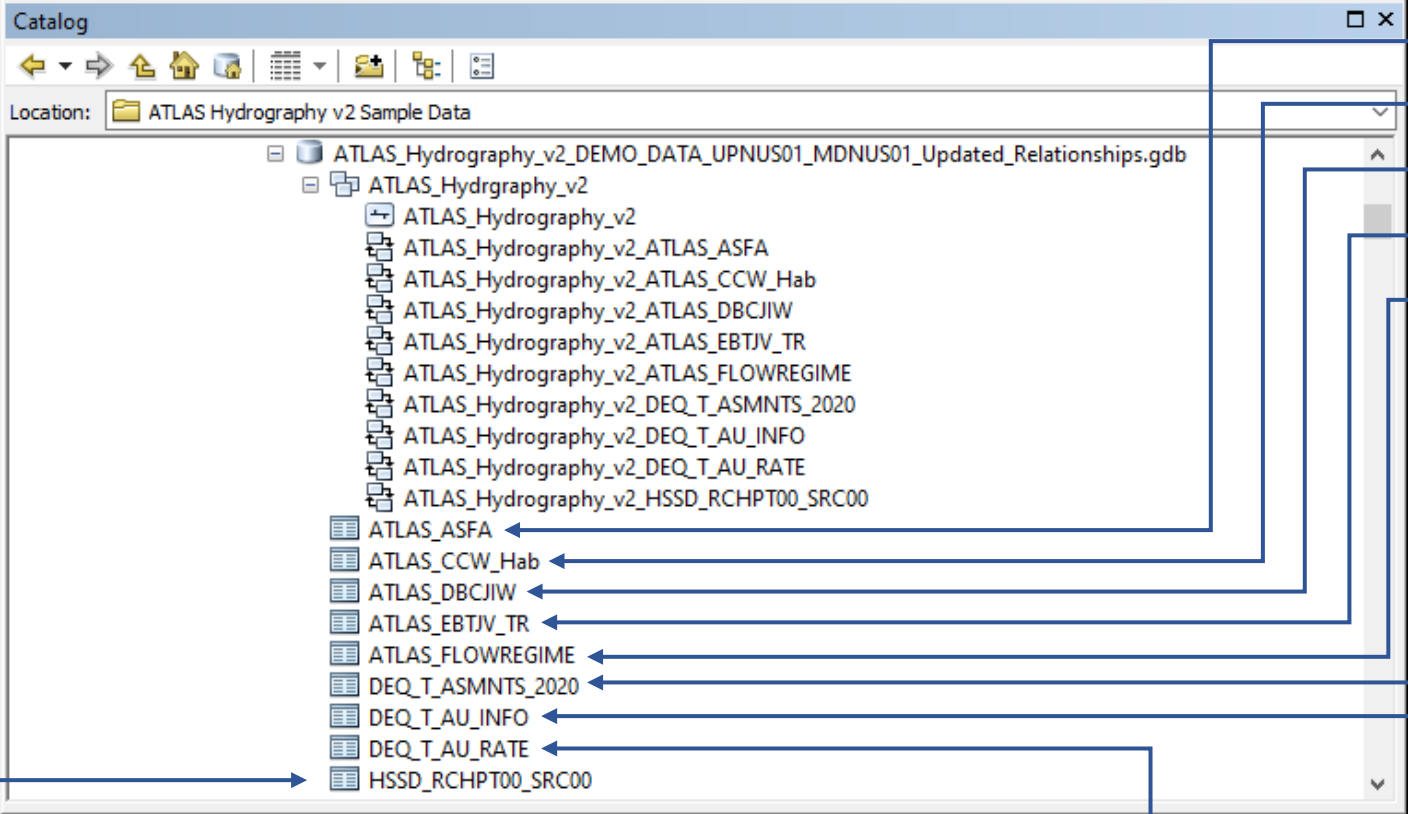
**Class B Nutrient Sensitive Waters**

**Resources for broad Hydrologic Reporting and Planning Needs**

**Broad applications**

**Upper Neuse 01 Sample Data**





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

### 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

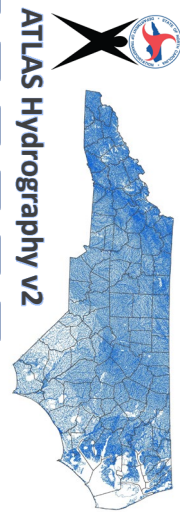
### NCDEQ Assessment Unit Ratings (WRAPS)

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

### NCDEQ Assessment Unit Information

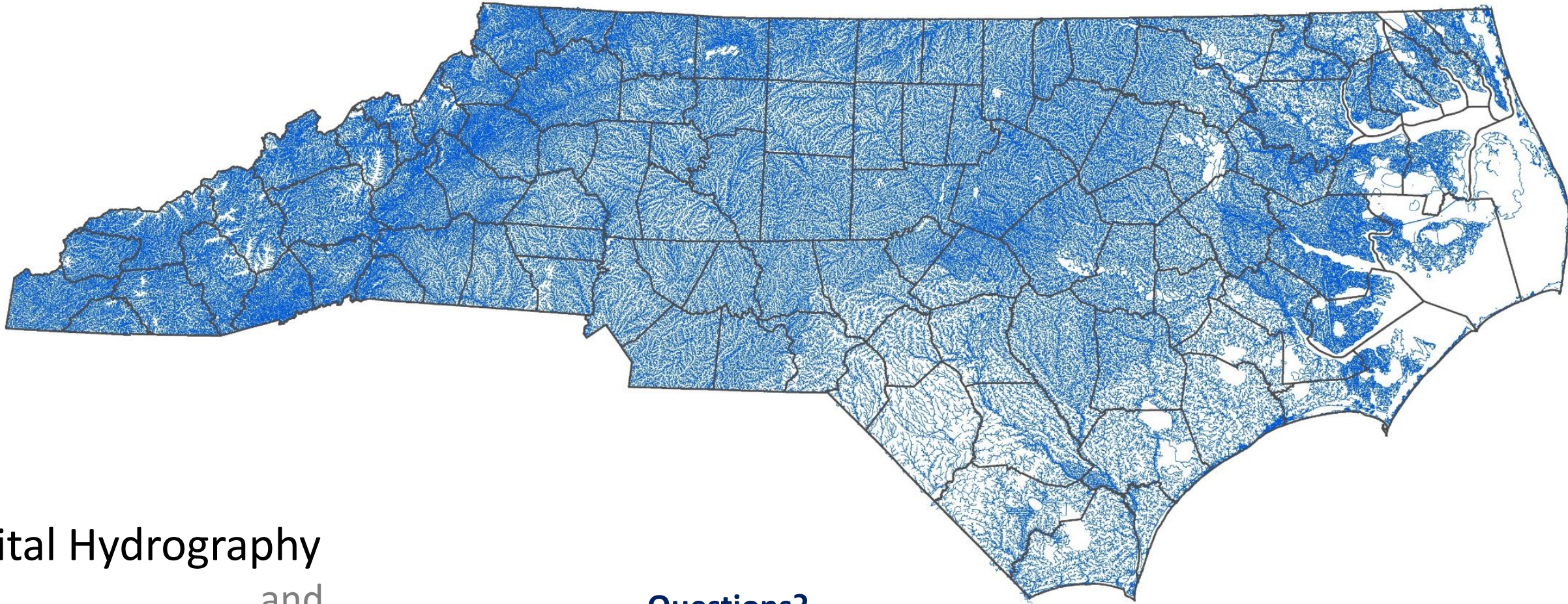
AU Name	BIMS Index Number
AU Number	Water Quality Classification
AU ID	AU Type (i.e., Estuary, Stream)
AU Description	AU Units (i.e., feet, acres)
AU Number	Hydrologically ordered BIMS list
HUC 8 Basin	Retired AU prior to current no.
Subbasin (HUC 8 Basin Name)	Year AU was created or activated
Indicator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

Sample Data Schema



**BIMS- Basinwide Information Management System**  
**WRAPS - Watershed Restoration, Assessment and Protection Superstructure**

# Surface Waters of North Carolina



Digital Hydrography  
and

Questions?

**NCDOT Project ATLAS**

**Contacts:**

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[sdavis@axiomenvironmental.org](mailto:sdavis@axiomenvironmental.org)

[zsolt.nagy@aecom.com](mailto:zsolt.nagy@aecom.com)



Advancing Transportation through Linkages, Automation, and Screening