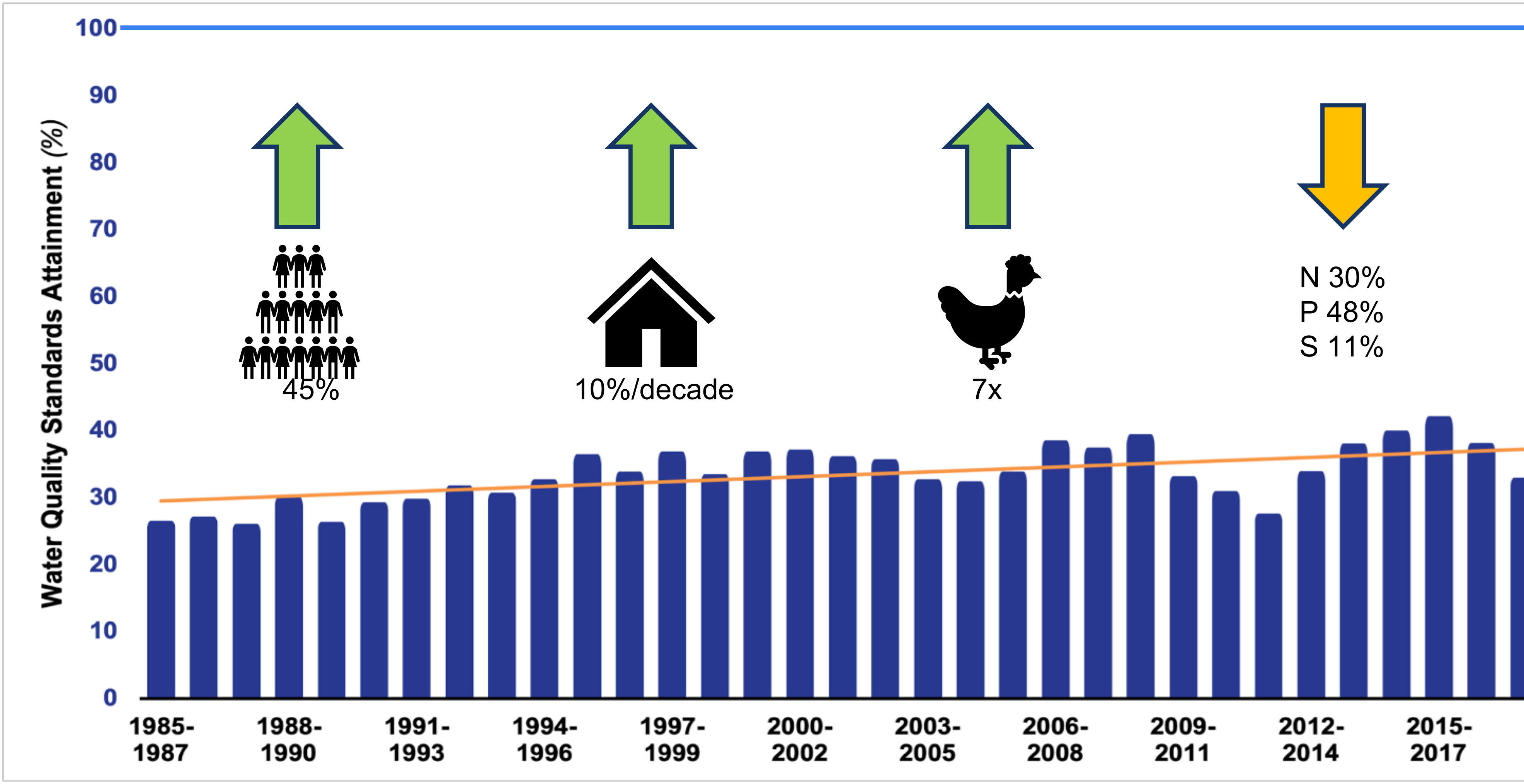
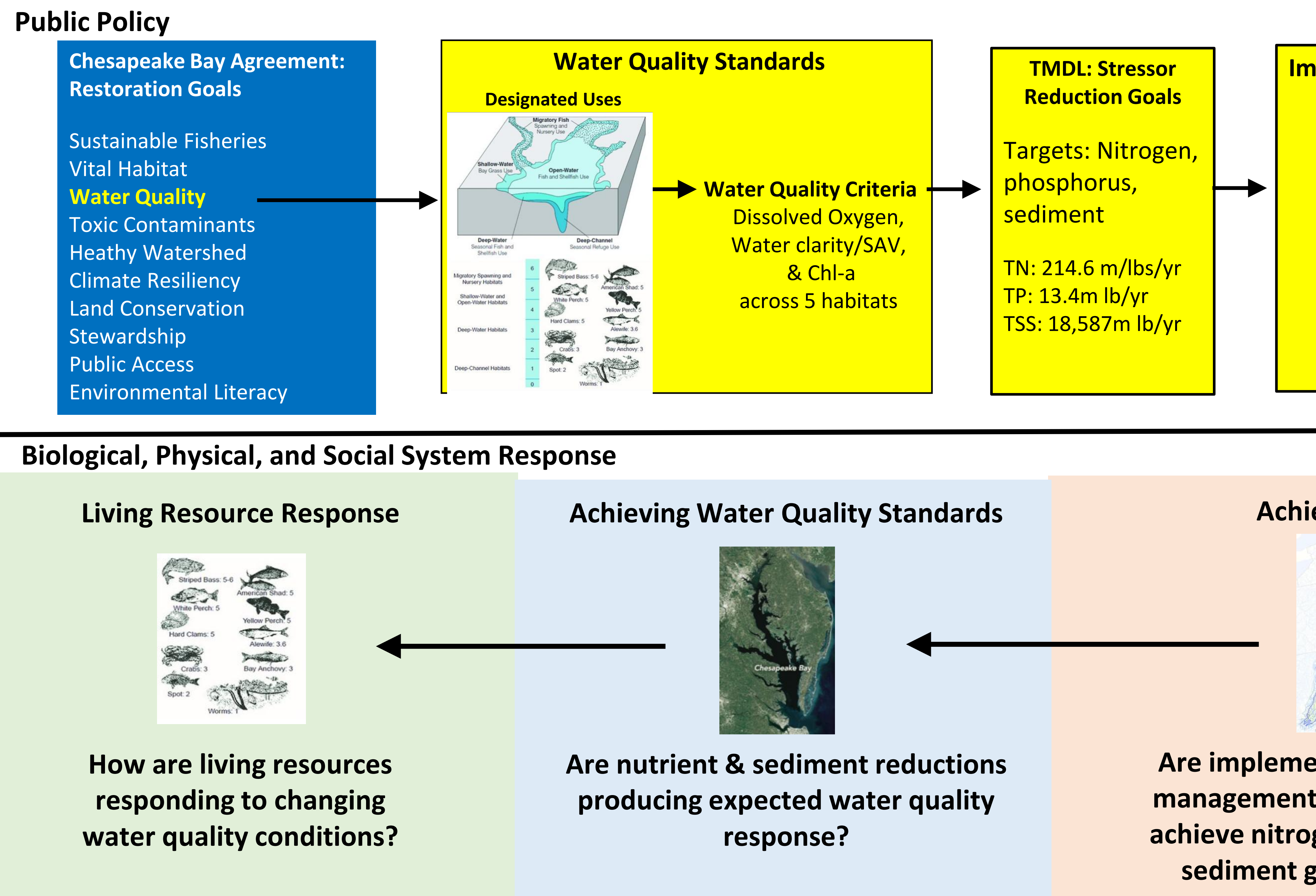
# Achieving Water Quality Goals in the Chesap
# Bay: A Comprehensive Evaluation of Syst
# Response (CESR)

Key Takeaways for LGAC
Denice Wardrop
4 September 2025

# Why this report, at this time, by these pe





Public Policy
Chesapeake Bay Agreement: Restoration Goals
Sustainable Fisheries
Vital Habitat
Water Quality
Toxic Contaminants
Heathy Watershed
Climate Resiliency
Land Conservation
Stewardship
Public Access
Environmental Literacy
Water Quality Standards
Designated Uses
Water Quality Criteria
Dissolved Oxygen, Water clarity/SAV, & Chl-a across 5 habitats
TMDL: Stressor Reduction Goals
Targets: Nitrogen, phosphorus, sediment
TN: 214.6 m/lbs/yr
TP: 13.4m lb/yr
TSS: 18,587m lb/yr
Im
Biological, Physical, and Social System Response
Living Resource Response
How are living resources responding to changing water quality conditions?
Achieving Water Quality Standards
Chesapeake Bay
Are nutrient & sediment reductions producing expected water quality response?
Achie
Are impleme
management
achieve nitrog
sediment g

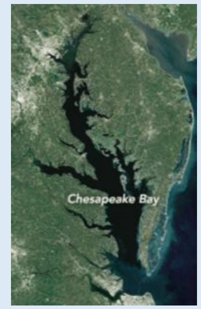
# Summary of CESR Findings and Implications

### Living Resource Response


**Findings:** The impact of WQ improvements on living resources depends on where WQ improvements occurs, antecedent conditions, & impact varies across species.

**Implications:** Potential to increase the impact on living resources from our WQ and restoration investments.

### Achieving Water Quality Standards




**Findings:** Bay water quality is improving, but the magnitude of the improvement appears to be lagging behind expectations

**Implications:** Full (100%) achievement of Bay water quality standards is a distant and doubtful.

### Achie

**Findings:** Nonpoint
not generating the
needed to achieve

**Implications:** To sul
nonpoint source ou
new programs and

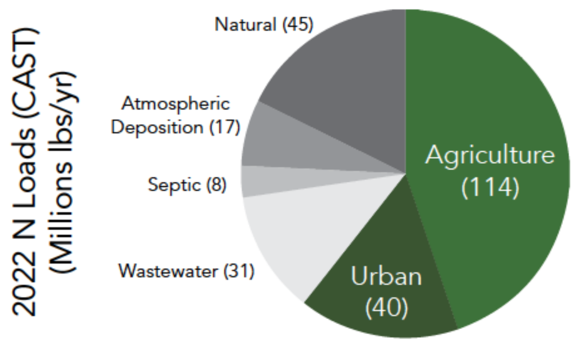
**Overarching Finding**: Complex problem with tradeoffs, uncertain outcomes, and no single "silver

**Overarching Implication**: Experiment, learn, and adapt

# Finding: Nonpoint source programs not generating enough pollut reductions to meet the TMDL.

## *Nonpoint source reductions are essential to meeting pollutant reductio*

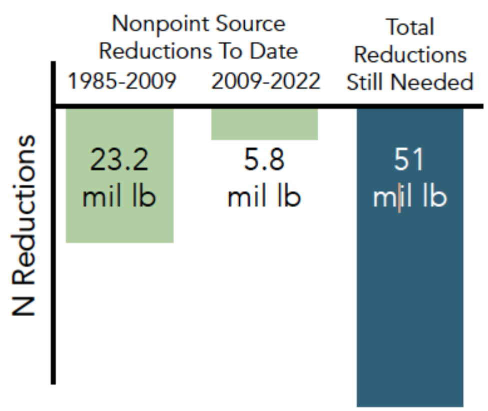
Nitrogen




Point source nutrient loads, primarily wastewater loads, have been dramatically reduced already, leaving little opportunity for more reductions. The CESR report focuses on the largest, manageable sources of nutrients to the Bay – agricultural (green) and urban (dark green) nonpoint source pollution.

Phosphoru


## *Current nonpoint source programs are not producing enough adoption*




To reduce nutrient pollution, new approaches must accele adoption of nutrient reduction practices in the locations w greatest load reduction potential. Over 50 million pounds nitrogen reduction is still needed to meet the current targ has taken over a decade to generate less than six million p nonpoint nitrogen reductions.

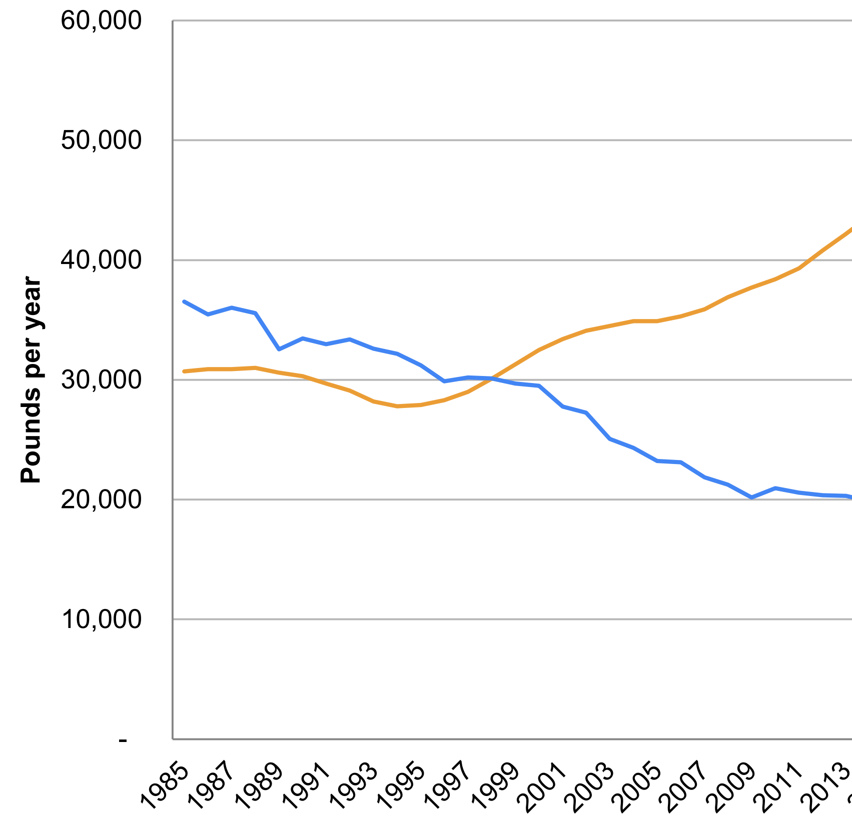
# Findings: Achieving Pollutant Reduction

## 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, Chop

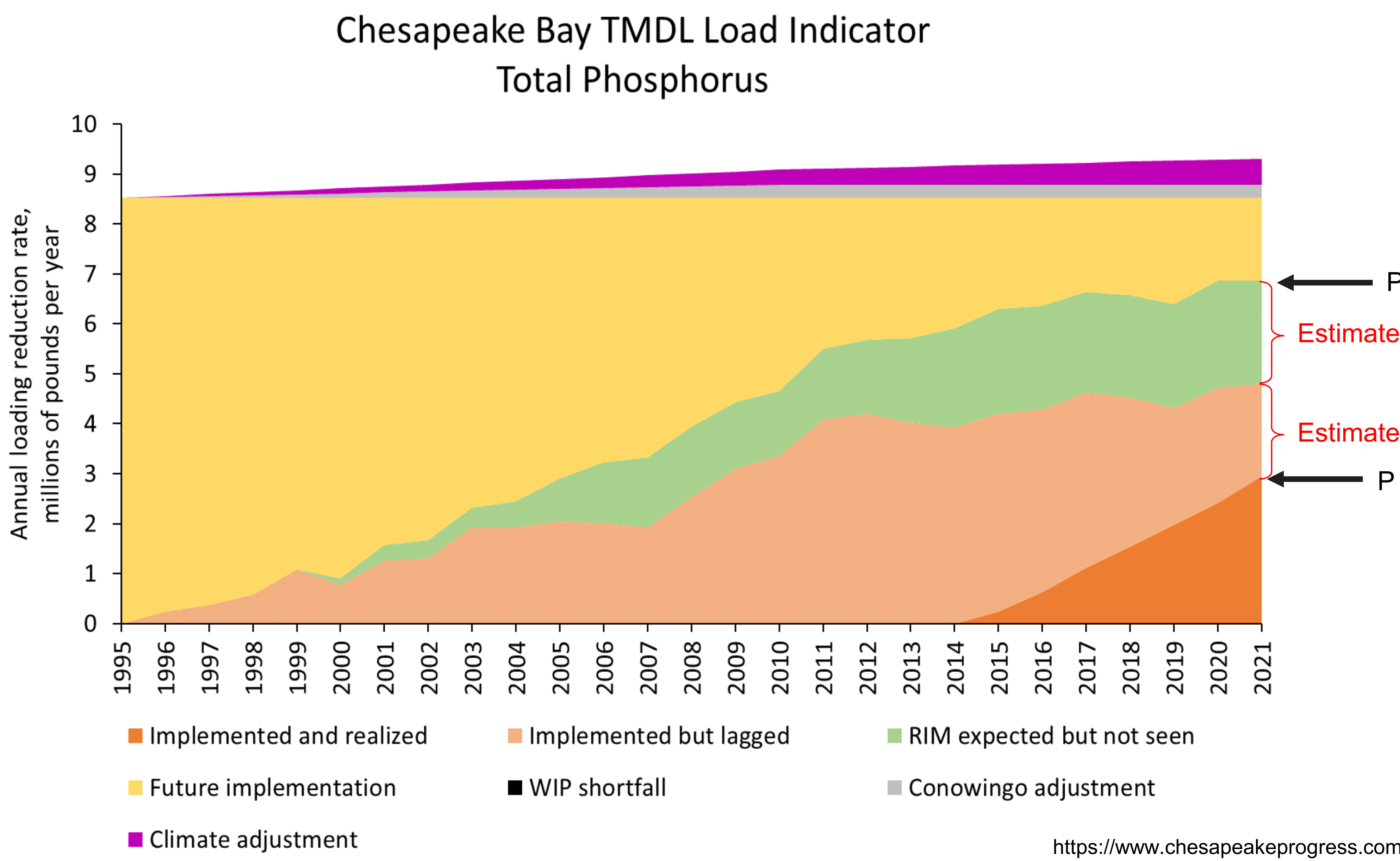


# What might explain the difference?

Lag times (solution: wait)

Knowledge gaps and uncertainties in understanding system response

# Phosphorus Response Gap

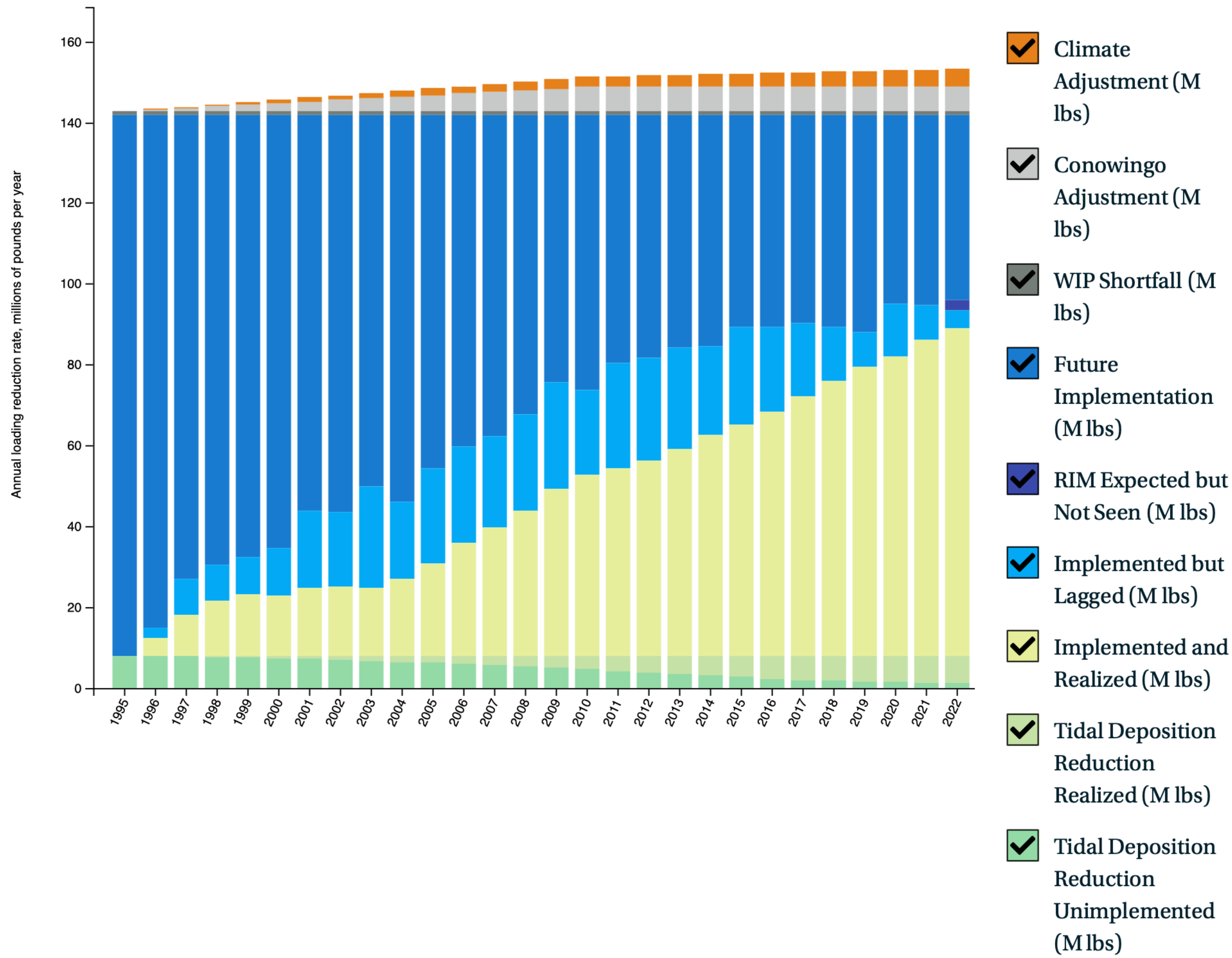



https://www.chesapeakeprogress.com

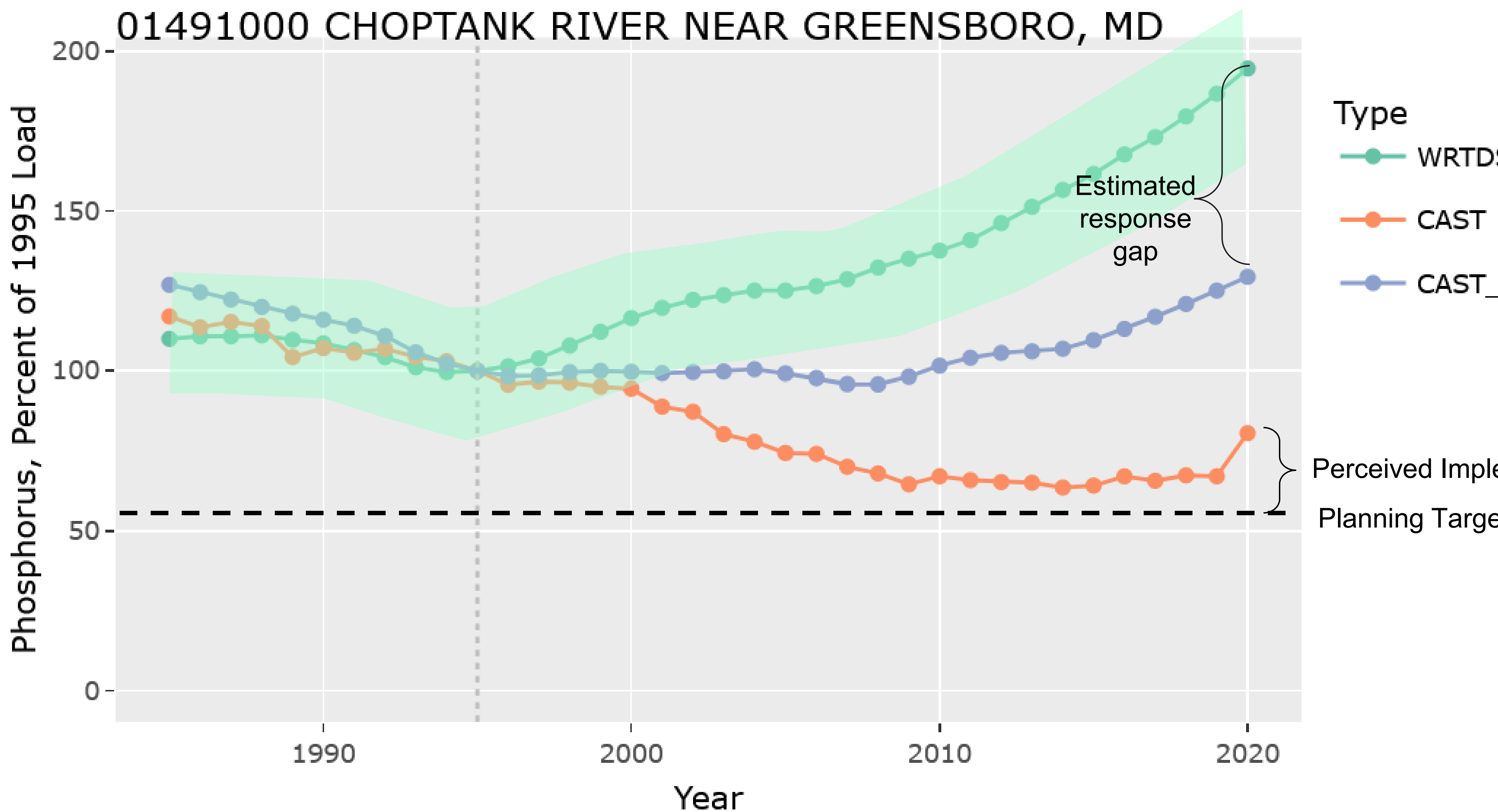
## Bay TMDL Indicator

VIEW CHART VIEW TABLE

Nitrogen Phosphorus

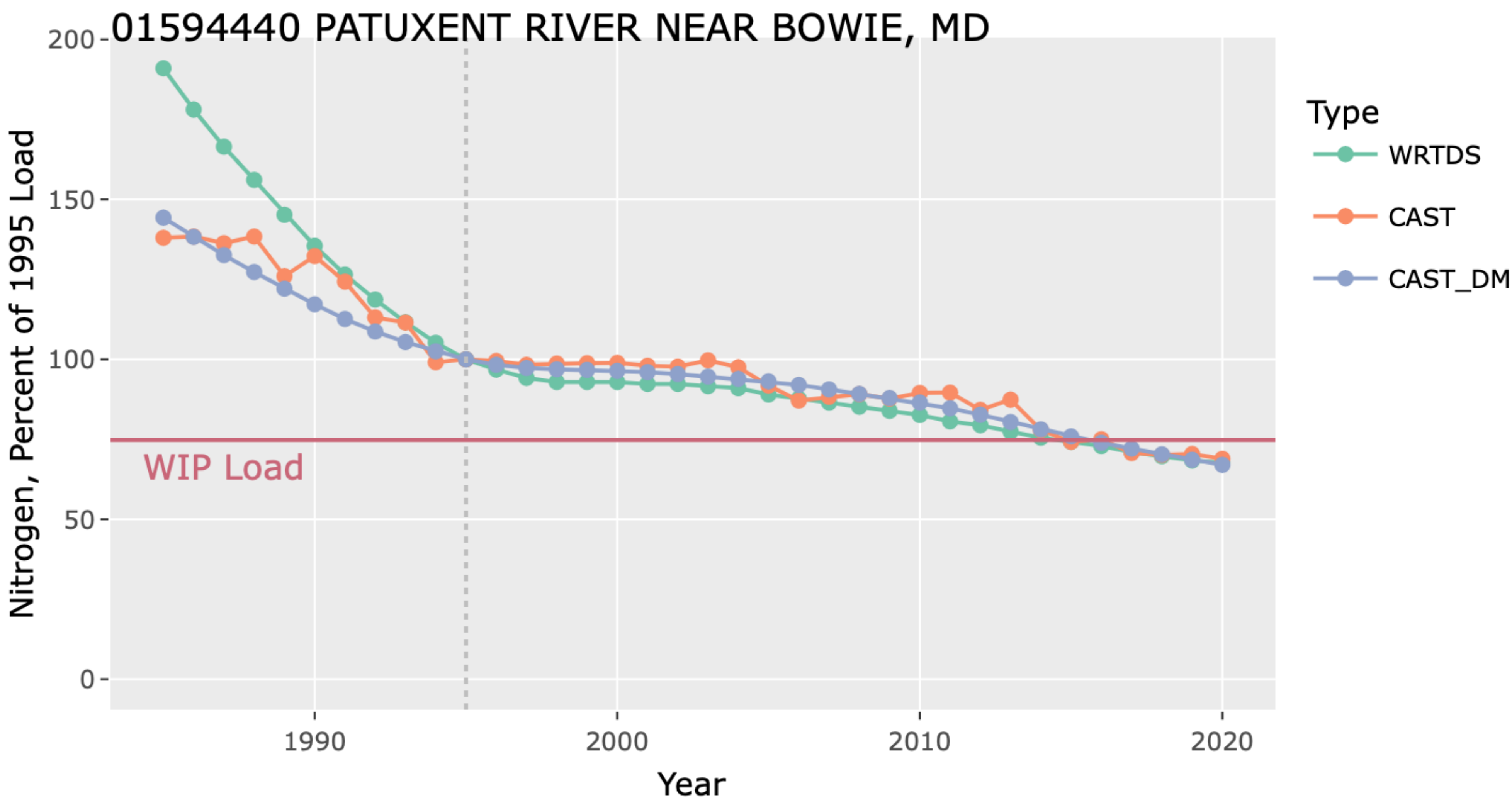


# Response gaps at local scales (Phosphorus)



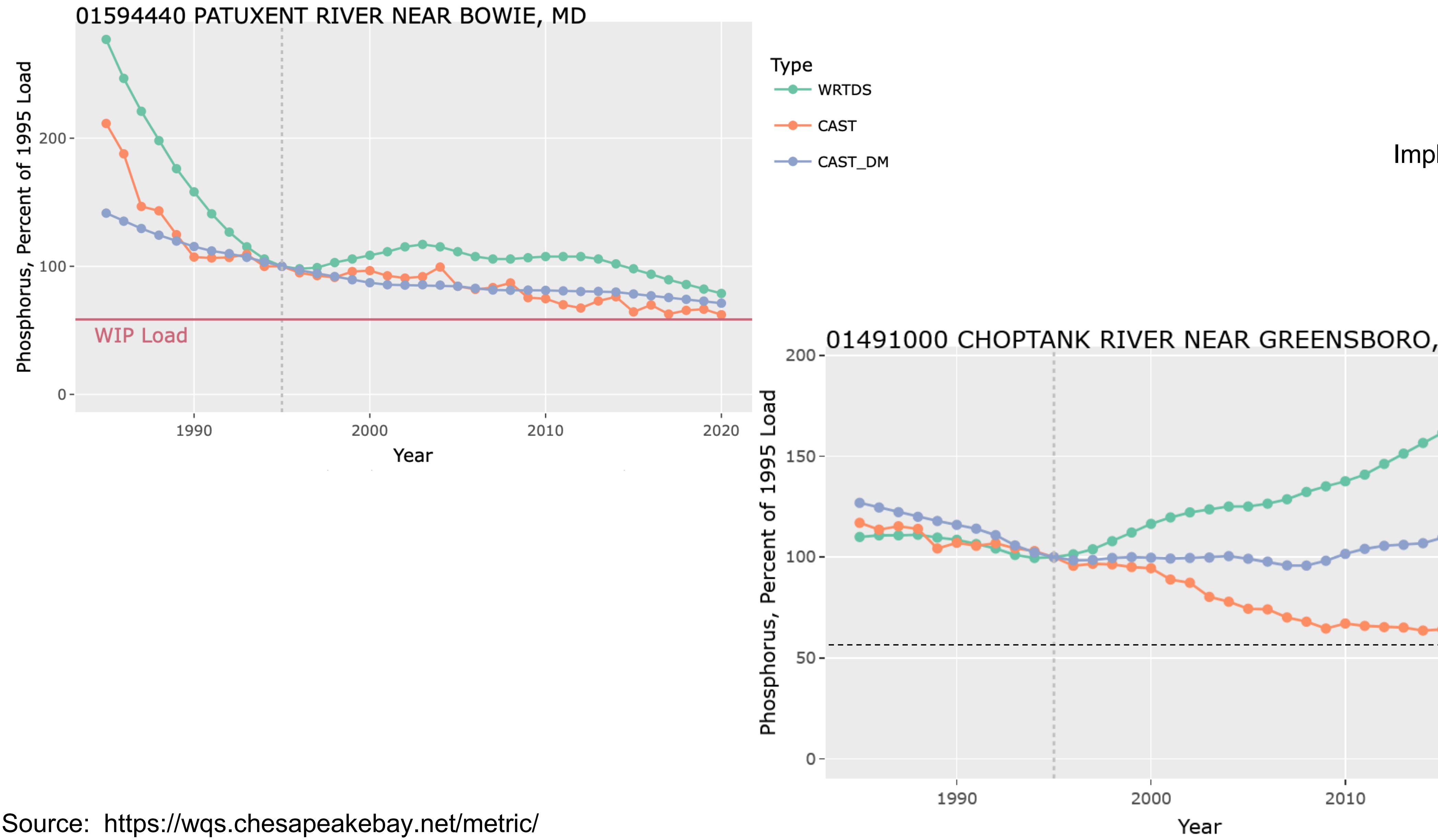

Source: https://wqs.chesapeakebay.net/metric/

# Response gaps at local scales (Nitrogen)



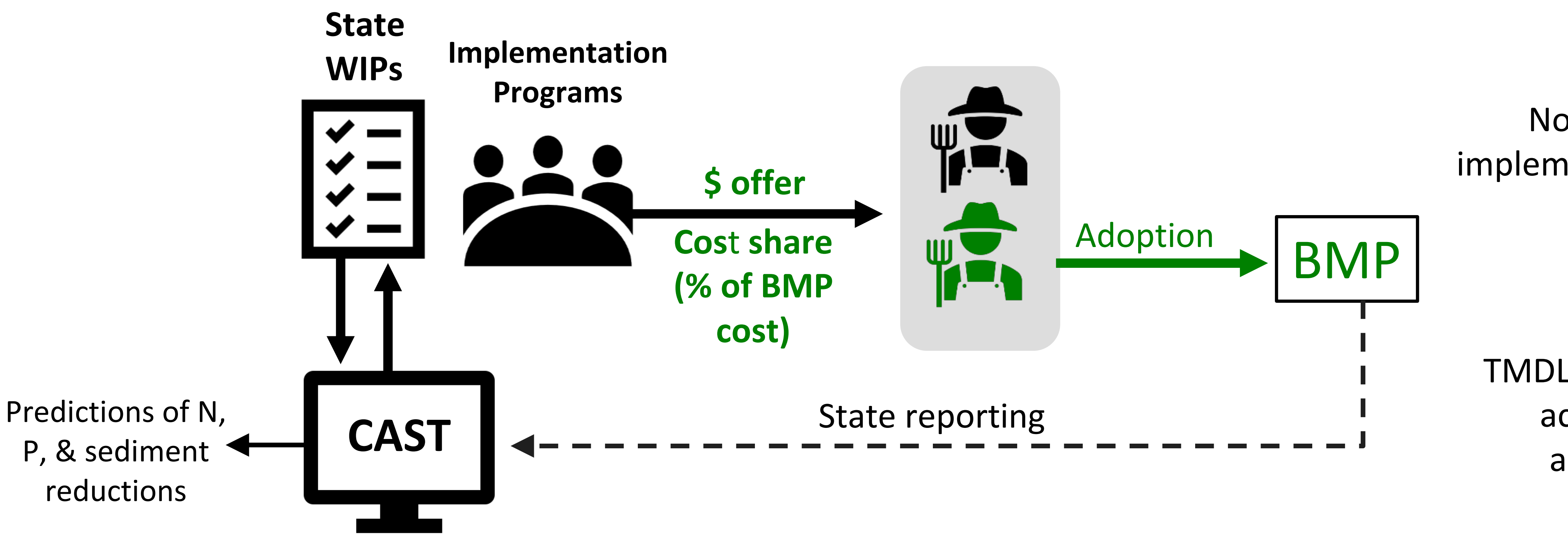

Source: https://wqs.chesapeakebay.net/metric/

# Different Stories Across the Watershed

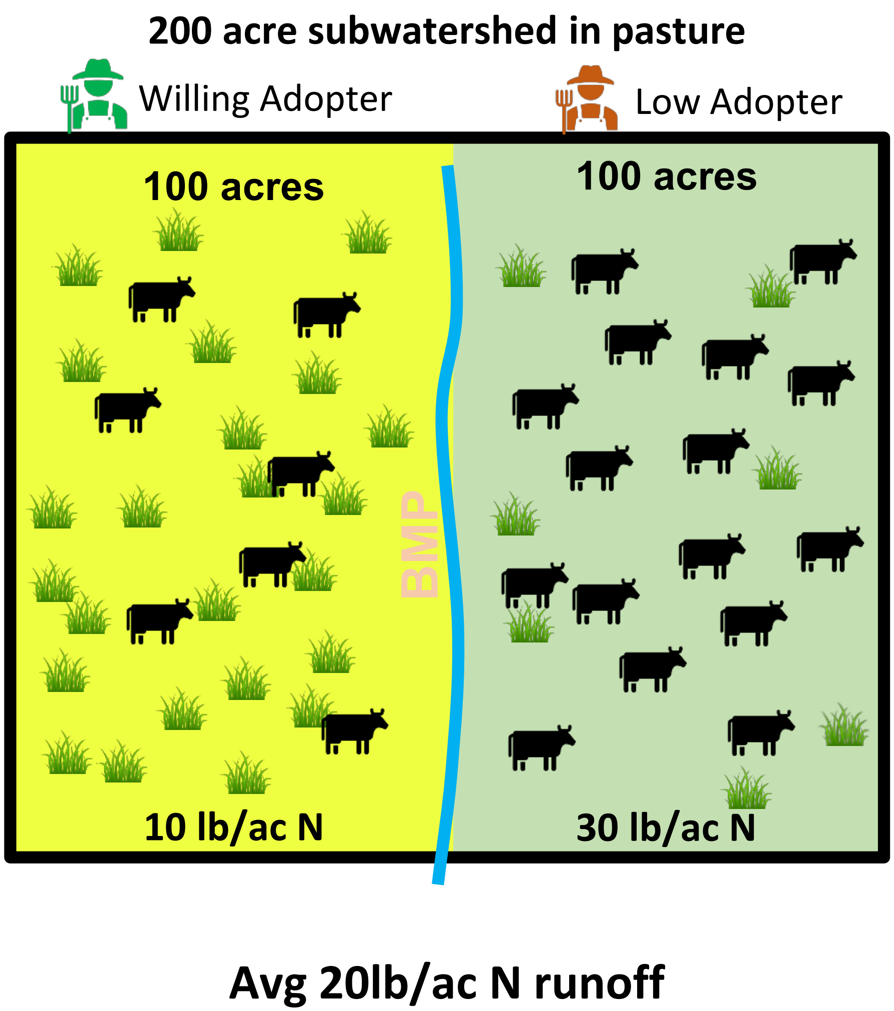



Source: https://wqs.chesapeakebay.net/metric/

# Nonpoint Source Policy

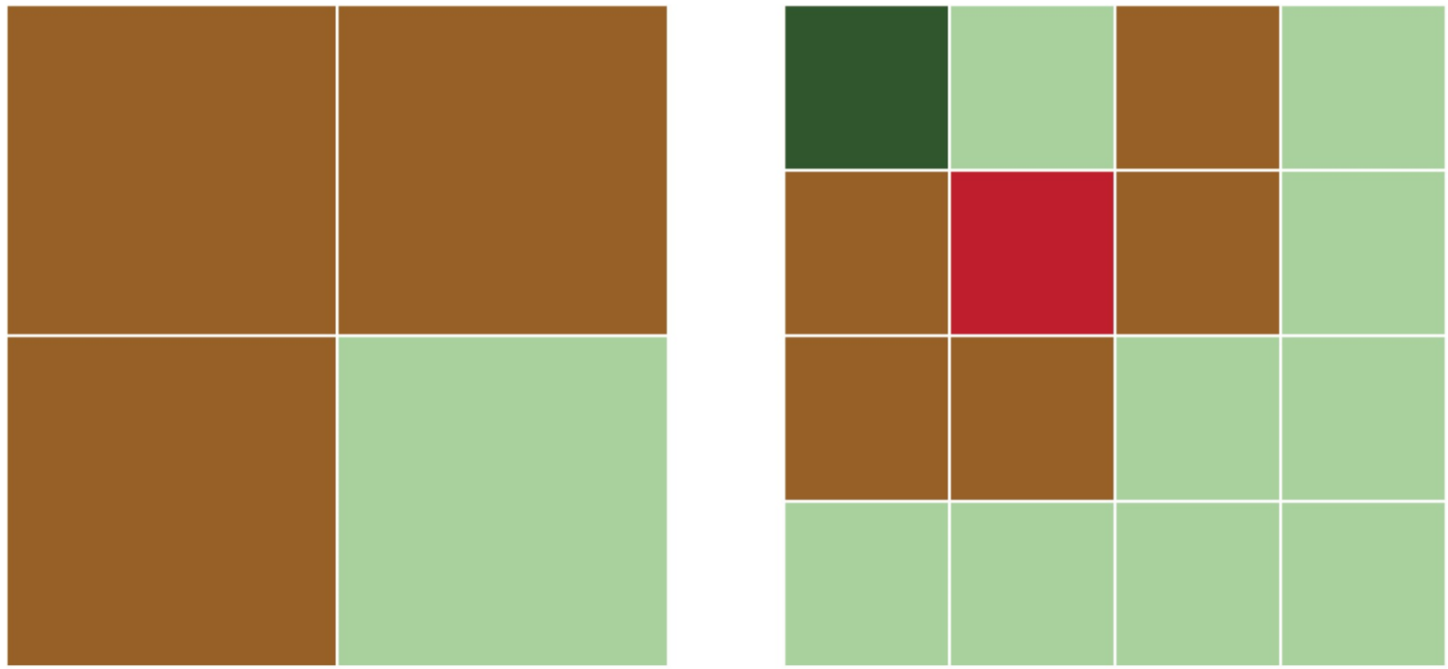


# The problem with coarse scale




| Scenario | Willing Adopter | Low Adopter |
|---|---|---|
| Actual Starting | 1000 lbs | 3000 lbs |
| CAST Assumed Starting | 2000 lbs | 2000 lbs |
| CAST w/BMP: 50% reduction on 50% of area | 1500 lbs | 1500 lbs |
| Actual w/ 50% reduction by Willing Adopter | 500 lbs | 3000 lbs |

# Targeting Conservation



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

# Incentivize Outcomes

Cover crops

Livestock Exclusion Fencing

Bioreactor

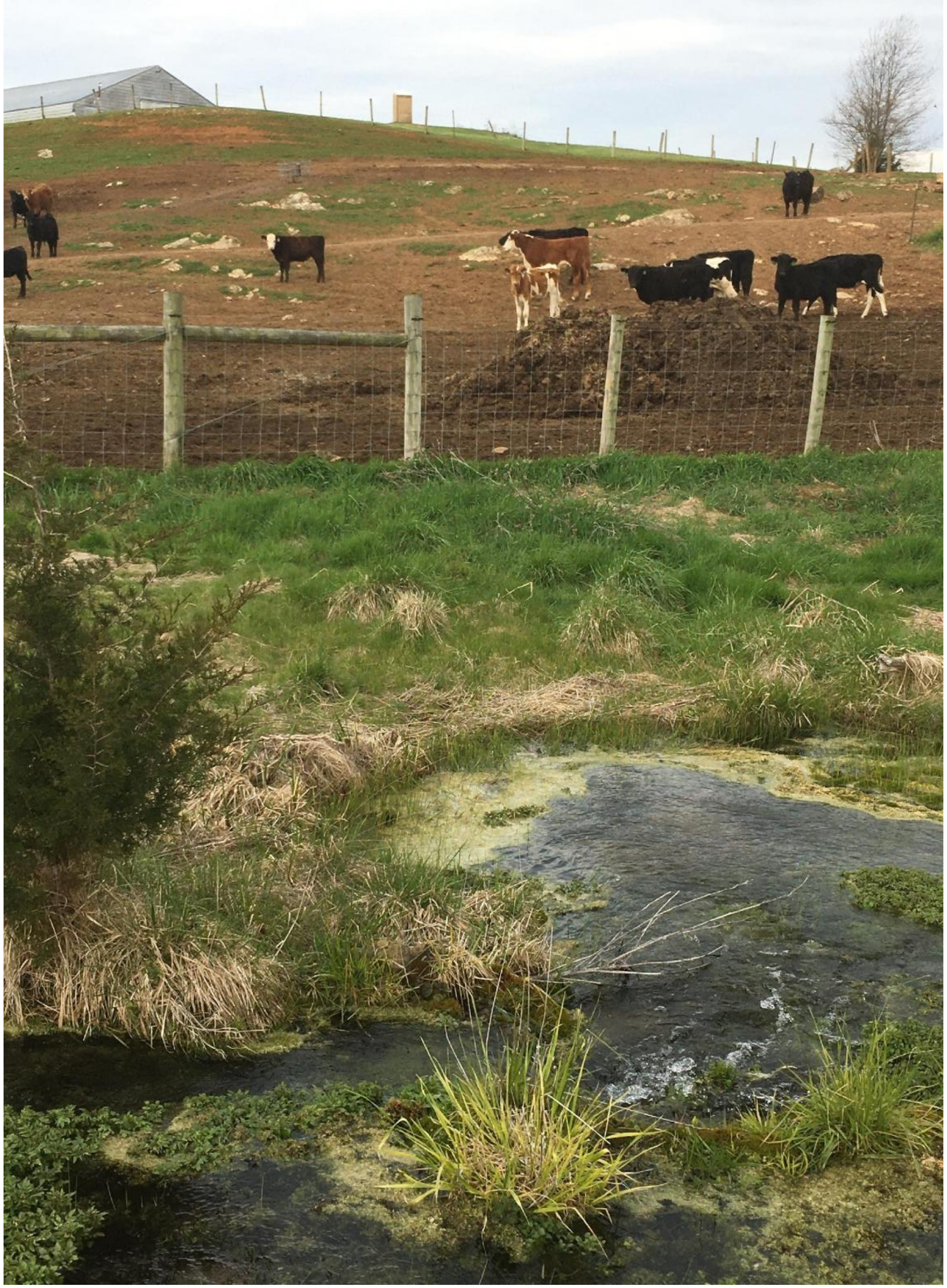
Low upfront installation costs
Private benefits

High up front insta
No private benefits

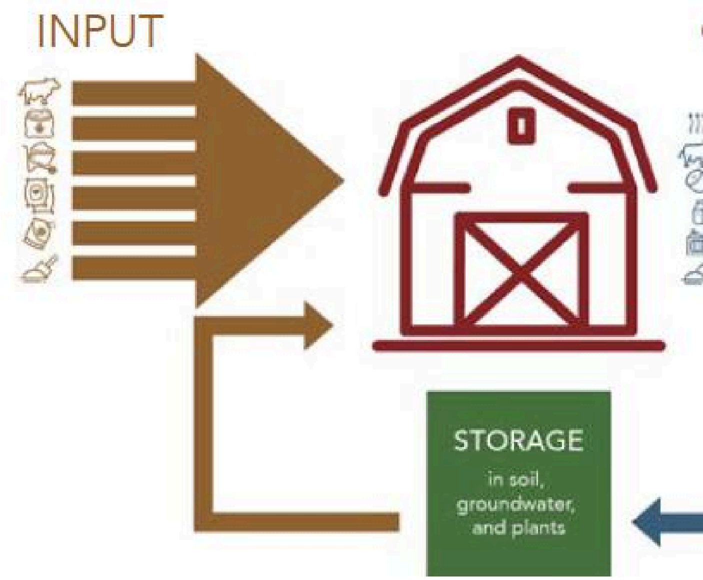
Under voluntary cost-share programs, adoption rates fall from left to right

Would different incentive systems create different adoption b

# Additional Focus on Mas



3x increase in
animal numbers

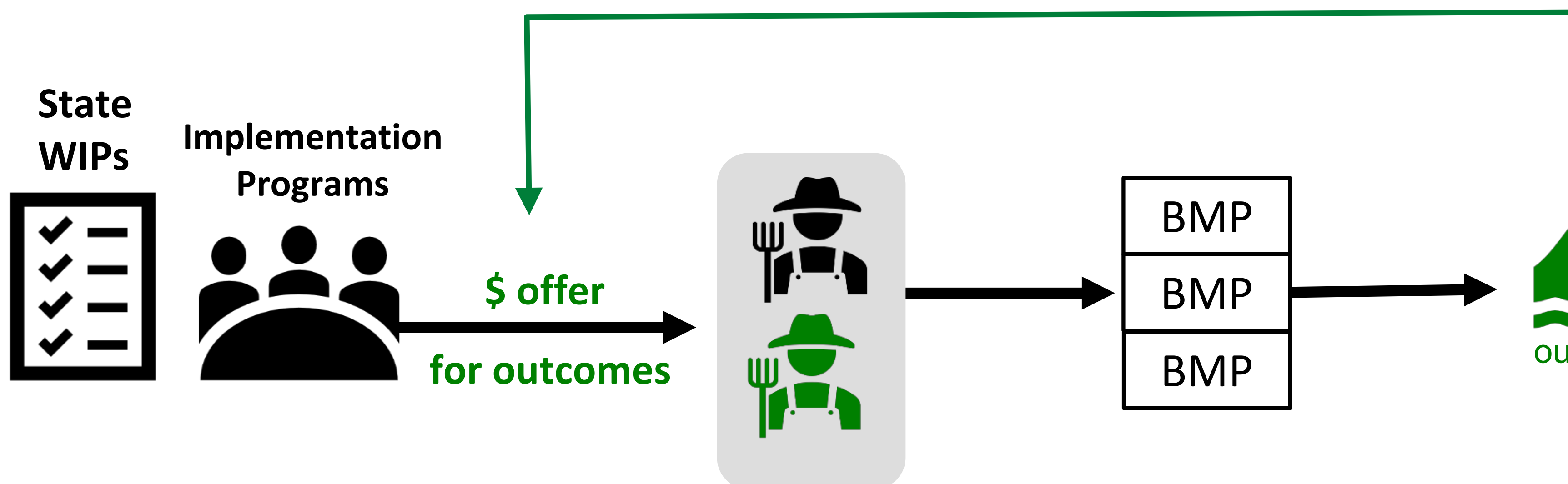



Result:
Increasing N
and P loads

4x increase
in BMPs

Sabo et al. 2021

# Pay for Performance (outcomes)

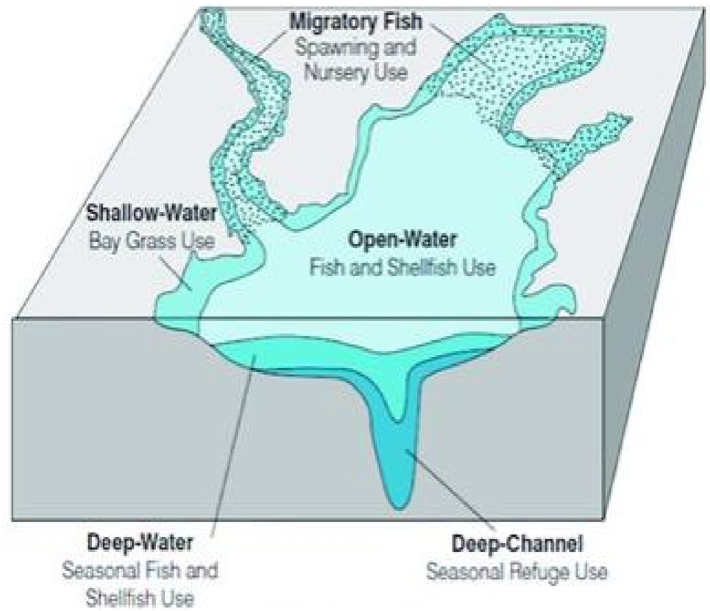


# Brief Refresher on Bay Water Quality Criteri

| Numeric Criteria |
|---|
| **Dissolved Oxygen (DO)** (30 day avg, 7 day avg, instantaneous): |
| **Water Clarity/Aquatic Vegetation** |
| **Chlorophyll a** |

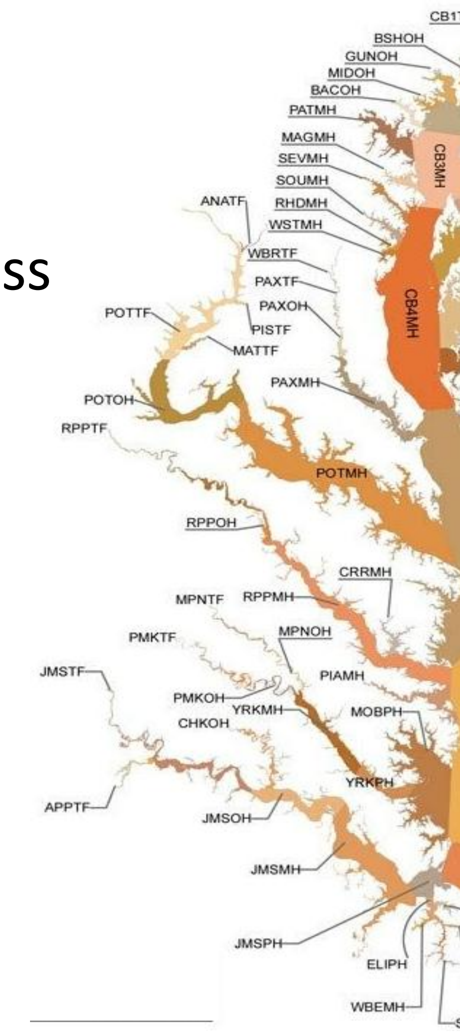
within

5 Bay habitats

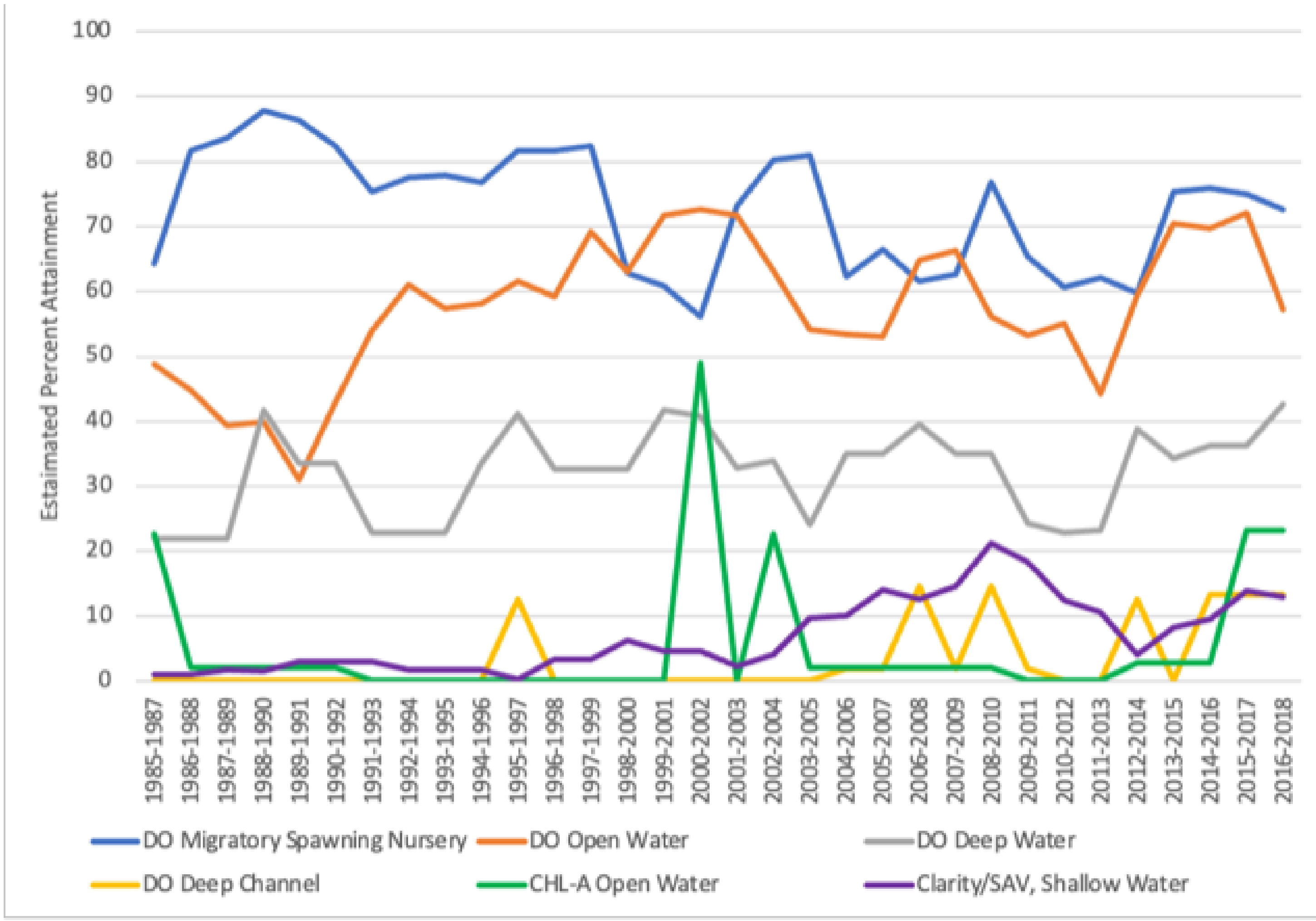


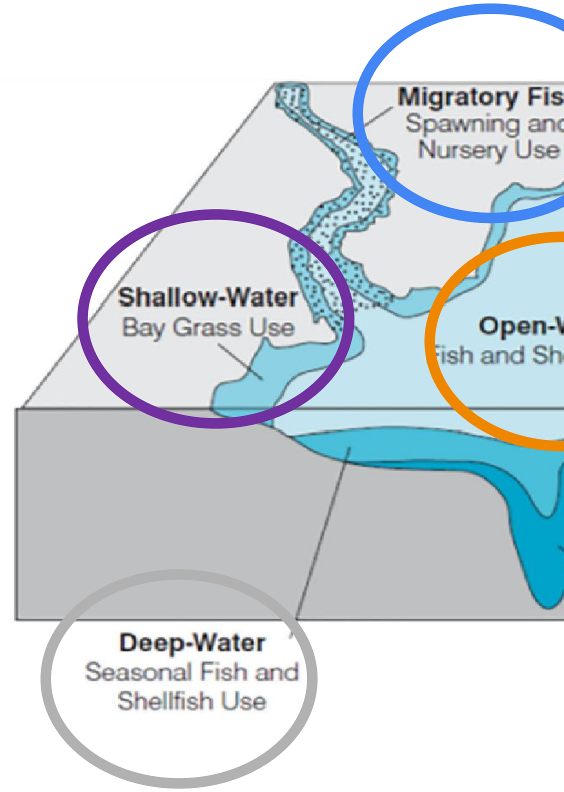

across

92 "se



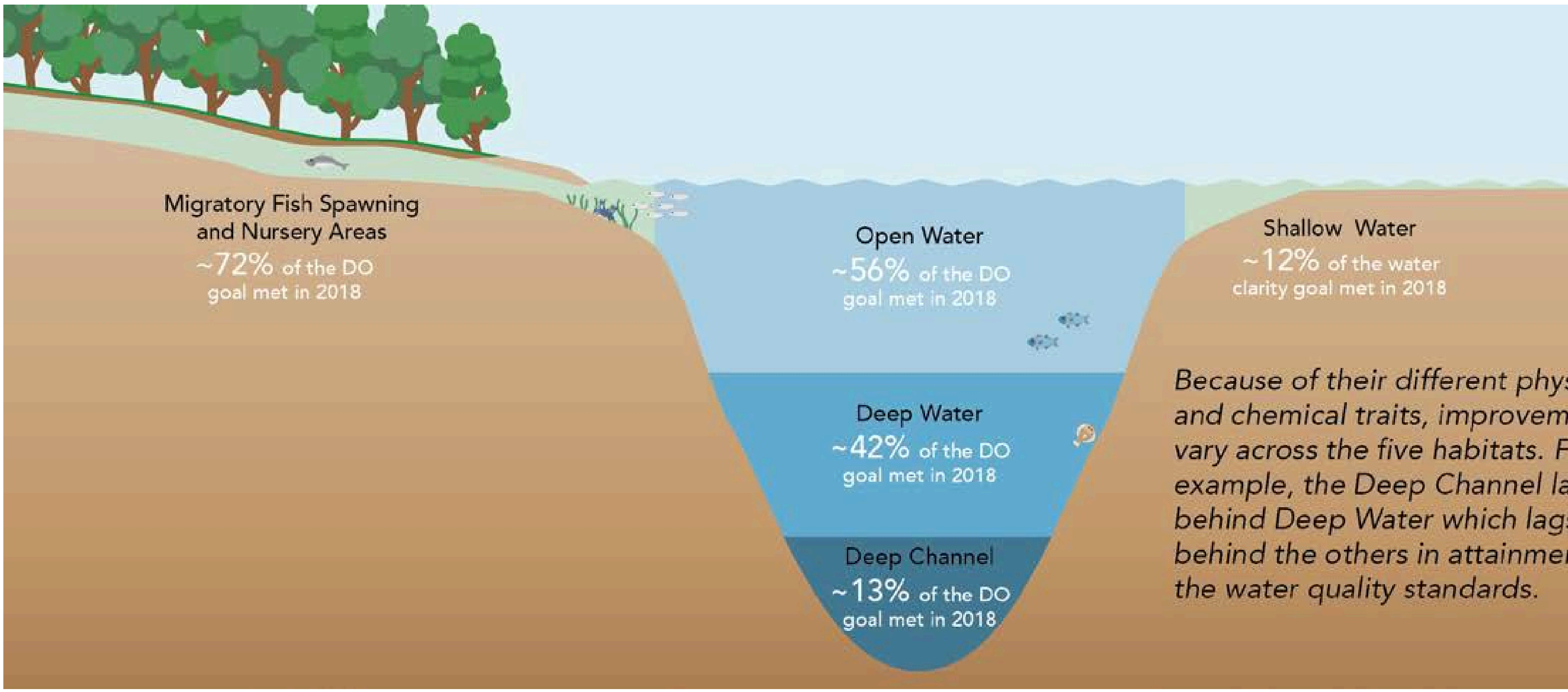
# Attainment of Water Quality Criteria Across Habit



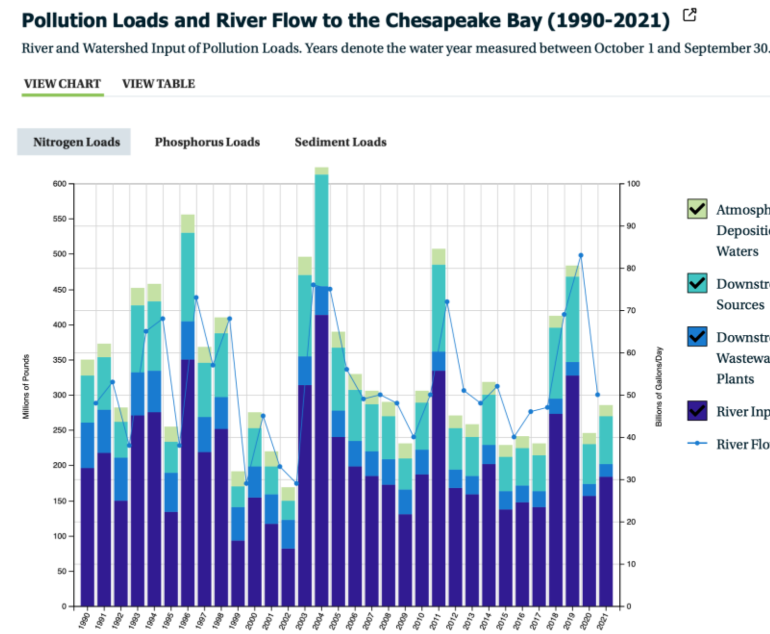

Source: Zh

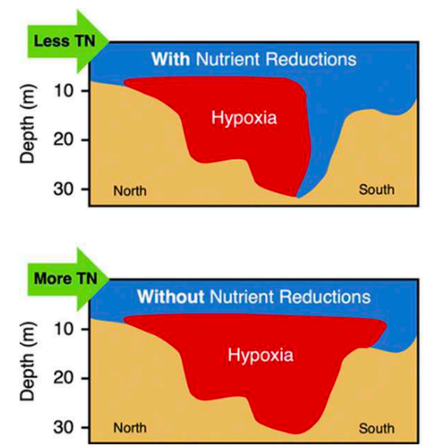
**Finding: Water quality is improving, but not as expected. So habitats are resistant to improvement, suggesting that our g might not be met, or at least might remain unmet until the future.**




# Why?

- Load reductions are not sufficiently large over an extended period
- Climate change, especially warming of Bay waters, has dampened the response that we expected from load reductions



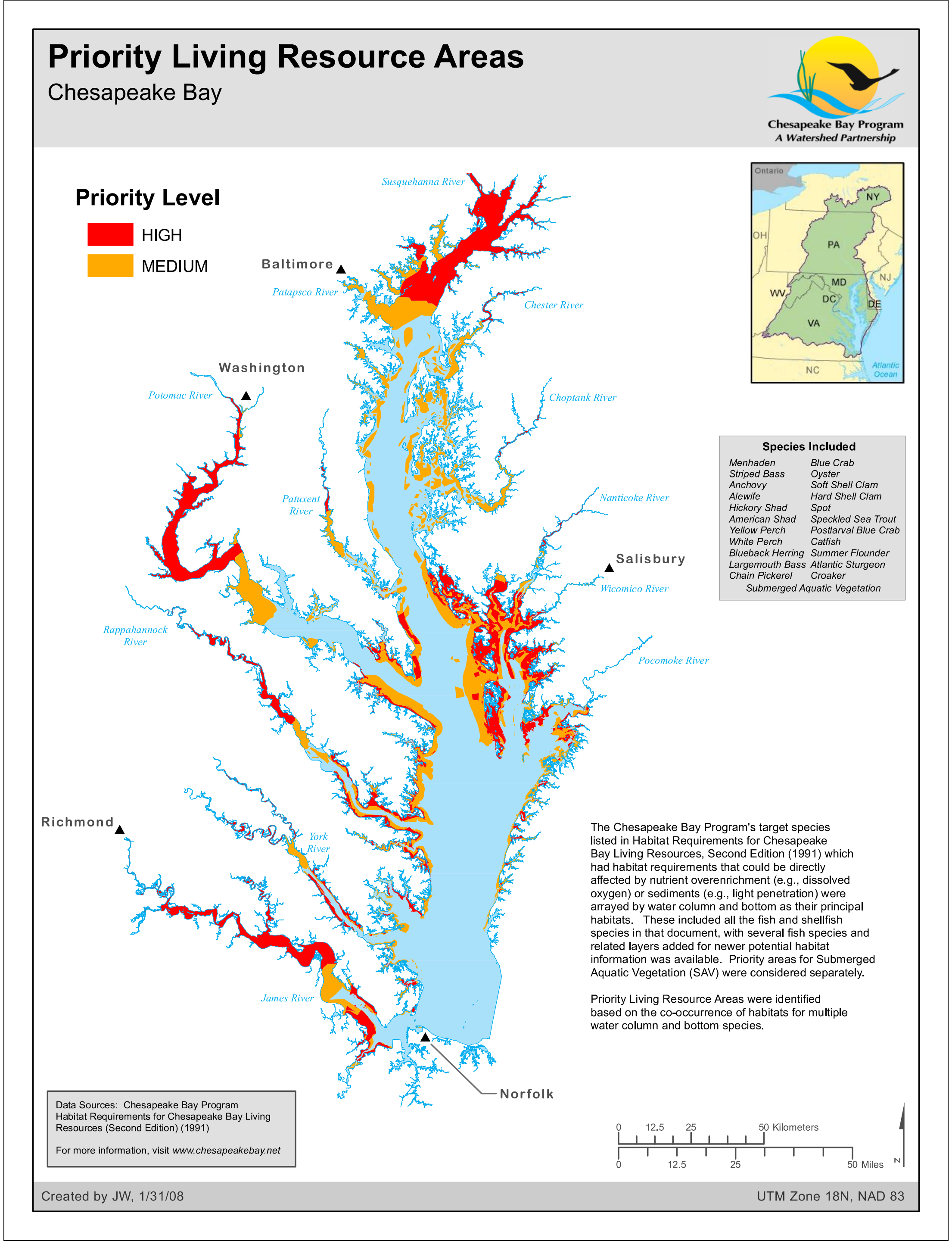




**If 35 years of nutrient reductions had not occu hypoxia would have:**

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

# Achieving Bay Wat
# Goals

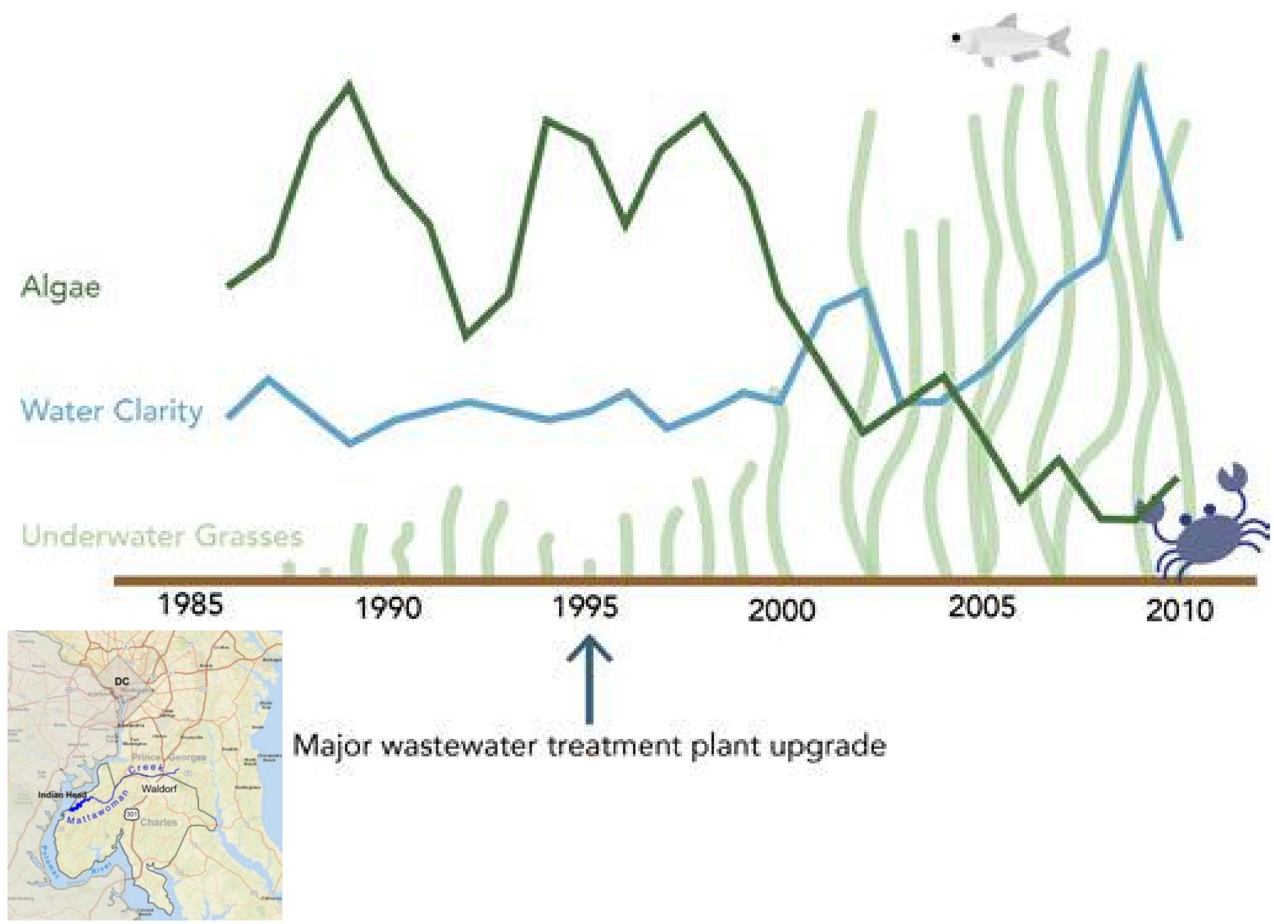
**Opportunity: Prioritize our e
attain water quality standar
that we can achieve the larg
possible benefit to living res
(example: tiered TMDL)**



# Achieving Bay Water Quality Goals

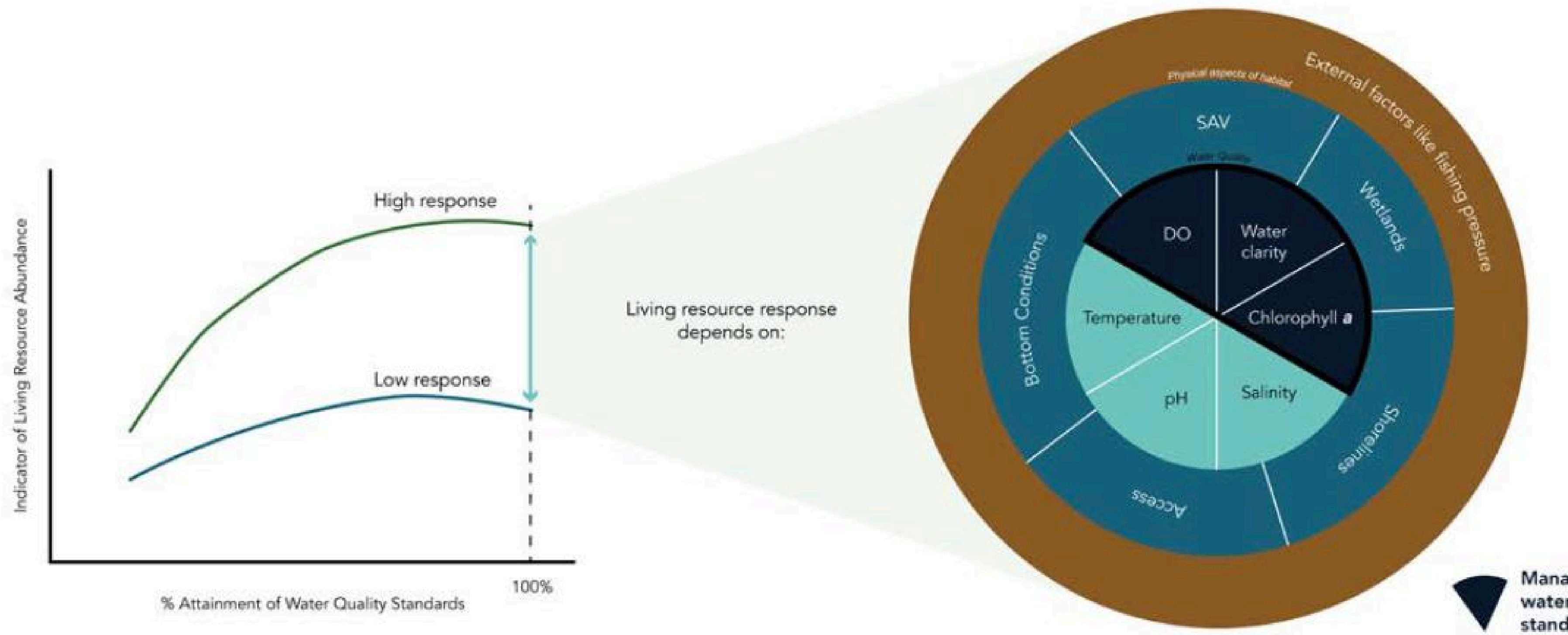
**Opportunity: Full attainment of water quality standards may not be possi steps can be taken to maximize living resource response to improvement**

Mattawoman Creek



# Achieving Bay Water Quality Standards/Living Resource Response

**Opportunity: Significant enhancement of LR can be achieved with add management actions without complete attainment of water quality g**



# Achieving Bay Water Quality Standards/LR Resp

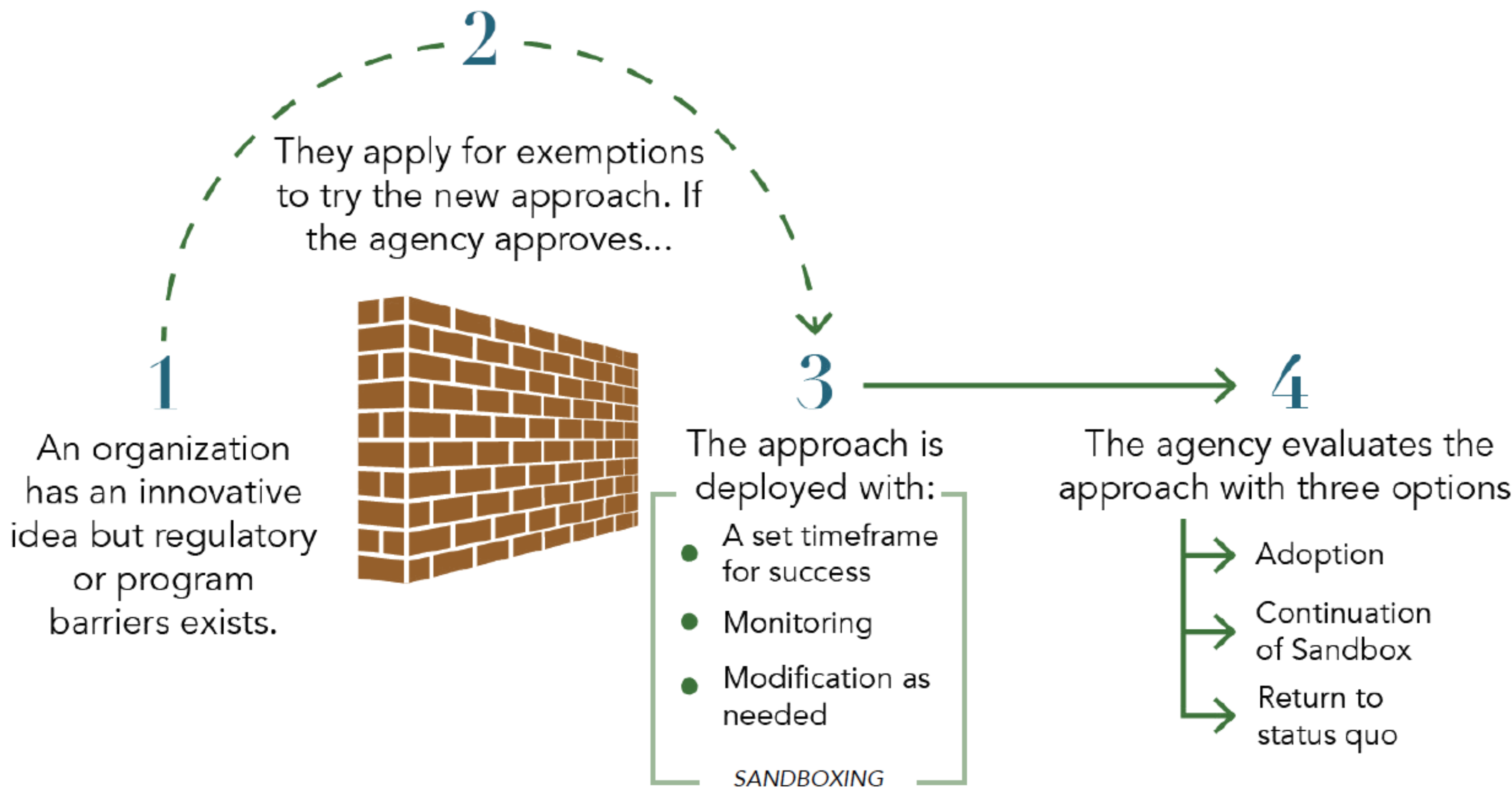
## Opportunity: Don’t leave benefits to Living Resources on the table

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


Credit: Center for Coastal Resources Management; Kelsey Broich, Network for Engineering with Nature, University of Georgia; Integration and Application Network (ian.umces.edu/media-library)

# Adaptive Management

## Finding: Making “learning while doing” central to Bay management





Achieving Water Quality Goals in the Chesap
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Response (CESR)
https://www.chesapeake.org/stac/cesr/
The Report
CESR
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