



Chesapeake Bay Program
Science. Restoration. Partnership.

Foundations for Tiered Implementation

January 26, 2026

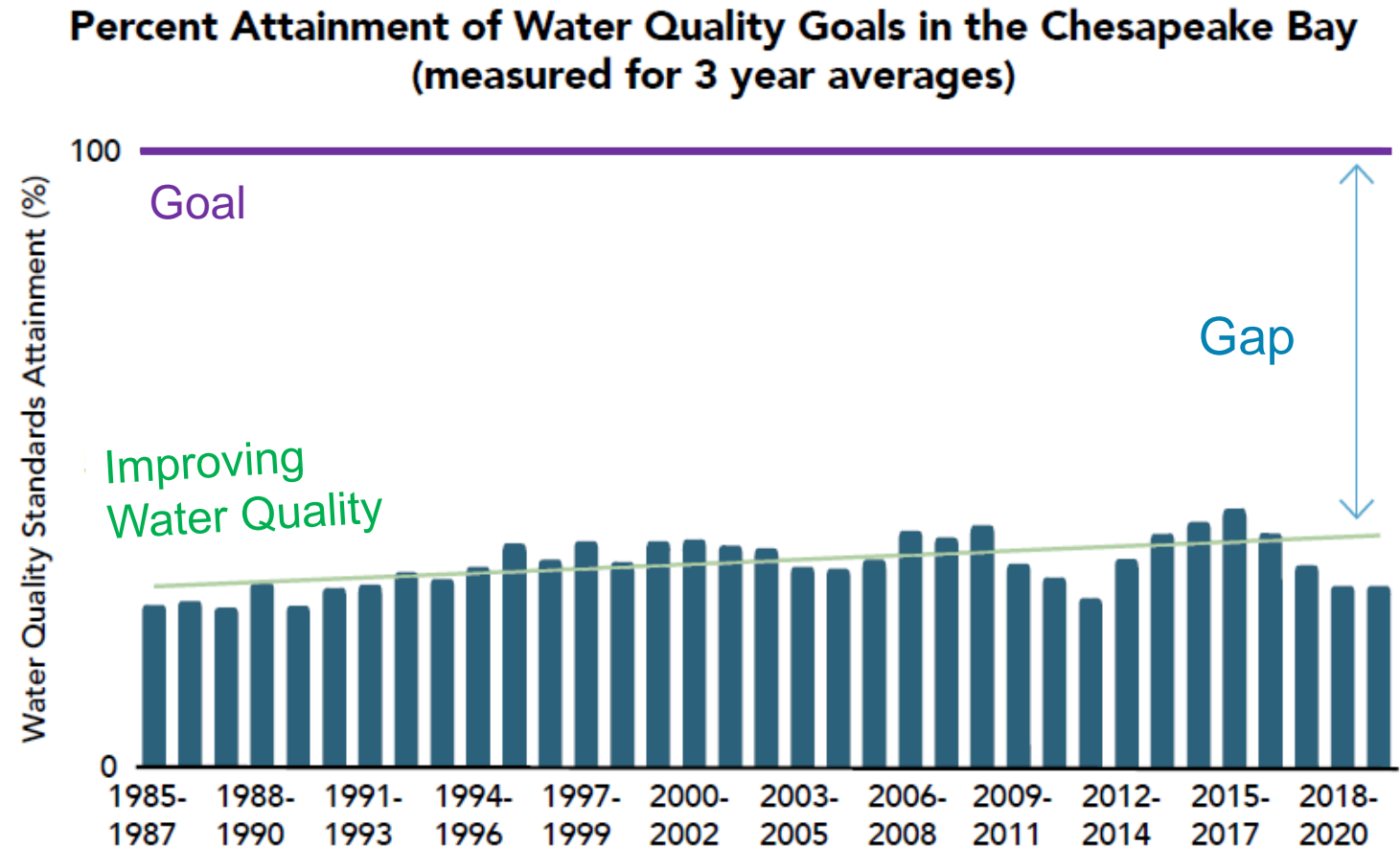
Dr. Kaylyn S. Gootman, EPA

Bruce Vogt, NOAA

WQGIT

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?



Chesapeake Bay Water Quality Goals

Water Quality Goal \longrightarrow **Measurement of the Goal** \longrightarrow **Achieving the Goal**

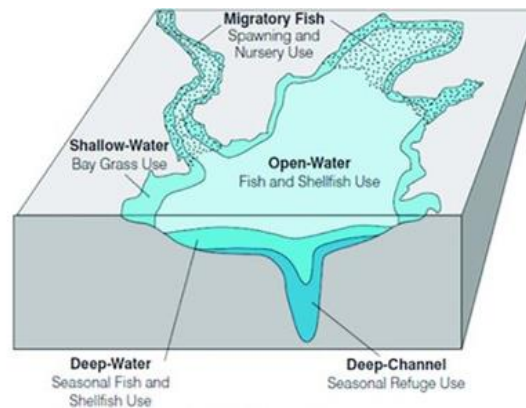
Protect aquatic living resources



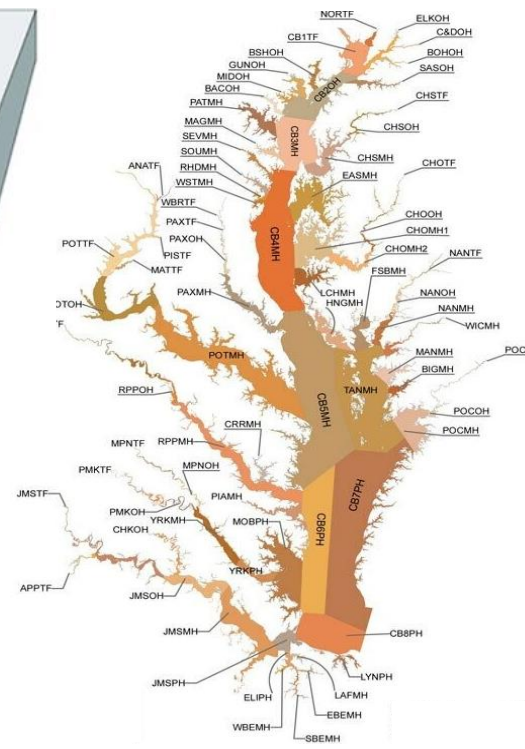
Numeric Criteria

Dissolved Oxygen
Water Clarity/SAV
Chlorophyll a

Across 5 habitats



in 92 Segments



TMDL

N, P, sediment targets
to meet goal

Pollutant Control Programs

Accountability

Chesapeake Bay Water Quality Goals

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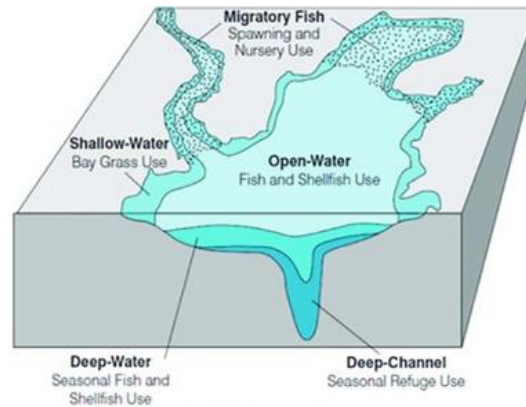
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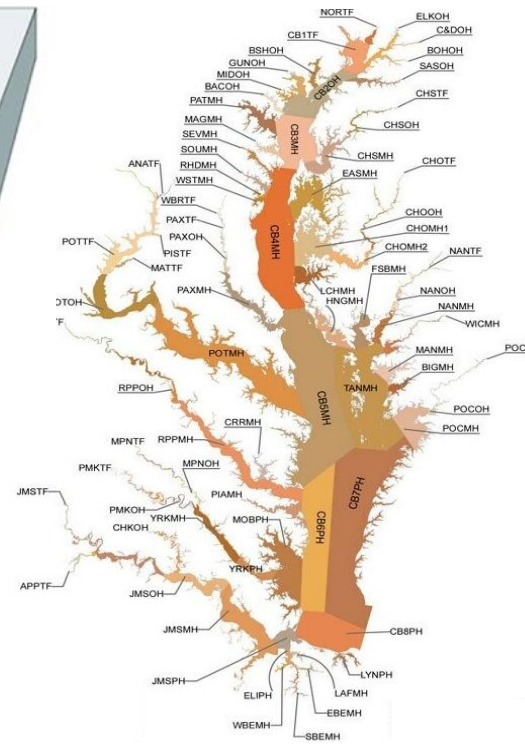
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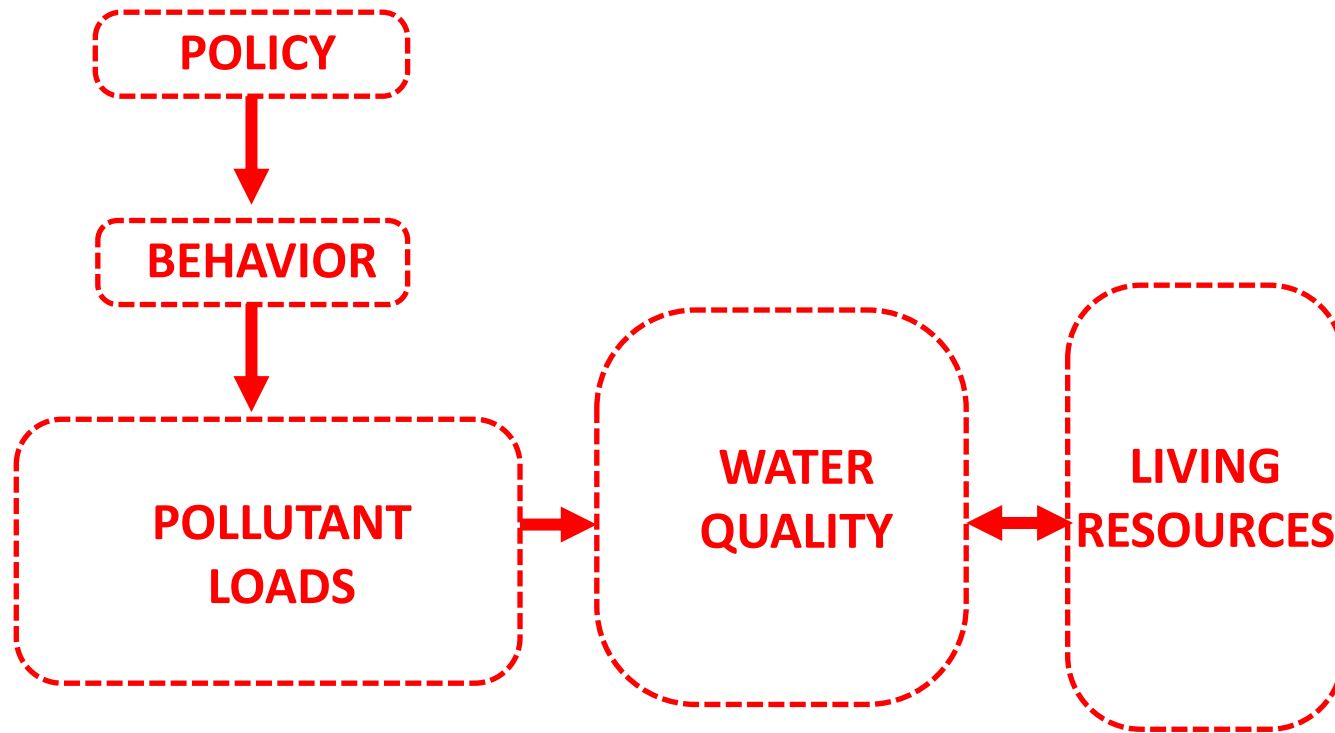
TMDL


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



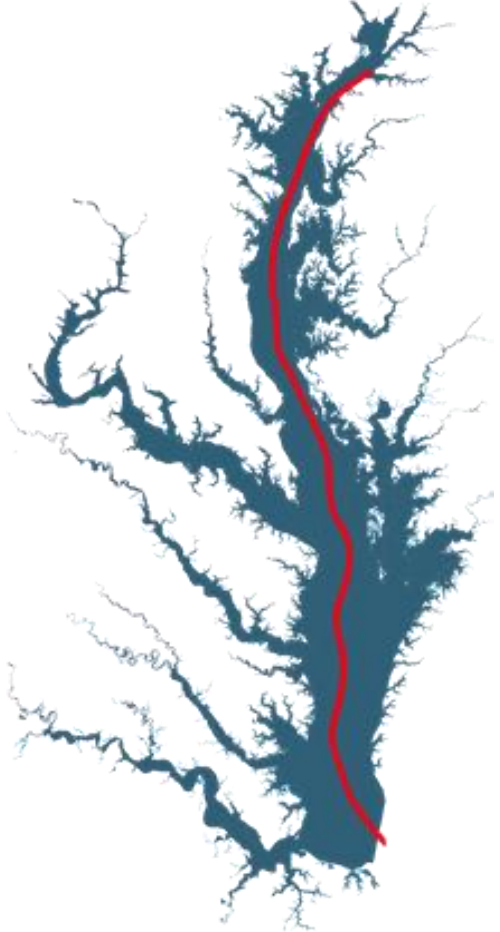
-Maryland Sea Grant

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

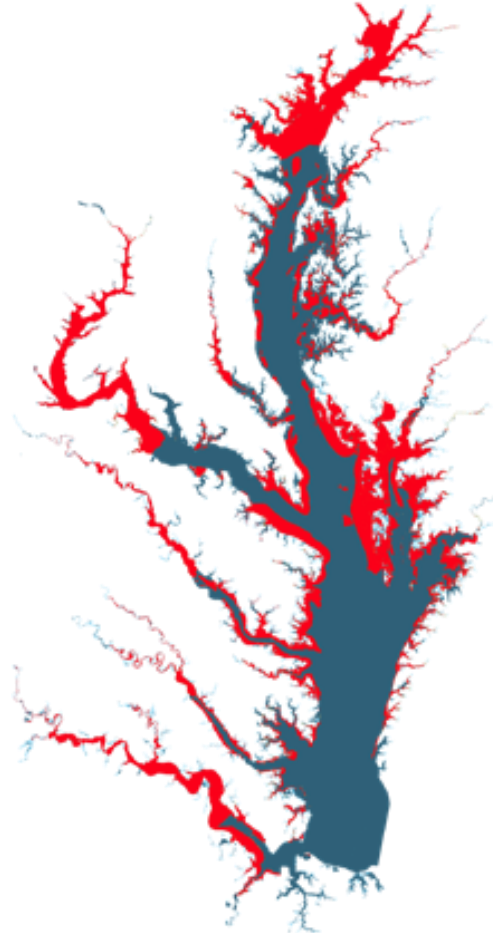
-CESR (p. viii)

Accelerating living resource response on our way to meeting overall goal

Deep water DO is most challenging water quality goal

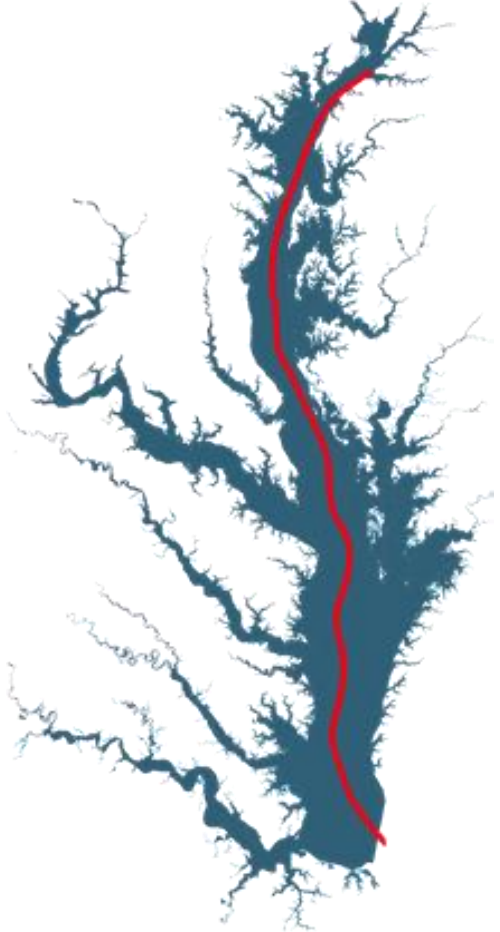


But most impactful living resource habitats are elsewhere

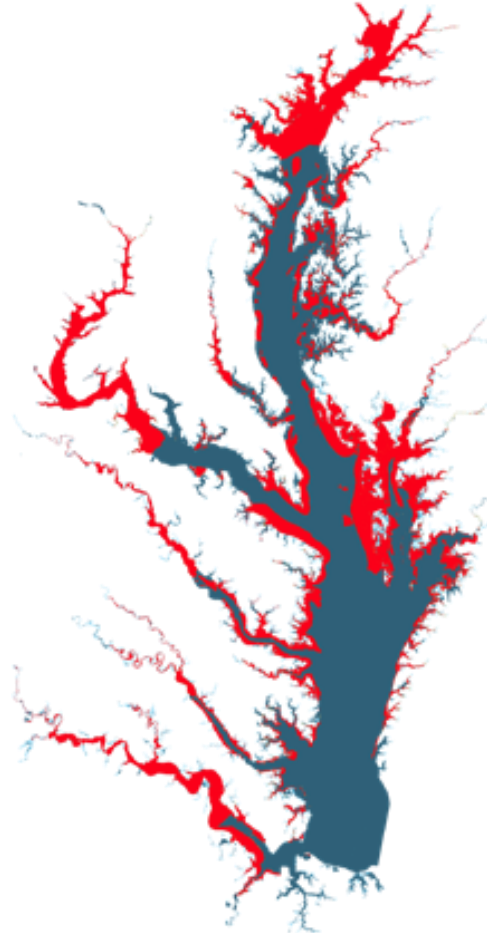


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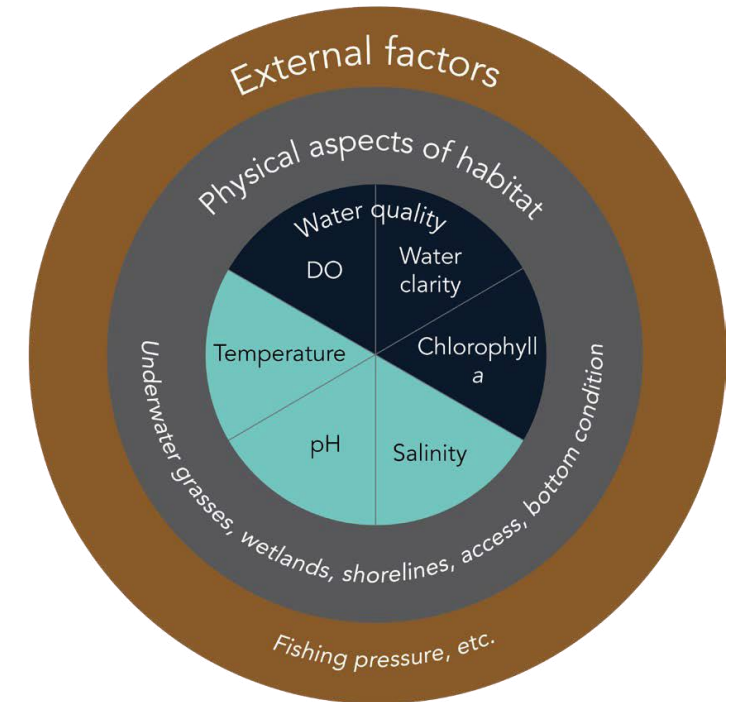
Deep water DO is most challenging water quality goal



But most impactful living resource habitats are elsewhere



Living resource habitat factors that matter



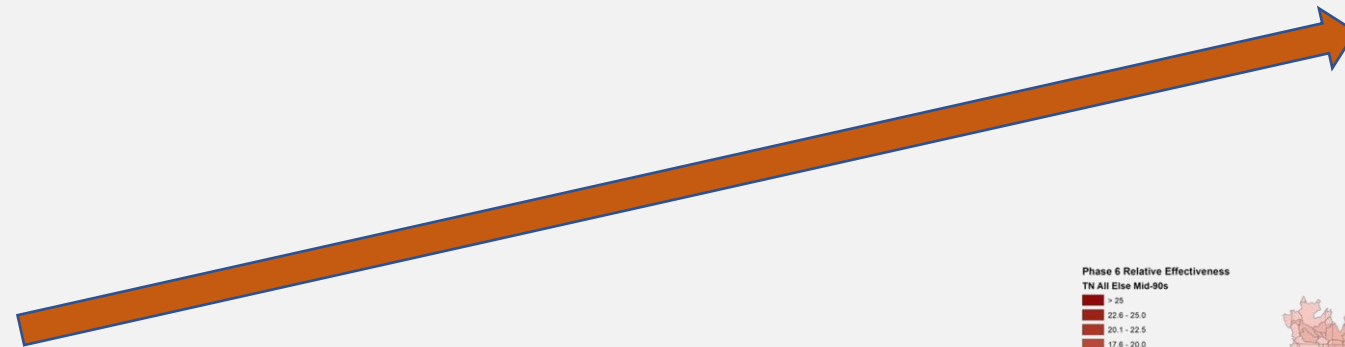
Guidelines for Planning Targets with the Default Approach

Everything
Everywhere
Everyone



Effort

Increasing relationship between
Relative Effectiveness and Effort



Effectiveness defined as the
deep channel and deep water

No BMPs

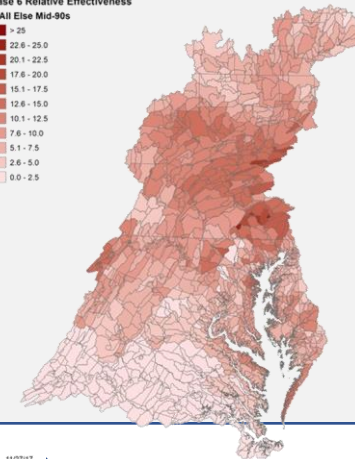


Effectiveness

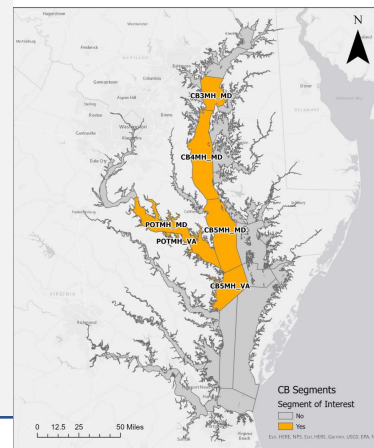


Phase 6 Relative Effectiveness
TN All Else Mid-90s

> 25
22.6 - 25.0
20.1 - 22.5
17.6 - 20.0
15.1 - 17.5
12.6 - 15.0
10.1 - 12.5
7.6 - 10.0
5.1 - 7.5
2.6 - 5.0
0.0 - 2.5



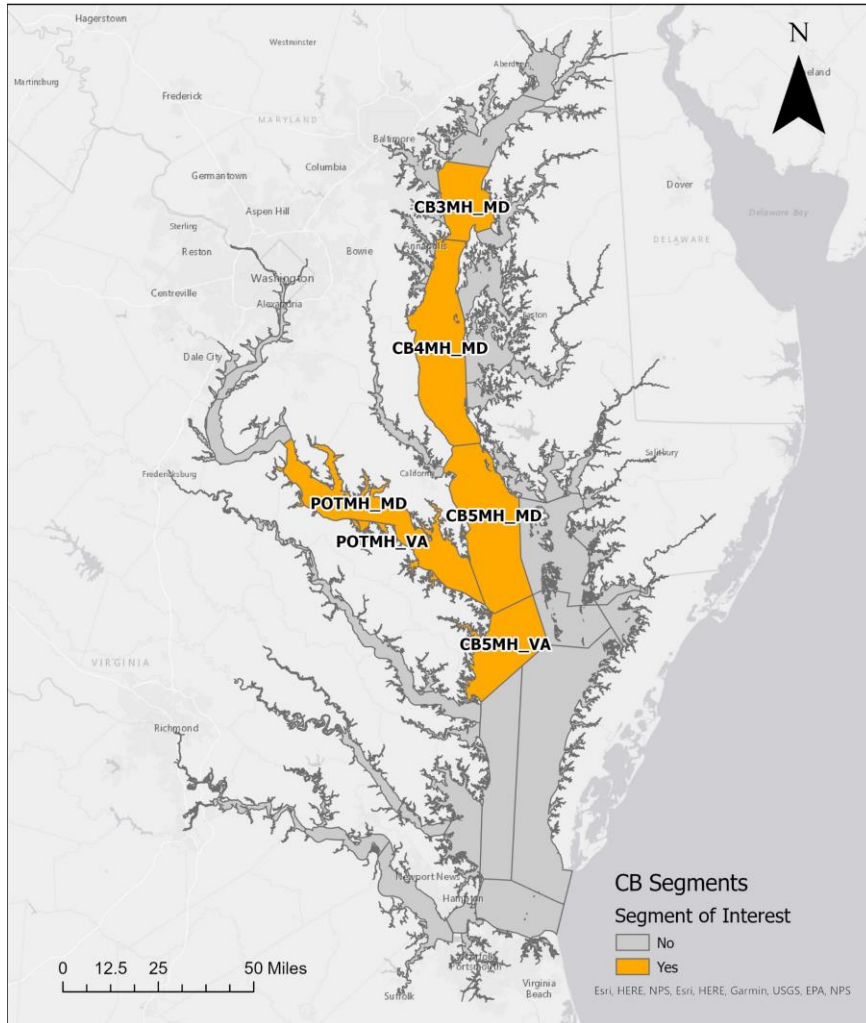
Chesapeake Bay Segments 3, 4, 5, and
Potomac Mesohaline



11/27/17

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

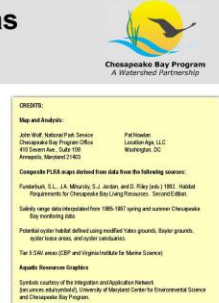
Chesapeake Bay Segments 3, 4, 5, and Potomac Mesohaline



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



Water Column Species



Priority Level



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 over-enrichment (e.g., dissolved oxygen) or sediments (e.g., light penetration) were analyzed 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 9-11 species were assigned as high priority for both water column and bottom overlay maps with area containing 7-8 species and 9 species, respectively, designated 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 so 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

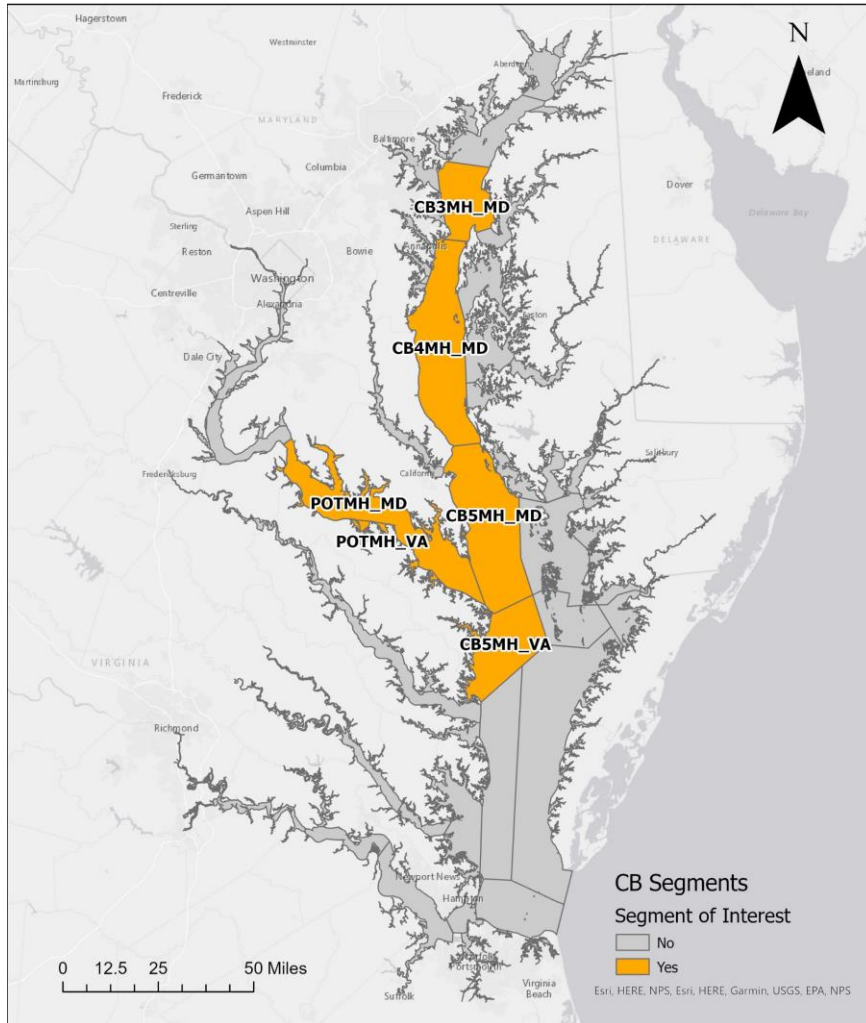


way. The team then visually examined the resultant map and drew polygons around the 14 areas—the designated draft *Priority Living Resource Areas*—that had the most extensive and contiguous high priority shading. The medium priority areas were included on the map because they were also important living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

Priority areas for Submerged Aquatic Vegetation (SAV) were determined by the SAV Workgroup using the VIMS SAV aerial survey data base, examining changes in SAV area over 1992-1997, and SAV status as a percentage of Tier II area in 1997 by the 78 CBP segments. Changes over 1992-1997 were used because many SAV trends changed direction at about that time, and the more recent changes were of the greatest interest. Priority SAV areas were those segments that lost over 60 hectares of SAV from 1992 to 1997, and segments that had no SAV mapped in 1997. These layers were not combined with the fish and shellfish layers shown here because they were based on different data and used different spatial scales. They were visually compared to the *Priority Living Resource Areas* (PLRAs) defined based on the fish and shellfish layers, and all of the SAV priority areas were also identified as PLRAs, with the exception of four small Maryland tributaries that lacked SAV in 1997 but were not identified as PLRAs (the Black, Rhode, West, and Potomac rivers).

Keep the process of distributing planning targets...

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



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

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

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Chesapeake Executive Council,
Directive 97-1



Water Column Species

- American Shad *Alosa sapidissima*
- Atlantic Menhaden *Brevoortia tyrannus*
- Bay Anchovy *Anchoa mitchilli*
- Striped Bass *Morone saxatilis*
- White Perch *Morone americana*
- Newfie *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

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Credits:
Map and Analysis:
John Wolf, National Park Service
Chesapeake Bay Program Office
410 Ocean Ave., Suite 100
Annapolis, Maryland 21403
Patricia L. Loefer, U.S. Army Corps of Engineers
410 Ocean Ave., Suite 100
Annapolis, Maryland 21403
Composite PLRA maps derived from data from the following sources:
Farrington, J.L., J.A. Murray, S.J. Jordan, and D. Hay (eds) 1992. *Habitat Requirements for Chesapeake Bay Living Resources*. Second Edition.
Safety maps dated approximately from 1985-1997 spring and summer Chesapeake Bay monitoring data.
Potential bottom habitat defined using modified Vicksburg, Rappahannock, and York River areas, and other subunits.
Tier II SAV areas (CBP and Virginia Institute for Marine Science)
Aquatic Resource Graphics
Symbols courtesy of the Integration and Application Network
Bioscience Resource Project, University of Maryland Center for Environmental and Estuarine Science and Chesapeake Bay Program.

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*

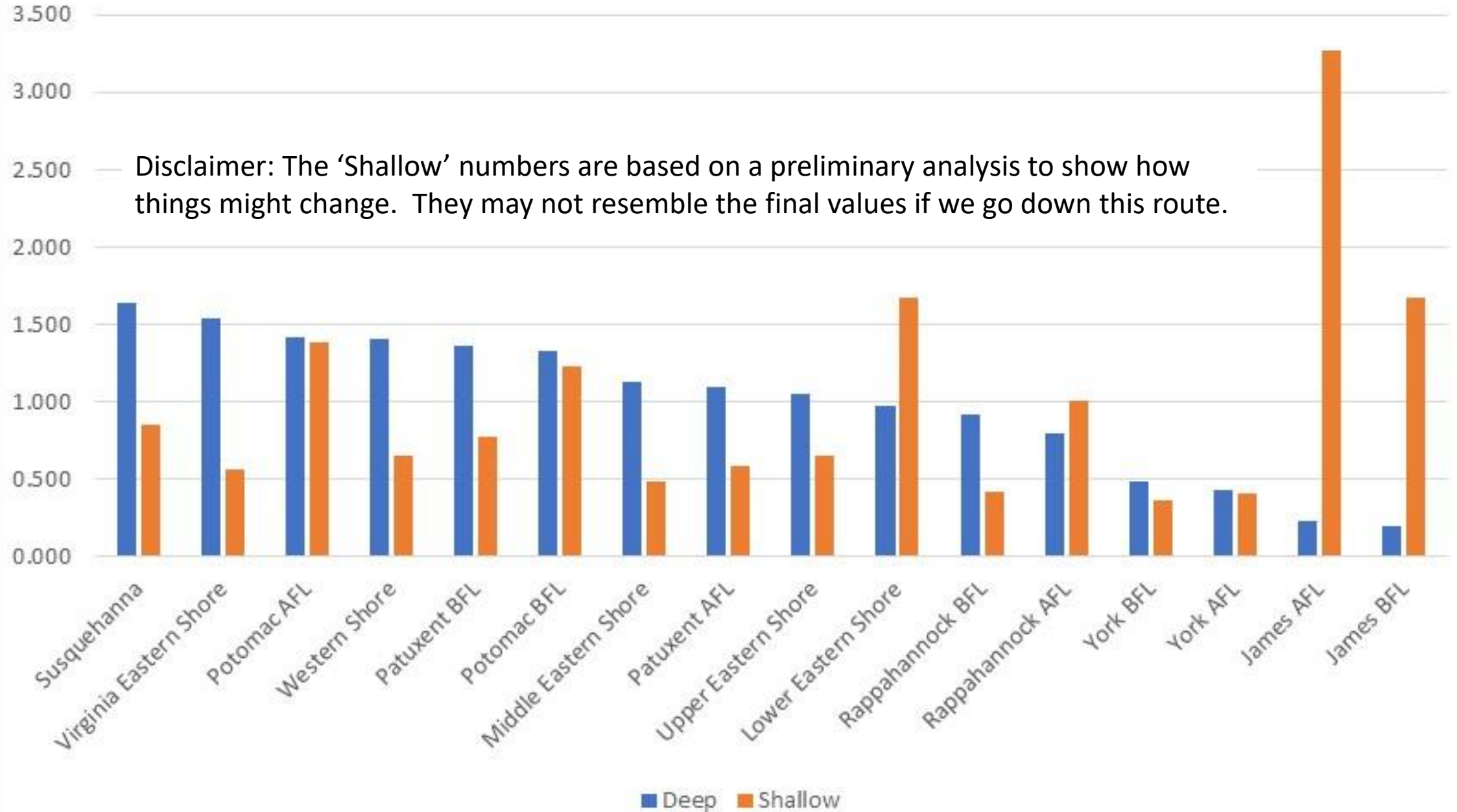
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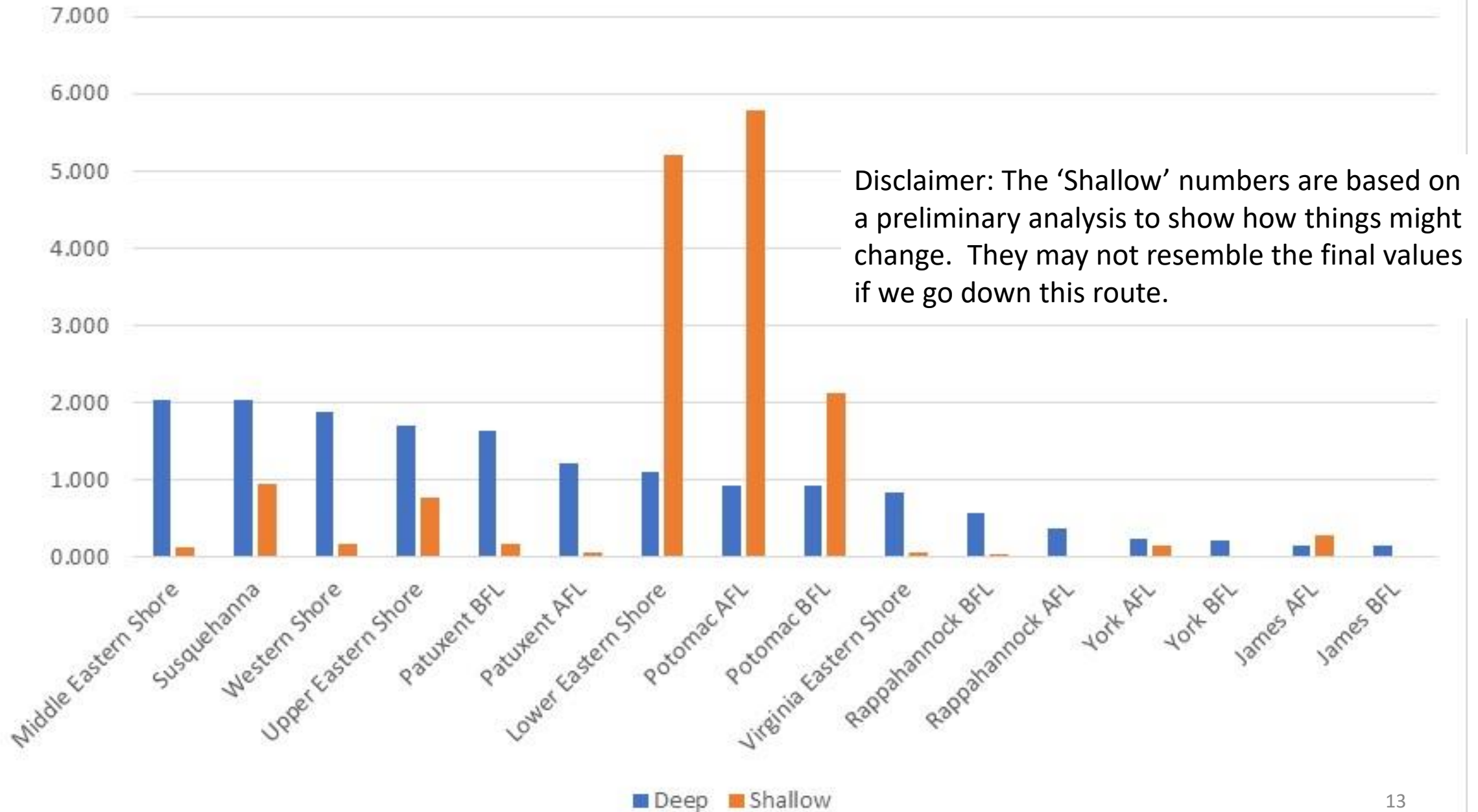
Normalized Estuarine Effectiveness

Nitrogen

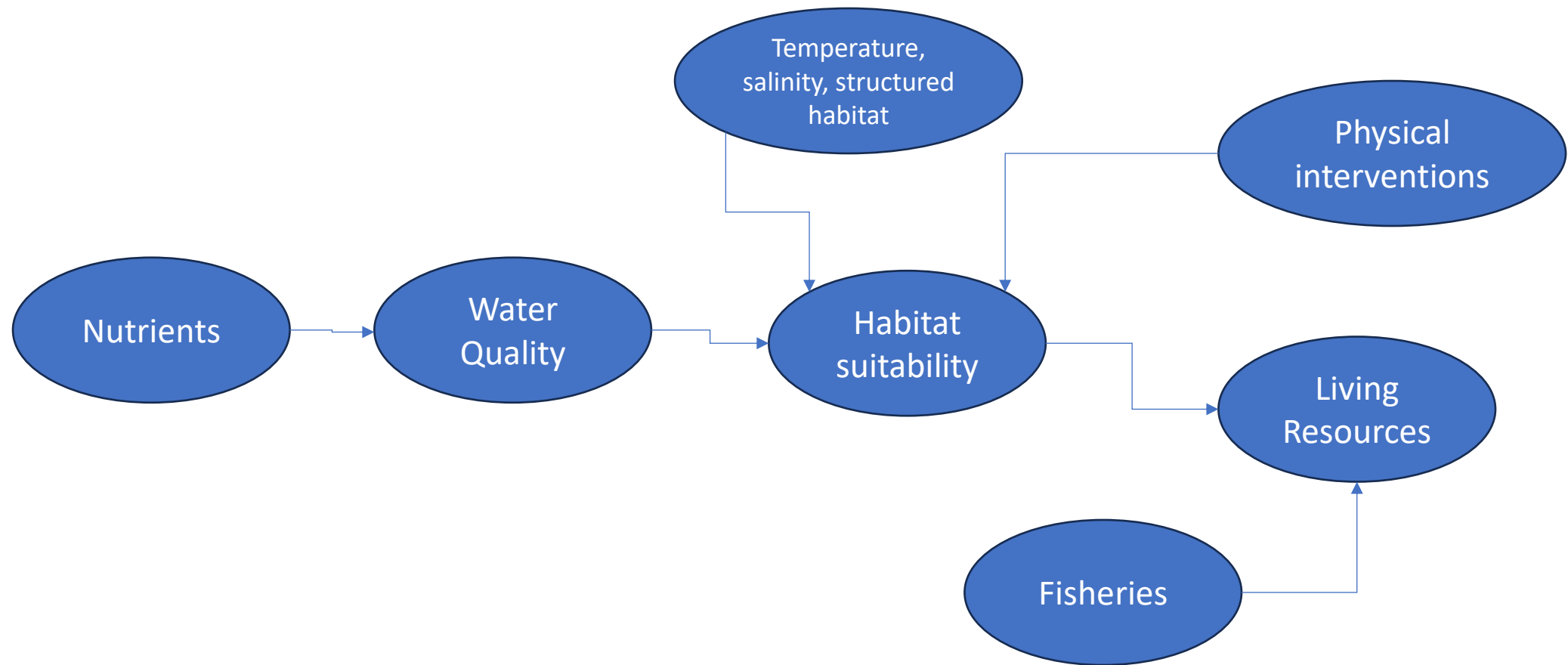
Disclaimer: The 'Shallow' numbers are based on a preliminary analysis to show how things might change. They may not resemble the final values if we go down this route.



Normalized Estuarine Effectiveness Phosphorus



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



Potential Overall plan

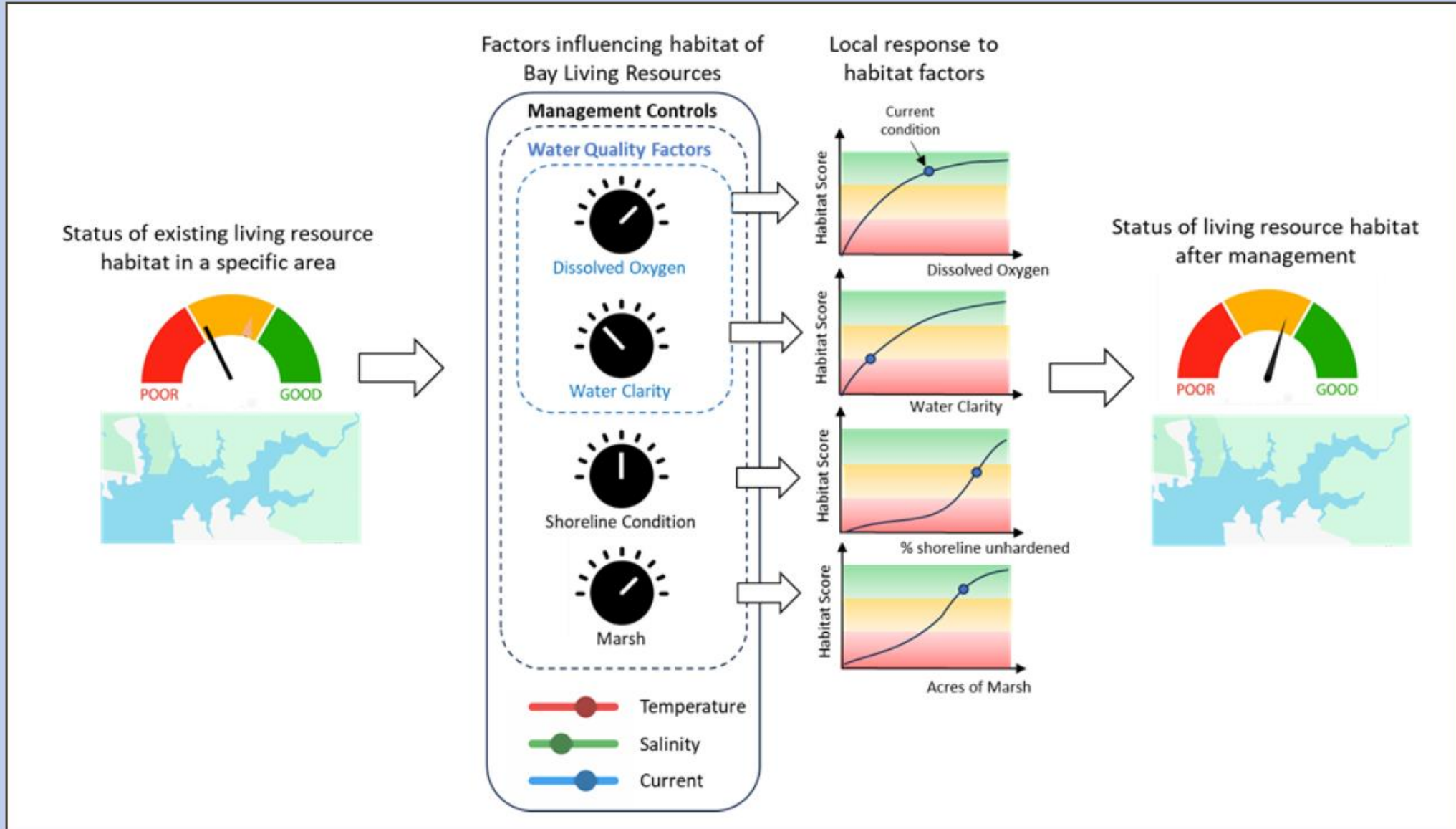
- Build 4D, MBM, MTM, Habitat suitability models
- Keep default approach as it is but prioritize in time based on LR needs (do an allocation-like exercise but use LR-relevant metrics)
 - Take care of the biggest differences first
- Develop tools that allow an organization to lookup from their Cbseg to see the best way to improve the LR
 - Numerical version of the conceptual model on the previous slide

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



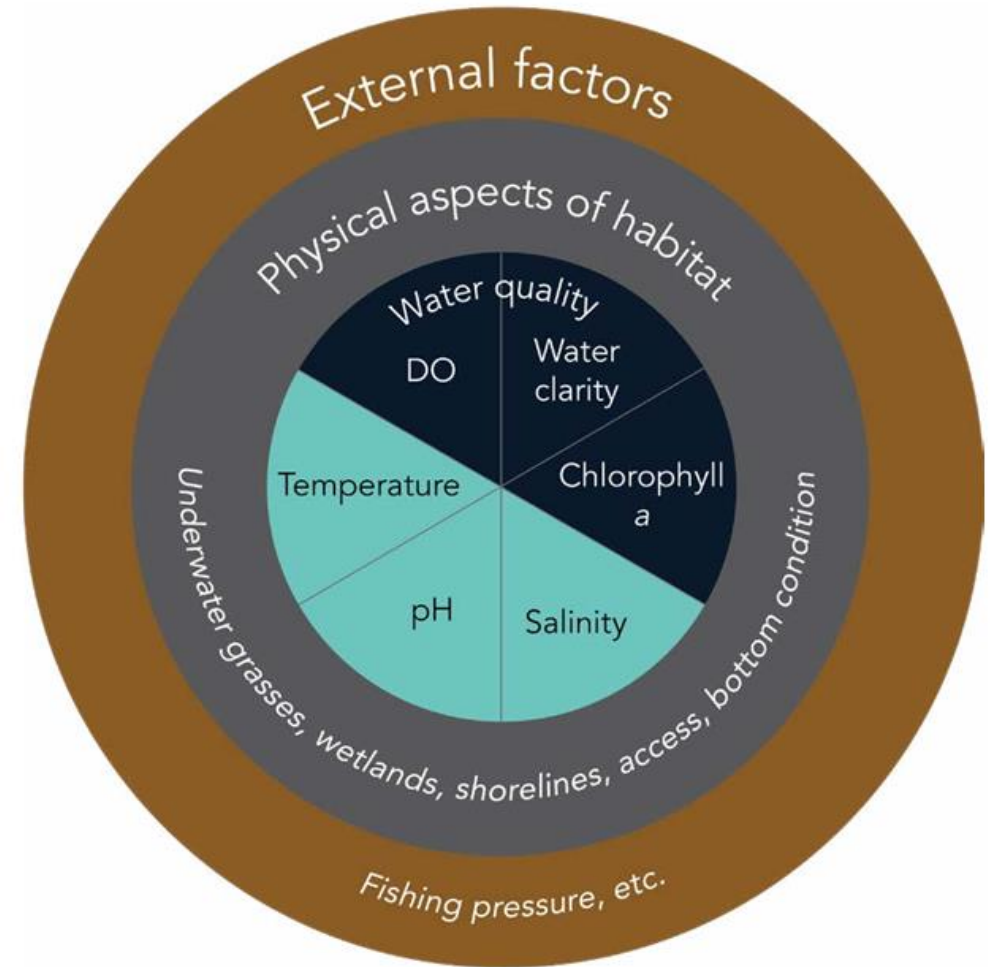
From Concept to Implementation

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)



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

Big Picture View & Motivation

- Priority Living Resource Habitat Area Identification
 - Task meant to drive a result, not just to improve understanding
 - Tie to management priority, tie to water quality and improve living resource outcomes
- Fast track to complete a habitat suitability index (HSI) for the 92 tidal segments of the Chesapeake Bay
 - This project is a priority of the CBP
- 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



Remember:

Outcomes need to have the most potential for CBP partnership implementation *and be feasible*



Ability to meet management objectives, resources required, data availability, achievable within timeline, reproducible to track changes over time, includes factors CBP can control

Objective

Determine the **approach to target** and **track linked responses** of **living resources**, **structural habitat**, and **water quality** while considering **known constraints**, including ability of approach to meet objectives at zero cost, and **generate a workplan**, including a **timeline** and **who** is contributing to this effort.

Project Support

Chesapeake Bay Program

- Members on the Project Oversight Committee

Scientific and Technical Advisory Committee (STAC)

- Members on the Project Analysis and Implementation Team and Project Oversight Committee
- Members coordinate external review

Virginia Institute of Marine Science (VIMS)

- Project Analysis and Implementation Team
- Dissertation Committee will review Colin's work

Chesapeake Research Consortium (CRC)

- Coordinate the merit review
- Help with communications
- Coordinate the hybrid meeting of the do-ers (October or November 2025)
- Technical editing of merit review
- Potential infographics support via Greenfin

Chesapeake Bay Program Data Center

- As needed consult

Chesapeake Bay Program Geospatial Analysis Team (GSAT)

- Public facing viewer/tool
- Potential Plan B doers

Chesapeake Bay Program Communications Team

- Develop communication pieces, webinars

- Additional analysis support from NOAA NCCOS and Chesapeake Bay Trust Chesapeake Conservation and Climate Corps

Additional Thoughts On This Work



CBP

Tiered Implementation talks starting across the partnership

Also, other uses of this information

- Collaboration and cooperation across goals and outcomes
- Ties outcomes together in one dataset

Keeping this team up to date as we go



First time NOAA and Fish GIT have direct connection to EPA WQ folks

Meets multiple needs

Novel effort for the CBP

- Builds off the CESR idea



Example of project with STAC members very collaborative with NOAA, EPA, VIMS, CBP

Only example or example in recent memory of this type of collaboration

Room for future collaborations with these groups?



Future

At some point, codify where this work lives under new structure/governance

Fold linked living resources and water quality into new way we work

Fish habitat team is a prime place to do this

Briefing/conversation/starting point for STAR

Work is starting point for other assessment

Data Sets



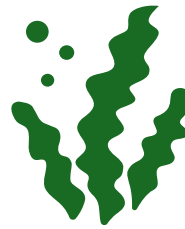
Fish Data

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



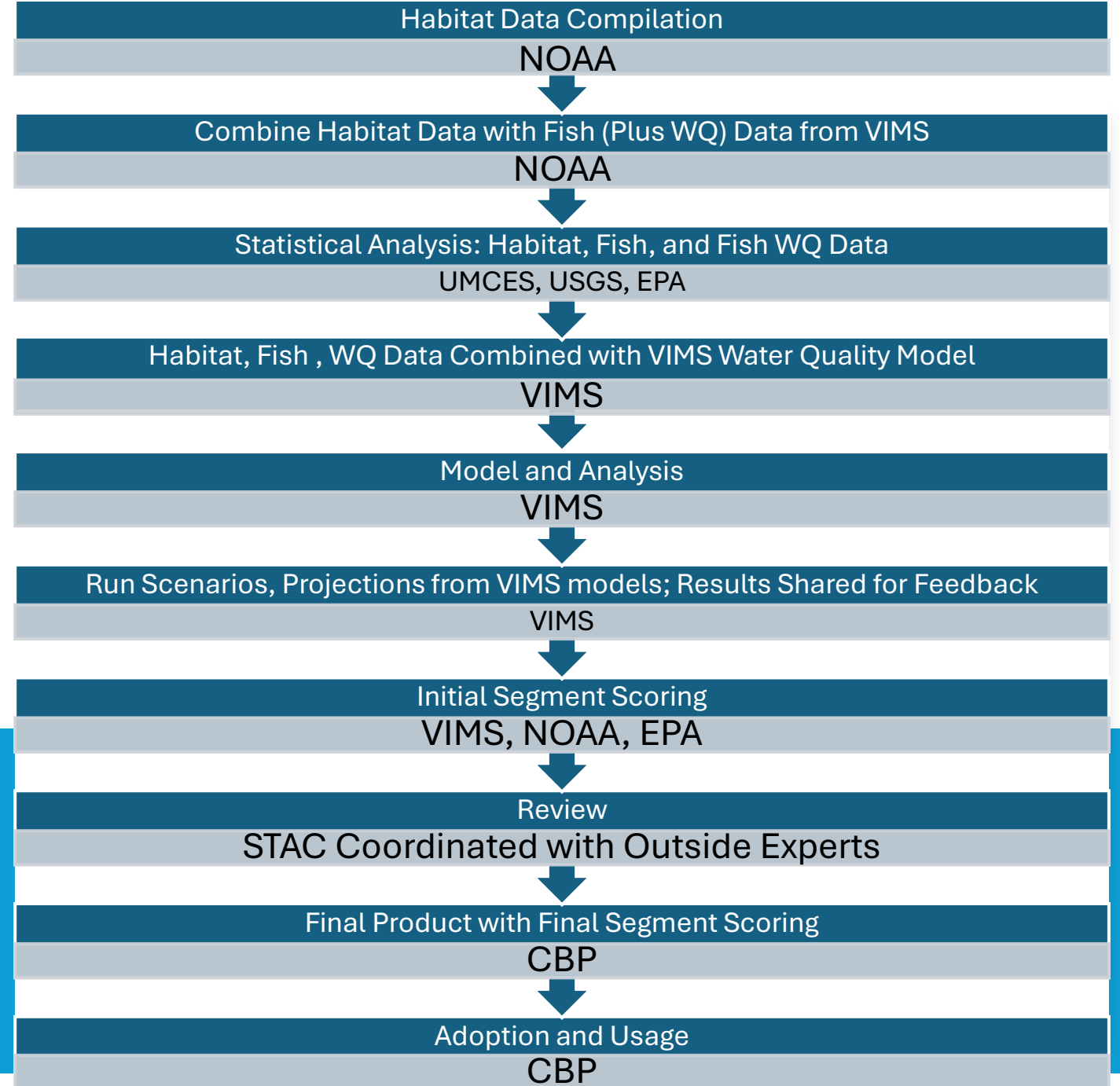
Water Quality Data

Initially from Fish Data

Then, VIMS model

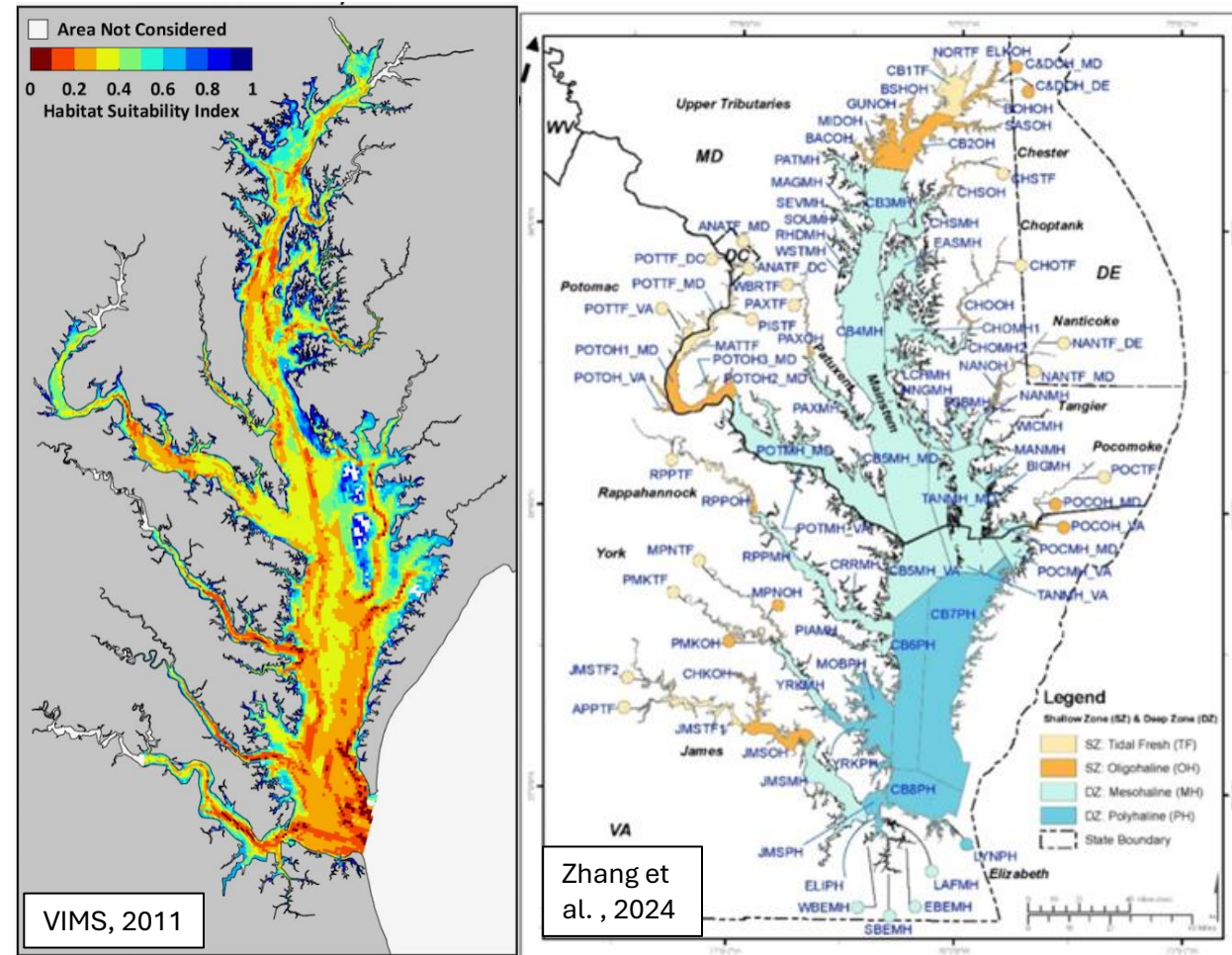
(Later, Phase 7)

Workflow



How is this going to work?

- Looking for relationships for habitat and fish data to build habitat suitability index (HSI, example on the left) for all 92 segments (map on the right)
- Recognize we don't have fish data everywhere
- Relationships evoked where data are absent, we will have the score



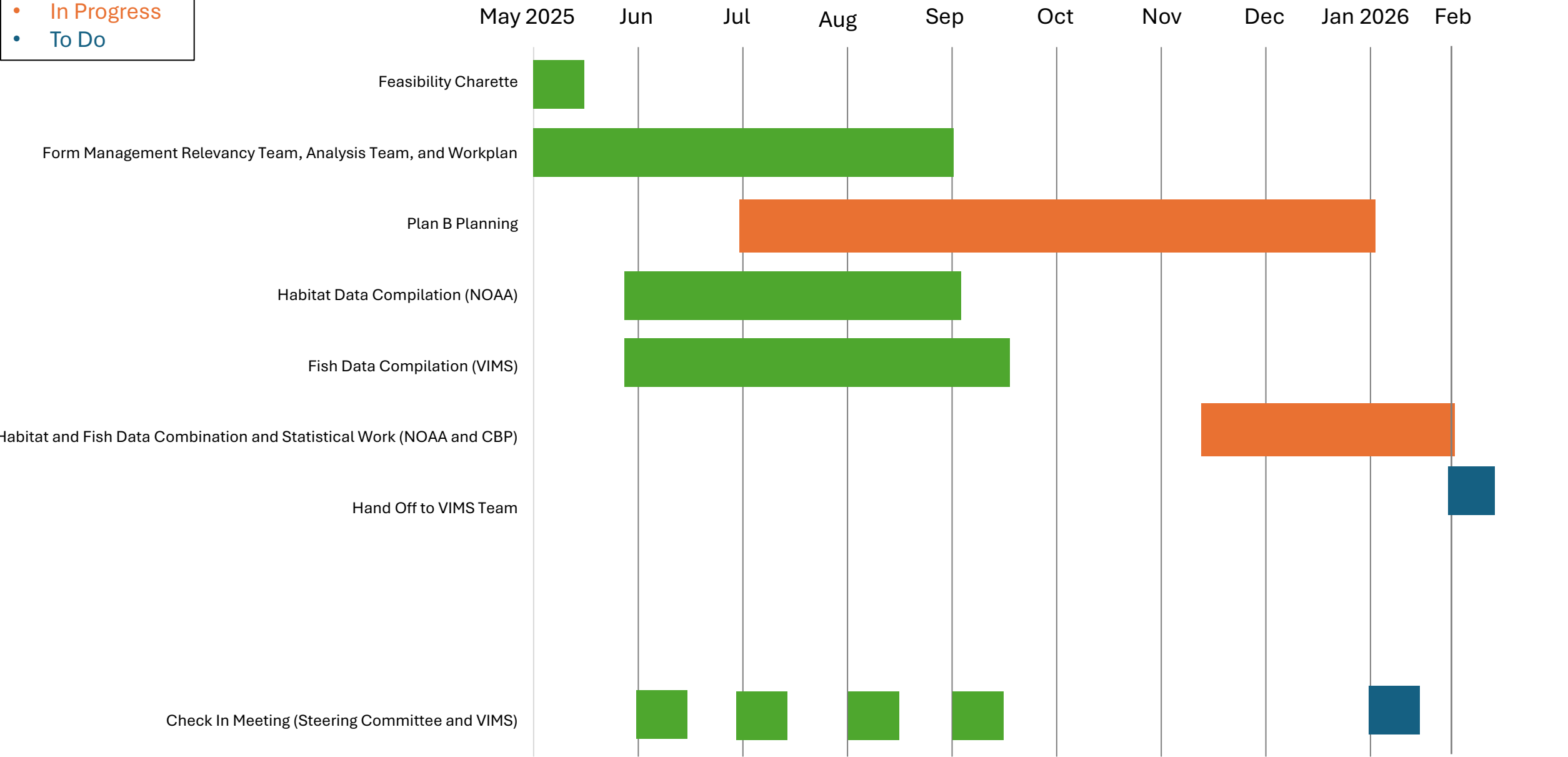
HSI based on fish, habitat, water quality data at the 92-segment scale

Legend

• Complete

• In Progress

• To Do

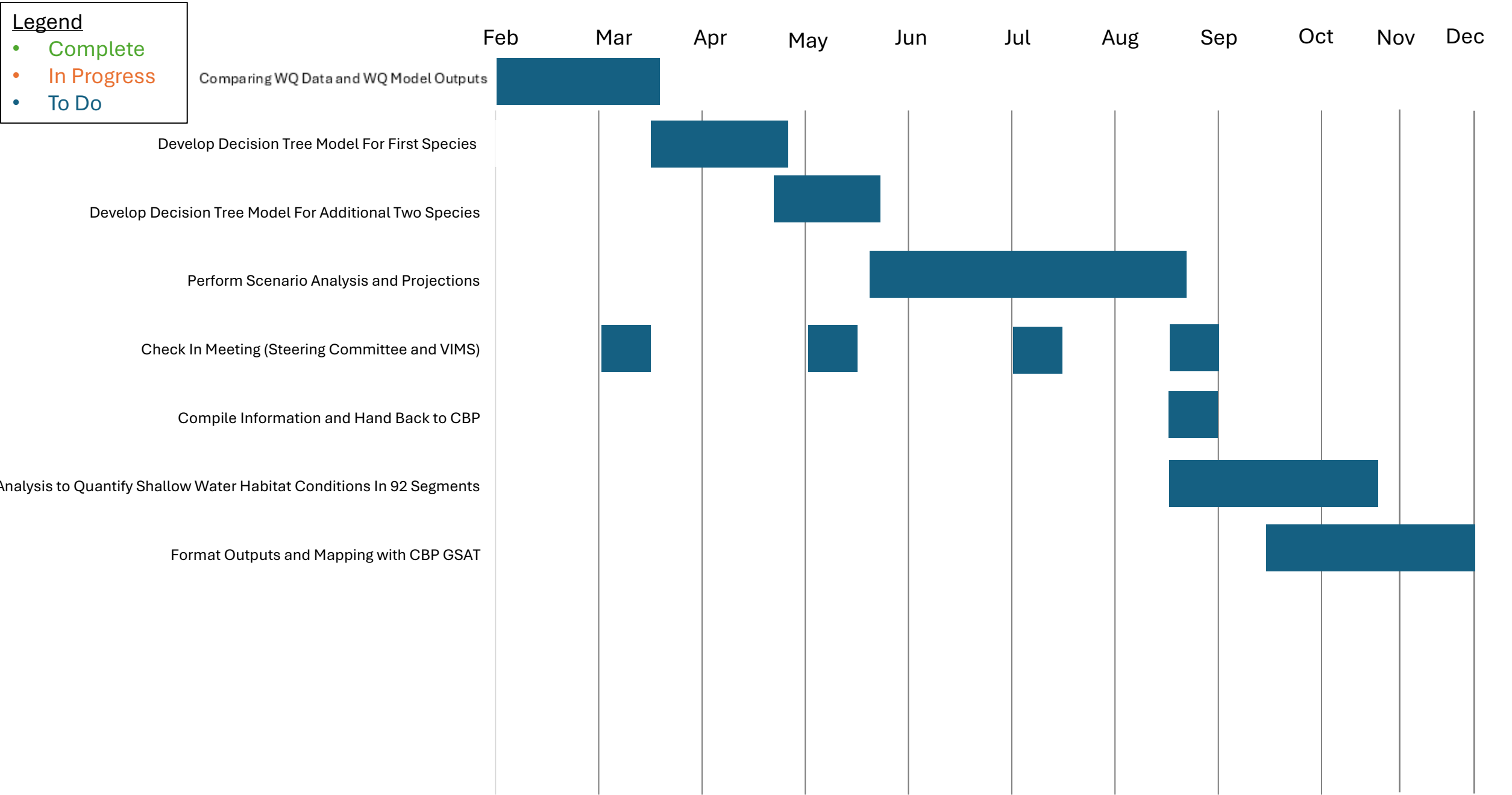


Legend

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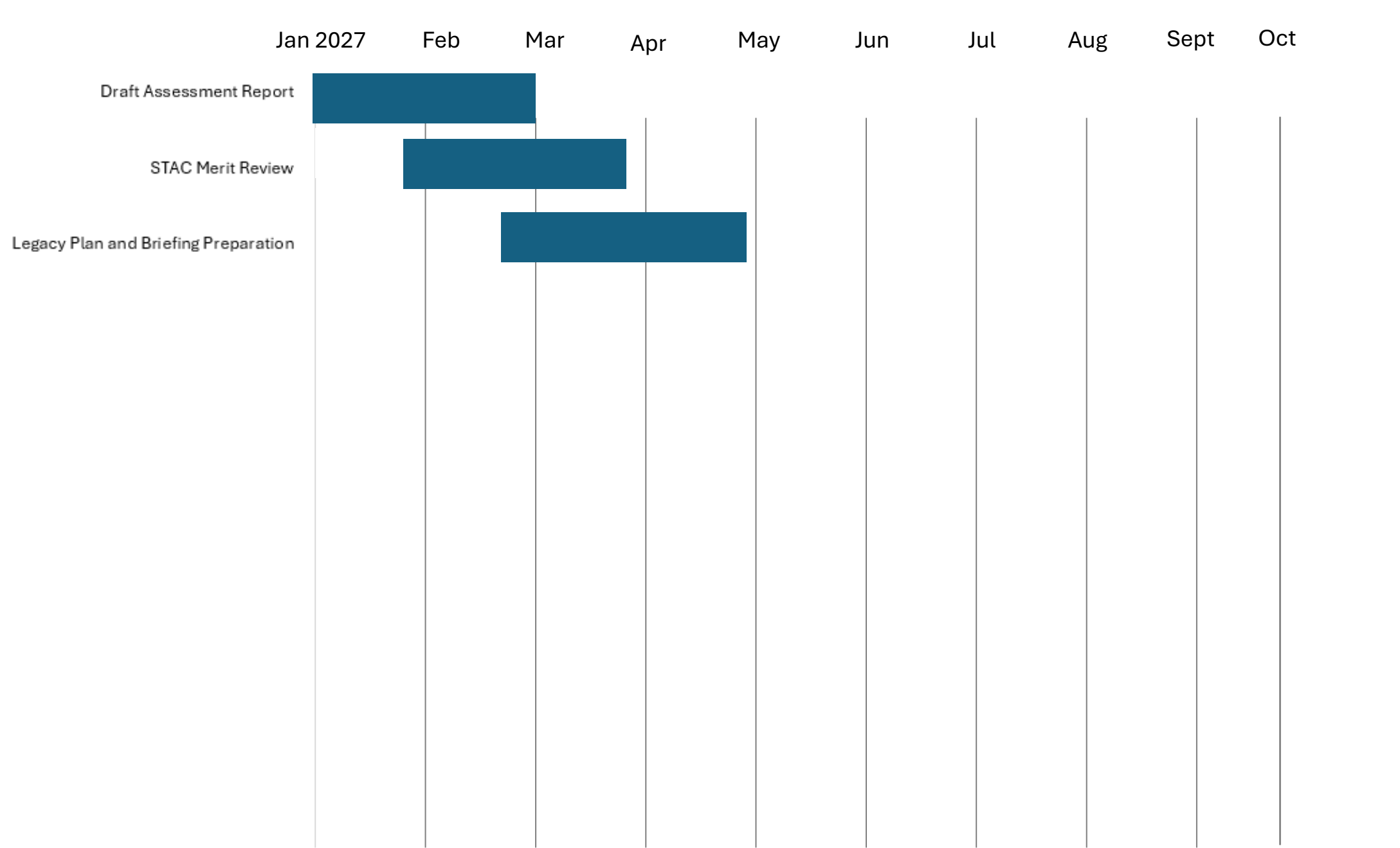


Legend

• Complete

• In Progress

• To Do



Parallel Path

We are hopeful that this approach to score 92 tidal segments will work

- Uncertainty with it working with the fish data, as there will be many places with zeros/no data/no fish information

However, we must meet our objective

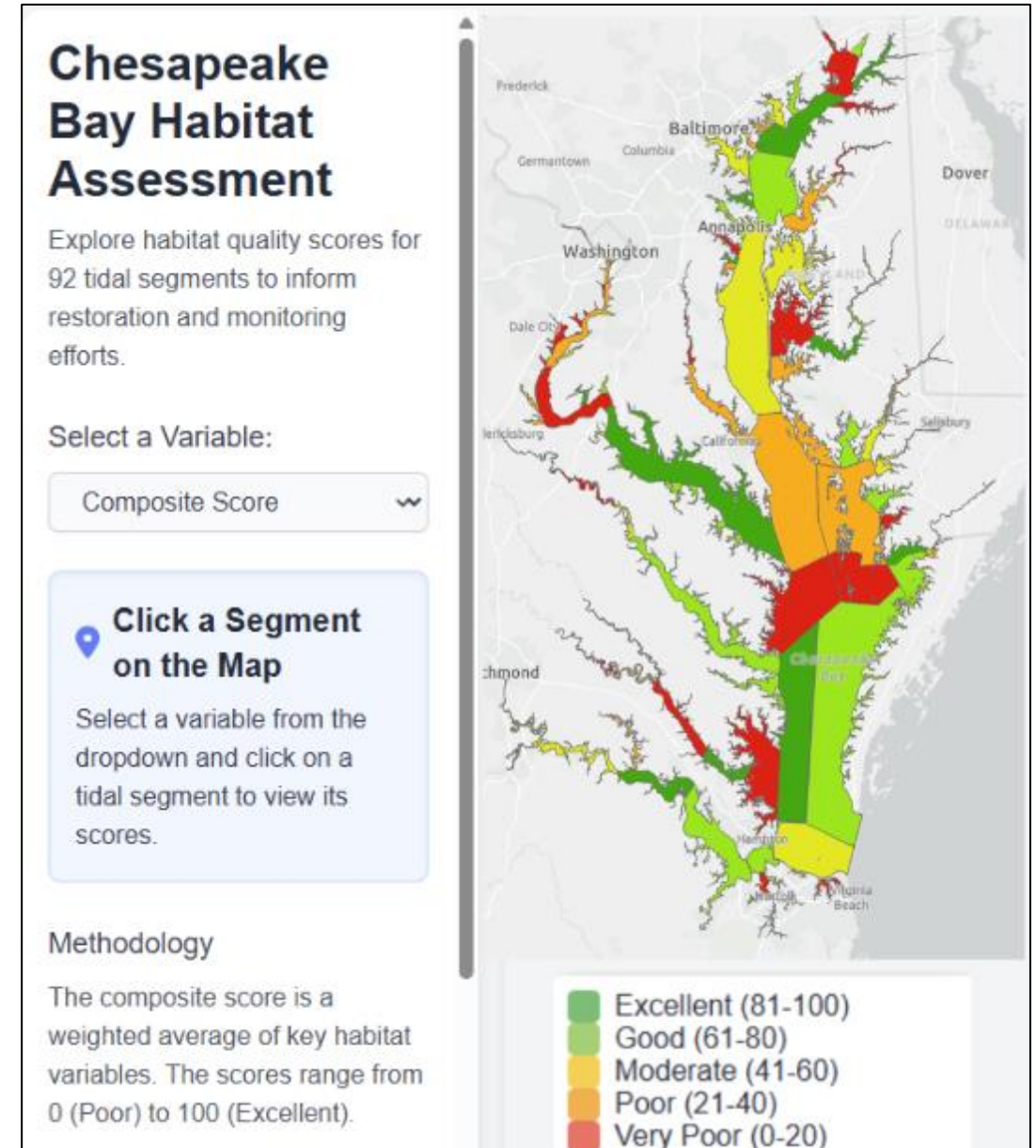
- Objective: places to focus on for tiered targeting

Plan for Parallel Path

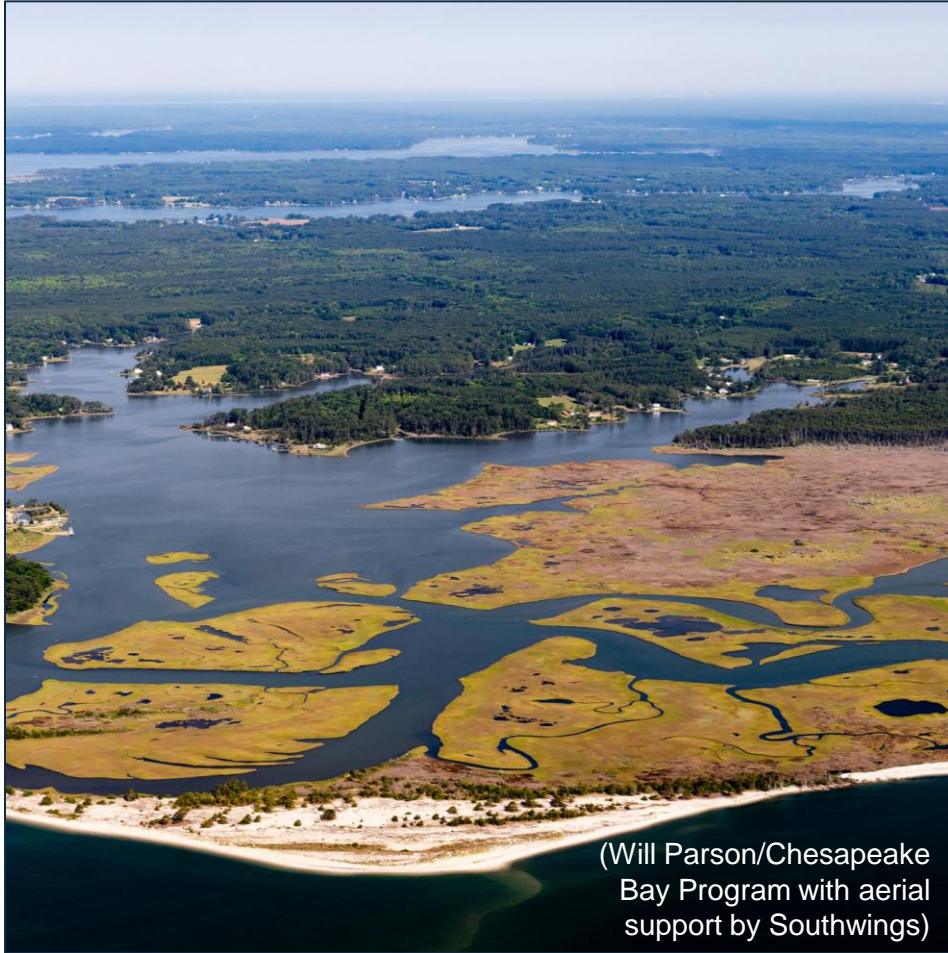
- Segment scoring based on habitat requirements, underscored by NOAA datasets
- Derived from geospatial habitat requirements and water quality data
- Composite score based on criteria weighting
- Provides a common, transparent, and scientifically-backed framework that allows all partners to work from a shared understanding of the Bay's health

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 targeting*
 - 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

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