Mapping floodplain in the Chesapeake watershed

Greg Noe

National Research Program, Reston VA

Funded by:
EDF
USGS Chesapeake Priority Ecosystem Science Program
USGS National Research Program

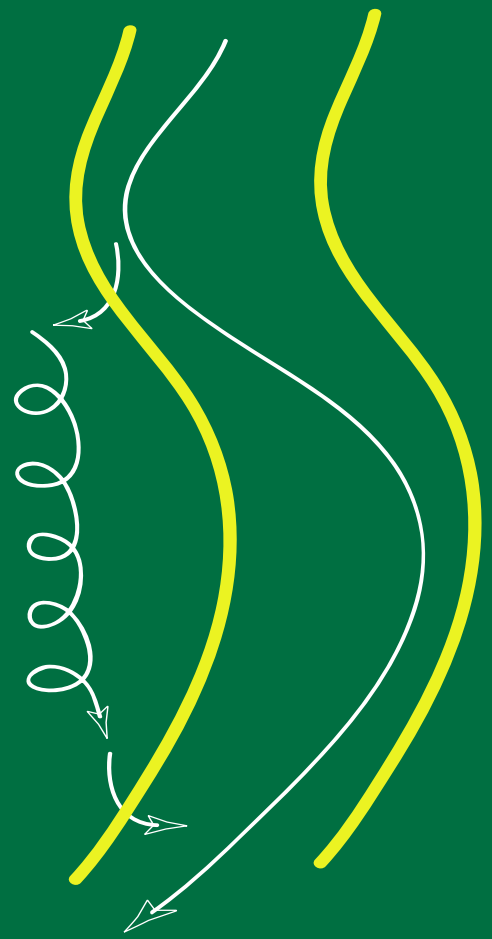
Floodplain nutrient and sediment retention

Floodplains are locations for significant material retention before river loading into coastal waters

Empirical studies have quantified large rates of N, P, and sediment trapping by floodplains in the Chesapeake watershed

Does this scale up?

Can it be predicted and modeled?



USGS

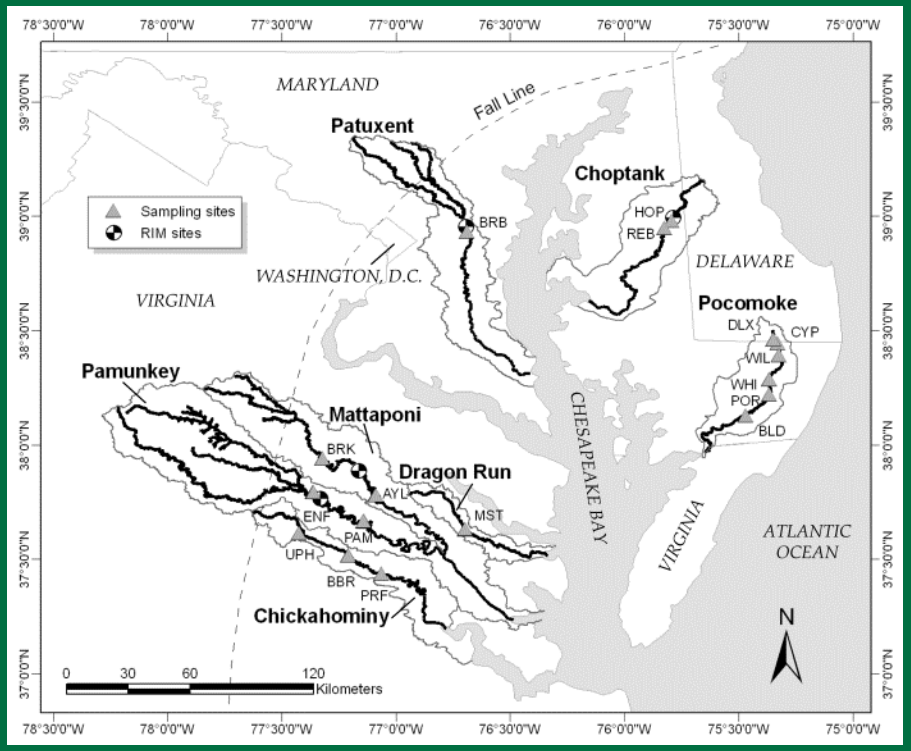
Coastal Plain floodplains trap large nutrient loads

1) Measured sedimentation fluxes in plots
2) Scaled to entire CP extent of floodplain
3) Compared to river load

$$\frac{g\ m^{-2}\ yr^{-1} \times \quad m^2}{g\ yr^{-1}}$$

Percent retention for 7 rivers:

	Median	Range
Nitrogen	22%	(5 to 150%)
Phosphorus	59%	(14 to 587%)
Sediment	119%	(53 to 690%)

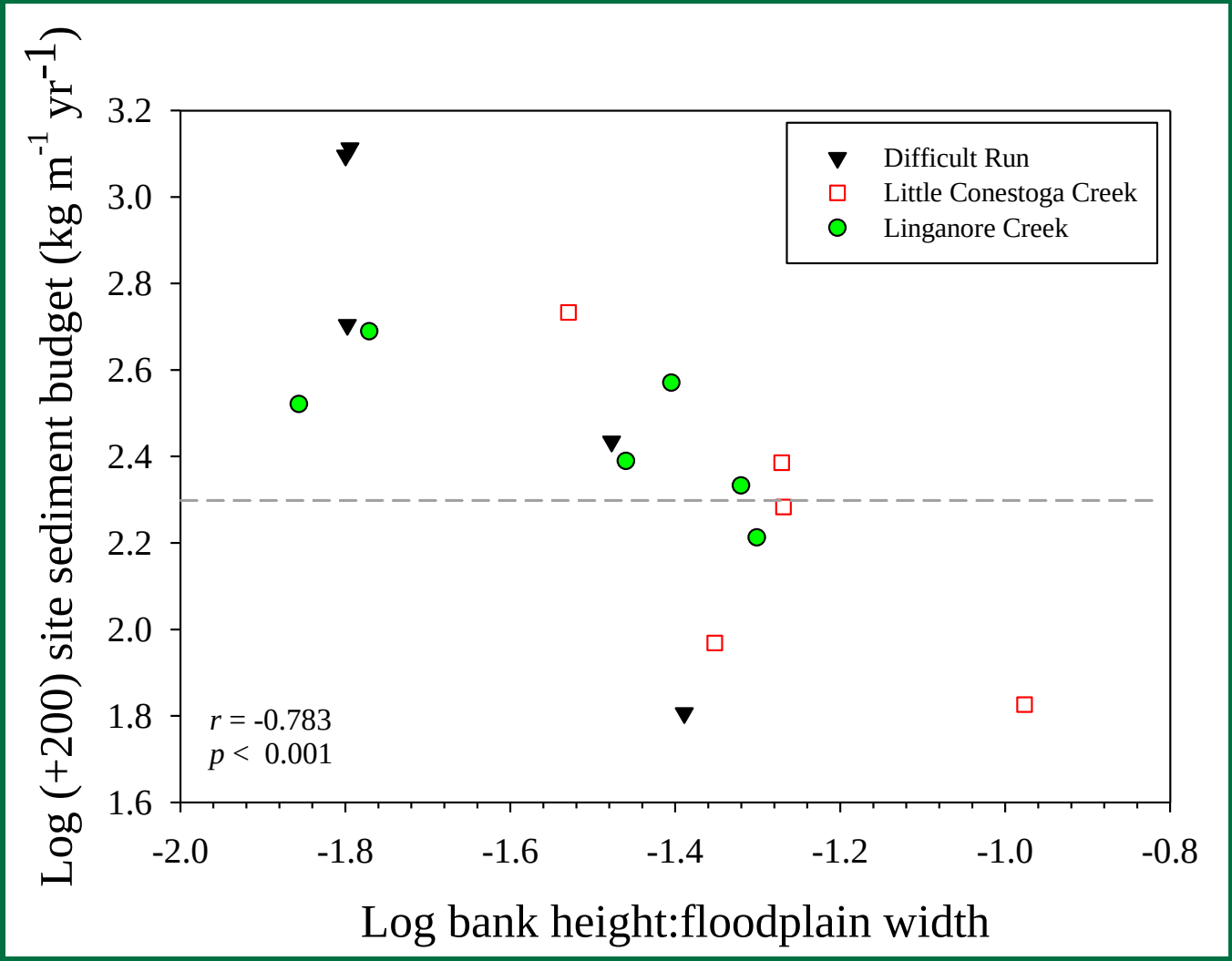


Noe and Hupp. 2009. *Ecosystems*.

USGS

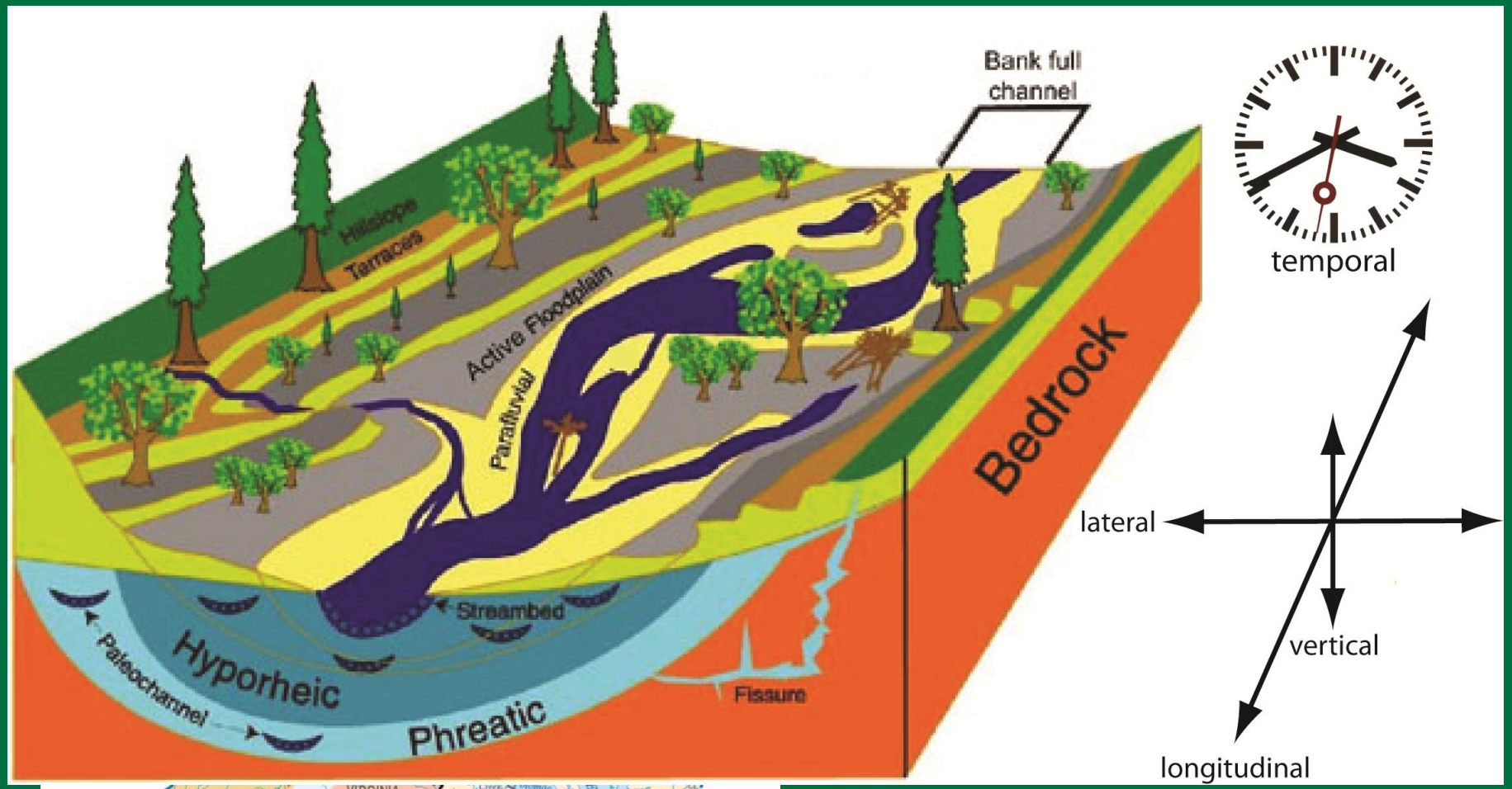
Geomorphic controls on floodplain sediment retention and loss

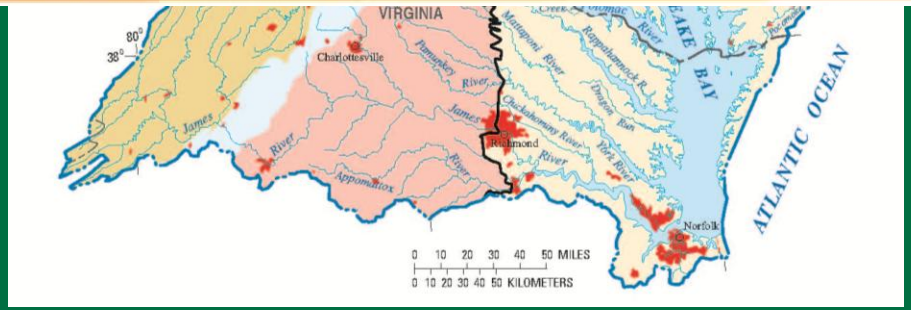
Chesapeake Piedmont



Schenk et al. 2013, *ESP&L*

Floodplain variability in the Chesapeake





Noe 2013, Treatise of Geomorphology

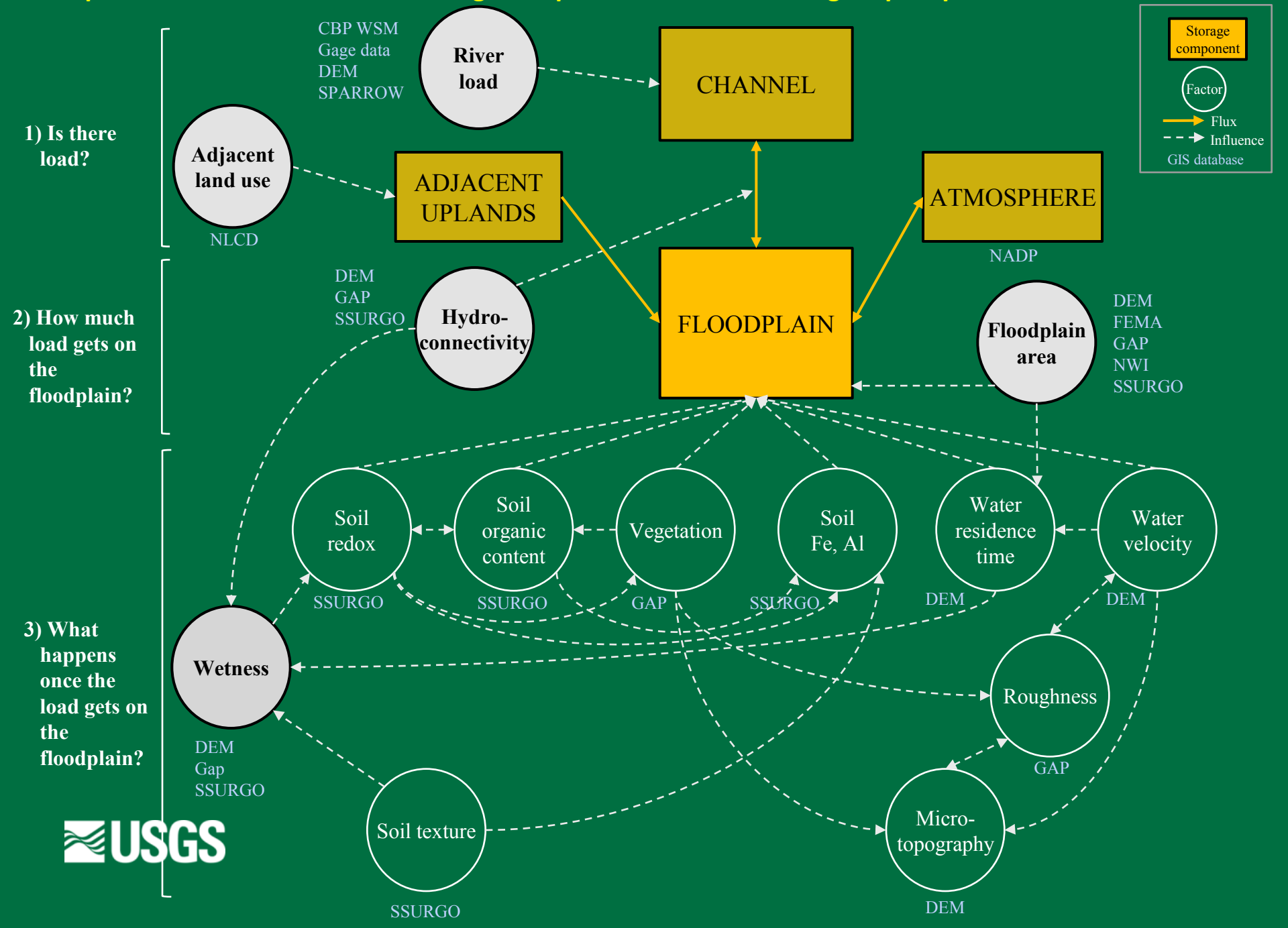
The Floodplain Restoration Prioritization Tool

Where to restore floodplain to have largest reductions in loads to the Chesapeake Bay?

1. Develop conceptual model of factors influencing load trapping by floodplains
2. Translate into quantitative index model using GIS data
3. Map potential load reduction
4. Identify degraded floodplain at sites

USGS

Conceptual model of factors influencing floodplain retention of nitrogen, phosphorus, and sediment



Potential GIS data for mapping floodplain area in Chesapeake

DEM processing

- Computer intensive
- Requires ground truthing

FEMA

- Large gaps in coverage
- 100 yr (or more) floodplain

NWI

- Maps various wetland types
- wetland ≠ floodplain, floodplain ≠ wetland
- Only natural vegetation systems could ID floodplain

GAP

- Partially based on NWI
- Only natural vegetation systems could ID floodplain
- Wetland vegetation systems can be classified as floodplain with varying degrees of wetness
- Mapped for entire watershed

USDA SSURGO

-Some gaps in coverage

-County variability in mapping of characteristics

USGS

Potential GIS data for mapping floodplain area in Chesapeake

USDA SSURGO

Flooding frequency
Drainage class
Hydric class
Hydrologic groups
Water table depth

618.30 Flooding Frequency Class, Duration Class, and Month

A. Definition.—"Flooding" is the temporary covering of the soil surface by flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources. Shallow water standing or flowing that is not concentrated as local runoff during or shortly after rain or snowmelt is excluded from the definition of flooding. Chapter 3 of the Soil Survey Manual provides additional information. Standing water (ponding) or water that forms a permanent covering is also excluded from the definition.

USGS

Potential GIS data for mapping floodplain area in Chesapeake

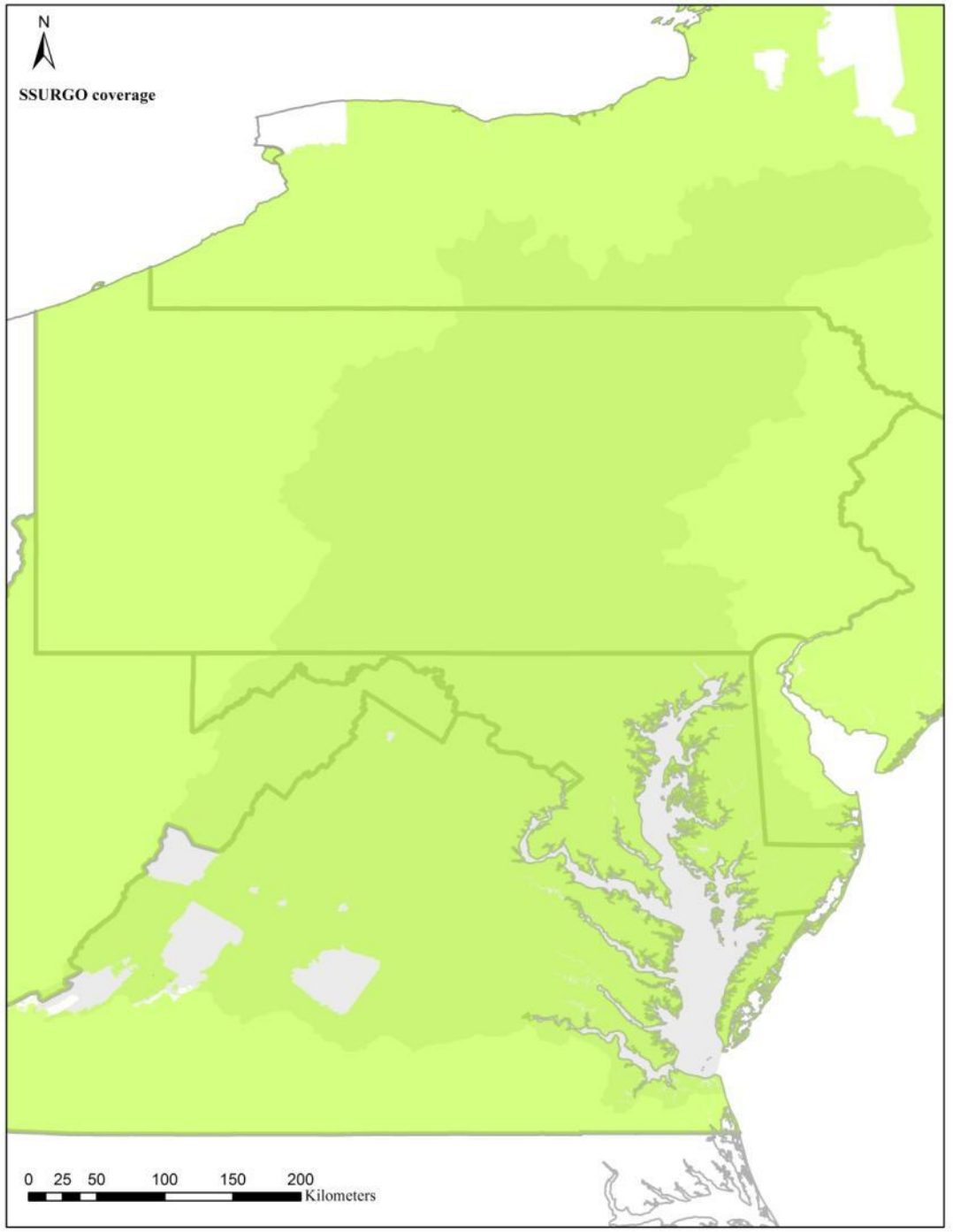
USDA SSURGO Flooding frequency

Flooding Frequency Class	Definition
None	No reasonable possibility of flooding; one chance out of 500 of flooding in any year or less than 1 time in 500 years.
Very rare	Flooding is very unlikely but is possible under extremely unusual weather conditions; less than 1 percent chance of flooding in any year or less than 1 time in 100 years but more than 1 time in 500 years.
Rare	Flooding is unlikely but is possible under unusual weather conditions; 1 to 5 percent chance of flooding in any year or nearly 1 to 5 times in 100 years
Occasional	Flooding is expected infrequently under usual weather conditions; 5 to 50 percent chance of flooding in any year or 5 to 50 times in 100 years.
Frequent	Flooding is likely to occur often under usual weather conditions; more than a 50 percent chance of flooding in any year (i.e., 50 times in 100 years), but less than a 50 percent chance of flooding in all months in any year.
Very frequent	Flooding is likely to occur very often under usual weather conditions; more than a 50 percent chance of flooding in all months of any year

USGS

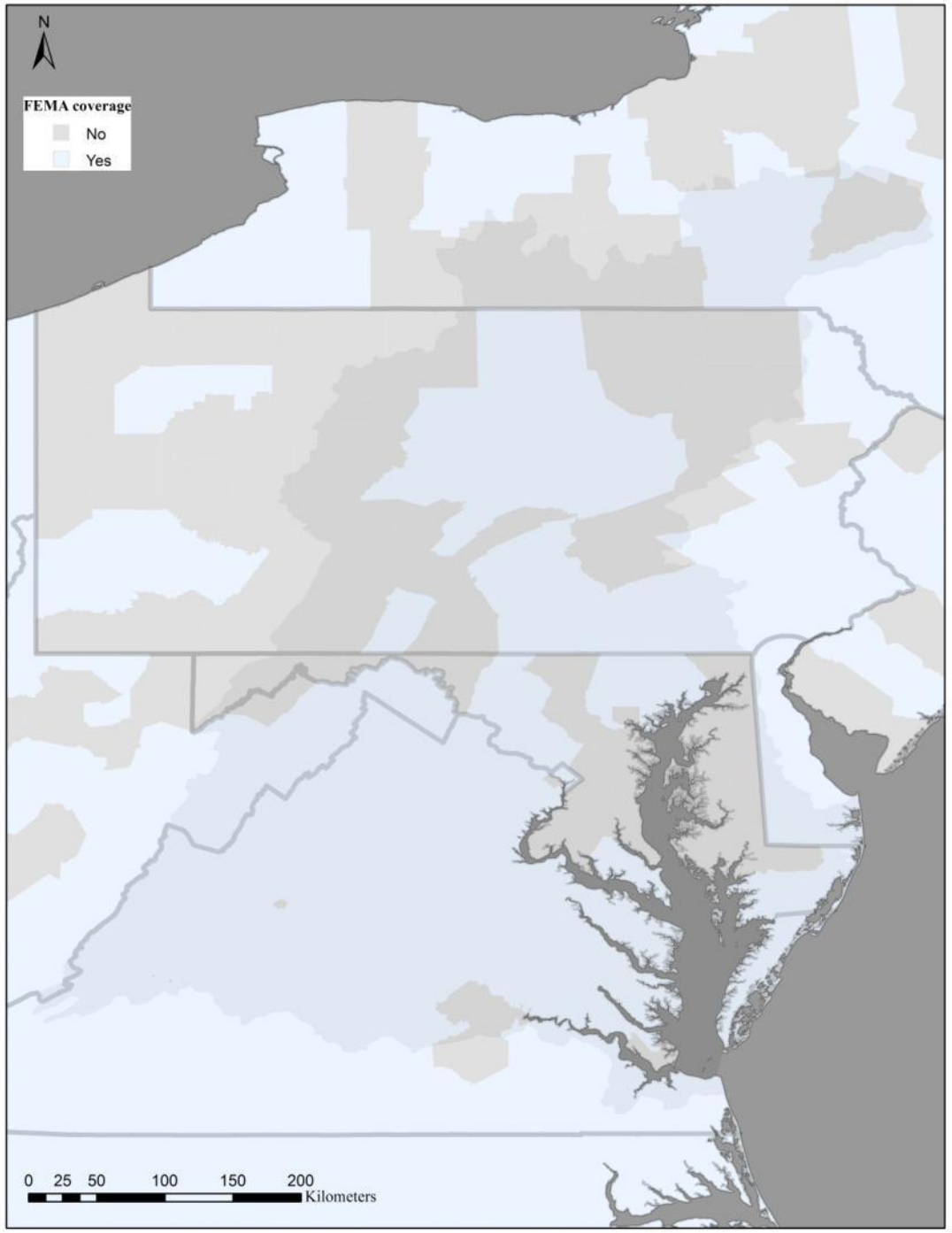
Potential GIS data for mapping floodplain area in Chesapeake

USDA SSURGO coverage



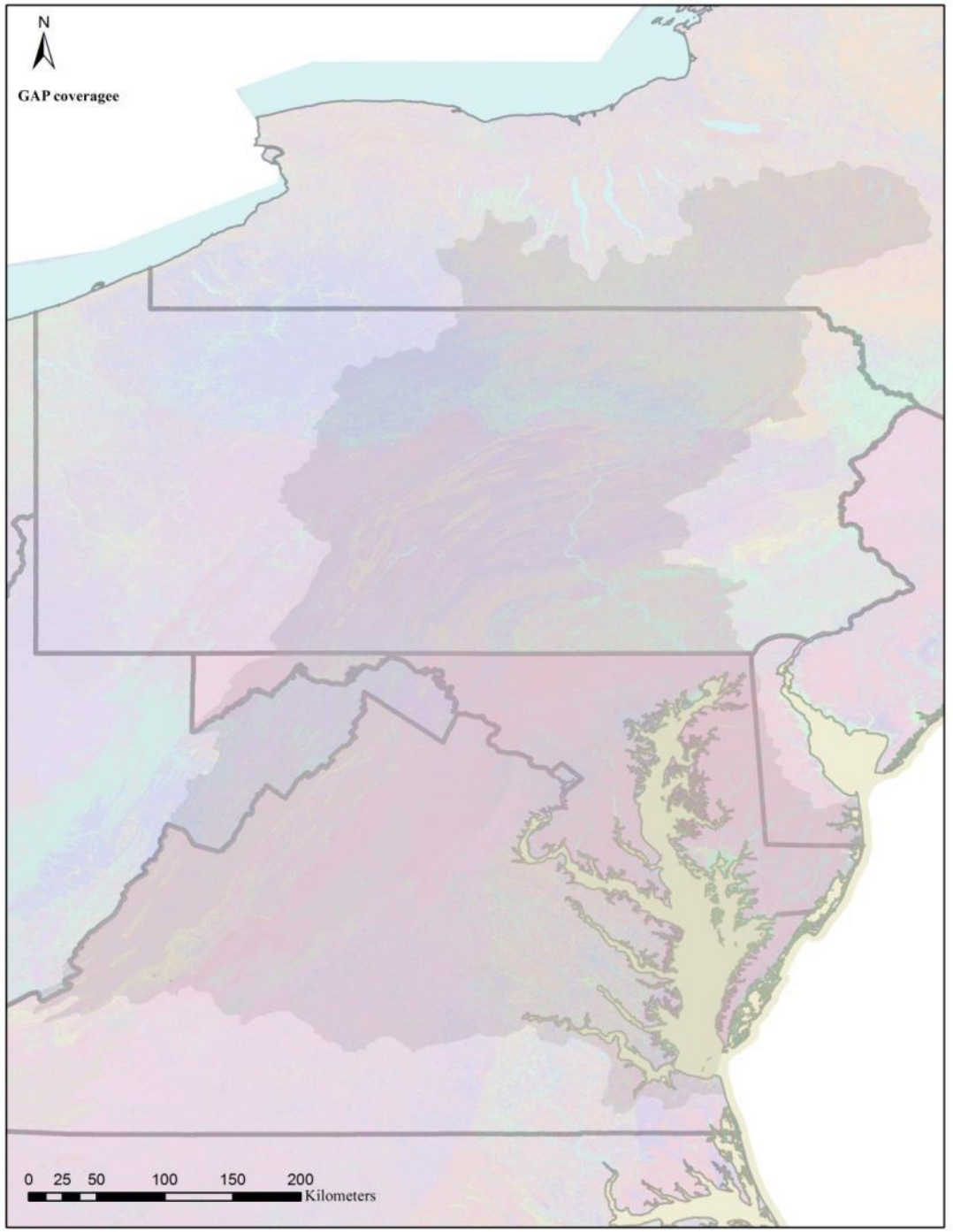
Potential GIS data for mapping floodplain area in Chesapeake

FEMA mapping coverage



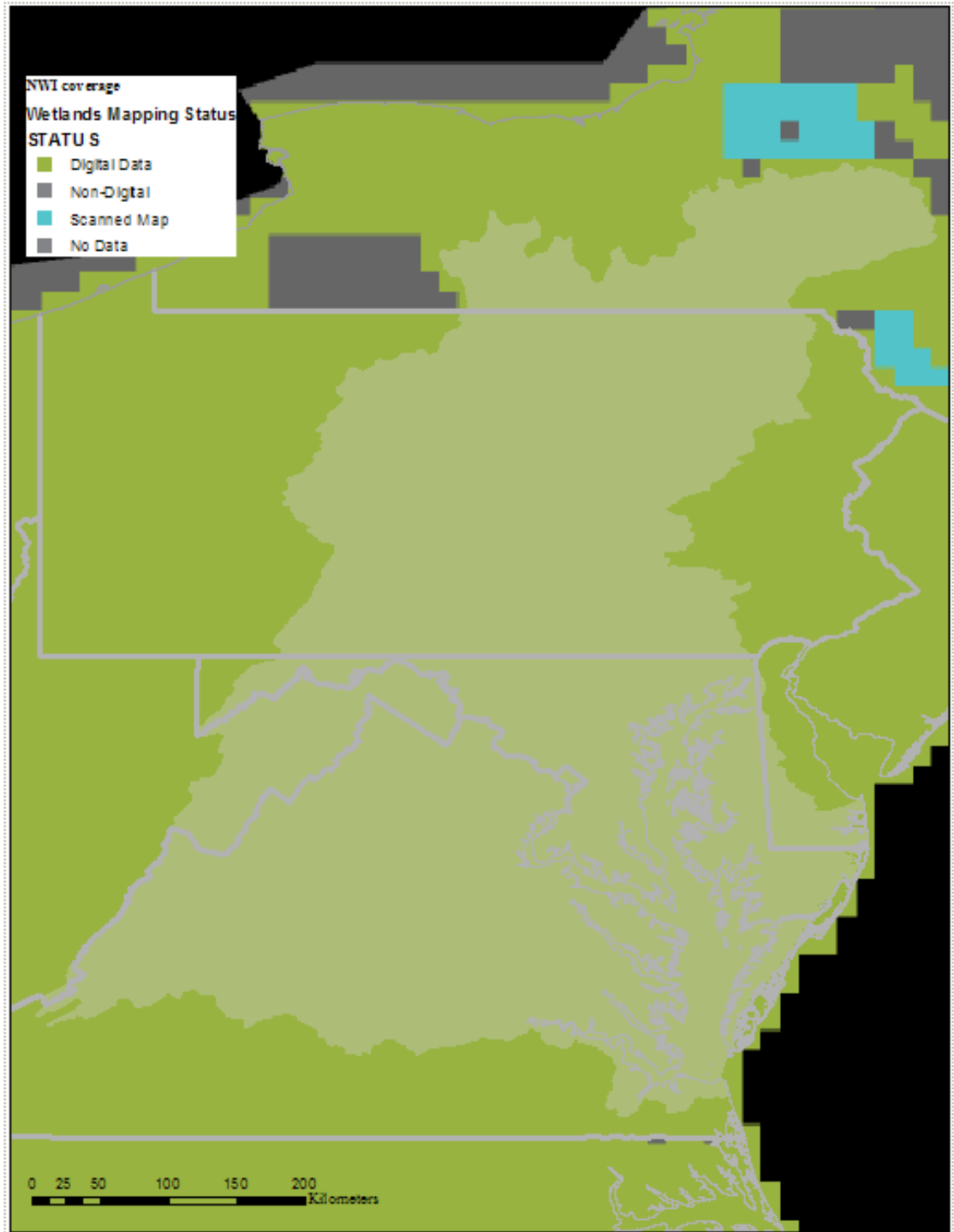
Potential GIS data for mapping floodplain area in Chesapeake

GAP vegetation mapping coverage



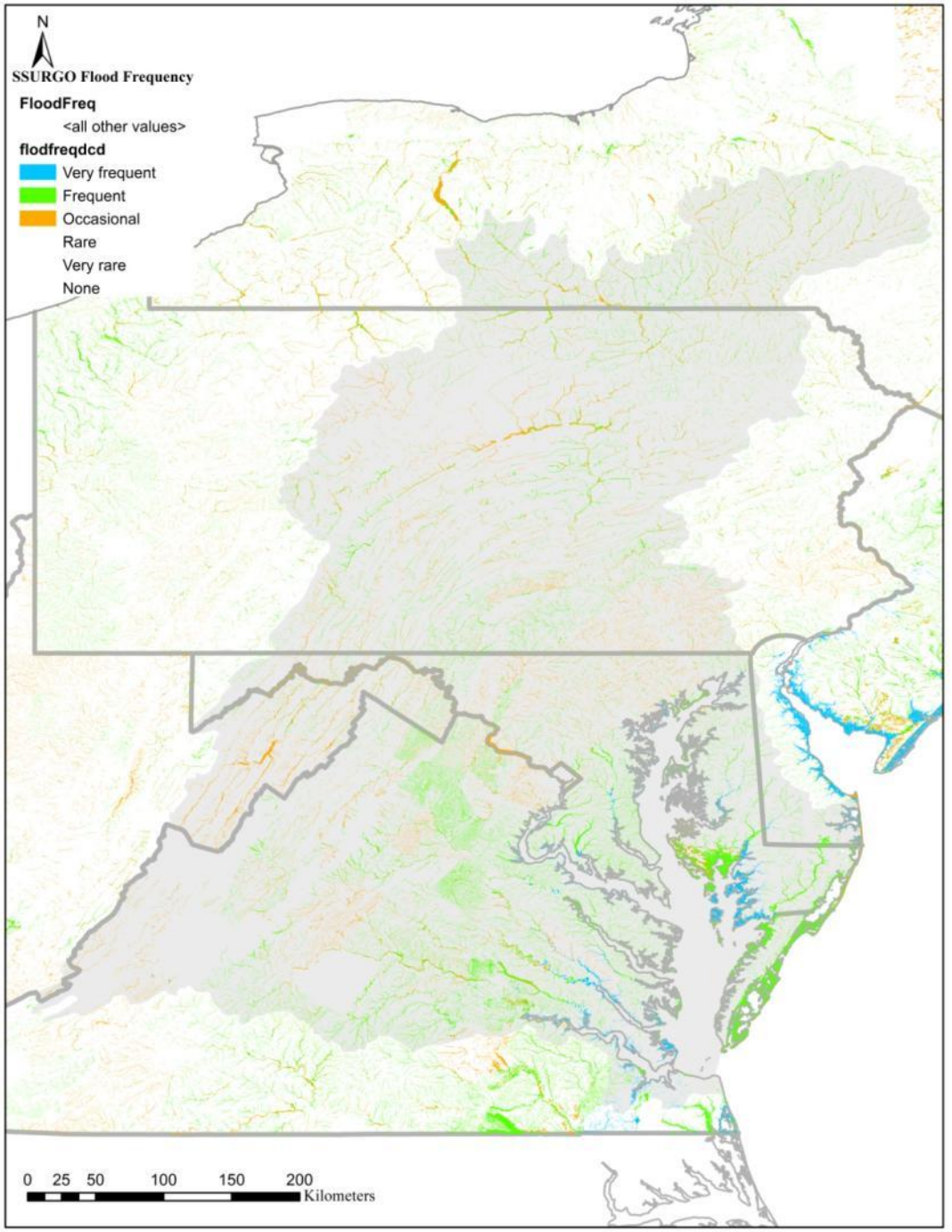
Potential GIS data for mapping floodplain area in Chesapeake

NWI coverage



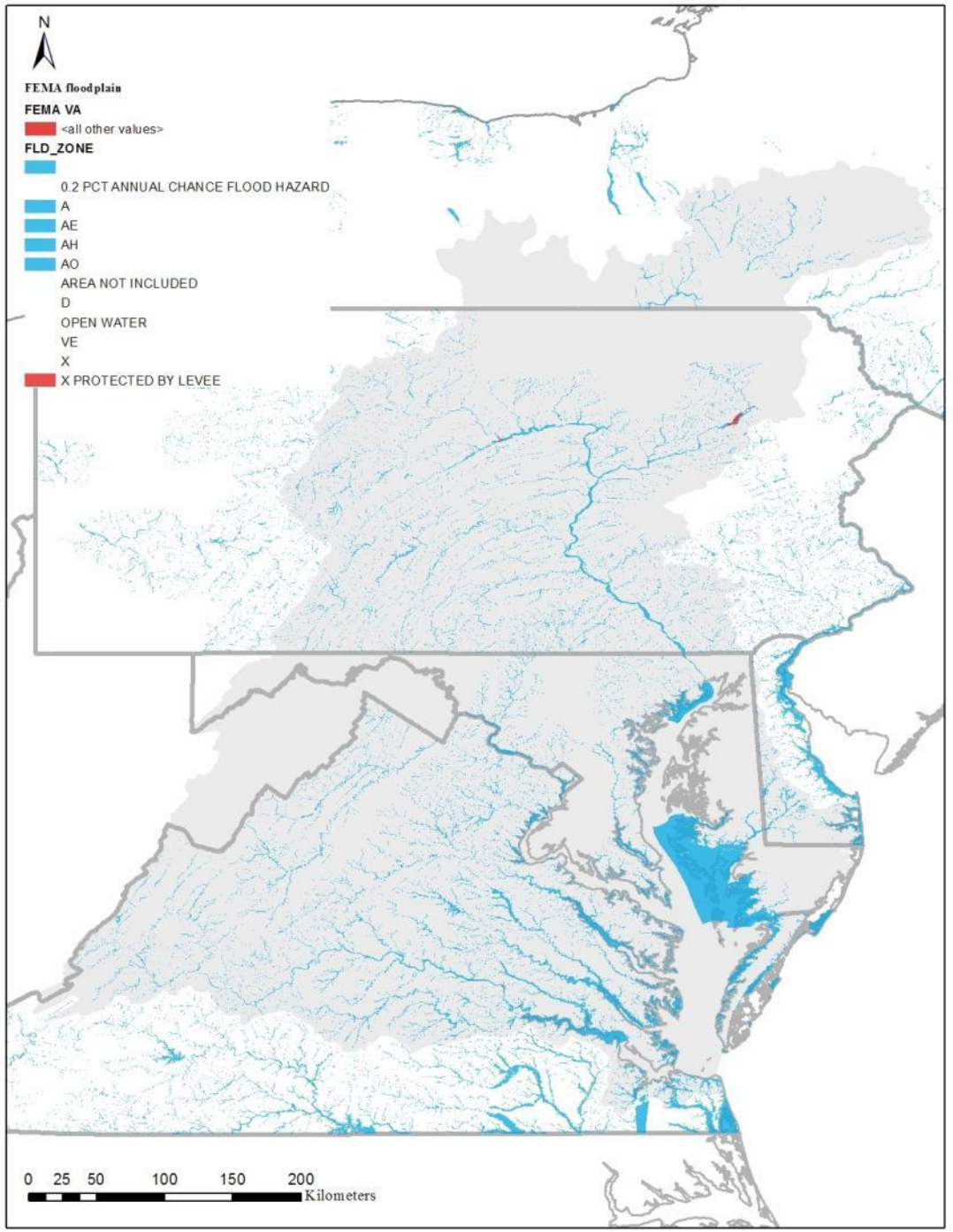
Potential GIS data for mapping floodplain area in Chesapeake

USDA SSURGO Flooding frequency



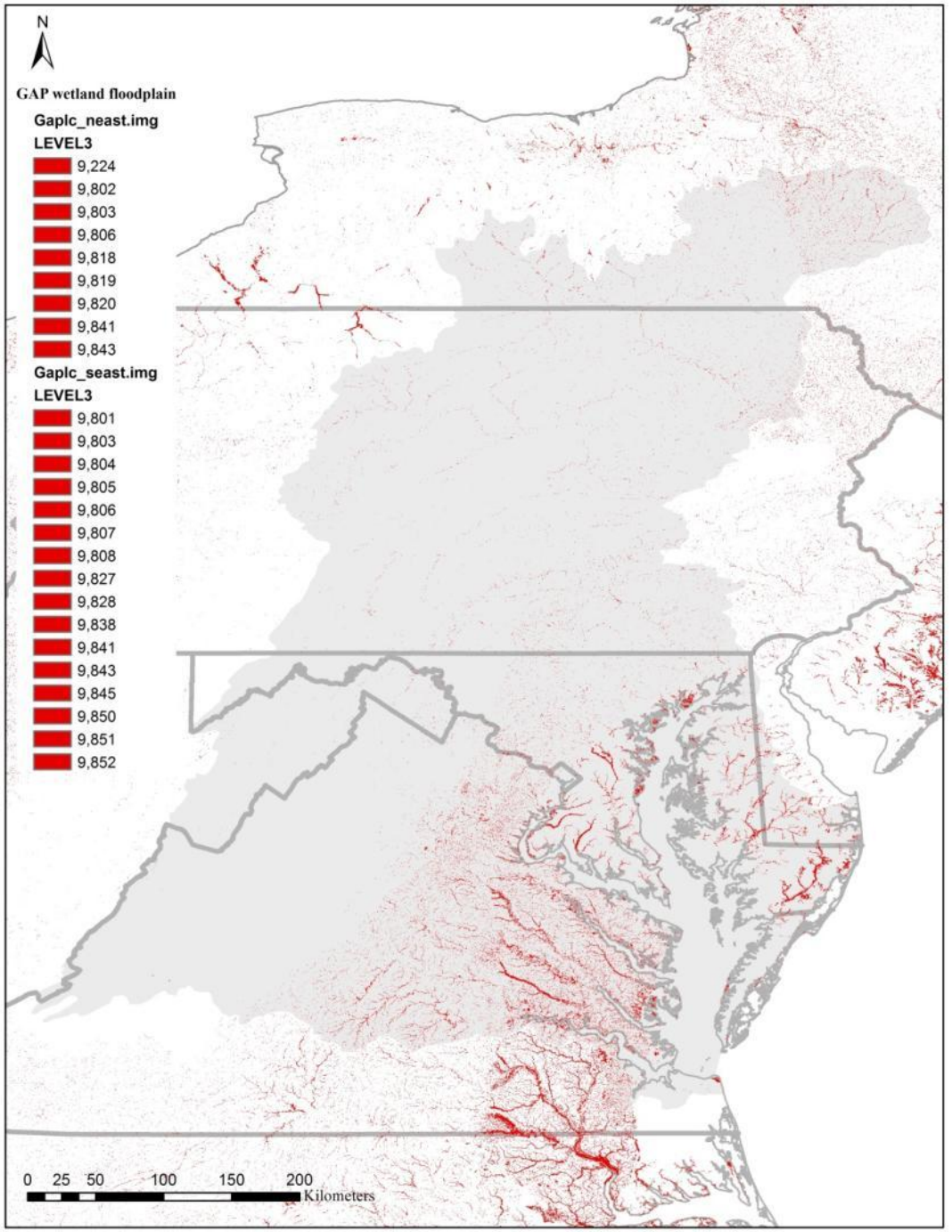
Potential GIS data for mapping floodplain area in Chesapeake

FEMA floodplain (≤ 100 yr)



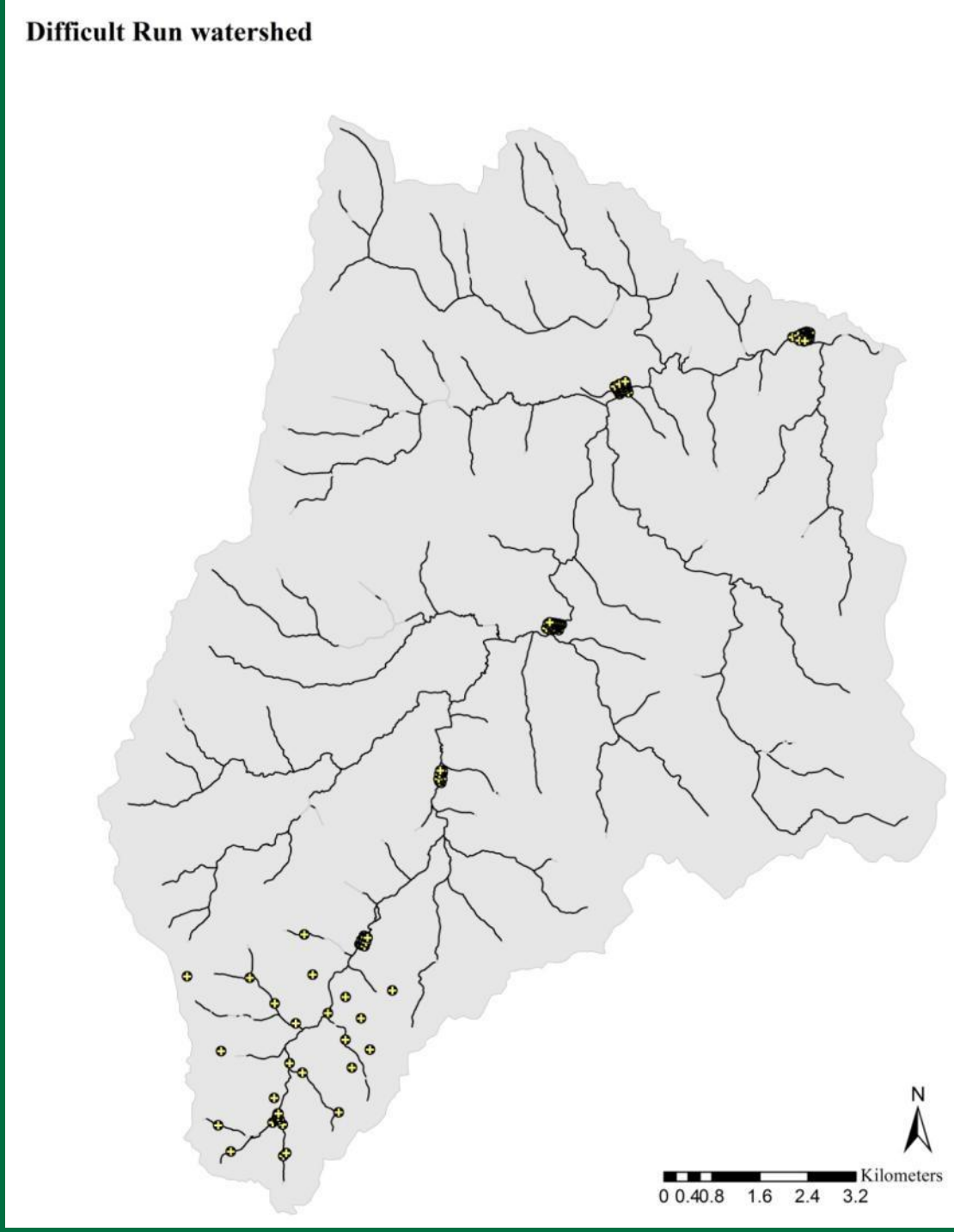
Potential GIS data for mapping floodplain area in Chesapeake

GAP floodplain wetlands

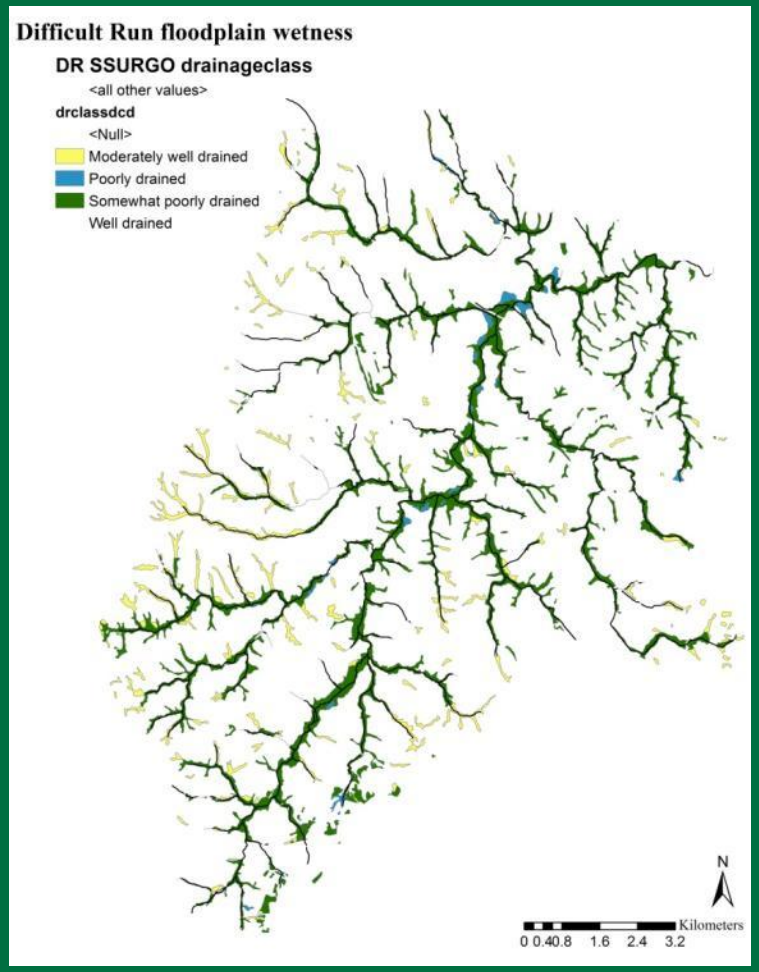


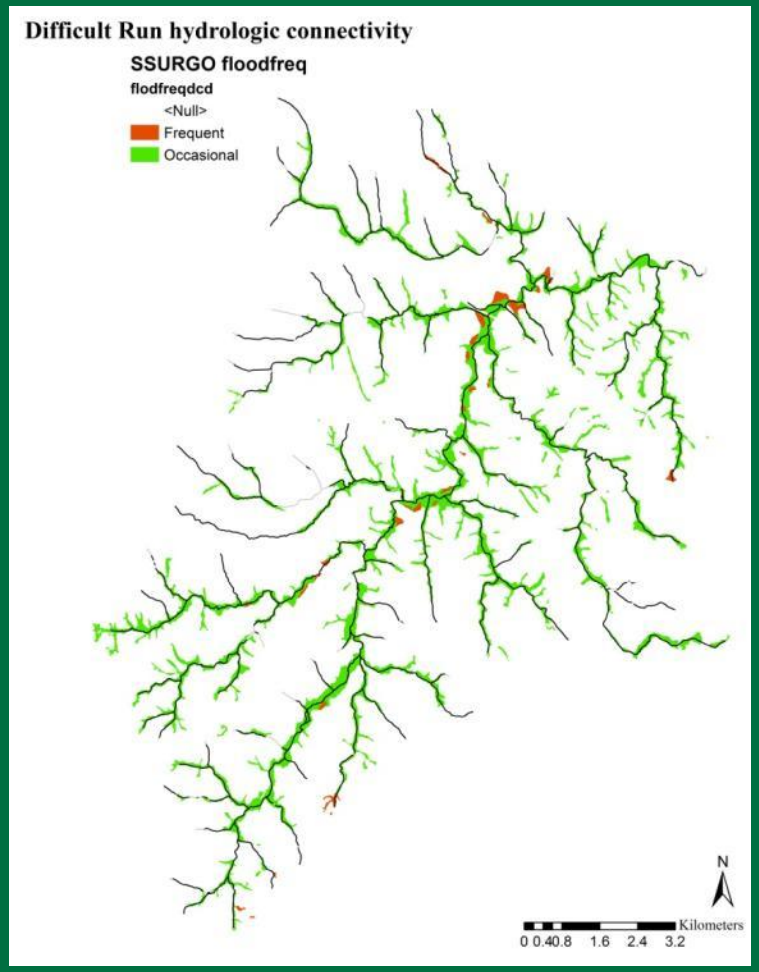
USGS

Potential GIS data for mapping floodplain area in Chesapeake: Difficult Run test



Potential GIS data for mapping floodplain area in Chesapeake: Difficult Run test

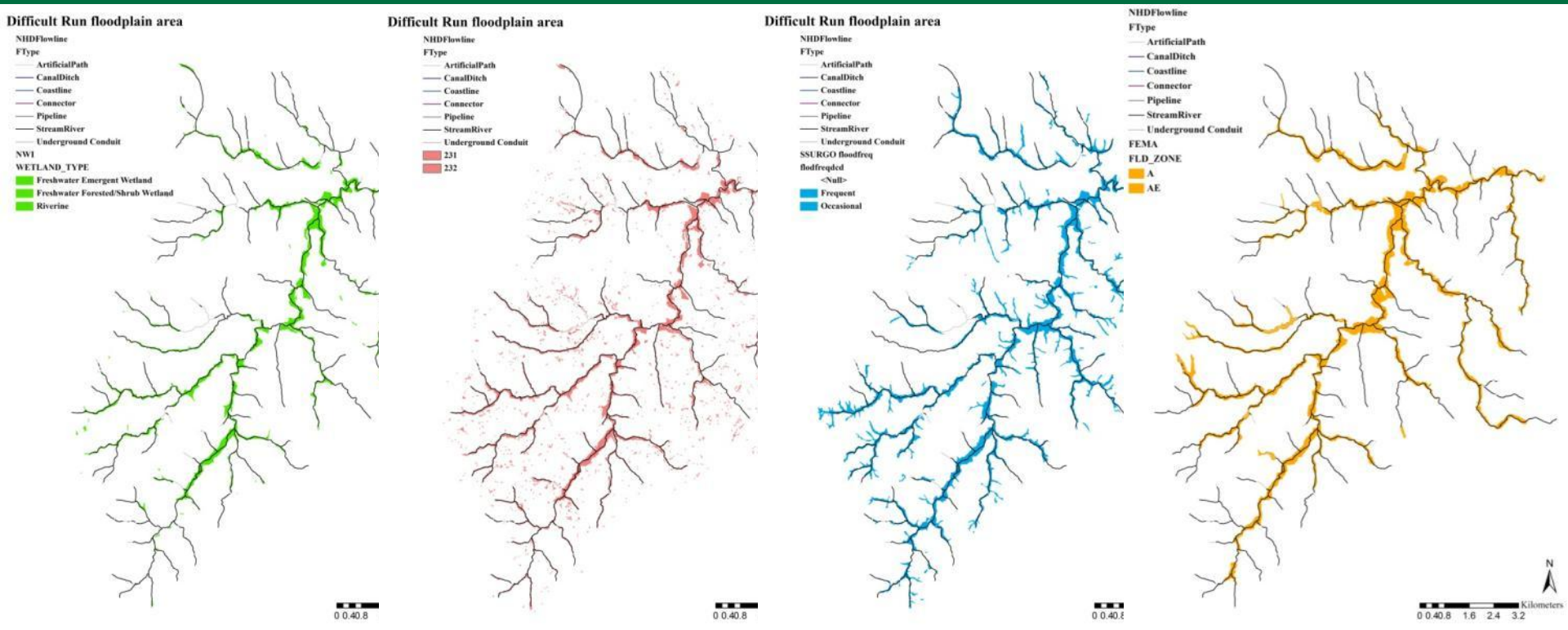




USGS

Potential GIS data for mapping floodplain area in Chesapeake: Difficult Run test

NWI GAP SSURGO flood freq FEMA



USGS

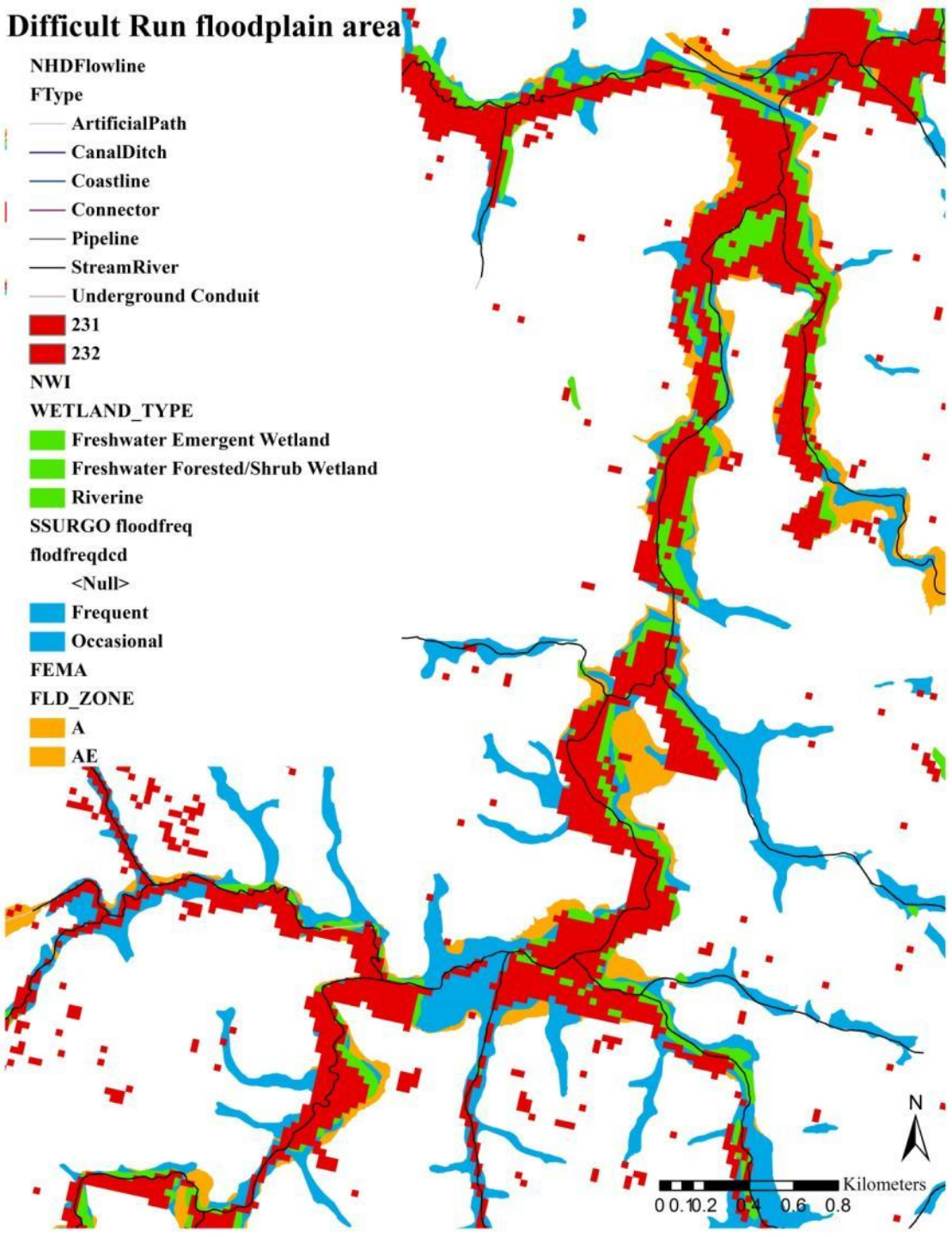
Potential GIS data for mapping floodplain area in Chesapeake: Difficult Run test

GAP

NWI

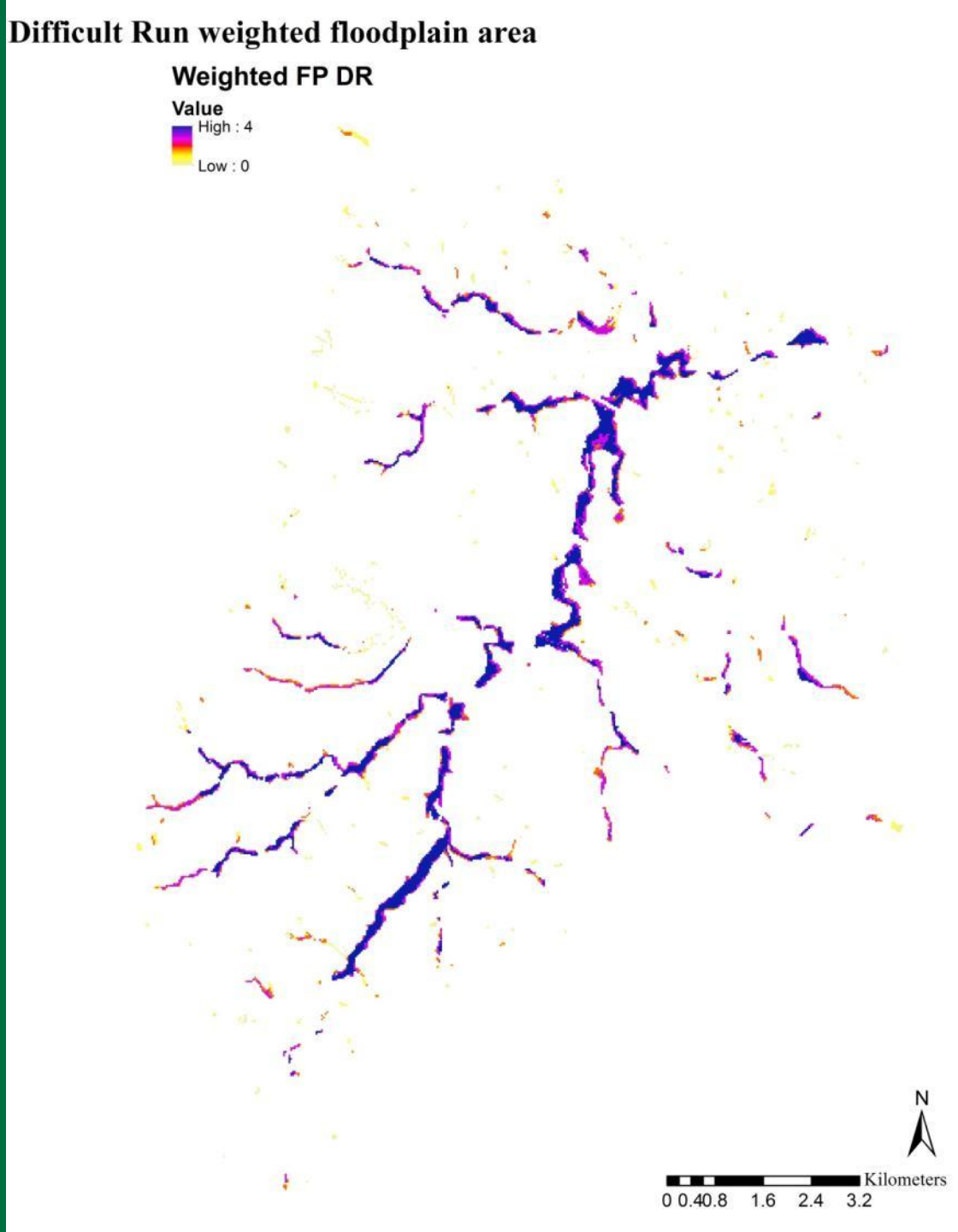
SSURGO flood freq

FEMA



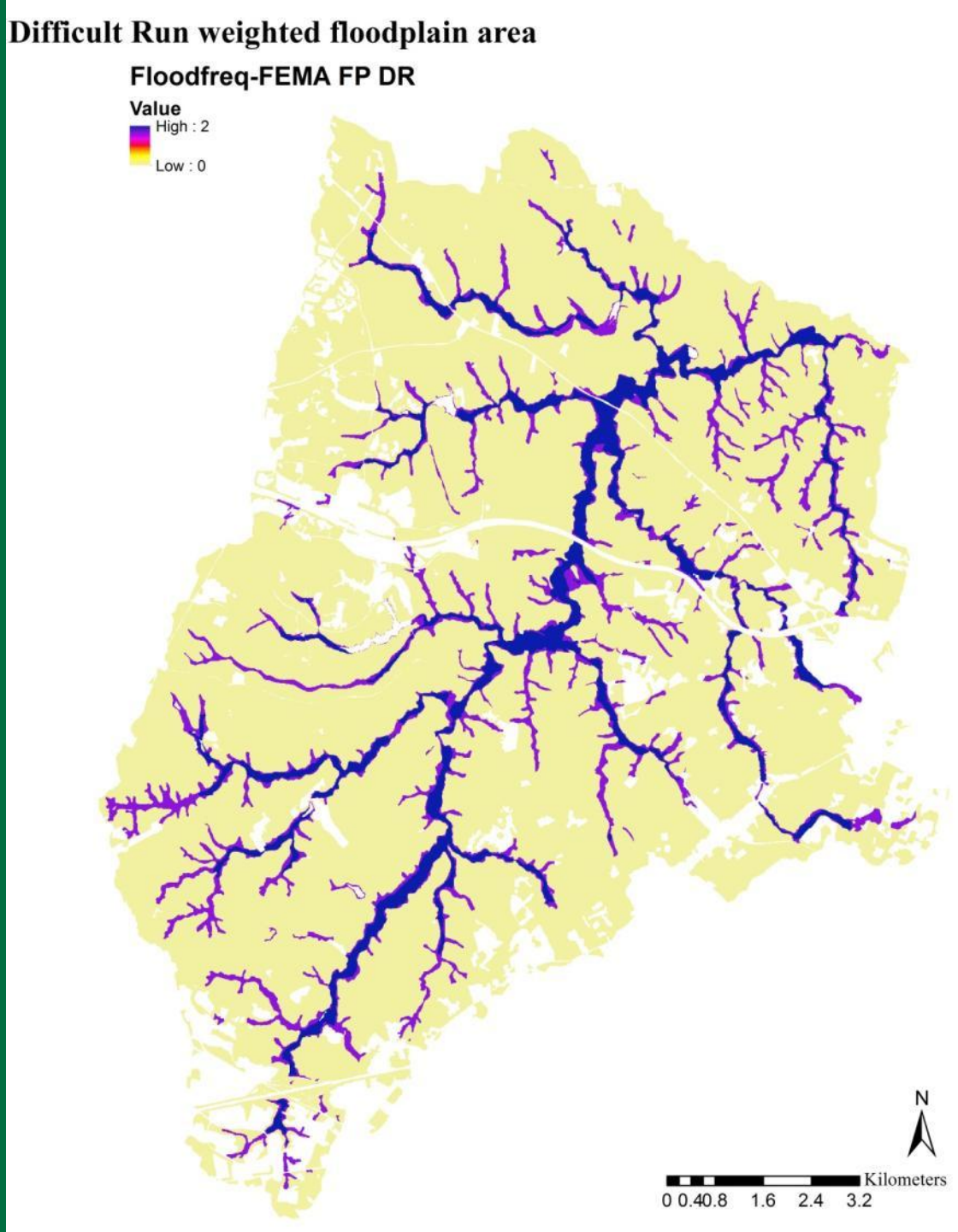
Potential GIS data for mapping floodplain area in Chesapeake: Difficult Run test

Equal weight composite of all 4



Potential GIS data for mapping floodplain area in Chesapeake: Difficult Run test

Flood freq – FEMA composite



Potential GIS data for mapping floodplain area in Chesapeake

DRAFT [DETAILS in DEVELOPMENT]

→ SSURGO Flood Frequency can map floodplain area in most of watershed

with gaps filled in by composite of FEMA (conservatie) /GAP (liberal)

USGS