



Chesapeake Bay Program
Science. Restoration. Partnership.

Foundations for Tiered Implementation

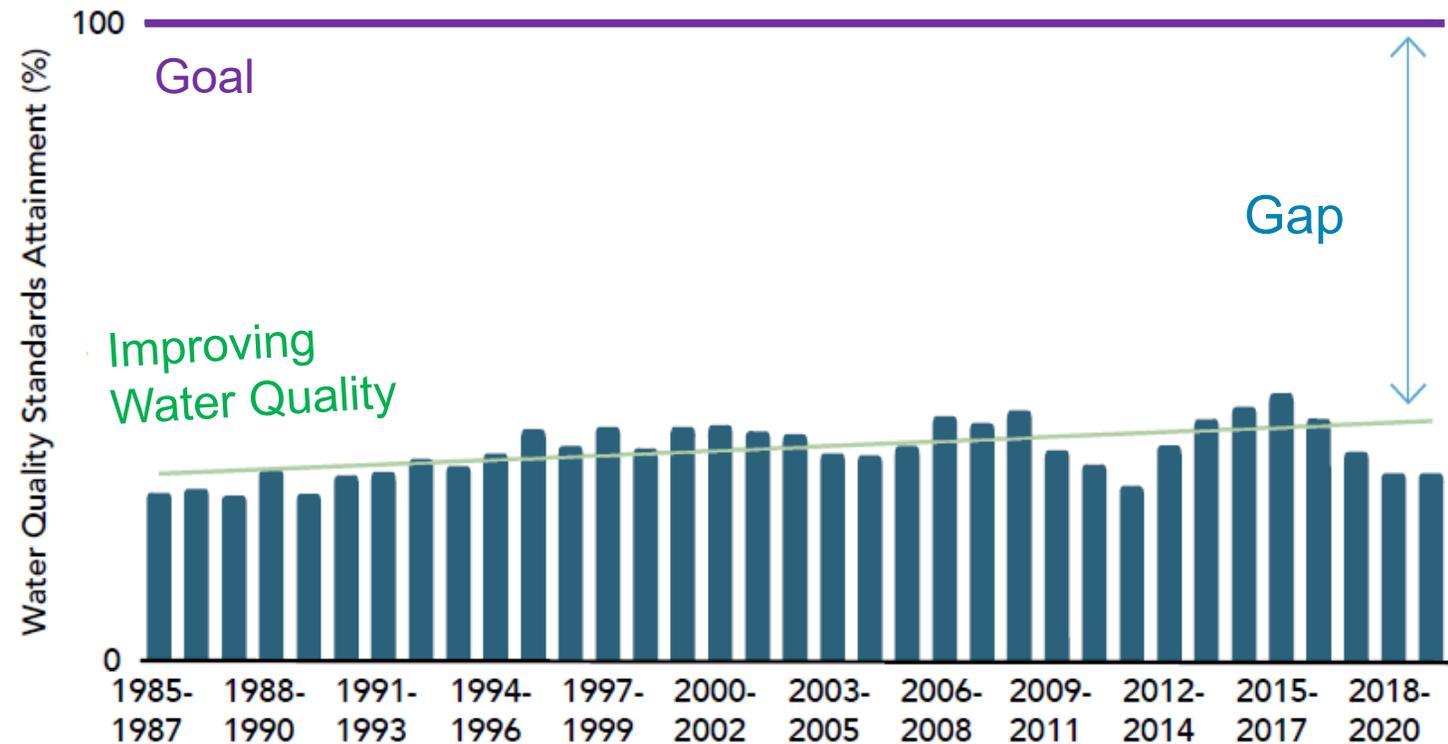
March 12, 2026

Dr. Kaylyn S. Gootman, EPA

Motivation: The CESR Report

- 40+ years of Chesapeake Bay restoration
- Improvements have been made, plus value in holding the line
- Why is there a gap & how do we close it?
- What might we do differently going forward?

Percent Attainment of Water Quality Goals in the Chesapeake Bay
(measured for 3 year averages)



RESTORING THE CHESAPEAKE BAY

Clean Water Goal



Measurement of the Goal



Achieving the Goal

Protect Aquatic Living Resources

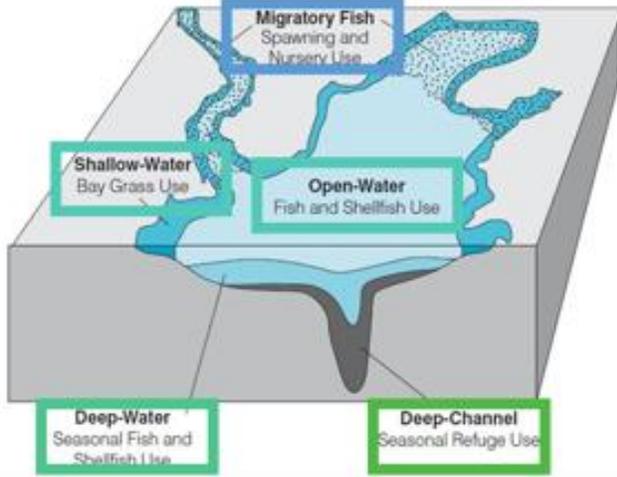
| | | | |
|---|---|-------------------|--------------------|
| Migratory Spawning and Nursery Habitats | 6 | Striped Bass: 5-6 | American Shad: 5-6 |
| Shallow-Water and Open-Water Habitats | 5 | White Perch: 5 | Yellow Perch: 5 |
| Deep-Water Habitats | 4 | Hard Clams: 5 | Alewife: 3.6 |
| | 3 | Crabs: 3 | Bay Anchovy: 3 |
| Deep-Channel Habitats | 2 | Spot: 2 | Worms: 1 |
| | 1 | | |
| | 0 | | |

Dissolved oxygen (mg liter⁻¹) concentrations required by different species and communities.

Numeric Criteria

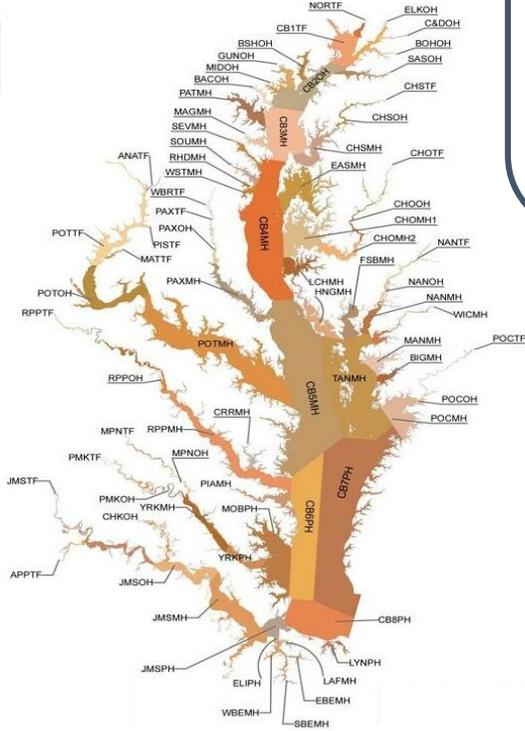
- Dissolved Oxygen
- Water Clarity/SAV
- Chlorophyll a

Across 5 habitats



Five Chesapeake Bay tidal water designated use zones.

in 92 Segments



TMDL

N, P, sediment targets to meet goal

↑

Pollutant Control Programs

↑

Accountability

RESTORING THE CHESAPEAKE BAY

Clean Water Goal

Measurement of the Goal

Achieving the Goal



Protect Aquatic Living Resources

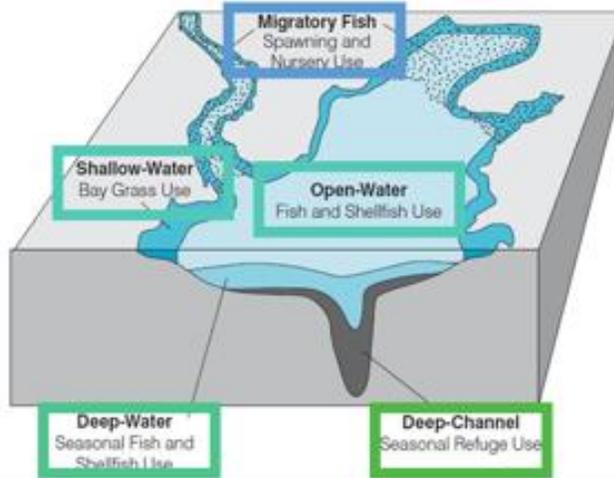
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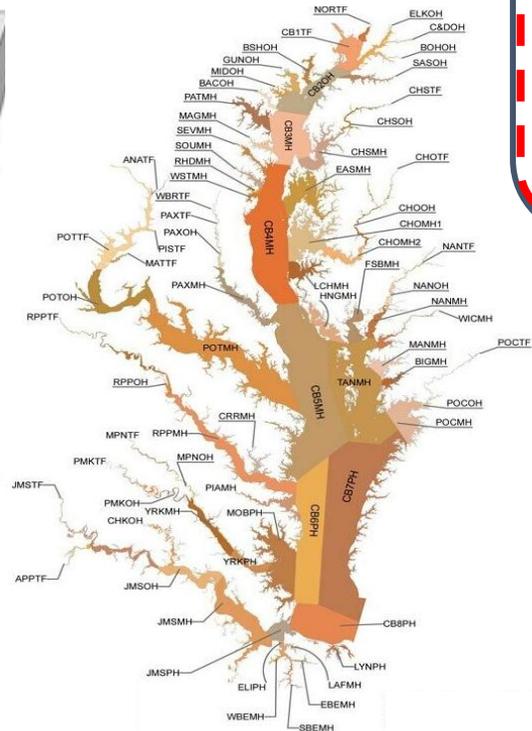
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Across 5 habitats



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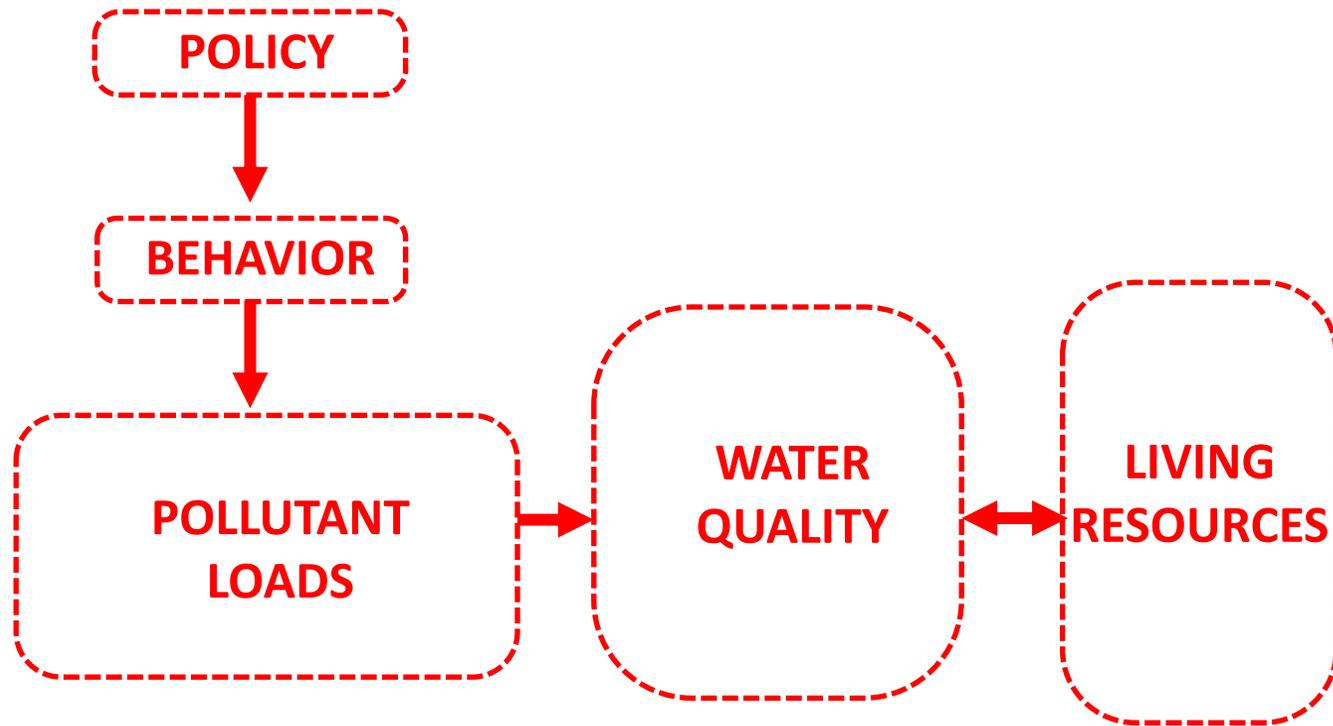
TMDL

N, P, sediment targets to meet goal

Pollutant Control Programs

Accountability

CESR Approach



- Systemic evaluation of what has occurred
- Policy relevant framing
-  50+ volunteer scientists
- Literature synthesis & supplemental empirical work

CESR Findings: Living Resources



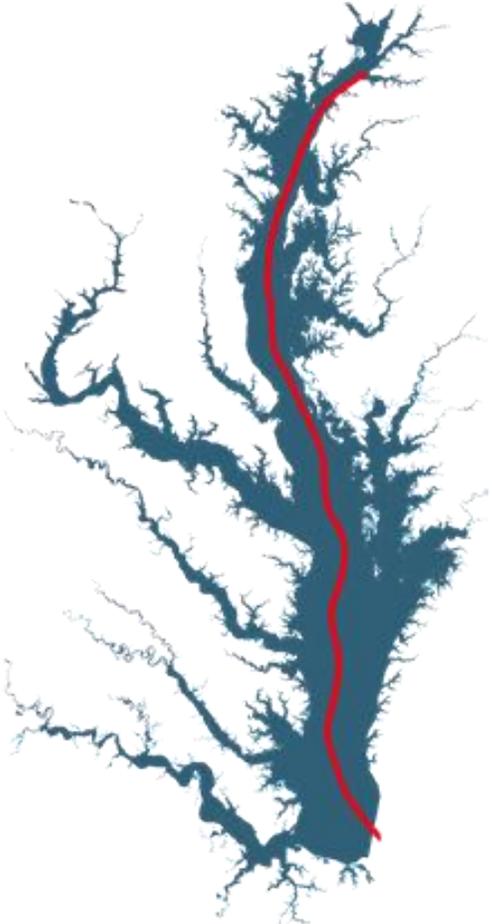
-Maryland Sea Grant

“Significant enhancement of living resources can be achieved through additional management actions without complete achievement of water quality standards across all habitats”

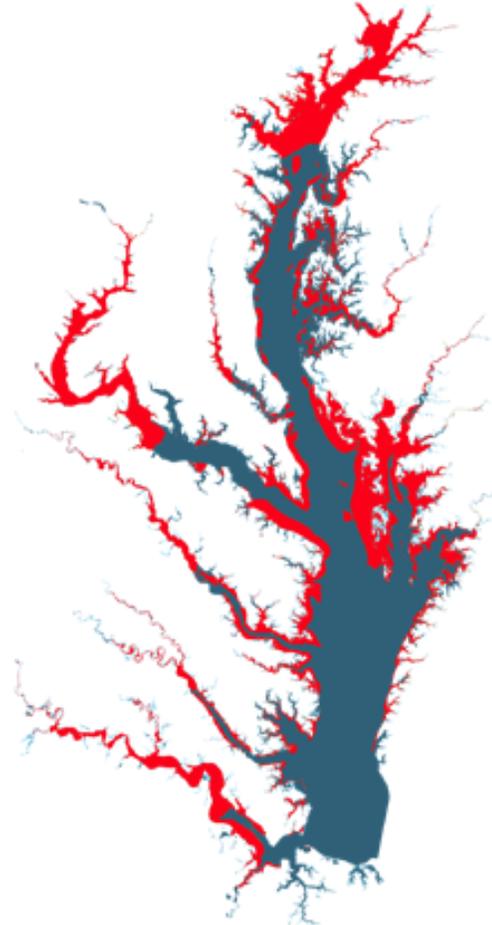
-CESR (p. viii)

Accelerating living resource response on our way to meeting overall goal

Deep water DO is most challenging water quality goal

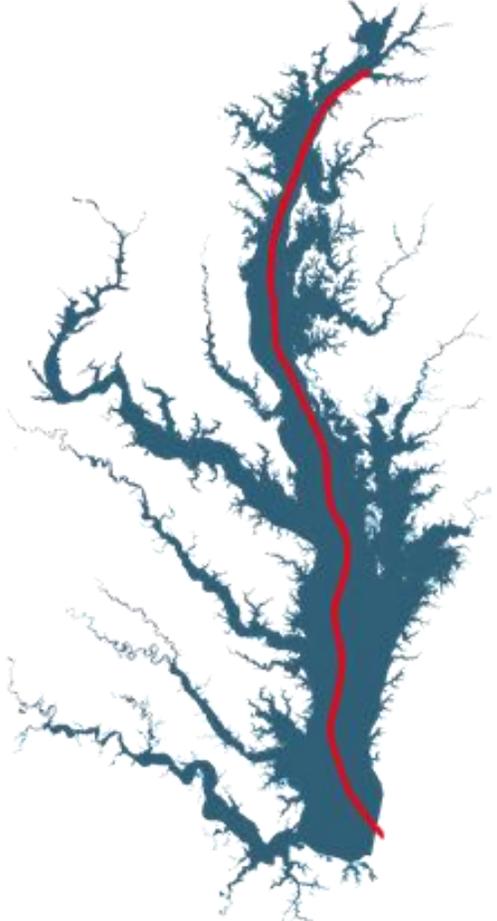


But most impactful living resource habitats are elsewhere

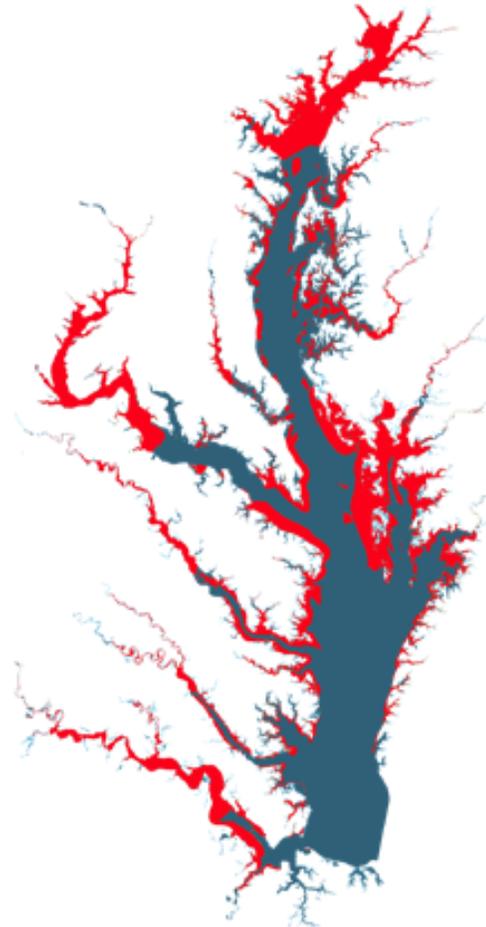


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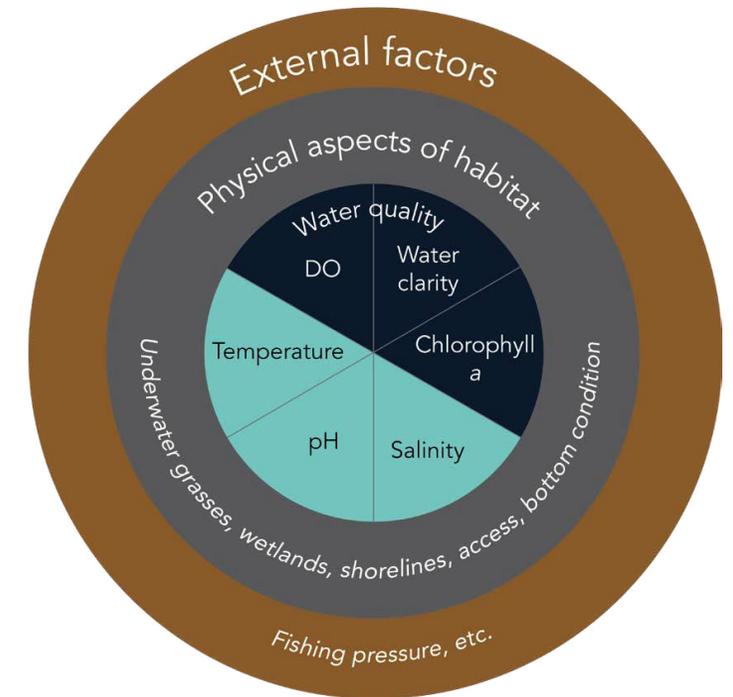
Deep water DO is most challenging water quality goal



But most impactful living resource habitats are elsewhere



Living resource habitat factors that matter



Guidelines for Planning Targets with the Default Approach

Everything
Everywhere
Everyone

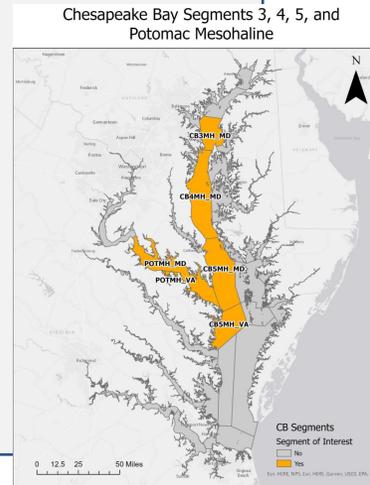
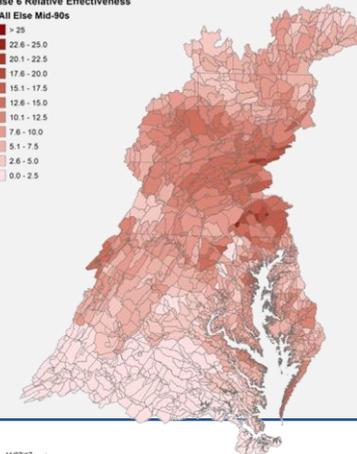
Effort

No BMPs

Increasing relationship between
Relative Effectiveness and Effort

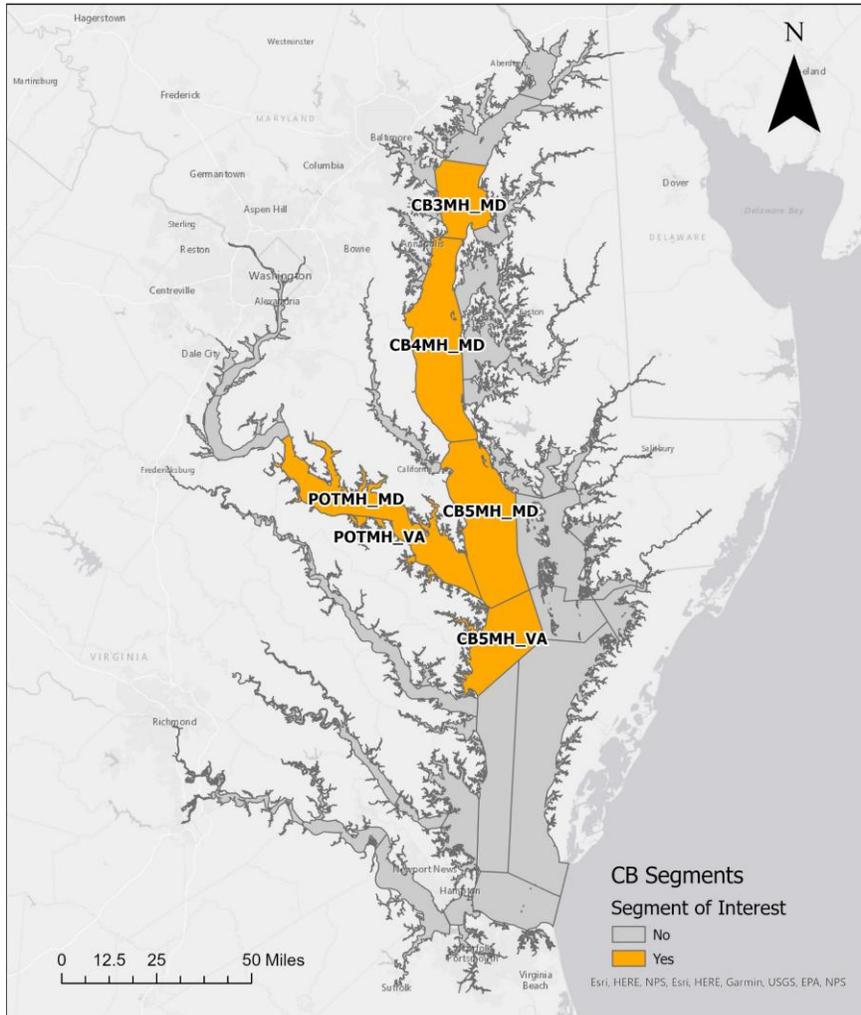
Effectiveness defined as the
deep channel and deep water

Effectiveness



...but the middle of the bay is not the most important habitat

Chesapeake Bay Segments 3, 4, 5, and Potomac Mesohaline



Chesapeake Bay Priority Living Resource Areas Using GIS to Identify Habitat Hot Spots



We direct the Chesapeake Bay Program to ... conduct an analysis and prepare a protocol ... to determine whether nutrient goals and reduction efforts can be further targeted to areas of persistent high loadings, especially where evidence indicates a linkage to critical living resources or human health concerns.
Chesapeake Executive Council,
Directive 97-1

Credits:
Map and Analysis: John Wolf, National Park Service, Chesapeake Bay Program Office, 410 Ocean Ave., Suite 100, Annapolis, Maryland 21403; Paul Hester, Loudoun, VA, LLC, Washington, DC.
Composite PLRA maps derived from data from the following sources: Fontaine, E.L., J.A. Murray, T.L. Jordan, and D. Flay (eds.) 1992. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition. Safety range data extrapolated from 1985-1987 spring and summer Chesapeake Bay monitoring data.
Potomac river habitat defined using modified Vitek groups, English groups, upper lower areas, and other categories.
Tier 1 SAV areas (CBP and Virginia Institute for Marine Science).
Aquatic Resource Graphics: Symbols courtesy of the Integration and Collaborative Research Resources Administration, University of Maryland Center for Environmental and Estuarine Science and Chesapeake Bay Program.

Water Column Species

- American Shad *Alosa sapidissima*
- Atlantic Menhaden *Brevoortia tyrannus*
- Bay Anchovy *Anchoa mitchilli*
- Striped Bass *Morone saxatilis*
- White Perch *Morone americana*
- Alewife *Alosa pseudoharengus*
- Hickory Shad *Alosa medirostris*
- Yellow Perch *Perca flavescens*
- Blueback Herring *Alosa aestivalis*
- Chain Pickerel *Esox niger*
- Largemouth Bass *Micropterus salmoides*

- Priority Level**
- HIGH
 - MEDIUM

Methodology

The Chesapeake Bay Program's target species listed in *Habitat Requirements for Chesapeake Bay Living Resources*, Second Edition which had habitat requirements that could be directly affected by nutrient enrichment (e.g., dissolved oxygen) or sedimentation (e.g., light penetration) were stratified by water column and bottom as their principal habitats. These included all the fish and shellfish species in that document, with several fish species and related layers added for which we had new potential habitat information. Priority areas for Submerged Aquatic Vegetation (SAV) were considered separately.

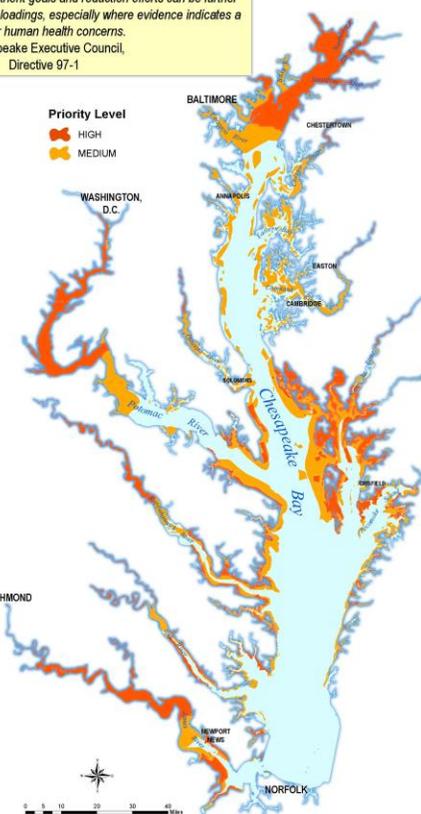
In the case of species with potential habitat distribution maps for multiple life stages, composite maps were produced by combining the individual GIS layers for each life stage. For species with separate spring and summer potential habitat distributions, a composite map was produced reflecting the combined extent of seasonal-based habitats.

Keeping the water column and bottom species separate at the beginning, the composite maps for each of the 11 species were overlaid. Each species' potential habitat was weighted equally as there was no straightforward justification for applying a weighting scheme.

With the water column and bottom habitat overlay maps still separate, team members looked for regions with clusters of common total numbers of target species habitats overlapping each other that reflected natural "break points" between otherwise contiguous geographical concentrations. The team assigned specific range designations (and, therefore, different colors) for the respective polygons that fell within the following ranges: areas with 0-11 species were assigned as high priority for both water column and bottom overlay maps with area containing 7-8 species and 9 species, respectively, design-

ated as medium priority in the water column and bottom overlay maps. Areas with less than these total number species overlaid dropped out.

Then the water column and bottom habitat maps were themselves overlaid to produce the draft **Priority Living Resource Areas** map. The high priority areas for both water column and bottom were combined that an area was shaded as high priority if it appeared in either layer, the two medium priority layers were combined the same



- SAV**
Submerged Aquatic Vegetation
- Bottom Species**
- Atlantic Croaker *Micropogonias undulatus*
 - Catfish
 - Spot *Leiostomus xanthurus*
 - Summer Flounder *Paralichthys dentatus*
 - Blue Crab *Callinectes sapidus*
 - Postlarval Blue Crab *Callinectes sapidus*
 - Soft Shelled Clam *Mya arenaria*
 - Hard Shelled Clam *Mercenaria mercenaria*
 - Eastern Oyster *Crassostrea virginica*
 - Atlantic Sturgeon *Acipenser oxyrinchus*
 - Speckled Sea Trout *Cynoscion nebulosus*

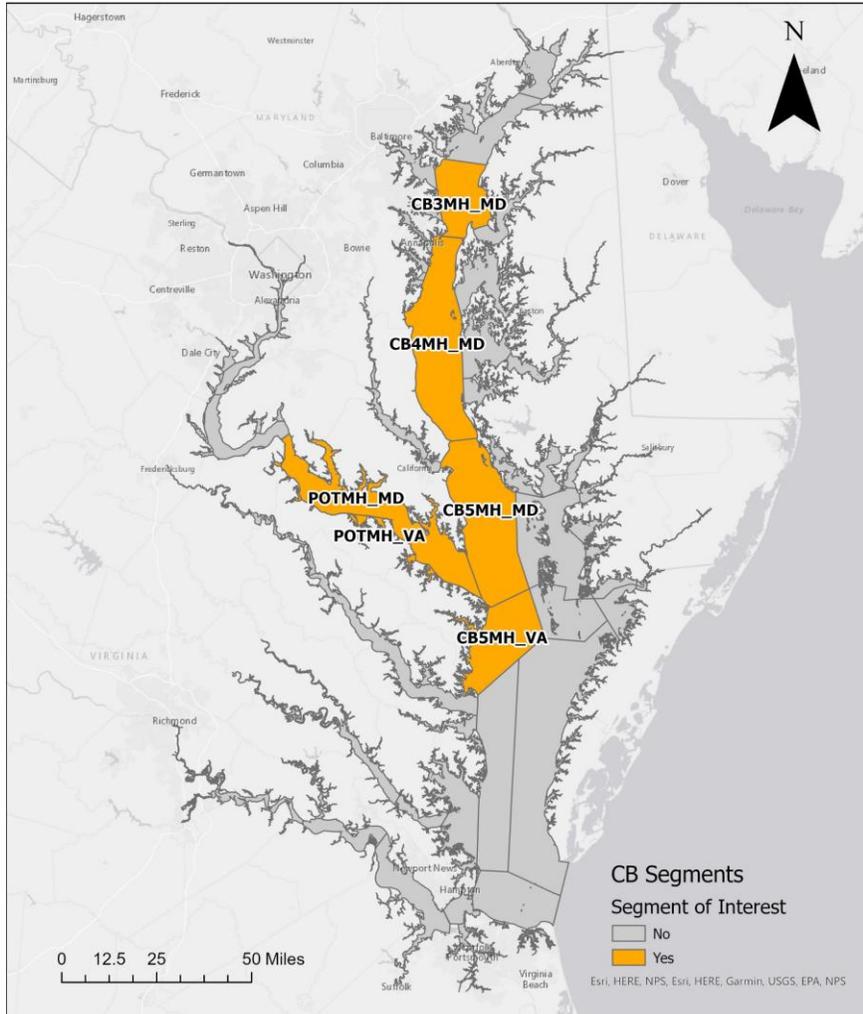
The team then visually examined the resultant map and drew polygons around the 14 areas—the designated draft **Priority Living Resource Areas**—that had the most extensive and contiguous high priority shading. The medium priority areas were included on the map because they were also important living resource habitats.

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Keep the process of distributing planning targets...

...but do the things first that affect living resources

Chesapeake Bay Segments 3, 4, 5, and Potomac Mesohaline



Chesapeake Bay Priority Living Resource Areas Using GIS to Identify Habitat Hot Spots



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COSTS:
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Chesapeake Bay Program Office
410 Ocean Ave., Suite 100
Annapolis, Maryland 21403
Patricia Lee
Leidos Inc., LLC
Washington, DC

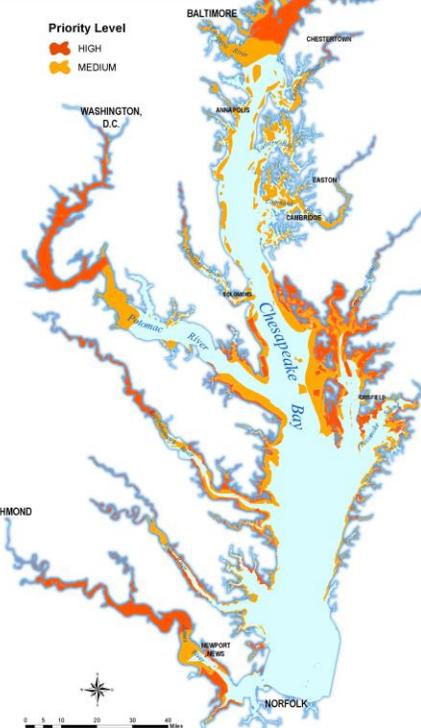
Copyright: PLRM maps derived from data from the following sources:
Friedlander, G.L., J.A. Murray, S.L. Jordan, and D. Riley (eds.) 1992. Habitat Requirements for Chesapeake Bay Living Resources. Second Edition.
Salinity range data interpolated from 1985-1997 spring and summer Chesapeake Bay monitoring data.
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Tier II SAV areas (CBP and Virginia Institute for Marine Science)

Aquatic Resource Graphics:
System courtesy of the Integrated and Collaborative Research Program, Department of Environmental and Estuarine Science and Chesapeake Bay Program.

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Potential Overall Plan



Build 4D Interpolator, Main Bay Model, Multiple Tributary Model, Habitat Suitability Model



Overall Goal

Keep default approach as it is and complete the planning target analysis based on Deep Water/Deep Channel



Tipping Points

Evaluate habitat suitability for the best place to make a positive impact based on improving DO



Develop visualization tools that aid Watershed Implementation Plan developers in evaluating options considering the tipping points

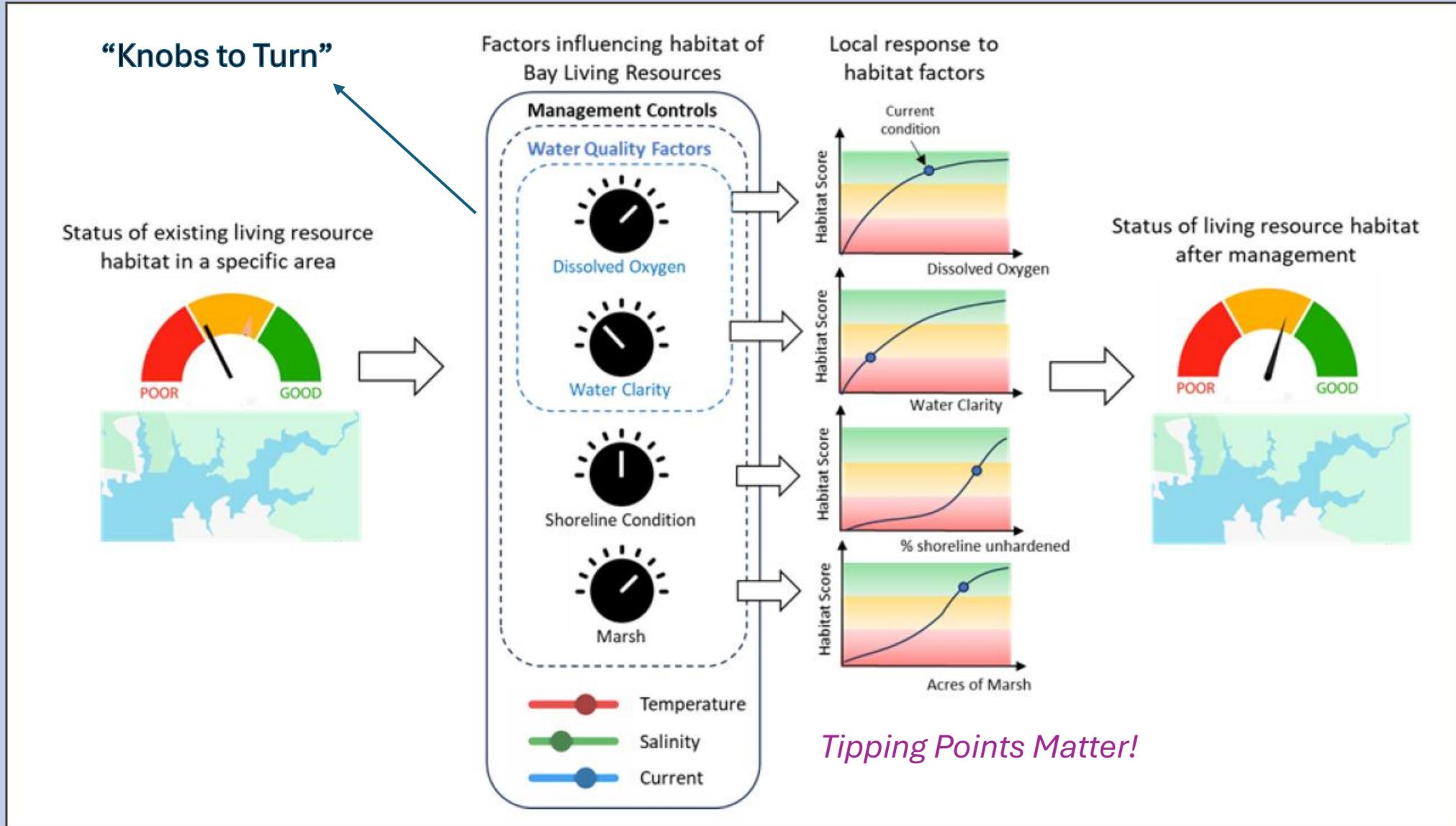
Consider prioritization of work toward based on moving the needle in those tipping point areas, while pursuing the overall goal
Ensure that these actions do not cause unintended consequences with regard to Deep Channel resuspension of nutrients

So, How Do
Living Resources
Fit Into This
Partnership
Process?



Photo by Charlie Nick/Chesapeake Bay Program

Assessing local water quality, stressor, and habitat conditions

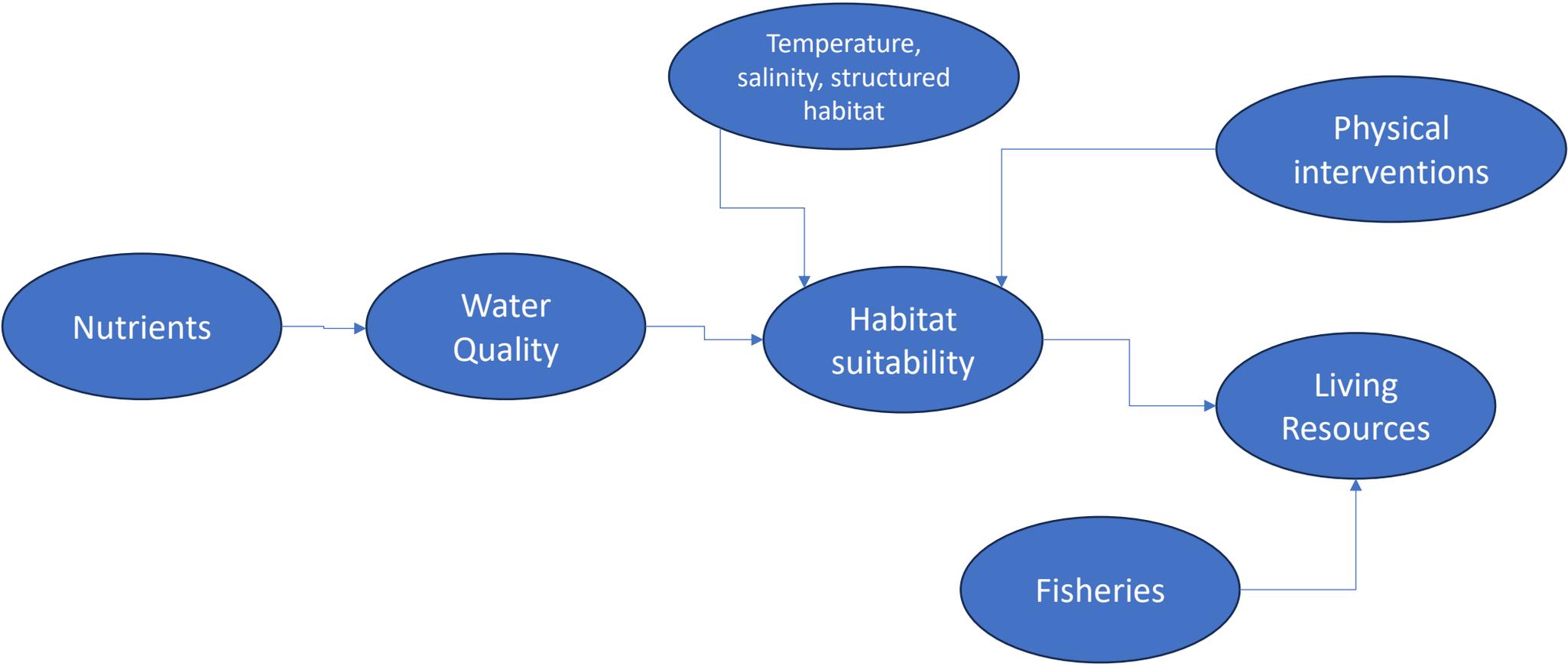


Tiered Implementation: From Concept to Application

1. Conduct habitat suitability analysis
2. Assess living resource habitat improvement potential of various segment/habitat combinations (dials) (local conditions to response to stressors reductions)
3. Identify relative contribution of upstream and estuarine N, P and sediment on segment-habitat nutrient levels
4. Set interim N, P, and S targets based on 1-3 (policy decision).
5. A future WIP planning process that includes consideration of other factors that impact living resource habitat and that includes incentives to adapt to observable outcomes (stressor-response)



Habitat Suitability = F(Water Quality, Temp; Salinity; Structured Habitat; Physical Interventions)

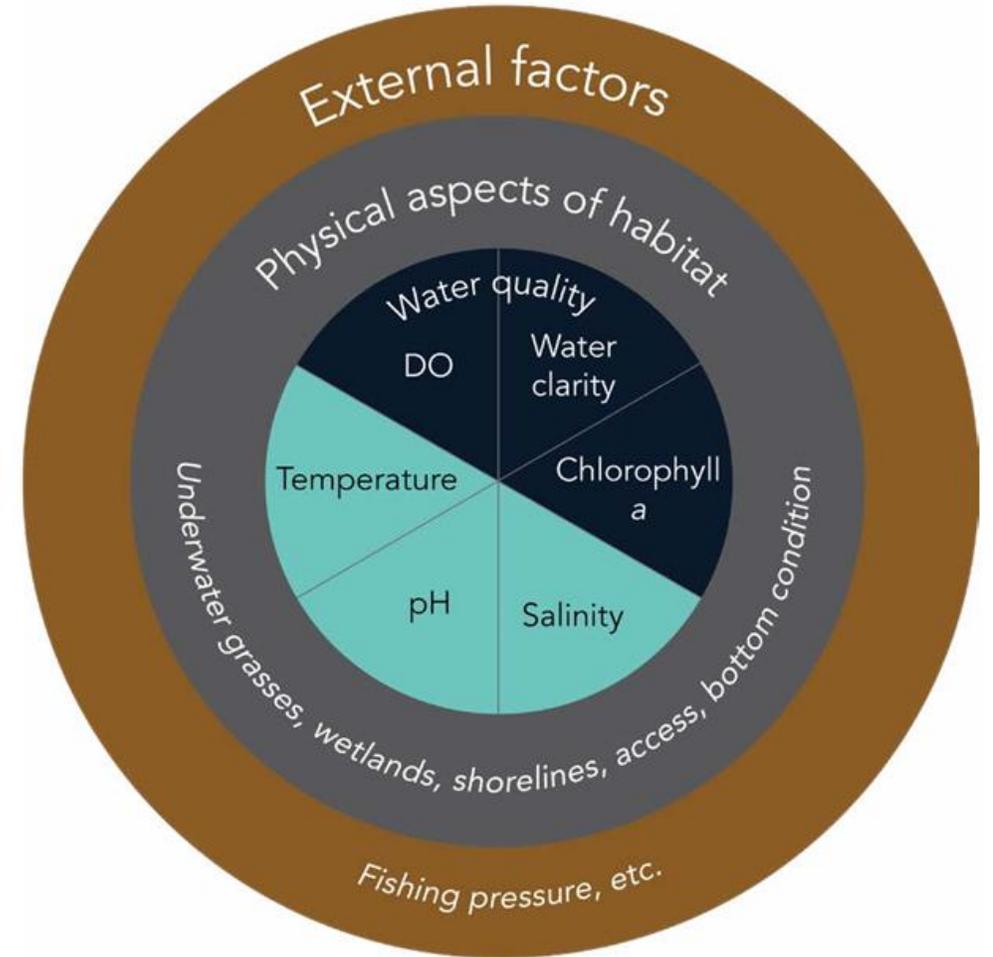


Big Picture View: Chesapeake Bay Habitat Suitability Analysis

- Task meant to drive a result, not just to improve understanding
- Tie to management priority, tie to water quality and improve living resource outcomes
- Outcomes need to have the most potential for CBP partnership implementation and be feasible
- Analysis is a step to:
 1. Implement recommendations of the CESR report
 2. Identify target areas for tiered implementation/targeting
 3. First step to implementing the Fish Habitat Outcome under the revised Bay Agreement
 4. Lead to prioritization and where to invest resources
 5. Identify where landscape work impacts water quality, fish habitat, and other outcomes

Opportunity to Link

1. Water quality management decisions
2. Potential improvements in tidal living resource responses



Managed by Bay water quality standards

Generally unmanaged and impacted by changing environmental conditions

Data Sets



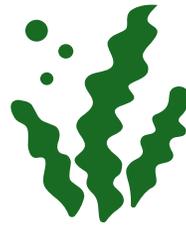
Fish Data

Juvenile Striped Bass

Bay Anchovy

Croaker

- *Note these three species provide excellent ecological coverage of the Bay*



Habitat Data

Substrate

Tidal Wetlands

SAV

Bathymetry

Oysters

Shoreline

Others



Water Quality Data

Initially from Fish Data

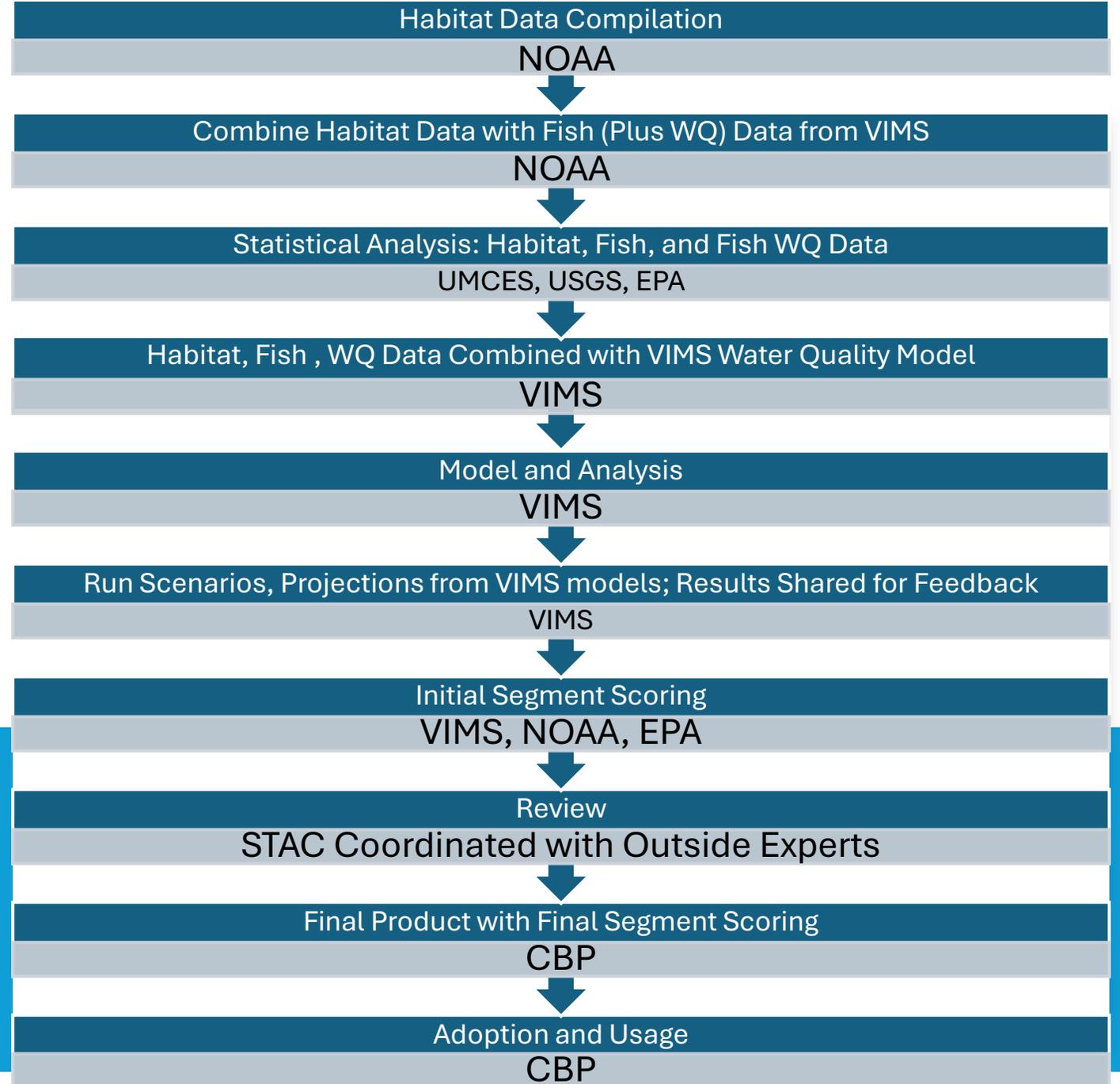
Then, VIMS model

(Later, Phase 7)

Workflow

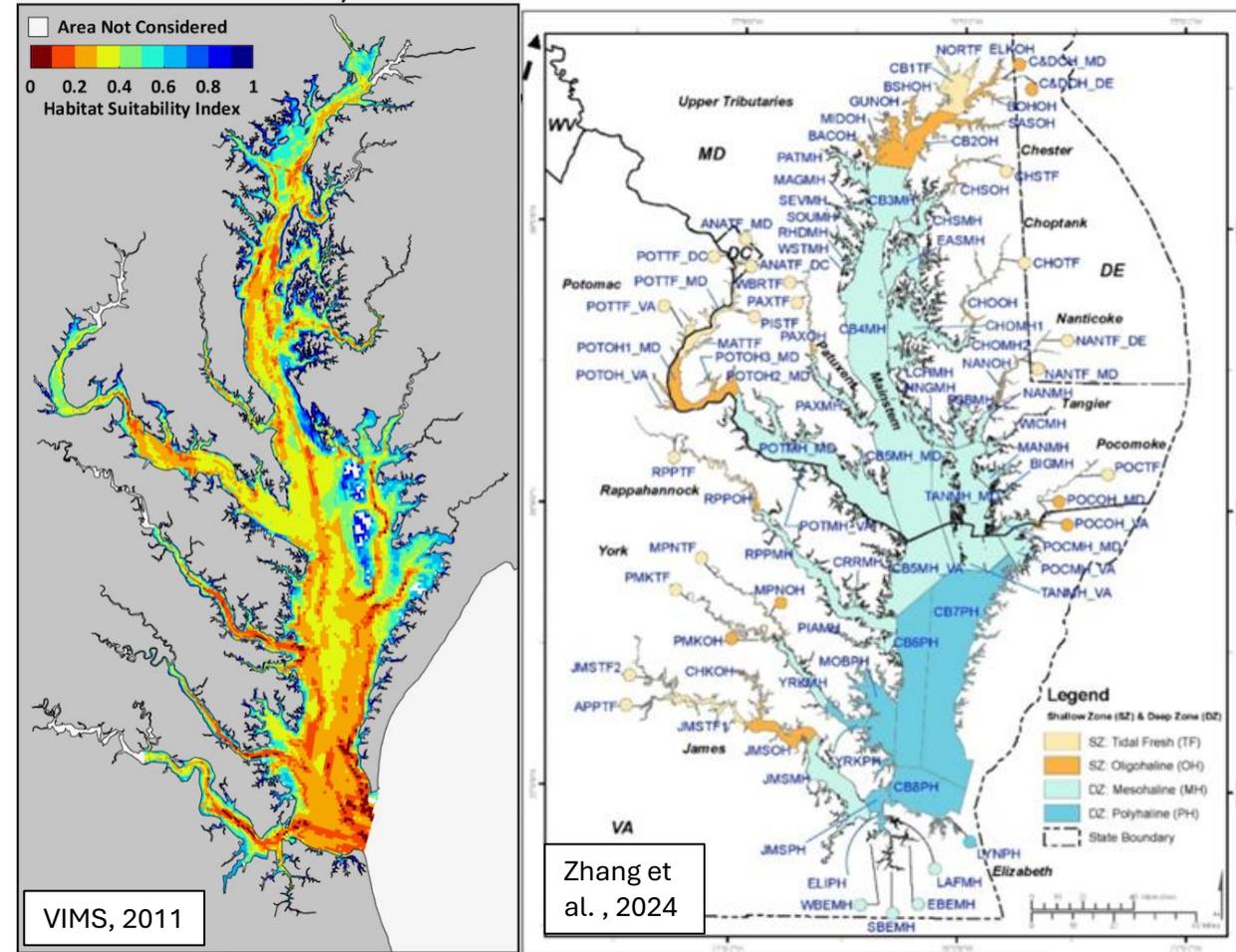
**Strategic collaboration between NOAA, EPA, new Thriving Fisheries, Habitat and Wildlife Goal, WQ practitioners*

**Example of project with STAC members collaborating with NOAA, EPA, VIMS, CBP*



How is this going to work?

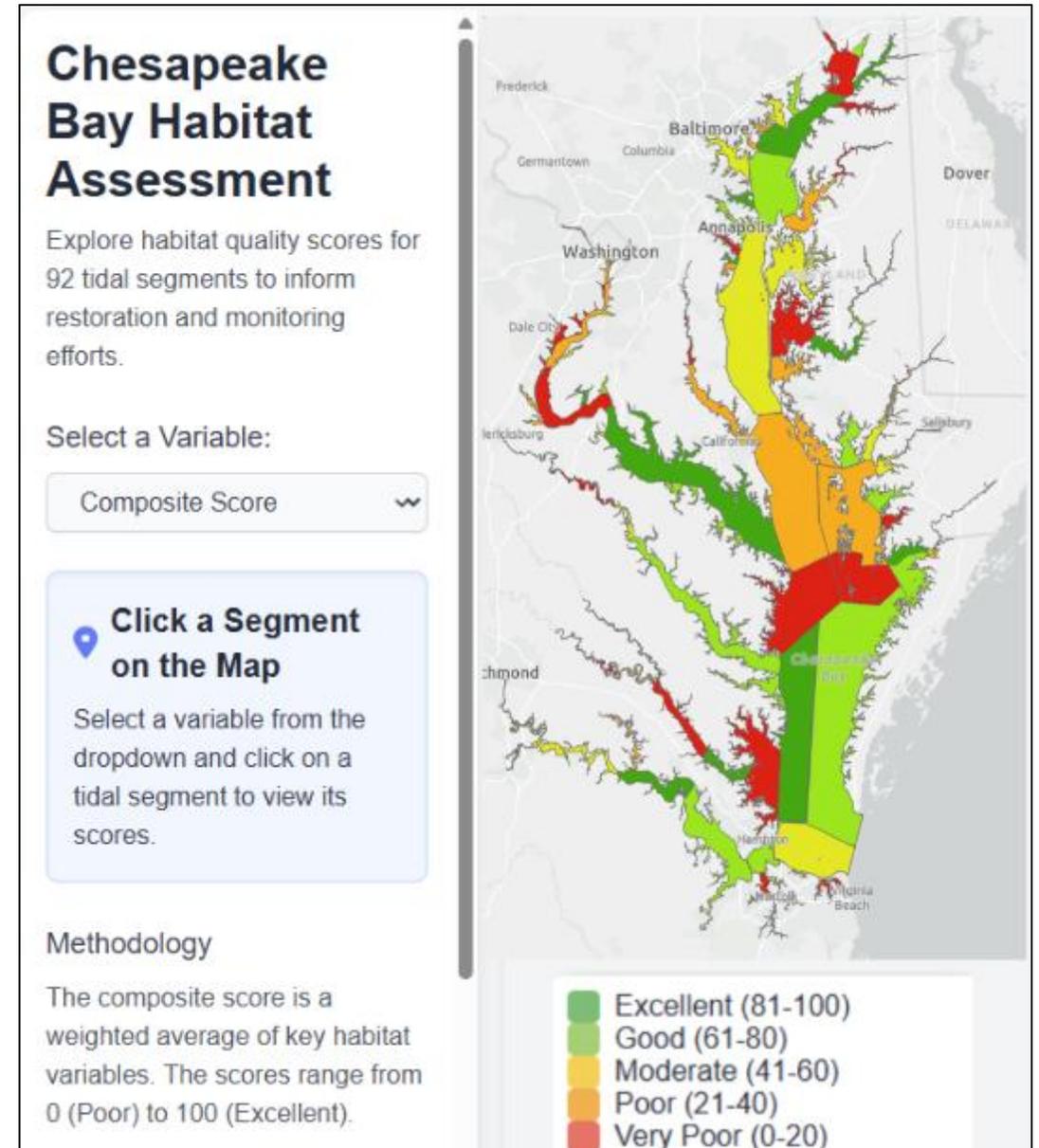
- Quantify relationships build habitat suitability index (example on left) for 92 management segments (map on right)
- Recognize we don't have fish data everywhere
- Relationships evoked where data are absent to quantify a score



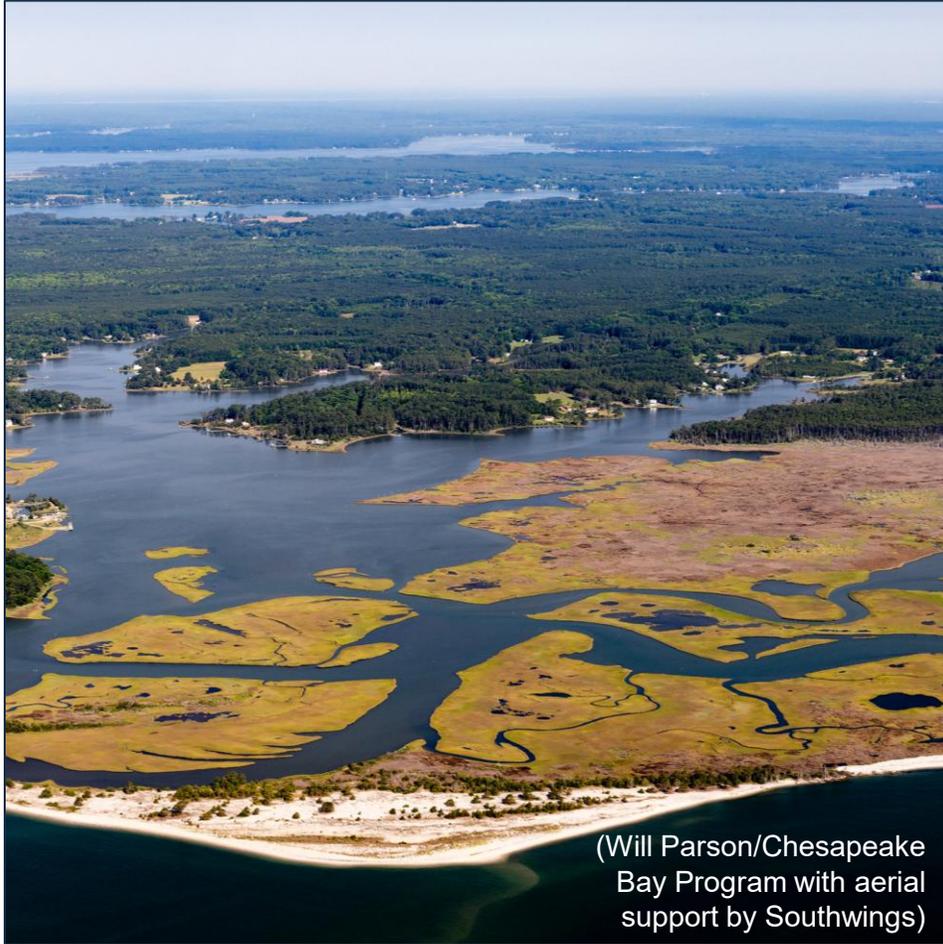
HSI based on fish, habitat, water quality data at the 92-segment scale

Potential End Product

- Visualization of habitat assessment for each of the 92 segments
 - Potential future GIS support ask for visualization and hosting on C4 network
- Inform targeting needs to
 - Implement tiered implementation
 - Prioritize areas for habitat restoration
- Repeated at future intervals with updated data



*Note, this graphic shows an example of what a visualization might look like and includes made-up data for the mockup.



(Will Parson/Chesapeake Bay Program with aerial support by Southwings)

Thank You!

Dr. Kaylyn S. Gootman

gootman.kaylyn@epa.gov

Bruce Vogt

Vogt.bruce@noaa.gov



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