



# Chesapeake Bay Restoration

## Evaluating an Improved Systems Approach to Crediting: Consideration of Wetland Ecosystem Services

Jeff Sweeney

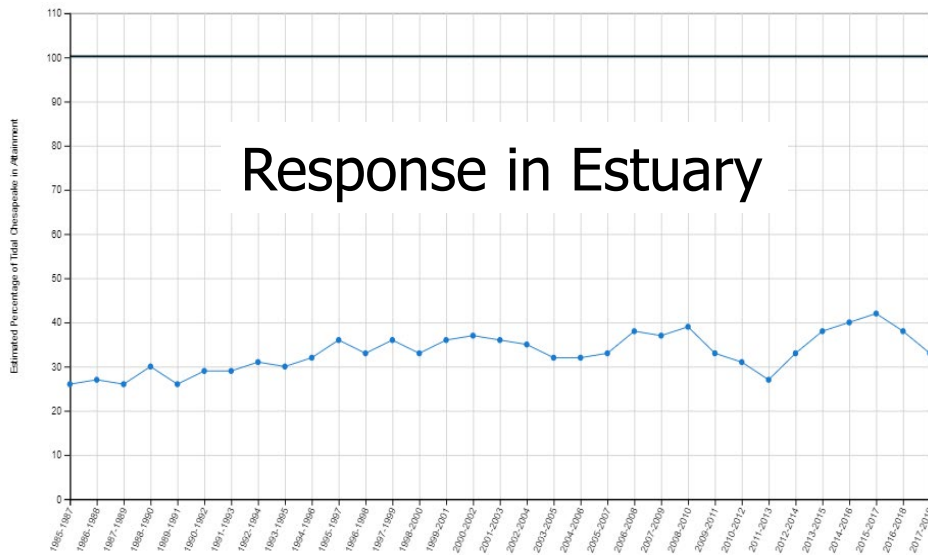
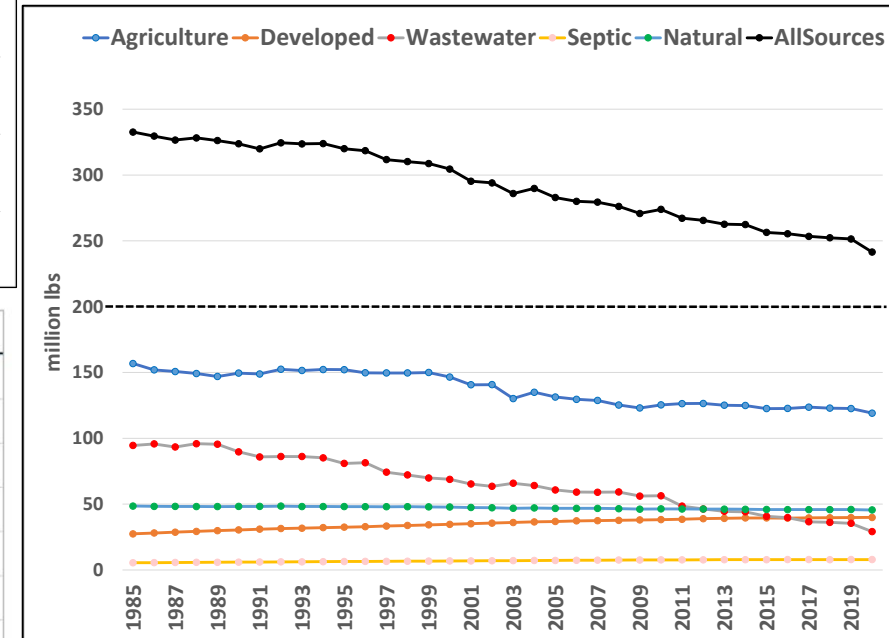
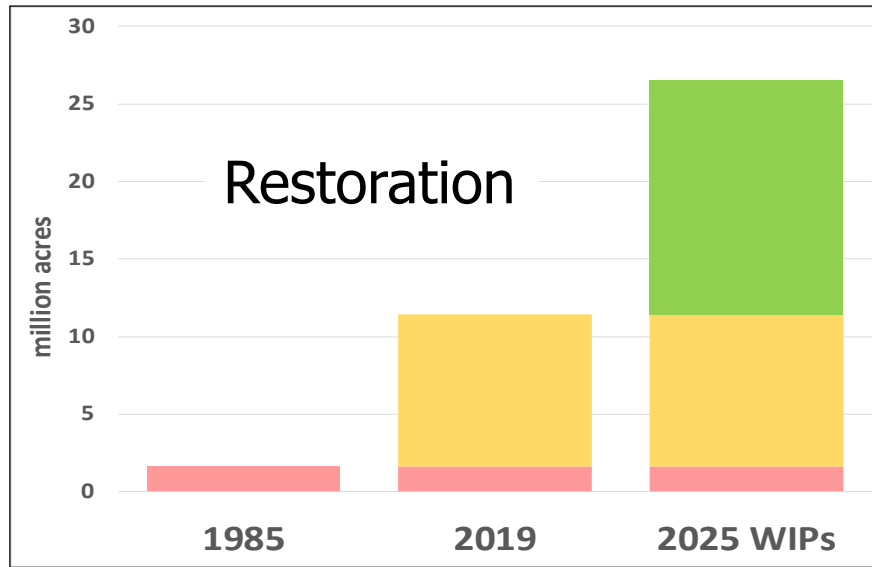
EPA, Chesapeake Bay Program Office

CBP STAC Workshop

March 22, 2022



# TMDL Accounting

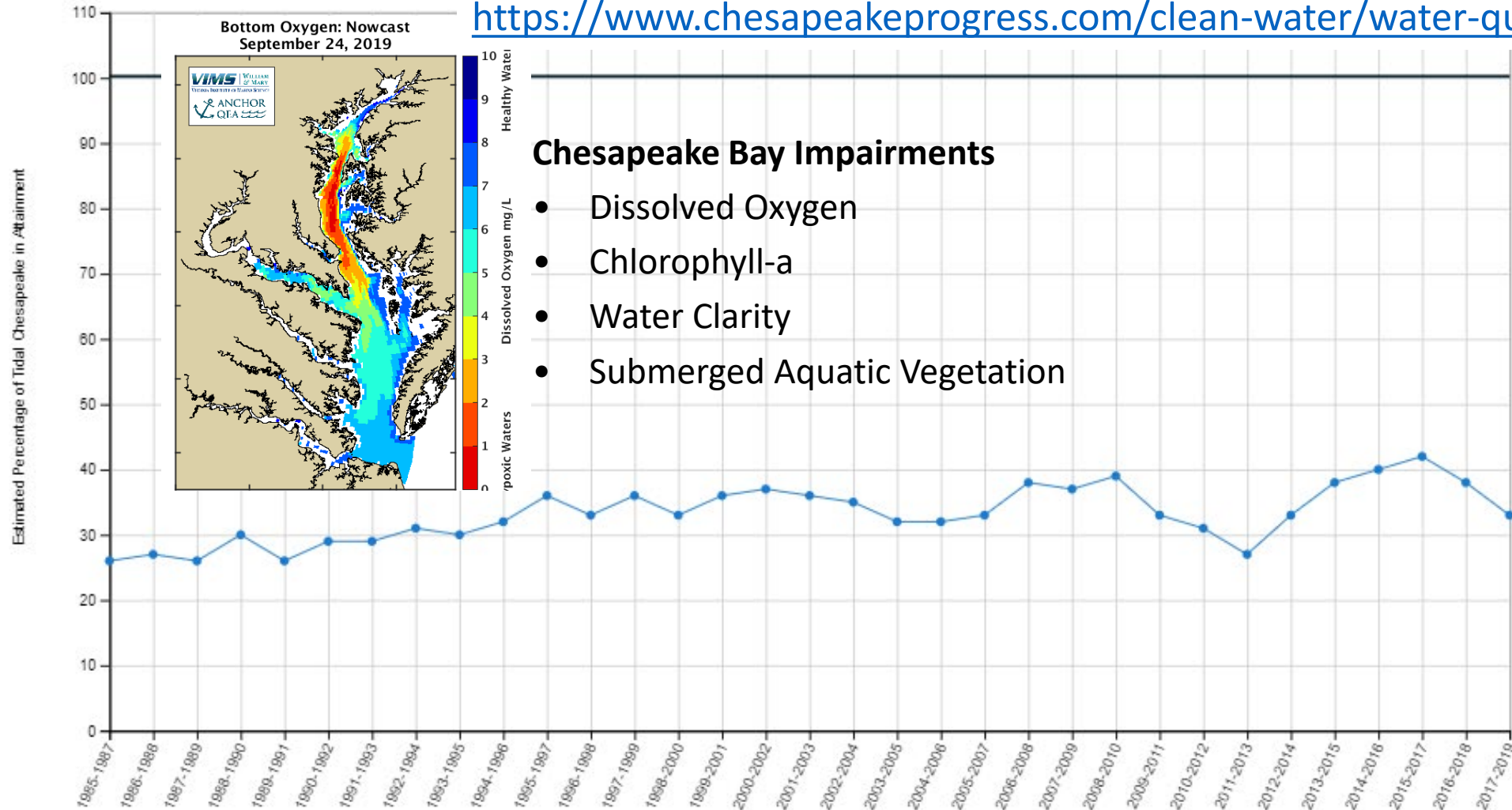




# TMDL Accounting: Tidal Water Monitoring

**Water Quality Standards Attainment (1985–2019)** During the 2017 to 2019 assessment period, an estimated 33% of bay tidal waters are in attainment.

<https://www.chesapeakeprogress.com/clean-water/water-quality>

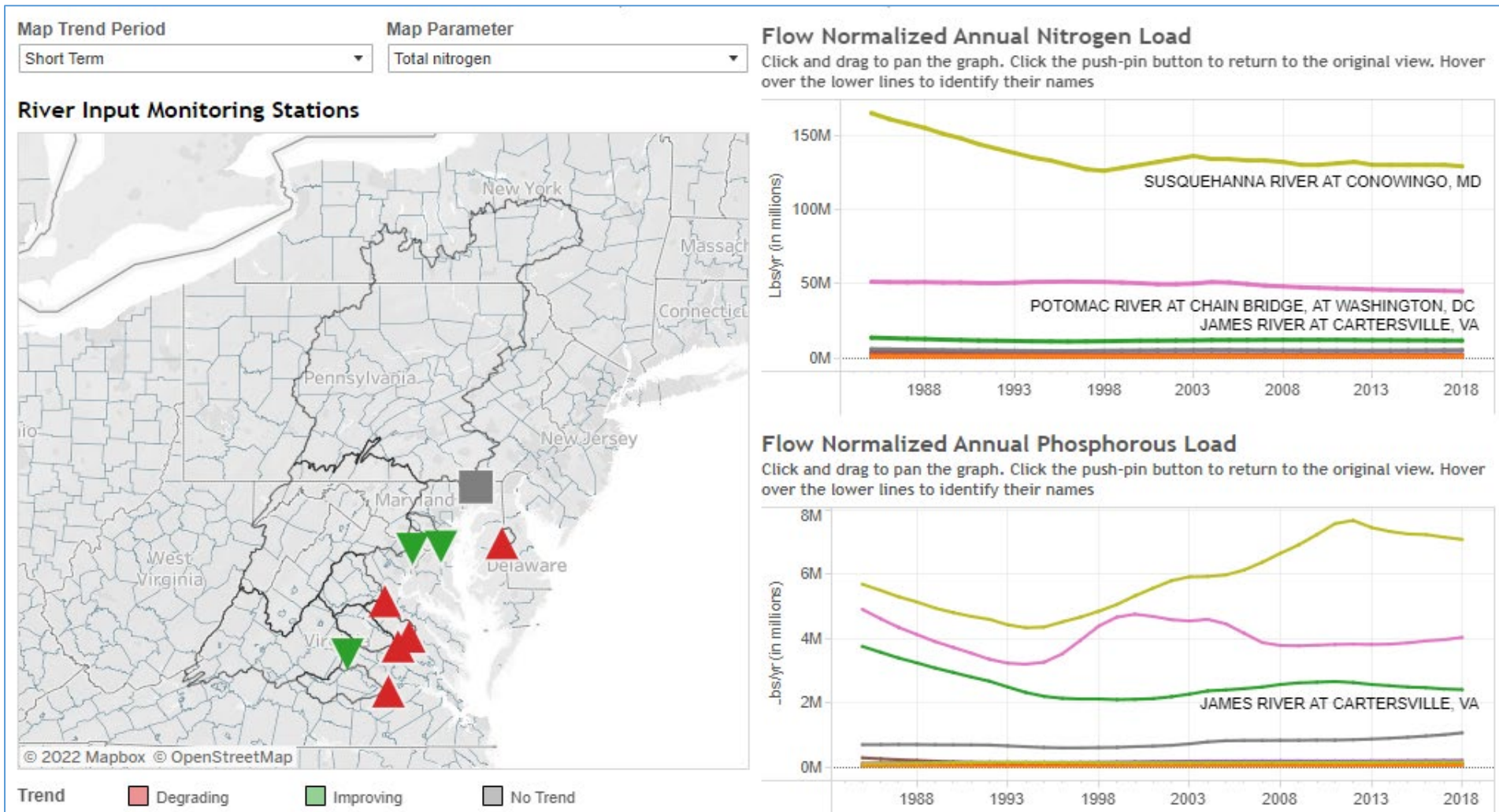




# TMDL Accounting: Non-Tidal Monitoring

## River Load Contributions to Tidal Waters (1985–2018) + >100 Other Stations

<http://gis.chesapeakebay.net/wip/dashboard/>



### Short-term Flow-Normalized Annual Nitrogen Load

- Susquehanna – no trend
- Potomac – improving
- James – improving
- Rappahannock – degrading
- Pamunkey – degrading
- Patuxent – improving
- Mattaponi – degrading
- Appomattox – degrading
- Choptank – degrading



# TMDL Accounting: Programmatic Evaluations

<https://www.epa.gov/chesapeake-bay-tmdl>



**What is the Bay TMDL?**



**Implementing the TMDL**

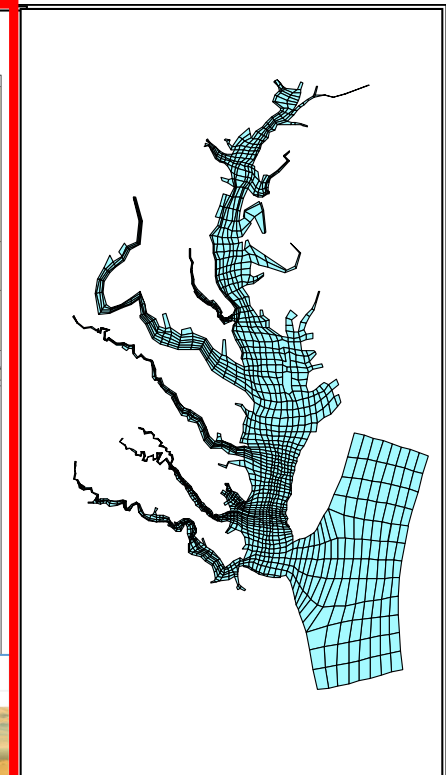
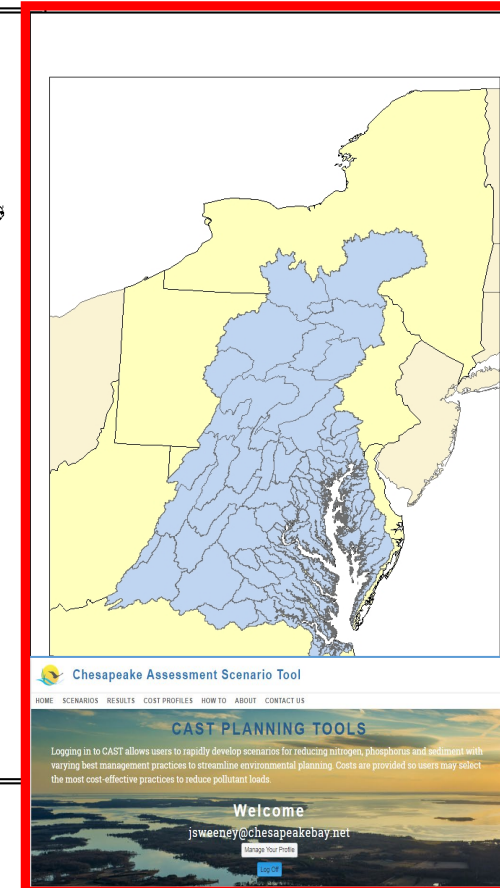
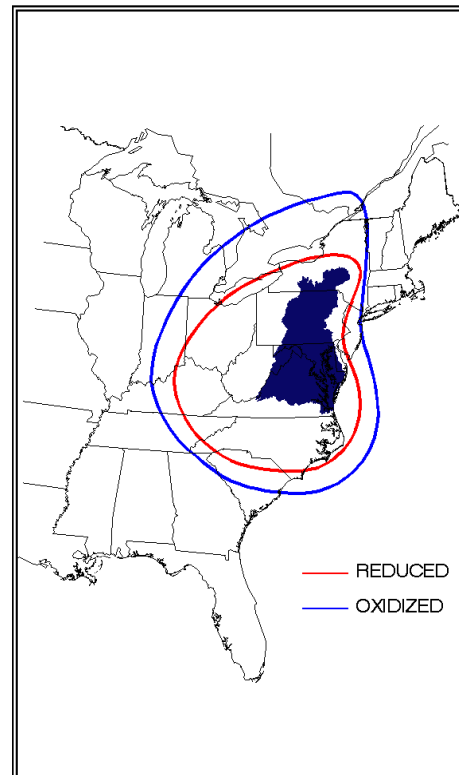


**Progress in the Watershed**



# TMDL Accounting: BMPs and Modeled Loads

- Partnership's Chesapeake Bay Models set TMDL allocations that would meet water quality standards;
- The CBP Watershed model is used, in part, to develop WIPs and 2-year Milestones
- The Watershed Model estimates progress toward loading and BMP goals annually





# CAST = Chesapeake Assessment Scenario Tool

The screenshot shows the CAST website homepage. At the top left is the logo. Below it is a navigation menu with links: HOME, SCENARIOS, RESULTS, COST PROFILES, HOW TO, ABOUT, CONTACT US. The main heading is "CAST PLANNING TOOLS". Below this is a paragraph: "Logging in to CAST allows users to rapidly develop scenarios for reducing nitrogen, phosphorus and sediment with varying best management practices to streamline environmental planning. Costs are provided so users may select the most cost-effective practices to reduce pollutant loads." Below the paragraph is a "Welcome" message. Underneath is a "RESOURCES" section with six cards:

- MODEL DOCUMENTATION**: Find information about the Phase 6 model, its documentation and links to calibration data, model review webinars and files. Button: Learn More
- DEVELOP A PLAN**: Get answers to your questions about how to use CAST to develop a plan. Button: Develop A Plan
- SOURCE DATA**: Download data tables including information on load sources and agencies, BMPs, animals, geographic references and delivery factors. Button: View Source Data
- RIVER TRENDS**: Scientists calculate flow-adjusted trends in nitrogen, phosphorus and sediment levels to better determine whether pollution has changed over time. Button: View Trends
- MAP TOOLS, BMPs & VERIFICATION**: View Geographical Information and Shapefiles, BMPs and Verification information. Button: Learn More
- TRACK TMDL PROGRESS**: Information on how to submit progress data via NEIEN and view implementation data on meeting the Chesapeake Bay TMDL. Button: Track TMDL Progress

- The complex becomes simple with CAST  
<https://cast.chesapeakebay.net/>
- Users select a geographic area, add and remove implementation, and get estimated nutrient & sediment reductions + costs in minutes.



# Where do the models get their information?

## The inputs to the model are numerous

- Manure nutrients, animal populations (12 categories)
- Nutrients from chemical fertilizers (AAPFCO)
- Soils, plant uptake, fixation
- Land uses (50 categories, 17 agricultural)
- Waste treatment facilities + septic
- Atmospheric deposition from CB airshed
- Precipitation, meteorological, elevation data
- Best Management Practices







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Wetlands





# Best Management Practices

- 300+ unique practice names available for reporting progress and for devising cost-effective implementation plans – across all sectors
  - Agriculture
  - Developed lands
  - Wastewater
  - Septic
  - Natural = forestry, oyster restoration, stream restoration, shoreline erosion controls





# Best Management Practices

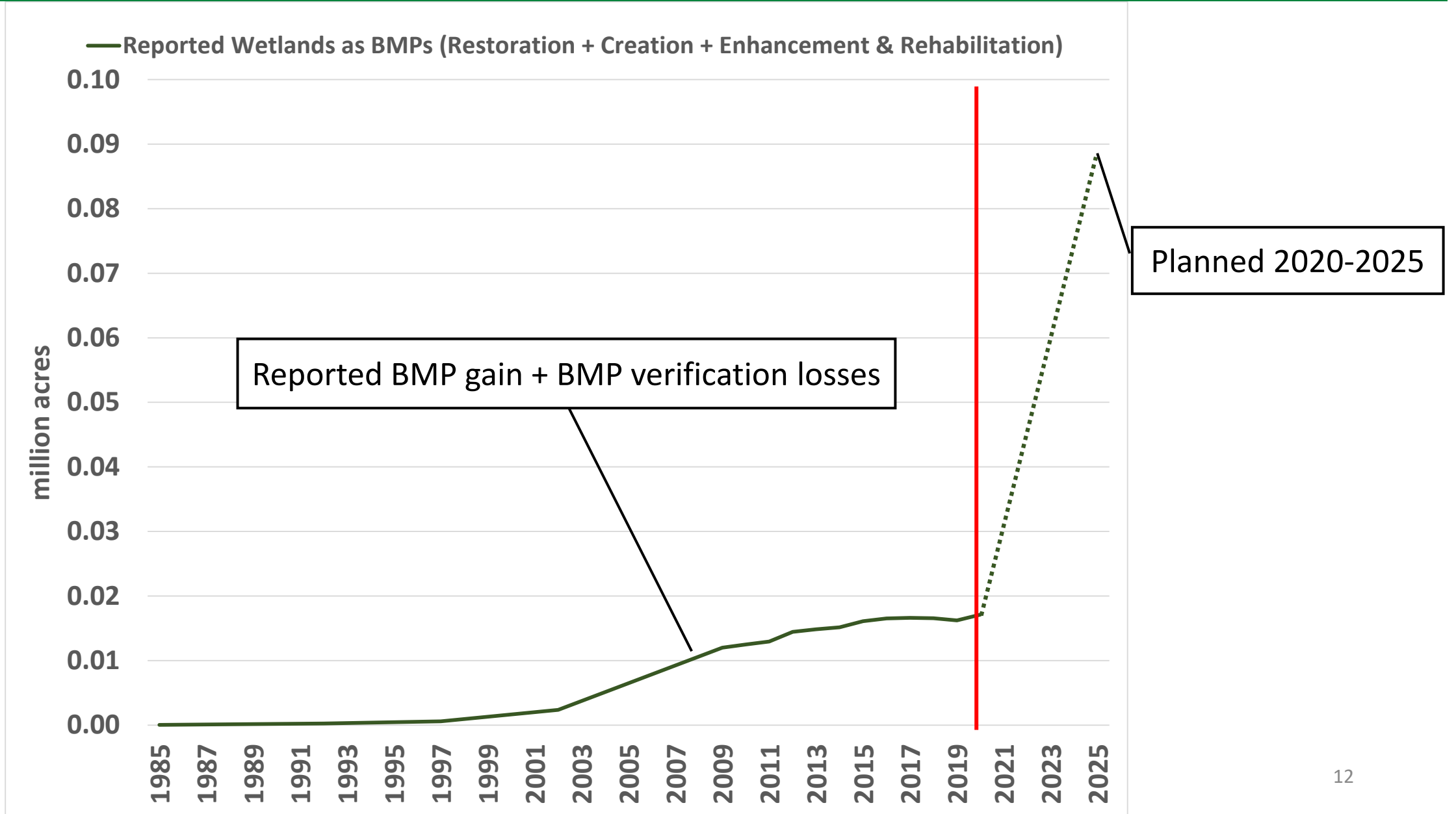
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Wetlands



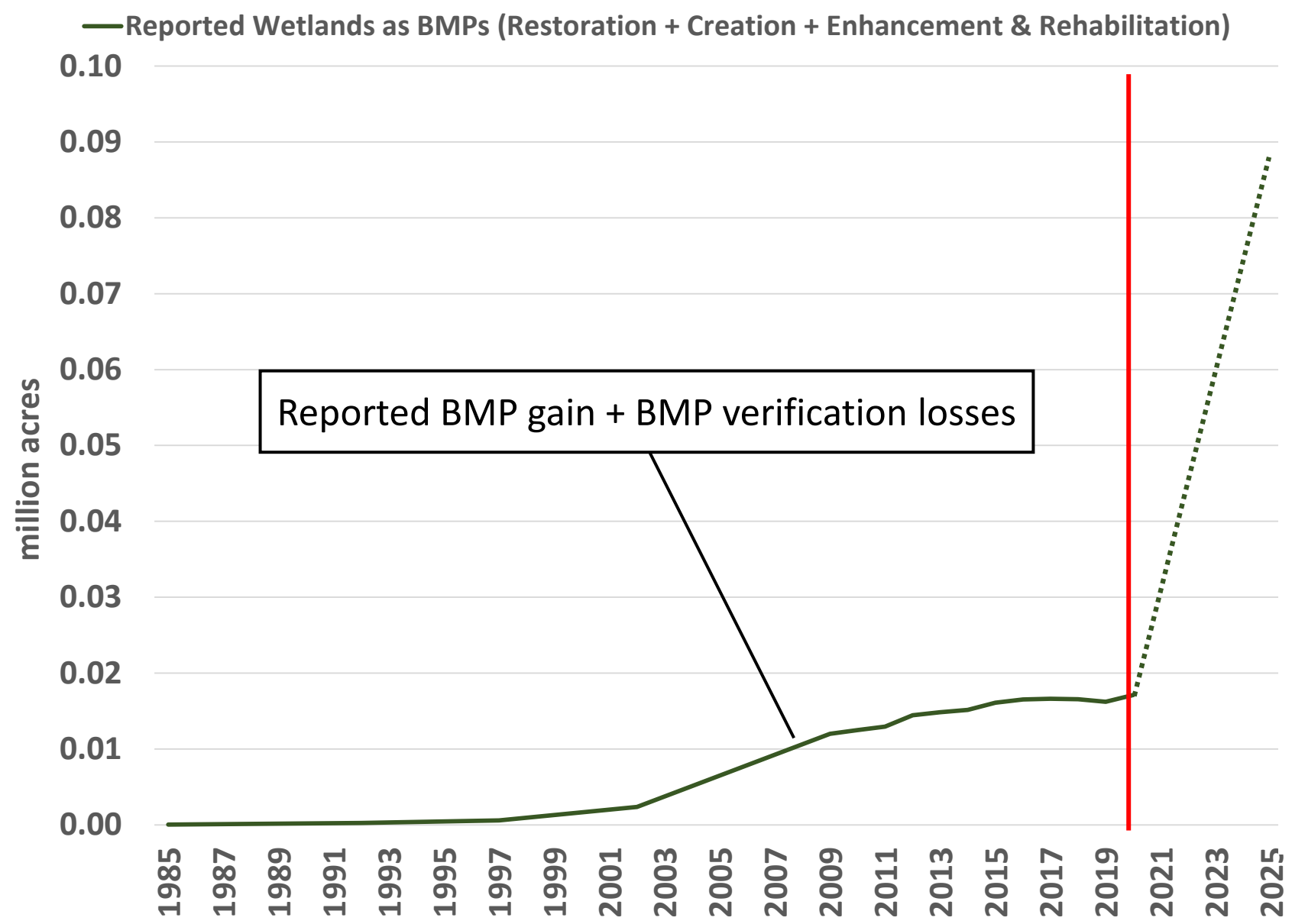


# Wetland BMP Changes (1985–2020 + 2025)





# Wetland BMP Changes (1985–2020 + 2025)



Vital Habitats Goal – Wetlands Outcome:  
Continually increase the capacity of wetlands to provide water quality and habitat benefits throughout the watershed. Create or reestablish 85,000 acres of tidal and non-tidal wetlands and enhance function of an additional 150,000 acres of degraded wetlands by 2025.



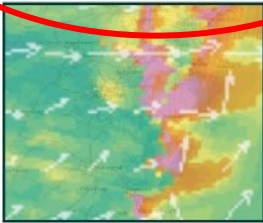
# Wetlands as Model Land Uses

## Data and Model Inputs

Pollution Control Data  
Land Use Data  
Point Sources Data  
Septic Data  
U.S. Census Data  
Agricultural Data



Land Use  
Change  
Model



Airshed  
Model

Precipitation Data  
Meteorological Data  
Elevation Data  
Soil Data

## Phase 6 Watershed Model/CAST



How much nitrogen, phosphorus, and sediment reaches the Bay under different management scenarios?

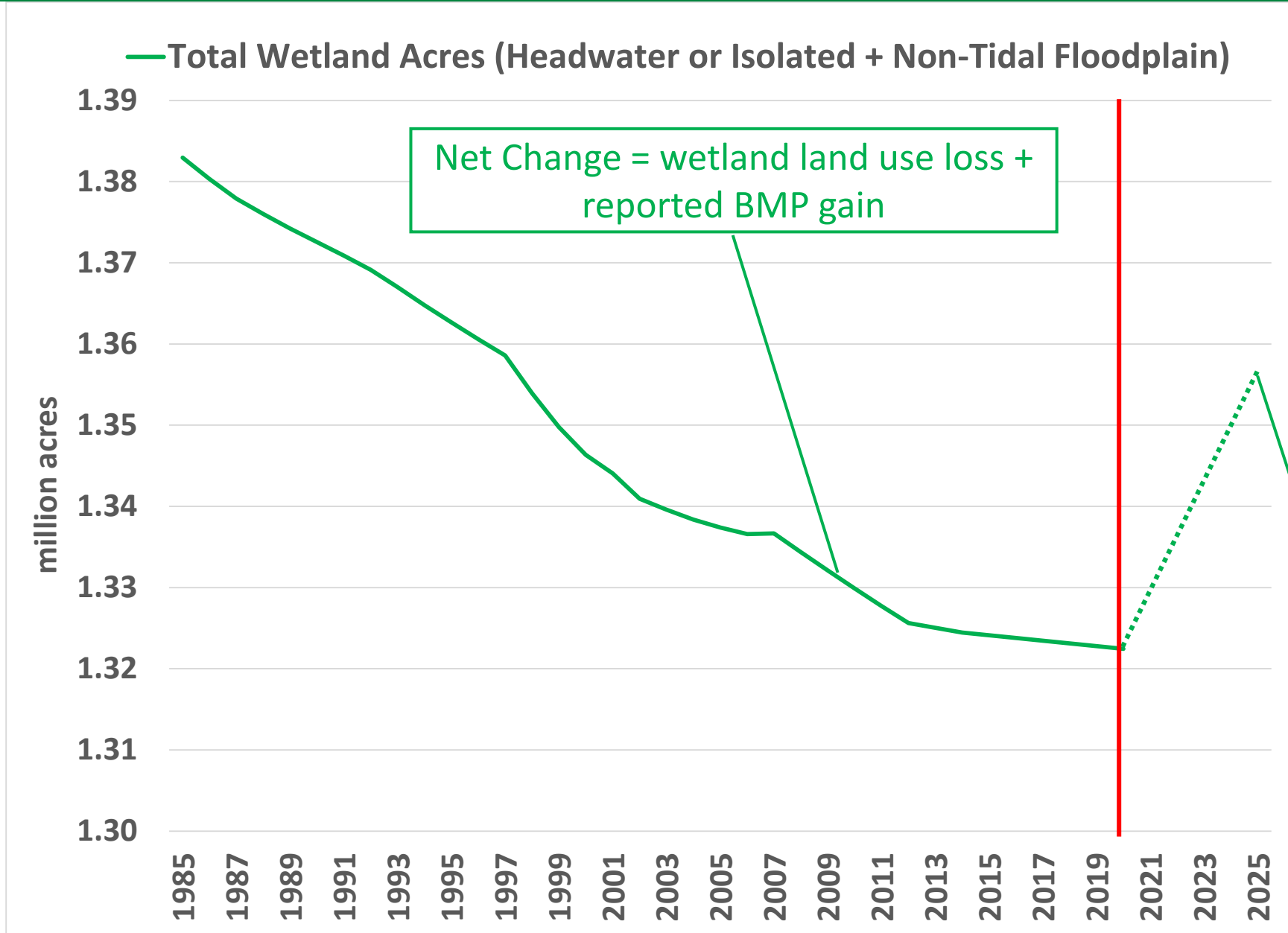
## Estuary Model



How does oxygen in the Chesapeake respond to different levels of nitrogen, phosphorus, and sediment?



# CBW Wetland Acre Changes (1985–2020 + 2025)



Planned 2020-2025



# How Do We Determine Wetland Areas in the Model?

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

**Other Wetlands** – National Wetlands Inventory (NWI) non-pond, non-lake wetlands, emergent wetlands mapped from high-resolution imagery outside Virginia, state designated wetlands, and state identified potential non-tidal, non-floodplain wetlands. These are typically headwater wetlands or isolated wetlands.

**Tidal Wetlands** – Wetlands classified as marine and estuarine wetland systems (E2EM, ESFO, W2SS) according to the NWI Wetlands and Deepwater Habitats Classification chart (<https://www.fws.gov/wetlands/Documents/Wetlands-and-Deepwater-Habitats-Classificationchart.pdf>), NWI palustrine wetlands (PEM, PFO, PSS) with water regime modifiers associated with tidal hydrological conditions (e.g., saltwater tidal or freshwater tidal), and all wetlands mapped from imagery that could be influenced by tidal characteristics/processes by having an elevation less than or equal to 2 meters above sea level according to the 10m-resolution NED (downloaded July 2015). Note that Tidal Wetlands are excluded from the watershed model but are being mapped for future input to the Water Quality and Sediment Transport Model (WQSTM) of the tidal Bay.





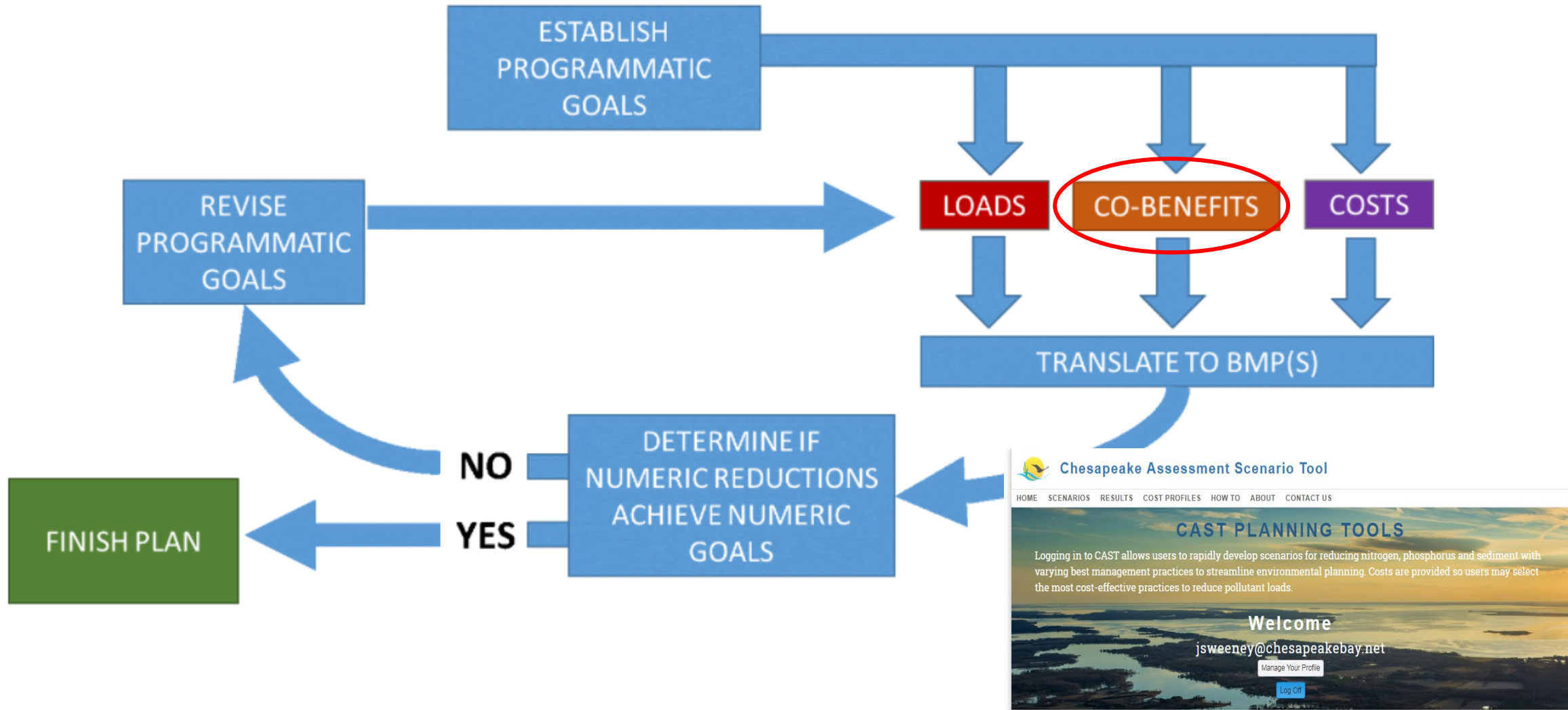
# State WIP Phase III WIP Strategies

- Protect and maintain what we have – forests, wetlands, productive agricultural lands
  - Economies that are natural resource-based contribute \$10's of billions to state economies annually
  - + Ecosystem service benefits (benefits that aren't valued through traditional markets, but provide important public services such as
    - 1) removing air pollution,
    - 2) carbon sequestration,
    - 3) recharging groundwater,
    - 4) stormwater mitigation/flood prevention and
    - 5) providing habitat for wildlife





# Steps to Developing a Plan and Assessing Progress





# Prioritizing BMP Co-Benefits

In addition to nutrient and sediment goals and reducing implementation costs related to water quality, there may be additional, complementary objectives related to the following:

- Brook Trout
- Climate Benefits
- Climate Resiliency
- Fish Habitat
- Forest Buffer
- Healthy Watersheds
- Protected Lands
- Public Access
- Sub-Aquatic Vegetation
- Stream Health
- Toxics
- Tree Canopy
- Wetlands



# Prioritizing BMP Co-Benefits – Wetlands

## **Protecting Wetlands for Human Health, Economic Development, and Infrastructure**

[https://cast-content.chesapeakebay.net/documents/CoBenefits/CoBeneWetlandFinal\\_2.8.18.pdf](https://cast-content.chesapeakebay.net/documents/CoBenefits/CoBeneWetlandFinal_2.8.18.pdf)

- Vital part of the landscape; key component to habitats and waterways
- Benefit community health by being an area of filtration for water moving through watershed
- Allow for streams and runoff flows to be slowed down allowing water to filter through the ground, often reducing pollutants and toxins
- Provide habitat for a diversity of wildlife and a complex food web; helping to minimize mosquitos and other nuisance insects through predator-prey interactions
- Provide recreational opportunities for bird watching and hunting; generate income for landowners, while promoting economic investment by community members
- Create buffer zones between water and upland areas, allowing for flood and sea level rise protection; helping to prevent damages to the surrounding infrastructure
- Working to improve their function, can offer powerful water quality and habitat benefits

The benefits of functioning wetlands and streams, while significant on their own, are even more powerful when acting together in wetland/stream complexes on the landscape.



# Wetland Restoration Co-Benefit Scores

Wetland Restoration and Streamside Wetland Restoration (Agriculture)						
Habitat						
Biodiversity and Habitat	Black Ducks	Brook Trout	Fish Passage	Stream Health	SAV	Wetlands
3.0	4.5	1.5	0.0	1.0	3.0	5.0
Sustainable Fisheries						
Blue Crab Abundance	Fish Habitat	Forage Fish	Oysters			
2.5	3.5	1.5	2.5			
Maintain Healthy Watersheds						
Healthy Watersheds	Land Use Methods and Metric Development					
1.0	4.0					
Fostering Chesapeake Stewardship						
Citizen Stewardship	Protected Lands					
0.5	3.5					

BMPs are ranked to indicate their impact on the co-benefits evaluated

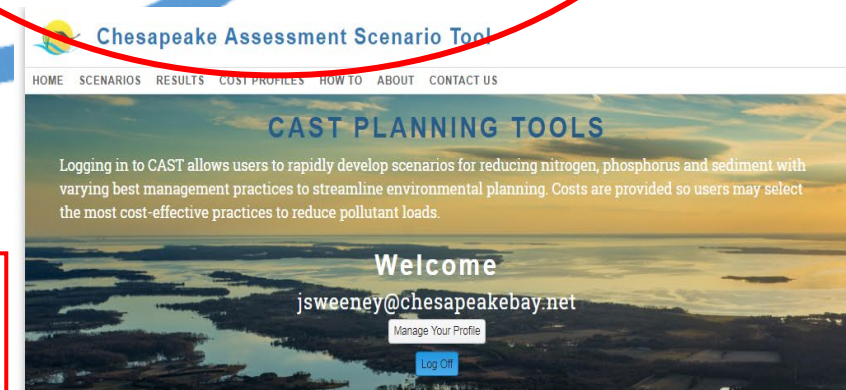
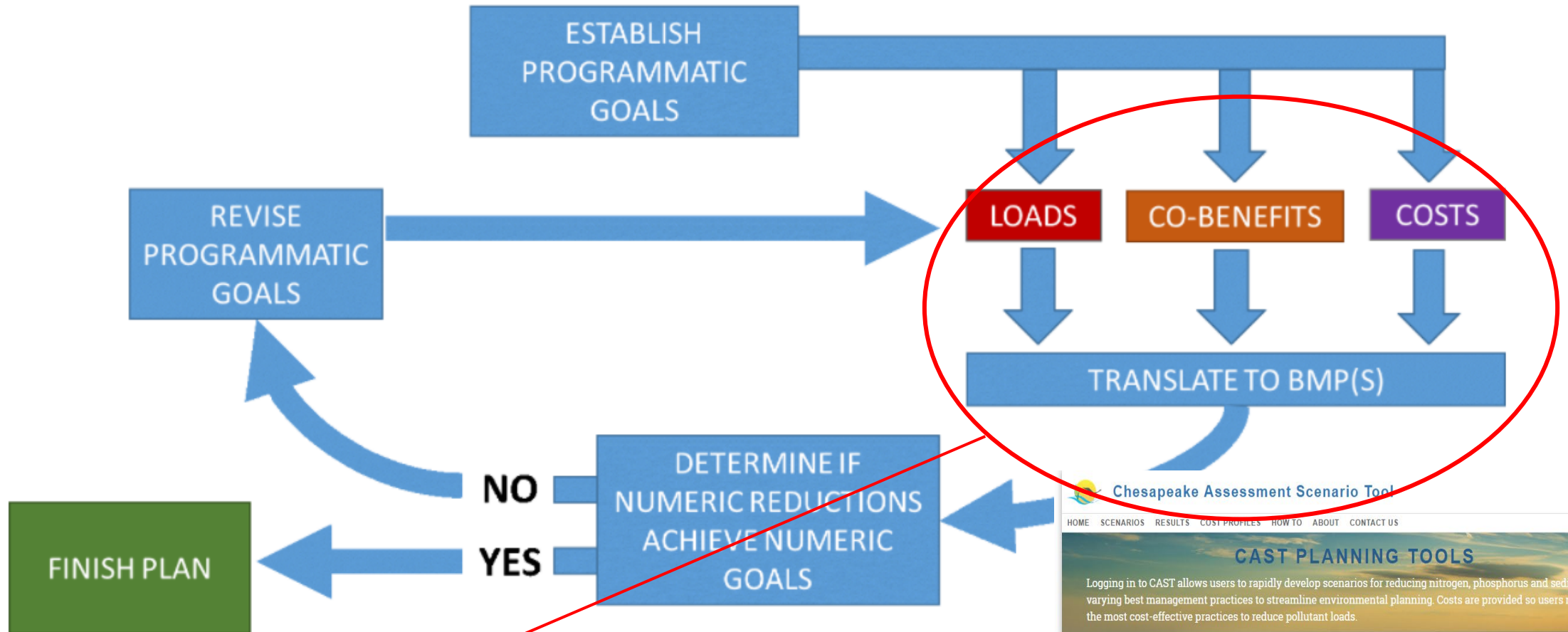
- BMP Co-Benefits Impact Scores and Spreadsheet Tool
- Report “Estimation of BMP Impact on CBP Management Strategies”  
<https://cast.chesapeakebay.net/Documentation/DevelopPlans>

Scoring matrix can be used in multiple ways:

- Characterize additional benefits beyond nutrients and sediment
- Select priority BMPs to adopt based on management priorities
- Help “sell” a restoration plan to govt. & non-govt. groups
- The BMPs selected should be efficient, maximize return on investment, and improve quality of life.



# Steps to Developing a Plan and Assessing Progress



Chesapeake Bay Program Optimization Project  
Wetlands goals can be used as “constraints” (minimum acres) or part of relative cost-effectiveness of BMPs if benefits can be monetized



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