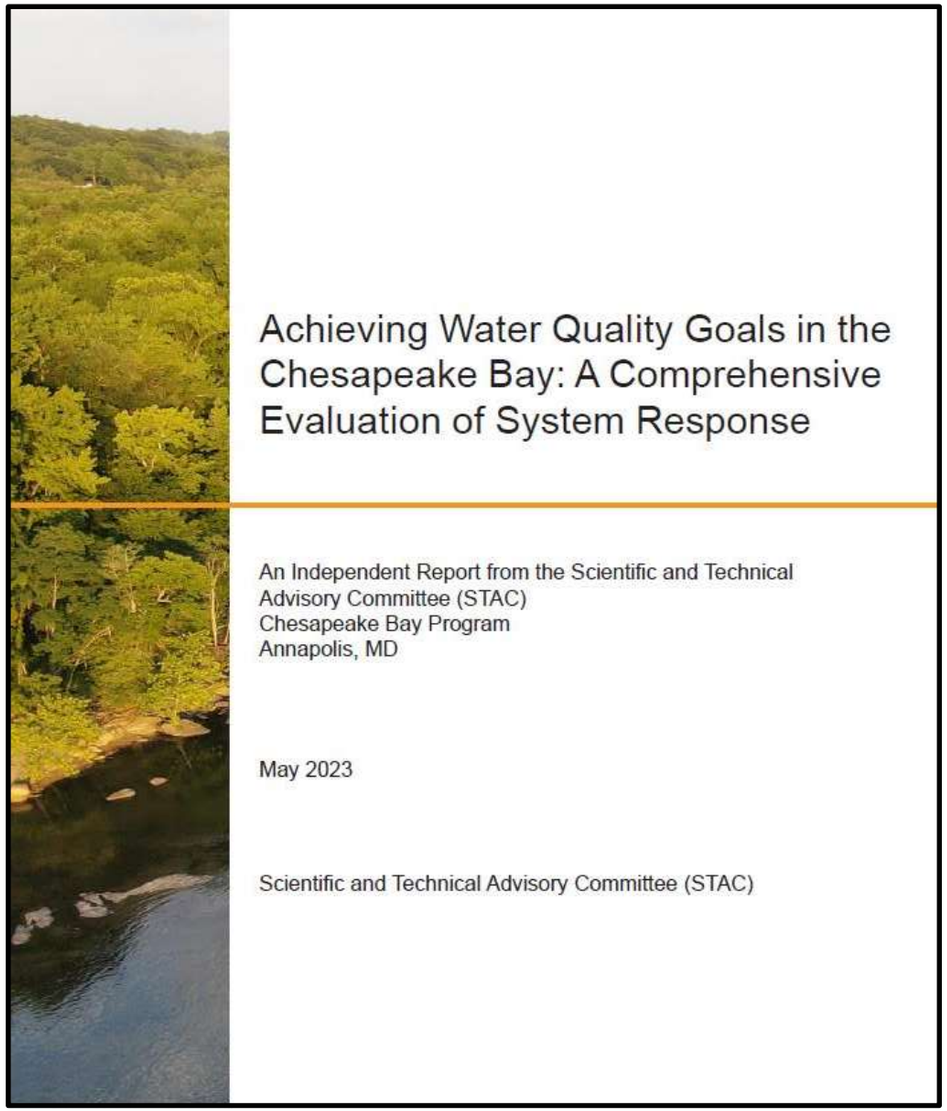
Learning Forward: Lessons for the Future

SRS Biennial Meeting

Kurt Stephenson & Denice Wardrop

May 11, 2023



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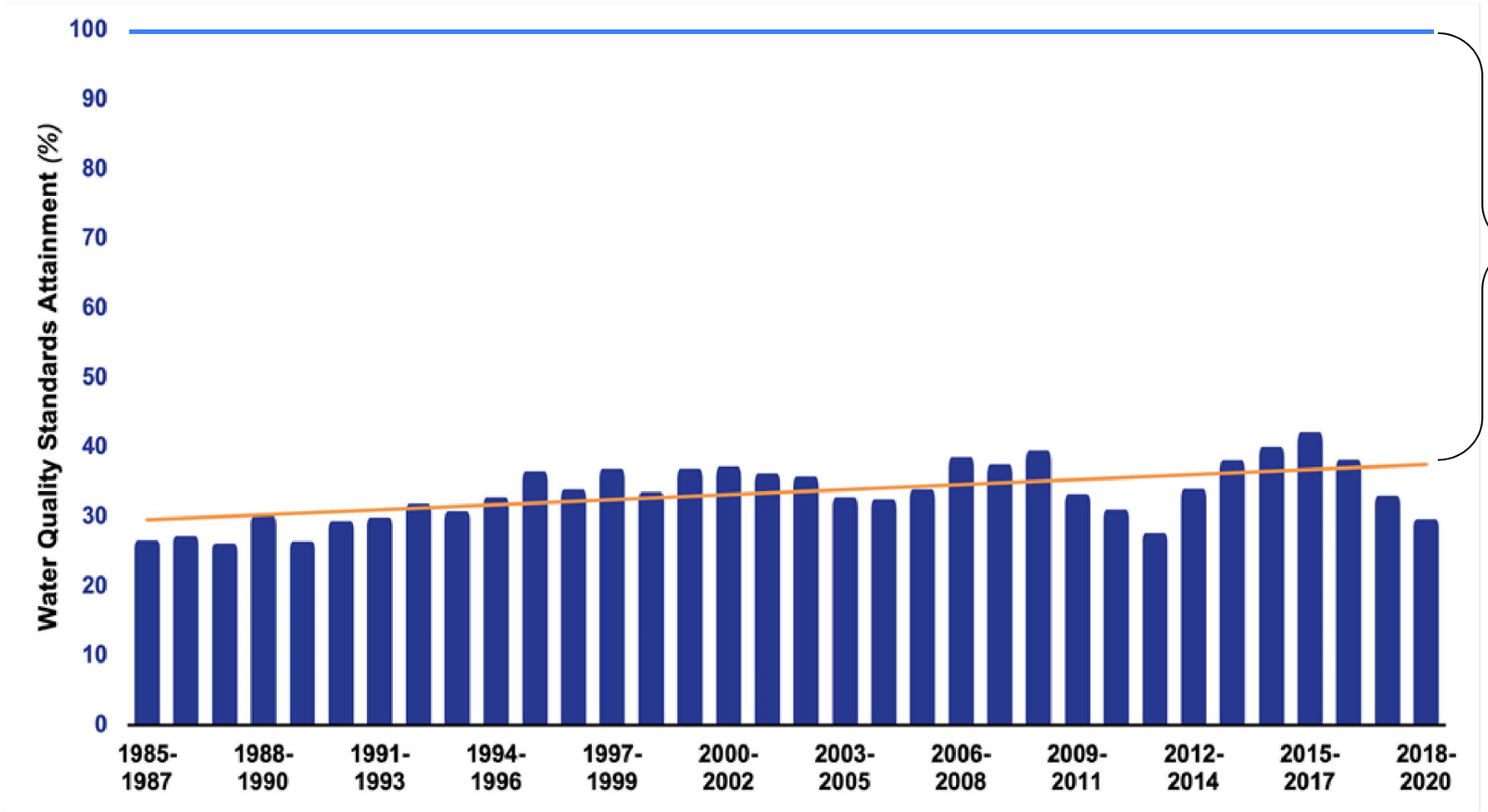
Achieving Bay Water Quality Standards



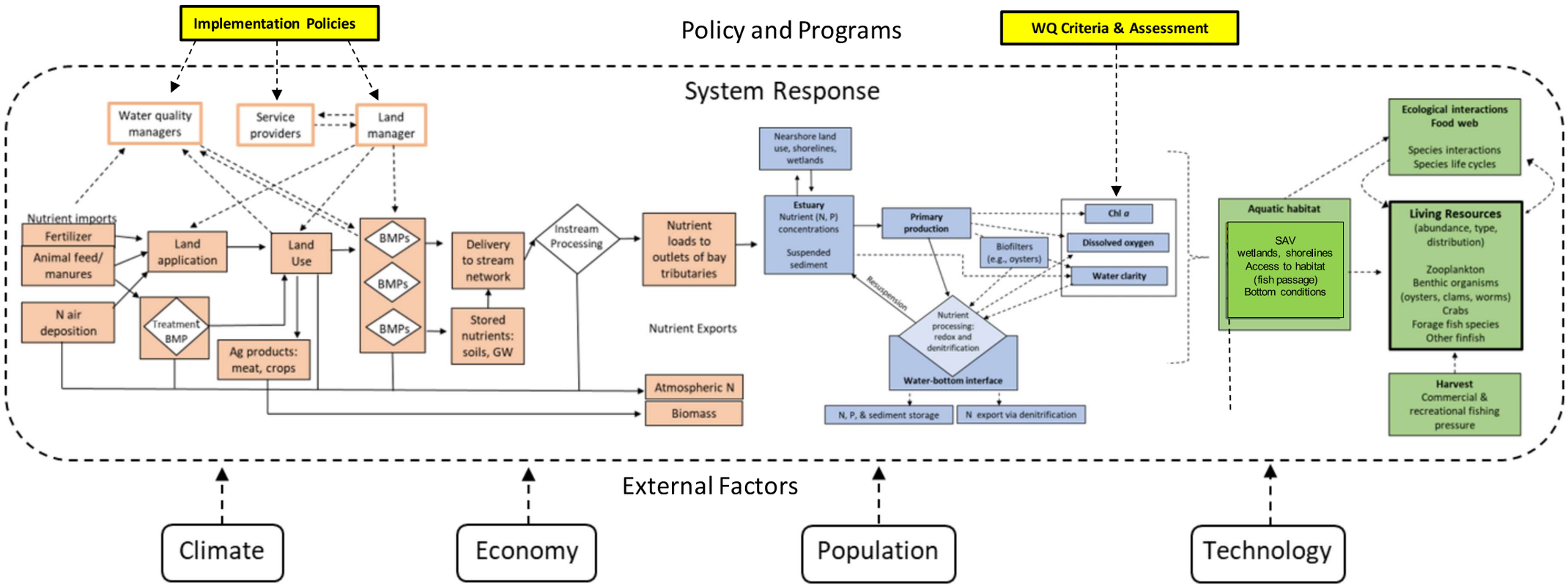
CESR Conclusions

Gaps & uncertainties present major challenges to achieving water quality goals & improving living resource response.

Opportunities to improve program effectiveness exist but requires programmatic change (not simply doing more of the same).

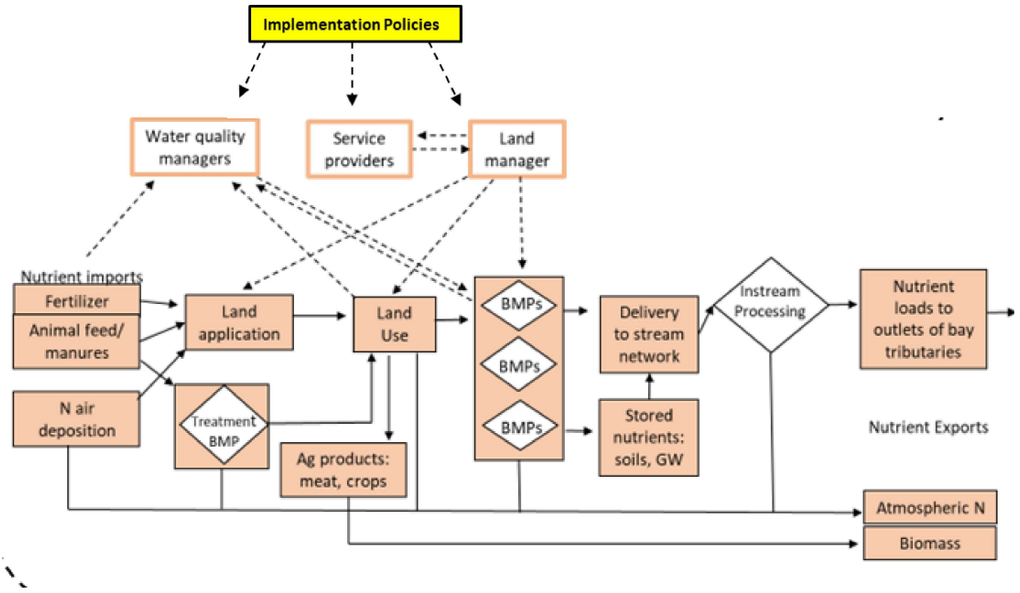
Photo by Will Parson/Chesapeake Bay Program

System Response to Meeting Bay Water Quality Standards

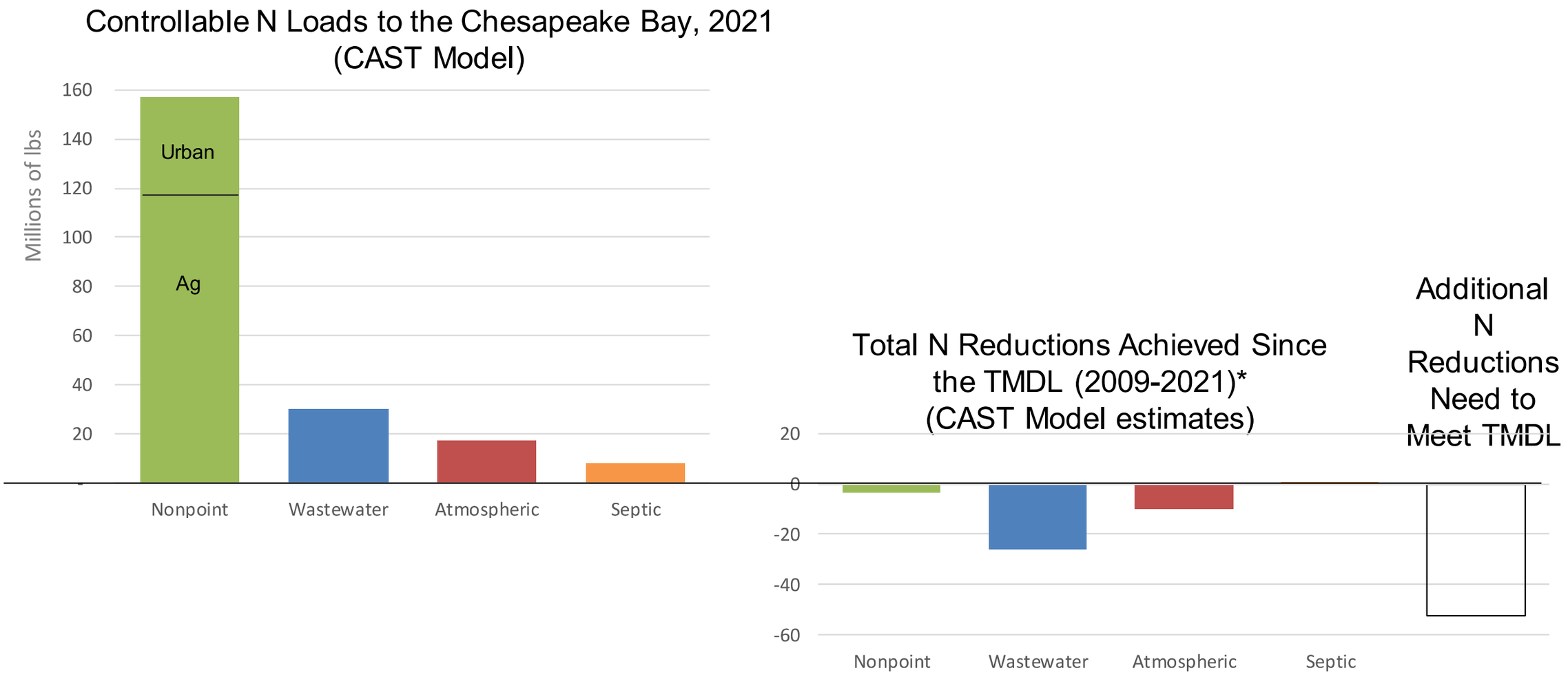


Findings and Implications:

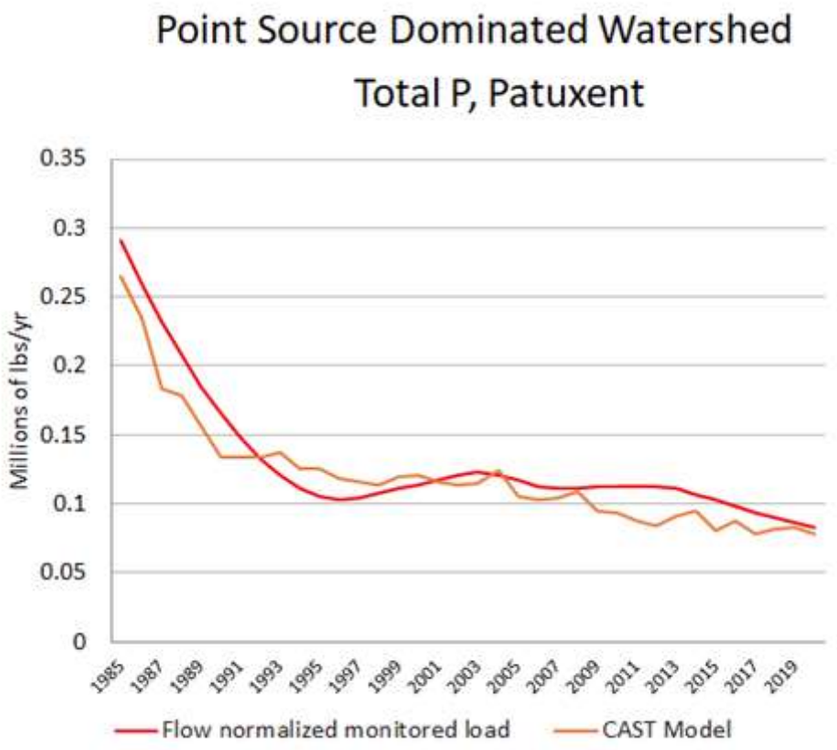
Pollutant Response to Management

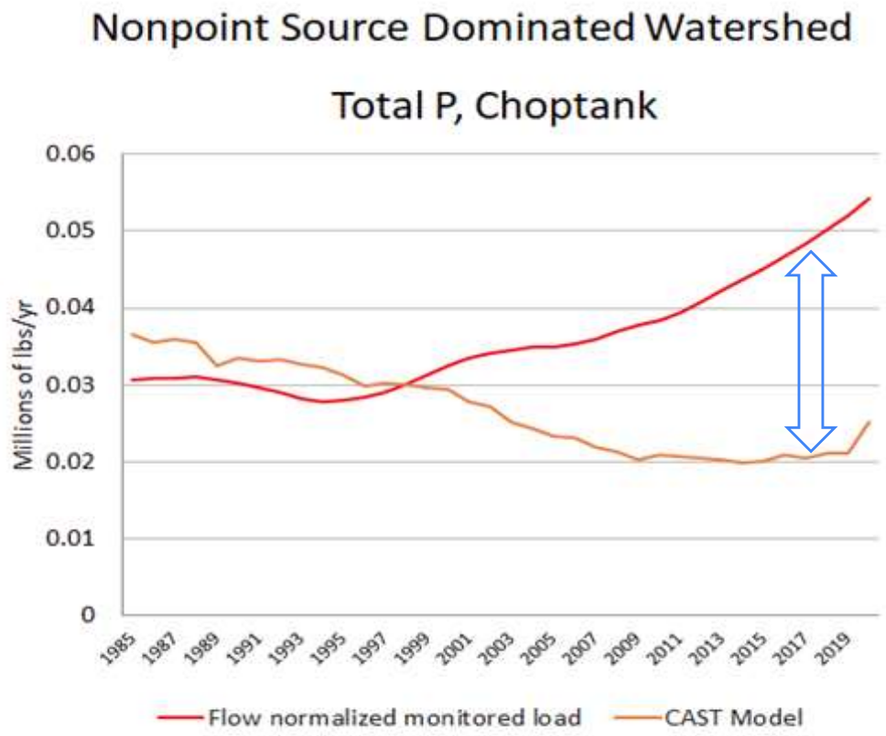


Are nonpoint source reductions generating enough adoption?



Nonpoint source BMPs being adopted may not be as effective as predicted





Studies have found mixed to little evidence of change in NPS loads between 1990 and today

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

Improving Nonpoint Source Program Effectiveness:

Incentives on Outcomes

Cover crops

Livestock Exclusion Fencing

Denitrifying Bioreactor

Low upfront installation costs
Private benefits

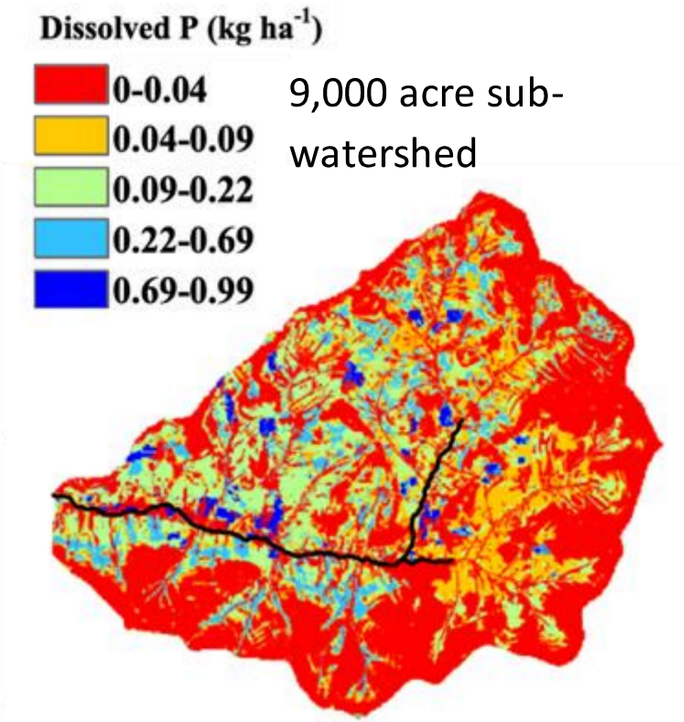
High up front installation costs
No private benefits

Public benefits: Pollutant removal benefits?

$ ➡ Outcome

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

Improving Nonpoint Source Program Effectiveness:
Targeting Outcomes



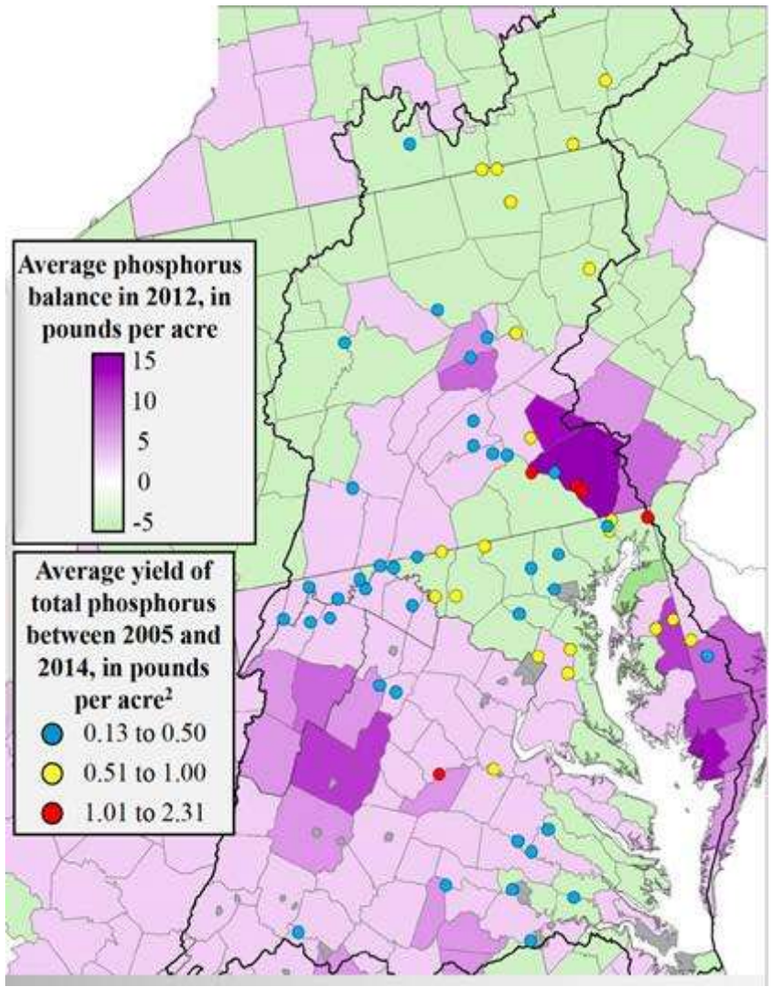
9,000 acre sub-watershed

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

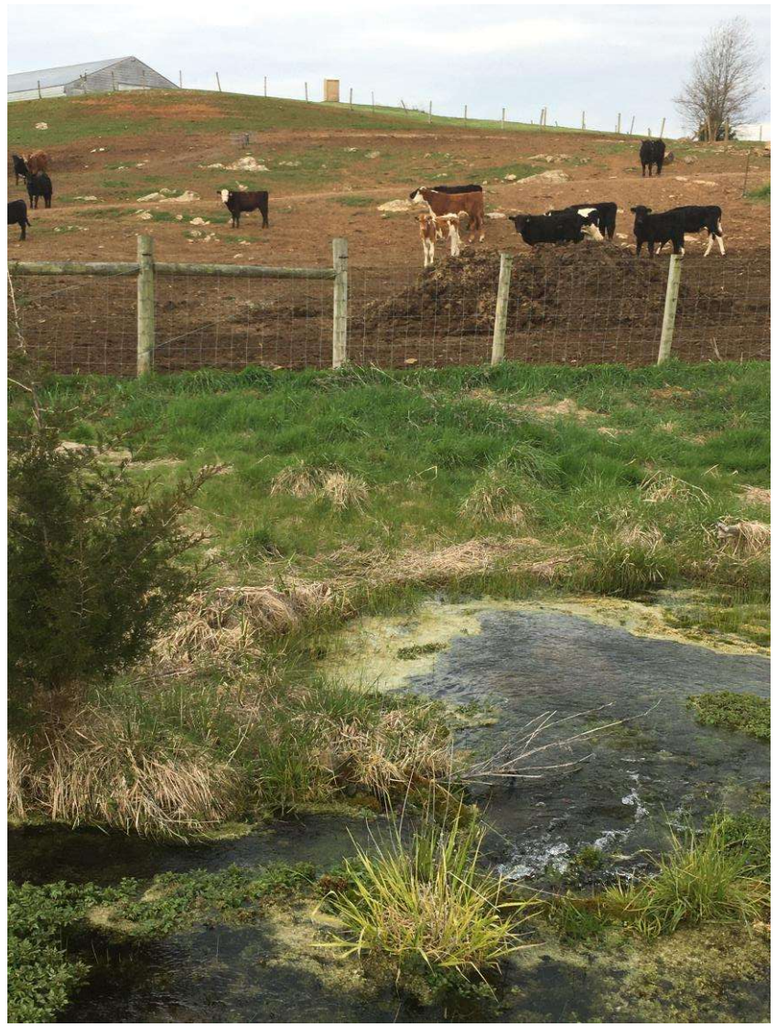
- Finer scale modeling & monitoring
- Incentives find & address high load area
- Alternatives to TMDL accounting/crediting

Improving Nonpoint Source Program Effectiveness:

Additional Focus on Mass Balance



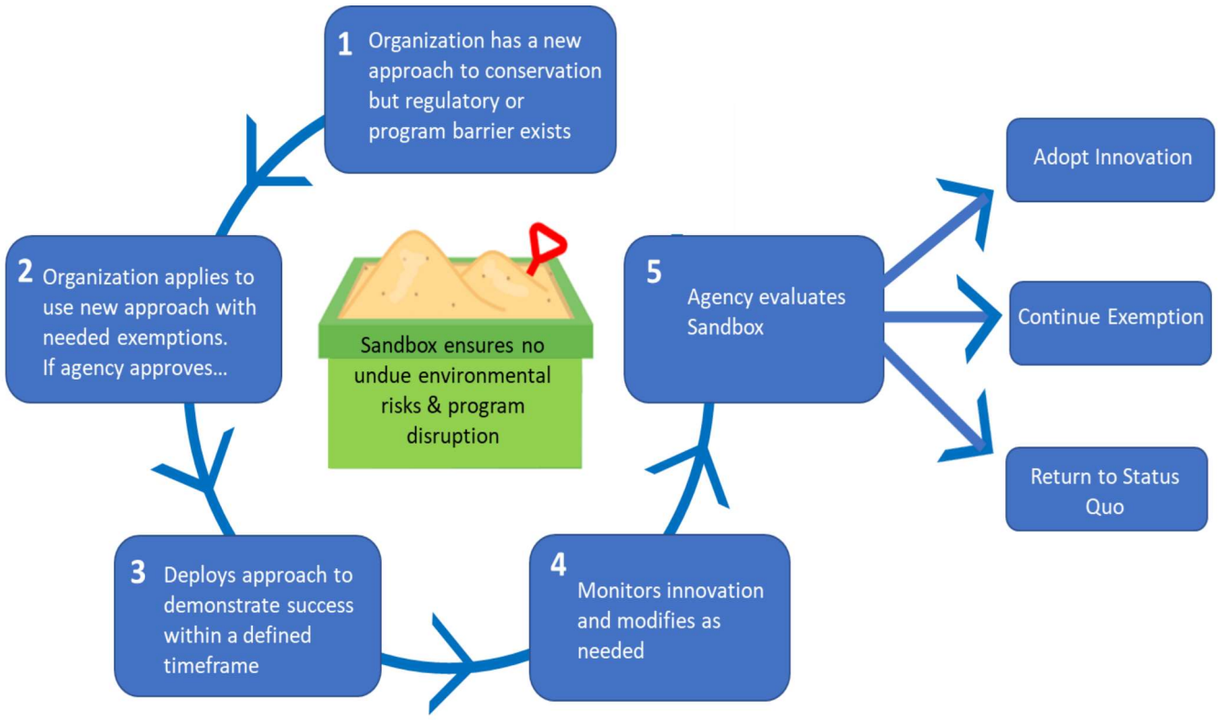
Moyer et al. 2107, Webber, 2017



Challenging mass balance

Well designed riparian BMP

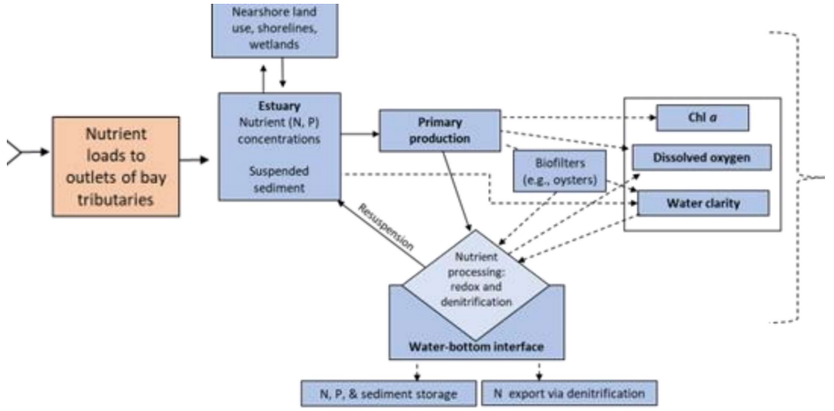
Improving Nonpoint Source Program Effectiveness:
New Opportunities for Technological & Institutional Innovation



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

Findings and Implications:

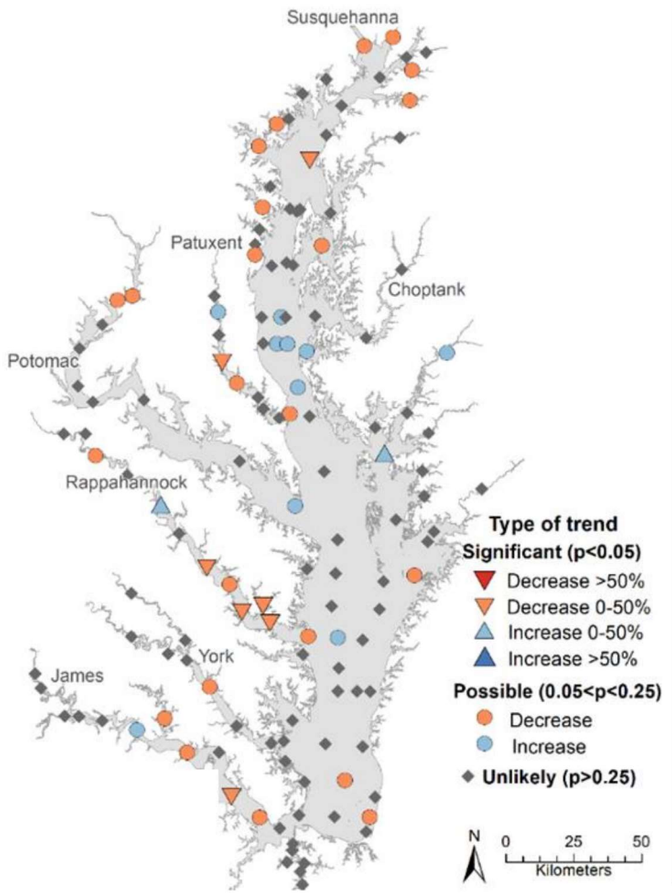
Water Quality Response



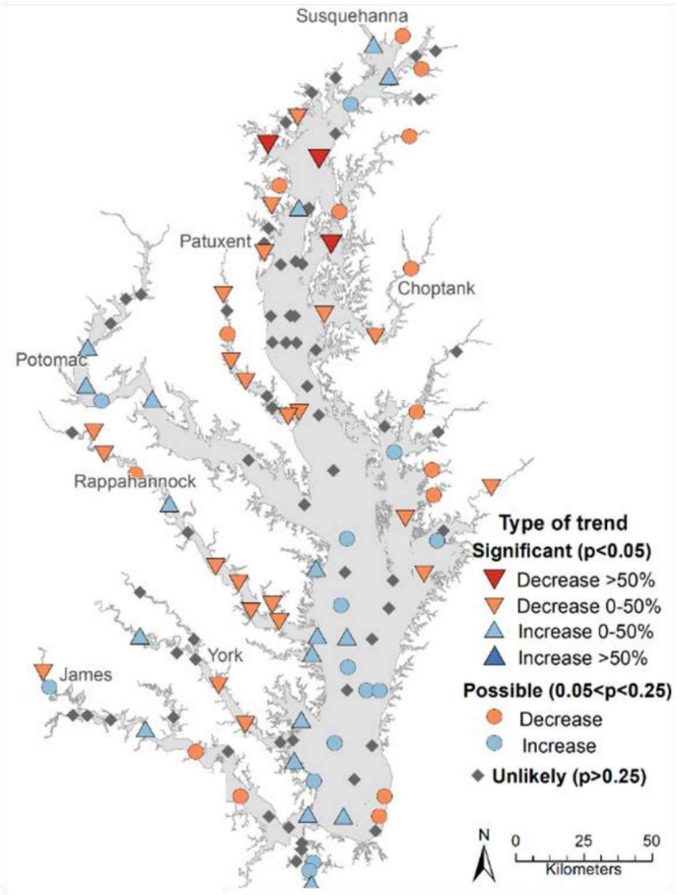
Water Quality Response at Bay Scale; DO

Chesapeake Bay bottom summer (June-Sept) dissolved oxygen

Short term change (2012 to 2021)

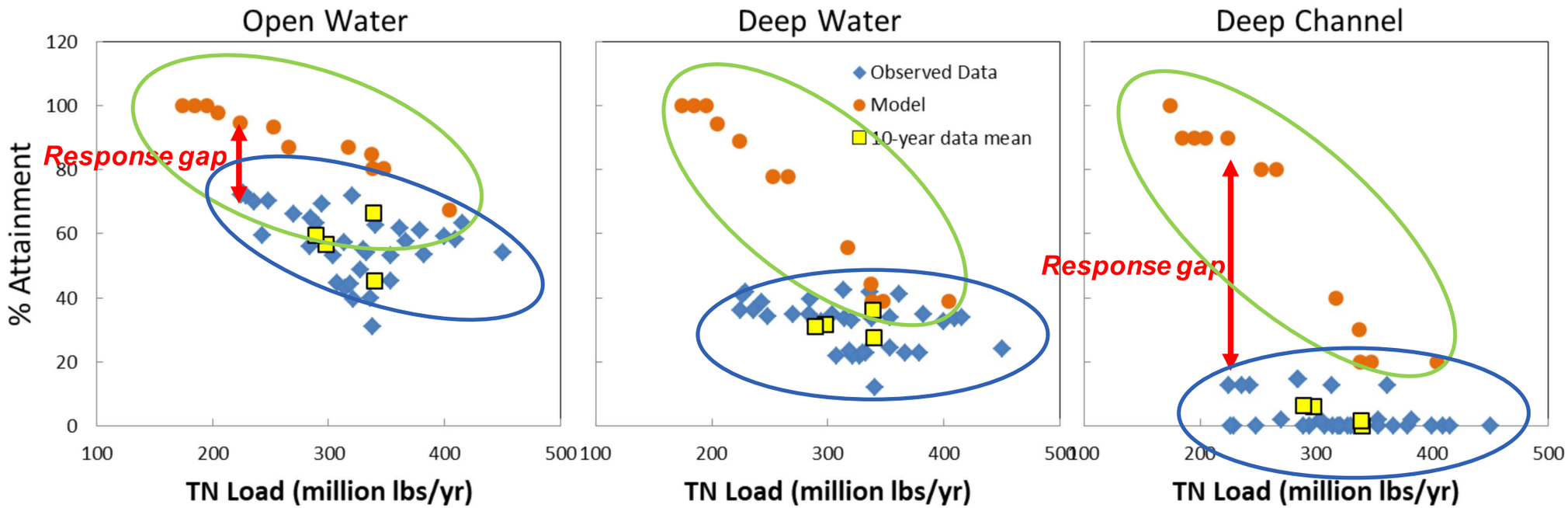


Long term change (1985/6 to 2021)



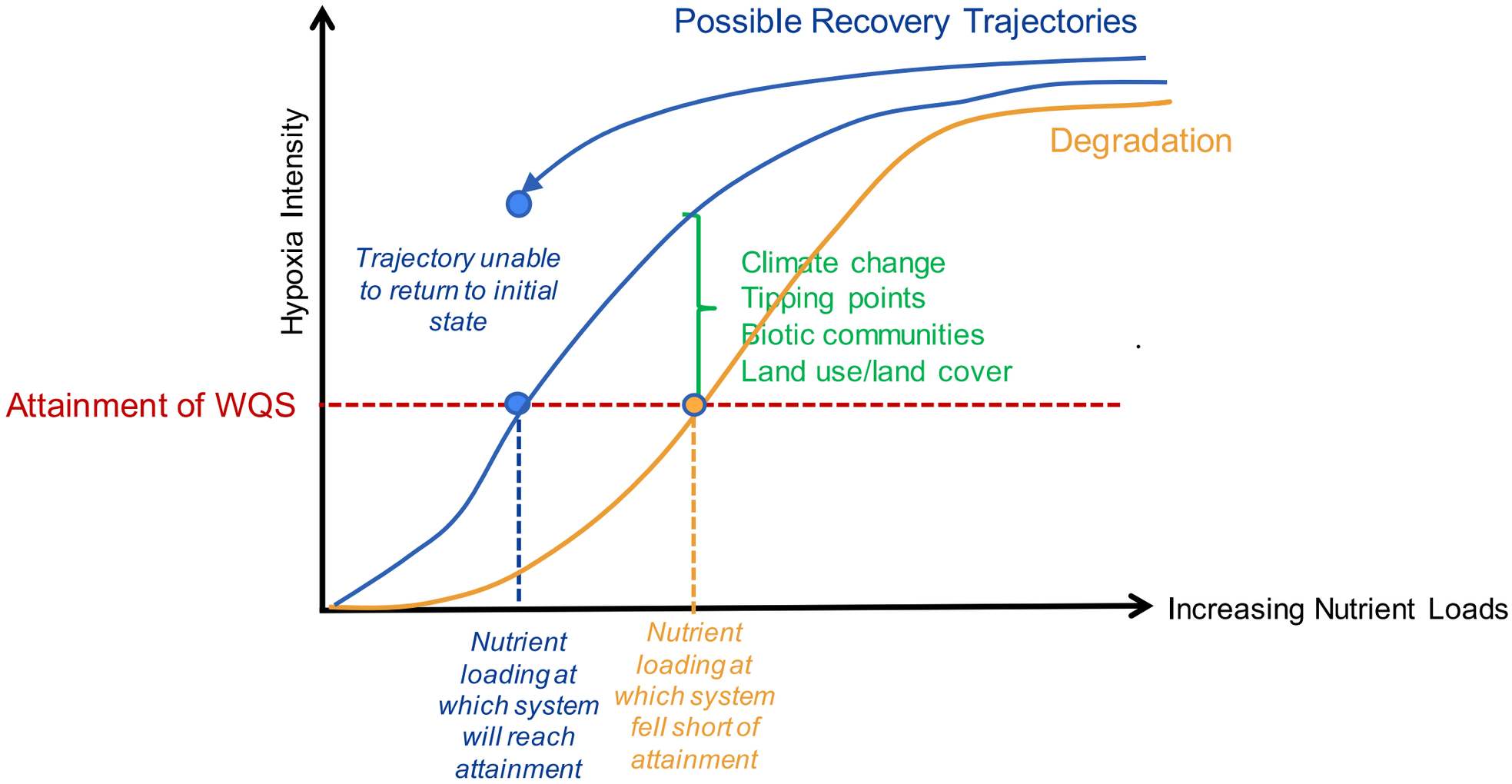
(Source: CBP)

Response Gap for DO across Habitats



Expected and realized relationships between TN loads and DO criteria attainment for open water, deep water, and deep channel habitat, calculated as 3-year running mean observed values (blue diamonds) and expected responses from estuary model (orange dots) for the same time periods. Yellow squares are 10-year means of the observed data.

Trajectories of Response



Implications

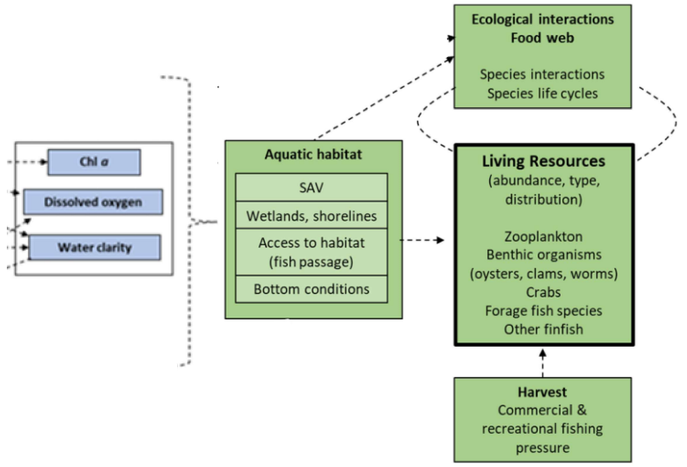
Load reductions have not produced expected level of response and the deep channel may be the last to reach attainment

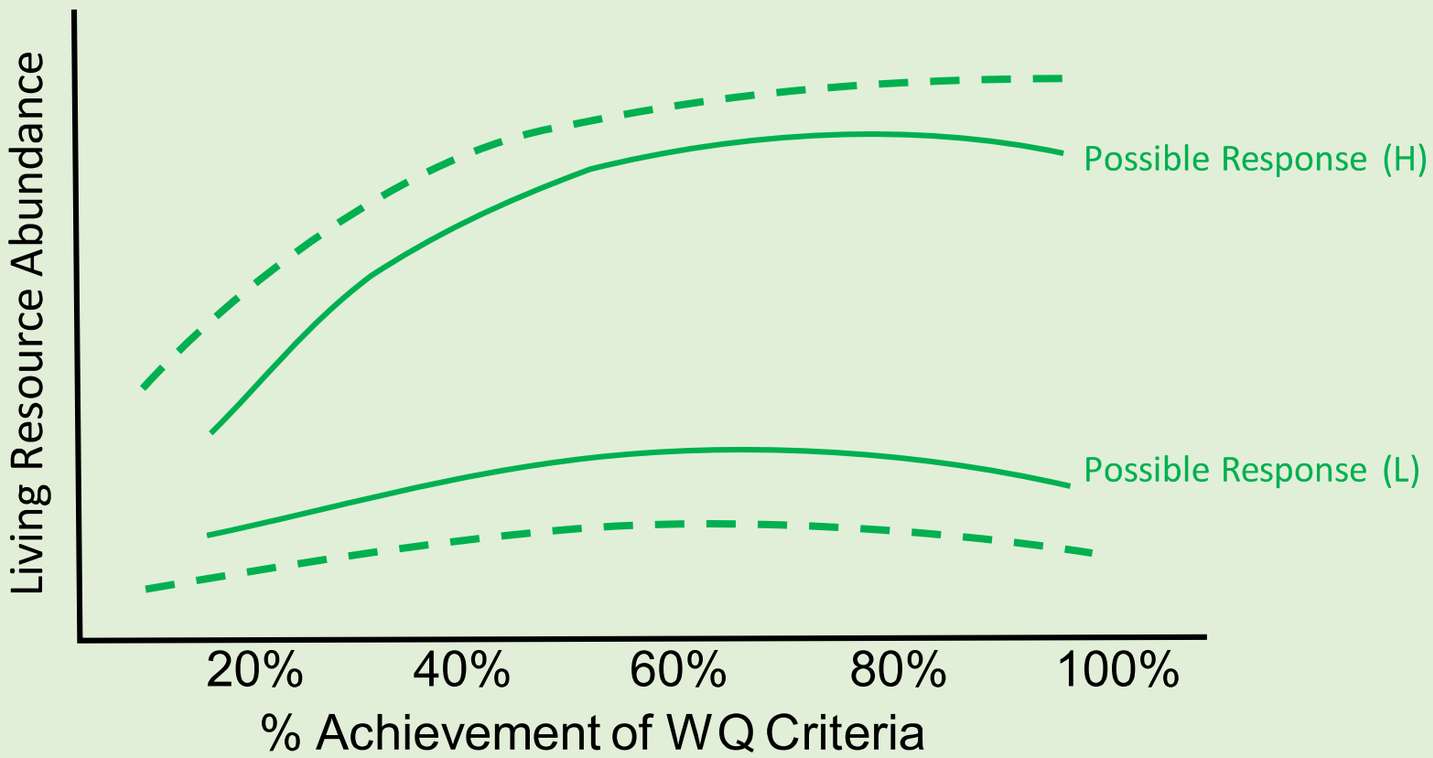
The Bay of the future is not the Bay of the past

- Refocus attention to habitats where recovery is most probable
- Monitor for understanding (versus accountability)
- Assess costs and tradeoffs of attainment in specific areas
- Rethink goals

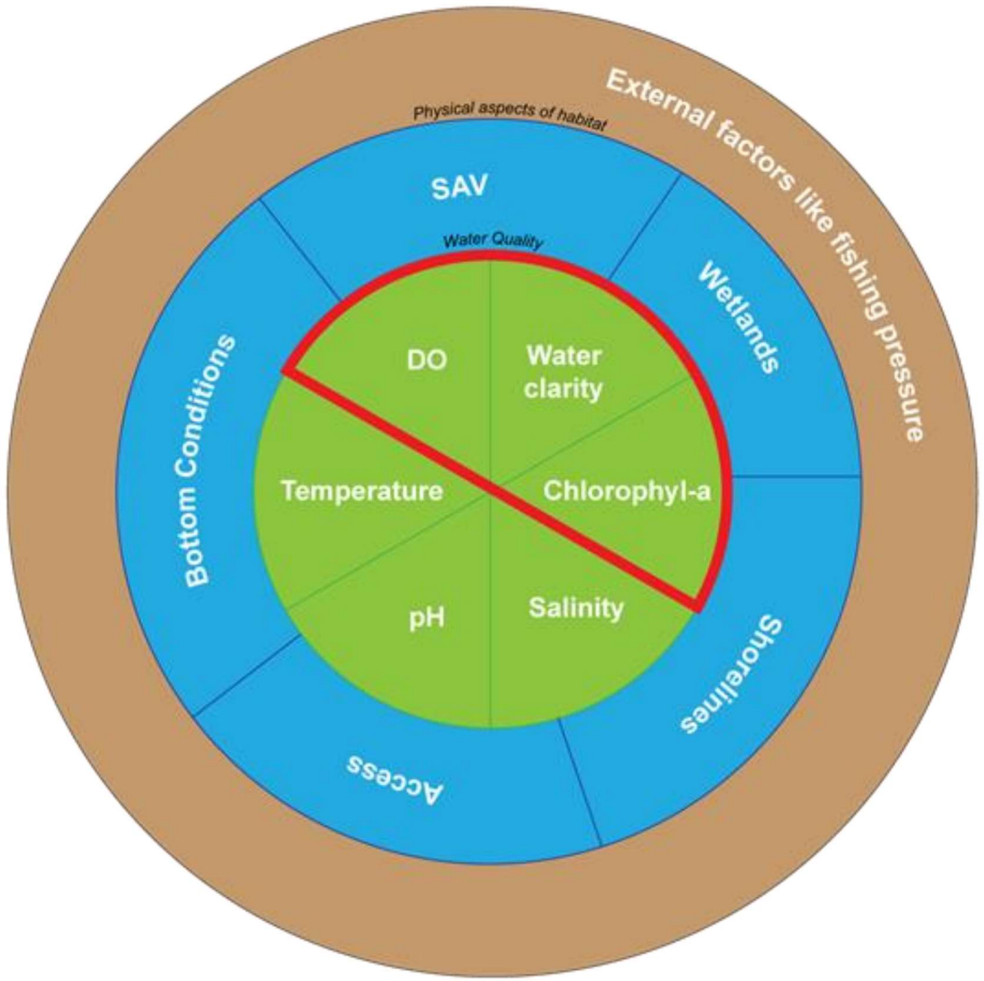
Findings and Implications:

Living Resource Response



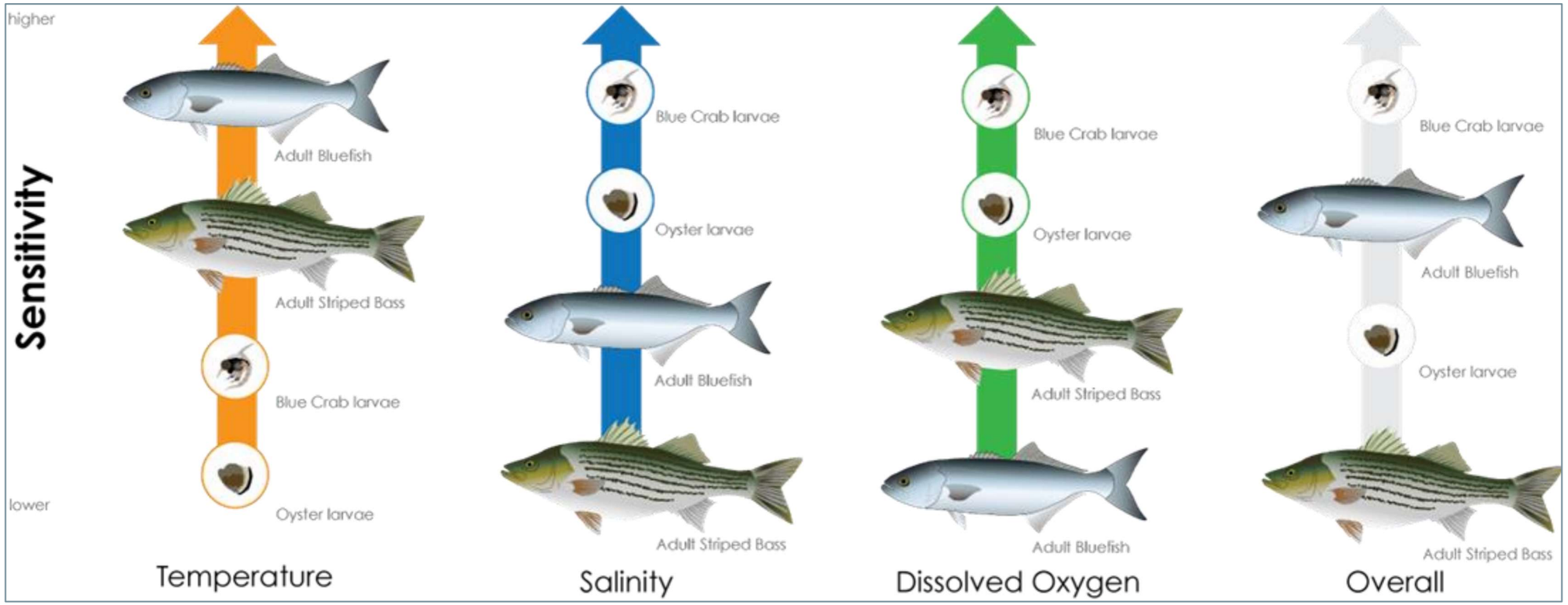

Living Resource Abundance
Possible Response (H)
Possible Response (L)
20%
40%
60%
80%
100%
% Achievement of WQ Criteria

Many Knobs of Living Resource Response



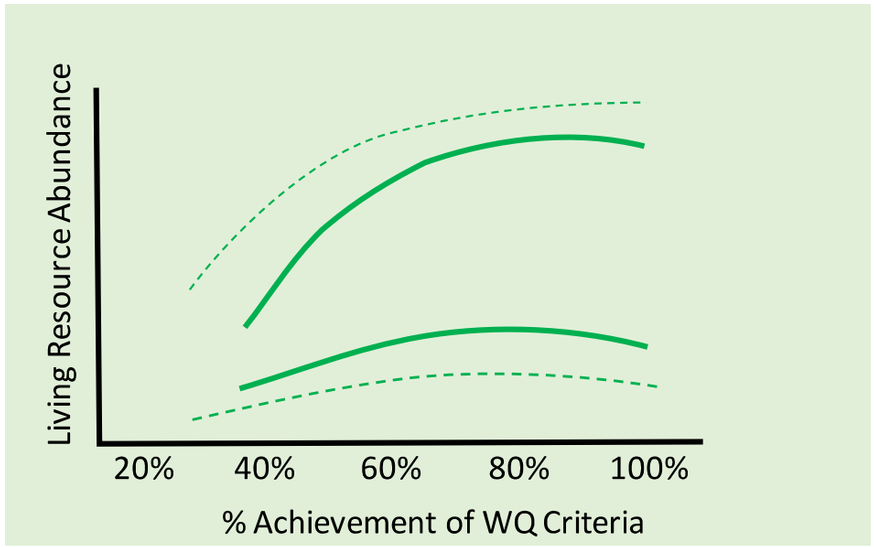
Managed by Bay water quality standards

Sensitivity varies over life history stage



Reinterpreted from Schelnger et al., 2022

Boosting the Curve



Full attainment may not be necessary to meet and support living resource goals

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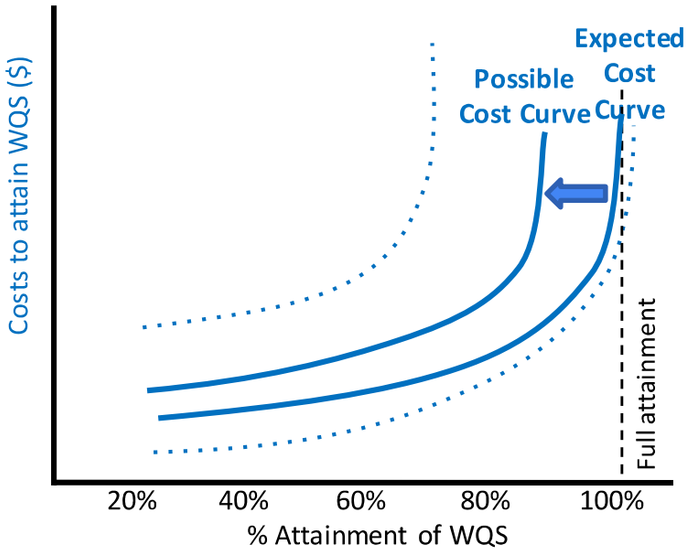
- Additional management actions may boost response to any given unit of water quality improvement
- Broaden articulation of benefits
- Recognize the implications of the steep part of the curve and prioritize nutrient reduction for maximizing living resource response (shallow waters)

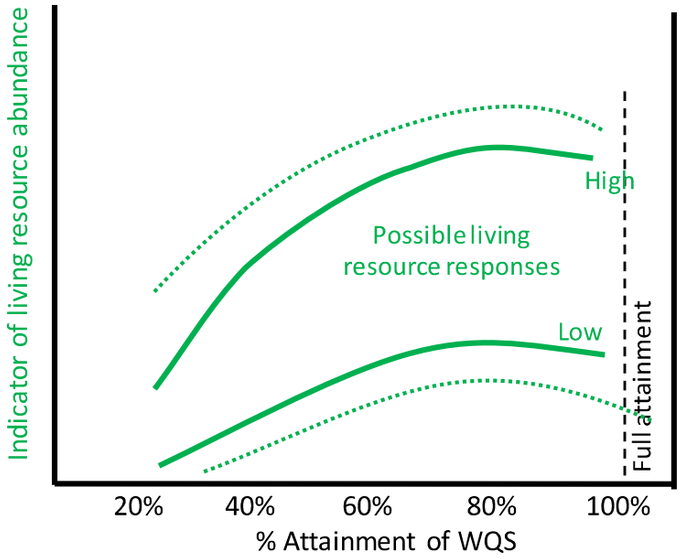
Costs of attaining WQS



Expected cost curve: costs increase rapidly as nutrient reductions approach TMDL goals and full attainment is expected to be achieved.

Possible cost curve: Gaps in nonpoint source and estuary response likely shifting cost curve to left and full attainment may not be possible

Possible living resource response

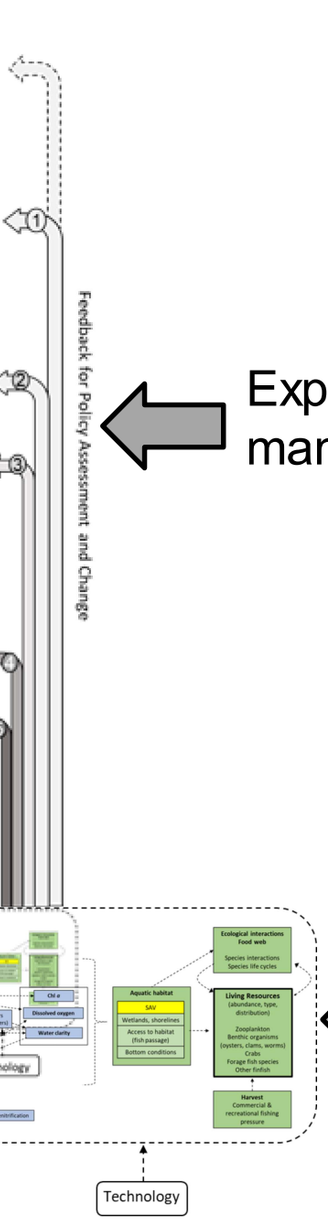


What is the consequence for living resources?

High LR curve: Maximum LR response for water quality improvements

Lower LR curve: LR response is dampened but could be shifted to High LR curve by changing the location & timing of Bay water quality improvements and improving other factors that influence living resource abundance (habitat, harvest, etc)

Expand Adaptive Decision-making



Improve transfer of learnings to relevant decisionmakers

Expand the scope of adaptive management

Improve capacity to identify and evaluate uncertainties and gaps in system response