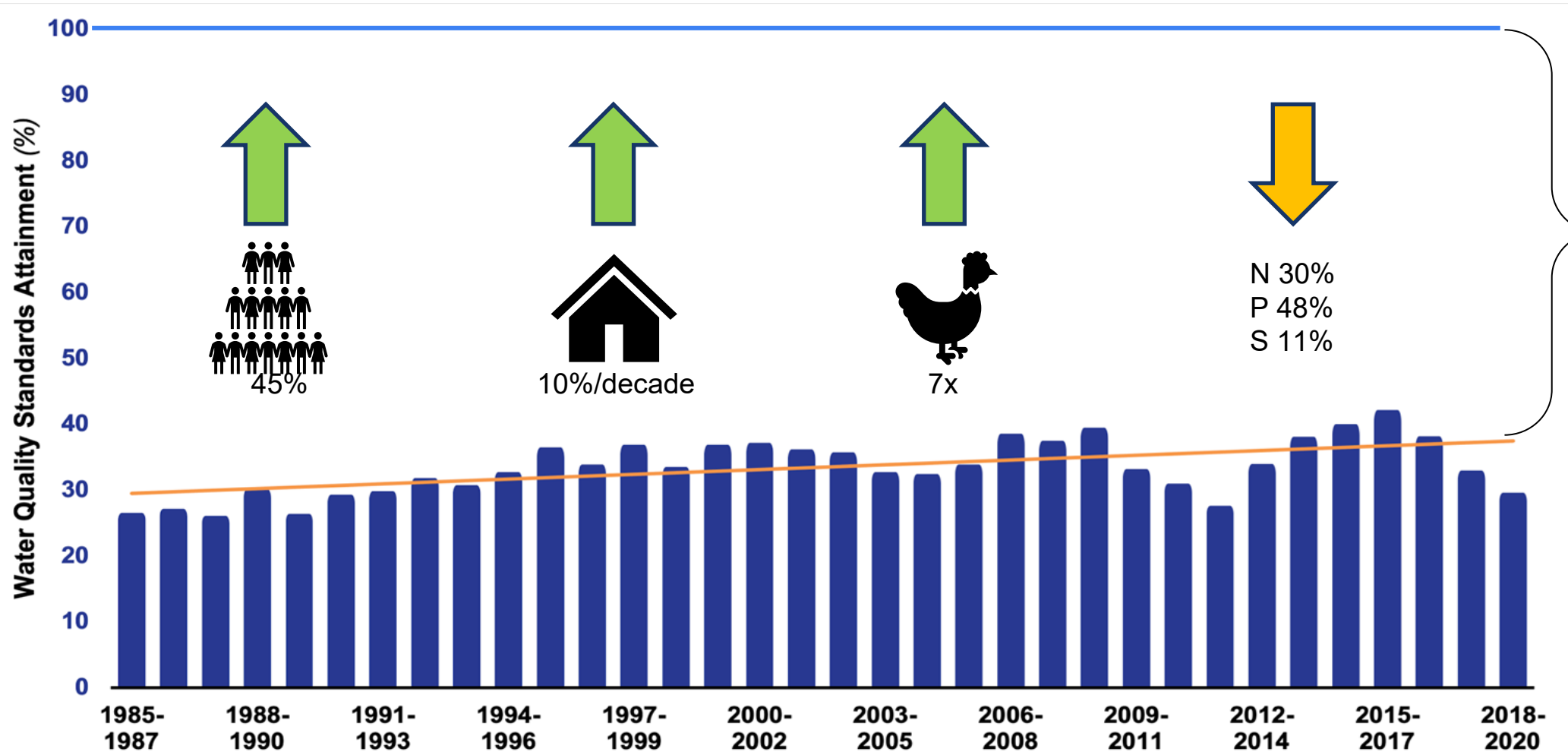


Achieving Water Quality Goals in the Chesapeake Bay: A Comprehensive Evaluation of System Response (CESR)

Denice Wardrop and Kurt Stephenson
January 15, 2024



Why this report, at this time, by these people?



Why?



Water Quality Policy Summary for the Chesapeake Bay

Chesapeake Bay Agreement



Water Quality Goal



Measurement of the Goal



Achieving the Goal

- Restoration Goals**
- Sustainable Fisheries
- Vital Habitat
- Water Quality**
- Toxic Contaminants
- Heathy Watershed
- Climate Resiliency
- Land Conservation
- Stewardship
- Public Access
- Environmental Literacy

Protect aquatic living resources

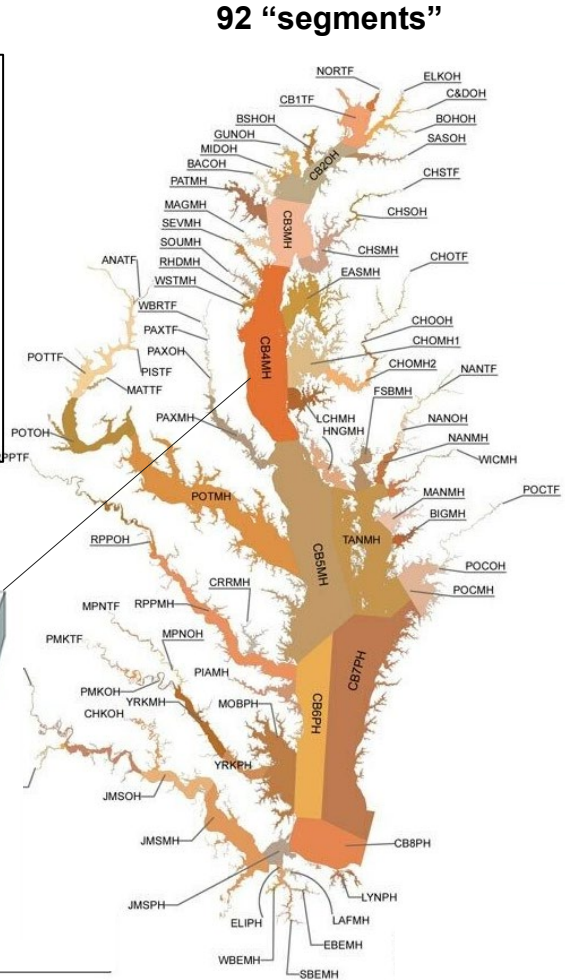
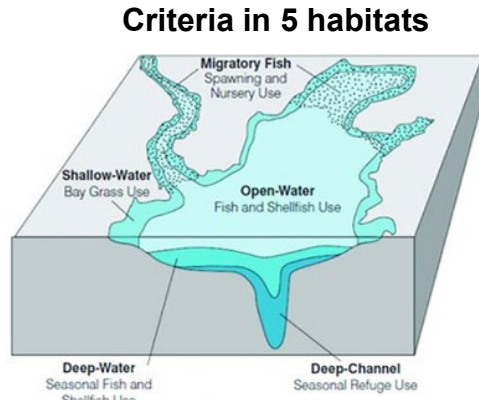
- Striped Bass: 5-6
- American Shad: 5
- White Perch: 5
- Yellow Perch: 5
- Hard Clams: 5
- Alewife: 3-6
- Crabs: 3
- Bay Anchovy: 3
- Spot: 2
- Worms: 1

Numeric Criteria

Dissolved Oxygen (DO)
(30 day avg, 7 day avg, instantaneous):

Water Clarity/Aquatic Vegetation

Chlorophyll a



= 1092 assessment points

TMDL

N, P, sediment targets to meet goal

↑

Pollutant Control Programs

↑

Accountability

CESR Summary

1. Achieving pollutant load reductions for the Bay

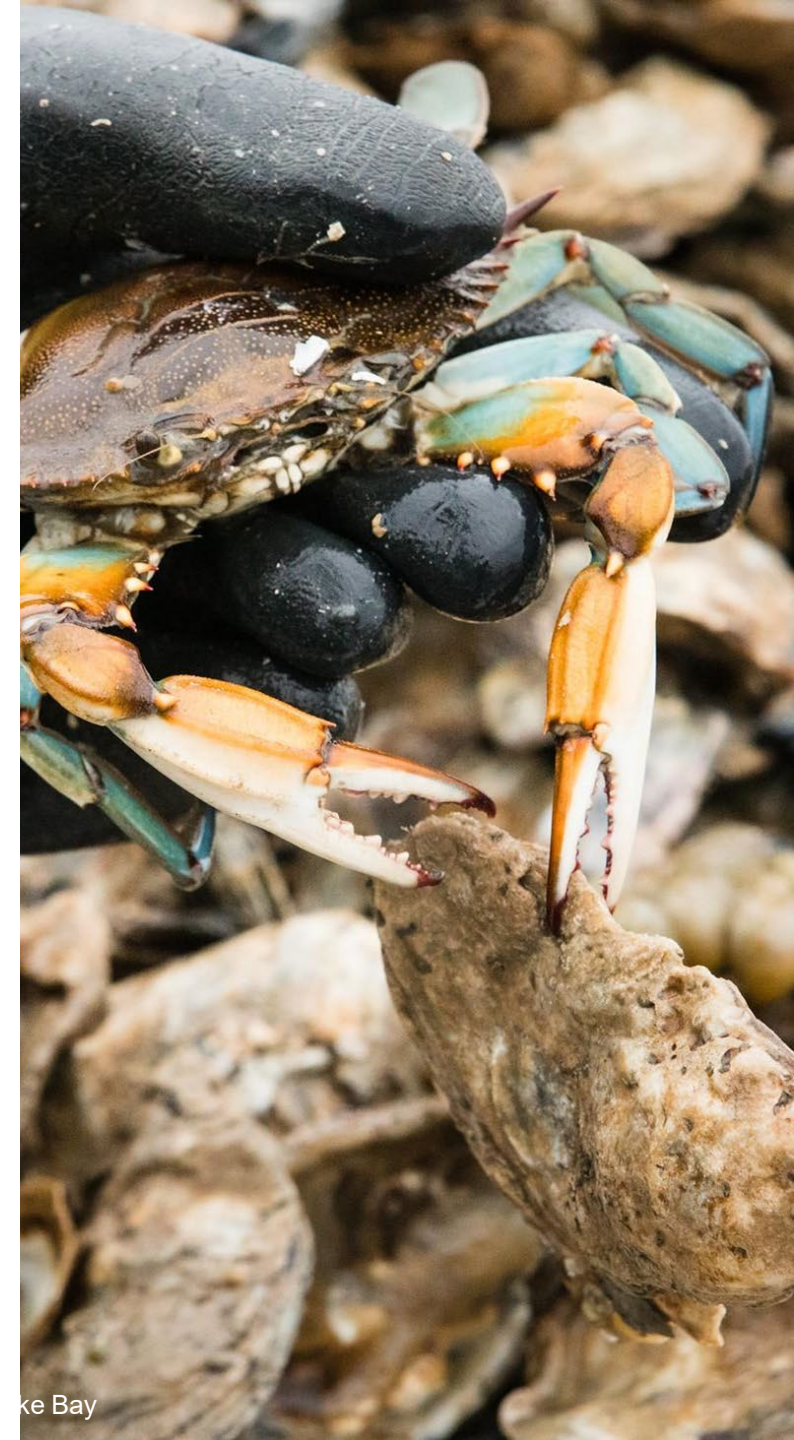
FINDING: Agricultural and urban nonpoint sources programs are not generating sufficient reductions to achieve Bay pollutant reduction targets.

OPPORTUNITIES: Reforms and new programs have potential to improve nonpoint source program effectiveness

2. Achieving Bay Water Quality Goals

FINDING: Bay water quality is improving but the magnitude of the change unlikely to achieve all water quality criteria

OPPORTUNITIES: Focus on potential impact on Bay living resources

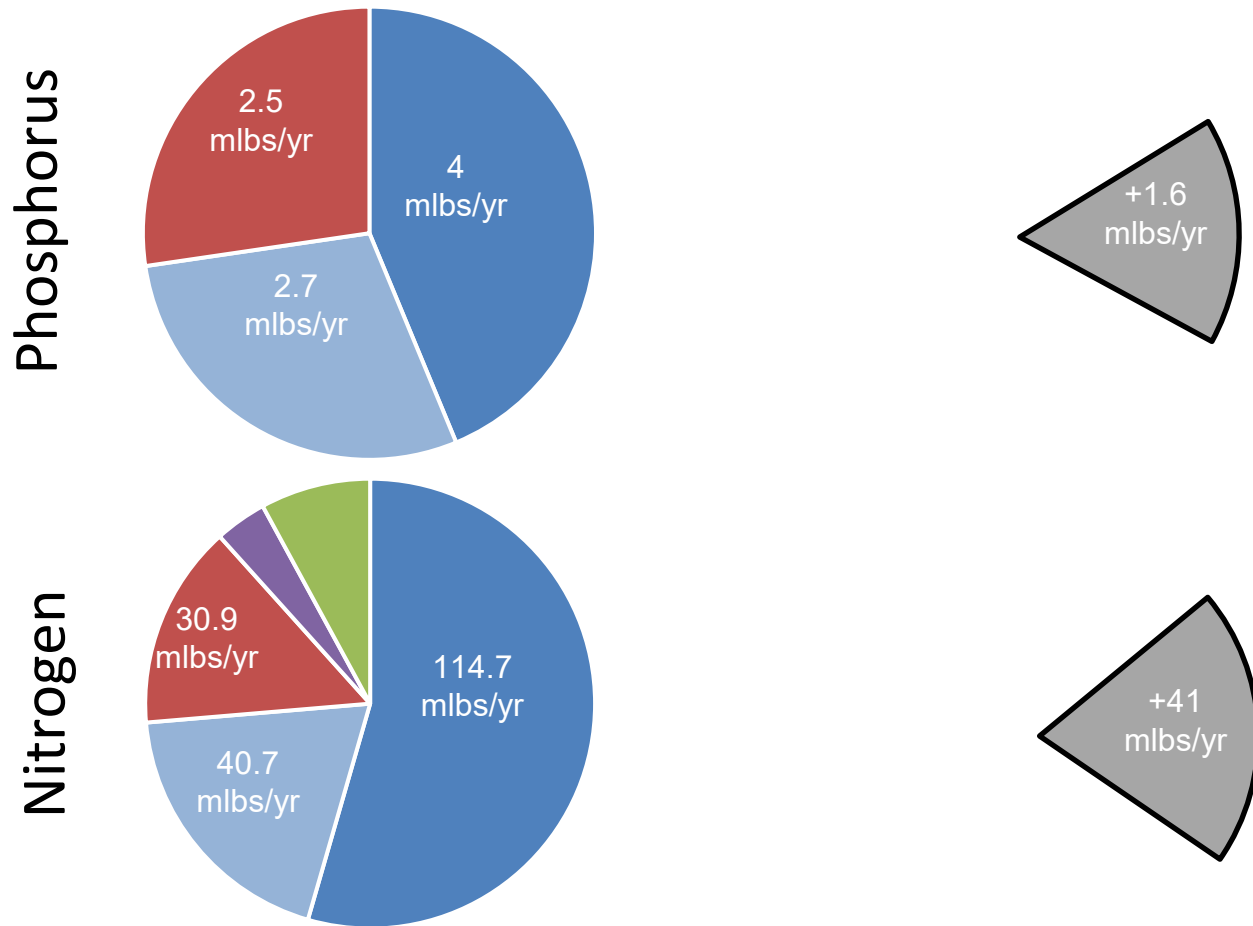




Achieving pollutant load reductions for the Bay

Findings: Achieving Pollutant Reductions

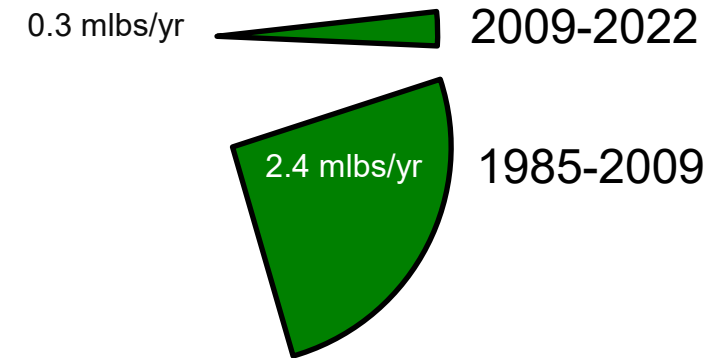
Distribution of pollutant loads to Bay, 2022



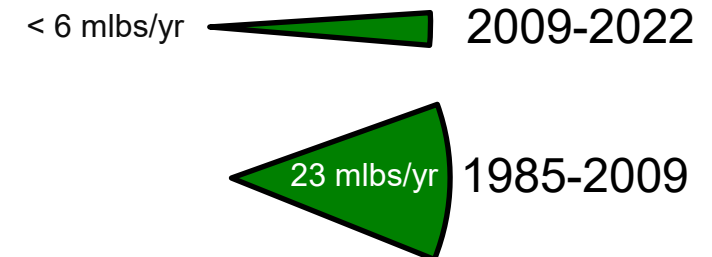
... but NPS programs not generating enough reductions

(according to CBP model)

P nonpoint source reductions achieved



N nonpoint source reductions achieved

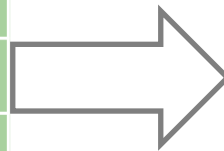


Findings: Achieving Pollutant Reductions

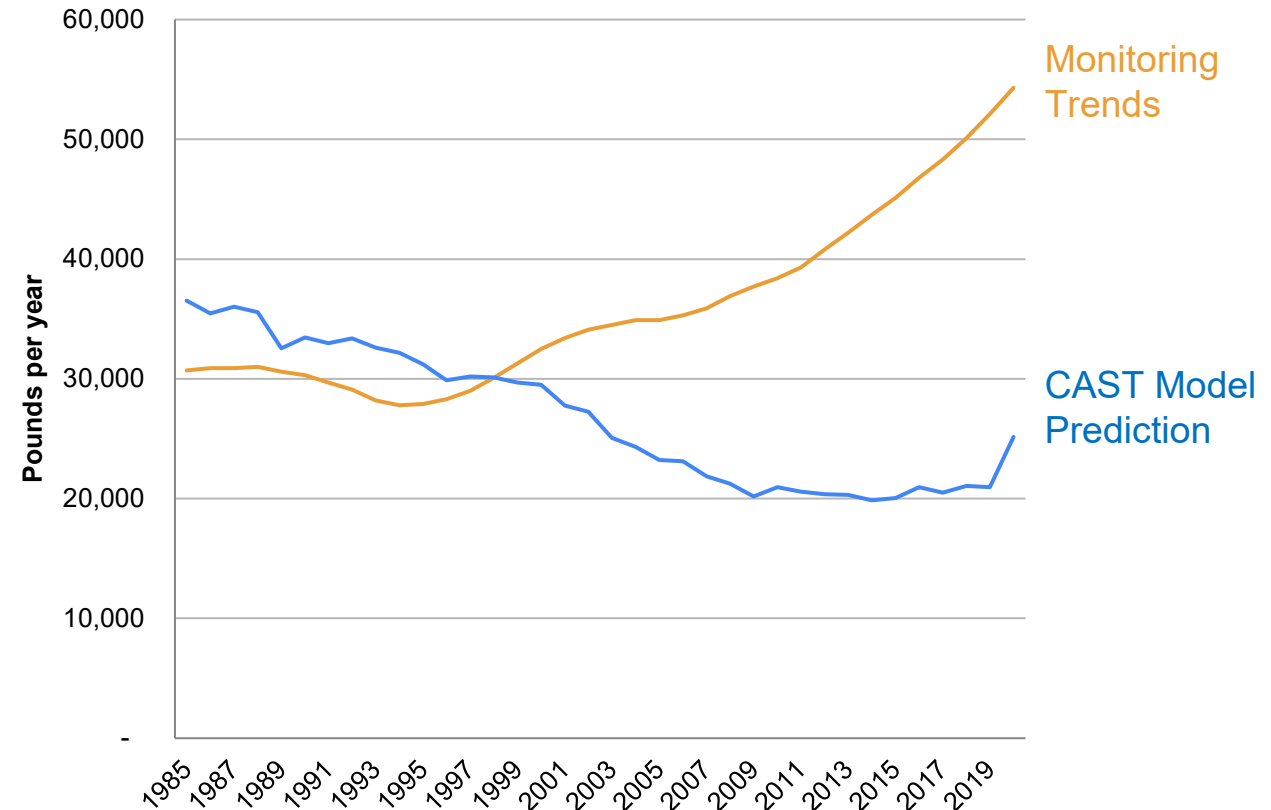
Nonpoint source programs may not be as effective as expected

Long term Trends in Total Phosphorus Loads

Rivers	Monitoring Observations	CAST model
Susquehanna	—	↓
Potomac	↓	↓
Choptank	↑	↓
Patuxent	↓	↓
Rappahannock	↑	↓
Mattaponi	—	↑
Pamunkey	↑	↓
James	↓	↓
Appomattox	↑	↓



Total Phosphorus Loads, Choptank



Achieving pollutant load reductions for the Bay: Opportunities for Nonpoint Sources

Improve approaches to address nutrient mass balance

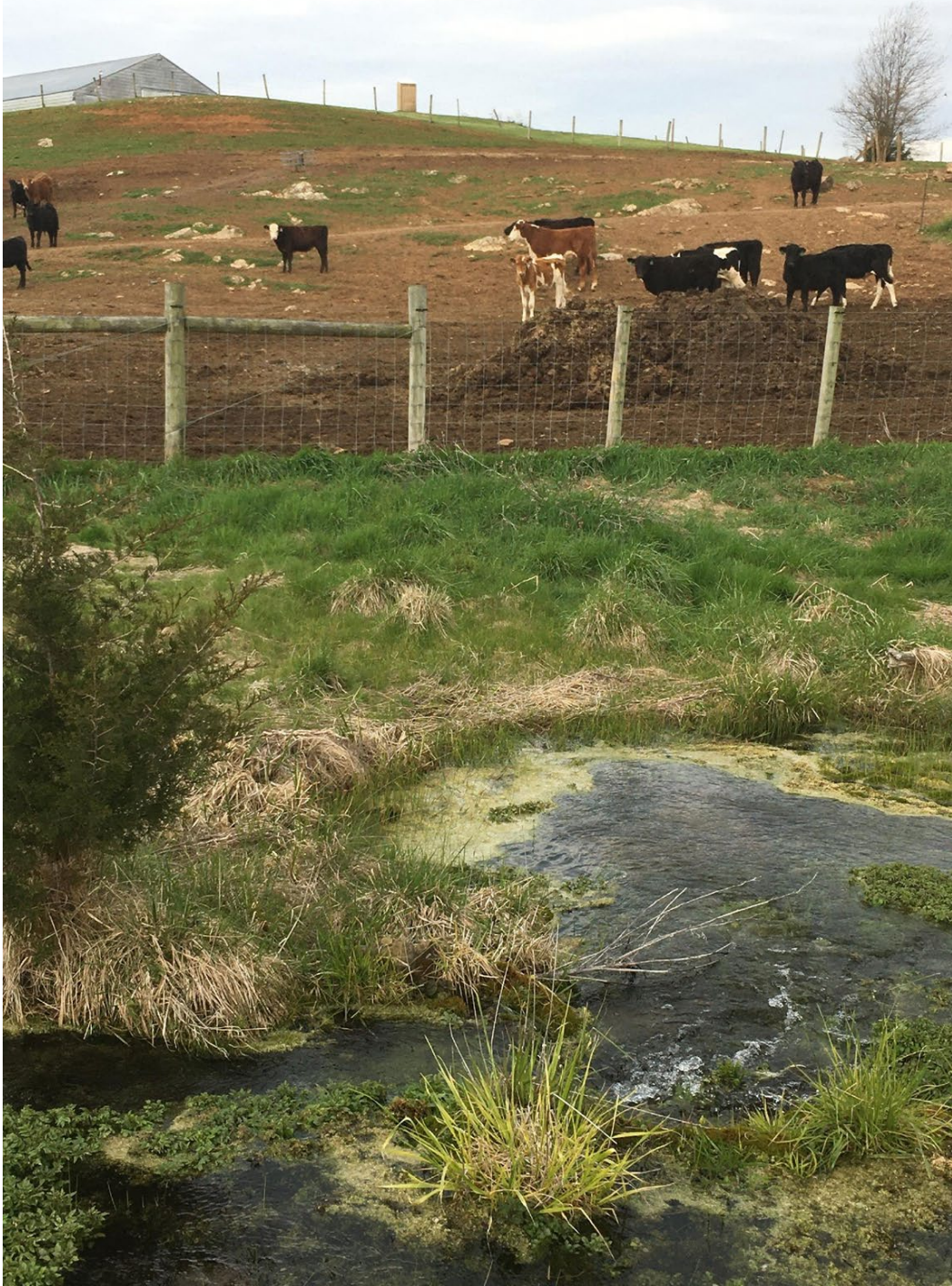
Additional Focus on Outcomes:

Improved targeting of conservation investments

New incentive programs (behavior change)

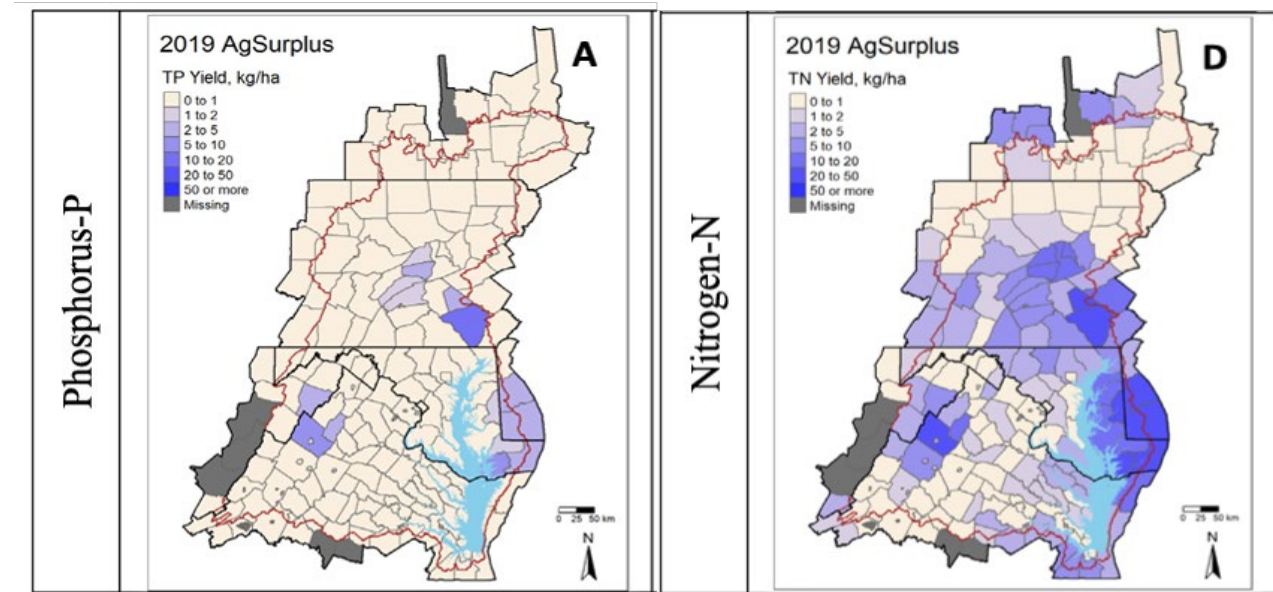
Attention/tools on local waters (monitoring, other modeling tools)

Encourage policy innovation (and permission to fail)



3x increase in
animal numbers

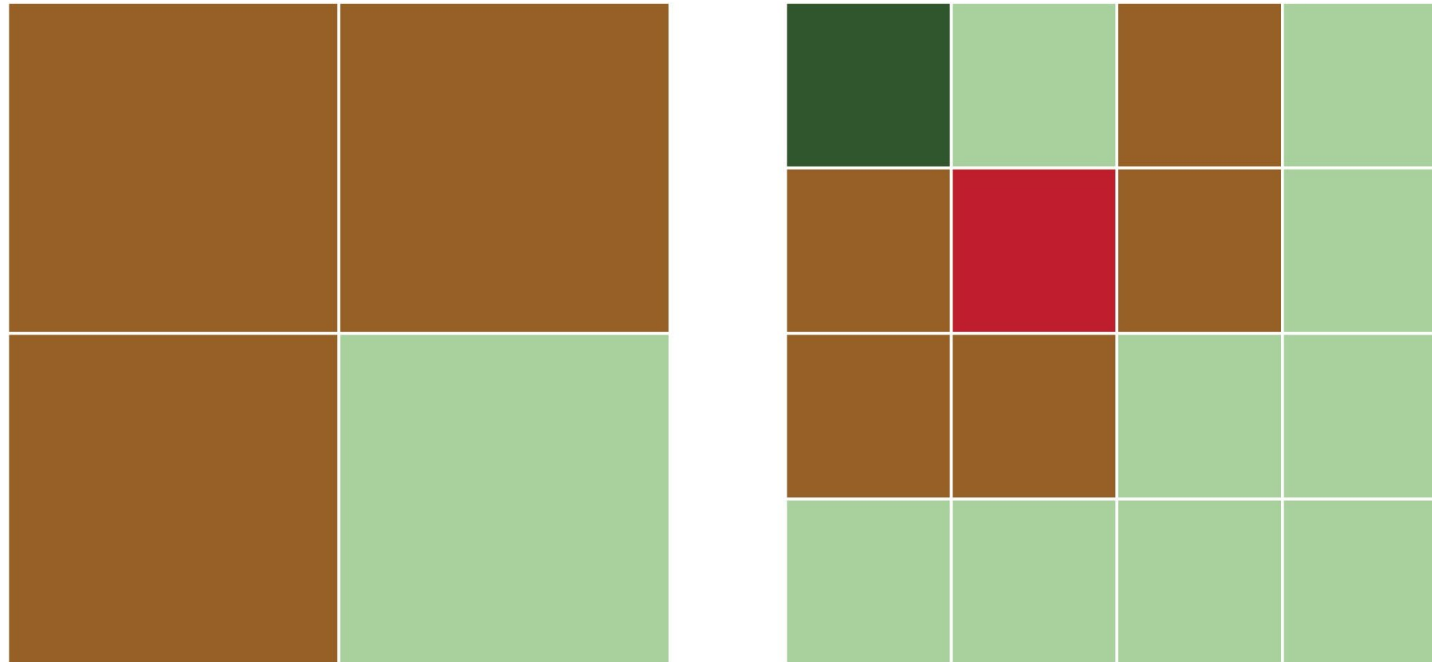
Mass Balance



4x increase
in BMPs

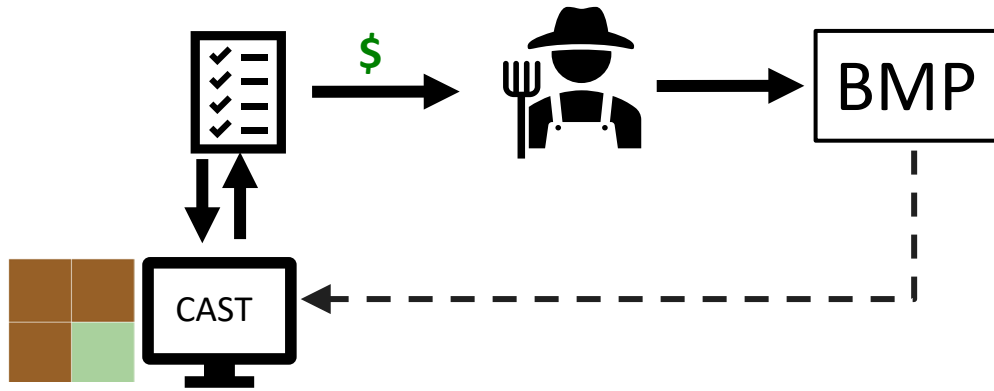
Sabo et al. 2021

Targeting Conservation

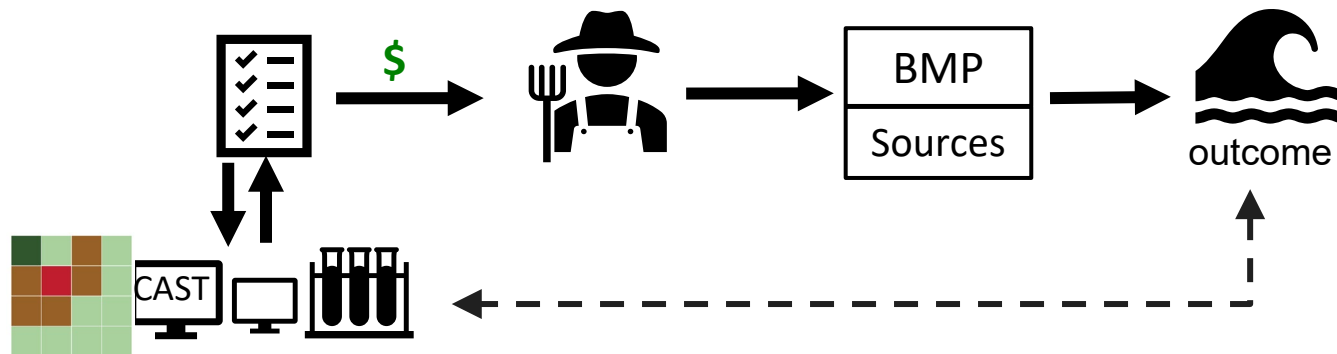


Larger scale makes it more difficult to pinpoint the problem
Targeting helps identify problem areas (red square)

Incentives, Behavior, and Outcomes



Practice Based Incentives



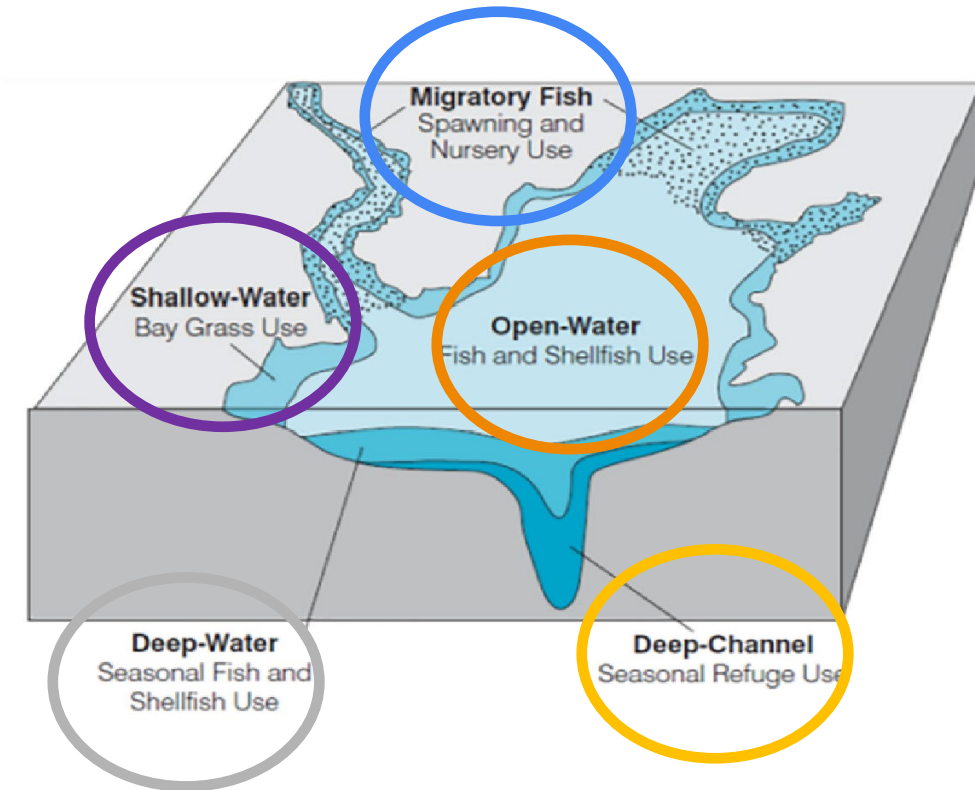
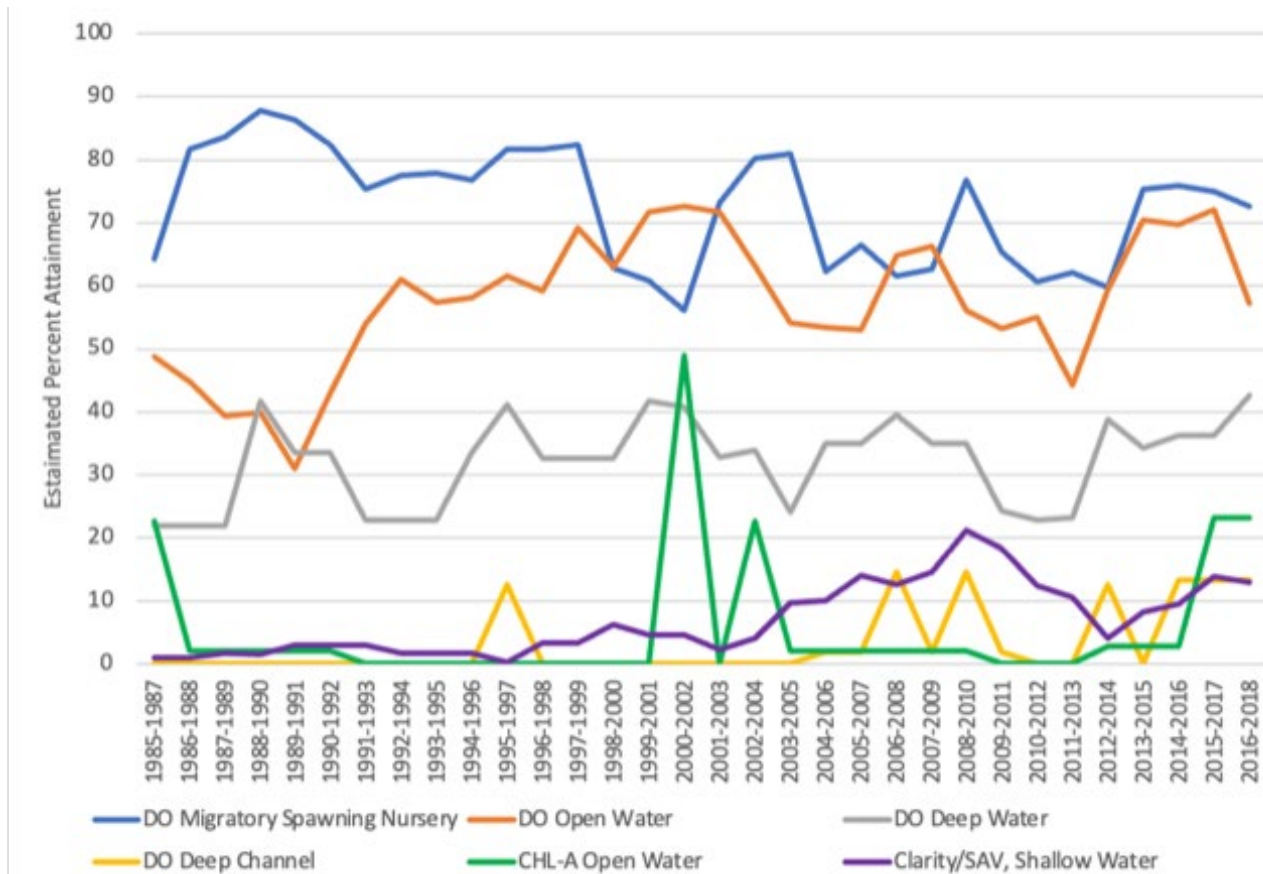
Outcome-Based Incentives

- Payments
- Accounting
- Design Innovations



Achieving Bay water quality goals

Finding: Bay water quality is improving but the magnitude of the change unlikely to achieve all water quality criteria



Finding: Bay water quality is improving but the magnitude of the change unlikely to achieve all water quality criteria

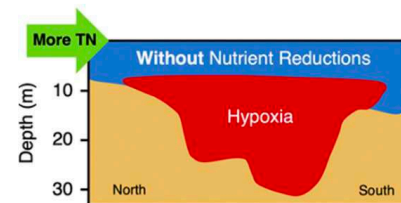
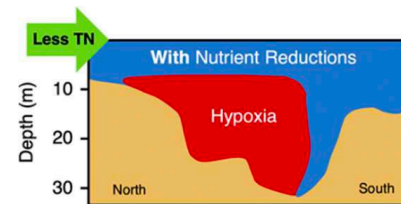
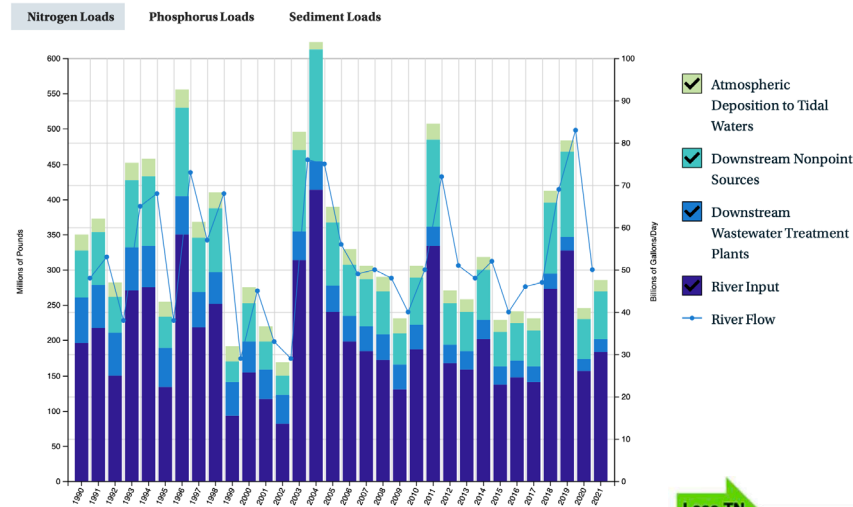
Why?

- Water quality improvements are not sufficiently large
- Climate change, especially warming of Bay waters, has dampened the response that we expected from load reductions.
- Imperfect understanding of conditions and the way that the ecosystem works

Pollution Loads and River Flow to the Chesapeake Bay (1990-2021)

River and Watershed Input of Pollution Loads. Years denote the water year measured between October 1 and September 30.

[VIEW CHART](#) [VIEW TABLE](#)



If 35 years of nutrient reductions had not occurred, hypoxia would have:

- Been **20-120% larger** for $O_2 < 3 \text{ mg L}^{-1}$
- Been **30-280% larger** for $O_2 < 1 \text{ mg L}^{-1}$
- Extended **further south** in the Bay
- Lasted **longer** during dry years



Achieving Bay water quality goals: Opportunities

Prioritize and focus WQ and restoration investments around living resources

Don't allow water quality investments to leave Living Resource benefits on the table

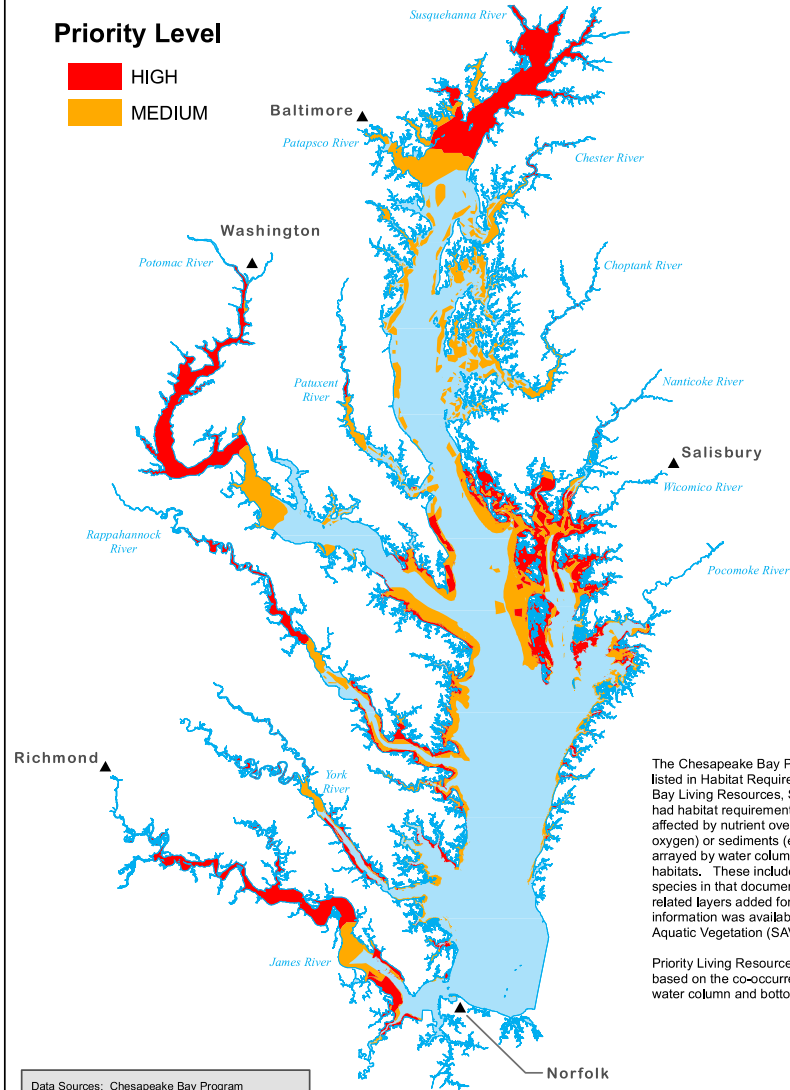
Priority Living Resource Areas

Chesapeake Bay



Priority Level

- HIGH
- MEDIUM



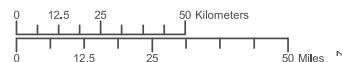
Species Included

- | | |
|------------------------------|----------------------|
| Menhaden | Blue Crab |
| Striped Bass | Oyster |
| Anchovy | Soft Shell Clam |
| Alewife | Hard Shell Clam |
| Hickory Shad | Spot |
| American Shad | Speckled Sea Trout |
| Yellow Perch | Postlarval Blue Crab |
| White Perch | Catfish |
| Blueback Herring | Summer Flounder |
| Largemouth Bass | Atlantic Sturgeon |
| Chain Pickerel | Croaker |
| Submerged Aquatic Vegetation | |

The Chesapeake Bay Program's target species listed in *Habitat Requirements for Chesapeake Bay Living Resources, Second Edition (1991)* which had habitat requirements that could be directly affected by nutrient overenrichment (e.g., dissolved oxygen) or sediments (e.g., light penetration) were arrayed by water column and bottom as their principal habitats. These included all the fish and shellfish species in that document, with several fish species and related layers added for newer potential habitat information that was available. Priority areas for Submerged Aquatic Vegetation (SAV) were considered separately.

Priority Living Resource Areas were identified based on the co-occurrence of habitats for multiple water column and bottom species.

Data Sources: Chesapeake Bay Program
Habitat Requirements for Chesapeake Bay Living Resources (Second Edition) (1991)
For more information, visit www.chesapeakebay.net



Achieving Bay Water Quality Goals

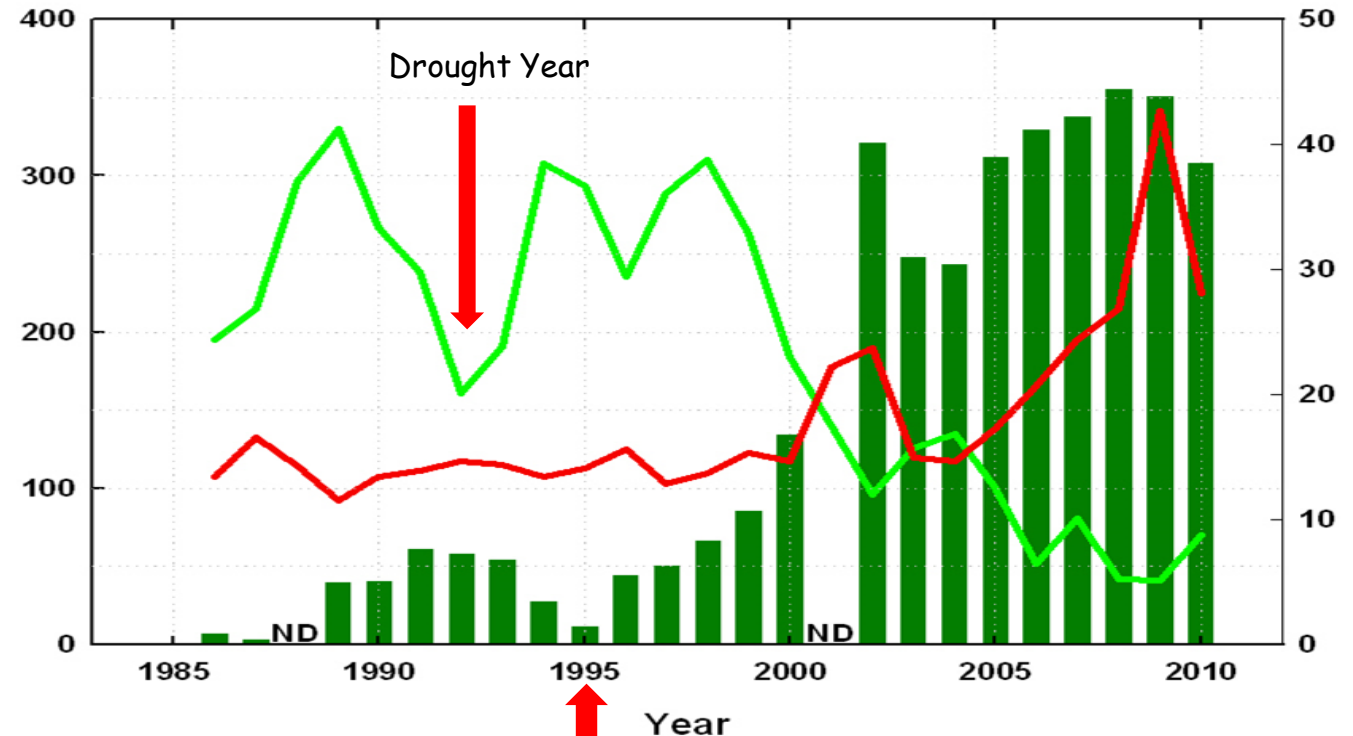
Opportunity: Prioritize our efforts to attain water quality standards so that we can achieve the largest possible benefit to living resources (example: tiered TMDL)

Achieving Bay Water Quality Goals

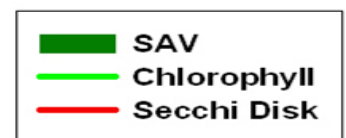
Opportunity: Prioritize our efforts to attain water quality standards so that we can achieve the largest possible benefit to living resources (example: tiered TMDL)



Mattawoman Creek

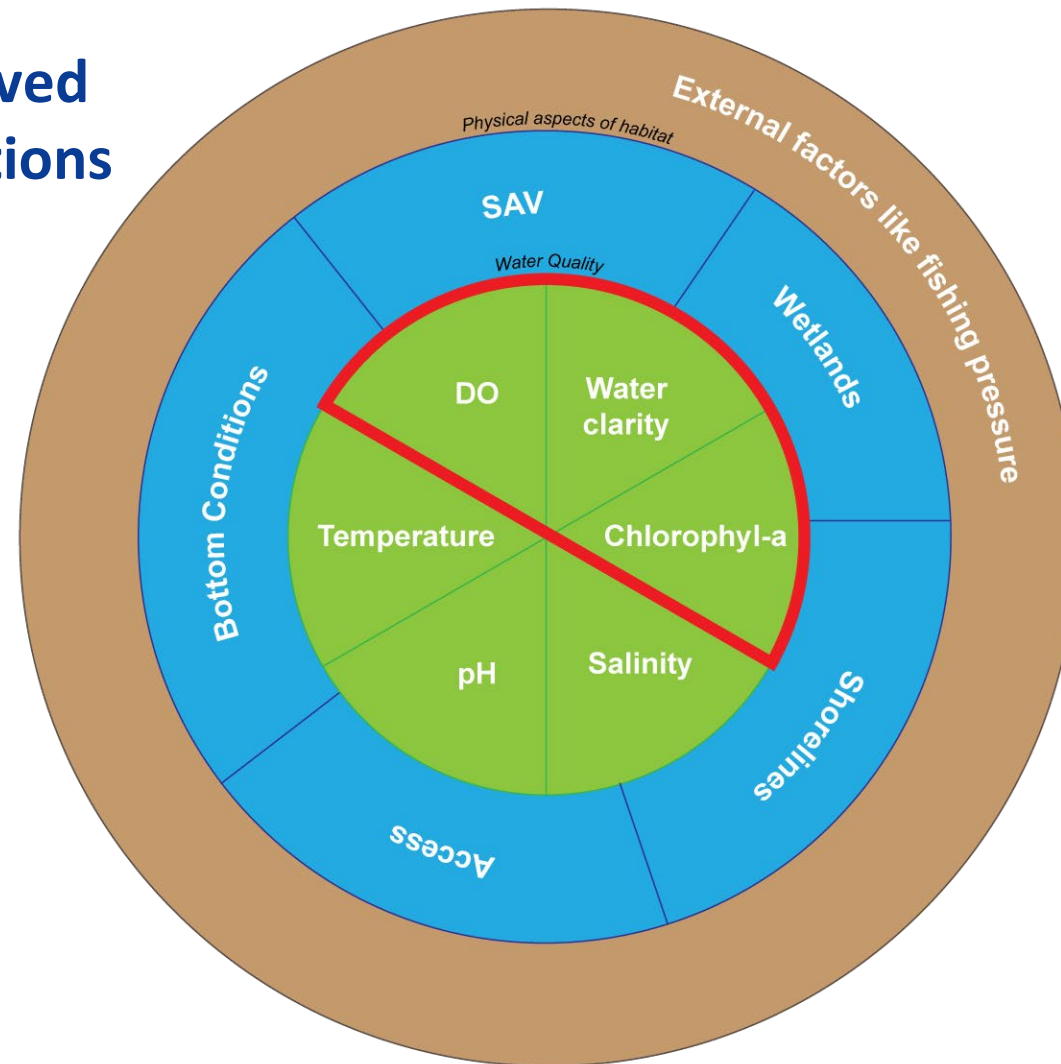


Major WWTP load reduction completed



Achieving Bay Water Quality Standards/Living Resource Response

Opportunity: Significant enhancement of LR can be achieved with additional management actions without complete attainment of water quality goals



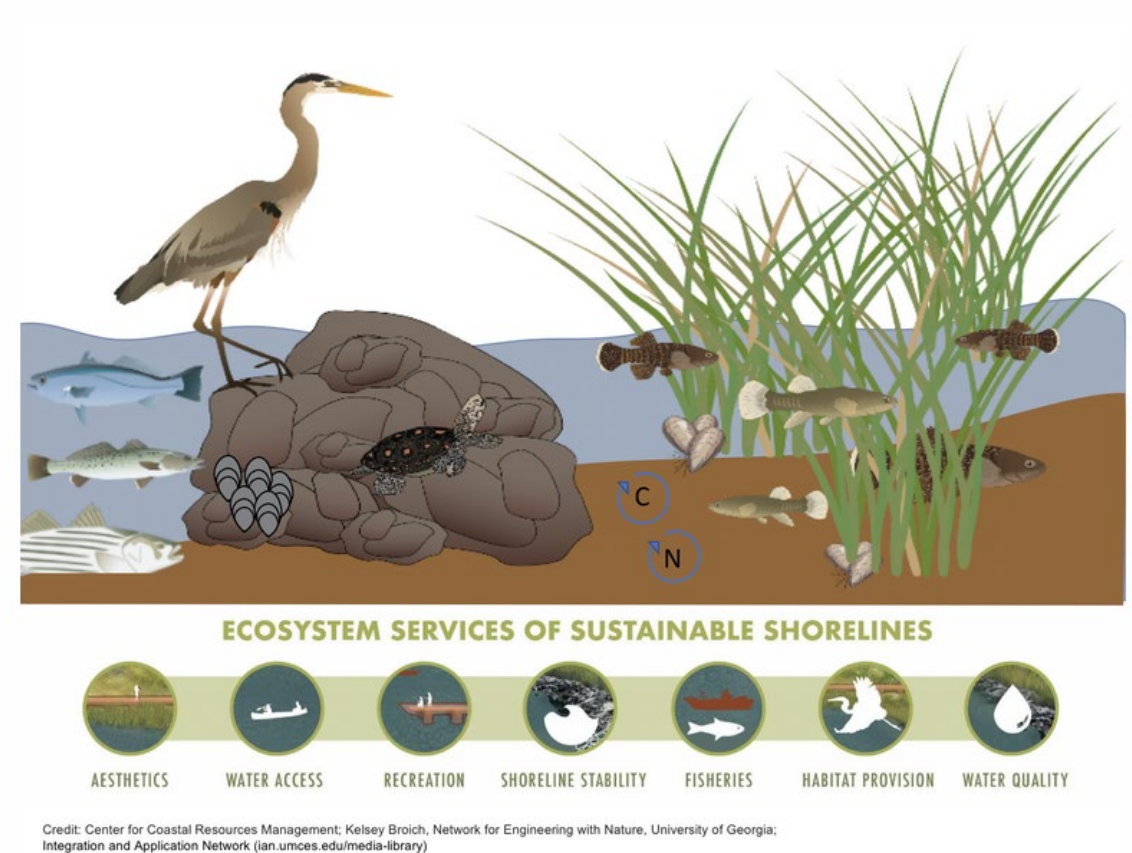
Managed by Bay water quality standards

Achieving Bay Water Quality Standards/LR Response

Opportunity: Don't leave benefits to Living Resources on the table



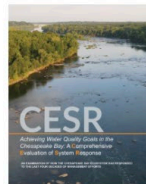
Jane Hawkey, Integration and Application Network (ian.umces.edu/media-library)



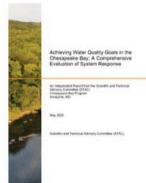
Achieving Water Quality Goals in the Chesapeake Bay: A Comprehensive Evaluation of System Response (CESR)

<https://www.chesapeake.org/stac/cesr/>

The Report



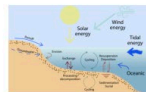
CESR Executive Summary



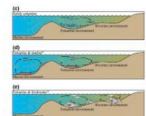
Achieving Water Quality Goals in the Chesapeake Bay: A Comprehensive Evaluation of System Response



Resource Document: Evaluation of Management Efforts to Reduce Nutrient and Sediment Contributions to the Chesapeake Bay Estuary



Resource Document: Knowledge Gaps, Uncertainties, and Opportunities Regarding the Response of the Chesapeake Bay Estuary to Restoration Efforts



Resource Document: A Proposed Framework for Analyzing Water Quality and Habitat Effects on the Living Resources of Chesapeake Bay

