COMPREHENSIVE EVALUATION OF SYSTEM RESPONSE (CESR) to Water Quality Management Efforts

Management Board Meeting
13 October 2022

OBJECTIVES FOR TODAY

- What is CESR
- Where we are in the process
- How can we (Management Board) best prepare to utilize it

Significant reductions in the face of change

1982

- Population in the watershed: 12.7 million
- Number of chickens: 160,763,080
- Between 1990 and 2007, impervious surfaces associated with growth in single-family homes are estimated to have increased about 34 percent, while the region's population increased by 18 percent.

2017

- Population in the watershed: 18.2 million
- Number of chickens: 1,141,466,636
- Since 2007, Pennsylvania, Maryland, and Virginia have been losing about 28,000 acres of farmland annually, much of it to development

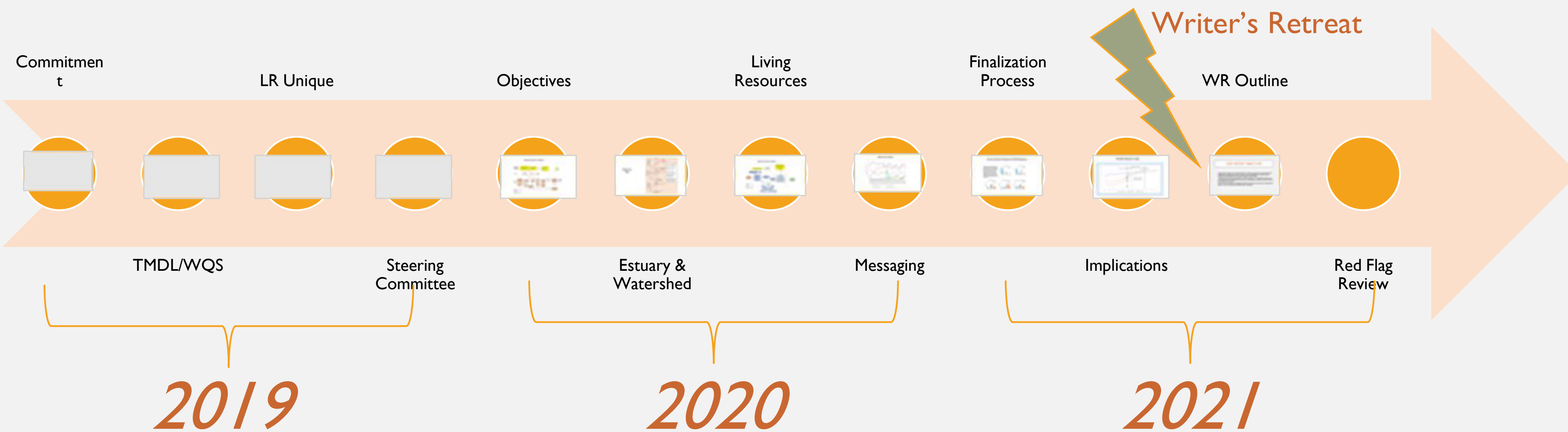
CESR REPORT OBJECTIVES

- Identify gaps between the expected physical, chemical, biological, and socioeconomic responses to management actions and their current realization, and identify recent scientific developments that can advance efforts to attain WQS;
- Characterize the critical uncertainties in system response to management actions and recommend research strategies that improve understanding of system response relevant to the attainment of WQS.
- Recommend strategies for integrating scientific and technical analysis into management efforts in order to aid decision-making under uncertainty.

Who is CESR?

- What it's not:
  - A report card on the restoration effort
  - A list of specific recommendations
- What it is:
  - An extraction of learnings after 30 years of water quality efforts
  - An identification of some opportunities for increasing program effectiveness

CESR Timeline
March 2019 – December 2021



Responsible science brokerage

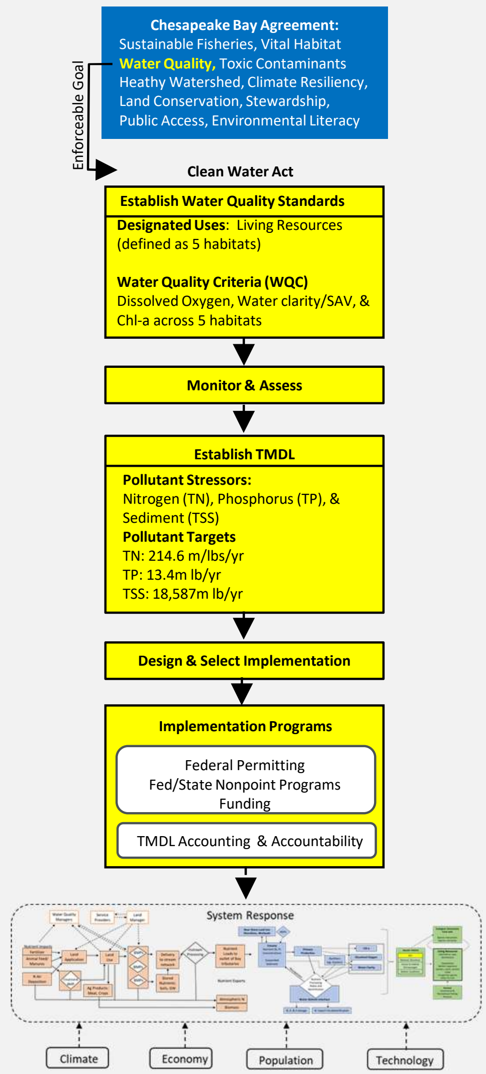
- Alignment of synthesis of evidence with policy needs
- Robust, transdisciplinary, with appropriate expert inputs
- Implications are articulated
- Choices and options instead of recommendations
- Communicates limitations and unavoidable biases
- Does not take a role in the policy choice process

Gluckman, P.D., Bardsley, A. & Kaiser, M. Brokerage at the science–policy interface: from conceptual framework to practical guidance. Humanit Soc Sci Commun 8, 84 (2021). https://doi.org/10.1057/s41599-021-00756-3

The Structure of the Report

"If I had an hour to solve a problem I'd spend 55 minutes thinking about the problem and five minutes thinking about solutions" *Albert Einstein*

Section 2: Policy Context and Report Organization



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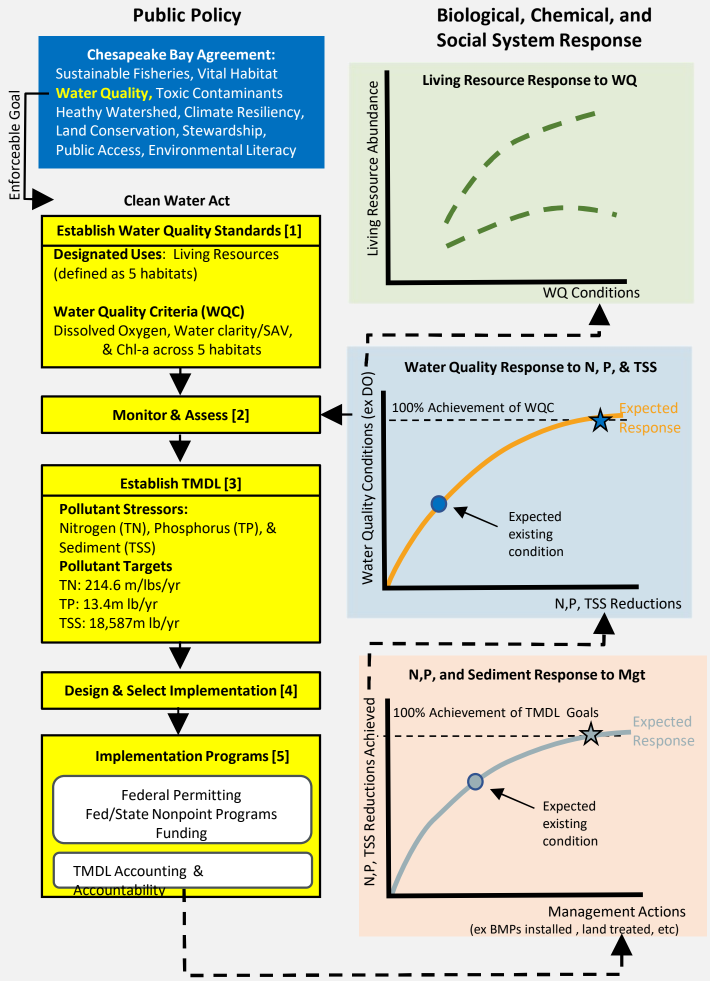
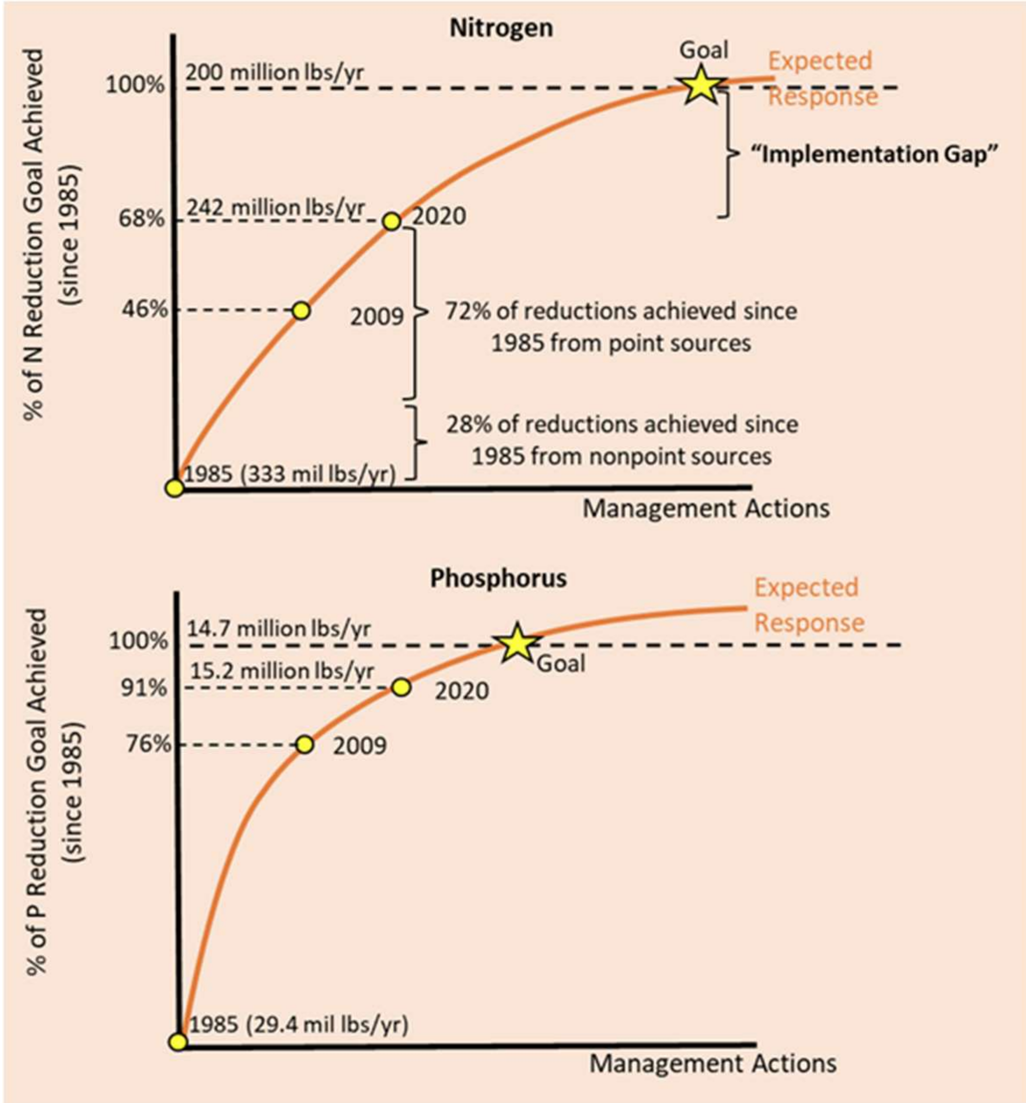
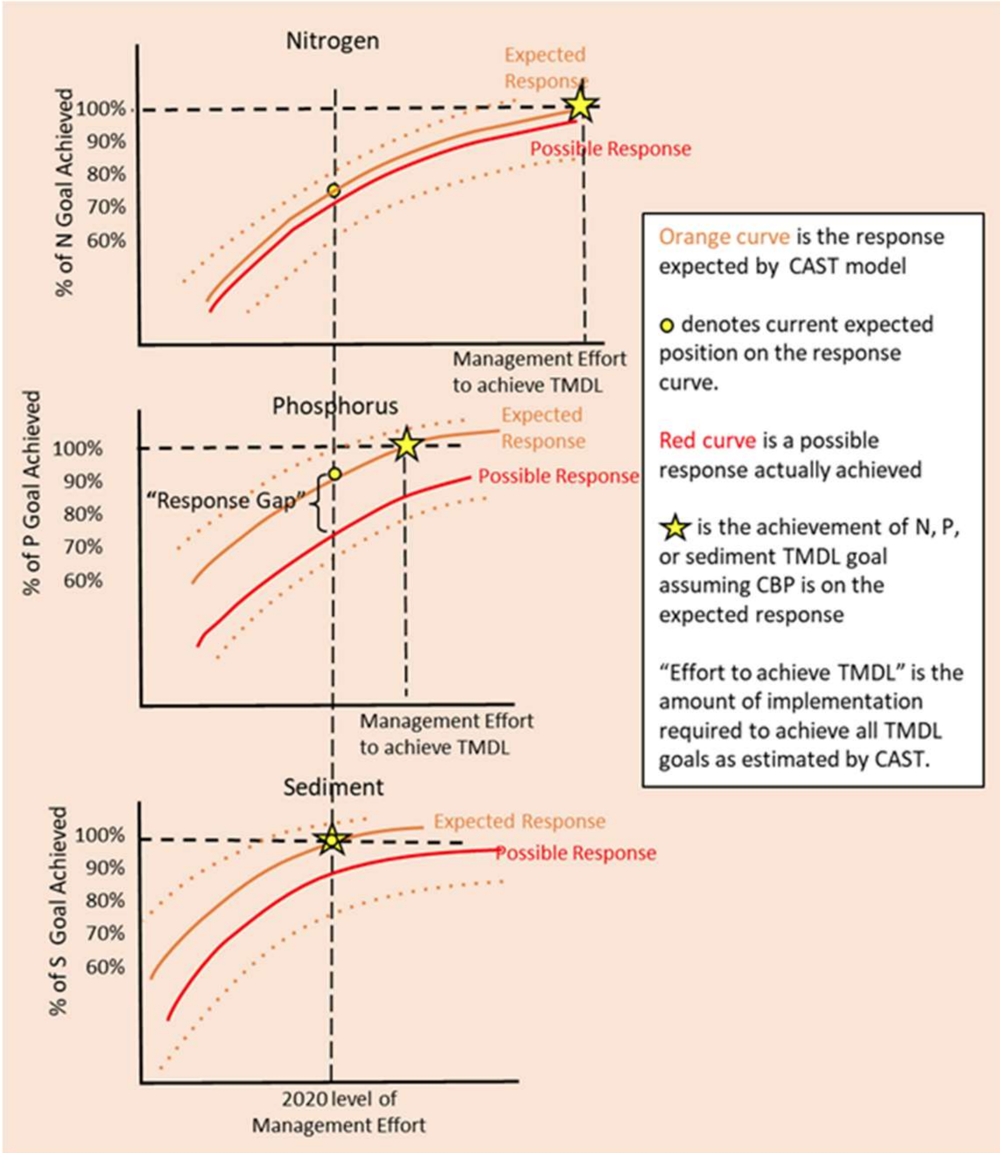


Section 3: Nutrient and Sediment Response to Management Efforts

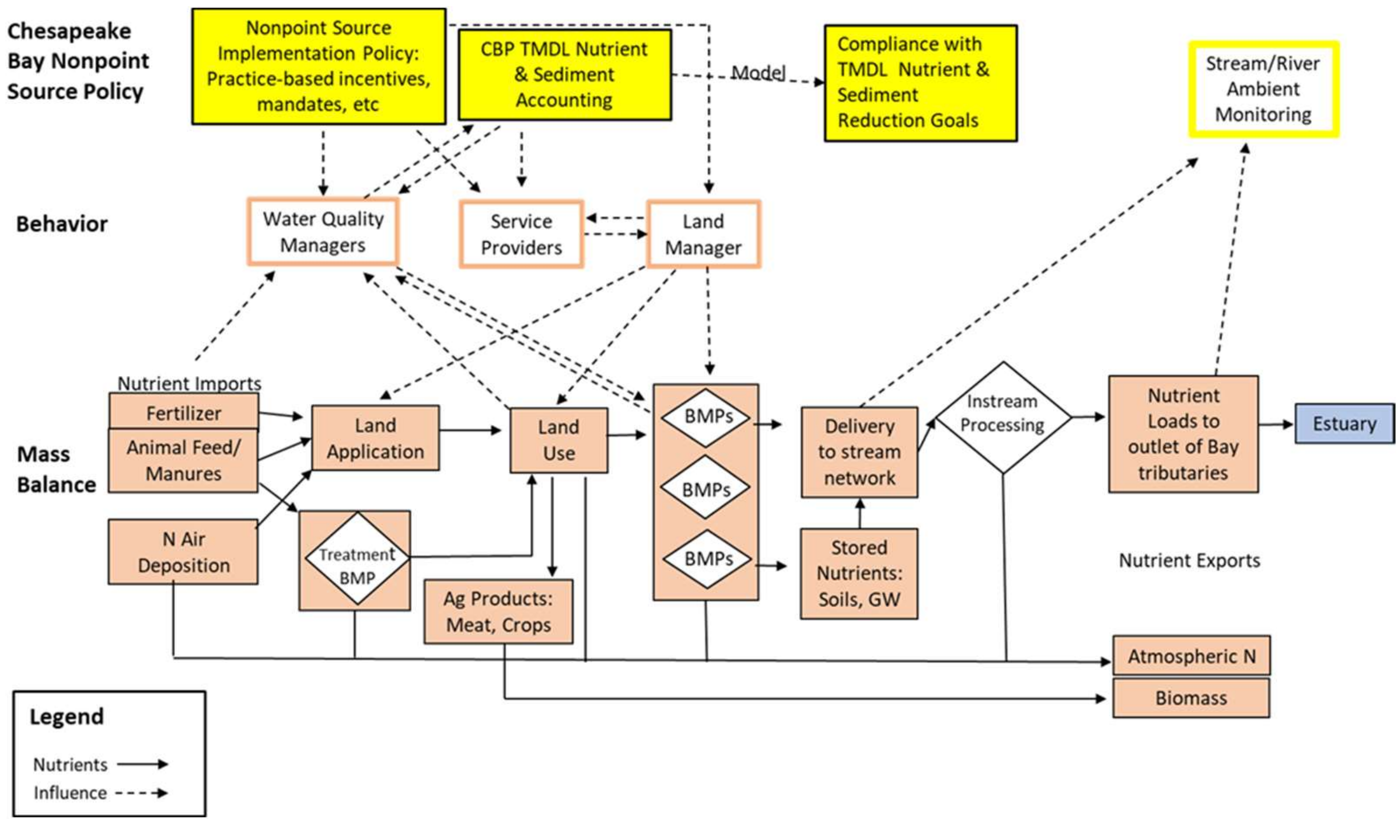
Implementation Gap



Response Gap

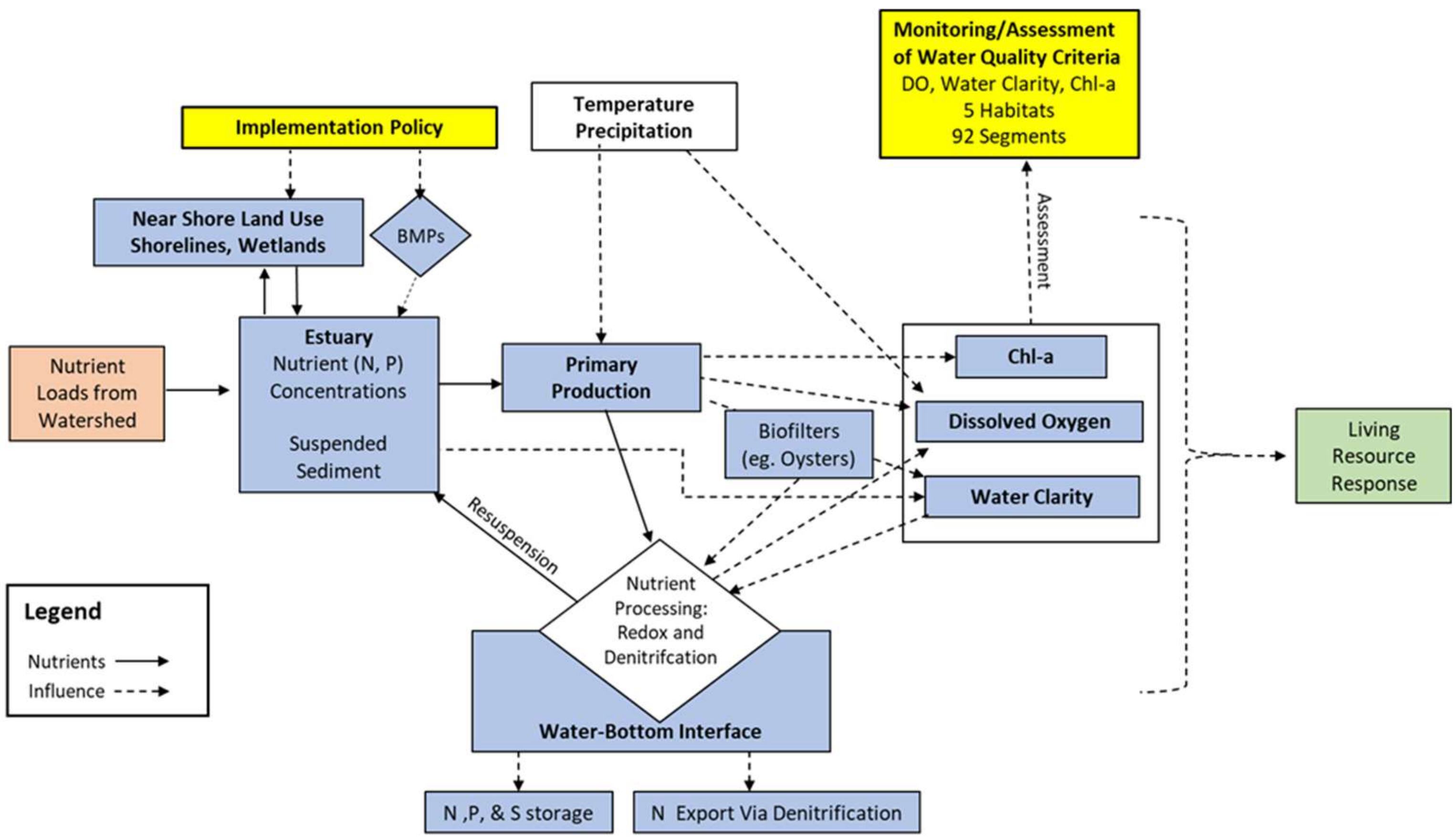


Organizing System Diagram

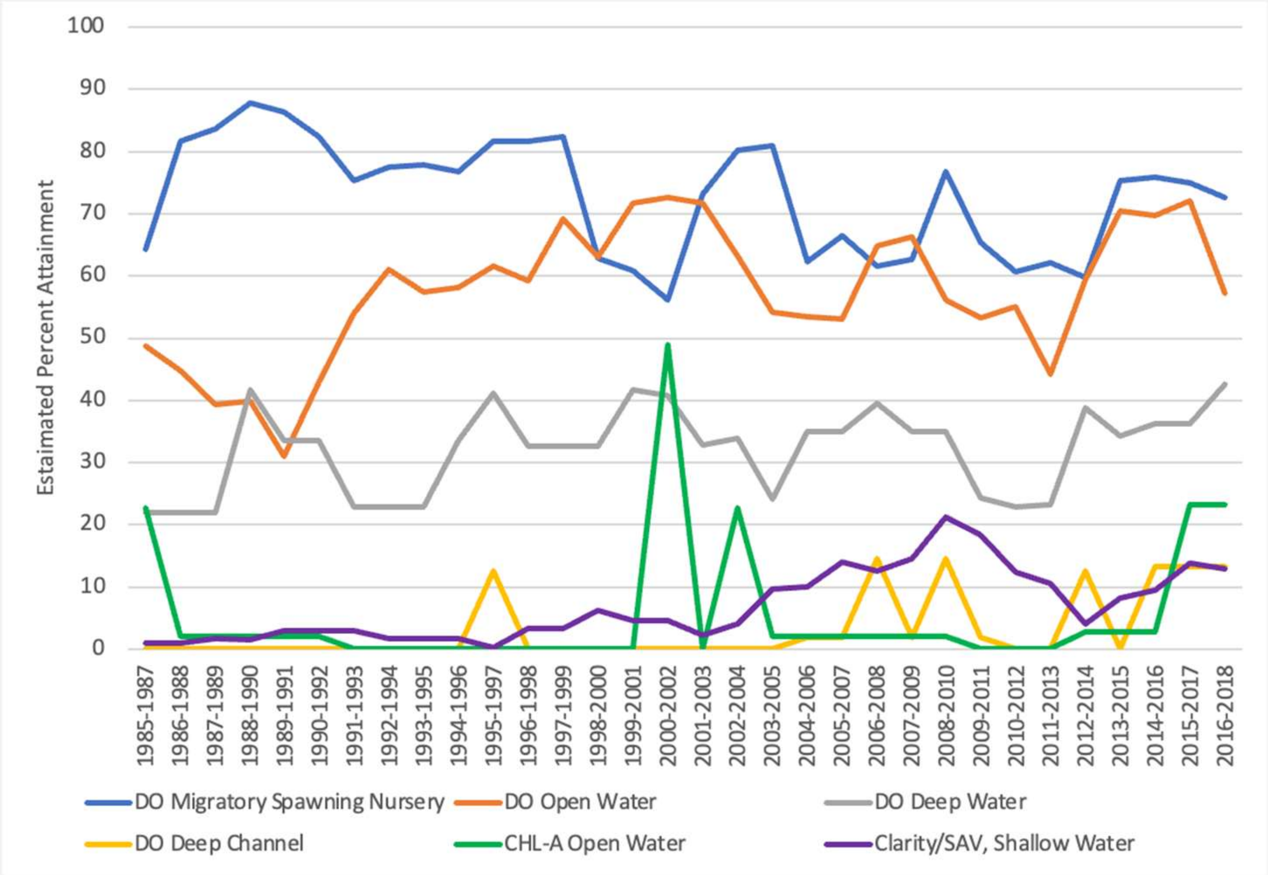


Section 4: Water Quality Response to Nutrient and Sediment Reductions

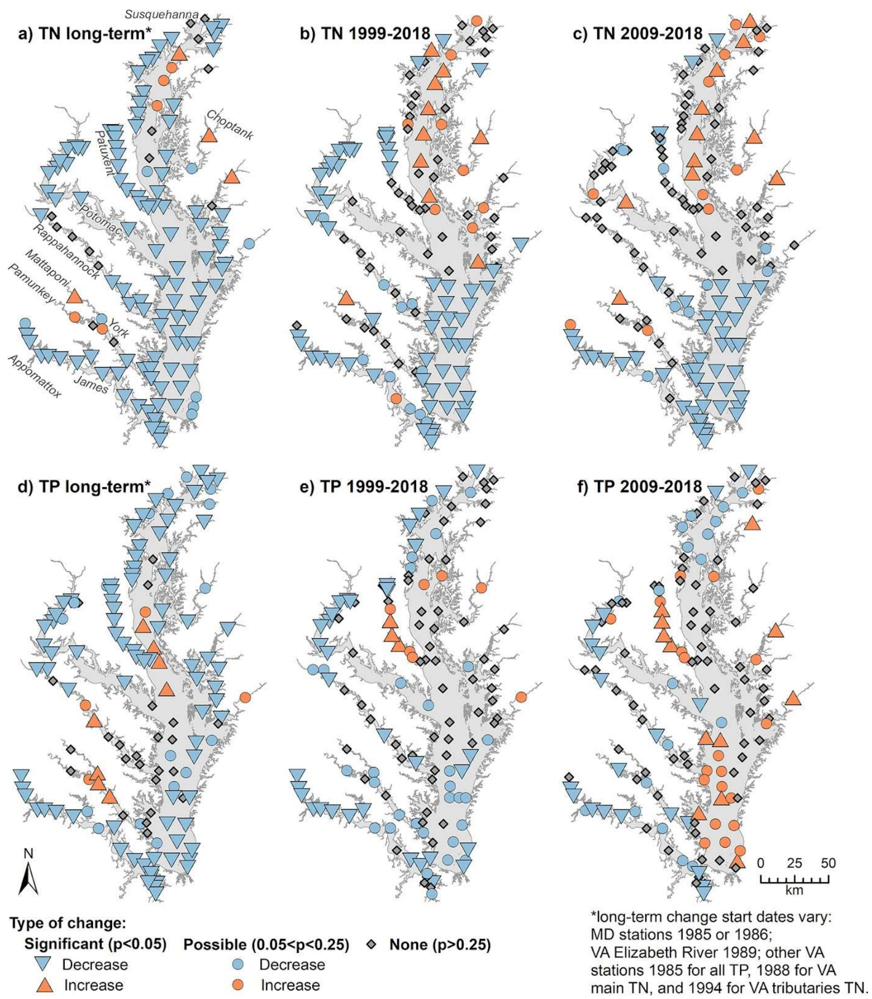
Organizing System Diagram



Attainment by Designated Uses

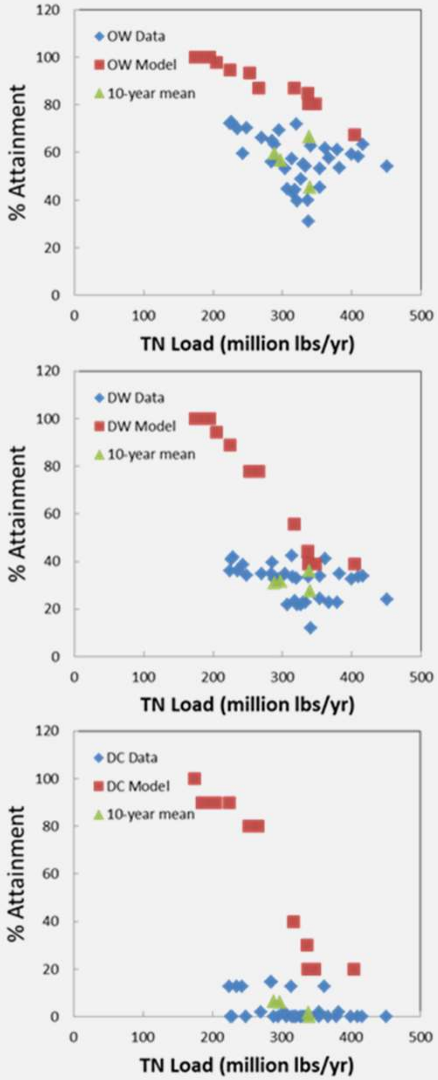


Are load reductions resulting in lower N, P, & S?



Chesapeake Bay tidal station categorical results for mean change in surface TN (a–c) and TP (d–f) over three time periods computed using temporal GAM fits (eqs 2 and 3) but not filtering for flow or any other explanatory variable. From Murphy et al., 2022.

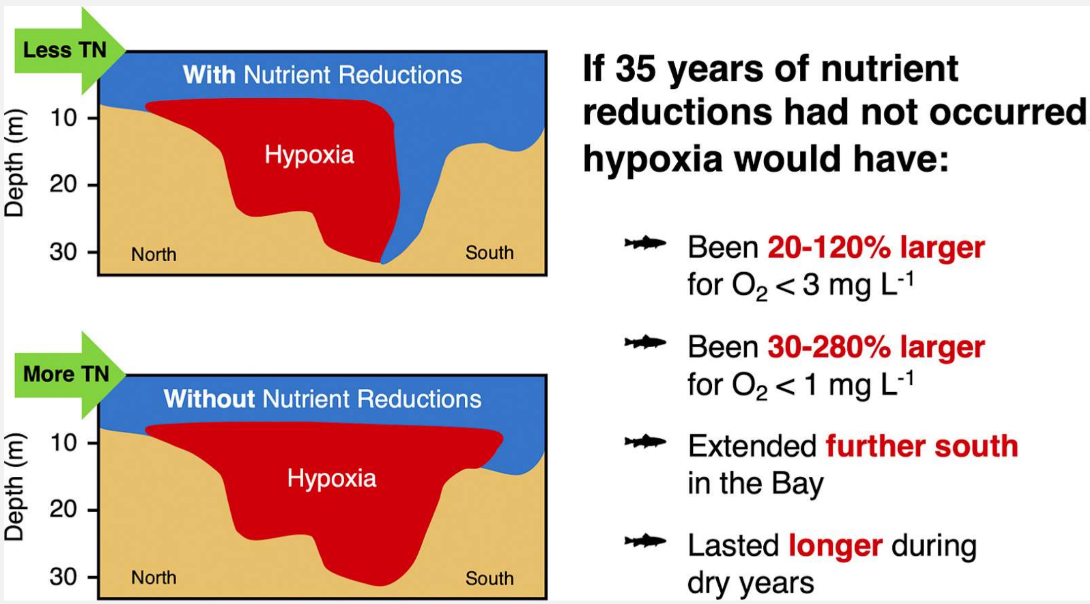
Translating load reductions to attainment



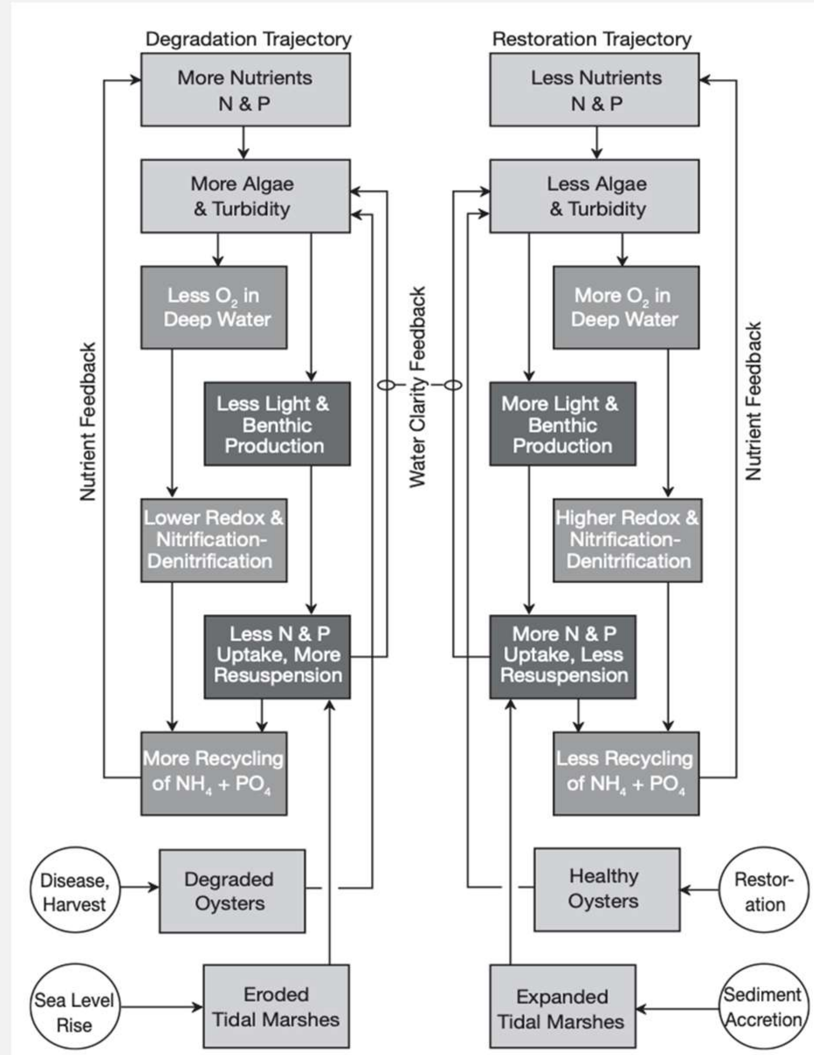
Graph of below fall line WSM+RIM TN loads and DO criteria attainment, calculated as three year running mean criteria versus the 3-year running mean RIM+WSM TN for the same time period. Red squares represent expected responses from the 2017 Mid-point Assessment. Green triangles are 10-year means of the observations. Graph by Jeremy Testa, based on data from Qian Zhang.

Why?

Non-linear Interactions and Climate Change

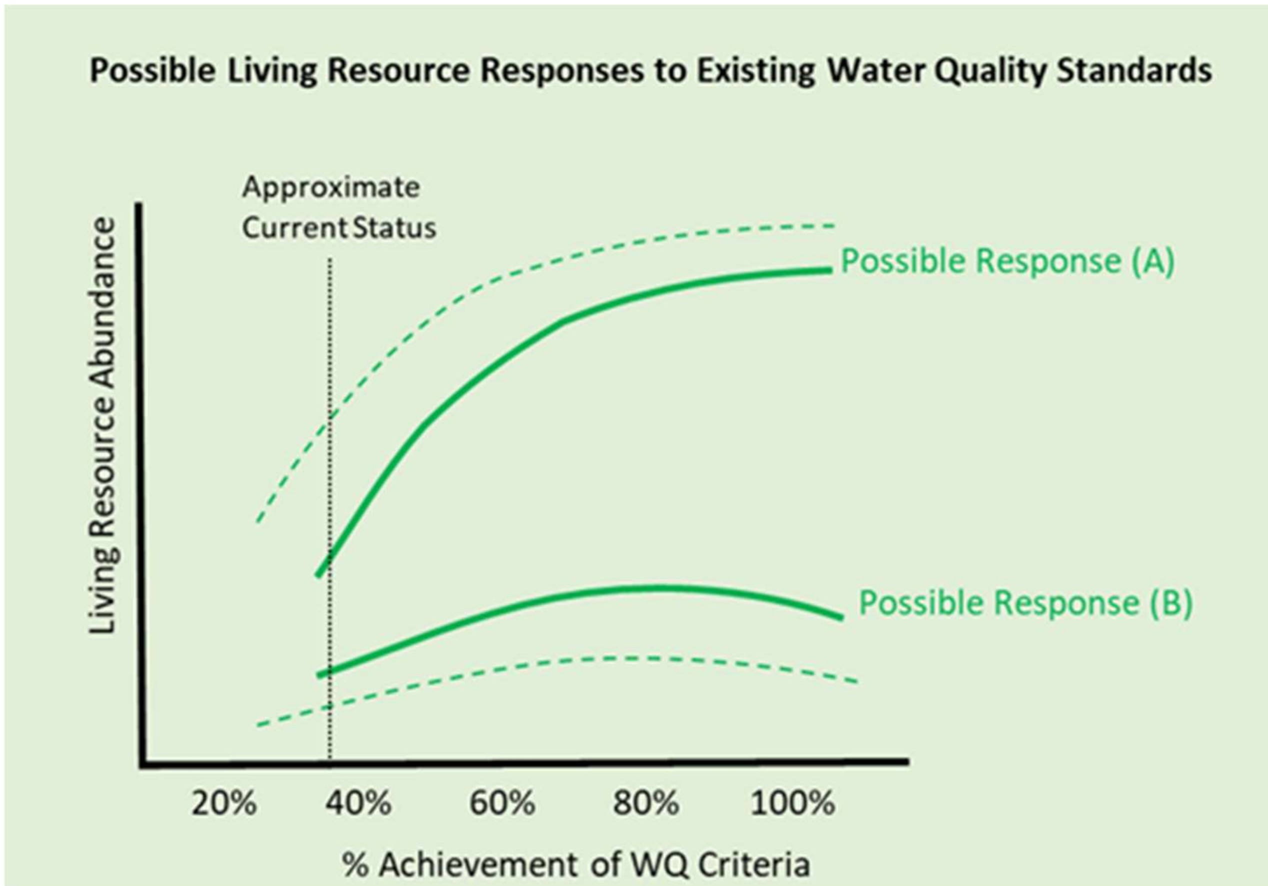


From Frankel et al., 2022

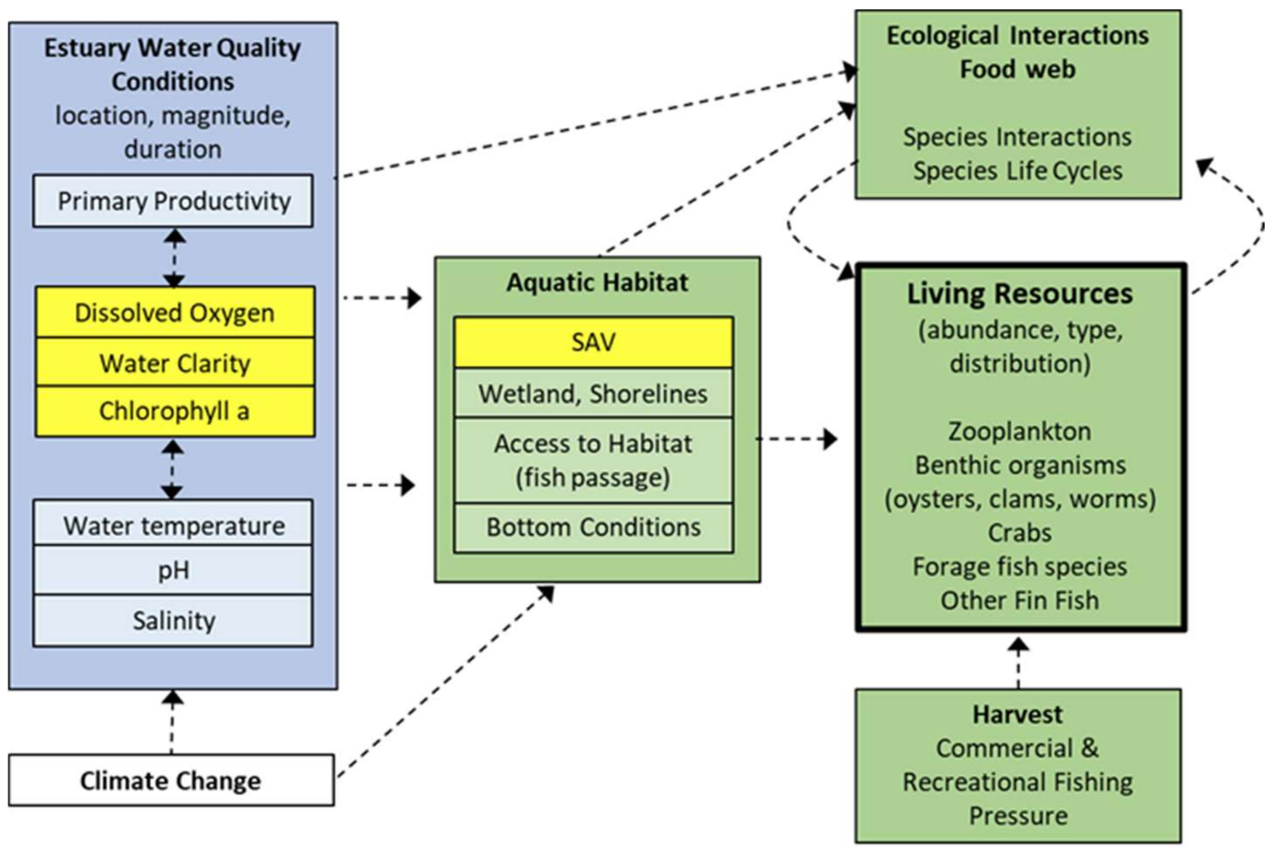


From Kemp et al., 2005

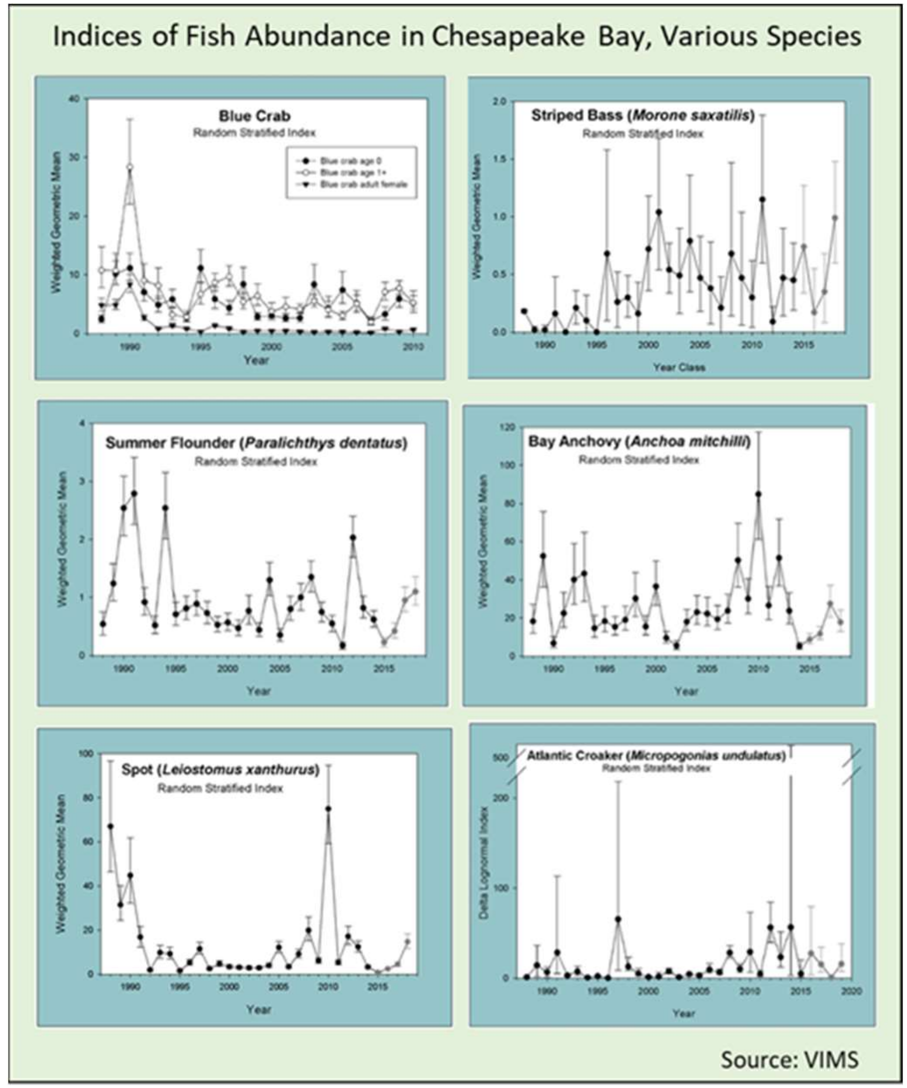
Section 5: Living Resource Response to Water Quality Conditions


Possible Living Resource Responses to Existing Water Quality Standards
Approximate
Current Status
Possible Response (A)
Possible Response (B)
Living Resource Abundance
20%
40%
60%
80%
100%
% Achievement of WQ Criteria

Organizing System Diagram



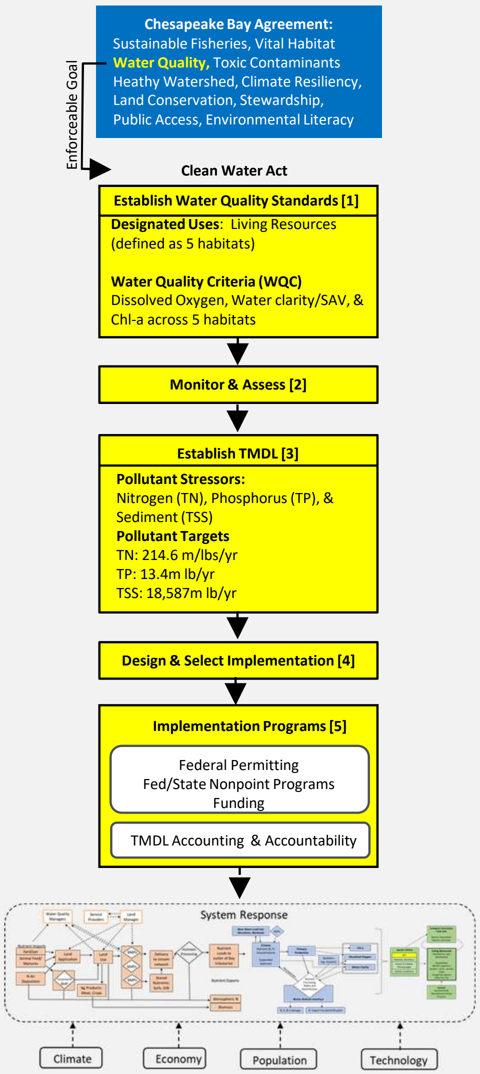
Evidence and Effort to Explain Observed Patterns



Section 6 Tentative Findings and Implications

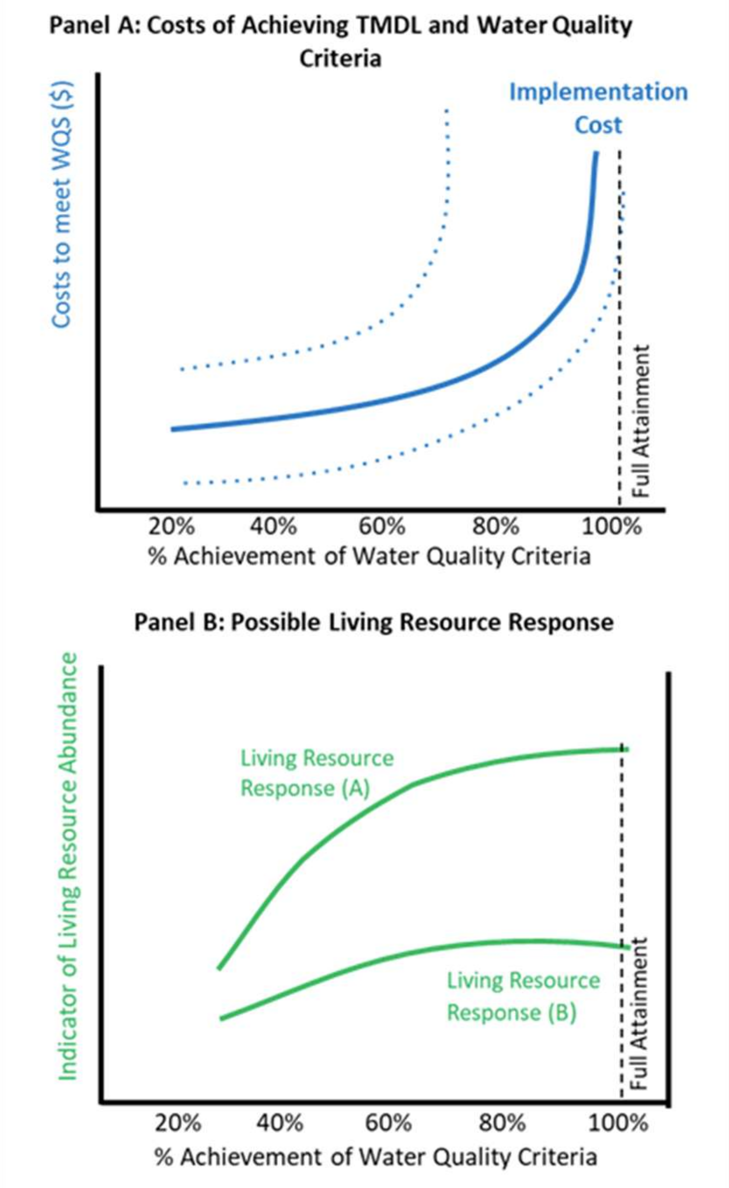
Two Premises

- The Chesapeake Bay system observed in the past will not be the same system we will have in the future.
- Water quality management will require new approaches to implementation and management.

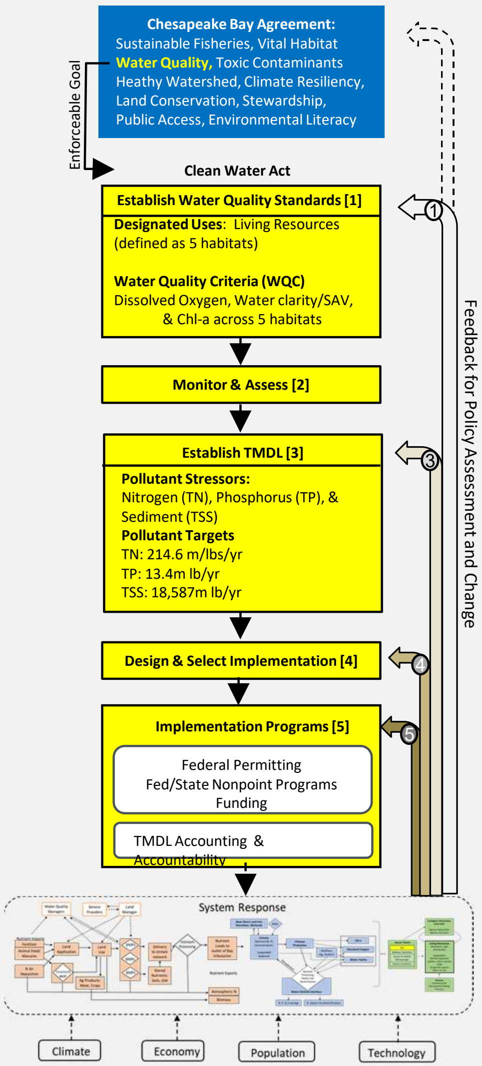


SUMMARY OF FINDINGS

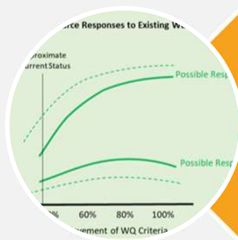
- ***Overall, the rate of progress in ambient water quality outcomes suggests that achievement of existing water quality criteria is uncertain and remains in the future.***
- ***Existing water quality planning and programs are likely to be insufficient to achieve the nonpoint source reductions called for under the TMDL.***
- ***Improving water quality alone, as measured by existing Bay water quality criteria, may be insufficient to generate desired changes in the composition and abundance of Bay living resources.***
- ***The current CBP adaptive management process has limited capacity to effectively address the uncertainties and response gaps described in this report.***



Panel A: Costs of Achieving TMDL and Water Quality Criteria
Costs to meet WQS ($)
Implementation Cost
Full Attainment
20%
40%
60%
80%
100%
% Achievement of Water Quality Criteria
Panel B: Possible Living Resource Response
Indicator of Living Resource Abundance
Living Resource Response (A)
Living Resource Response (B)
Full Attainment
20%
40%
60%
80%
100%
% Achievement of Water Quality Criteria

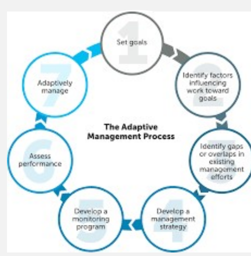


Implications



Improving living resource response to water quality management efforts

Improving effectiveness of nonpoint source management programs



Enhanced adaptive management

By End-of-Year

- Comprehensive Evaluation of System Response Report
- Three Resource Documents
  - Easton, Z., K. Stephenson, B. Benham, J.K. Bohlke, C. Brosch, A. Buda, A. Collick, L. Fowler, E. Gilinsky, C. Hershner, A. Miller, G. Noe, L. Palm-Forster, T. Thompson. 2022. Evaluation of Watershed System Response to Nutrient and Sediment Policy and Management, STAC Publication Number 22-XXX. Chesapeake Bay Program Scientific and Technical Advisory Committee (STAC), Edgewater, MD. XX pp.
  - Testa, J.M., W.C. Dennison, W.P. Ball, K. Boomer, D.M. Gibson, L. Linker, M.C. Runge, and L. Sanford,. 2022. Knowledge Gaps, Uncertainties, and Opportunities Regarding the Response of the Chesapeake Bay Estuary to proposed TMDLs, STAC Publication Number 22-XXX. Chesapeake Bay Program Scientific and Technical Advisory Committee {STAC), Edgewater, MD. XX pp.
  - Rose, K., M.E. Monaco, T. Ihde, J. Hubbart, E. Smith, J. Stauffer, and K. J. Havens. 2022. Proposed Framework for Analyzing Water Quality and Habitat Effects on the Living Resources of Chesapeake Bay. STAC Publication Number 22-XXX. Chesapeake Bay Program Scientific and Technical Advisory Committee (STAC), Edgewater, MD. XX pp.