High-resolution Wetland Classification / Mapping

Peter R. Claggett[1], Labeeb Ahmed[2], Jacob Czawlytco[3], Sean MacFaden[4], Jarlath O'Neil-Dunne[4], and Rachel Soobitsky[3]

1 Presenting Author, Lower Mississippi-Gulf Water Science Center, U.S. Geological Survey, Annapolis, MD 21403
2 Attain LLC, Annapolis, MD 21403
3 Chesapeake Conservancy, Annapolis, MD 21403
4 University of Vermont Spatial Analysis Laboratory, Burlington, VT 05405

CBP Wetlands Workgroup
October 20, 2020 -> updated for Land Use Workgroup's November 4, 2020 meeting

U.S. Department of the Interior
U.S. Geological Survey

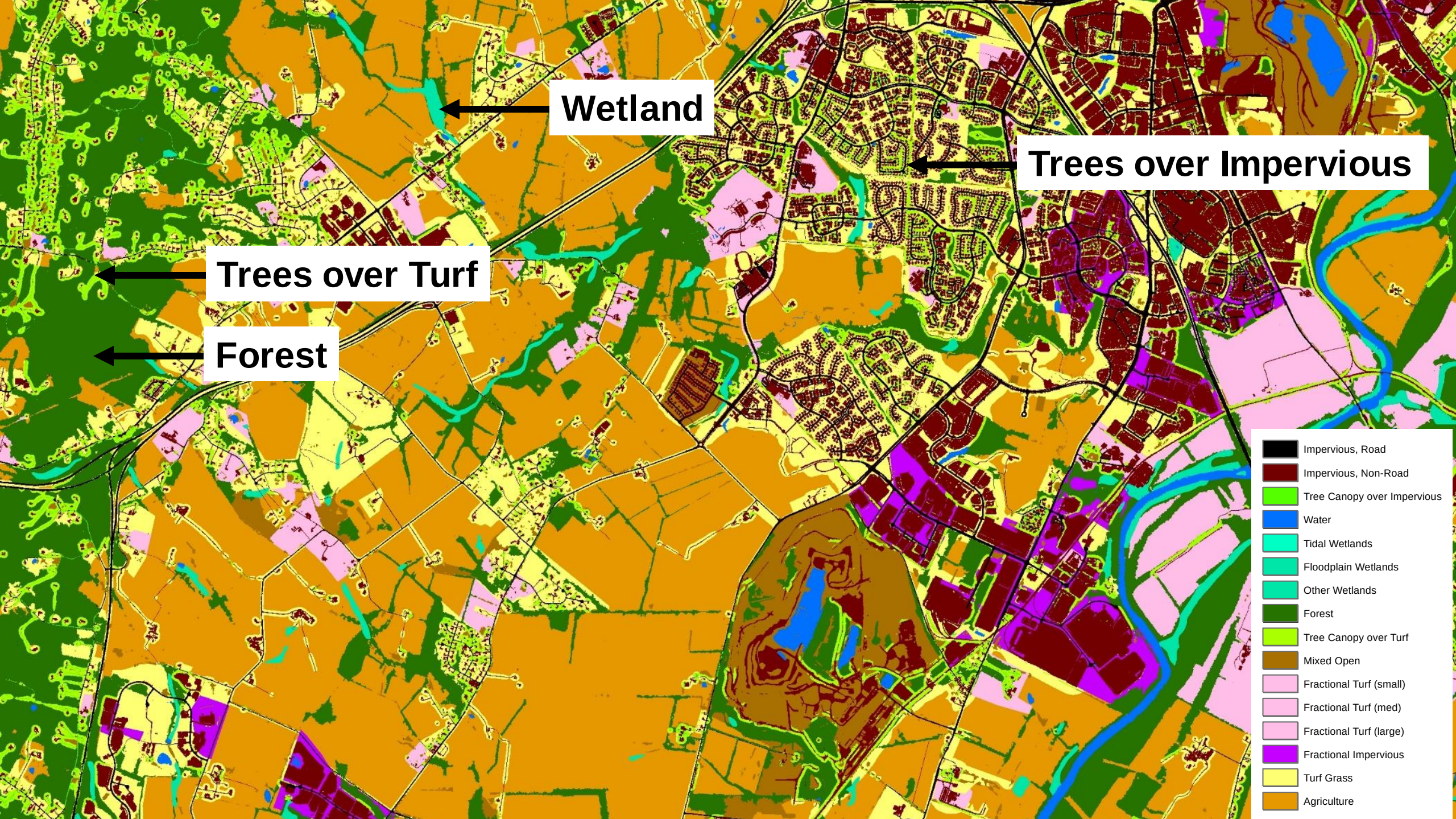
Purpose

Mapping goals

- Consistent, comprehensive, and spatially accurate
- Based on the best available data

Classification goals

- General, but accurate, and related to one or more wetland functions


Wetland
Trees over Impervious
Trees over Turf
Forest
Impervious, Road
Impervious, Non-Road
Tree Canopy over Impervious
Water
Tidal Wetlands
Floodplain Wetlands
Other Wetlands
Forest
Tree Canopy over Turf
Mixed Open
Fractional Turf (small)
Fractional Turf (med)
Fractional Turf (large)
Fractional Impervious
Turf Grass
Agriculture

Chesapeake Bay Program Land Use Classification (58-64 classes)

1. Water (8)
- 1.1 Lentic
  - 1.1.1 Estuary
  - 1.1.2 Lakes & Ponds
- 1.2 Lotic
  - 1.2.1 Streams
    - 1.2.1.1 Sunlit
    - 1.2.1.2 Shaded
    - 1.2.1.3 Culverted/ Buried
  - 1.2.2.Ditches
    - 1.2.2.1 Sunlit
    - 1.2.2.2 Shaded
    - 1.2.2.3 Culverted/ Buried

2. Developed (12)
- 2.1 Impervious
  - 2.1.1 Roads
  - 2.1.2 Structures
  - 2.1.3 Other Impervious (Parking lots, driveways)
- 2.2 Pervious
  - 2.2.1 Turf Grass
  - 2.2.2 Bare Construction
  - 2.2.3 Suspended Succession (rights-of-way)
    - 2.1.7.1 Barren
    - 2.1.7.2 Herbaceous
    - 2.1.7.3 Scrub-shrub
- 2.3 Urban Tree Canopy (TC)
  - 2.3.1 TC over Roads
  - 2.3.2 TC over Structures
  - 2.3.3 TC over Other Impervious
  - 2.3.4 TC over Turf Grass

3. Forest (5)
- 3.1 Contiguous (> 1 acre)
- 3.2 Fragmented (< 1 acre)
- 3.3 Natural Succession (e.g., Fallow)
  - 3.3.1 Barren
  - 3.3.2 Herbaceous
  - 3.3.3 Scrub-shrub

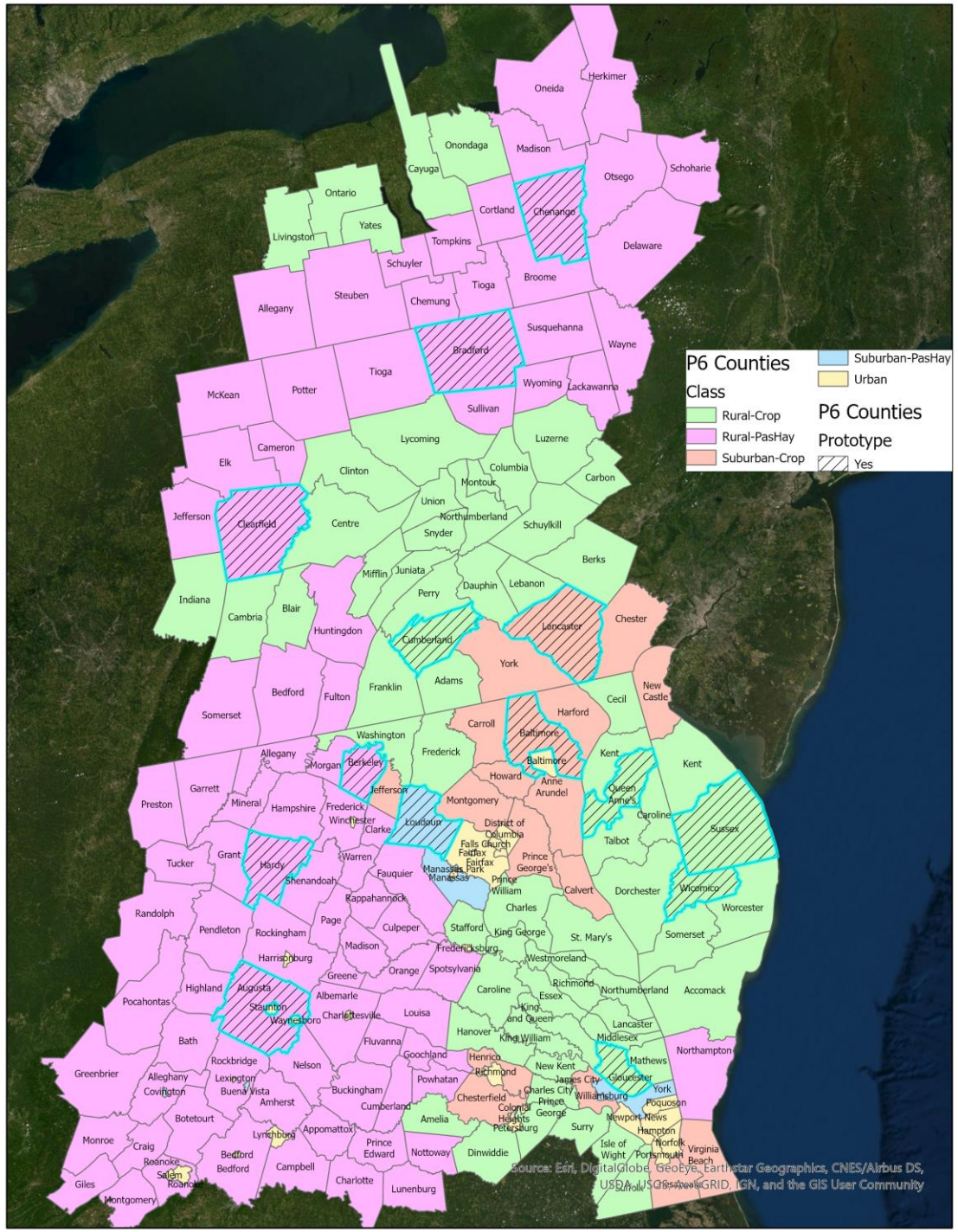
4. Production (14)
- 4.1 Agriculture*
  - 4.1.1 Cropland
    - 4.1.1.1 Barren
    - 4.1.1.2 Herbaceous
  - 4.1.2 Pasture
    - 4.1.2.1 Barren
    - 4.1.2.2 Herbaceous
  - 4.1.3 Orchard/vineyard
    - 4.1.3.1 Barren
    - 4.1.3.2 Herbaceous
    - 4.1.3.3 Scrub-shrub
- 4.2 Timber Harvest
  - 4.2.1 Barren
  - 4.2.2 Herbaceous
  - 4.2.3 Scrub-shrub
- 4.3 Solar fields
- 4.4 Extractive
  - 4.4.1 Barren
  - 4.4.2 Herbaceous
  - 4.4.3 Scrub-shrub

5. Wetlands and Water Margins (25)
- 5.1 Tidal (fresh and saline)
  - 5.1.1 Open water
  - 5.1.2 Barren
  - 5.1.3 Herbaceous
  - 5.1.4 Scrub-shrub
  - 5.1.5 Contiguous Forest
  - 5.1.6 Fragmented Forest
- 5.2 Non-tidal
  - 5.2.1 Headwater (Riverine)
    - 5.2.1.1 Open water
    - 5.2.1.2 Barren
    - 5.2.1.3 etc.
  - 5.2.2 Floodplain (Riverine)
    - 5.2.2.1 Open water
    - 5.2.2.2 Barren
    - 5.2.2.3 etc…
  - 5.2.3 Terrene
    - 5.2.3.1 Open water
    - 5.2.3.2 Barren
    - 5.2.3.3 etc…
- 5.3 Bare shore

USGS

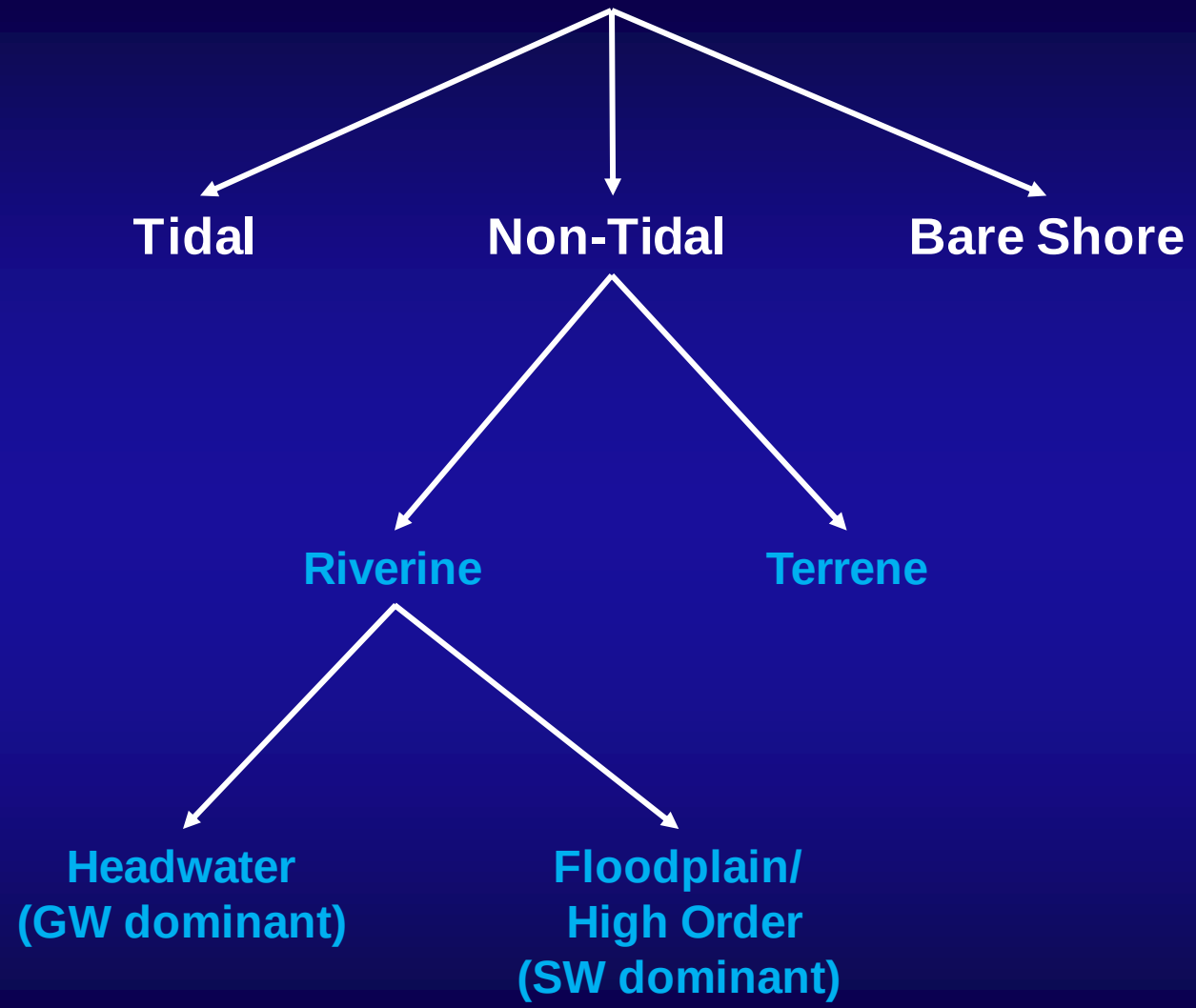
Fourteen Counties Selected to Prototype Development of the 2017 High-res Land Use Data

FIPS	CNTY_NAME	P_Crop	P_Dev	Class
10005	SUSSEX	97.4%	18.8%	Rural-Crop
24005	BALTIMORE	66.7%	38.6%	Suburban-Crop
24035	QUEEN ANNES	96.3%	14.2%	Rural-Crop
24045	WICOMICO	94.5%	20.6%	Rural-Crop
36017	CHENANGO	28.3%	5.8%	Rural-PasHay
42015	BRADFORD	39.2%	5.7%	Rural-PasHay
42033	CLEARFIELD	42.0%	8.1%	Rural-PasHay
42041	CUMBERLAND	65.8%	24.6%	Rural-Crop
42071	LANCASTER	68.2%	29.2%	Suburban-Crop
51015	AUGUSTA	27.1%	9.3%	Rural-PasHay
51073	GLOUCESTER	85.1%	12.6%	Rural-Crop
51107	LOUDOUN	33.1%	27.7%	Suburban-PasHay
54003	BERKELEY	33.1%	23.8%	Rural-PasHay
54031	HARDY	22.2%	6.4%	Rural-PasHay

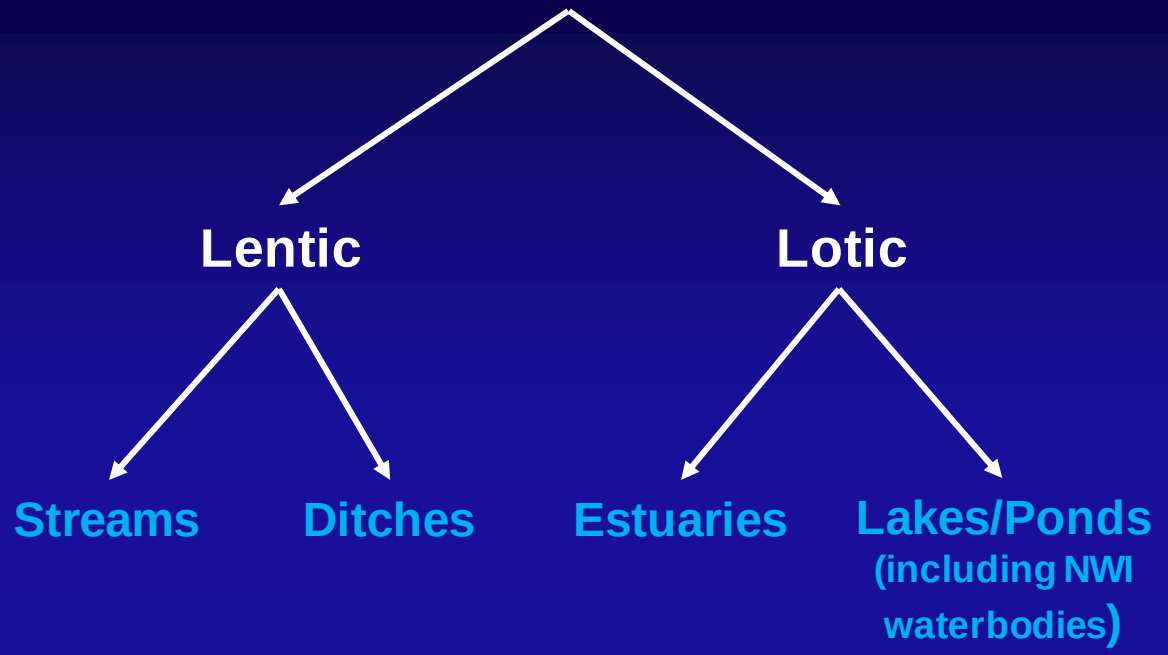


USGS

Wetlands and Water Margins



Water



USGS

Tidal Wetlands

Current Definition:

Estuarine wetlands (E2EM, ESFO, W2SS), palustrine wetlands (PEM, PFO, PSS) with water regime modifiers associated with tidal hydrological conditions (e.g., saltwater tidal or freshwater tidal) and all wetlands within meter elevation of tidal surface waters.

Problems:

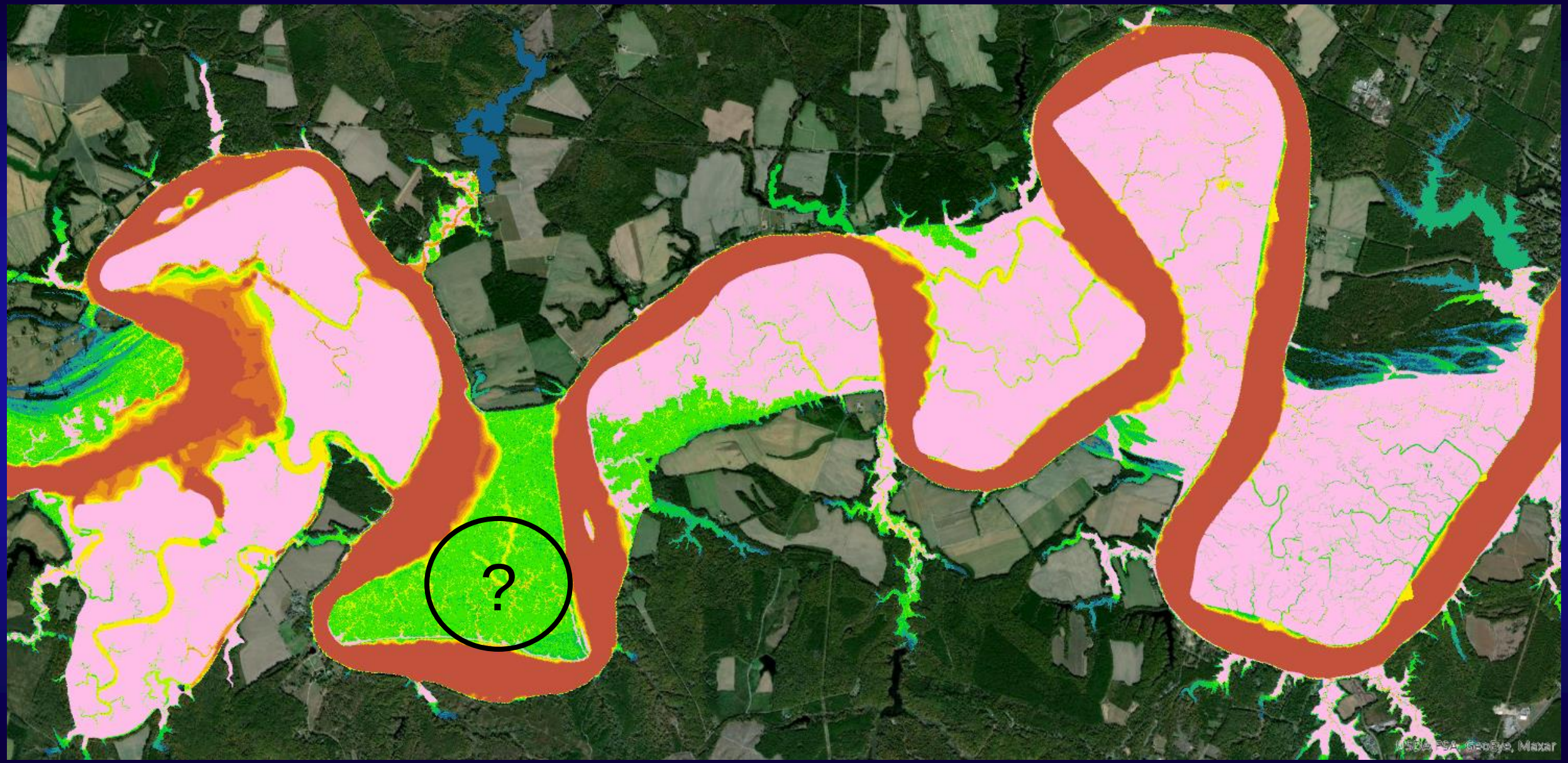
- Partially relied on NWI which is outdated and not comprehensive;
- Tidal wetland extent was not updated in Virginia as part of the 2013 land cover mapping effort;
- Used a 10-meter DEM and 1-meter elevation threshold to describe the tidal zone;
- Adjacency to tidal waters not enforced when adding wetlands based on elevation.

Proposed Solution:

Update tidal wetland extent in Virginia as part of 2017 land cover mapping effort. Use high-resolution land cover, state wetlands datasets (DE, MD, and VA), NWI, 1-ft LiDAR elevation Sea-Level Rise zone. Enforcing adjacency to SLR zone.

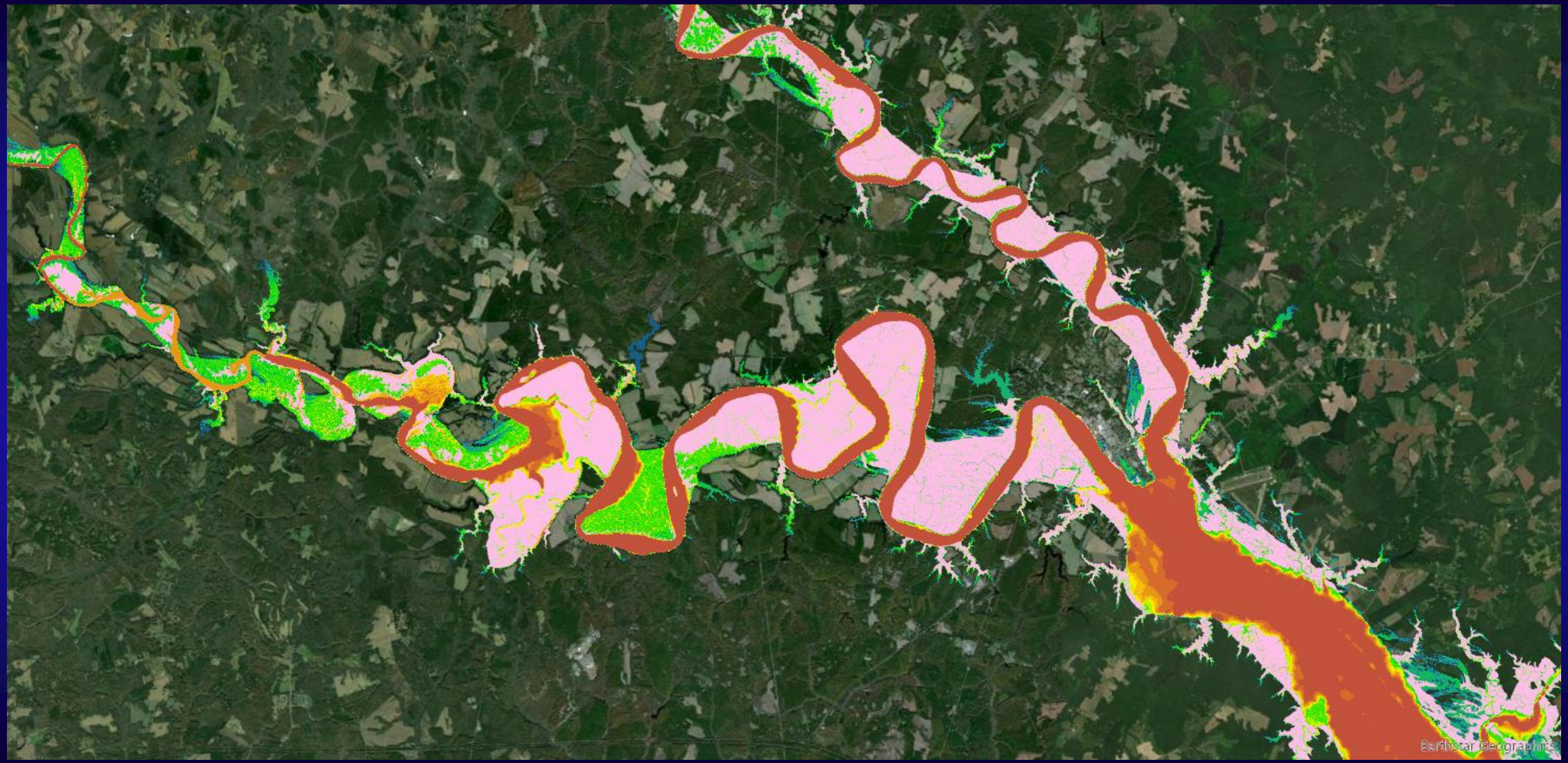
USGS

VIMS Tidal Marsh Inventory



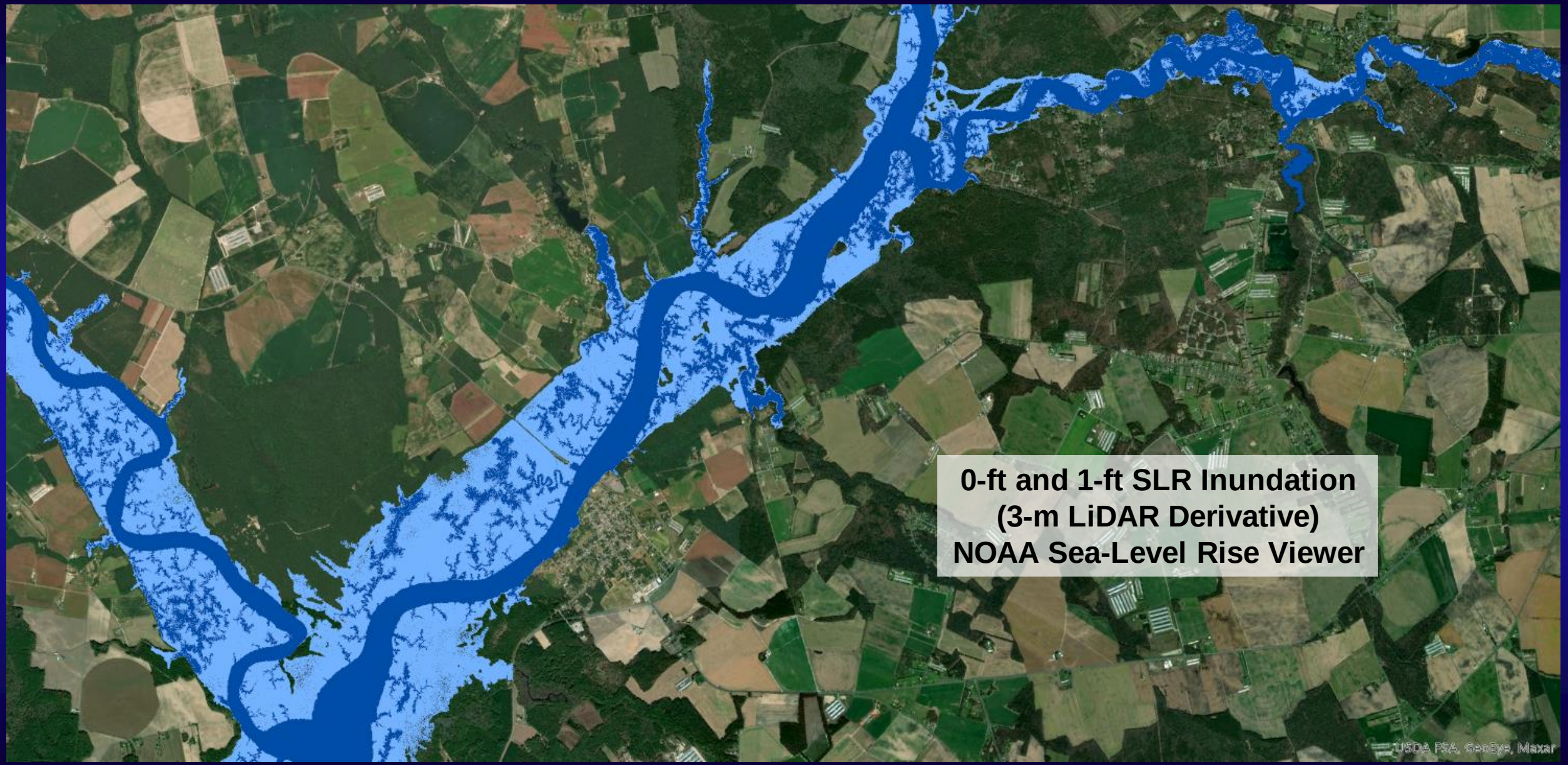
USGS

VIMS Tidal Marsh Inventory



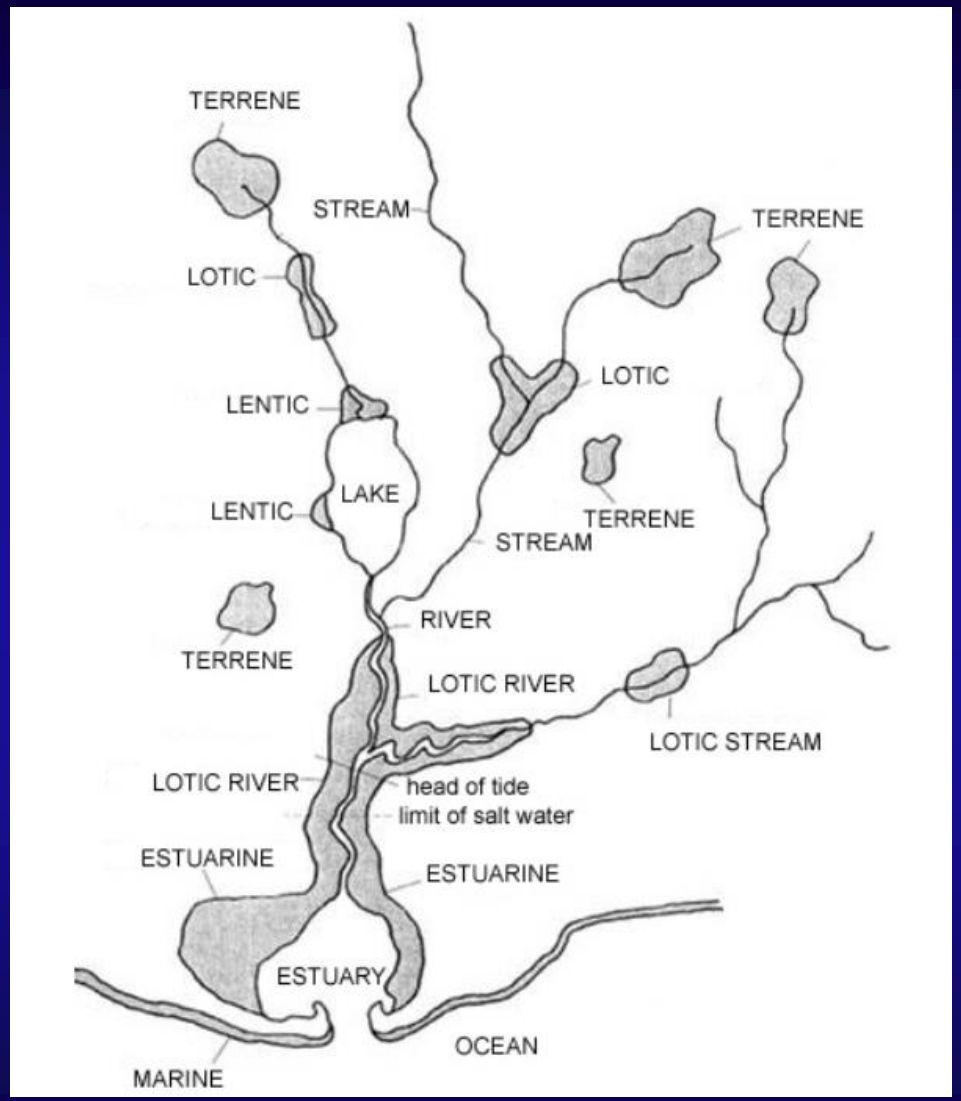
USGS

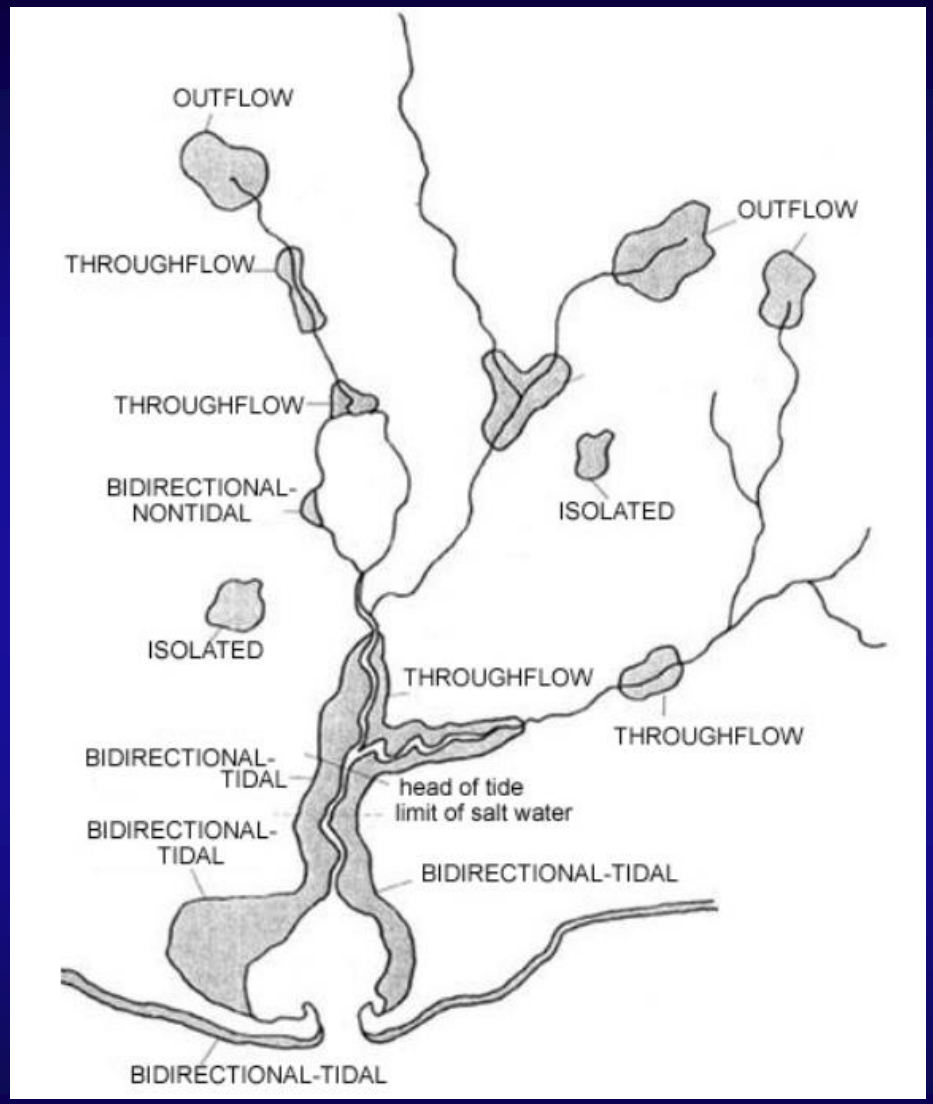
Maryland and Delaware Wetland Datasets



USGS

Characterizing Wetlands (NWI approach)



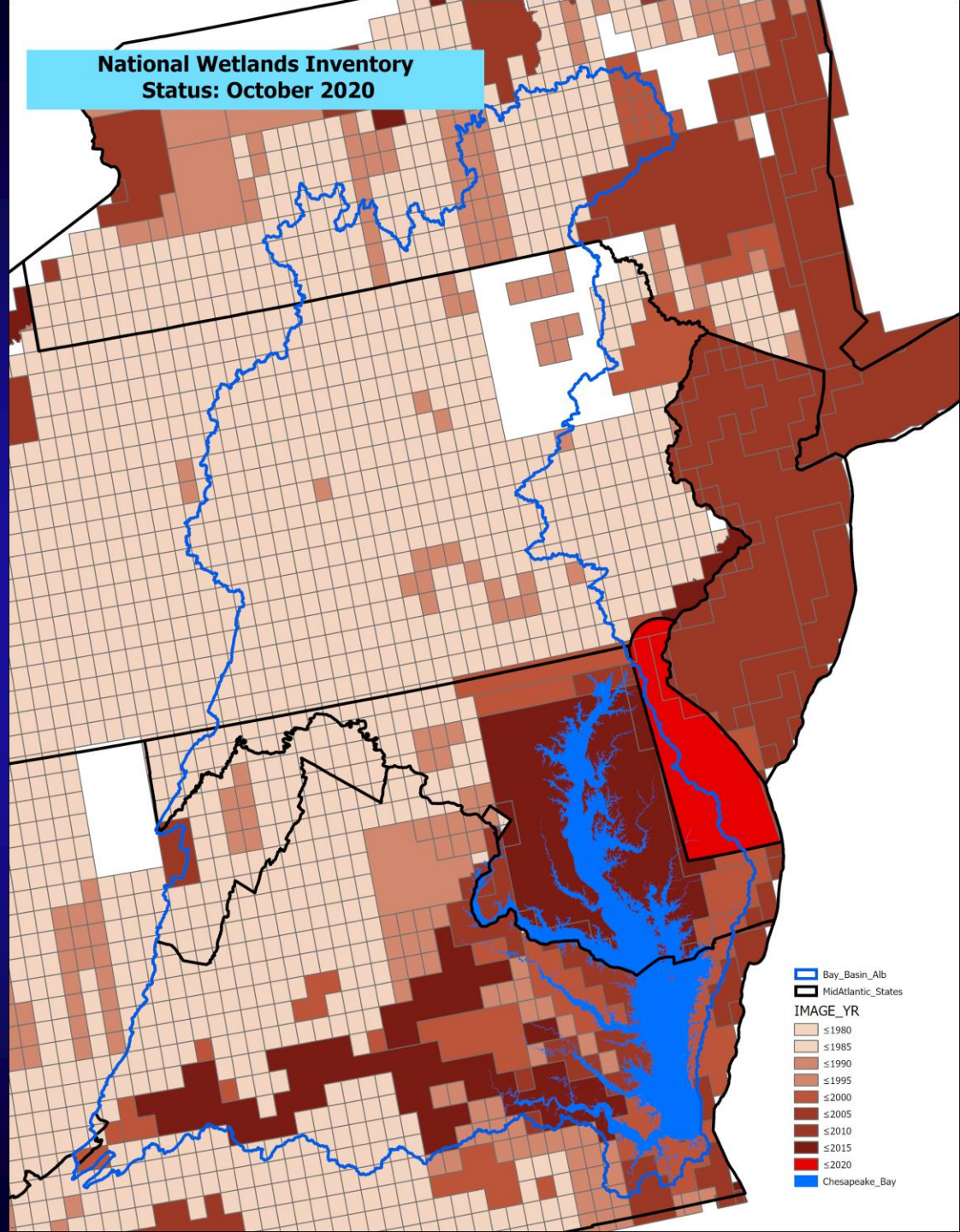


Source: https://www.fws.gov/northeast/ecologicalservices/pdf/wetlands/NWIPlus_Presentation_ASWM_Nov2013.pdf

USGS

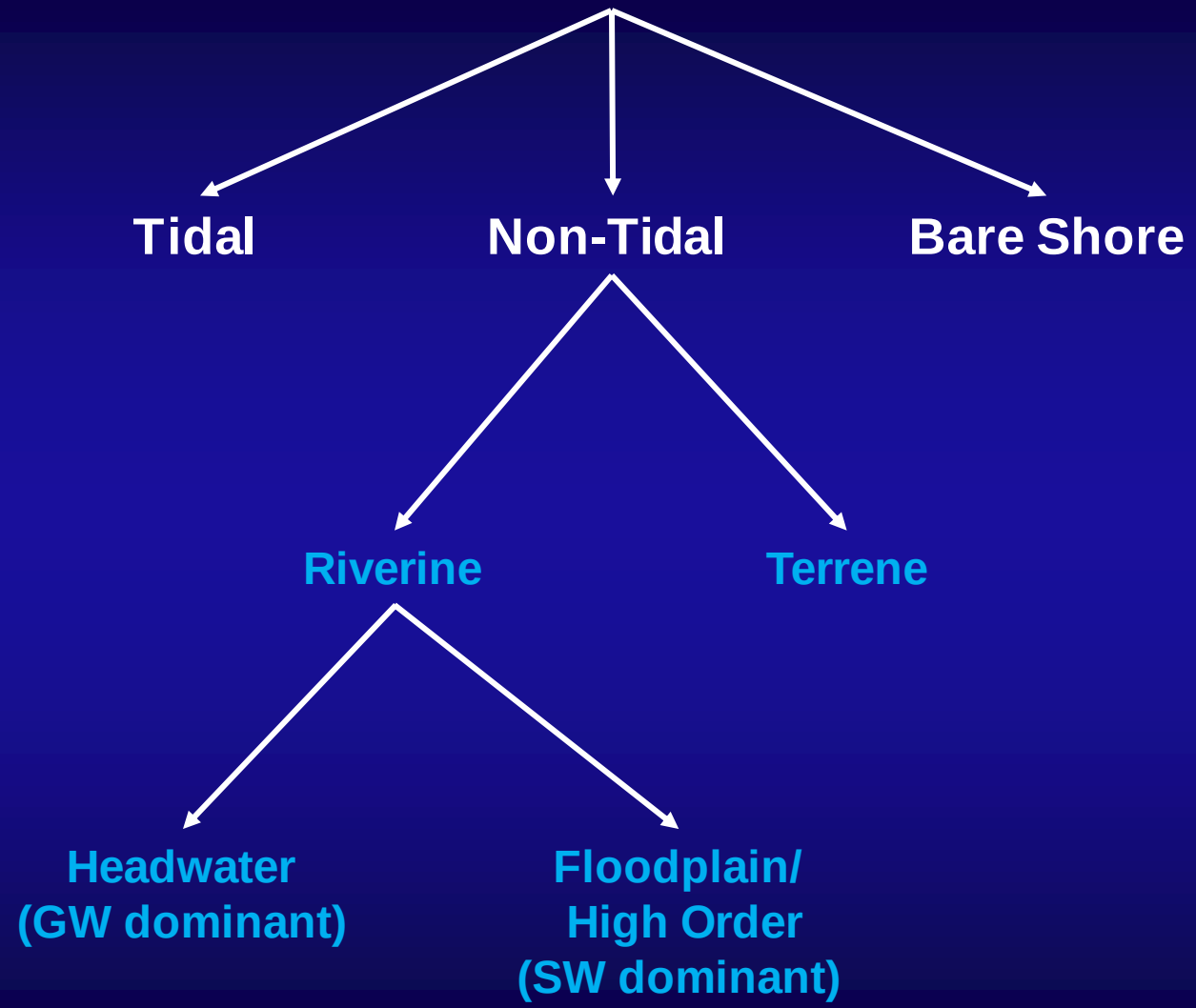
Status of the National Wetlands Inventory October 2020

Vintage of NWI in the majority of watershed are 1980's

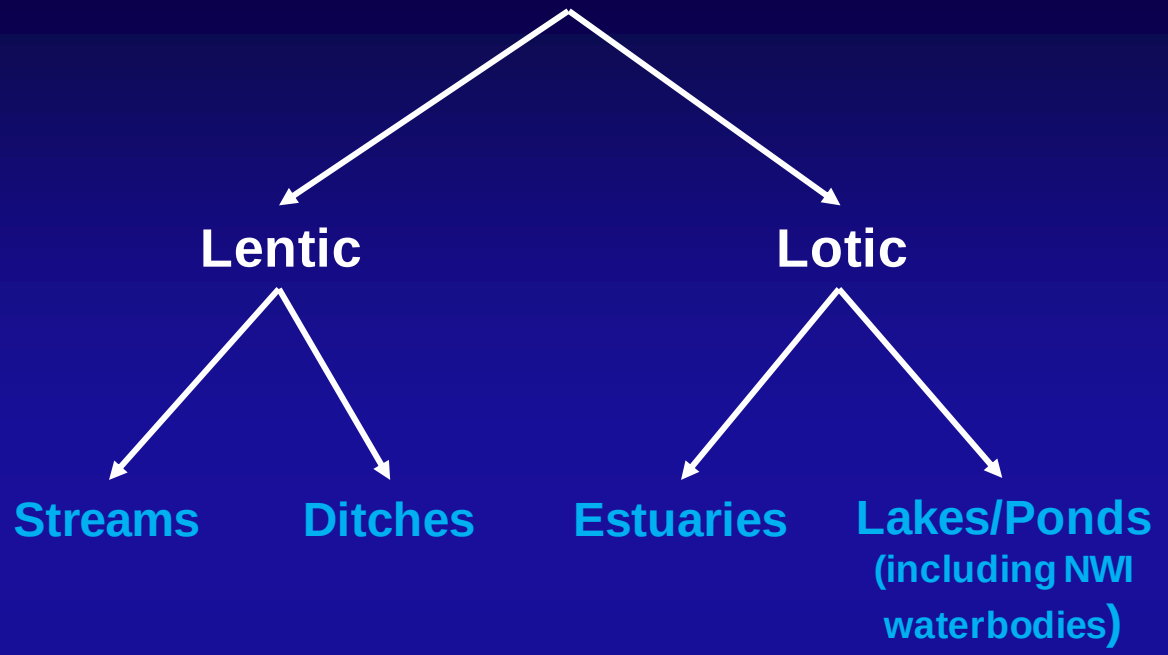


USGS

Wetlands and Water Margins



Water



USGS

Non-Tidal Wetlands

Current Definitions:

Floodplain Wetlands = National Wetlands Inventory (NWI) non-pond, non-lake wetlands, emergent wetlands mapped from high-resolution imagery outside Virginia, state designated wetlands and potential non-tidal wetlands located within the FEMA designated 100-year floodplain or on frequently flooded soils (SSURGO).

Other Wetlands = same as above except not intersecting with FEMA 100-year floodplain or frequently flooded soils.

Problems:

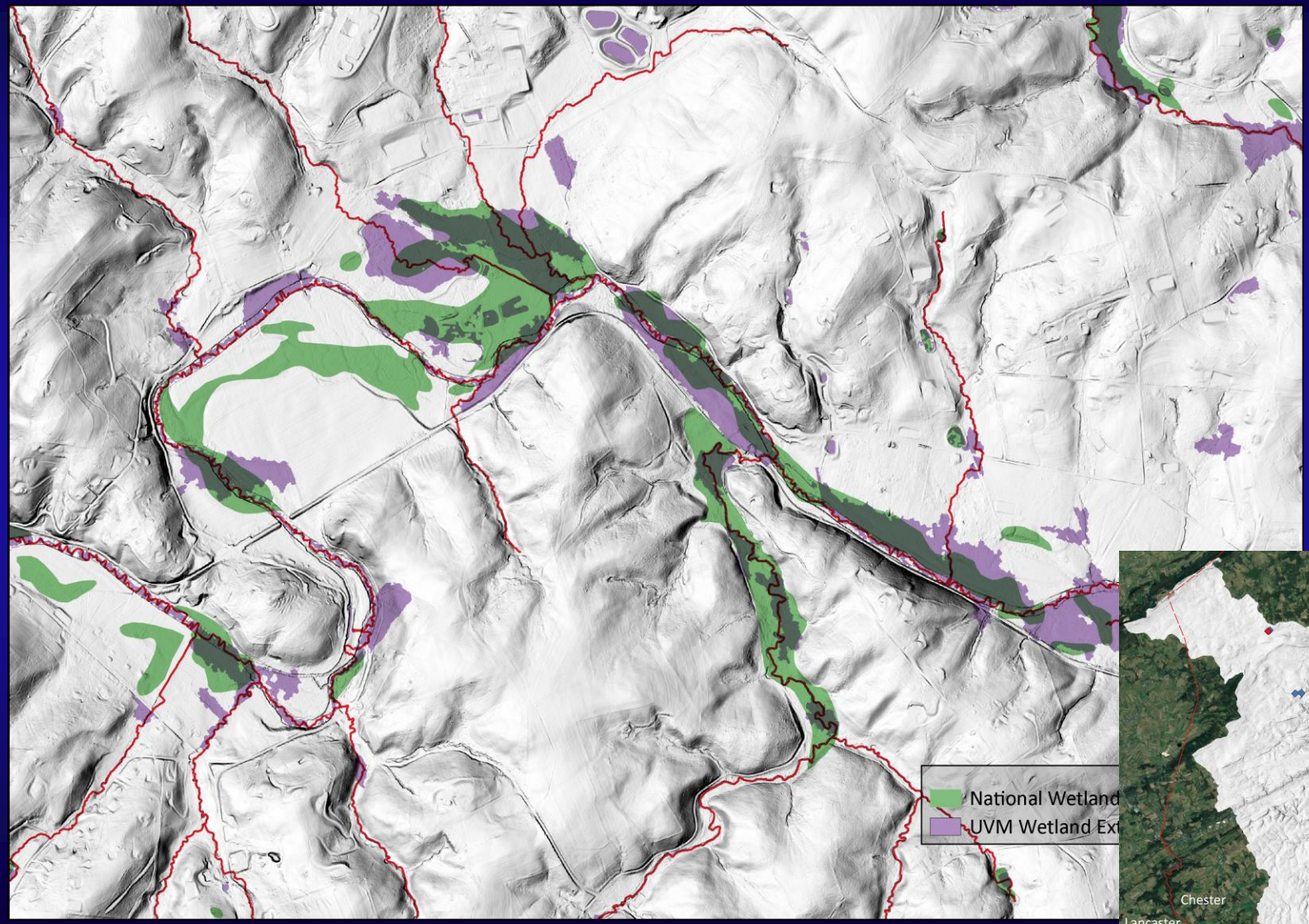
- Floodplain maps were not comprehensive and omitted headwater riverine margins (classed as “other”)
- “Floodplain” is not a commonly used wetland classification term.
- Potential wetlands only mapped for Pennsylvania portion of the watershed.

Proposed Solution:

Expand potential wetland mapping to all states. Classify wetlands as riverine (headwater), riverine (high order?), and terrene. Use “Height above Nearest Drainage” (HAND) from LiDAR, SSURGO soil attributes, and FEMA 100-yr floodplains to more comprehensively class wetlands subject to periodic flooding. Rely on NWI, state wetlands datasets (DE and MD), and potential wetland maps to identify wetlands. All wetland ponds will be classed as “Water, Lentic”.

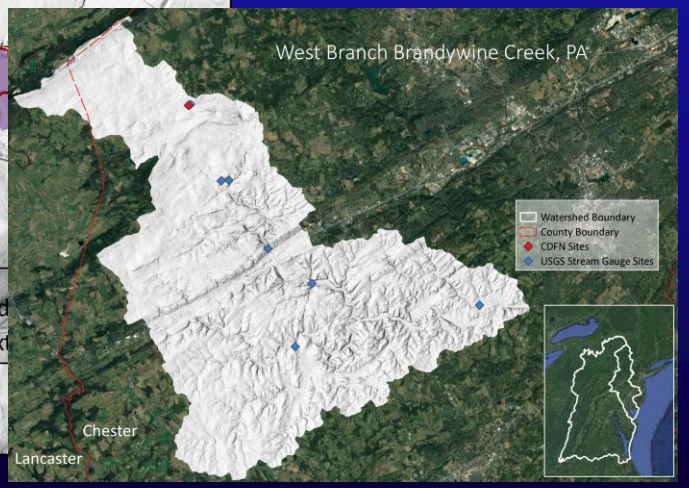
USGS

Wetland Extent Comparison



Potential Wetlands (UVM)

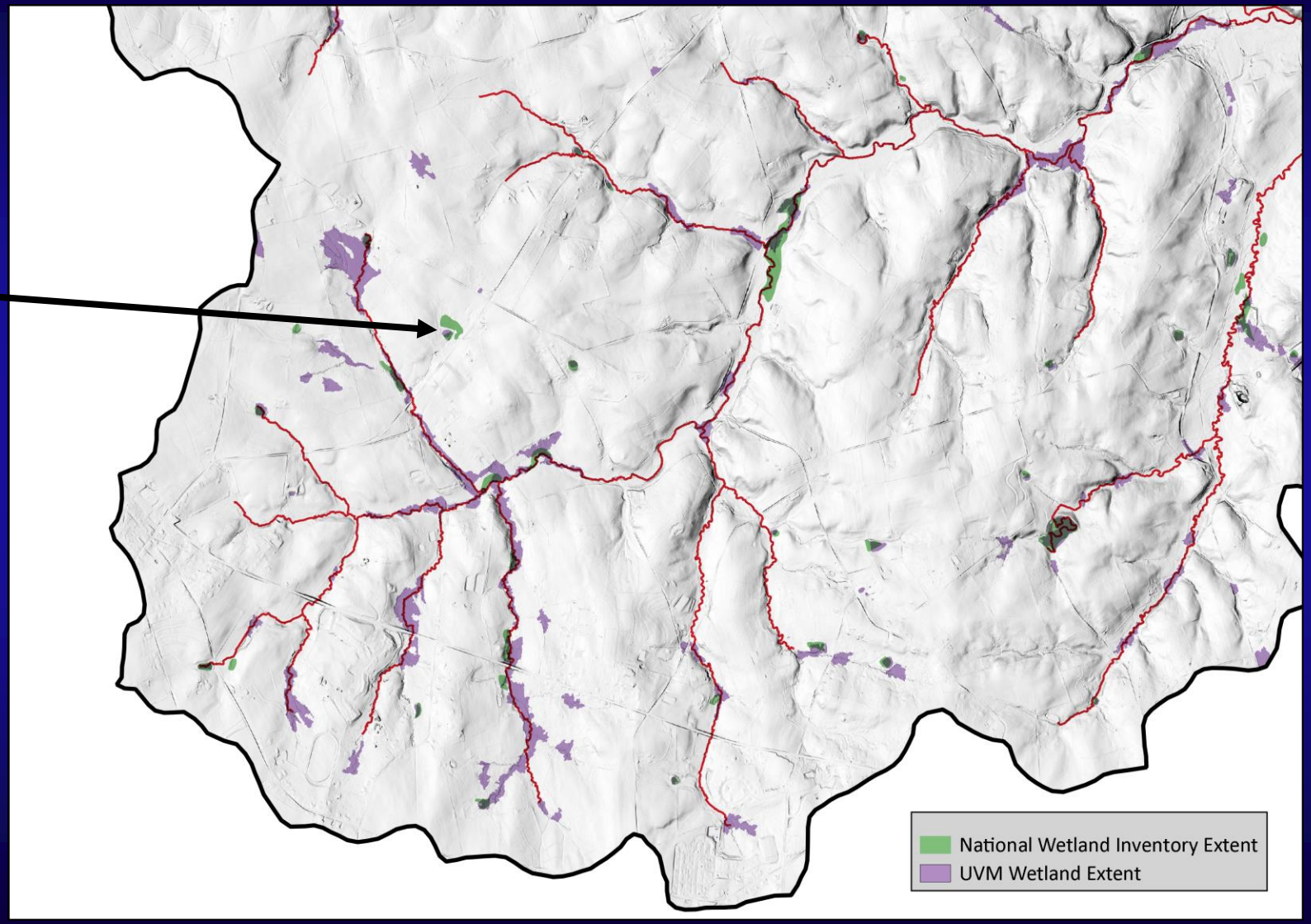
National Wetlands Inventory (NWI)



USGS

Wetland Extent Comparison

Geographically Isolated Wetlands

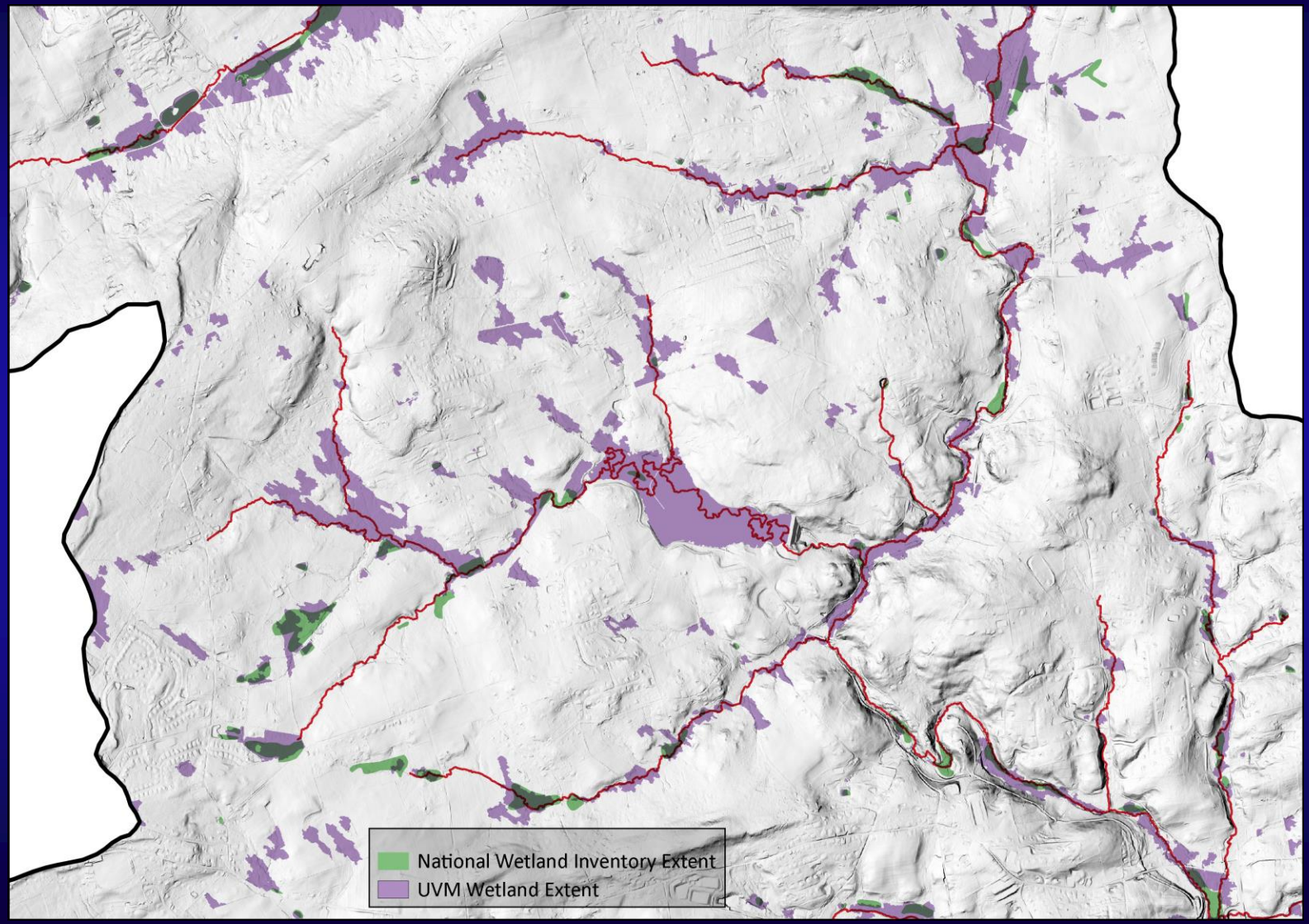


Potential Wetlands (UVM)

National Wetlands Inventory (NWI)

USGS

Wetland Extent Comparison

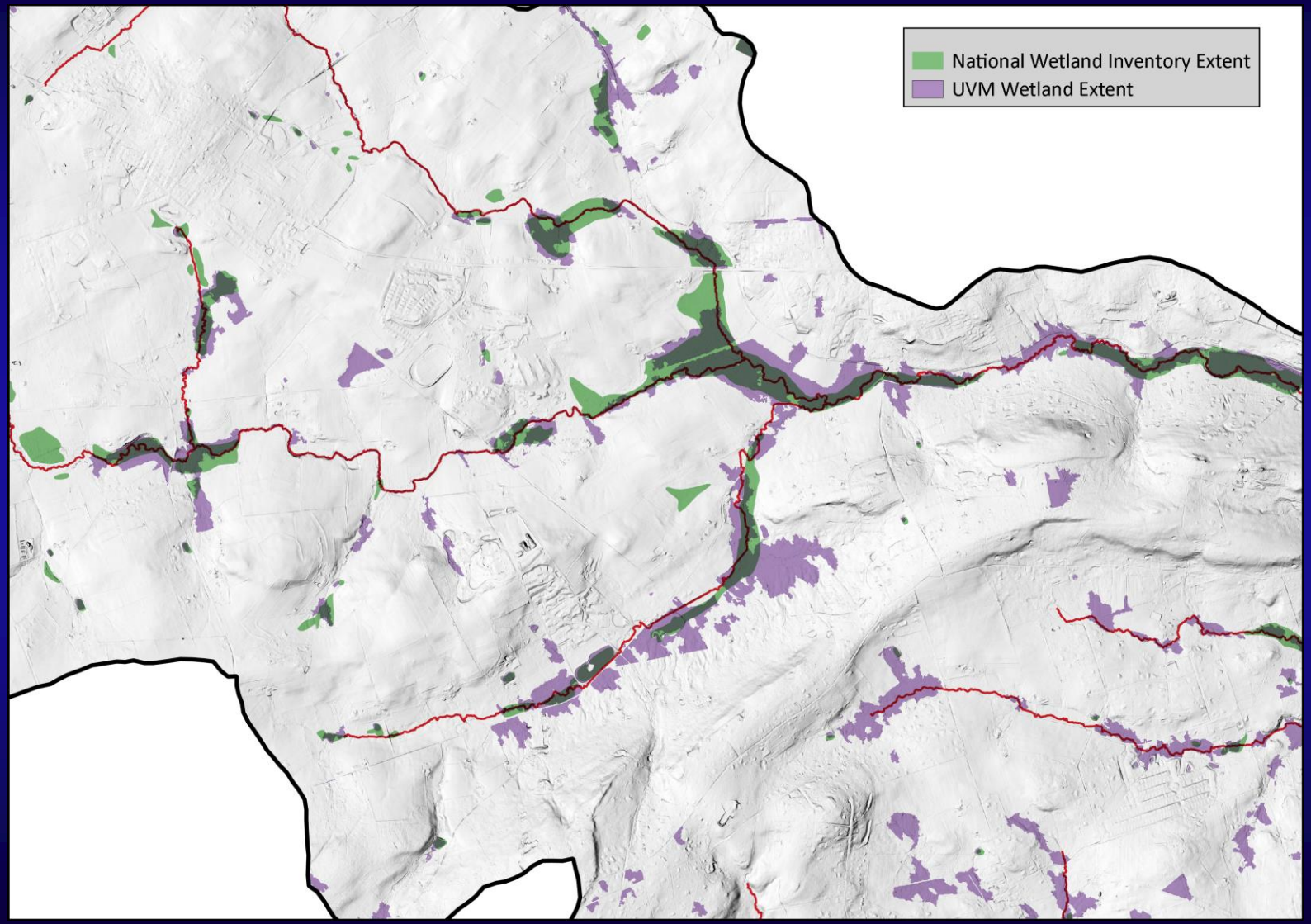


Potential Wetlands (UVM)

National Wetlands Inventory (NWI)

USGS

Wetland Extent Comparison



Potential Wetlands (UVM)

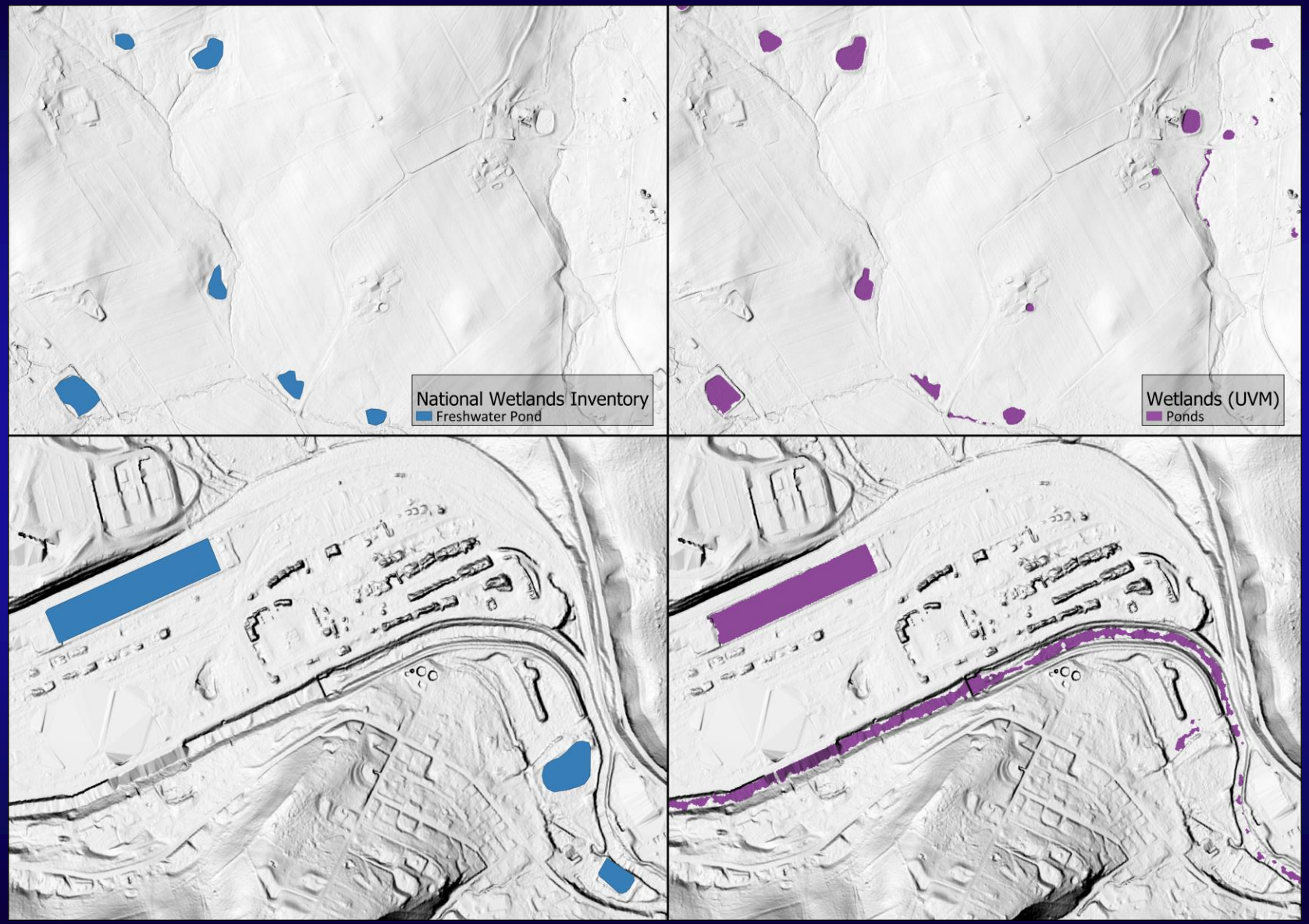
National Wetlands Inventory (NWI)

USGS

Ponds – spatial mismatch between NWI and Imagery

USGS

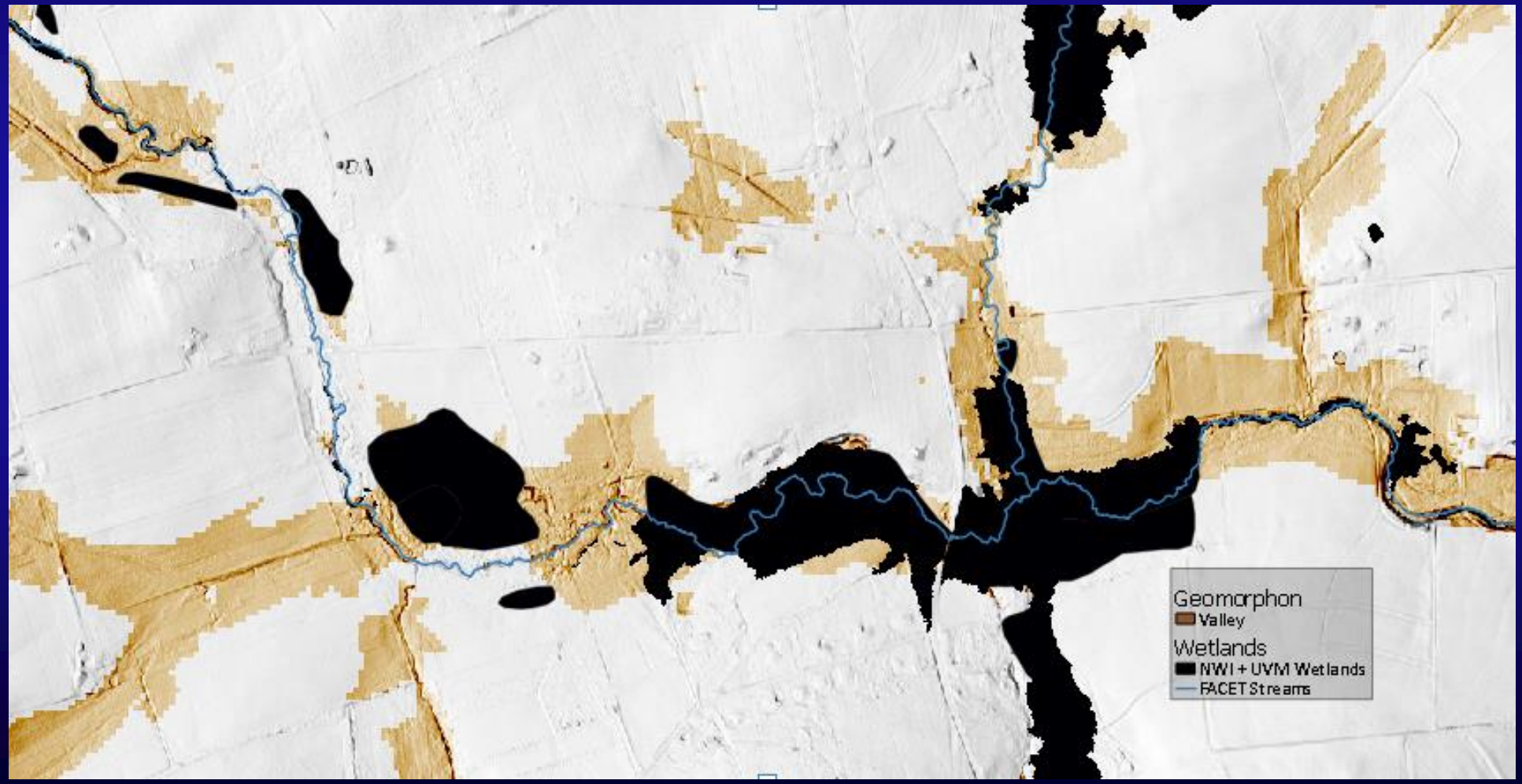
All ponds and lakes will be classed as ‘Water, Lentic”



USGS

Differentiate Riverine vs Terrene Wetlands

- Map valleys using geomorphons and buffered streams
- All wetlands intersecting valleys = riverine
- All wetlands outside valleys = terrene



USGS

Differentiate Headwater vs Floodplain Wetlands

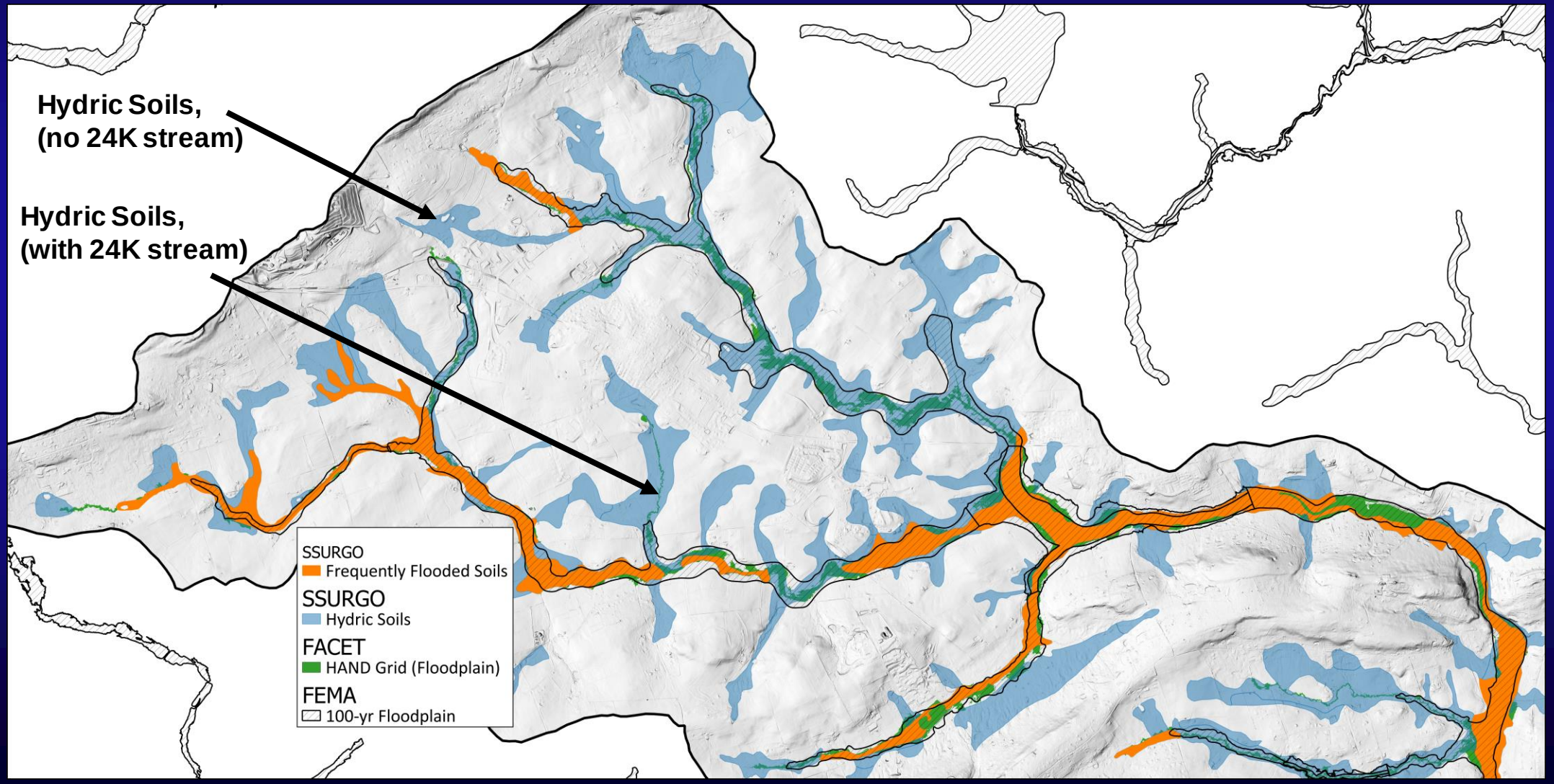
“Headwater Wetlands are the source of streams or located along first and second order perennial streams plus upstream intermittent watercourses”

Source: https://www.fws.gov/northeast/ecologicalservices/pdf/presentations/GeographicallyIsolatedandHeadwaterWetlandsInNewEngland.pdf

USGS

Differentiate Headwater vs Floodplain Wetlands

- Map floodplains using frequently flooded and hydric soils, FEMA 100-year floodplains, and Height-Above-Nearest Drainage.



USGS

Recommendations/ Outstanding Issues:

Tidal Wetlands:

Update tidal wetland extent in Virginia as part of 2017 land cover mapping effort. Rely solely on high-resolution land cover, state wetlands datasets (DE, MD, and VA), 1-ft LiDAR elevation, and proximity (enforcing adjacency requirement). Do not use NWI for this purpose.

Non-Tidal Wetlands:

Map three classes: Riverine- headwater; Riverine- floodplain; and Terrene.

Issues and potential solutions:

- Scale of streams (24K? Hyper-res?)
- Width of stream buffer (50 meter?, 100 meter?)
- Headwater vs. floodplain
  - Confluence between first and second order (scale dependent)?
  - First downstream abrupt change in stream power?
  - Stream entrenchment ratio?
  - Continuously thresholded HAND grid?

USGS


USGS
science for a changing world