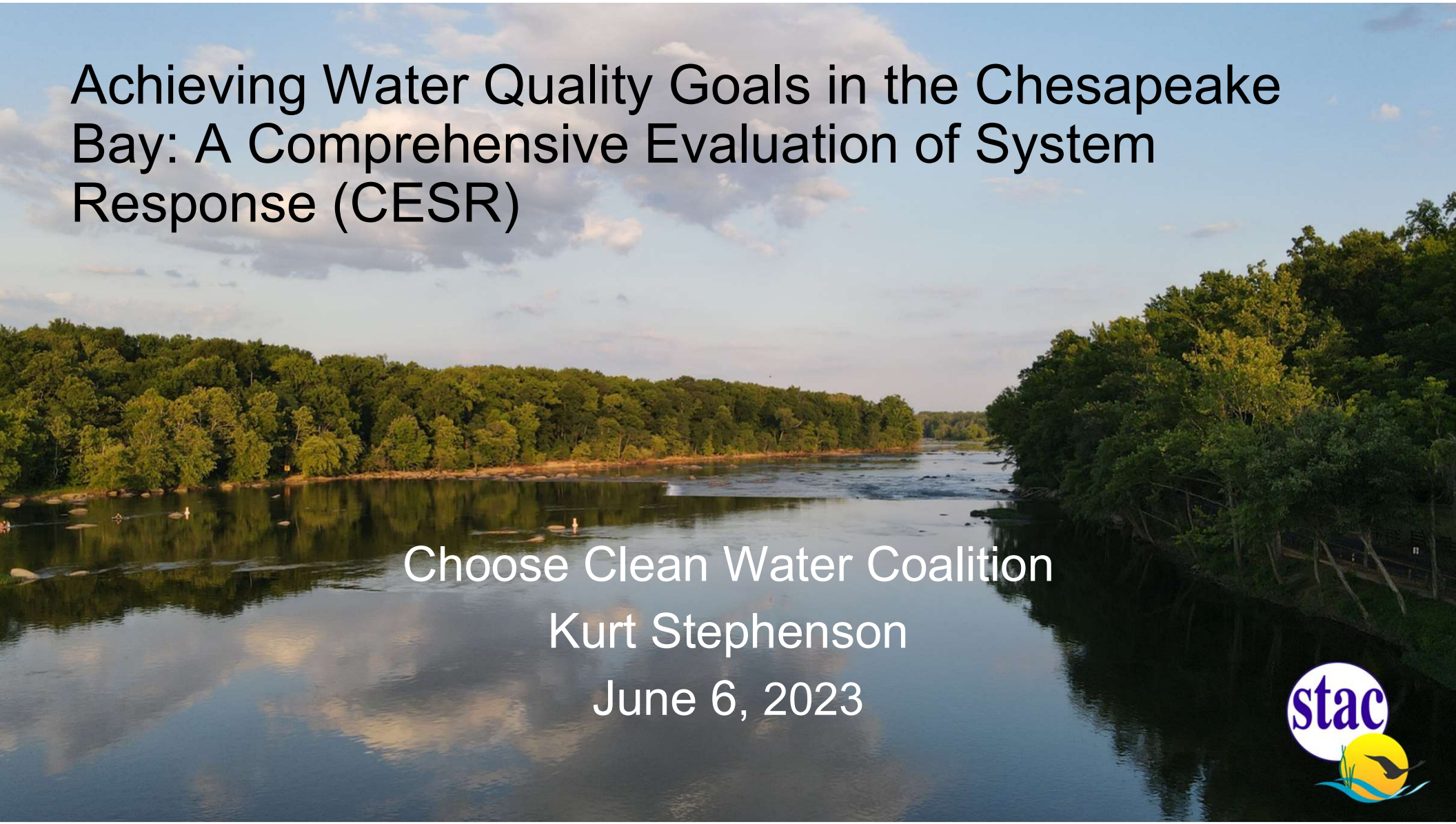
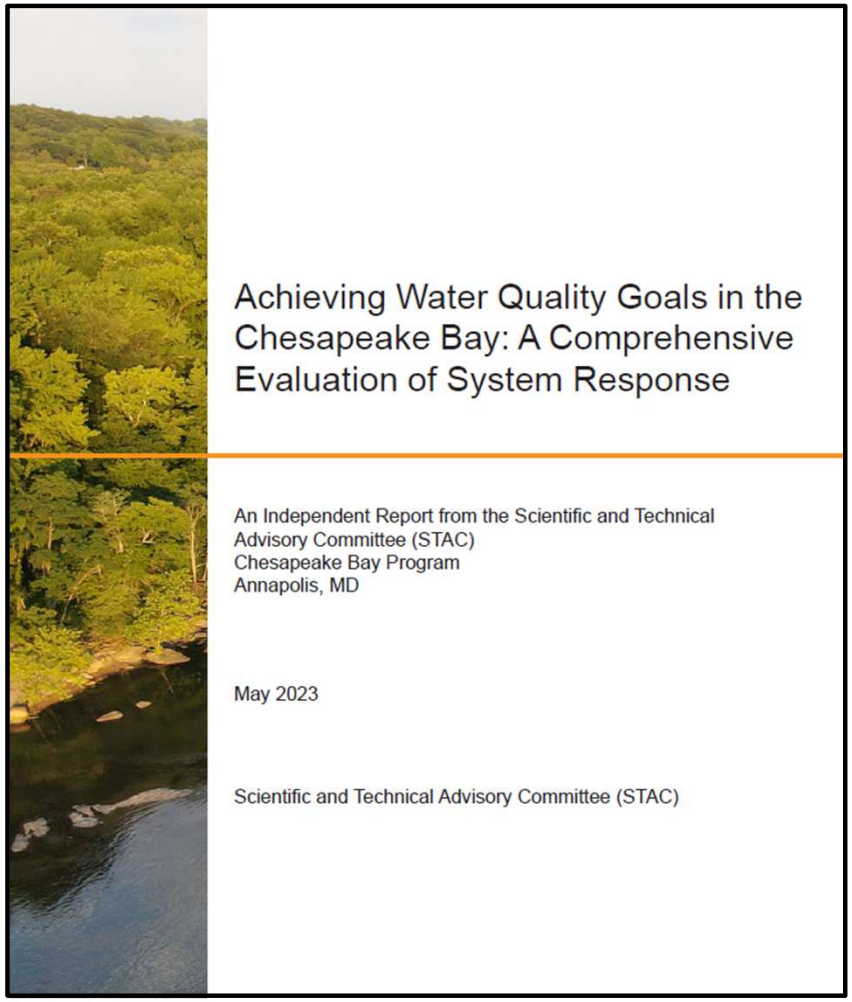
Achieving Water Quality Goals in the Chesapeake Bay: A Comprehensive Evaluation of System Response (CESR)



Choose Clean Water Coalition

Kurt Stephenson

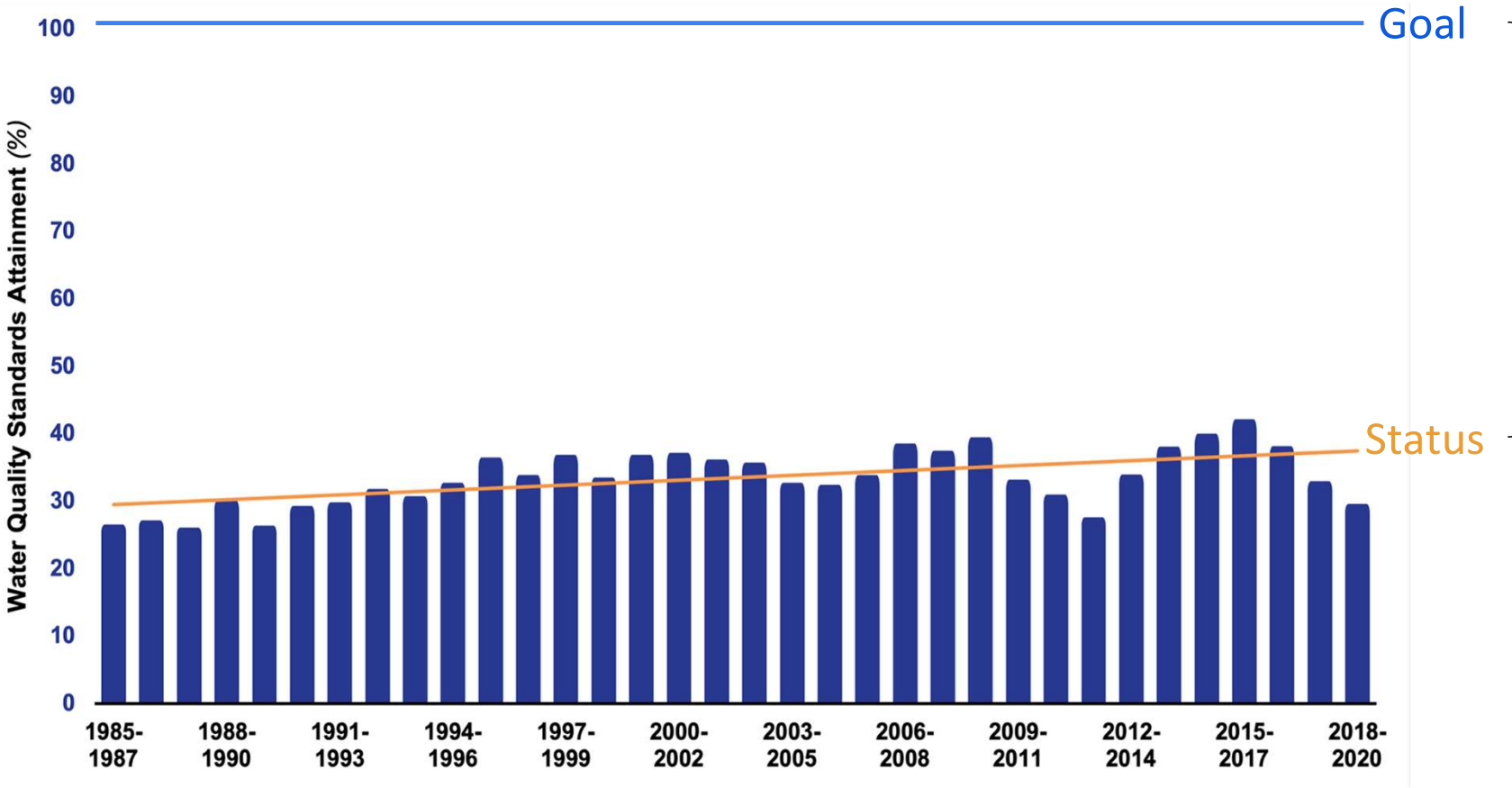
June 6, 2023



"CESR" Report

- 2 editors
- 8 members of a writers group
- 11 steering committee members
- 50+ contributing members of Scientific and Technical Advisory Committee (STAC)

Achieving Bay Water Quality Standards



Why?

How to Improve response?

CESR Conclusions

Gaps in implementation and system response present major challenges to achieving TMDL, water quality goals & improving living resource response.

Opportunities to improve program effectiveness exist but require programmatic change (not just spending more on doing the same things).

Photo by Will Parson/Chesapeake Bay Program

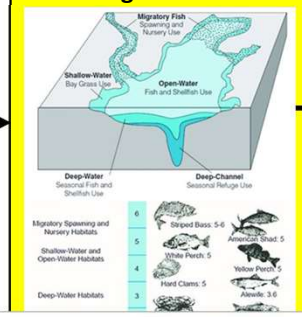
Public Policy

Chesapeake Bay Agreement: Restoration Goals

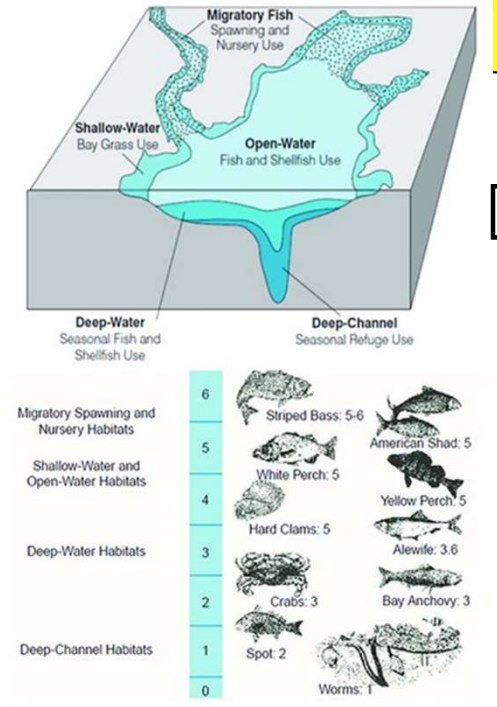
Sustainable Fisheries
Vital Habitat
Water Quality
Toxic Contaminants
Heathy Watershed
Climate Resiliency
Land Conservation
Stewardship
Public Access
Environmental Literacy

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: 13.3m lb/yr
TSS: 18,587m lb/yr

Implementation Policies

Federal permitting
Fed/State nonpoint programs
Funding

TMDL accounting & accountability

Numeric criteria for:
Dissolved Oxygen
Water Clarity/Submerged vegetation
Chlorophyll a

Public Policy

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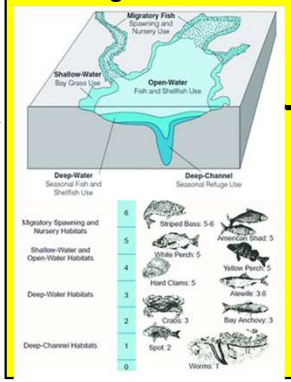

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Biological, Physical, and Social System Response

Achieving TMDL:

Are implementation policies and management actions sufficient to achieve nitrogen, phosphorus and sediment goals in the TMDL?

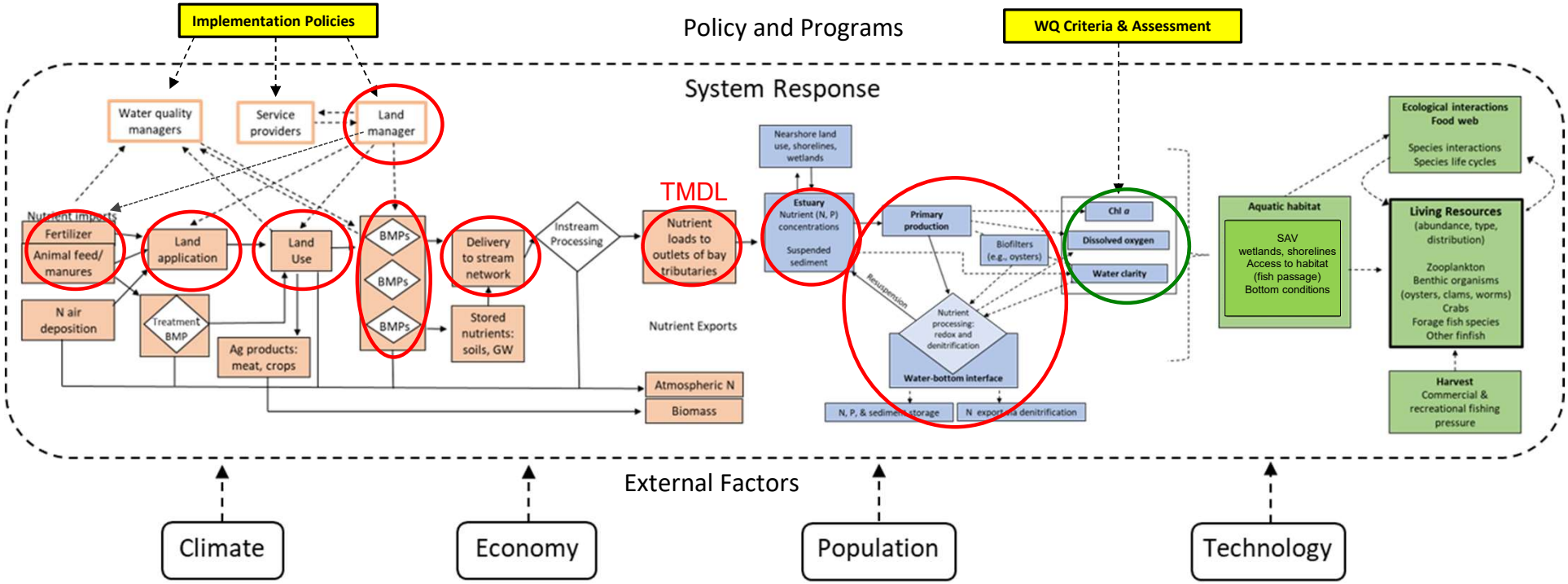
Achieving Water Quality Standards

Are nutrient & sediment reductions producing expected water quality response?

Living Resource Response

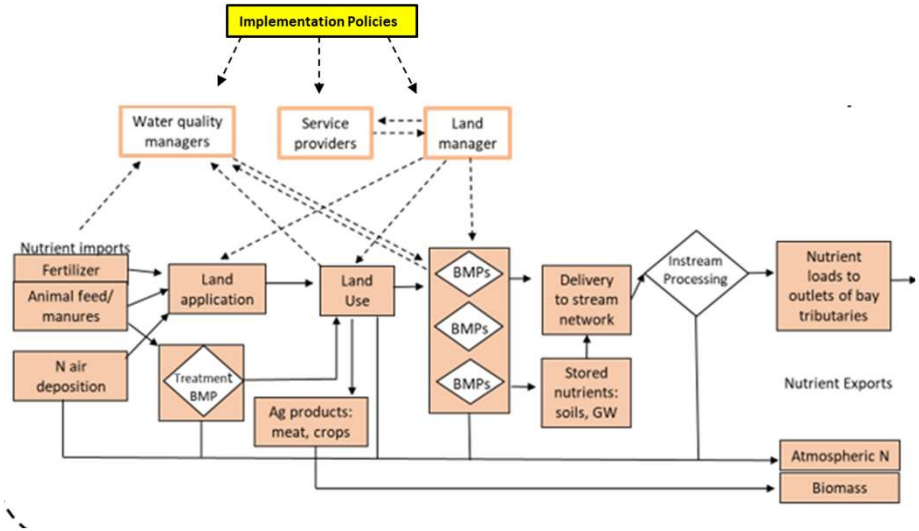
How are living resources responding to changing water quality conditions?

System Response to Meeting Bay Water Quality Standards



Findings and Implications:

Pollutant Response to Management Efforts

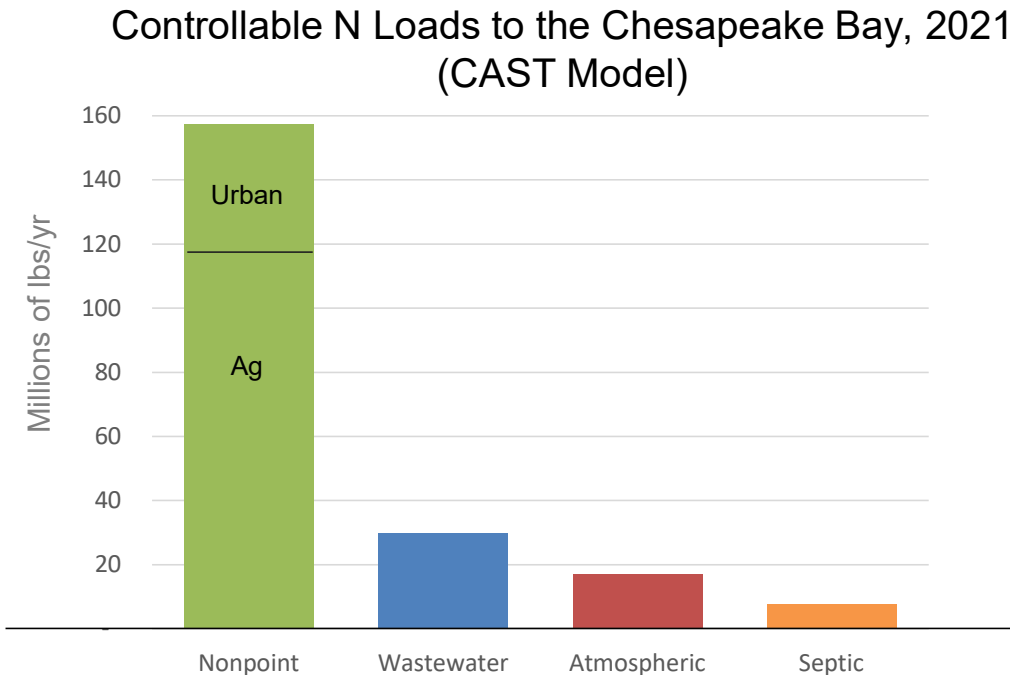


FINDINGS: Achieving TMDL dependent on significant reductions agricultural & urban nutrient runoff (nonpoint).

Existing nonpoint source water quality programs are insufficient to achieve the nonpoint source reductions required by the TMDL

1. Not generating enough implementation
2. Implementation not as effective as expected

Are nonpoint source programs generating enough adoption/change ("implementation gap")?

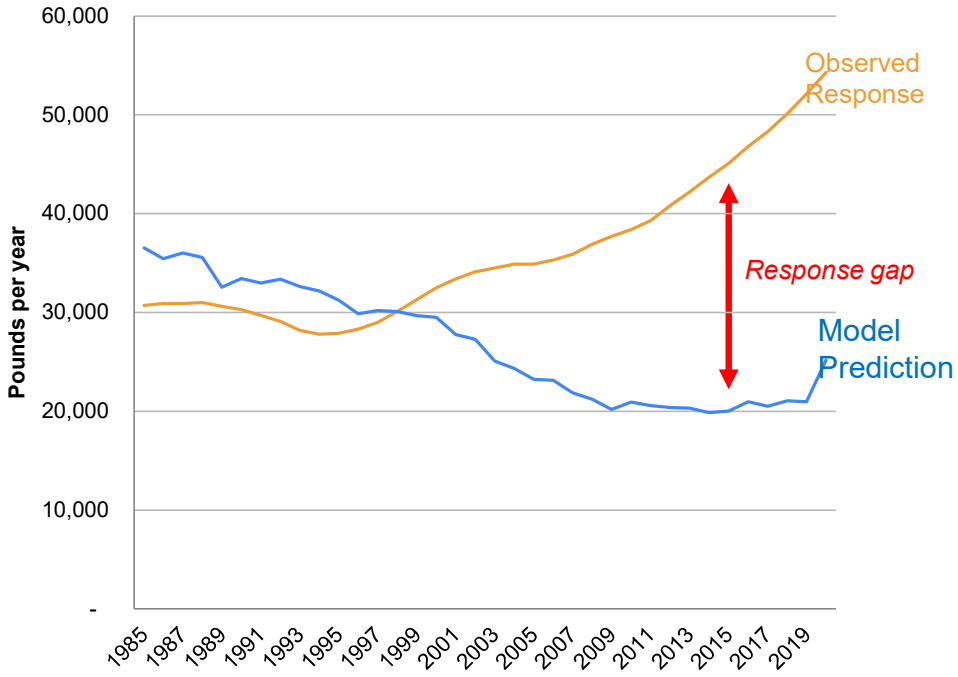


Possible reasons for the limited implementation progress?

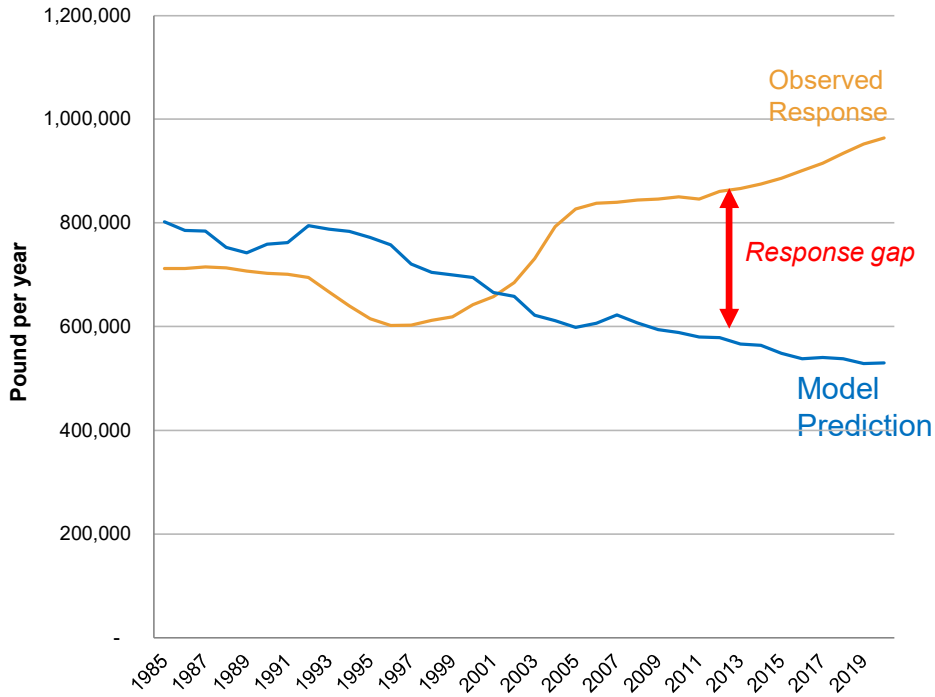
- Nutrient Mass Imbalances
- Limits to current voluntary financial incentive programs (“cost-share”)

Point #2: Nonpoint source practices may not be as effectives as expected

Total Phosphorus Loads, Choptank



Total Phosphorus Loads, Rappahannock



Possible reasons our nonpoint source efforts may not be as effective as we think (response gap)?

- Lag times/Legacy sources (efforts are effective but not yet realized)
- BMP Effectiveness
- Behavior/Implementation (who, what, where)
- Data Limitations (e.g. nutrient inputs)

Opportunities for improving nonpoint source effectiveness

Improving Nonpoint Source Program Effectiveness:

Practices v Outcomes

Cover crops

Livestock Exclusion Fencing

Denitrifying Bioreactor

Low upfront installation costs
Private benefits

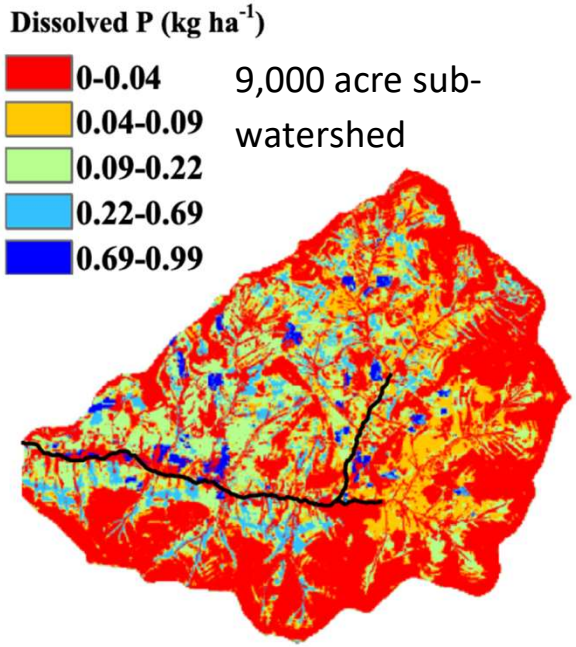
High up front installation costs
No private benefits

Public benefits: Pollutant removal benefits?

$ → Outcome

- Pay for Performance/Success
- Incentives for demonstrated outcomes (greater certainty)

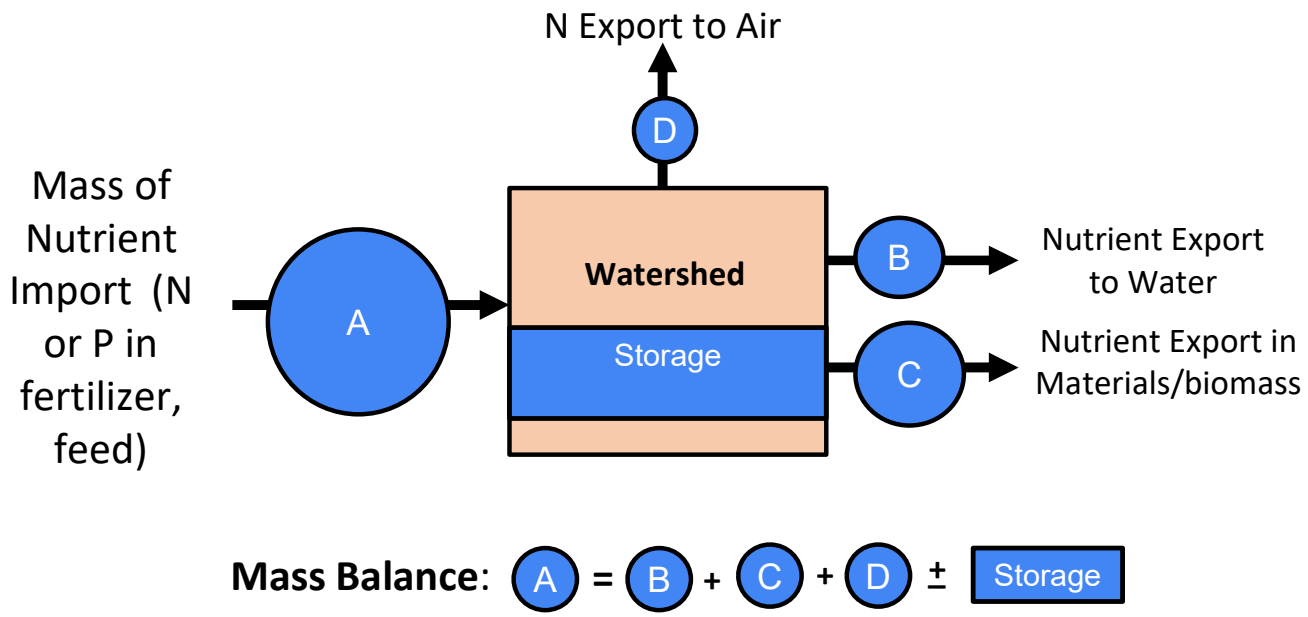
Improving Nonpoint Source Program Effectiveness:
Targeting Outcomes



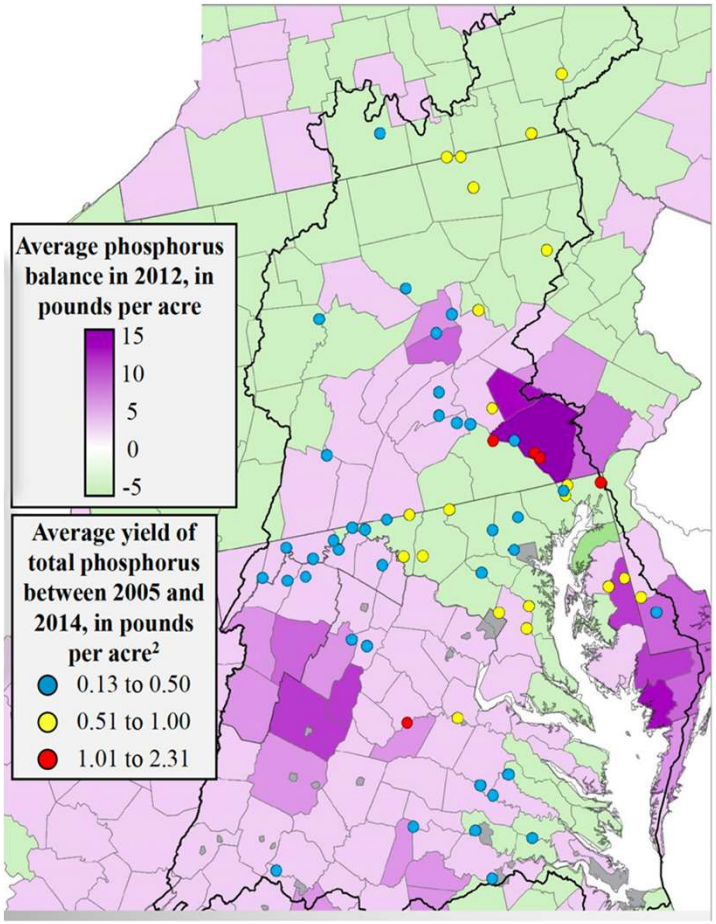
Large variation in nonpoint source loads and BMP effectiveness across landscape and land managers

- Finer scale modeling & monitoring
- Incentives to find & address high load area
- Alternatives to TMDL accounting/crediting

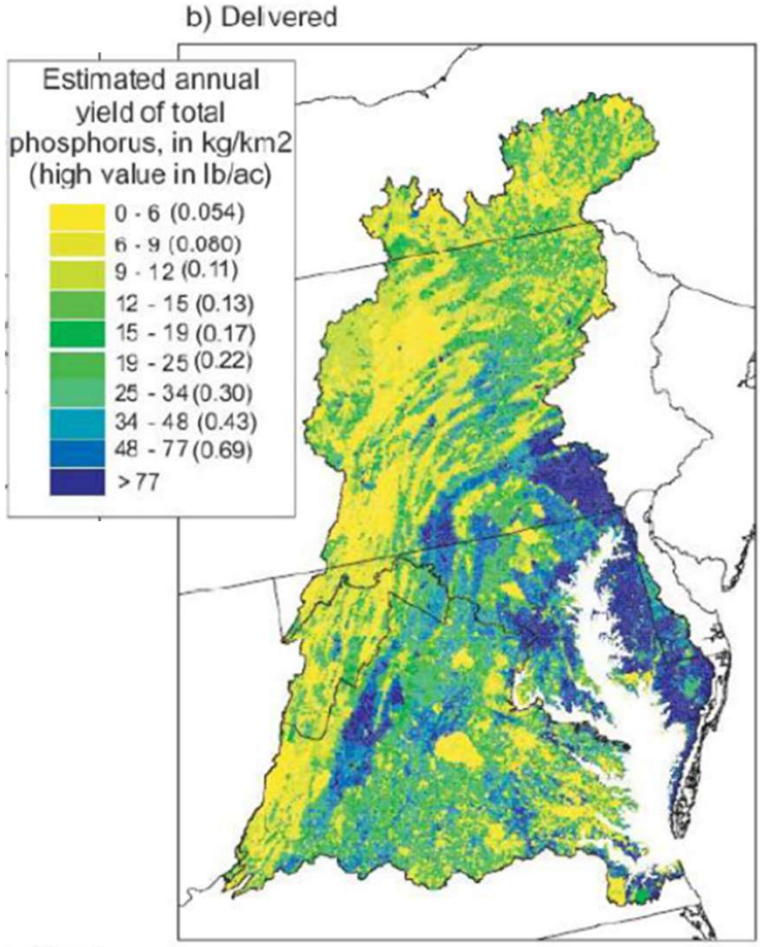
Improving Effectiveness: Addressing Mass Balance



Nutrient Mass Balance

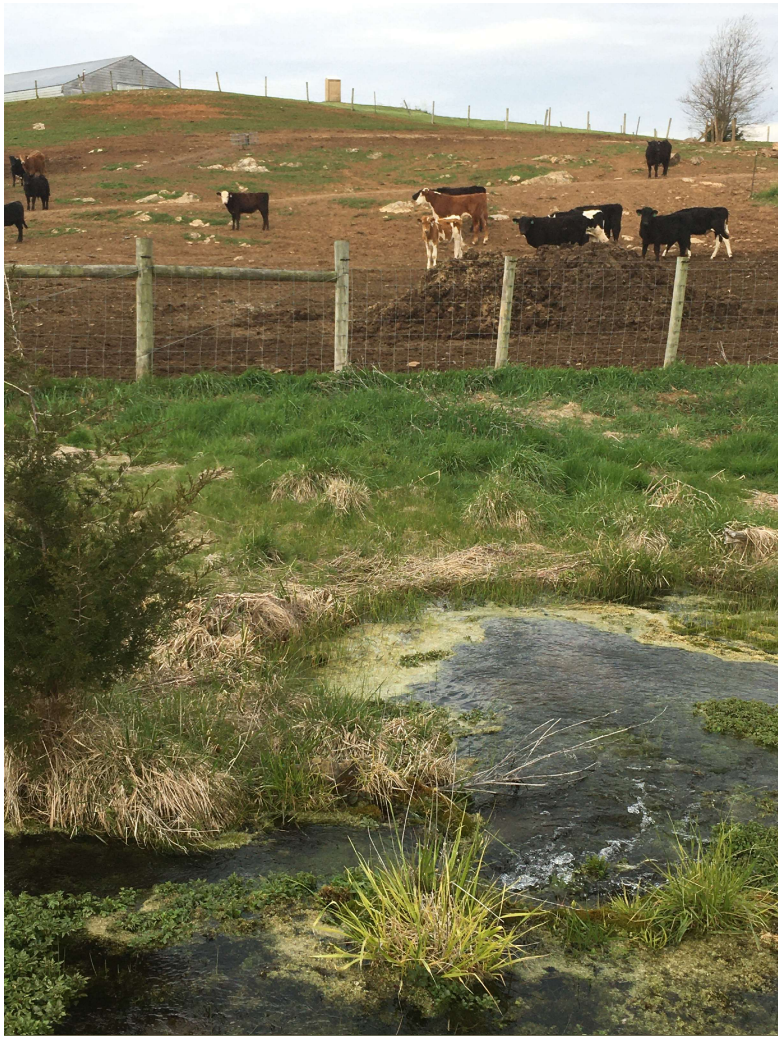


Moyer et al. 2017, Webber, 2017



Source: USGS Sparrow Model Output

Illustration of a CBP showcase watershed: Smith Creek



Livestock manure

Over past 3 decades, the number of animal units increasing

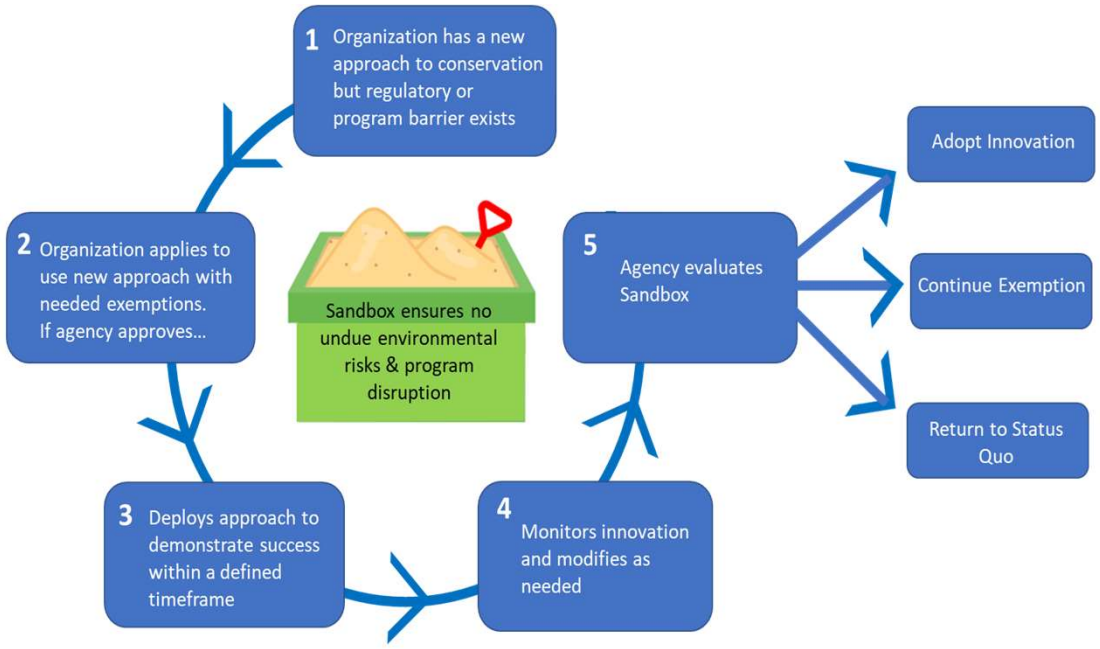
Well designed and maintained riparian buffer (BMP)

Over past 3 decades, 4x increase in # of BMPs installed.

Net Result:

Monitored N loads increasing over time

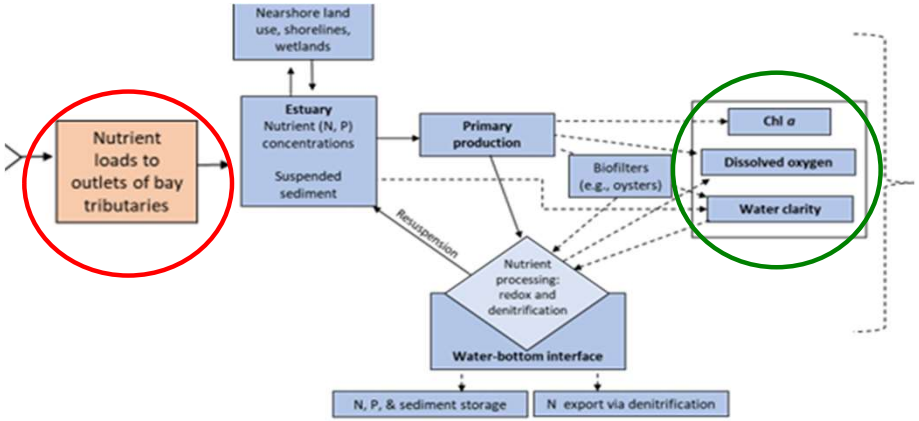
Improving Nonpoint Source Program Effectiveness:
New Opportunities for Technological & Institutional Innovation



The Sandboxing Process (Figure adapted from Higgins and Male, 2019)

Findings:

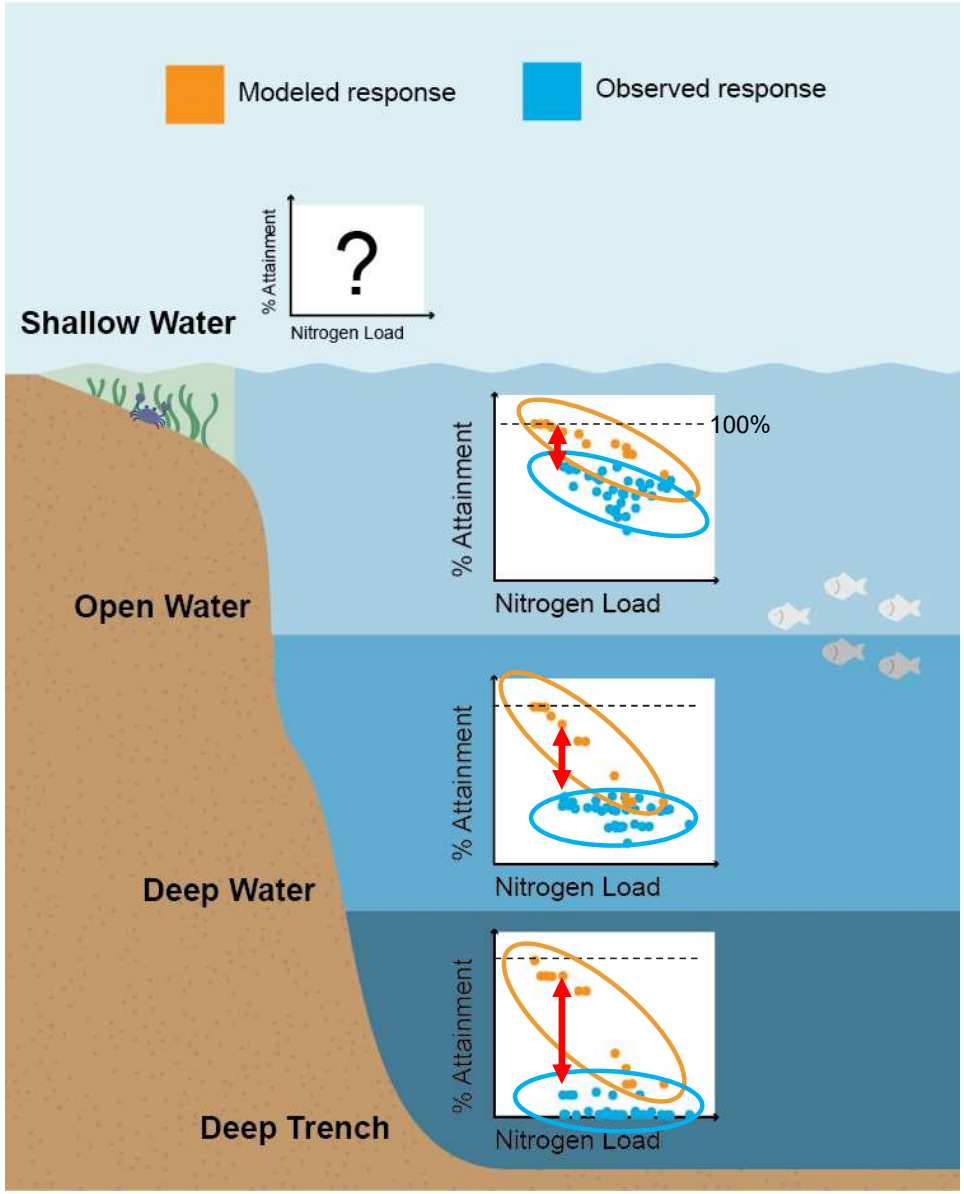
Bay Water Quality Response to Nutrient Reductions



FINDING: Load reductions have produced water quality improvements in some areas but often not at levels expected. Full achievement of WQS is distant & unlikely, particularly for deep water habitats

Expected and observed dissolved oxygen response

- Potential response gap across habitats
- Response gap largest for deep channel
- Response gap largest at low loads
- No expected response for shallow waters

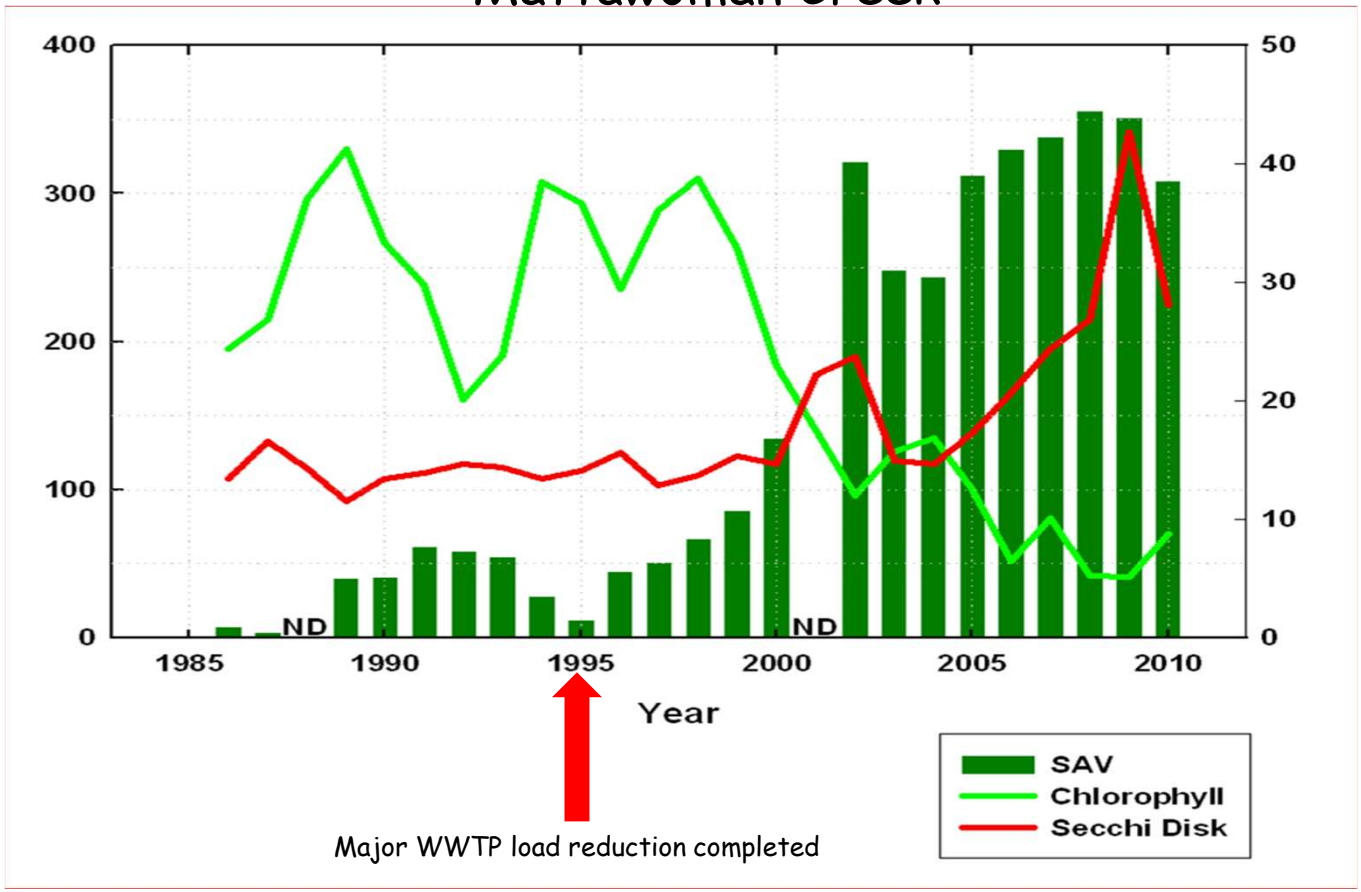


Why response gaps?

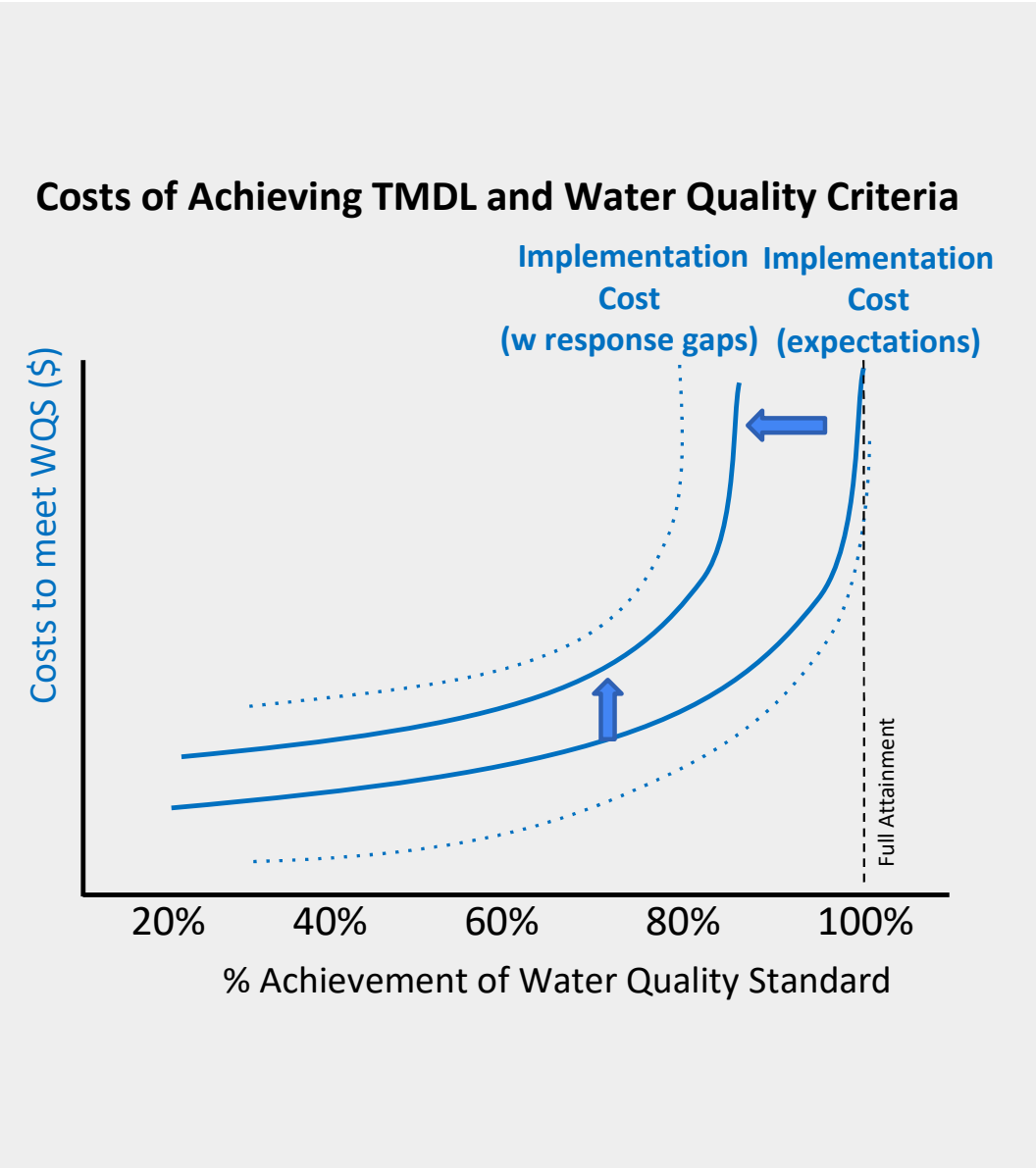
- Climate change (ex. warming waters)
- “Tipping points”

Examples of rapid recovery in regions of the Bay

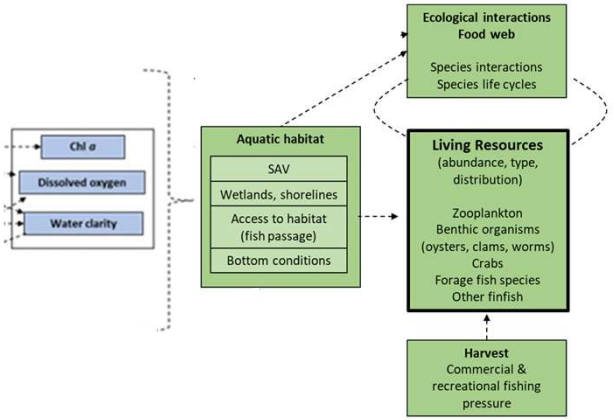
Mattawoman Creek



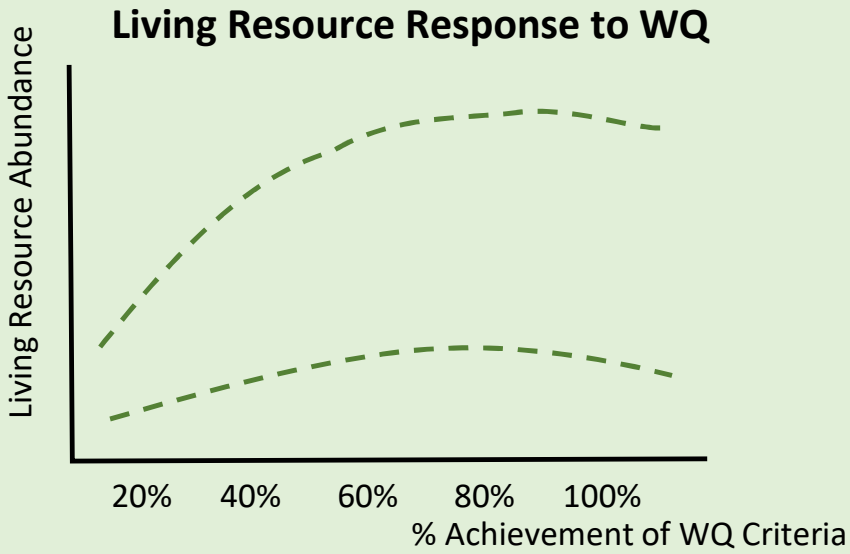
Implications

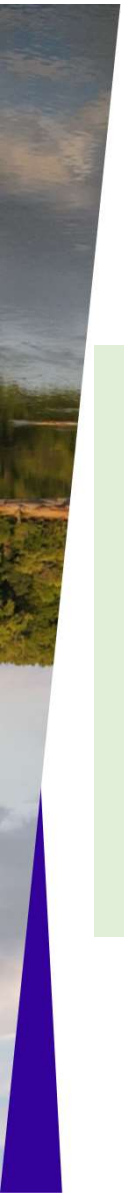


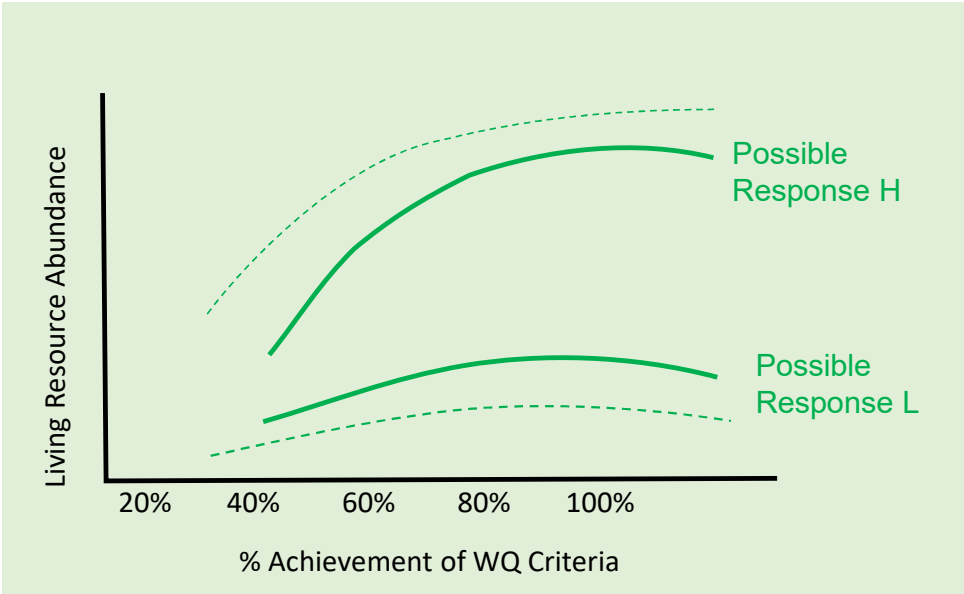
Findings: Living Resource Response to Water Quality Improvement



Living resource response to changes in water quality criteria







Findings

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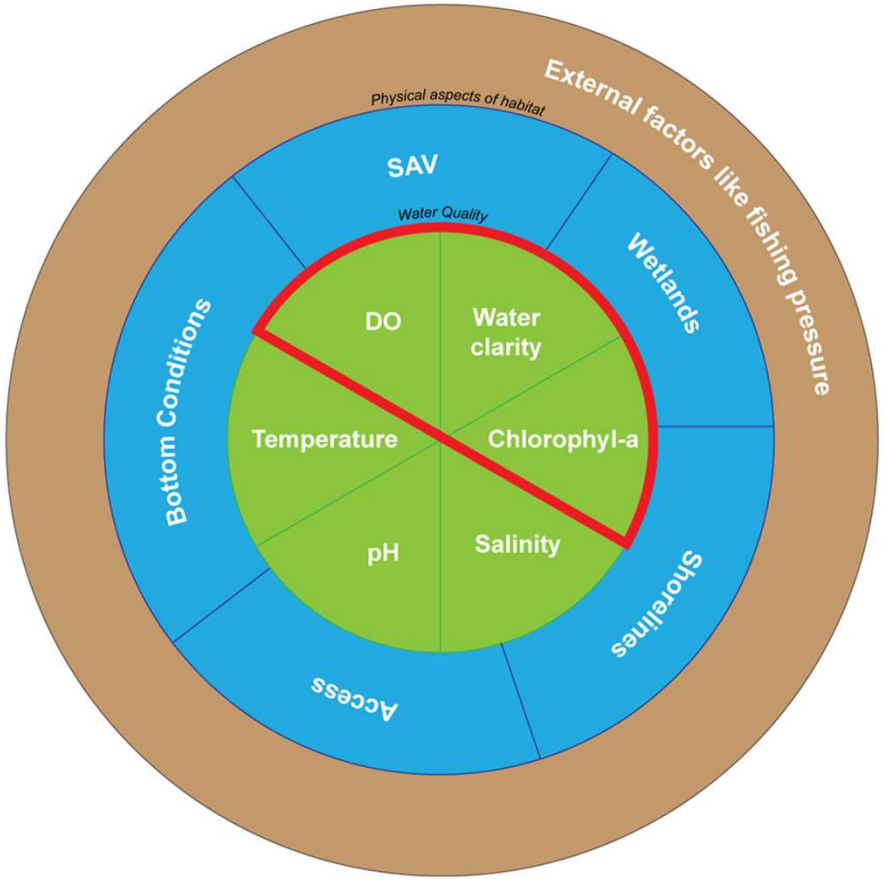
The living resource response to water quality improvement (H or L response) depends on:

- Where WQ response to nutrient and sediment reductions occur
- Status of other factors that influence living resource response

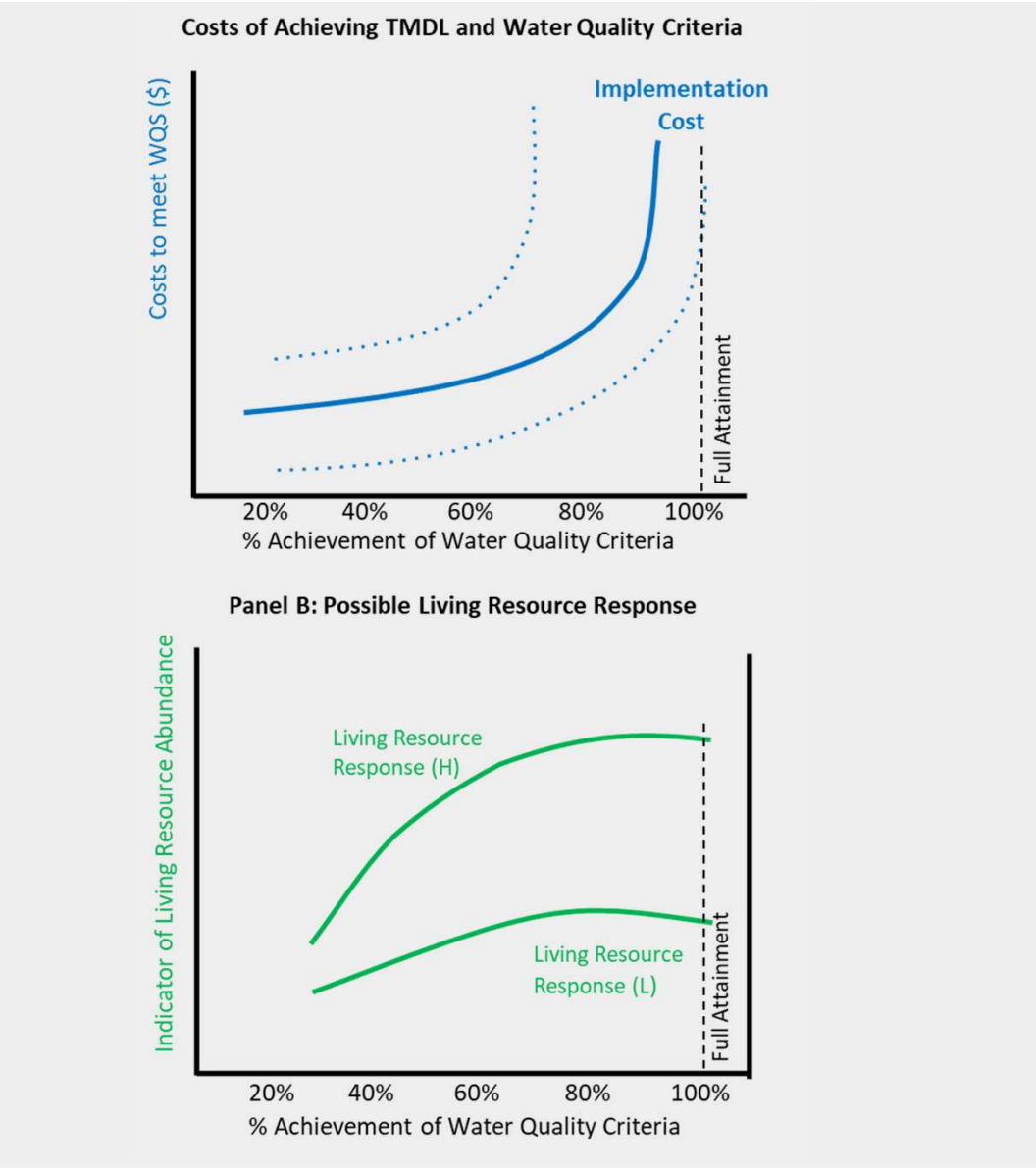
Many Knobs of Living Resource Response



Managed by Bay water quality standards

Implications

Full attainment of current water quality criteria may not be necessary to improve and support living resources goals



CESR Implications for Water Quality Goals & Living Resources

Additional nutrient reductions needed to maintain and improve water quality.

Opportunities to improve living resource response without achieving full attainment of water quality criteria

Prioritize management actions that improve living resource response

- Example: targeted attention in shallow water habitats through tiered approach to TMDL implementation