Putting it all together: integrating monitoring, modeling, and research to inform management across the Bay watershed

Emily Trentacoste, PhD
EPA Chesapeake Bay Program Office
Modeling Workgroup Quarterly
April 11, 2018

Contributions from: Jimmy Webber, Doug Moyer, Joel Blomquist, Jeni Keisman, John Wolf, Rebecca Murphy, Matt Johnston, Qian Zhang, Lindsey Gordon & more

A LOT of new and updated info available…

Monitoring & Trends

Nontidal water quality

Tidal water quality

Tidal attainment

Stream & tidal benthic

Submerged aquatic vegetation

Modeling Tools

CBP Watershed Model

Geographic load distribution

Geographic influence on Bay

BMP progress reports

Synthesis Analyses

USGS Regional Nitrogen, Phosphorus and Sediment Syntheses

SAV Synthesis

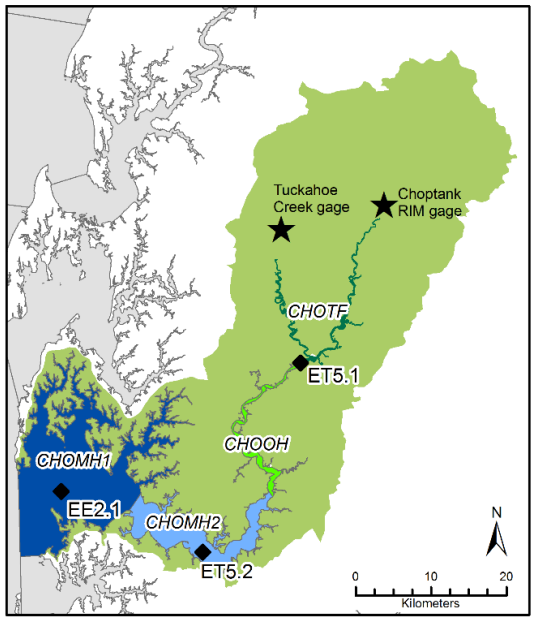
Water Clarity Synthesis

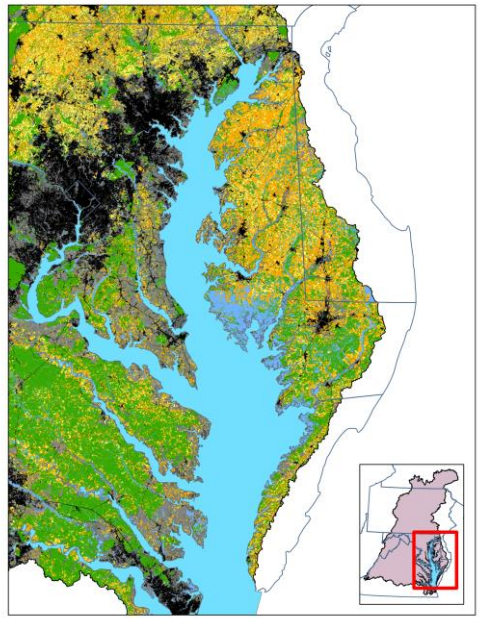
Water Quality Synthesis

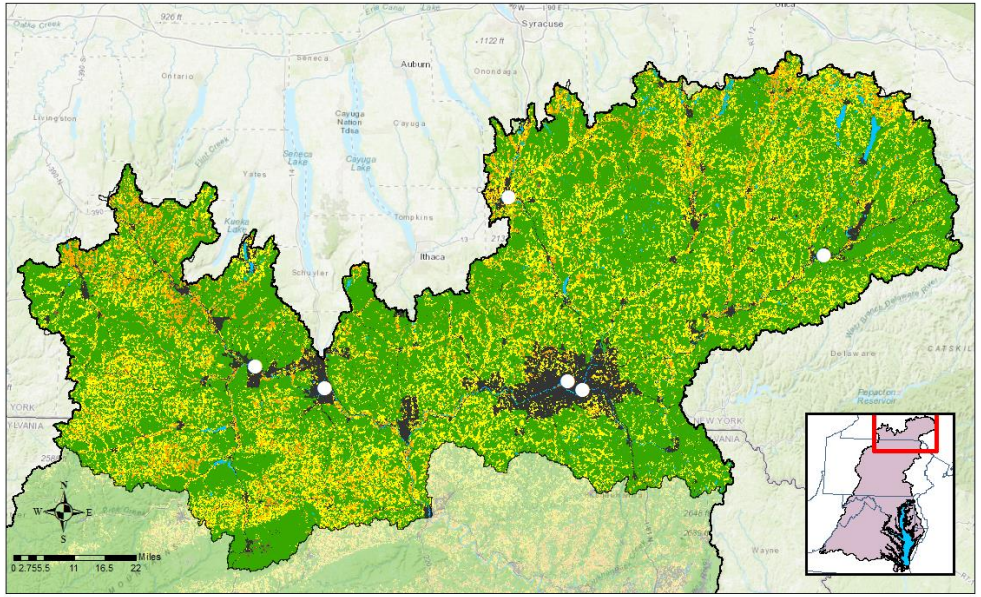
…and more to come

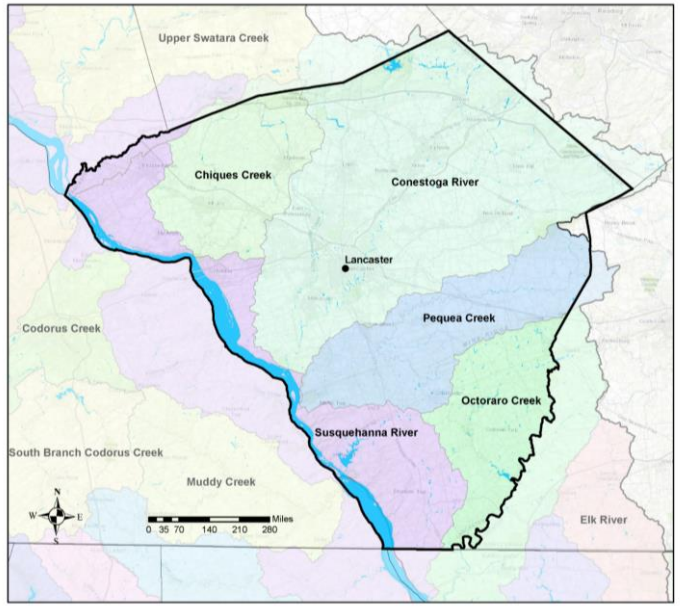
Developing storylines to demonstrate management connections

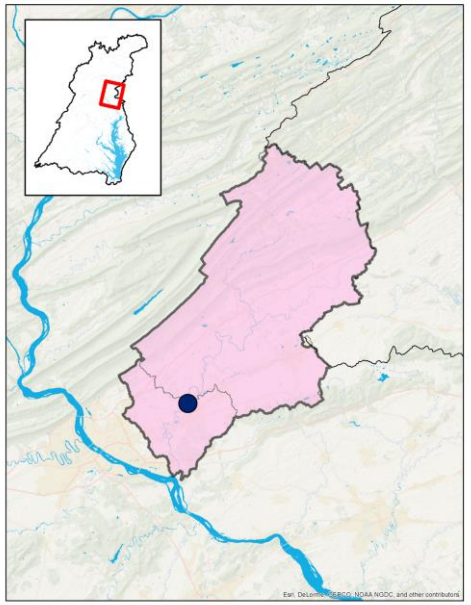
- Storylines were developed to demonstrate how the science can be integrated and assessed at smaller scales to inform planning efforts
- Received positive feedback on concept of storylines and their utility
- We've been working with jurisdictions and local groups to develop storylines across the watershed (tidal and non-tidal)











Developing storylines: A Choptank River example

- Storylines were developed to demonstrate how the science can be integrated and assessed at smaller scales to inform planning efforts
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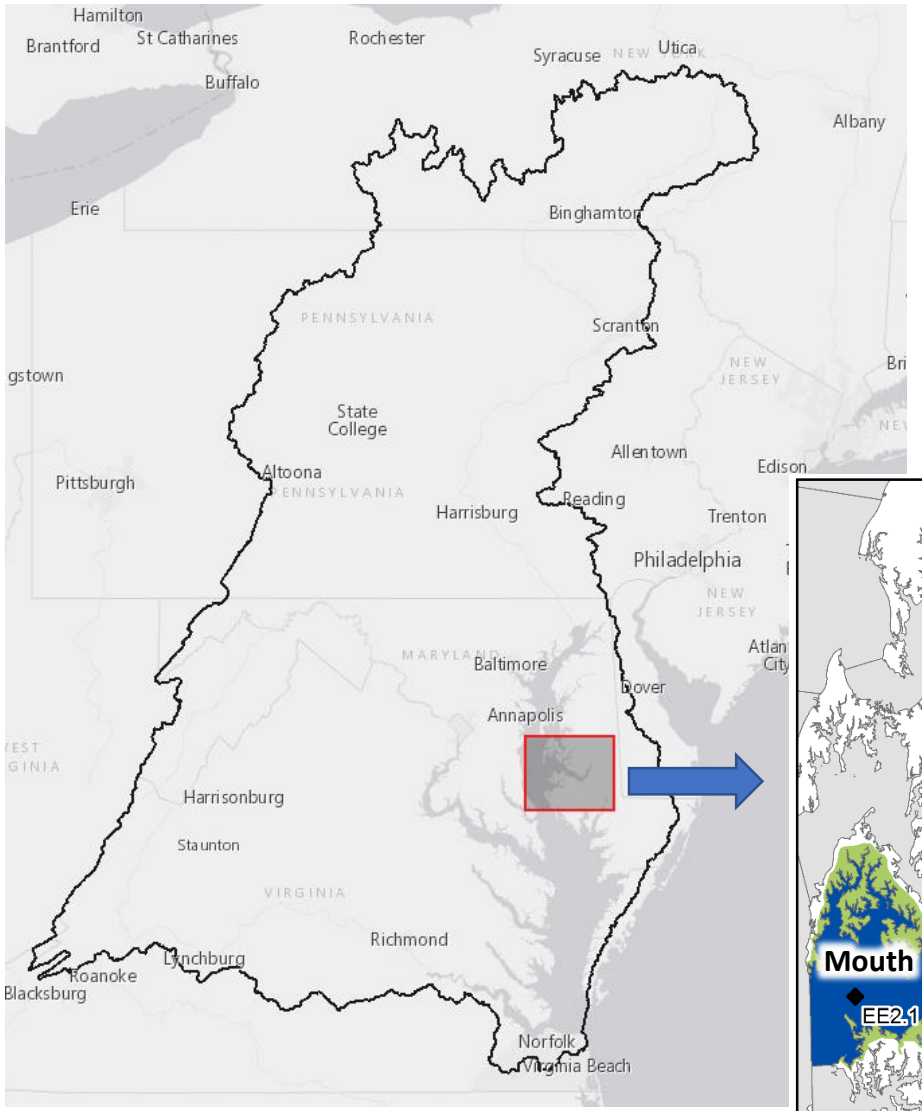
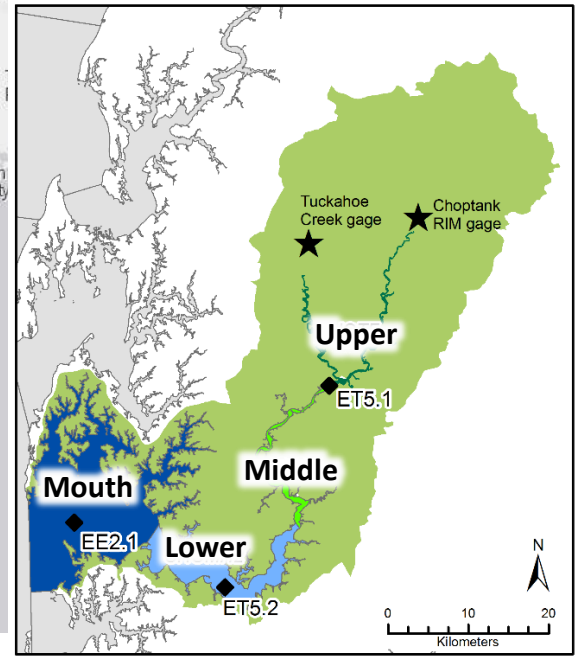
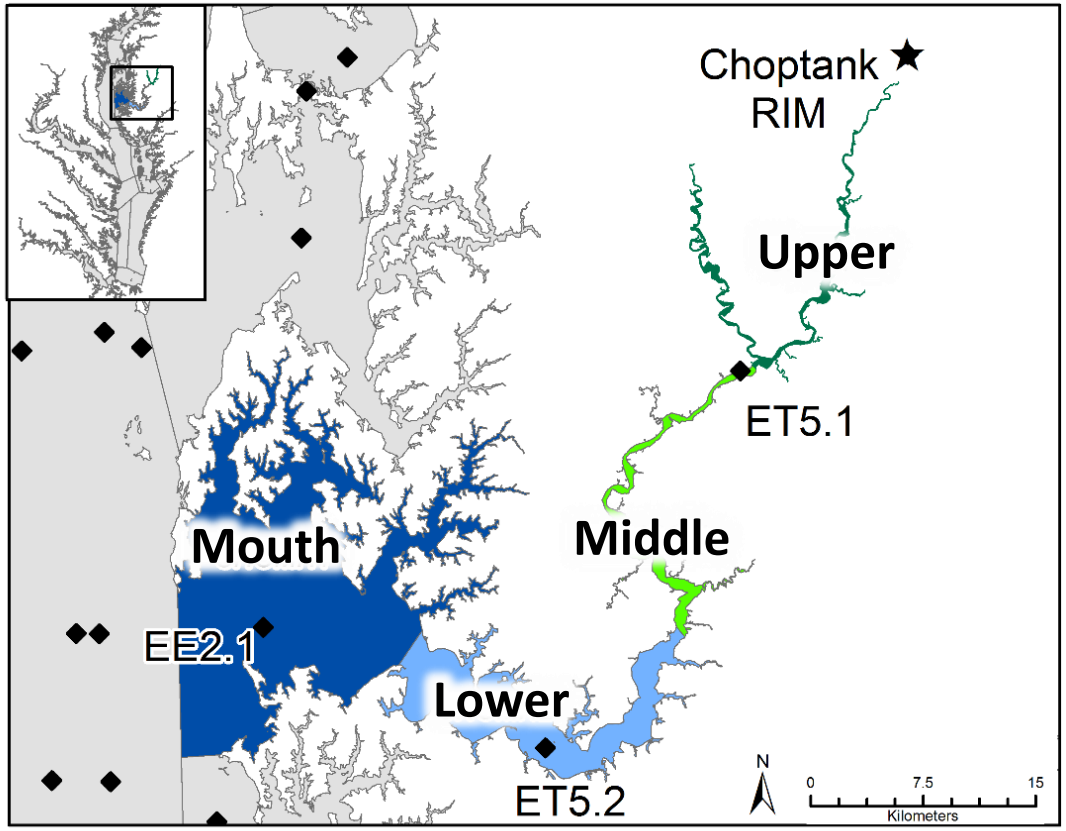


Choptank River



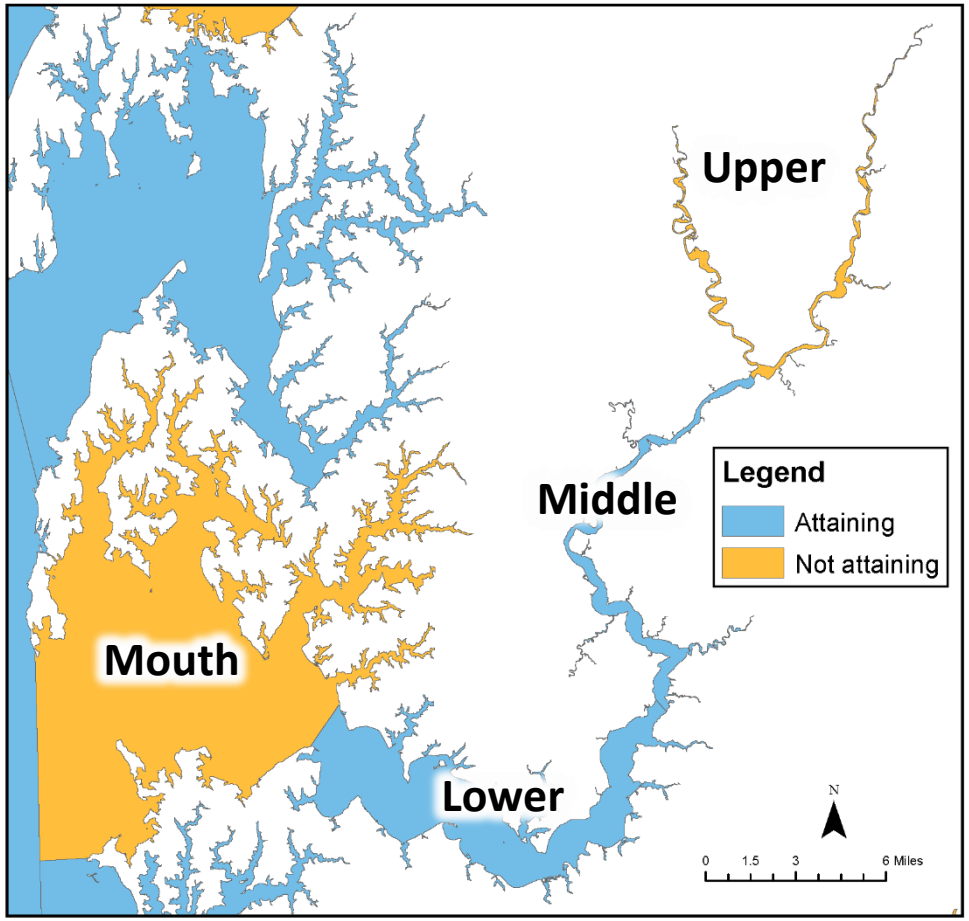
Starting in the tidal waters: water quality standards

Choptank River tidal segments



Map and graph: Rebecca Murphy, UMCES

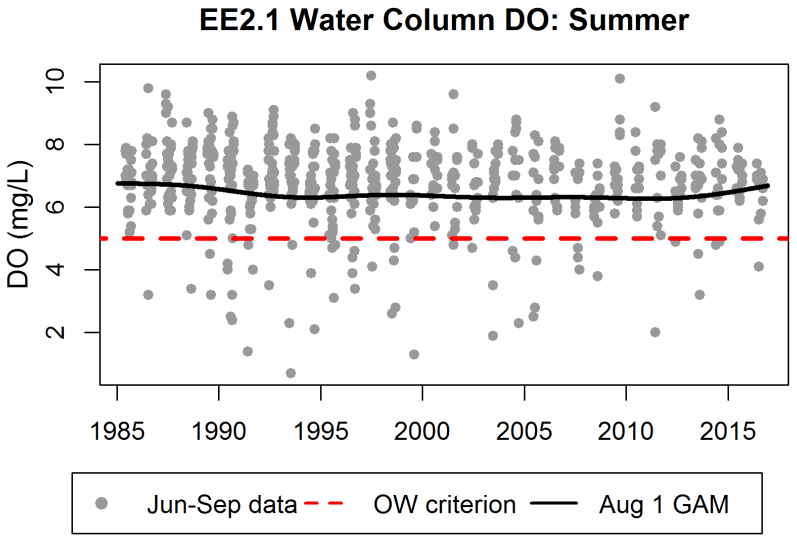
Choptank River attainment of open water dissolved oxygen criterion

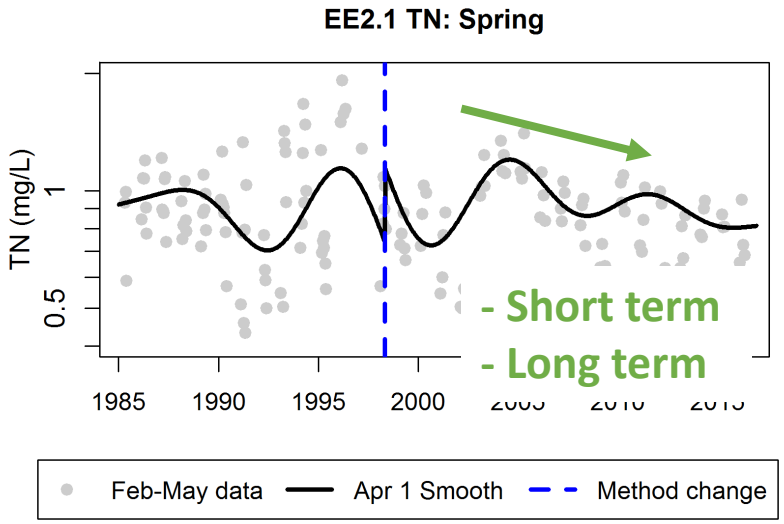


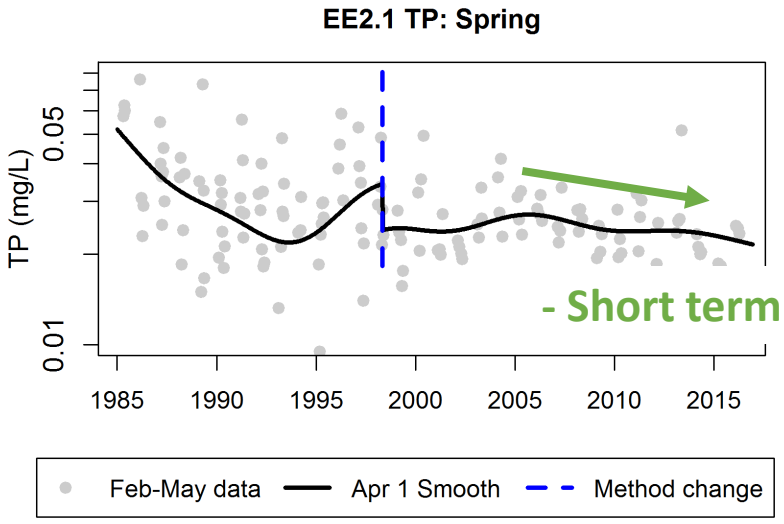
- Portions of the river are not attaining water quality standards
- Sources, drivers, and trends are different along the river

Water quality drivers of attainment

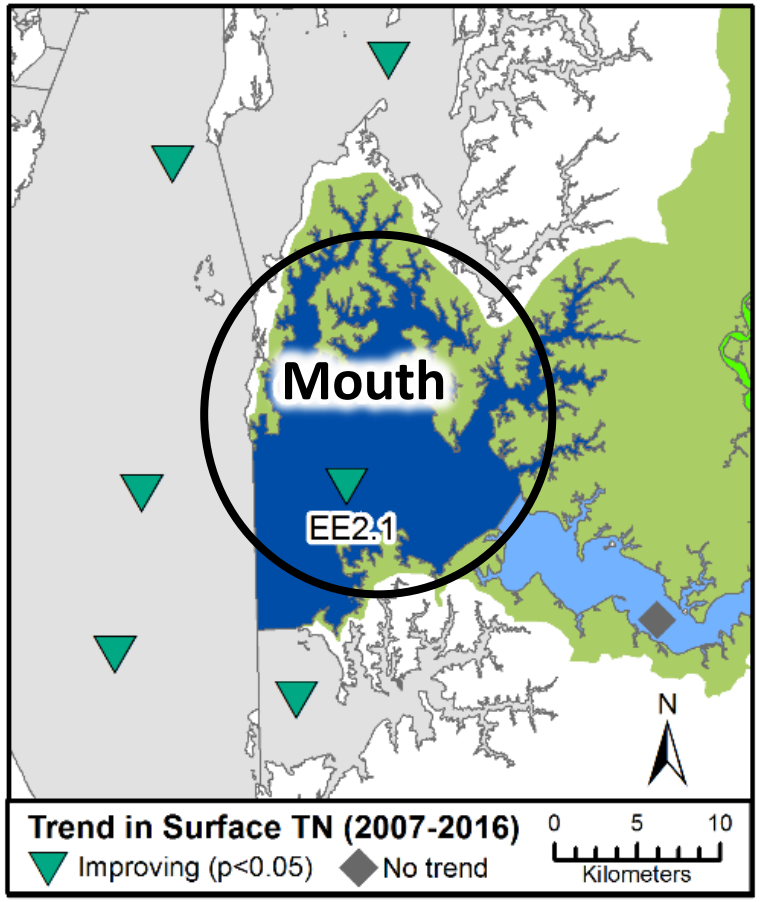
- Mouth of the river already has good DO in the summer and is rarely hypoxic
- Nutrients have been decreasing at and around the mouth







Nitrogen trends 2007-2016

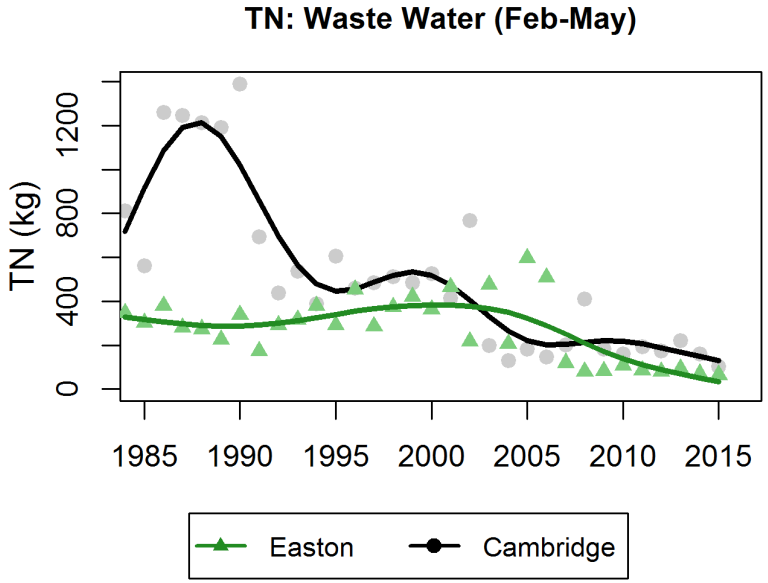


From trends run by Renee Karrh, MDDNR

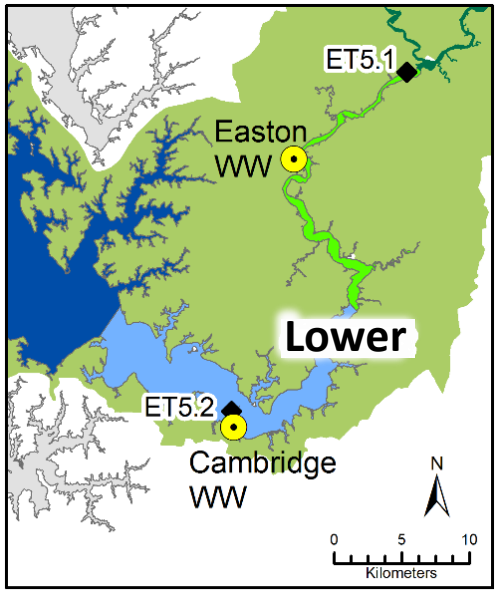
GAMs: Rebecca Murphy, UMCES; Renee Karrh, MDDNR

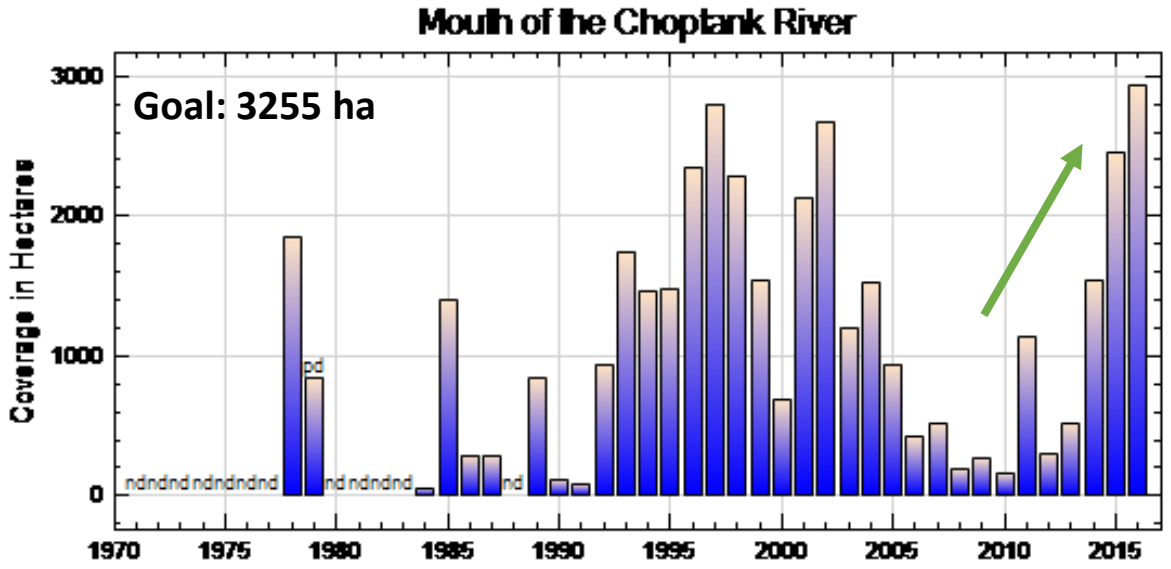
Water quality drivers of attainment

- Mouth of the river already has good DO in the summer and is rarely hypoxic
- Nutrients have been decreasing at and around the mouth
- Wastewater upgrades have contributed to decrease in nutrients
- SAV has shown recovery in recent years



Wastewater treatment plants



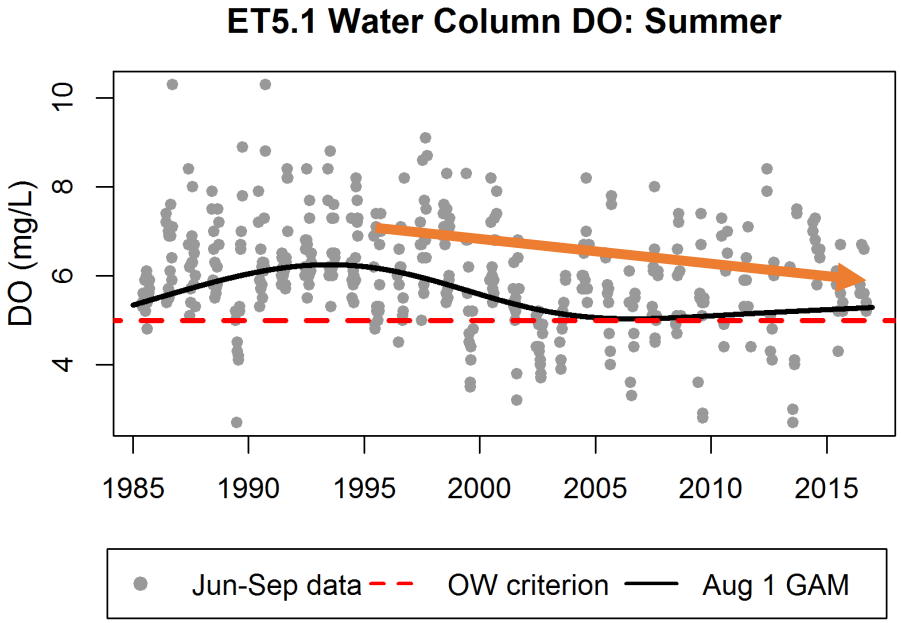


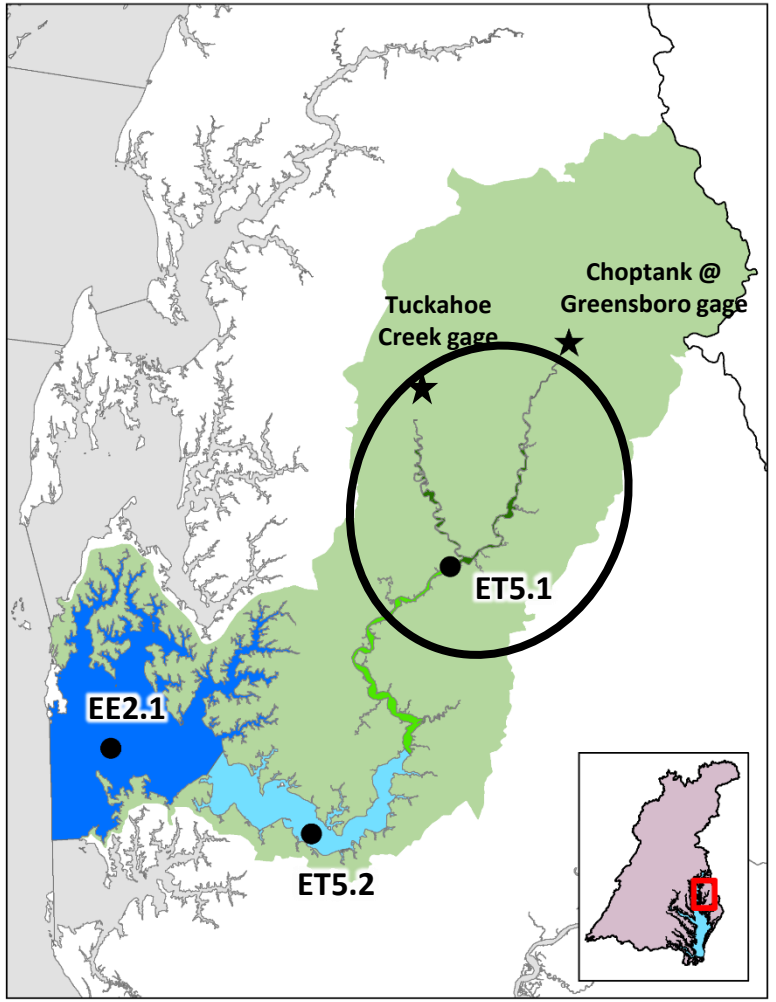
SAV coverage 2016

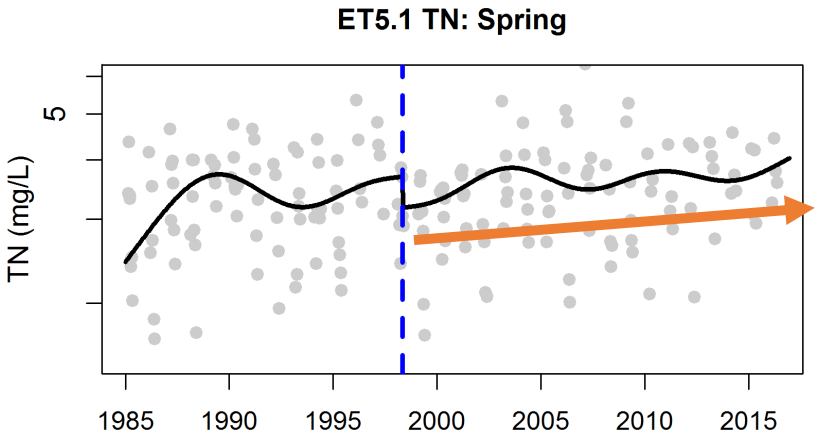
WW: CBP Point Source Database, graph and map by Rebecca Murphy, UMCES; SAV graph: http://web.vims.edu/bio/sav/index.html

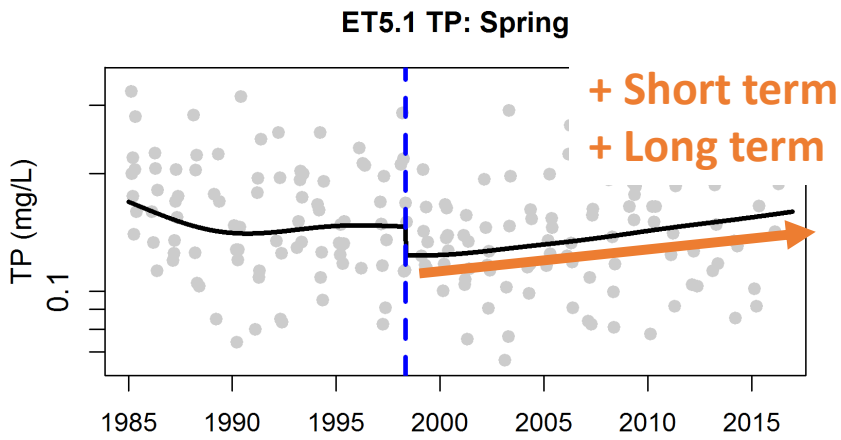
Water quality drivers of attainment

- Upper river has shown long-term decline of summer dissolved oxygen and clarity
- Tidal nutrient concentrations influence DO
- Research has connected decline in water quality to increased nutrients from watershed









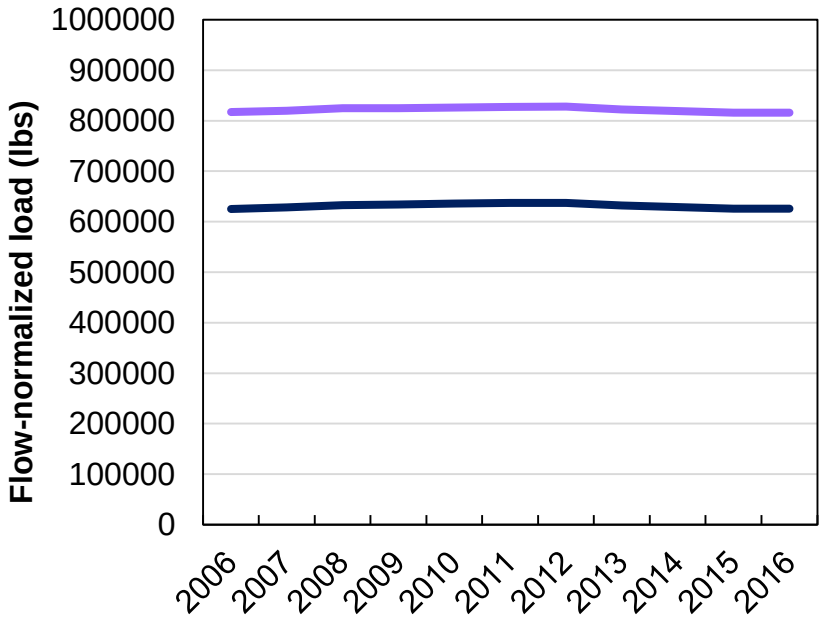
+ Short term
+ Long term

GAMs: Rebecca Murphy, UMCES; Renee Karrh, MDDNR

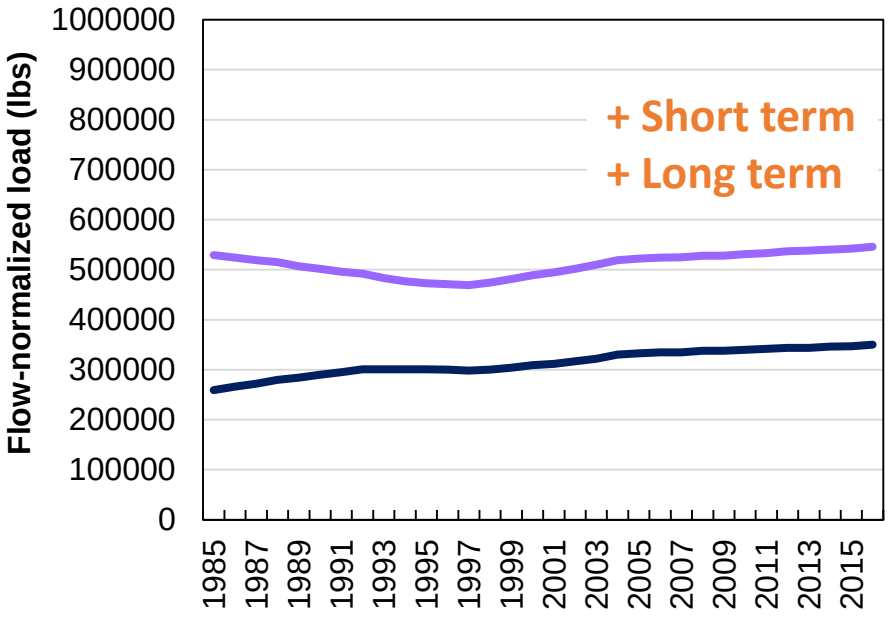
Watershed Loads

(flow-normalized)

Tuckahoe Creek: Nitrogen Load

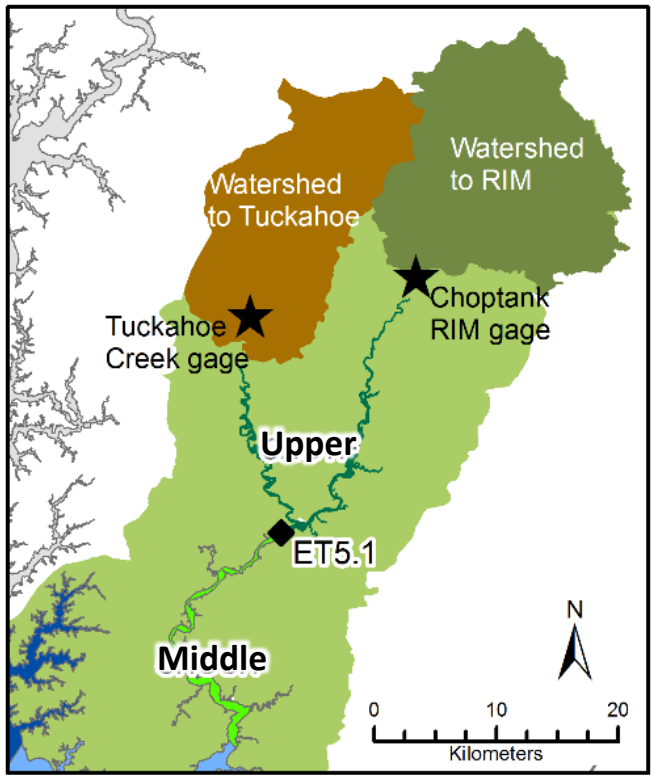


Choptank @ Greensboro: Nitrogen Load



Total Nitrogen

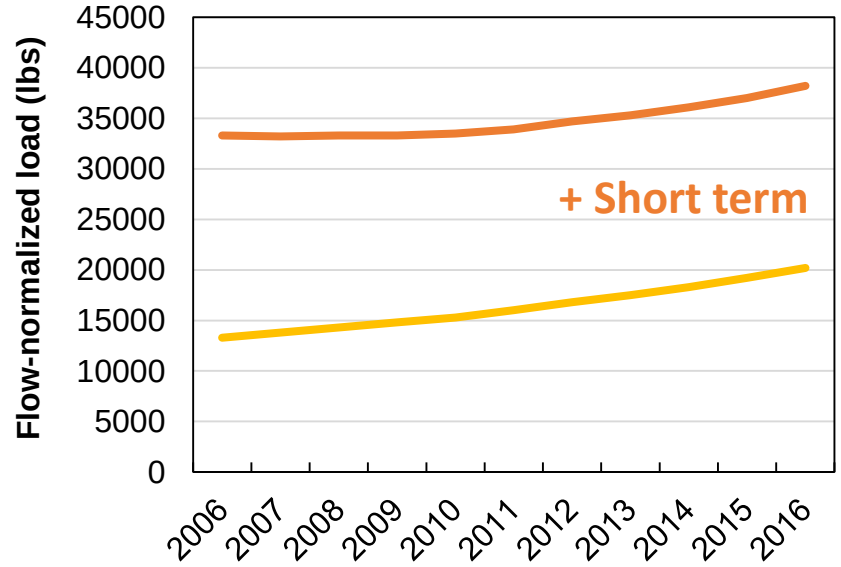
Nitrate



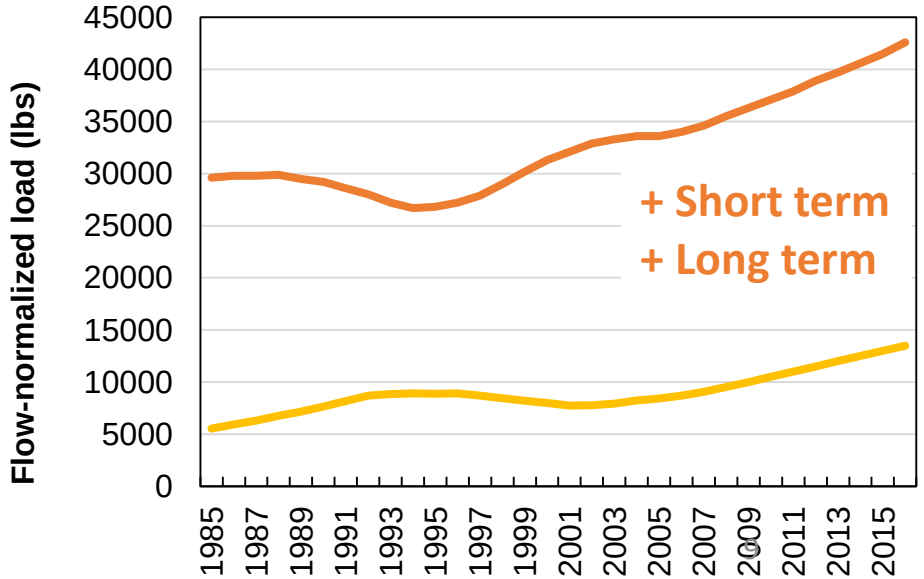
Total Phosphorus

Orthophosphorus

Tuckahoe Creek: Phosphorus Load



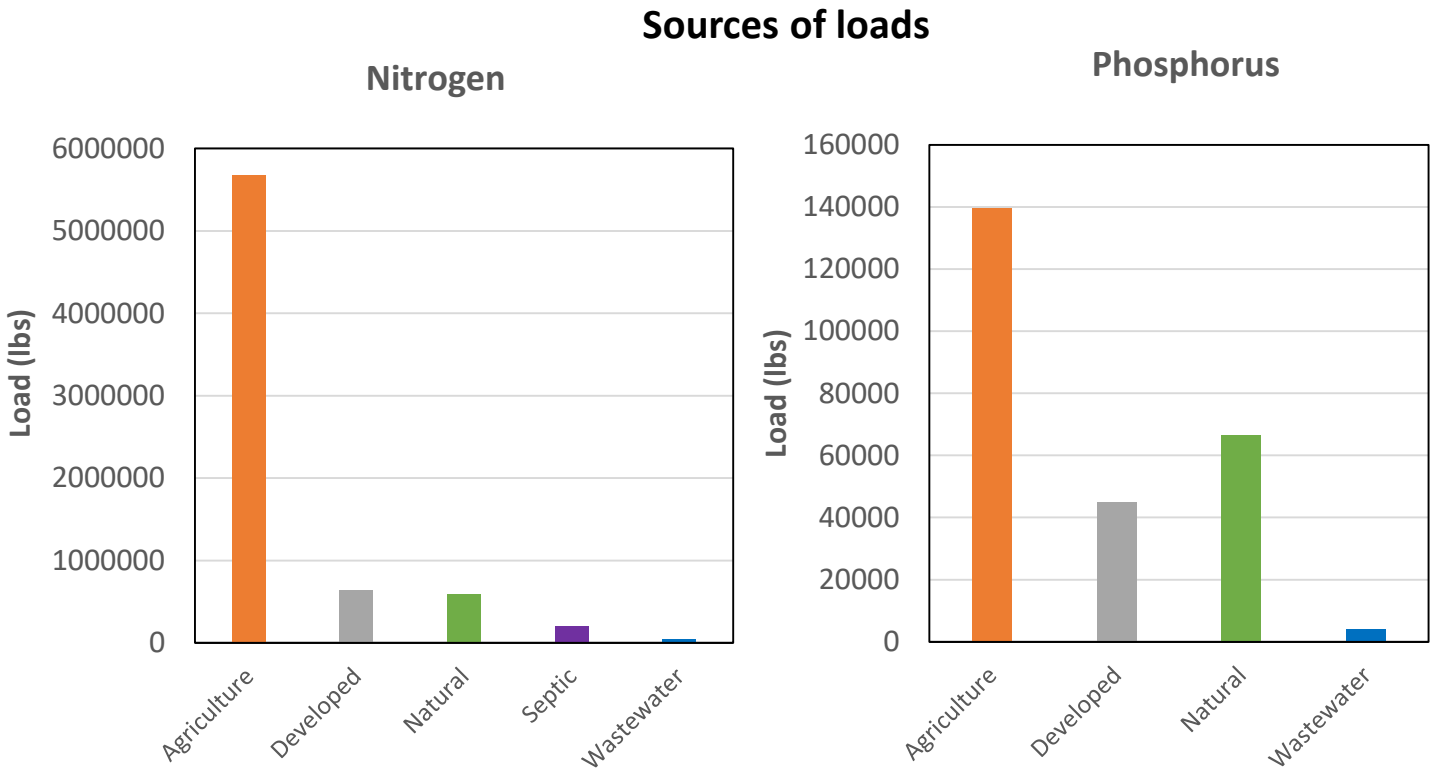
Choptank @ Greensboro: Phosphorus Load

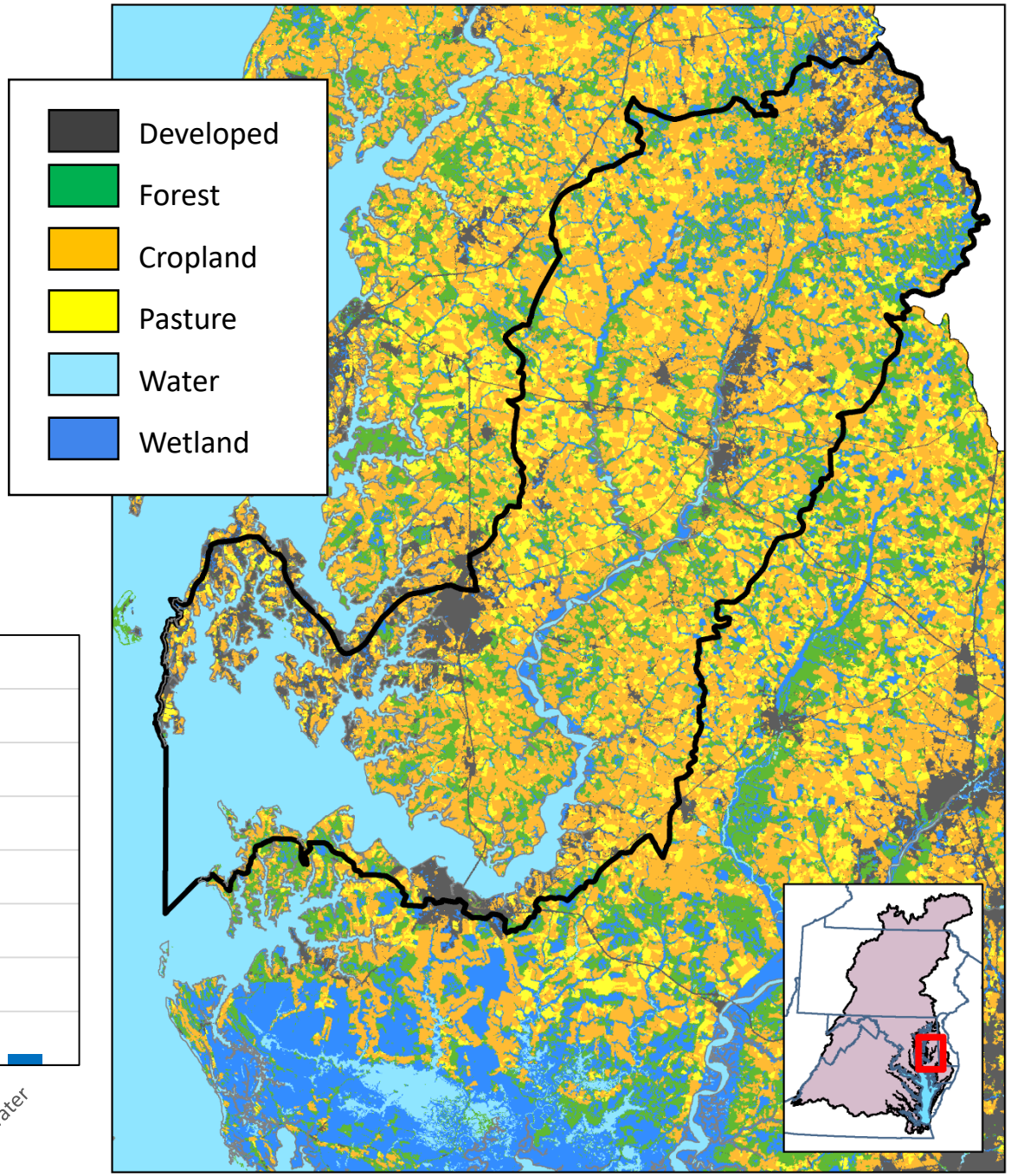


USGS Chesapeake Bay Non-tidal Network:
https://cbrim.er.usgs.gov/

Where do nutrients come from in the watershed?

- Nutrient and sediment loads come primarily from agriculture, specifically cropland
- Different localities can have unique issues



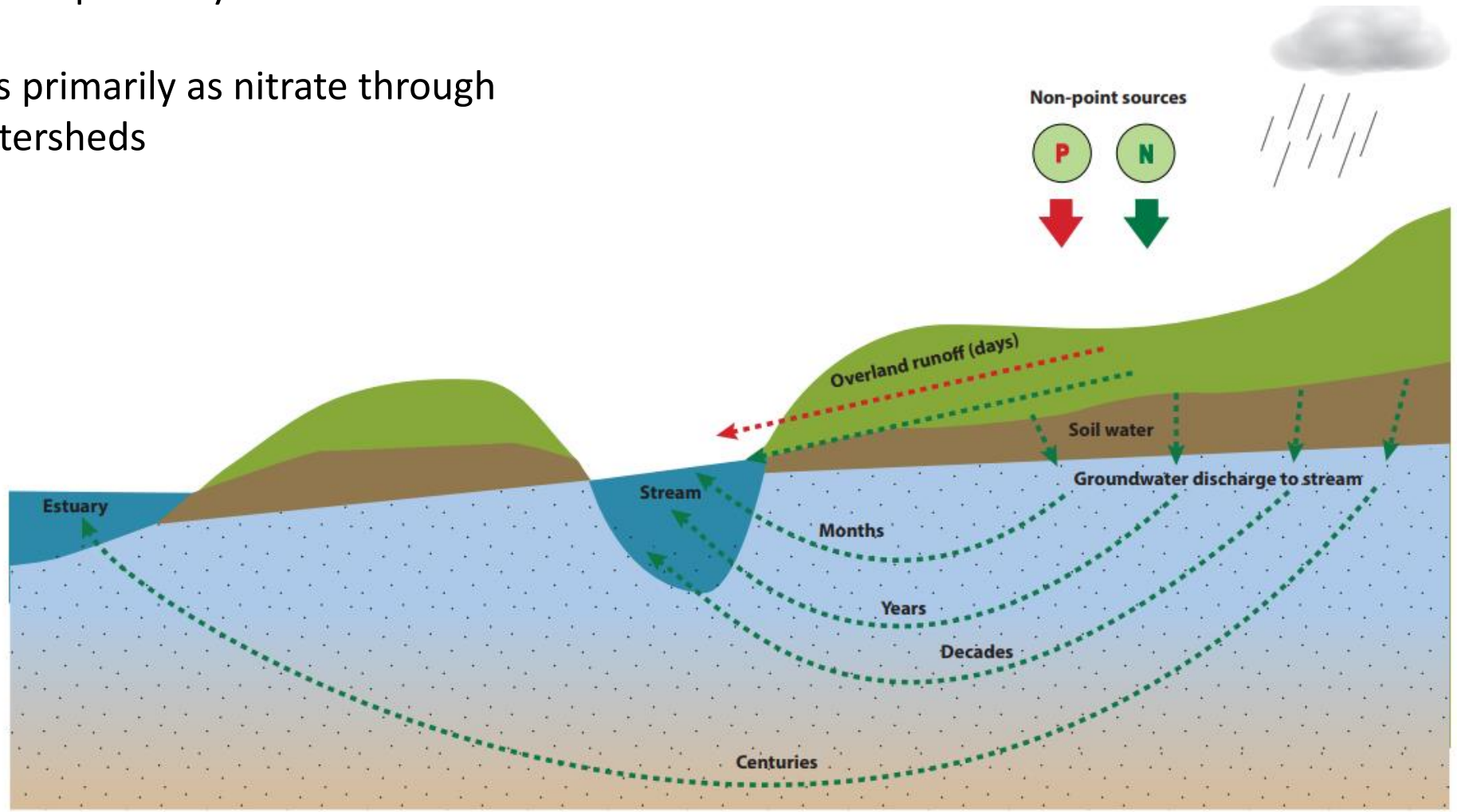


Chesapeake Bay Phase 6 Program Watershed Model. Draft 2016 Progress.

Map data from Falcone, J.A., 2015.

The transport of nutrients matters

- Phosphorus reaches streams primarily from overland runoff during storms
- Nitrogen reaches streams primarily as nitrate through groundwater in some watersheds



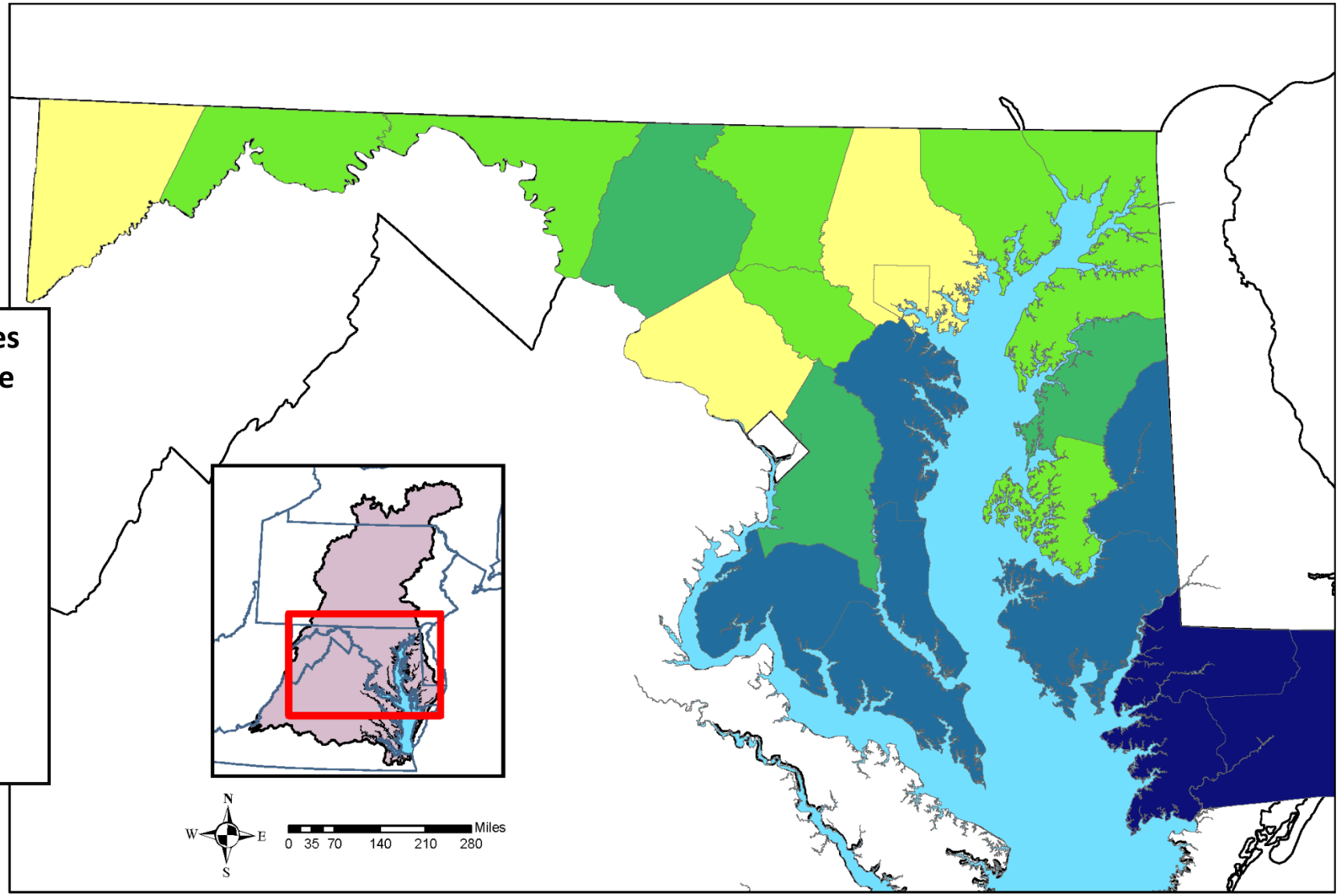
Ator, S.W. & Denver, J.M., 2015.
Bachman, L.J., et al., 1998.

Diagram from Lyerly, A.L. et al., 2014.

Soil phosphorus and water quality are linked

- High soil phosphorus levels can lead to increased loads of phosphorus into streams

Fertility Index Value of Maryland Counties



Maryland Department of Agriculture
Phosphorus Management Tool

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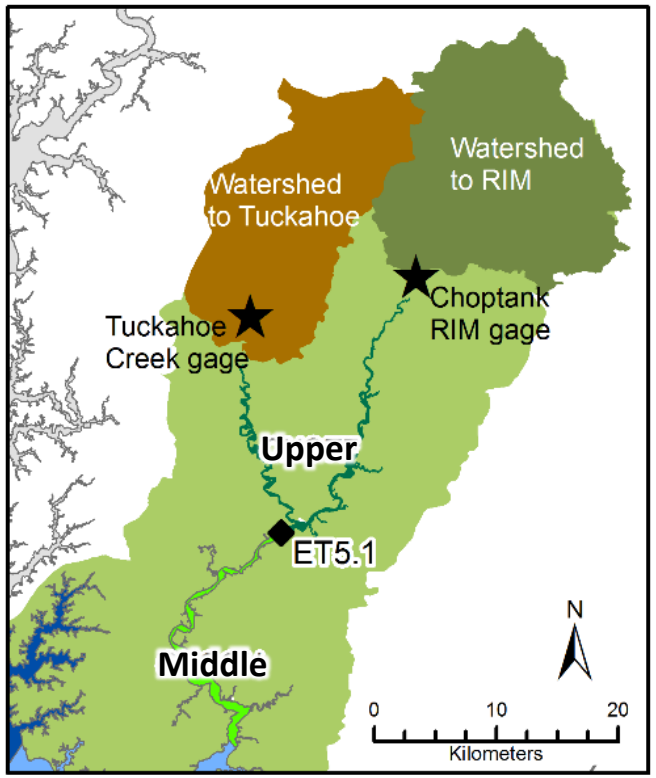
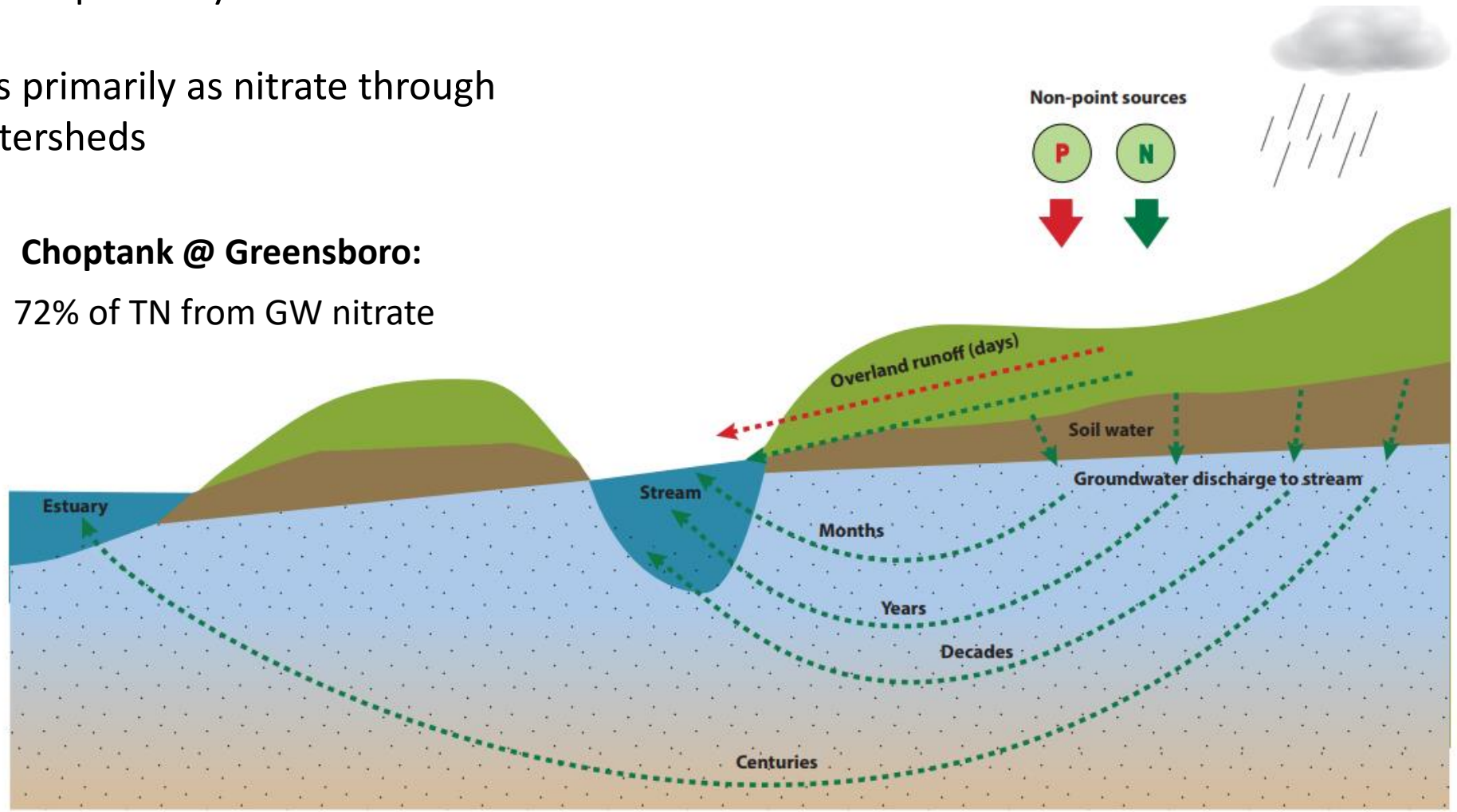


Choptank @ Greensboro:

72% of TN from GW nitrate



Ator, S.W. & Denver, J.M., 2015.
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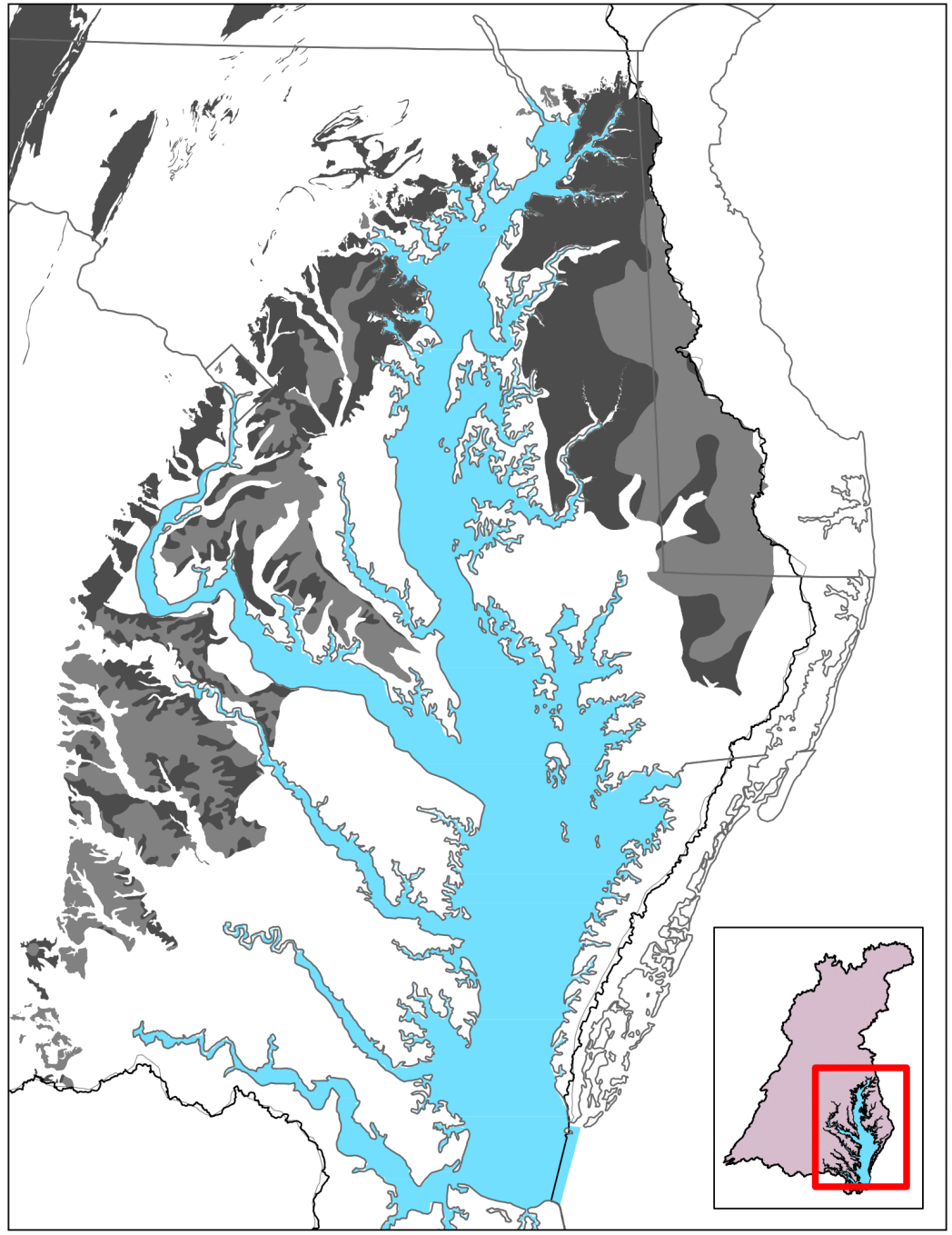
Diagram from Lyerly, A.L. et al., 2014.

Certain areas are more vulnerable to movement of nitrate into groundwater

- Geology makes the groundwater (and therefore streams) in some areas especially vulnerable to high nitrogen inputs
- These areas can be some of the most effective places to focus practices for mitigating nitrate in groundwater

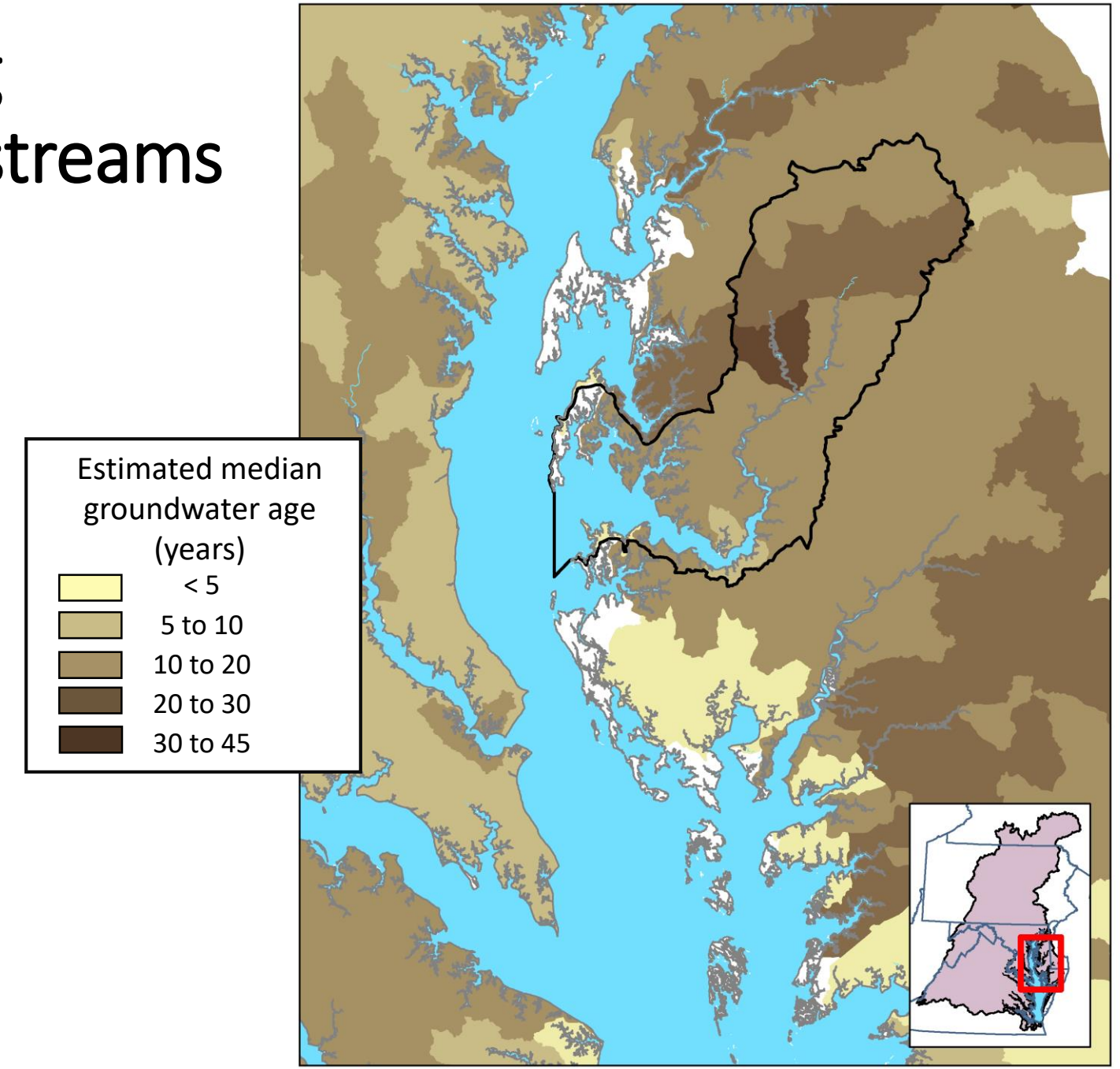


Ator, S.W. & Denver, J.M., 2015.

Map modified from Jimmy Webber, USGS, using Brakebill, JW 2000 and Ator, S. et al. 2005.

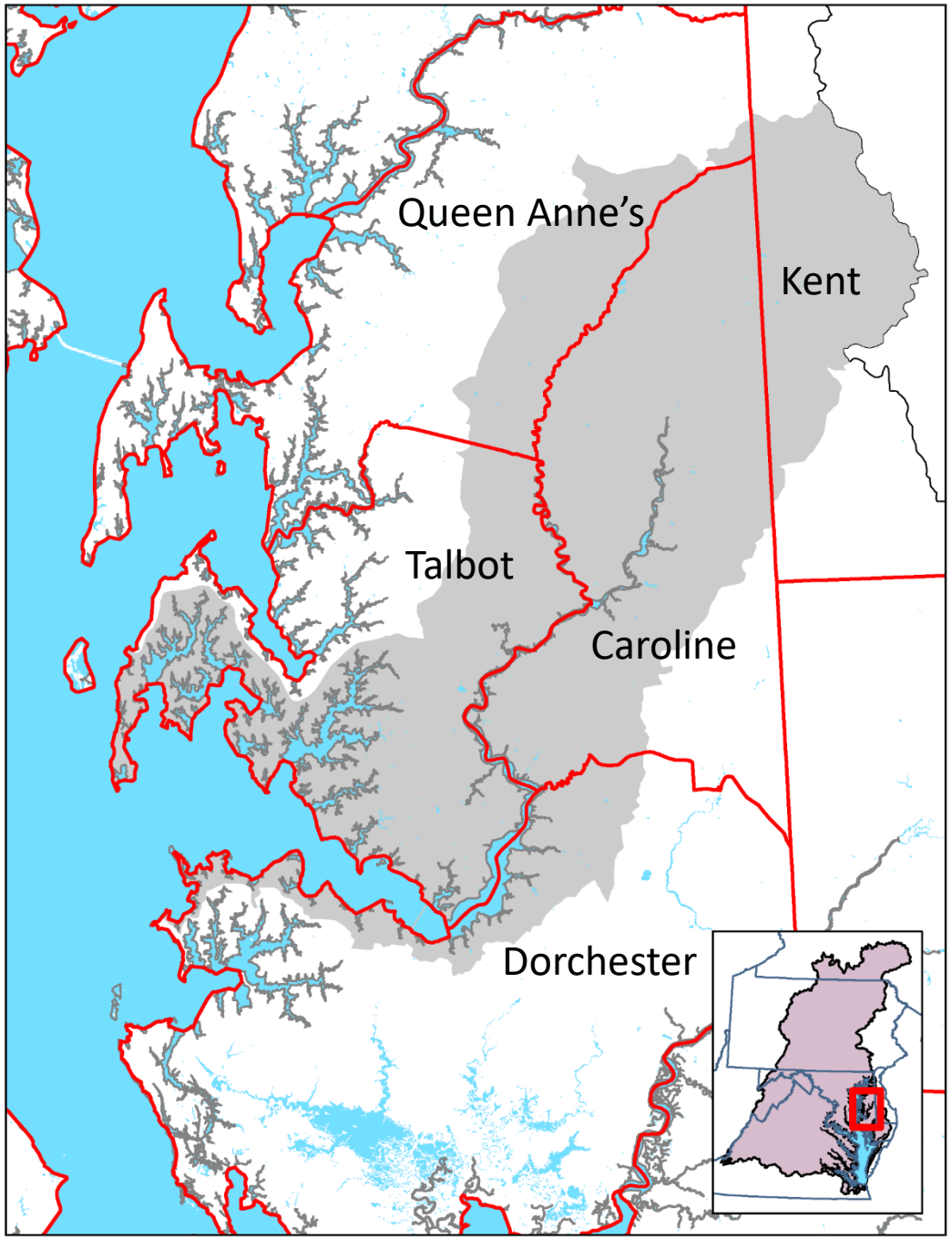
Groundwater takes varying amounts of time to reach streams depending on location

- Nitrate in groundwater represents a range of ages from recent to decades old
- Benefits from management actions will manifest immediately as well as into the future



Phase 6 Watershed Model groundwater age estimates. Data from Ghopal Batt, Chesapeake Bay Program. Map modified from Jimmy Webber, USGS..

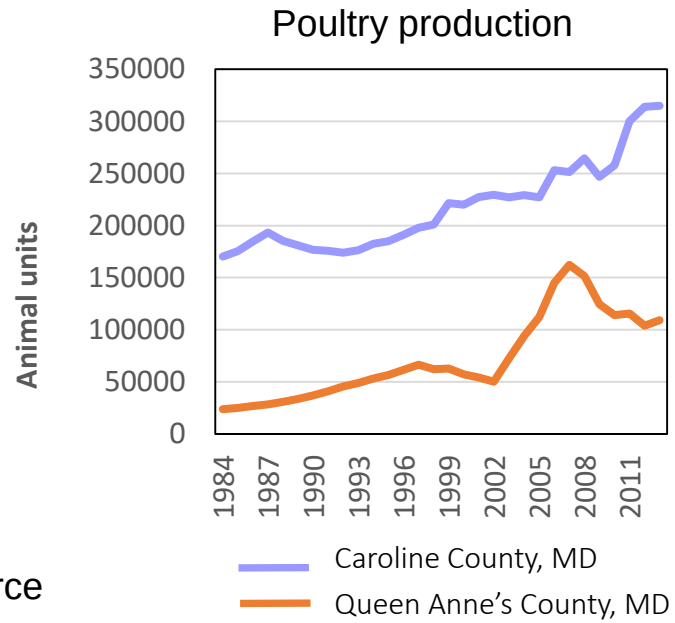
Sources, drivers, and impacts can differ over political boundaries

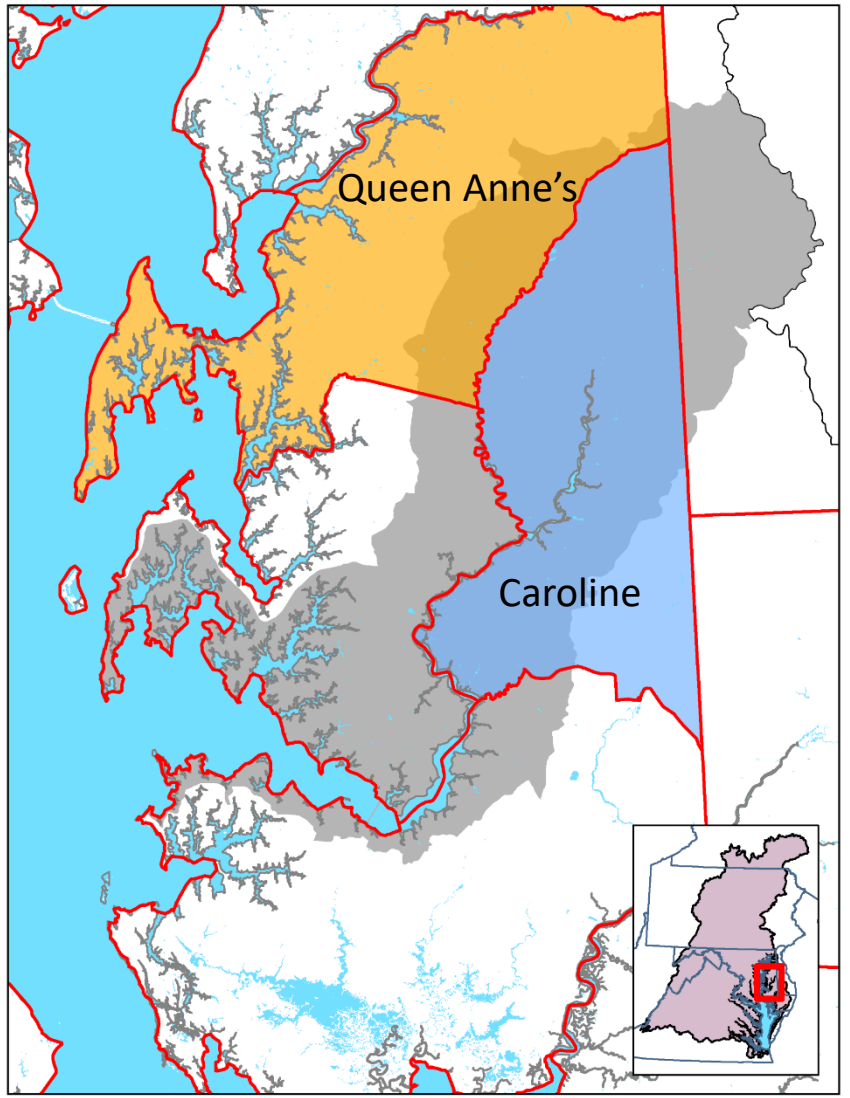


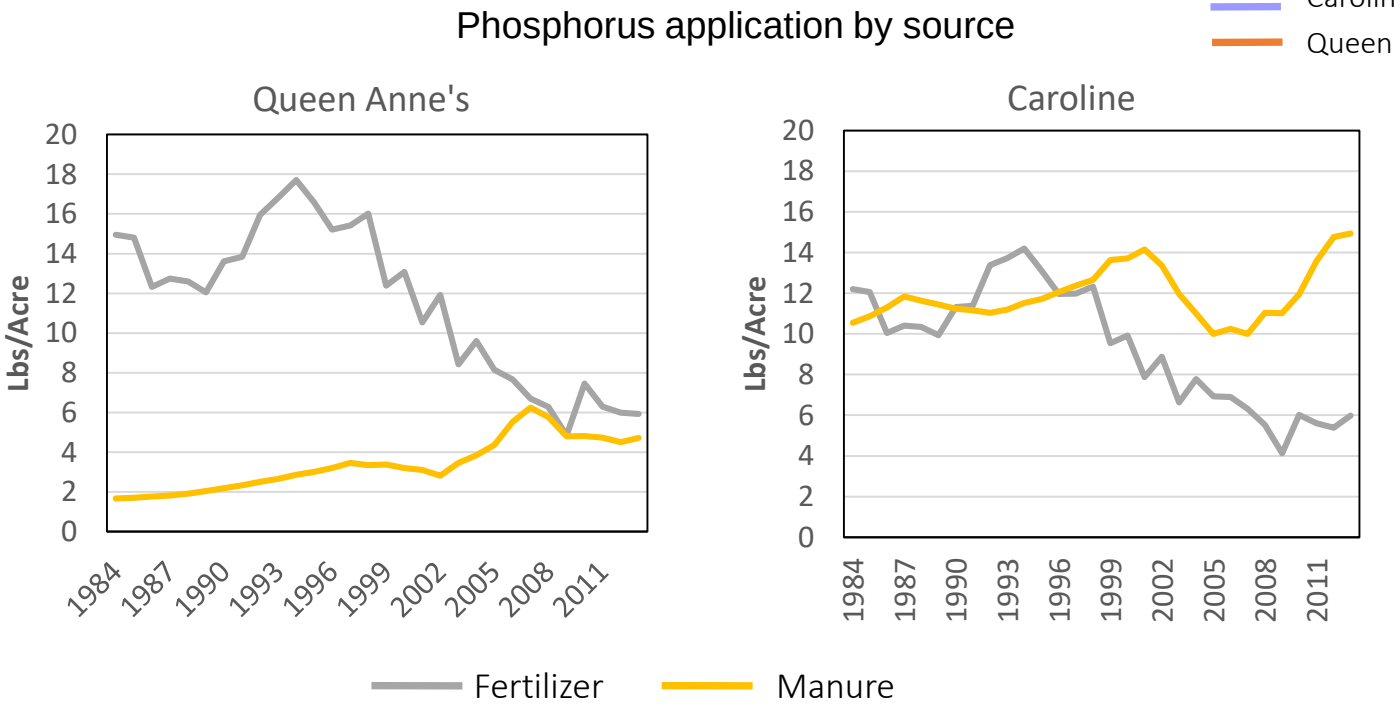
Sources, drivers, and impacts can differ between counties

Example: Queen Anne's & Caroline

- Different agricultural production
- Different application practices
- Different impact on soils & streams







Chesapeake Bay Phase 6 Program Watershed Model Calibration Inputs. http://cast.chesapeakebay.net

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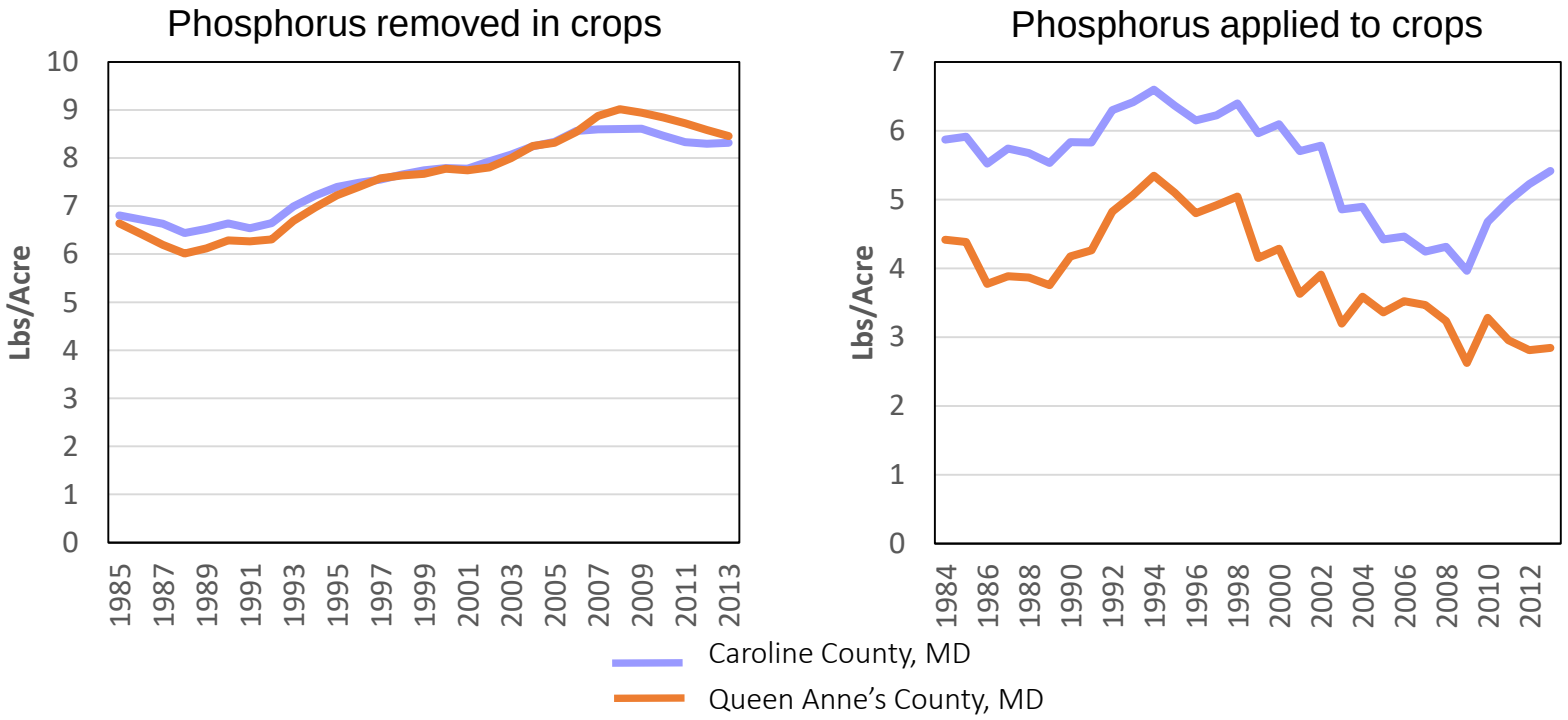

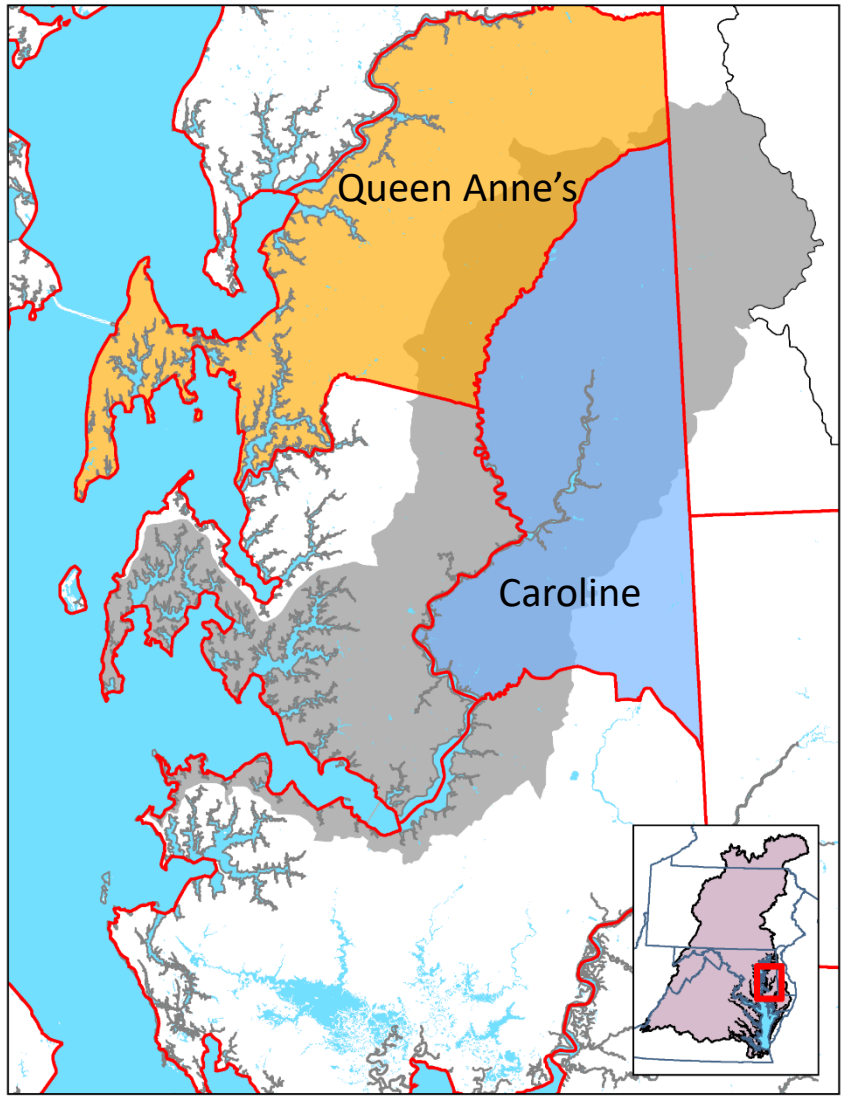

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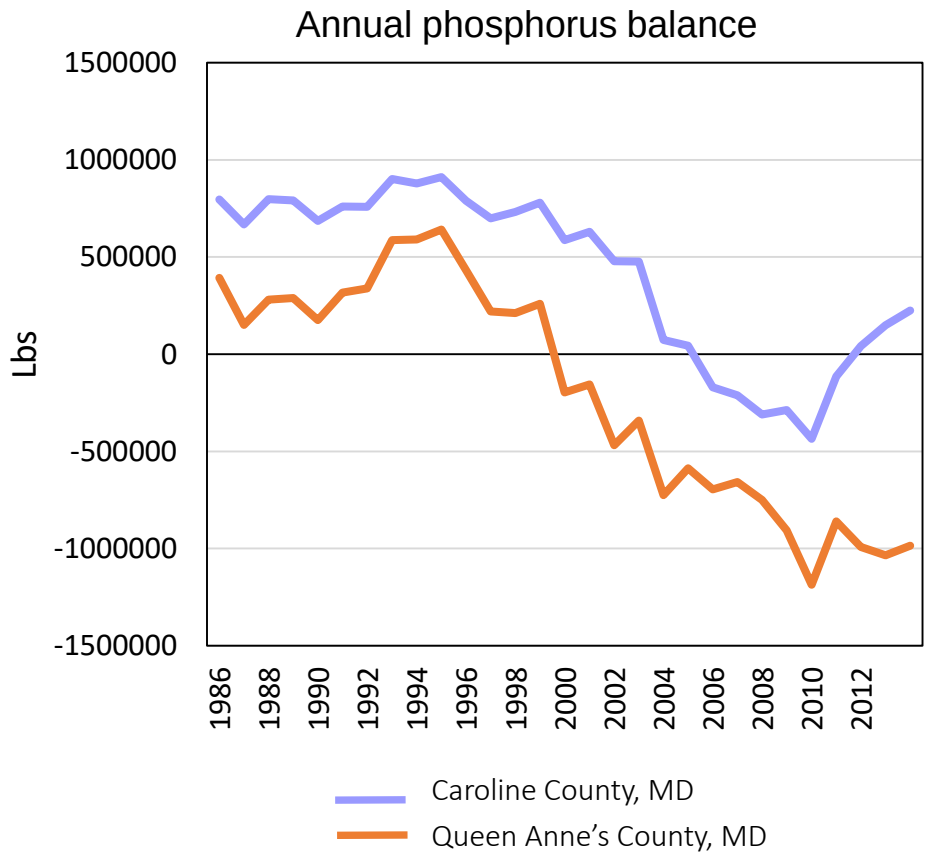

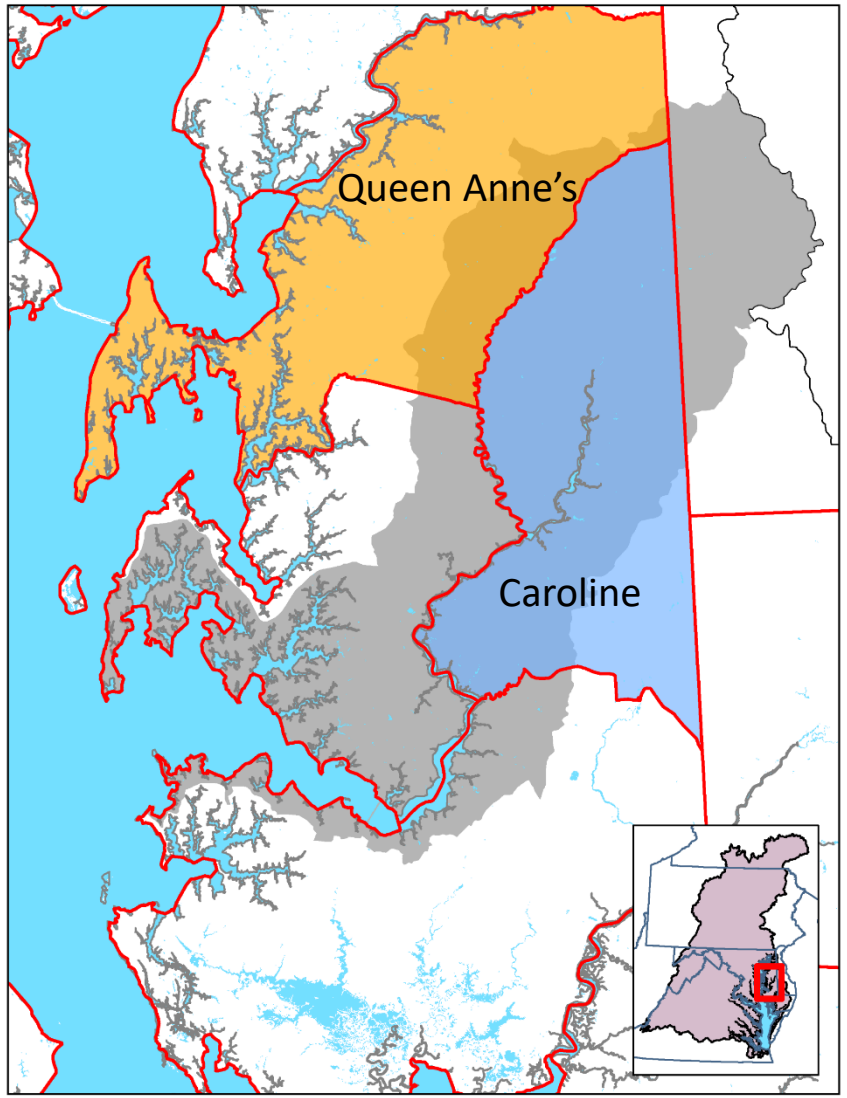

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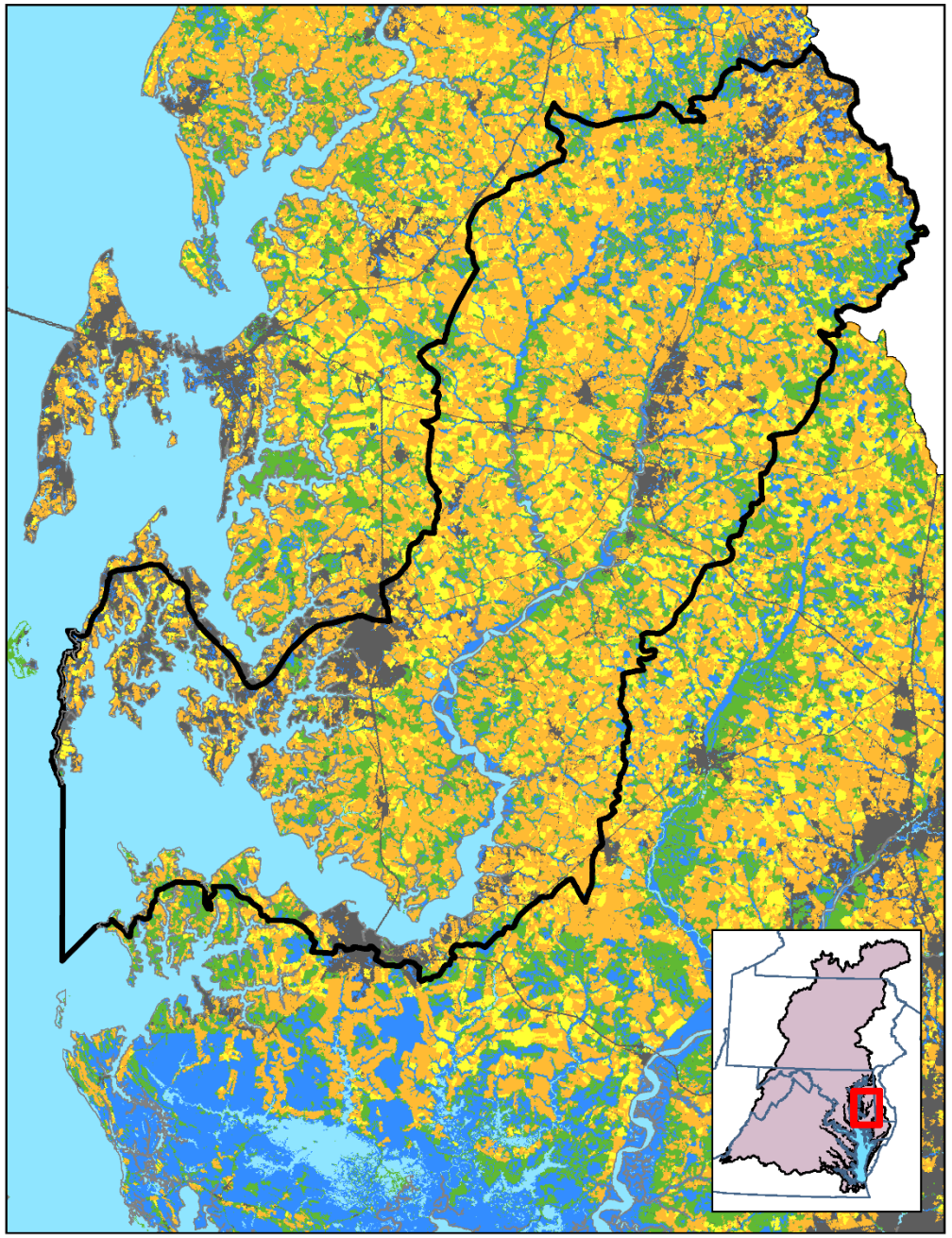
Making the management connection:

What have we done so far and what are the opportunities moving forward?

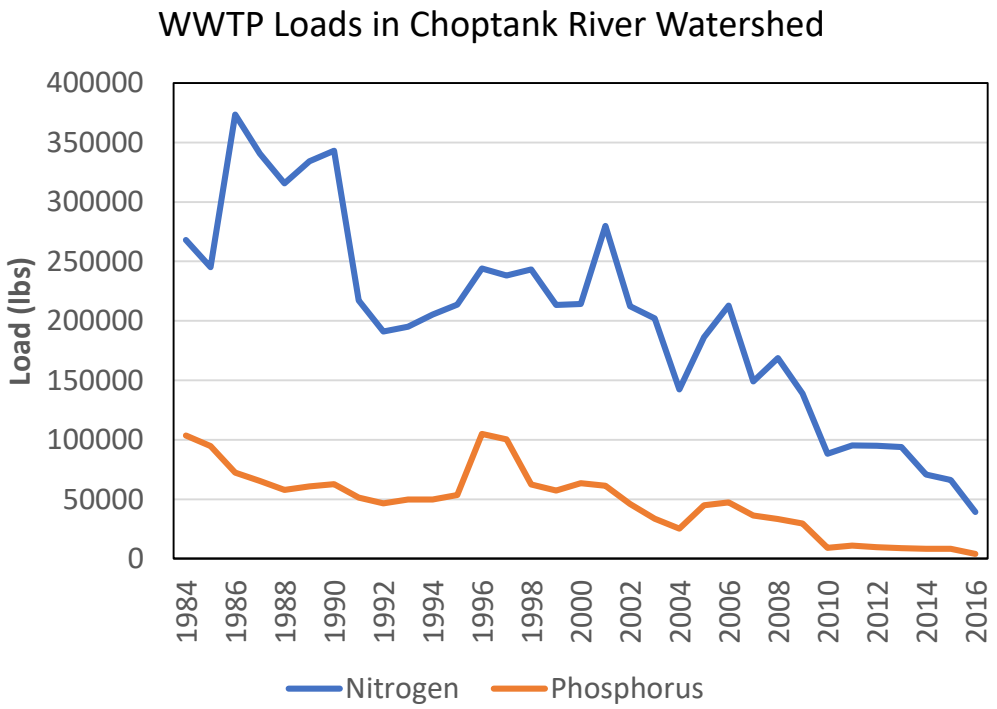


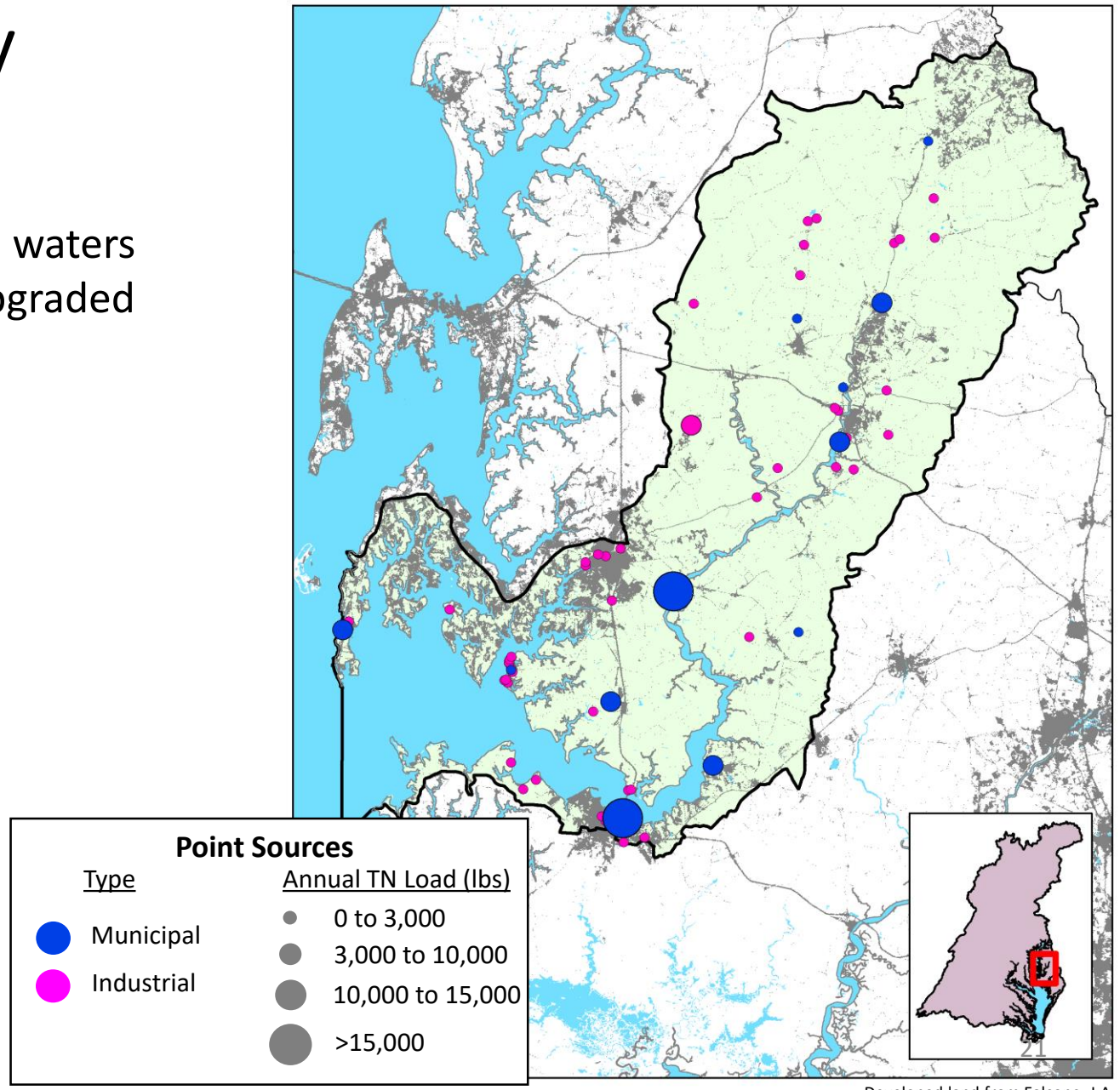
Map data from Falcone, J.A., 2015.

Agriculture is major source of nutrients and sediment, but other sectors can impact locally

Wastewater:

- Wastewater discharges impact local tidal waters
- Major WWTPs in Choptank have been upgraded





Chesapeake Bay Phase 6 Program Watershed Model.
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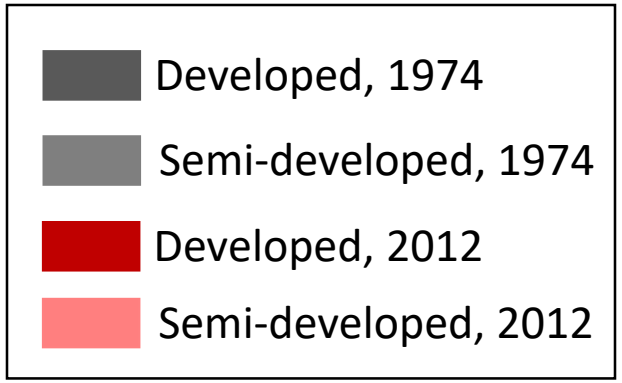
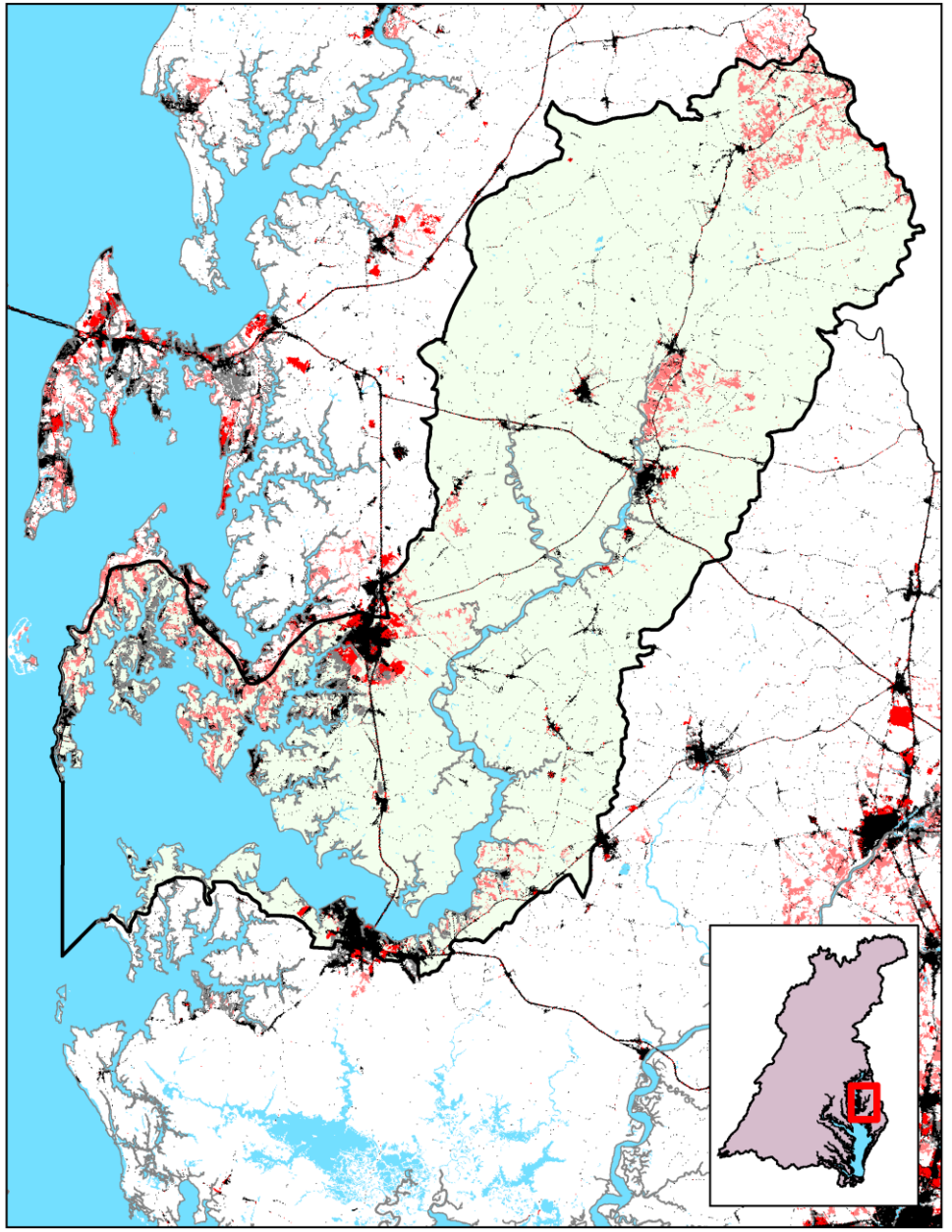
Developed land from Falcone, J.A., 2015.

Agriculture is major source of nutrients and sediment, but other sectors can impact locally

Developed:

- As development continues, implementation of stormwater practices will become increasingly important





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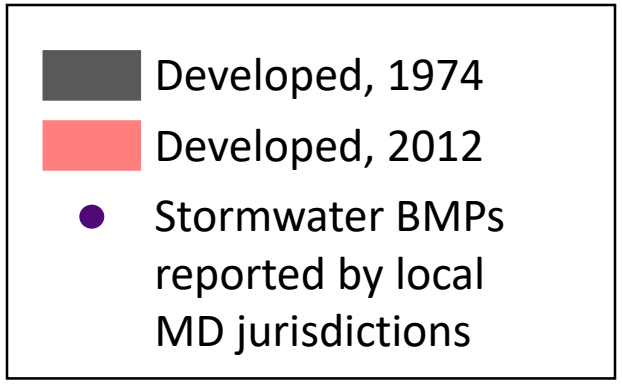
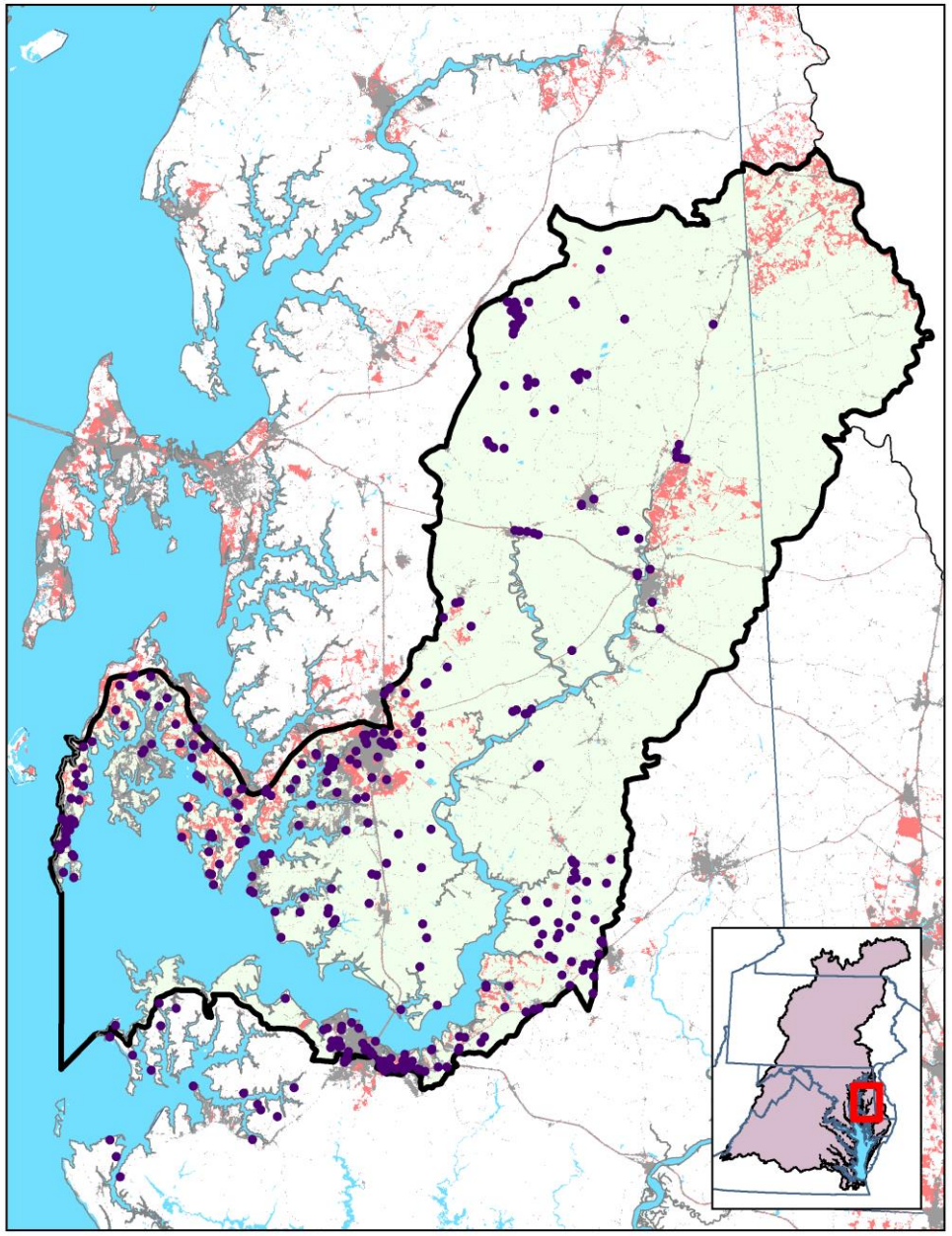
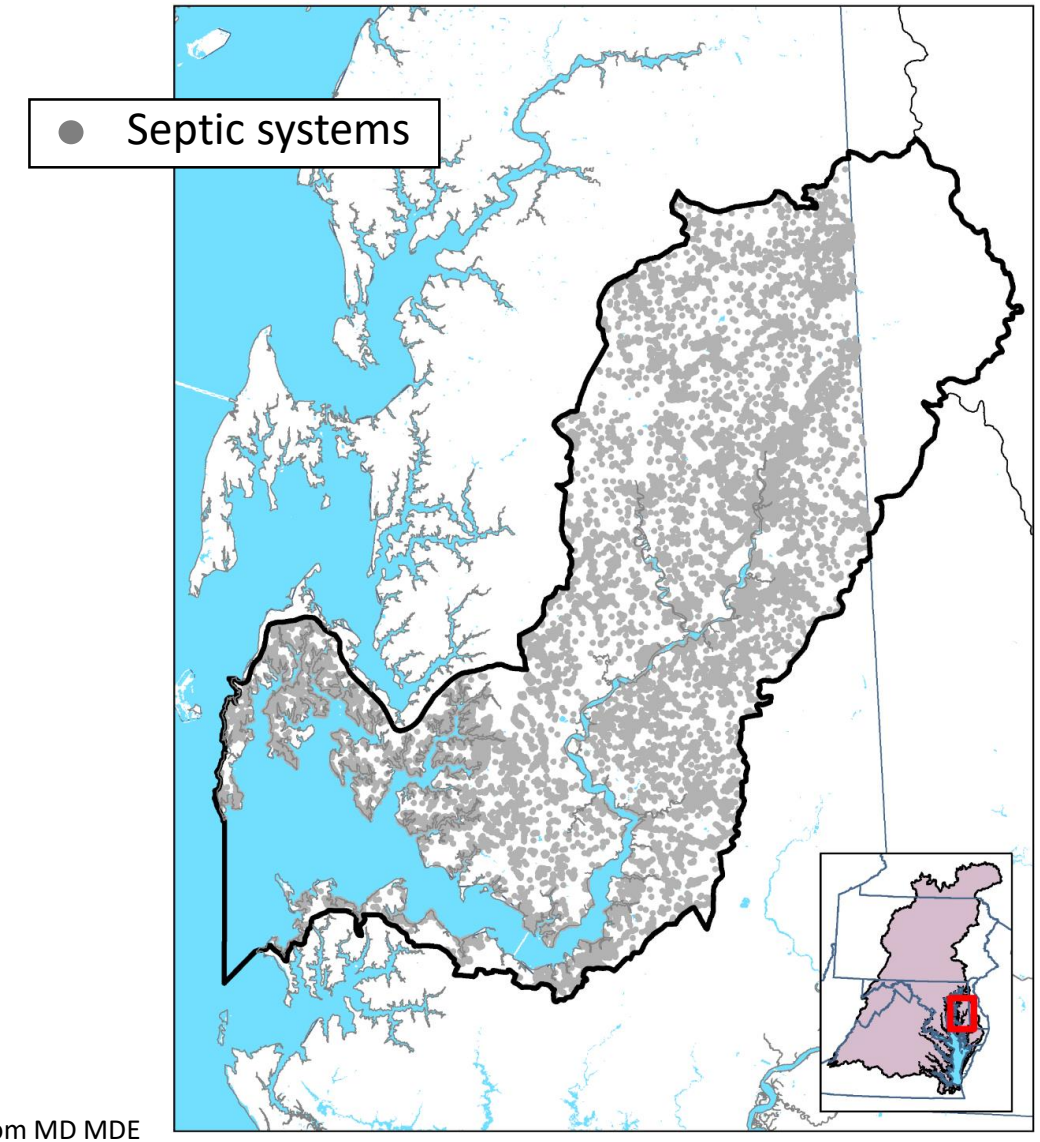


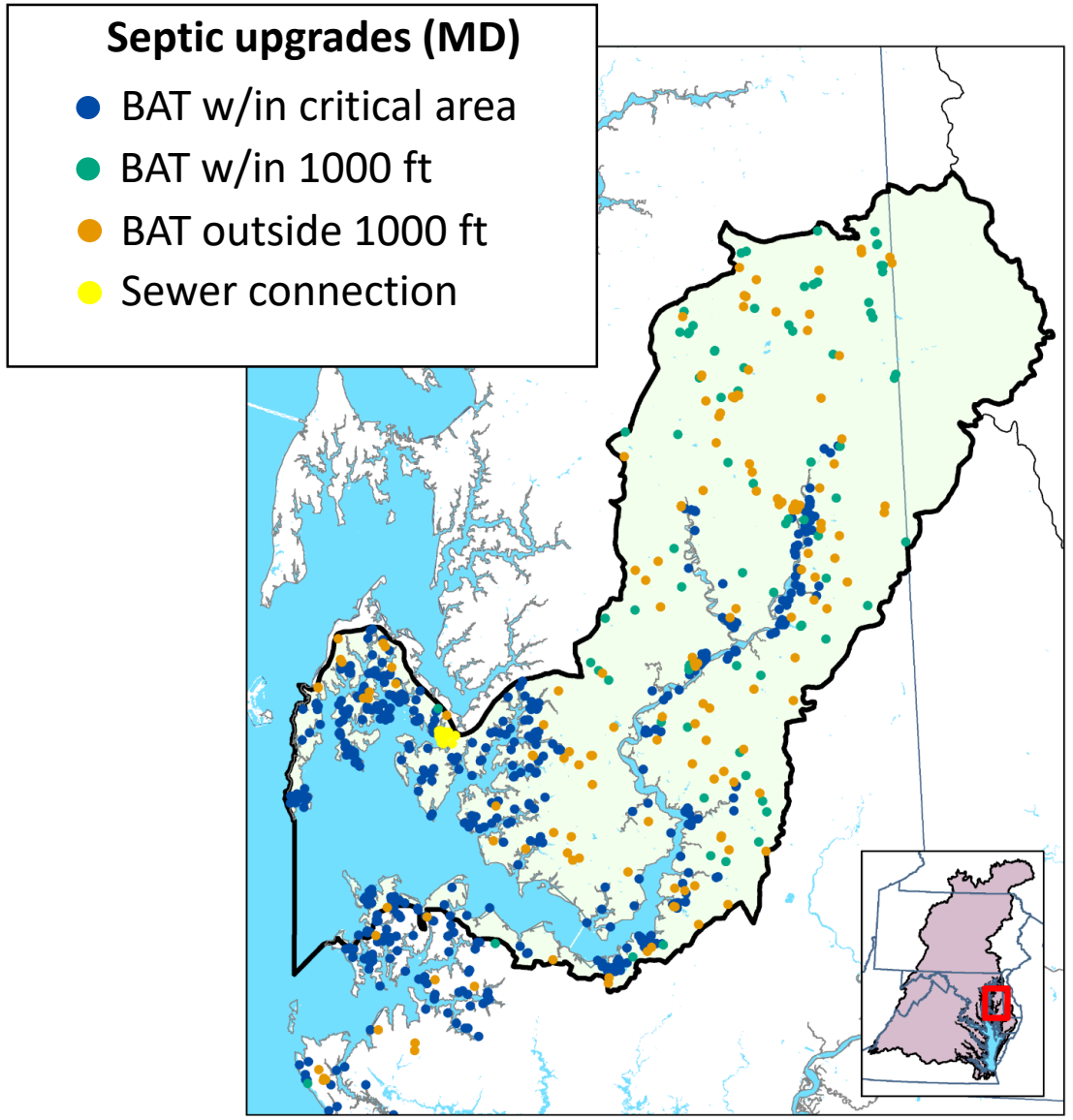


Data from Greg Sandi, MDE

Developed land from Falcone, J.A., 2015.

Agriculture is major source of nutrients and sediment, but other sectors can impact locally

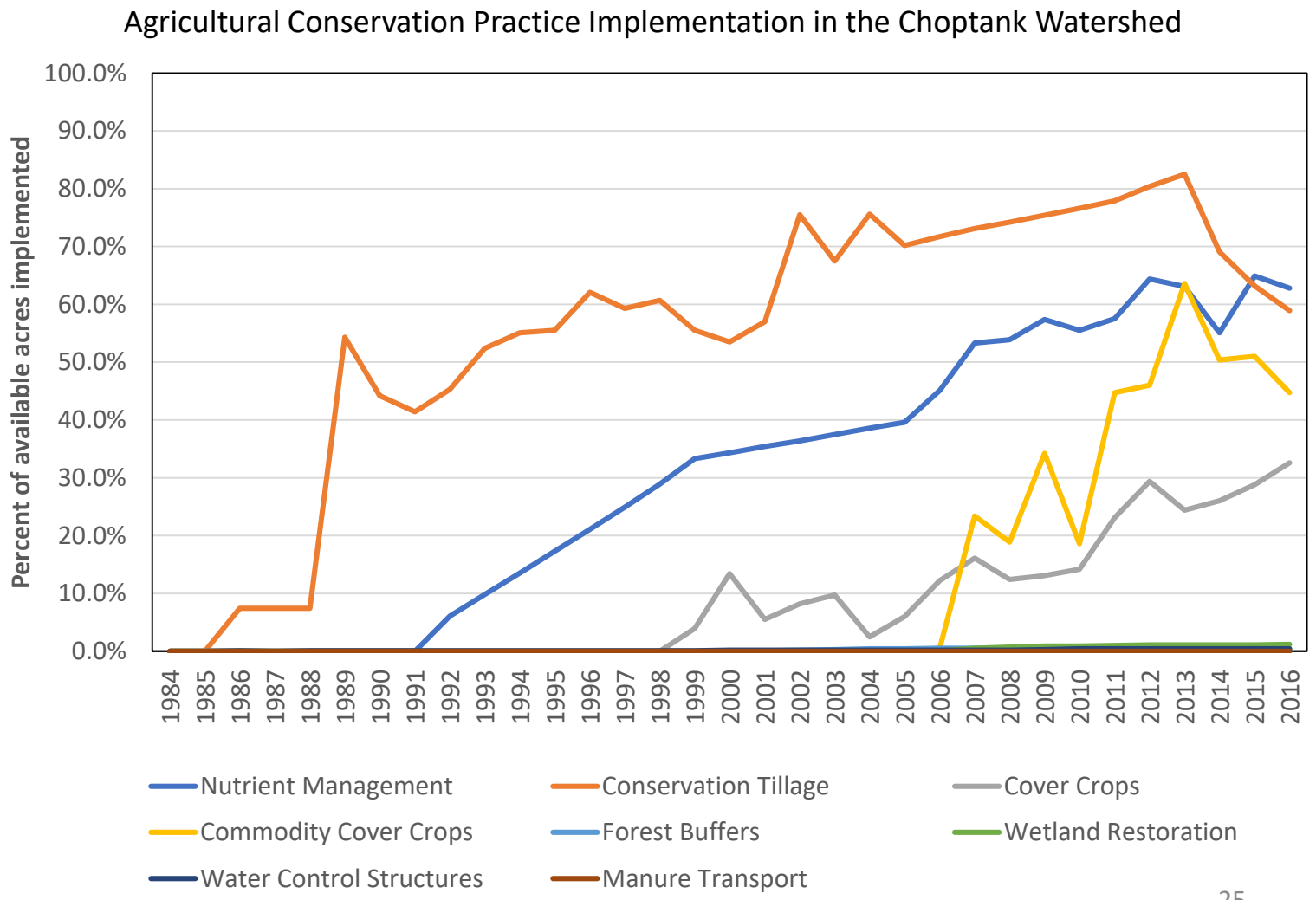




Data from MD MDE

What practices address the issues in the Choptank? Have we been implementing them?

- Conservation tillage has been the longest and most widely implemented practice
- Major issues are nitrogen in groundwater, soil phosphorus, and overland runoff of sediment and phosphorus
- Effective practices could be cover crops, forest buffers, water control structures, manure transport, wetland restoration, appropriate nutrient management



Chesapeake Bay Phase 6 Program Watershed Model. http://cast.chesapeakebay.net

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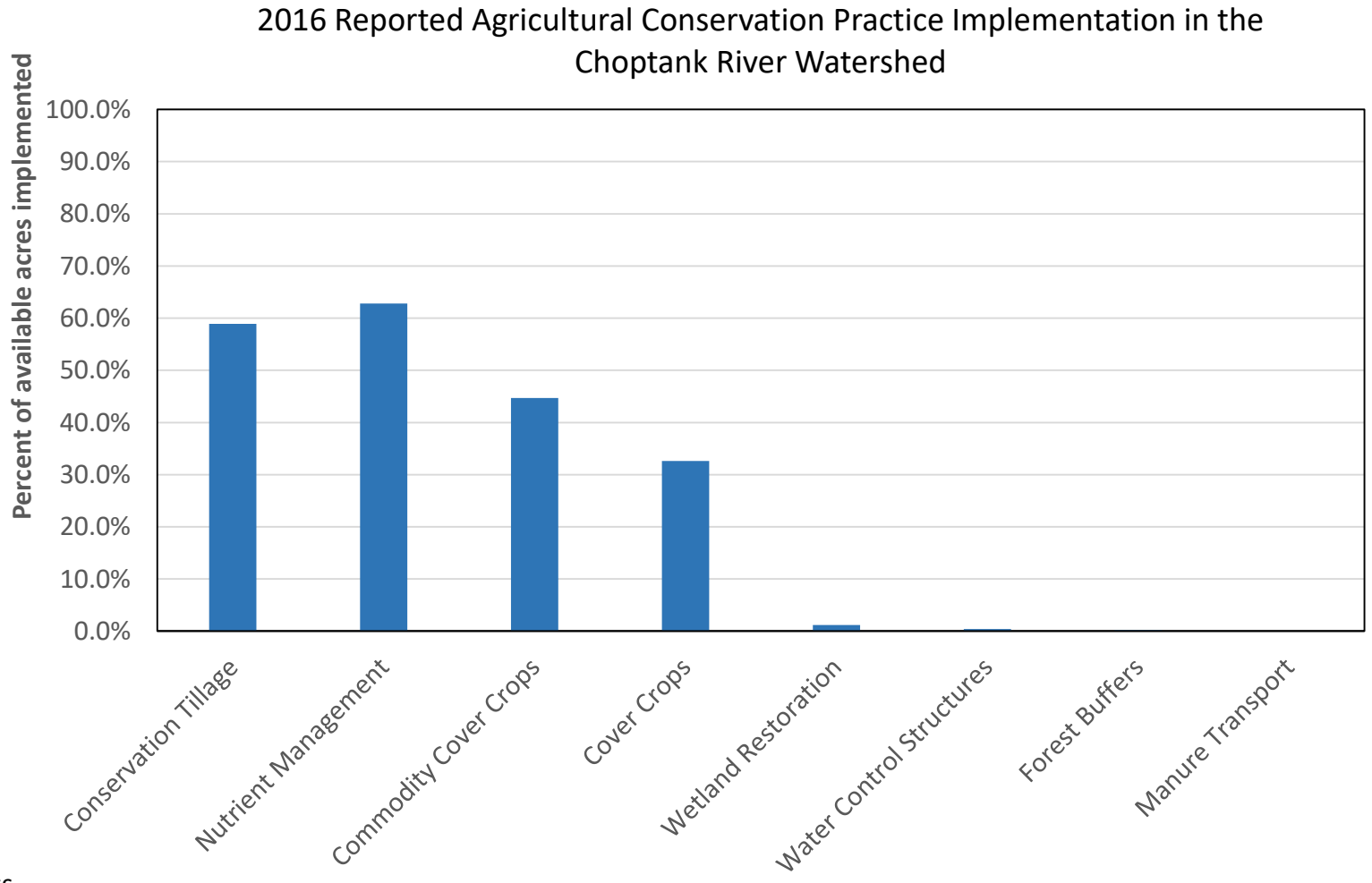

Chesapeake Bay Phase 6 Program Watershed Model Draft 2016 Progress. http://cast.chesapeakebay.net

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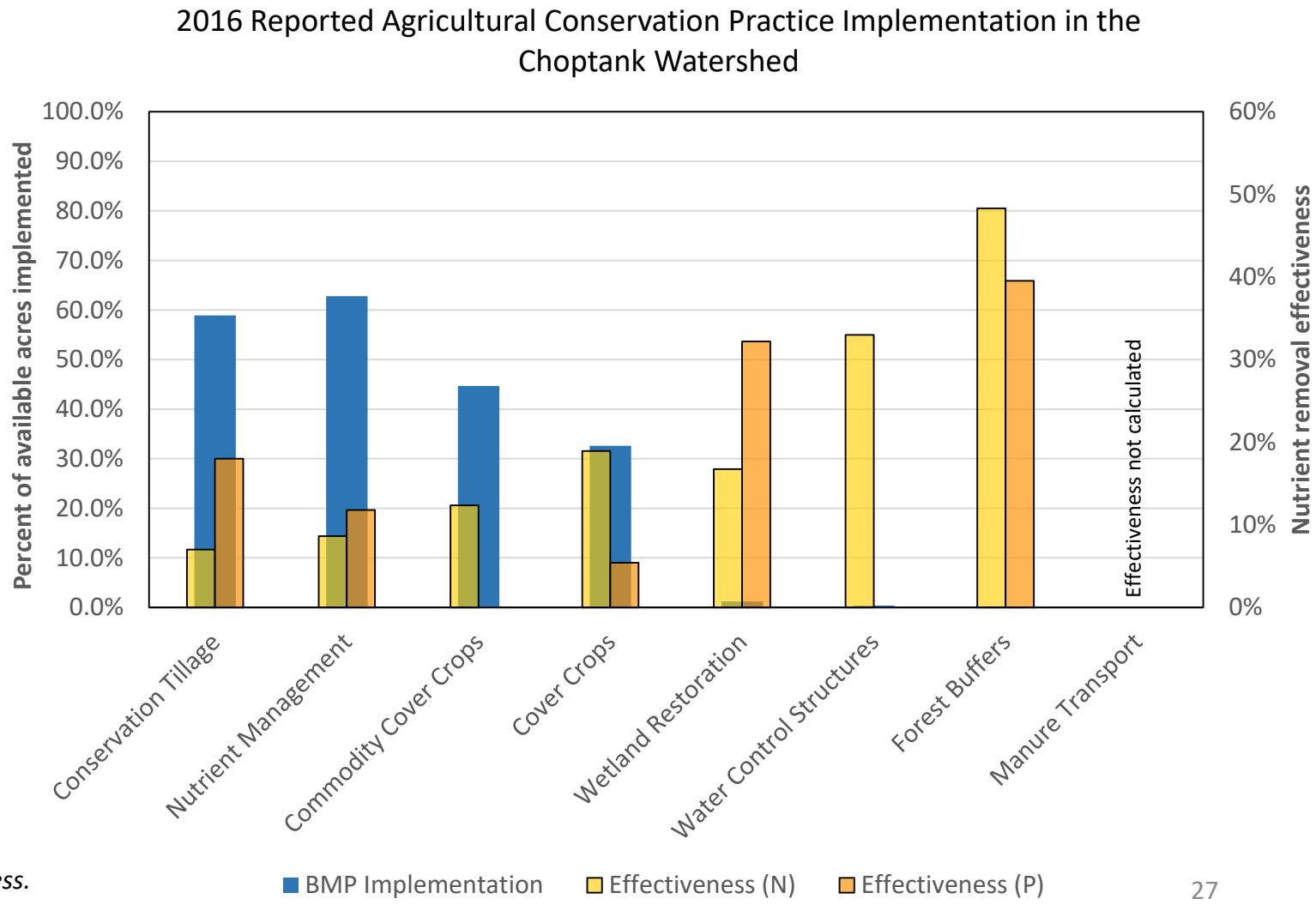
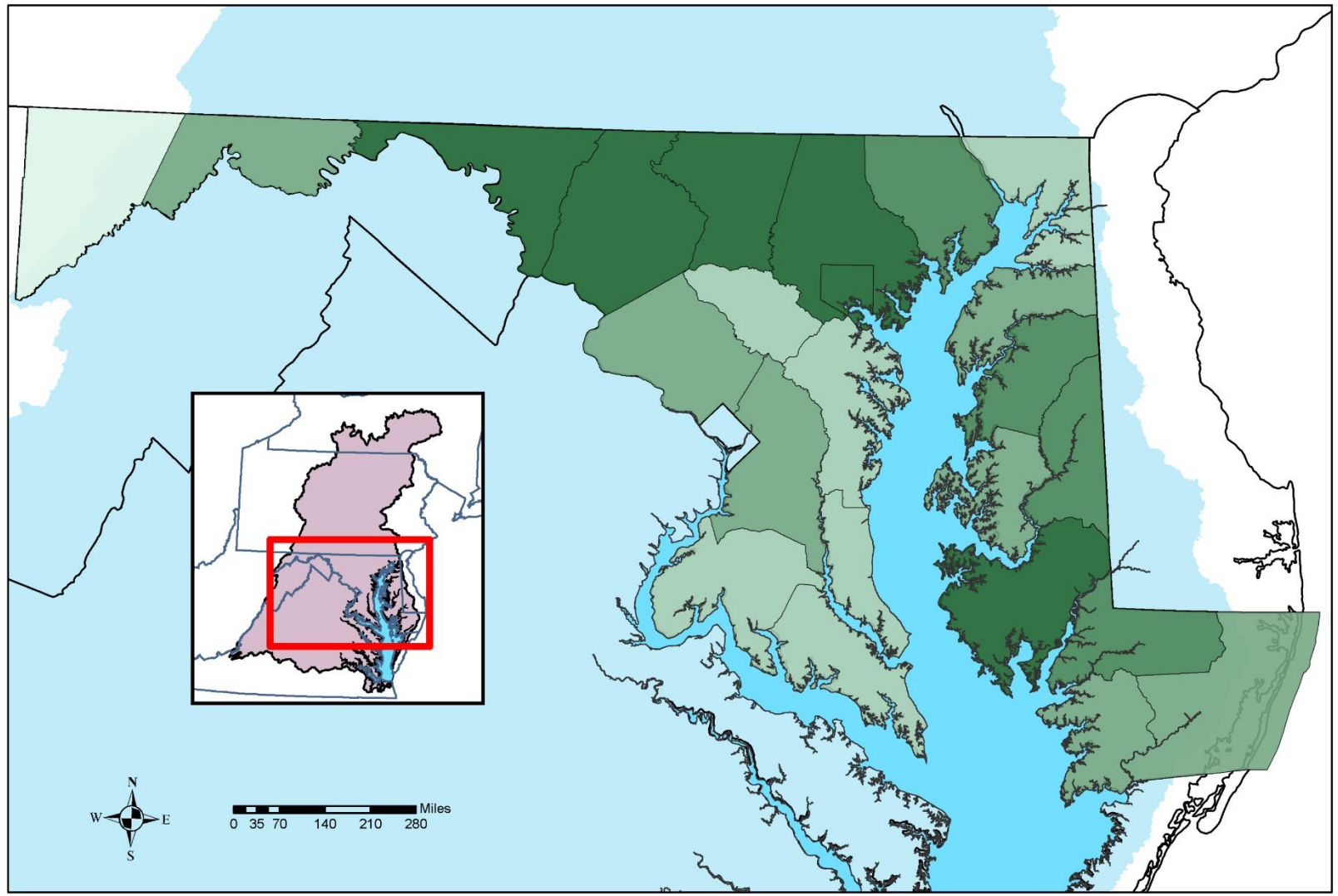


Chesapeake Bay Phase 6 Program Watershed Model Draft 2016 Progress. http://cast.chesapeakebay.net

The low hanging fruit isn't all gone!

- Opportunities exist to focus restoration efforts geographically and by the most cost-effective practices

Acres available for grass or forest buffer implementation



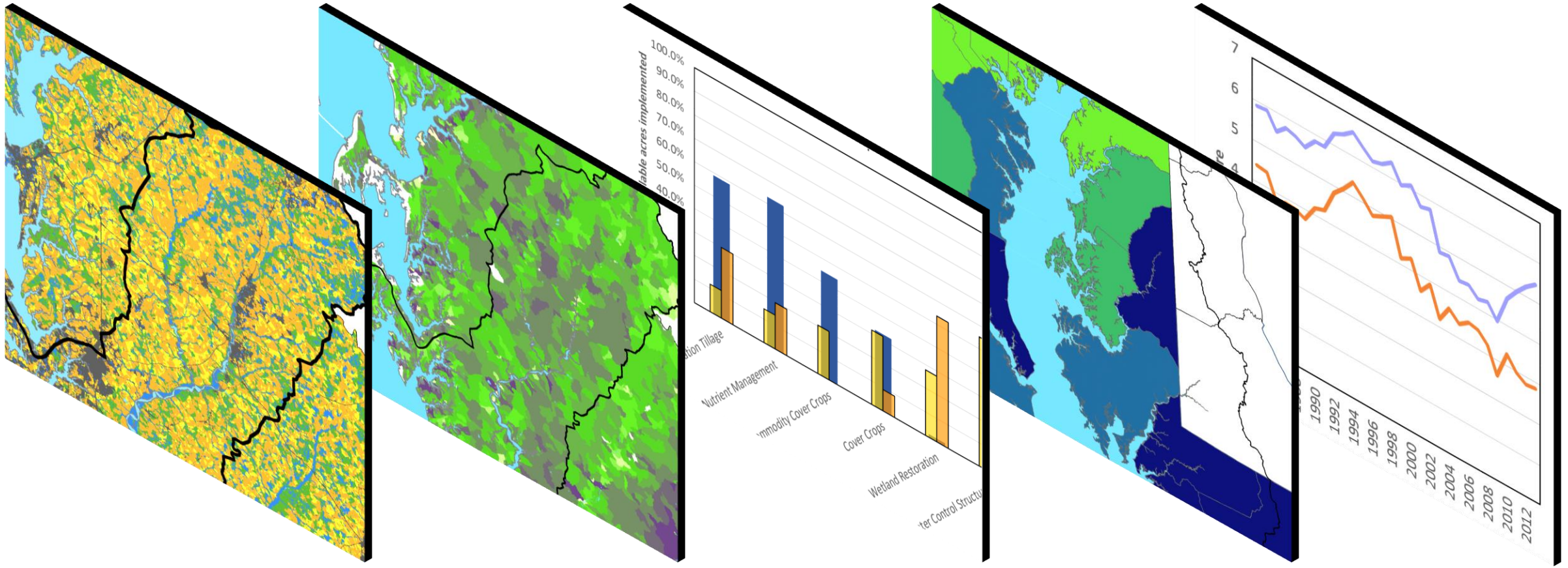
Acres available for buffer implementation

Fewer acres

More acres

Data from Lindsey Gordon, CRC CBP

Integrating information to tell a story



Telling a story

Local water quality

What's happening with local water quality in my area? What's the status? What are the trends?

Sources and drivers behind local water quality

Where does pollution come from?
Where geographically?
How is pollution getting onto the landscape?
How is pollution making it to streams?

Effective management practices

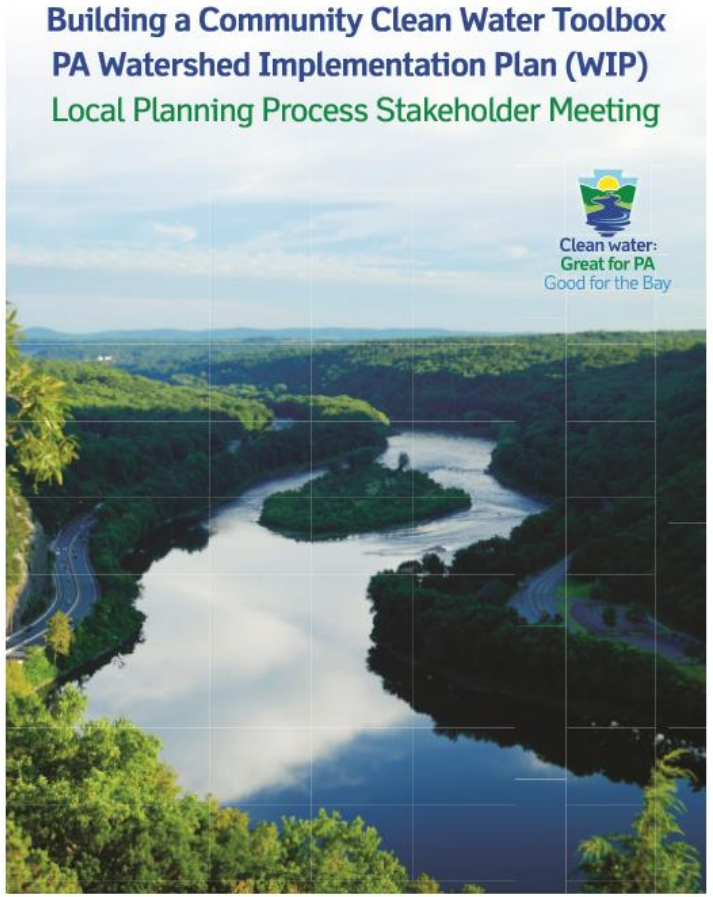
What practices address the sources and drivers?
What are the most effective practices?
What are the most cost-effective practices?

Opportunities for restoration efforts

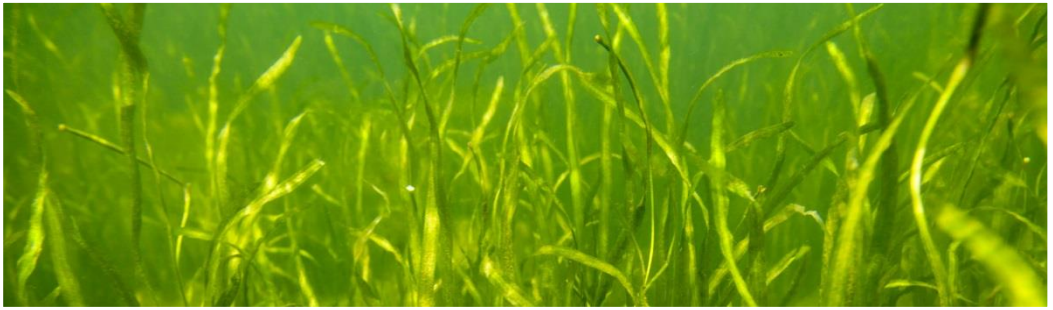
Where are the most effective places to focus efforts?
What practices have been implemented and to what extent?
Do they address the sources and drivers?
Are they the most effective?
Where do opportunities for implementation exist?

We are currently working with the jurisdictions and local partners to incorporate this information into their planning efforts…

- Example: Pennsylvania – using storyline concept to develop county “toolboxes” and provide information to local areas
- Example: WIP Dashboard – building online tools that consolidate information into one place and provide guidance on using it
- Example: LGAC – working with local stakeholders on disseminating storylines and getting feedback



Source: PADEP



Emily Trentacoste

trentacoste.emily@epa.gov

410-267-5797