Comprehensive Evaluation of System Response

- Identify gaps and uncertainties in system response —physical, chemical, biological, and socioeconomic— that impact efforts designed to attain WQS.
- Identify recent scientific developments that can shed light on the gaps and uncertainties in system response to advance efforts to attain WQS, and
- Recommend research strategies that improve understanding of system response to support informed decision making to attain WQS.
- Recommend strategies for integrating scientific and technical analysis with active adaptive management in order to aid decision-making under uncertainty (to achieve WQS).

Public Policy

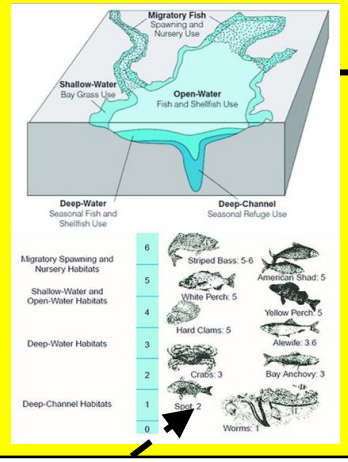
Chesapeake Bay Agreement: Restoration Goals

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

Enforceable Goal

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 loads to achieve water quality criteria

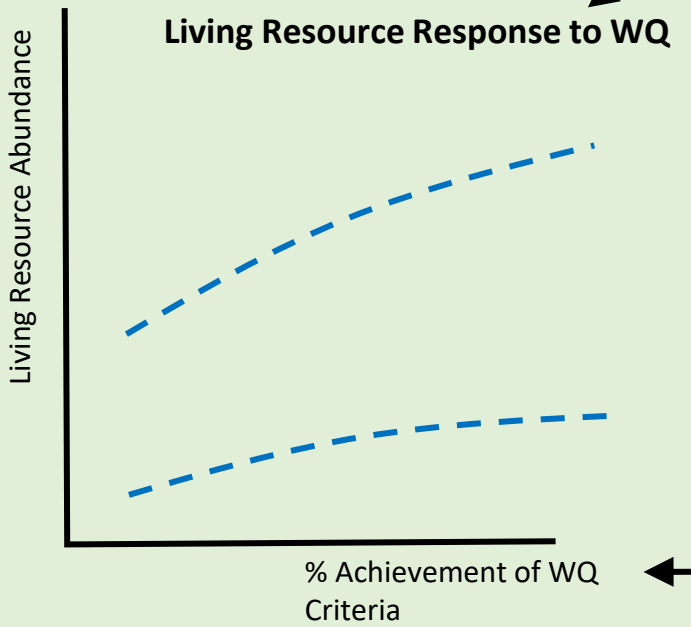
TN: 214.6 m/lbs/yr
TP: 13.4m lb/yr
TSS: 18,587m lb/yr

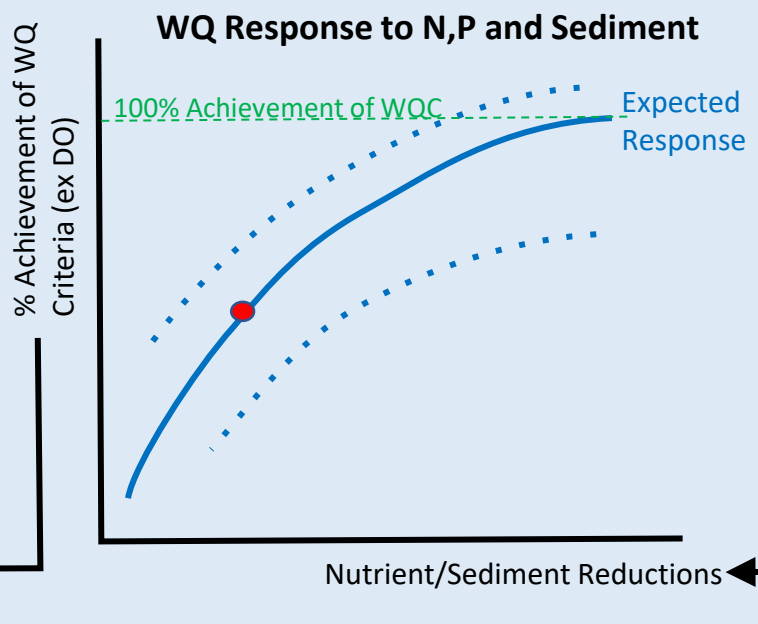
Implementation Policy

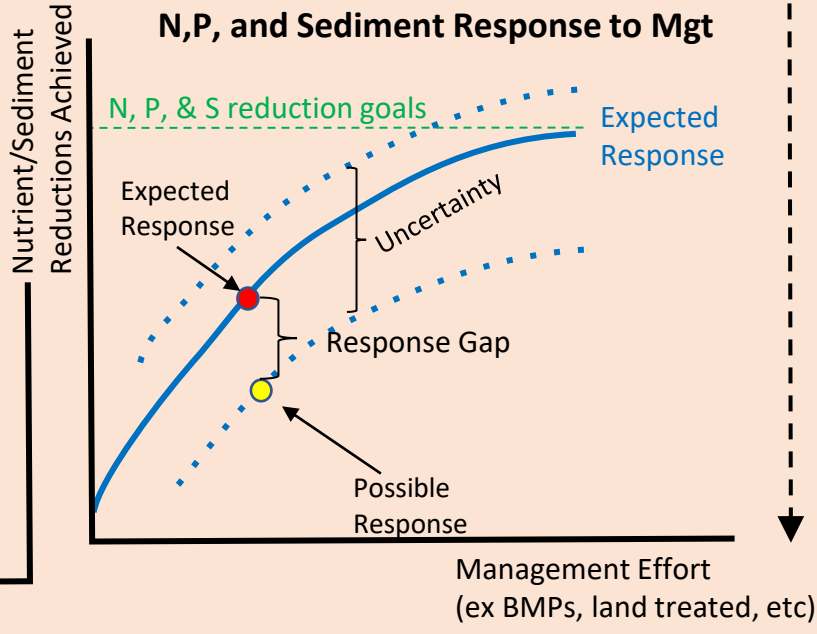
Policies designed to reduce stressors to achieve WQS.

Point source
Urban nonpoint source
Ag nonpoint source
Budgets

Biological, Physical, and Social System Response





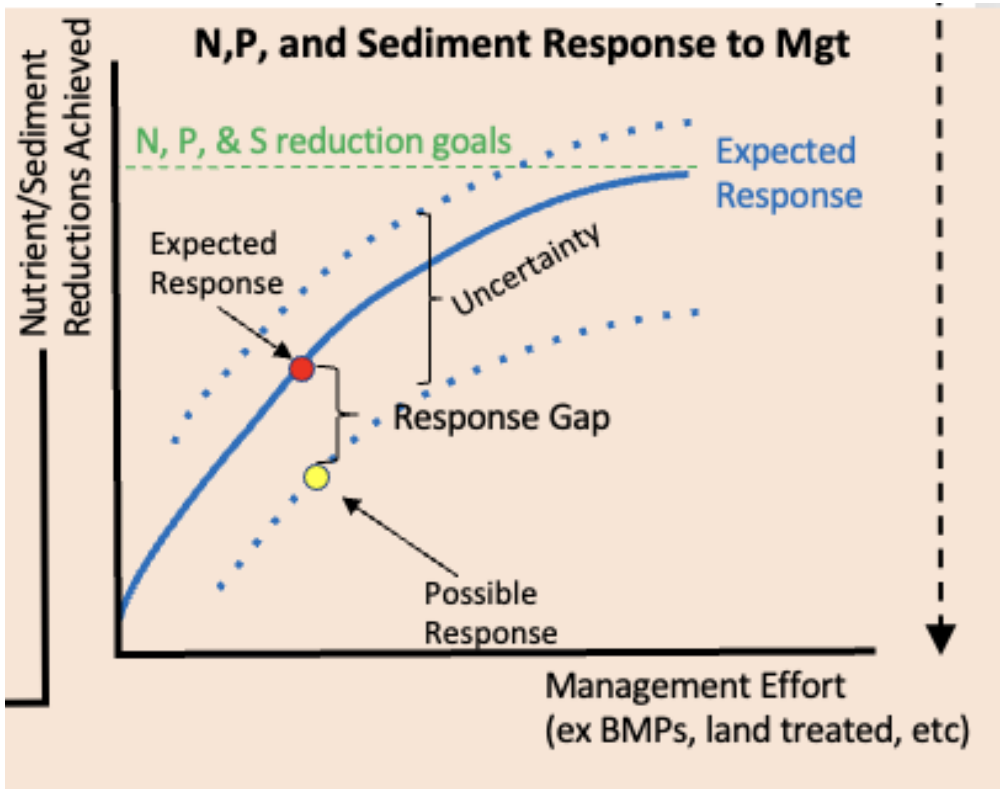


Watershed Framing Questions

- Is the physical and social system responding to management efforts to meet TMDL N, P, and S goals in ways consistent with expectations?

- What are the major uncertainties in efforts to reduce N, P, and S stressors delivered to the Chesapeake Bay?

- What management actions/policy options could improve nutrient/sediment response or reduce response uncertainties? (see implications)



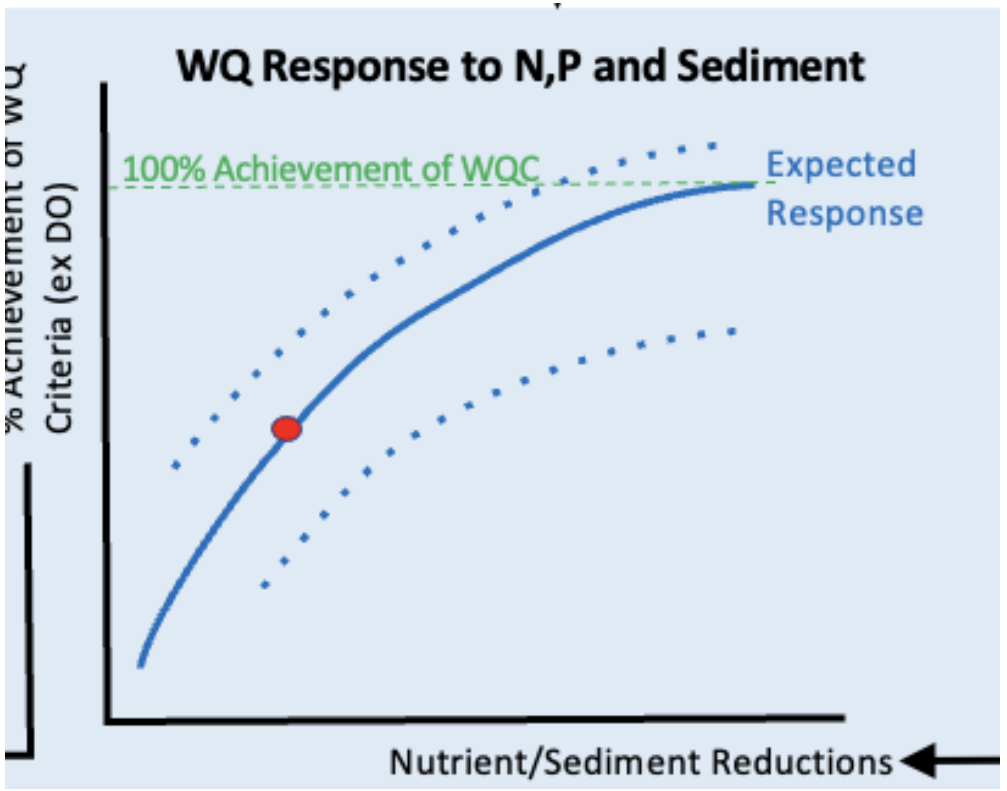
Estuary Framing Questions

- Is estuary water quality responding in ways consistent with expected response to stressor reductions (N,P, & S) achieved to date?

- What are the major uncertainties in efforts to assess Bay water quality criteria (DO, water clarity/SAV, chl-a)?

- What are the major uncertainties in efforts to achieve Bay water quality criteria (DO, water clarity/SAV, chl-a)?

- What management actions/policy options could improve estuary water quality (criteria) response?



Living Resource Framing Questions

- To date, how is the CBP assessing the response of LR to management actions designed to improve WQ and habitat? And how does this compare to other large-scale restoration programs?

- What are the challenges relating the response of living resources to current numeric water quality criteria and habitat actions, recognizing that living resource conditions are affected by changes in multiple factors?

- What can be done to improve confidence in understanding LR response to WQ conditions?

- What LR reflect or are responsive to WQ conditions? How can the analyses inform what types and magnitude of changes in water quality and habitat are needed to evoke an agreed-upon set of the desired living resources responses?

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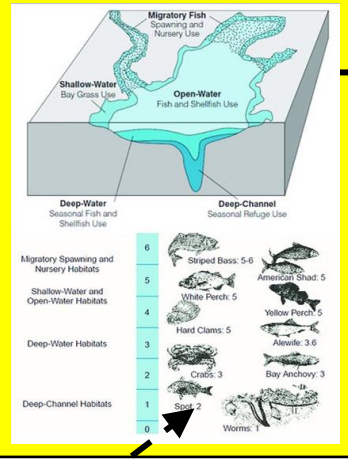

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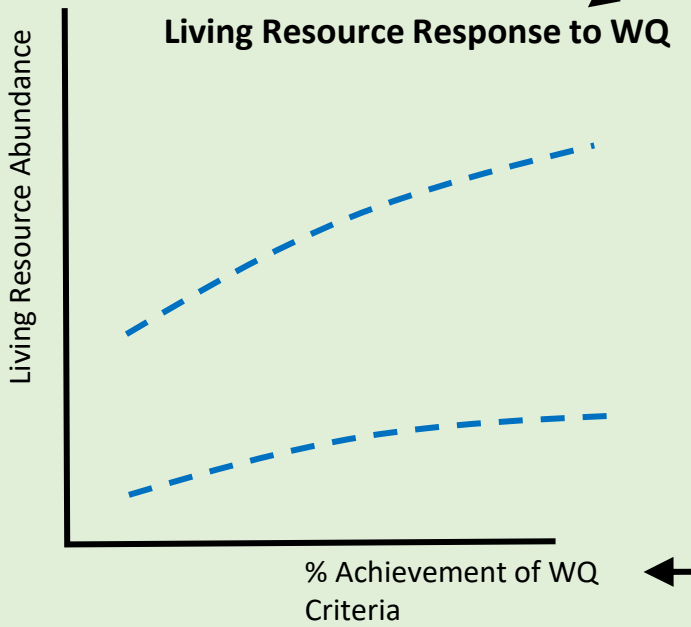
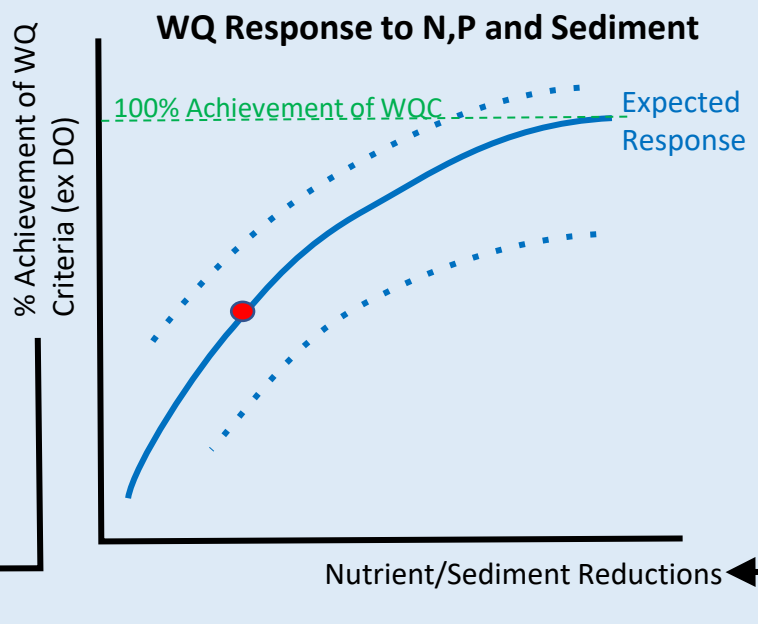
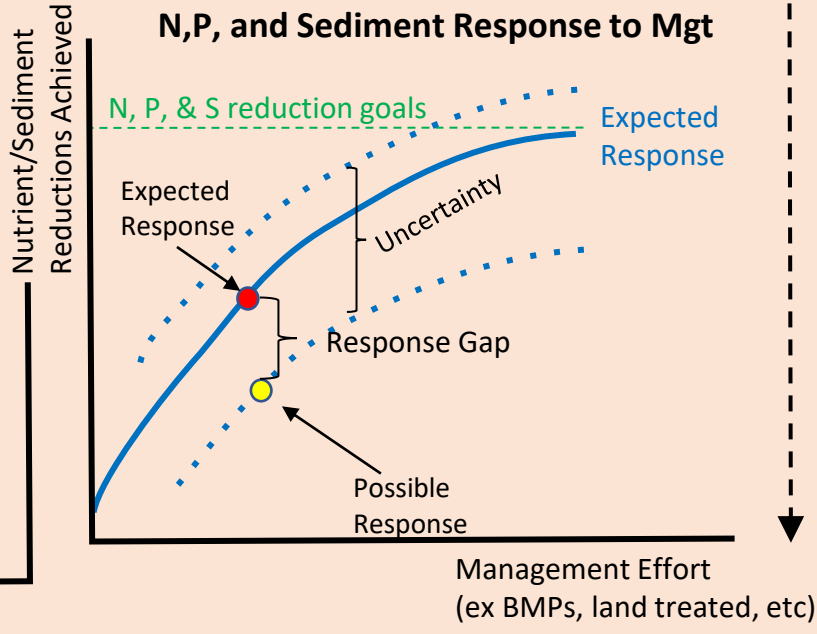
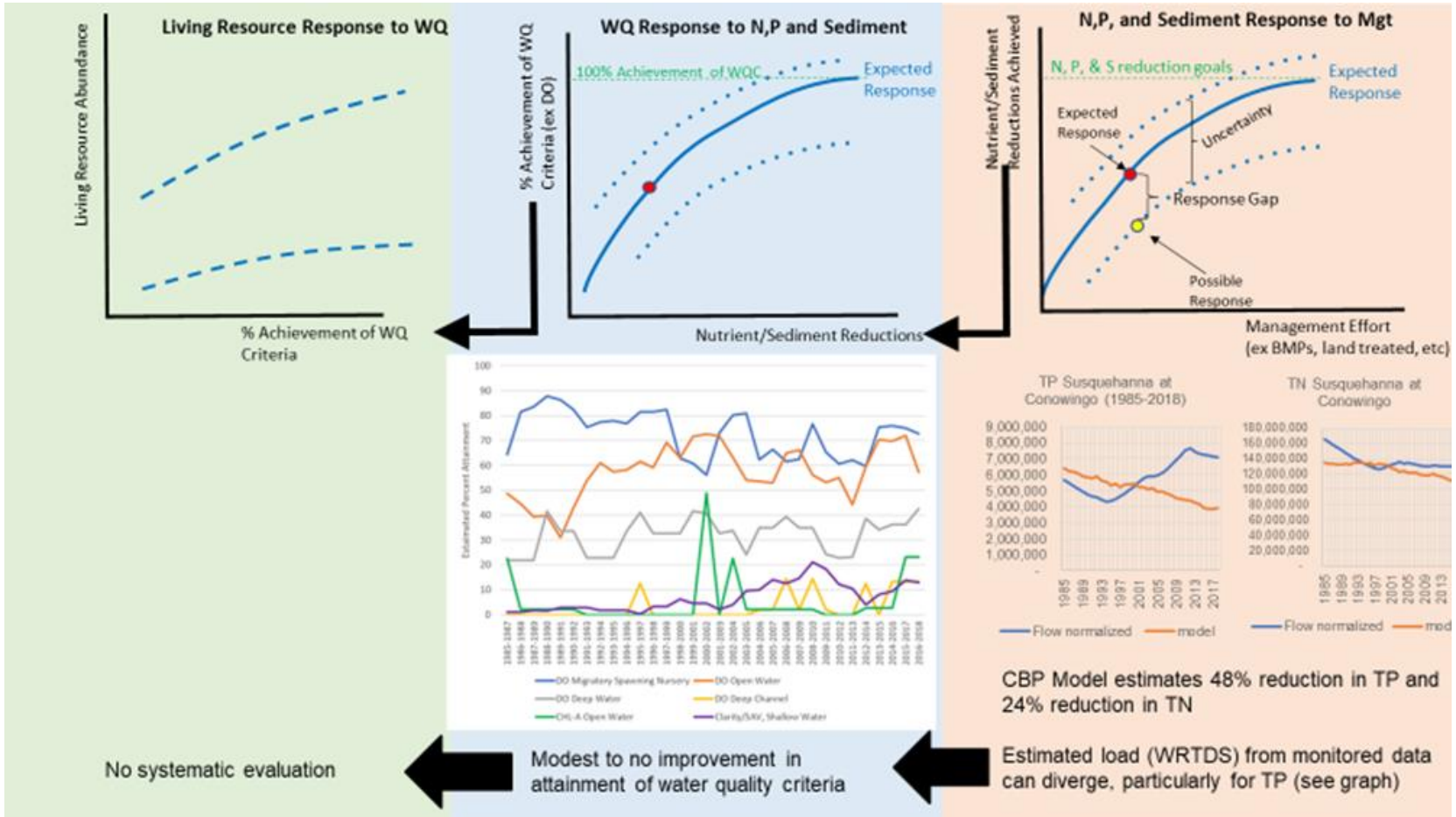


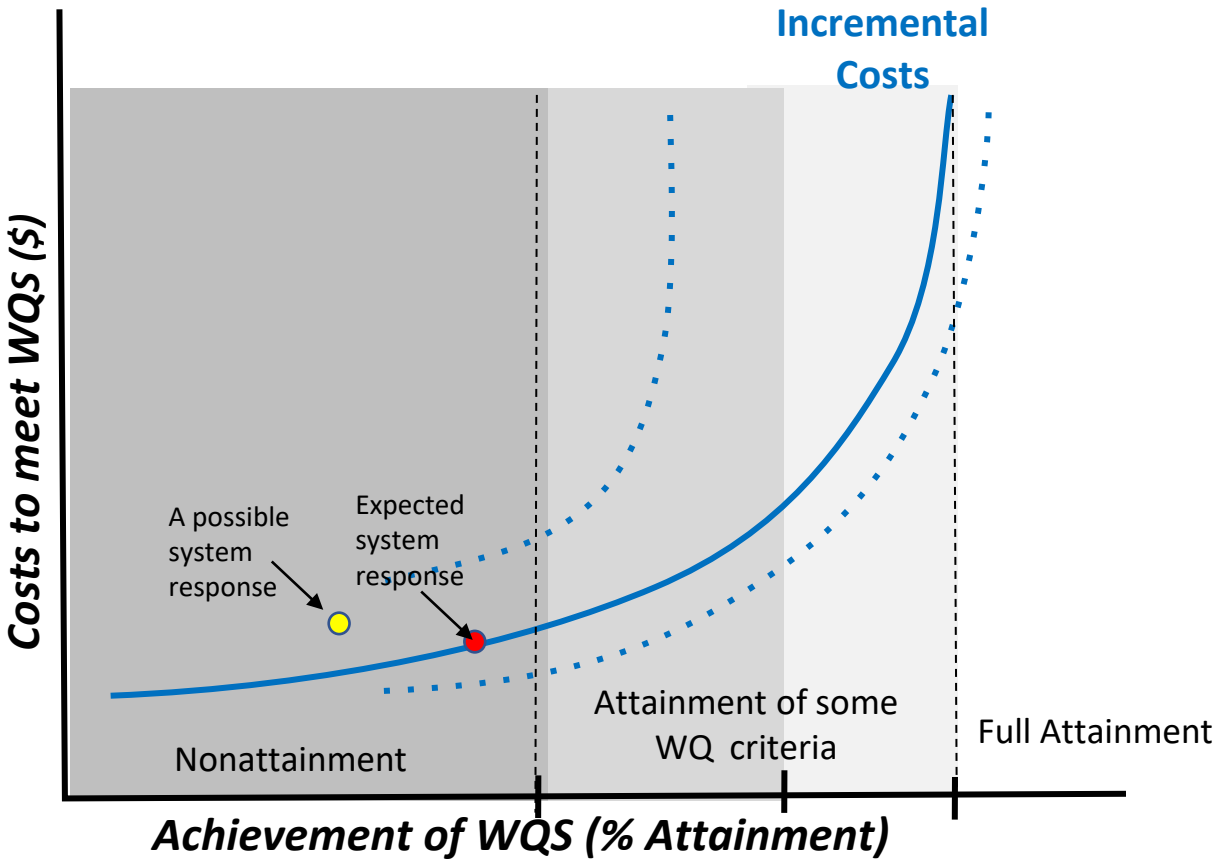


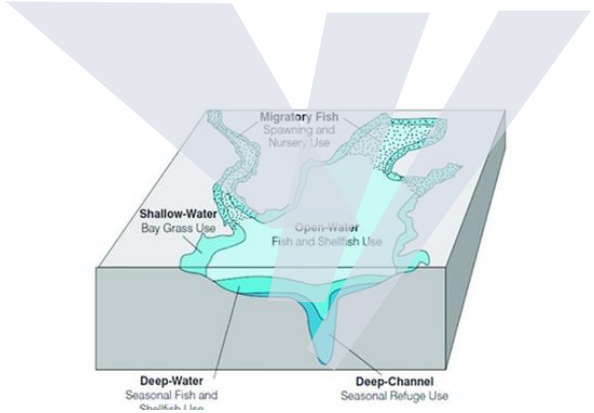



Living Resource Response to WQ
Living Resource Abundance
% Achievement of WQ Criteria
WQ Response to N,P and Sediment
% Achievement of WQ Criteria (ex DO)
100% Achievement of WQC
Expected Response
Nutrient/Sediment Reductions
N,P, and Sediment Response to Mgt
Nutrient/Sediment Reductions Achieved
N, P, & S reduction goals
Expected Response
Expected Response
Uncertainty
Response Gap
Possible Response
Management Effort (ex BMPs, land treated, etc)
TP Susquehanna at Conowingo (1985-2018)
TN Susquehanna at Conowingo
Flow normalized
model
CBP Model estimates 48% reduction in TP and 24% reduction in TN
Estimated load (WRTDS) from monitored data can diverge, particularly for TP (see graph)
Modest to no improvement in attainment of water quality criteria
No systematic evaluation

Implications

- Expand Adaptive Governance/Management. The attainment of WQS will only get costlier and the effectiveness of nutrient/sediment investments more uncertain; therefore, the program must evolve beyond its current adaptive management approach.
- Rethink Criteria. Given what we've learned and the changing stressors on the Bay, it will be necessary to reconsider desired endpoints and/or reevaluate how they are defined. Defining and assessing criteria must be tightly linked
- More Effective Implementation. The existing NPS programs will be insufficient to meet TMDL goals. Both physical (BMP effectiveness) and social (behavioral change) aspects of implementation need revision to make substantial progress in reducing nonpoint source nutrient/sediment loads
- Evaluate Tradeoffs/Allocate Resources Appropriately. The TMDL operates in the context of a larger set of goals and a future of changing conditions; this implies that success will involve both a reflection on our goals as well as how we design our approach


Incremental Costs
Costs to meet WQS ($)
A possible system response
Expected system response
Nonattainment
Attainment of some WQ criteria
Full Attainment
Achievement of WQS (% Attainment)


Migratory Fish Spawning and Nursery Use
Shallow-Water Bay Grass Use
Open-Water Fish and Shellfish Use
Deep-Water Seasonal Fish and
Deep-Channel Seasonal Refuge Use