Collaborative Marsh Adaptation Project
Final Report

CBT Scope #2: Partnership-Building and Identification of Collaborative Tidal Marsh Adaptation Projects

June 2024

Image credit: Scott Lerberg, Chesapeake Bay National Estuarine Research Reserve in Virginia

Contents

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Abbreviations

ACFHP   Atlantic Coastal Fish Habitat Partnership

CBP   Chesapeake Bay Program

CRWG   Climate Resiliency Workgroup

CZM   Coastal Zone Management

DoD   U.S. Department of Defense

EPA   U.S. Environmental Protection Agency

ESA   Endangered Species Act

FEMA   The Federal Emergency Management Agency

GIS   Geographic Information System

GIT   Goal Implementation Team

InVEST   Integrated Valuation of Ecosystem Services and Tradeoffs

MD DNR   Maryland Department of Natural Resources

MMCE   Marsh Migration Corridor Envelope

NCCOS   National Centers for Coastal Ocean Science

NOAA   U.S. National Oceanic and Atmospheric Administration

REPI   Readiness and Environmental Protection Integration

SLAMM   Sea Level Affecting Marshes Model 5.0

SLR   Sea Level Rise

STAR   Scientific, Technical Assessment and Reporting

TEA   Targeted Ecological Areas

TLP   Thin Layer Placement

UVVR   Unvegetated to Vegetated Ratio

VIMS   Virginia Institute of Marine Science

Executive Summary

This report describes the process and outcomes of the 2022 Chesapeake Bay Program's (CBP) Goal Implementation Team GIT-funded Scope 2 project for, "Partnership-Building and Identification of Collaborative Tidal Marsh Adaptation Projects" (hereafter referred to as the Collaborative Tidal Marsh Adaptation Project." This project identified tidal marsh areas and potential protection and restoration strategies in Virginia and Maryland for collaborative projects to build resilience and adapt to effects of climate change, particularly sea level rise, that threaten coastal communities and habitats. In framing the project, the team adopted the definition of marsh adaptation as "incorporating climate change information and resilience strategies when planning, designing, implementing, and managing marsh restoration and conservation[1] projects to enhance health and longevity of marsh area."

An extensive review of tidal marsh research, tools, data and metrics, and previous workshop findings informed the project approach, which includes four phases of activities and milestones to ultimately support a workshop focused on partnership building in two specific areas of Maryland and Virginia. Key components include mapping metrics to identify areas of need; selection of focus areas aligned with potential partner interests and priorities; and planning and analysis within selected focus areas. These components set CBP partners up to identify potential marsh adaptation projects.

Throughout the project, the team compiled and analyzed data and engaged a wide range of stakeholders to share knowledge, resources, and input on an ongoing basis. This collaborative approach helped refine the methodology for identifying potential projects and marsh adaptation strategies. The methodology resulted in identification of six focus areas and selection of two, Maryland's Wicomico River/Monie Bay area, and Virginia's Middle Peninsula, for focused partnership building. Stakeholders working in the two areas provided input to guide workshop topics, redirecting the focus of the workshop from project selection to addressing challenges and opportunities for project advancement directly relevant to current challenges around marsh adaptation planning and implementation. The topics included improving collaboration between partners and communities, adapting regulatory frameworks, balancing short-term needs and long-term planning, and innovating marsh adaptation tools and technologies.

Overall, this report summarizes key project activities and findings, stakeholder engagement, resilience metrics, focus area rankings for workshop selection, marsh adaptation research, workshop findings and lessons learned, and guidance to replicate this work for other regional geographies. The Collaborative Tidal Marsh Adaptation project created several resources, including a Tidal Marsh Adaptation Mapper, to support targeting of marsh protection and restoration projects and findings that the Chesapeake Bay Program can use to advance short-term and long-term marsh adaptation planning. The findings and products generated from this project could also be used to support planning discussions for the Chesapeake Bay Program's *Beyond 2025* initiative that is evaluating next steps for goals and outcomes in the 2014 Chesapeake Bay Watershed Agreement.

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[1] In this definition, "conservation" refers to a broad range of activities including preserving, protecting, restoring, and enhancing wetland habitats for indigenous wildlife and vegetation. For specific marsh adaptation terms used throughout the project, see *Tidal Marsh Adaptation Framing and Definitions* in the Appendix.

Key Project Outcomes

- Selection of regional focus areas in Maryland and Virginia for targeting large-scale tidal marsh adaptation projects

- Identification of partner agencies and organizations likely to support collaborative, large-scale tidal marsh restoration and research

- Targeting methodology to identify potential large-scale tidal marsh adaptation projects for short-term (less than 5 years) and long-term (greater than 5 years) planning

- Integration of key marsh adaptation data in the Tidal Marsh Adaptation Mapper, developed and maintained by the Chesapeake Bay Program GIS team

Key Project Findings

- Addressing regulatory barriers is a priority to advance tidal marsh adaptation at small and large scales. Delays caused by permitting hinder project planning, development of funding applications for projects, and implementation of newer adaptation technologies--ultimately inhibiting action and innovation.

- A resource to promote collaboration for marsh adaptation opportunities, such as a tool that matches priorities, project needs, partners, and available resources (i.e., materials such as sediment, technical assistance, funding) to streamline project planning. Without a knowledge base to share information, the inability to align activities, specifically around dredging and beneficial use, leads to missed opportunities. Updated information that can help accelerate marsh adaptation projects at small and large scales includes:

  o contacts at organizations supporting tidal marsh projects,

  o potential project locations and specific needs,

  o available materials to support adaptation (e.g., sediment for thin-layer placement), and

  o funding resources.

- Extensive partner and community engagement and communication is necessary before, during and after marsh adaptation projects. Recent large-scale projects highlight the importance of partner and community communication and engagement and reveal specific opportunities and suggestions for improvement.

- Working with private landowners on tidal marsh adaptation planning is critical to address climate impacts to coastal communities and habitats, given the large amount of privately owned coastline in Maryland and Virginia. Participants prioritized the need to build trust with communities, and to create more innovative regulatory mechanisms, such as revised easement language to increase flexibility and development of new incentive programs to encourage resilience planning.

- Six geographic focus areas identified in Maryland and Virginia present opportunities for marsh adaptation efforts that can address the impacts of climate change by increasing the resilience of

coastal communities and critical habitats areas. The following regions would benefit from partnership building and collaborative tidal marsh adaptation project planning activities:

- o Choptank River, MD

- o Wicomico River (Monie Bay to Deal Island, MD)*

- o Pocomoke Sound Area (Crisfield, MD to Saxis, VA)

- o Middle Peninsula, VA*

- o Middle Peninsula Tribal Lands (Mattaponi, Pamunkey)

- o Elizabeth River Watershed (Norfolk, Portsmouth, Chesapeake, Suffolk), VA

*As the two areas selected for workshop discussion, partnership building and collaborative planning activities were initiated in these two areas during the Tidal Marsh Adaptation Project.

Introduction

The 2022 EPA Goal Implementation Team (GIT) Scope 2 project for "Partnership-Building and Identification of Collaborative Tidal Marsh Adaptation Projects" is a Scientific, Technical Assessment and Reporting (STAR) GIT project that aims to advance the Chesapeake Bay Program (CBP) Climate Adaptation Outcome in the 2014 Chesapeake Bay Watershed Agreement. The project goal was to identify collaborative large-scale tidal marsh adaptation projects that maximize marsh benefits under changing climate conditions. A review of existing resilience and social vulnerability metrics, tidal marsh research, and the reports and findings of other wetland workshops conducted 2019 to 2023, as well as input from subject matter experts, informed the project approach, data analysis, and methodology. Key project tasks to foster collaboration involved:

- stakeholder engagement to gather information and create opportunities for dialog between practitioners and potential partners,
- documentation and mapping of stakeholder interests and priorities to support alignment of partners with funding and project opportunities, and
- facilitating a culminating workshop to share information and address pressing topics relevant to current and future marsh adaptation project planning and implementation efforts.

Key project outcomes included selection of regional focus areas in Maryland and Virginia for targeting large-scale tidal marsh adaptation projects; identification of partner agencies and organizations likely to support collaborative, large-scale tidal marsh restoration and research; a methodology to identify potential large-scale tidal marsh adaptation projects where funding can be pursued in the short-term (less than 5 years) and long-term (greater than 5 years); and integration of marsh resilience, social vulnerability, and ecosystem services data in a mapper.

These project outcomes can support the CBP Climate Resiliency Workgroup (CRWG), Wetland Workgroup, and partners' efforts to build interest and momentum in short-term and long-term actions across federal, state, and local jurisdictions, environmental stakeholders, and research partners for pursuing marsh adaptation projects that can bolster progress in achieving the CBP climate adaptation and wetland acre outcomes in the 2014 Chesapeake Bay Watershed Agreement. This work also supports the Fish Habitat and Black Duck outcomes as tidal marshes play an important role providing habitat for fish and birds. The end-users of this information include the STAR/Climate Resiliency Workgroup, Habitat GIT/Wetland Workgroup, and the identified partner collaborations from the workshop. This document serves as the final project report and describes the project process and the work completed.

2014 Chesapeake Bay Watershed Agreement

Climate Adaptation Outcome: *Pursue, design, and construct restoration and protection projects to enhance resiliency of the Bay and aquatic ecosystems from the impacts of coastal erosion, coastal flooding, more intense and frequent, storms, and sea level rise.*

Wetlands Outcome: *Create or re-establish 85,000 acres tidal & non-tidal wetlands & enhance function of an additional 150,000 acres of degraded wetlands by 2025.*

Fish Habitat: *Continually improve effectiveness of fish habitat conservation and restoration efforts by identifying and characterizing critical spawning, nursery and forage areas within the Bay and tributaries for important fish and shellfish and use existing and new tools to integrate information and conduct assessments to inform restoration and conservation efforts.*

Black Duck outcome: *By 2025, restore, enhance, and preserve wetland habitats that support a wintering population of 100,000 black ducks, a species representative of the health of tidal marshes across the watershed. Refine population targets through 2025 based on best available science.*

Project Overview

Approach

The overall project approach was divided into four phases of activities and milestones, depicted in Figure 1, to advance the project from gathering data and information to evaluate areas of need for marsh adaptation in the larger project area (Maryland and Virginia), to identifying specific focus areas supported by regional and local data and collaborative discussions with stakeholders implementing and researching marsh projects. Each phase included stakeholder outreach, data integration and analysis, and findings that inform the subsequent phases leading to the identification of collaborative marsh adaptation projects and needs to advance these projects. The project methodology is documented through Phase 4, which includes the culminating workshop.

Broader-Scale Targeting

Phase 1: Metric Mapping

- Climate vulnerability
- Adaptive capacity
- Ecological services
- Social vulnerability

➜ Identify Areas of Need

Phase 2: Partner Alignment Mapping

- Partner areas of activity
- Partner areas of interest

➜ Identify Focus Areas

Finer-Scale Targeting and Customization

Phase 3: Identify Project Opportunities

- Add specific regional data
- Connect data with funding priorities/ ecosystem services
- Facilitate partnership building activities

➜ Identify Collaborative Marsh Adaptation Projects

Phase 4: Conduct Partner Workshop

- Address topics specific to focus area project planning
- Facilitate discussion of opportunites and challenges for project advancement
- Identify potential partnerships, projects and next steps for project development

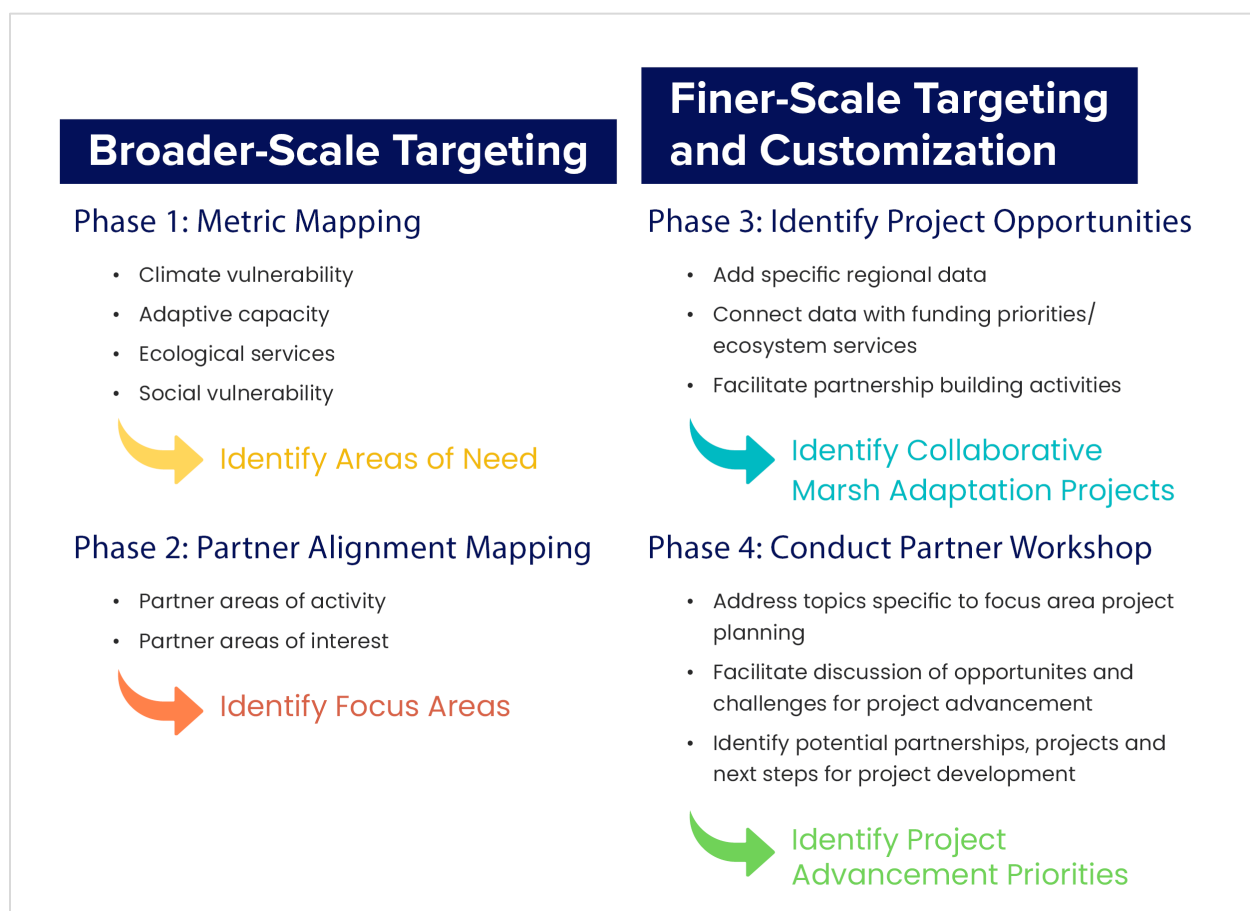➜ Identify Project Advancement Priorities

Figure 1. Project Approach

Use of Existing Data and Tools

A tiered approach to data integration and analysis for broad-scale and finer-scale targeting (Figure 1) enabled the team to leverage more specific data as the project analysis area was narrowed from Virginia and Maryland to specific focus areas that aligned with needs for marsh adaptation. Stakeholder outreach was conducted at each phase to gather input to refine the methodology, review data sources, and identify important project considerations. See *Data Layer Spreadsheet* in the Appendix for a complete list of data and sources used in the project.

First Tier Data

First tier data was compiled during broader scale targeting (Figure 1) and includes existing Bay-wide resilience metrics, ecological indices, and social vulnerability criteria to identify areas of need for marsh adaptation projects. Areas of need were determined by where there is the most need for marsh adaptation based on climate change (e.g., sea level rise), social vulnerability (e.g., census factors, such as low income) and ecological indices.

The addition of data from partners supporting marsh implementation and research projects, which included locations of partner activity and information about partner interests, guided the identification of six regional focus areas. From the six, the steering committee selected two regional focus areas, one in Maryland and one in Virginia, for a workshop to support further discussions centered around project identification and funding advancement for marsh adaptation. The project funding was at a level that could only support further analyses and workshop discussions for two of the identified focus areas. Lessons learned from this effort can inform future work in the remaining focus areas based on future resources and the capacity of local partners.

Second Tier Data

Second tier data was compiled during finer scale targeting (Figure 1) and includes supplemental regional datasets such as detailed site conditions, habitat features, and land attributes to help users assess opportunities for projects and partnerships. The project team used second-tier data and input from partners actively working in the regions to identify potential project opportunities in the two selected regional focus areas. The additional data sets provide information to identify potential partnerships and projects aligned with specific opportunities, such as habitat priorities and funding tools.

Tidal Marsh Adaptation Mapper and Other Project Resources

Resources and tools developed to support the methodology included the Tidal Marsh Adaptation Mapper (https://gis.chesapeakebay.net/climate/marshadaptation/tiers1-2/) (see Figure 2), which incorporates first and second tier data for widespread use and to inform the identification of marsh adaptation projects, and marsh adaptation scenario worksheets, which guide partners to consider marsh adaptation strategies during project siting and planning activities (see Phase 3 of report).

Targeting tidal marsh data, resilience metrics, and geospatial data developed to reflect the locations of active marsh projects or areas of interest for marsh work by partners was integrated into the Tidal Marsh Adaptation Mapper (Figure 2), which provides a layered view of marsh adaptation data from a range of existing tools and sources. The Chesapeake Bay Program GIS team maintains the Tidal Marsh Adaptation Mapper and a comprehensive data layer spreadsheet which provides a detailed description of the data layers and sources used in the mapper.
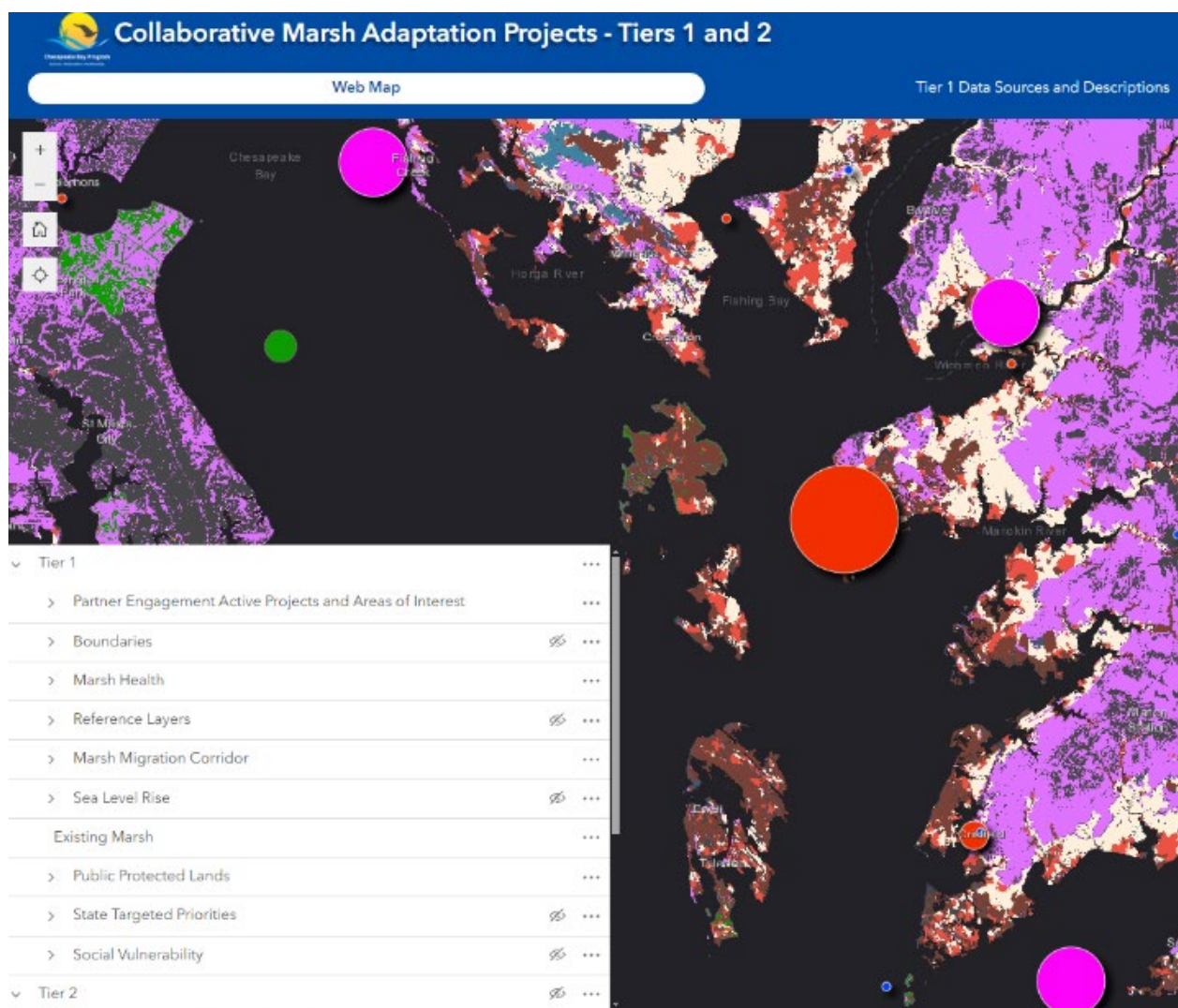
Figure 2. Image of the Tidal Marsh Adaptation Mapper (https://gis.chesapeakebay.net/climate/marshadaptation/tiers1-2/),

Phase 1 Metric Mapping - Methodology

Overview

The project team identified regional priorities for tidal marsh restoration, research, and resilience in Phase 1 based on findings from marsh adaptation research and previous regional workshops, analysis of relevant tools, data and metrics, and steering committee and stakeholder input. These priorities guided the process for selecting and using data to highlight *areas of need* for tidal marsh adaptation through restoration, protection, and research efforts. The process included the following steps:

1. Review regional research and published outcomes of other collaborative efforts (i.e., workshops, workgroup reports) and summarize key findings.
2. Conduct steering committee meetings and exploratory meetings with stakeholders for input on priorities, data and metrics, and relevant projects and research initiatives.
3. Review and document data in a GIS data layer repository (spreadsheet) of all potentially relevant information.
4. Select data layers to be used to identify focus areas, through team discussion and stakeholder input.
5. Integrate data layers into web map or another GIS platform.
6. Select criteria and thresholds for each data layer to determine potential need for marsh adaptation projects based on climate change risks (e.g., sea level rise), social vulnerability (e.g., census factors, such as low income) and ecological indices.
7. Analyze data to determine large-scale areas of need in Maryland and Virginia.

Research

Current regional research and recent wetland and marsh related workshop outcomes provided information about data, innovative tools and technologies, and relevant research initiatives, as well as specific considerations such as site conditions and dynamics (i.e., sediment supply limitations in Virginia), property attributes, and regulatory challenges. See *Tidal Marsh Resilience Summary* in the Appendix for a more information about the research and workshop outcomes.

The team also reviewed and documented a wide range of existing metrics, data sources, and mapping tools that provide information relevant to tidal marsh adaptation planning. The steering committee and other contributors helped to identify the data most relevant to targeting potential areas of need and opportunity for large scale marsh adaptation projects. See *Data Layer Spreadsheet* in the Appendix for a list of the data sources and tools reviewed.

Outreach

The project team met with the steering committee during Phase 1 to learn about the priorities of the institutions, practices, and interests they represent, as well as those of other groups not represented on the committee but prevalent context of resilience planning in tidal regions of Maryland and Virginia. The committee also provided input on the proposed methodology, data and metrics, and additional resources to inform Phase 1 activities.

Initial steering committee meetings focused on developing the project approach, starting with refining the goal (or site parameter) criteria to consider overlap between areas exhibiting characteristics tied to social vulnerability, conservation priorities, and adaptive marsh capacity. Early discussions also included gathering information about relevant initiatives, tools, and datasets for the team to review. Next, the steering committee provided input on specific indicators, and in doing so, helped to identify data sets, tools, and other sources of existing data and metrics for consideration. As Phase 1 progressed, the steering committee and project team worked together to narrow the list of indicators and establish thresholds to support focus area identification. The project team and steering committee used a virtual whiteboard to present and capture input (see Figure 3). The indicators and thresholds were incorporated into the Tidal Marsh Adaptation Mapper, which was refined on an ongoing basis to improve labeling and flexibility for analysis as the project progressed.

The project team also met with several stakeholders to discuss recently published marsh adaptation research in context of this project to inform data integration and analysis activity. During this time, the *Marsh Data Synthesis Project*[2], which documented a methodology to evaluate marsh migration potential, was nearing completion, and the steering committee and project team anticipated the methodology would inform the project approach to characterizing marsh adaptive capacity. Upon its release, the team met with the project lead, Molly Mitchell, to learn how the methodology could be applied to the project area (tidal Maryland and Virginia).

Another important resource shared during steering committee review by Neil Ganju included the newly developed *USGS Wetland Synthesis*[3] research, based upon which the participants concluded that UVVR provides an important indicator for marsh health. This research also supported scenario design for marsh adaptation strategies around conservation and restoration which were developed during Phase 3.

Data Selection

To build upon existing resources and research, the project team evaluated a wide range of GIS mapping tools and other sources to identify data layers that contribute to understanding how tidal marsh conditions and dynamics affect coastal resilience, particularly in context of approximately 2 feet and 4 feet of sea level rise. The project team documented and compiled this data in a data inventory spreadsheet that identifies tools and data layers relevant to conservation priorities, marsh migration, marsh health, and social vulnerability across Maryland and Virginia (see *Data Layer Spreadsheet* in the Appendix).

The members of the steering committee guided the data selection process, drawing upon their expertise in coastal environments and involvement in marsh resilience planning and research across the Chesapeake Bay region. The steering committee narrowed the data inventory to the most relevant data for identifying regional focus areas that offered project opportunities for marsh protection and restoration adaptation efforts. The steering committee members' knowledge of recent literature,

[2] Marsh Data Synthesis Project: Update on "Synthesis of Shoreline, Sea Level Rise, and Marsh Migration Data for Wetland Restoration Targeting." Molly Mitchell, Virginia Institute of Marine Science. December 14, 2021. https://cbtrust.org/wp-content/uploads/VIMS_Marsh_Migration_final_reportmetadatsheets_30Sept2022.pdf

[3] USGS Coastal Wetland Synthesis Products and Tools for Chesapeake Bay. Neil Ganju, Kate Ackerman, and Zafer Defne, Woods Hole Coastal and Marine Science Center U.S. Geological Survey. https://d18lev1ok5leia.cloudfront.net/chesapeakebay/documents/Ganju_CRWG_Oct22_revised.pptx.pdf

newest available data, completed and ongoing projects, as well as gaps in marsh adaptation work supported the selection process. They provided insights and clarity to many of the datasets regarding methodologies, outputs, and version control. The scale and relationships between the chosen data were ultimately used to identify potential focus areas, further described in the Data Analysis section.

Data Thresholds

After refining the data to be used for marsh adaptation targeting, thresholds were set for each of the factors within the eight categories. The thresholds were determined to group and display data on a map to identify areas of need for marsh adaptation based on the presence of specific criteria indicating significant vulnerability and adaptive capacity. The thresholds and categorization of data for each factor are described in the Phase 1 project findings and are visualized within the Tidal Marsh Adaptation Mapper https://gis.chesapeakebay.net/climate/marshadaptation/tiers1-2/ (https://gis.chesapeakebay.net/climate/marshadaptation/tiers1-2/).
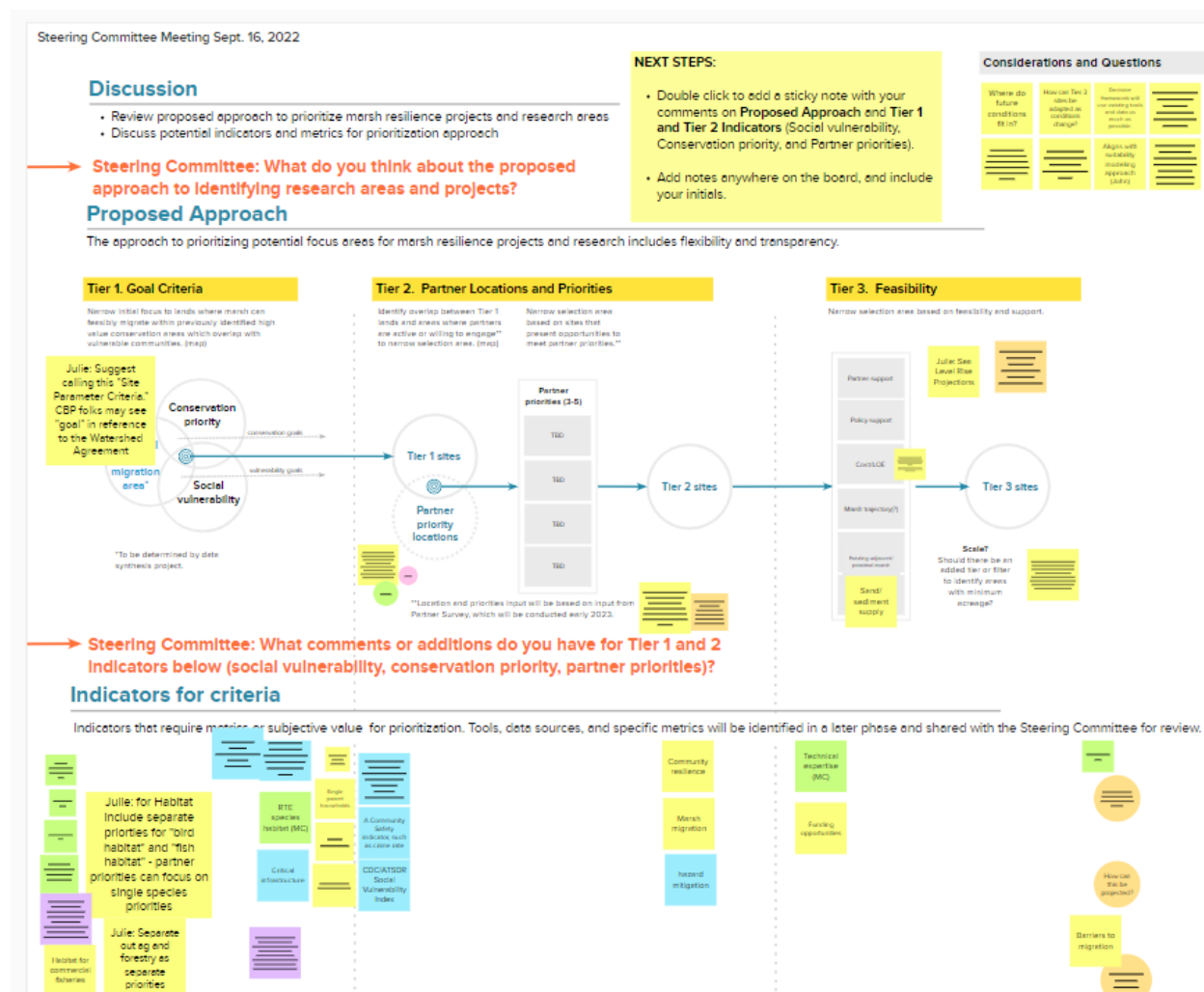

Figure 3. Image of virtual whiteboard showing examples of input from steering committee on project approach and indicator criteria.

Phase 1 Metric Mapping - Project Findings

Phase 1 Outreach (Steering Committee and Research Meetings) Findings

Steering Committee meetings and reviews during Phase 1 resulting in finalizing the project approach and identification and refinement of data sources, indicators, and parameters for focus area identification. Outreach to specific researcher leads also informed key parts of the project development, including the approach to evaluating tidal marsh adaptive capacity and scenario design for tidal marsh conservation and restoration strategies.

Key findings and outcomes:

- Refined project approach and selection of focus area indicators: climate vulnerability, adaptive capacity, ecological services, and social vulnerability (see Figure 1).
- Data sources for Tier 1 data analysis. Based on input, Tier 1 (and some Tier 2) data and indicators were documented and maintained in the *Data Layer Spreadsheet*, available for review in the Appendix.
- Integration of recent marsh migration research and resources into approach for analyzing marsh migration potential using existing data and tools (i.e., Marsh Migration Corridor Envelope to identify key migration areas, UVVR as an indicator of marsh health), and into subsequent phases of the project focused on identifying potential adaptation approaches (Phase 3).

Phase 1 Literature Review Research Findings

The *Tidal Marsh Resilience Summary* in the Appendix provides detailed summaries of the research literature and workshop findings that were reviewed to inform the use of datasets and tools that the project team can build on for analysis. Additionally, the document review of recent research, workshop proceedings, and action plans identified common themes and priorities that informed workshop topics.

Key Resilience Research Topics

The following topics appeared across many of the documents as emerging focal areas in research, planning, implementation, and management of tidal marsh adaptation efforts.

- **Marsh Adaptation Strategies, Tactics, and Interventions.** Groups are applying a variety of proven and innovative practices related to restoring, creating, enhancing, and managing marsh based on capacity, funding, physical barriers, specific interests, and community support.
- **Marsh Adaptation Partners and Programs.** Many partners and programs supporting marsh and wetland protection, creation, enhancement, and other adaptation measures at small and large scales exist at local, regional, state, and federal levels, and are managed by a variety of government agencies, non-profit organizations, and public-private partnerships.
- **Marsh Migration.** There is a strong focus on integrating resilience strategies and metrics, especially marsh migration, into marsh management plans.
- **Project Site Selection.** Tools have been developed to analyze data for site selection and are contingent upon availability of specific metrics and require defined objectives.
- **Data and Information Access.** Easy access to data and information is critical for collaboration and cohesive resilience planning.

- **Broader Stakeholder Collaboration**. Workshops specified the need for increased collaboration with community and government stakeholders.
- **Tidal Wetland/Marsh Benefits.** Materials reference the many benefits wetlands provide and highlight considerations for how those benefits drive wetland management decisions.
- **Vulnerable Communities.** Research and workshop documents state the need to focus on environmental justice communities and other vulnerable communities in resilience planning.
- **Government, Policy, and Regulatory Variations.** Differences between locations and leaders require increased local knowledge and communication for broad-based resilience planning.
- **Cost, Benefits and Financial Responsibility.** Quantifying benefits and managing costs is important for planning and identifying opportunities for funding.

Resilience Research Discussion Questions (pertinent to tidal marsh adaptation planning)
Further discussion of the following topics can advance planning for tidal marsh adaptation efforts.

- What are the priorities and objectives for marsh management?
- What are critical components of marsh adaptation projects?
- How can we strengthen the connection between resilient coastlines and resilient communities through marsh adaptation?
- How can stakeholders address "coastal squeeze" and plan for land transition (farmland to marsh, forest to marsh, infrastructure removal, relocation) to support long-term marsh adaptation?
- What are the most important indicators of resilience?
- How can existing tools, methodologies, strategies from other entities be leveraged to support ongoing tidal marsh resilience efforts?
- Who provides coordination oversight of marsh resilience efforts (strategy, data, knowledge, policy, community engagement)?

Resilience Research Key Takeaways
- Preserving intact coastal corridors for marsh migration is an adaptive approach to address the environmental impacts of sea level rise associated with climate change.
- Marsh migration is particularly important in Virginia, where marsh restoration and preservation efforts are limited by sediment availability.
- New land management practices are needed to support healthy marsh migration and adaptation in context of sea level rise.
- Marsh migration is dependent on multiple factors including a positive elevation gradient or slope inland, sediment supply, hydrology, limited impervious barriers, intact habitat corridors and more. Correlations between elevation, SLR, UVVR and tidal range inform proposed approaches to tidal marsh adaptation.
- Experts want a more collaborative approach to increasing resilience and highlight the need for dedicated resources (staff, funding) to synthesize and share information about projects, outcomes, research, lessons learned and other information pertinent to practitioners.
- Engaging lawmakers and leaders on an ongoing basis is critical to build political will that is necessary to implement marsh adaptation efforts at a scale that will protect ecosystems and communities.

- Quantifying benefits, creating economic programs for resilient landscapes such as blue carbon credits, and refining cost-benefit analyses can support efforts to engage communities and lawmakers.

Resilience Research Tools, Data, and Metrics

The following information in the research and workshop materials provided helpful insight for selecting the tools, data, and metrics used specifically for the Tidal Marsh Adaptation project.

- Materials reiterate the need for common metrics to evaluate marsh condition, marsh resilience, and social vulnerability, and propose several datasets to address the need.
  - For marsh condition, the Coastal Wetland Synthesis project proposes UVVR as a useful metric for marsh condition in context of marsh migration planning, and the project created a new metric to measure potential marsh lifespan.
  - Kirwan's research identifies specific metrics necessary to consider marsh resilience (through migration) in the Chesapeake Bay, calling attention to site conditions specific to parts of the Bay that differ from other regions included in migration studies.
  - The materials propose several methods for quantifying benefits to address social vulnerability through marsh adaptation, but do not propose specific metrics to measure social vulnerability in context of marsh adaptation or site selection.
- Many tools exist that integrate data sources for different uses related to marsh adaptation. Deciding which tool(s) to use can require research and clear definition of goals and objectives.
  - The Coastal Resilience Workshop materials provide a good source for overviews of the many tools and guidance for tool selection.
  - The Marsh Migration Synthesis project shares important insights about the application of various tools including SLAMM, InVEST and others to model marsh migration potential, and provides a methodology for integration five tools to project potential migration corridors.
- Kirwan's research for *Healthy marsh migration review identifies a* comprehensive list of ecological metrics needed for marsh resilience planning specific to the Chesapeake Bay (see page 15, table 1 in document).

Phase 1 Data (Tier 1 Data) Findings

Data Selection

Based on the steering committee's input throughout Phase 1, the final datasets chosen for focus area consideration and selection were compiled into eight categories that are listed below (see the full list of data in Appendix document, *Data Layer Spreadsheet*).

1. Existing Marshes, Marsh Size
2. Marsh Stability
3. Marsh Adaptive Capacity
4. State Targeted Priority Areas
5. Risk and Vulnerability
6. Sea Level Rise (SLR) Projection
7. Protected Lands

The following data (referred to as Tier 1 data) was selected for targeting focus areas:

Layer Group Name	Data Layers
Boundaries	Parcels, HUCs, Basins, Watershed
Partner Engagement - Active Projects and Areas of Interest	Partner Activity & Focus Areas
Marsh Health	UVVR, Tidal Range, Elevation, Marsh Units
Reference Layers	Marsh Mask
	Impervious Surfaces
Marsh Migration Corridor	Multiple Models - 2 ft Sea Level Rise
	Multiple Models - 4 ft Sea Level Rise
Sea Level Rise	U.S. Sea Level Rise - Intermediate (2050)
	U.S. Sea Level Rise - Intermediate High (2050)
	U.S. Sea Level Rise - Intermediate (2090)
	U.S. Sea Level Rise - High (2090)
Existing Marsh	National Wetlands Inventory
	Virginia Tidal Wetlands
Protected Lands	MD DNR Owned Lands and Conservation Easements
	MD Environmental Trust Easements
	MD Protected Federal Lands
	VA Protected Lands
	Dept of Defense Lands
State Targeted Priorities	MD Targeted Ecological Areas (TEAs)
	ConserveVirginia Map
Social Vulnerability	FEMA National Risk Index-Census Tracts

The following thresholds were selected to support data analysis. The thresholds are based on factors that the steering committee and project team identified to help characterize marsh areas suitable for adaptation measures based on adaptive capacity, social vulnerability, and partner engagement.

1. *Existing Marshes, Marsh Size*

The size of existing marsh properties is used to evaluate the potential for large scale marsh adaptation projects. Several medium or small-scale marsh areas in proximity to one another or within/near a specific community might be considered as one "large-scale" tidal marsh adaptation project. Large scale acreage number (1,000+) was selected as a baseline figure, based on input from the Chesapeake Bay Program's Habitat Goal Implementation Team (GIT) members for sustaining native bird species. This data was broken down into the following categories:

- Large scale: 1,000+ acres
- Medium scale: 500-999 acres
- Small scale: less than 500 acres

2. *Marsh Stability*

Marsh stability is an important consideration to ascertain existing and near-term marsh vulnerability and adaptability and, as documented in Phase 3 of the methodology, to inform adaptative strategies for restoration or protection. Marsh stability was determined using the [United States Geological Survey's Unvegetated to Vegetated Ratio (UVVR)](#)[4]. The UVVR is an indicator of marsh vulnerability and is defined as the ratio of unvegetated area to vegetated area across an entire marsh system, covering marsh plains, channels, ponds, and intertidal flats. Higher values of UVVR indicate more open water and less vegetative cover, which leads to more vulnerability to ongoing marsh loss. UVVR values greater than 0.1 indicate a tipping point toward marsh degradation. UVVR above a score of 1 indicates that a marsh complex may cease to be geomorphically characterized as a vegetated wetland and may function more as an estuary. This data was used to assess existing marsh condition and differentiate marsh stability/ vulnerability using three categories based on UVVR score:

- Less stable/vulnerable marshes= Greater than 0.15
- Marsh stability/ degradation tipping point threshold = 0.10-0.15
- Stable Marsh= Less than 0.10

3. *Marsh Adaptive Capacity*

The potential for marsh to migrate upland is based on data from the Marsh Migration Corridor Envelope (MMCE) presented in *[Synthesis of Shoreline, Sea Level Rise, and Marsh Migration Data for Wetland Restoration Targeting](#)* [5]. The MMCE combines data from five migration models to indicate areas where marsh is more likely to migrate based on factors including elevation, sea level rise, exposure, sediment availability and more. For this project, the models used were based on geographic reach and consisted of three models that are available Bay-wide for 2-foot and 4-foot SLR scenarios. The individual output of the three models, as well as overlap in marsh migration areas

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[4] For more information about UVVR, see https://www.sciencebase.gov/catalog/item/630f9ba4d34e36012efa0924.
[5] For more information about the marsh migration methodology, see https://scholarworks.wm.edu/reports/2861/.

among the models, was used to show potential marsh migration areas. The three models used to show the MMCE and marsh adaptive capacity are:

- NOAA Sea Level Rise Viewer
- SLAMM 5.0 Sea Level Affecting Marshes Model
- InVEST Integrated Valuation of Ecosystem Services and Tradeoffs model

The MMCE data layers for Maryland and Virginia can be found on the Chesapeake Geoplatform[6].

4. State Targeted Priority Areas

The data analysis for focus area consideration includes Maryland and Virginia state targeted priority areas, which have been determined by the states through a data-driven process for identifying highest priority lands for protection based on ecological value and other considerations such as agricultural, scenic, and cultural attributes. This data includes Maryland Targeted Ecological Areas (TEAs) and Virginia Natural Heritage Conserve Virginia areas.

5. Risk and Vulnerability

Socially vulnerable or disadvantaged populations were also prioritized in targeting potential focus areas. The FEMA National Risk Index was chosen to identify and visualize these communities in maps for analysis. This dataset was chosen to evaluate potentially vulnerable communities because it is an authoritative metric that considers not just social vulnerability, but also community resilience and risks from natural hazards in the metric calculation. The FEMA Index provides a combined value that uses federal data sources like other tools that consider social vulnerability.

The FEMA rating defines risk as the potential for negative impacts as a result of a natural hazard based on social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood), community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions), and expected annual loss (represents the average economic loss in dollars resulting from natural hazards each year). The Index breaks down areas into risk categories of Very High, Relatively High, Relatively Moderate, Relatively Low, and Very Low for both counties and census tracts.

6. SLR Projections

Sea level rise projections indicate marsh vulnerability to climate change over time. The project team and steering committee agreed that NOAA 2050 and 2090 sea level rise projections are most relevant to project planning timeframes for this project. The mid-century timeframe connects with short-term actions, and an end-of-century timeframe supports planning and consideration for long-term actions. The mapper includes data for 2050 and 2090 Intermediate, and Intermediate-High scenarios.

7. Protected Lands

Federal and state protection of marshes is another factor to consider in context of potential access, support, and timeframes for planning and implementing tidal marsh adaptation projects. The project team and stakeholders predict a greater likelihood of implementing near-term tidal marsh

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[6] The Chesapeake Geoplatform is available here https://data-chesbay.opendata.arcgis.com/documents/f9d2744b0b09434bac45033d0eb3390b/about.

adaptation projects on federal and state-owned lands. Privately owned lands might be considered for more long-term tidal marsh adaptation efforts such as conservation. Planning projects on privately owned lands likely require more time for managing conservation easements, acquisition, and/or land use transition that might be required. The specific protection designation requires consideration because several types, such as Maryland Wildlands and federal Department of Defense (DoD) lands, might have significant restrictions. Protected lands mapped for this project include Maryland's Department of Natural Resources (MD DNR) owned lands and easements, Maryland Environmental Trust easements, DoD land, and Virginia protected lands.

Analysis

Tier 1 data layers, formatted and symbolized according to the defined thresholds and categories, were mapped in an online web viewer, which was the starting point for development of the Tidal Marsh Adaptation Mapper (see Figure 4).

The project team examined areas that exhibited the following criteria based on data compiled for targeting to identify *areas of need*, from which focus areas would be selected:

Key criteria to identify areas of need:

- Approximately 1,000 acres or more of contiguous marsh, or multiple areas with smaller marsh acreage in proximity totaling approximately 1,000 acres
- Susceptible to 2050 or 2090 sea level inundation
- Designated as a targeted ecological area
- Vulnerable or at risk (rated very high or relatively high FEMA Risk Index)
- Adaptive capacity potential (based on MMCE data)

Additional criteria for analysis:

- Presence of some, if not all, extensive protected lands adjacent to or including marsh
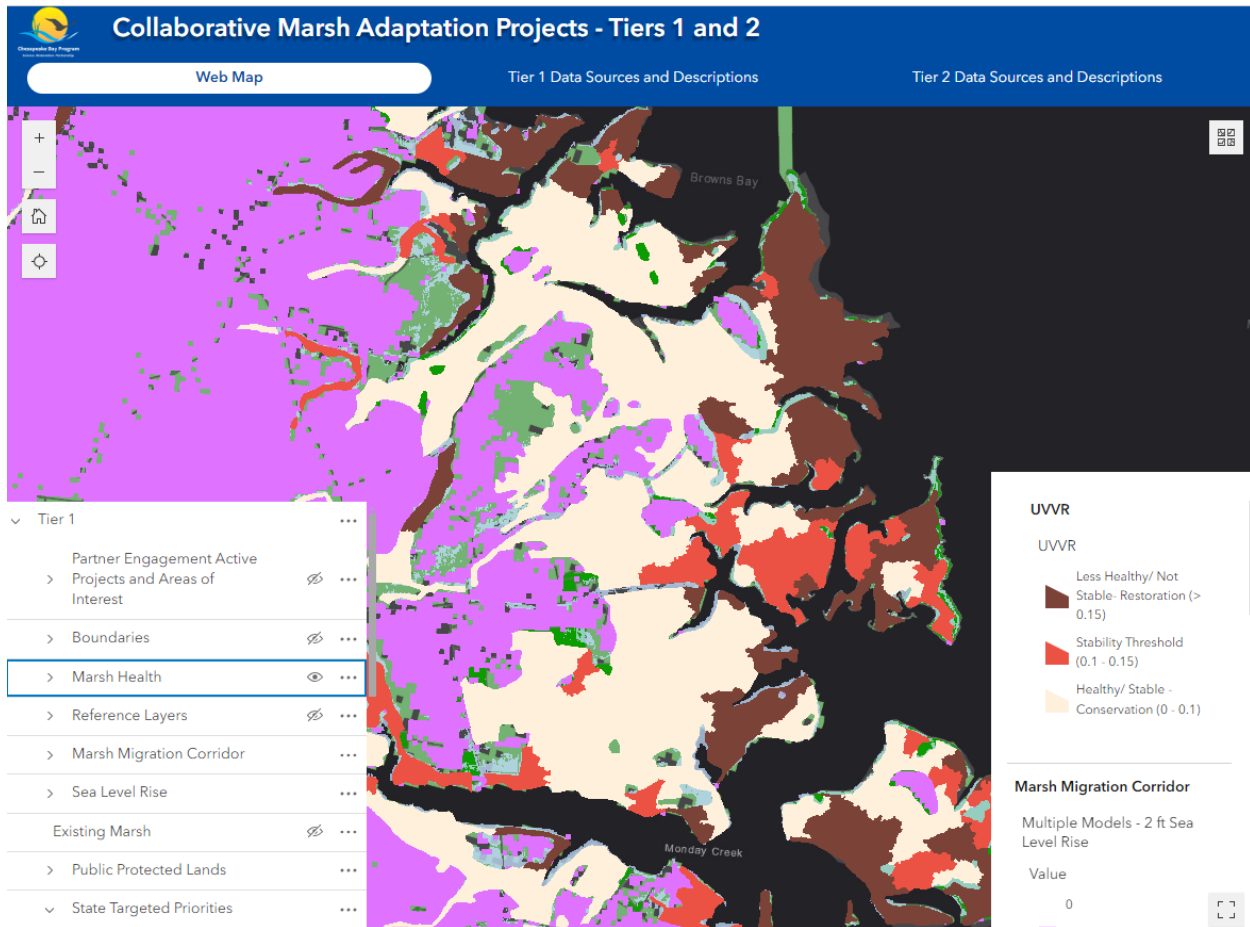- UVVR indicators near or below stability threshold

Figure 4. An image of the Tidal Marsh Adaptation Mapper displaying data layers identified for targeting marsh adaptation project focus areas in Phase 1.

Phase 2 Partner Alignment Mapping - Methodology

Overview

Through extensive stakeholder outreach in Phase 2, the project team collected information from regional experts and potential partners about tidal marsh adaptation priorities, challenges, and organizational interests, as well as geospatial data about existing and planned marsh adaptation projects across the project area (Maryland and Virginia). This information helped the team target geographic focus areas that are well positioned for marsh adaptation efforts, such as restoration and conservation projects, based on close alignment of data indicating areas of need (defined by resilience, ecological and social vulnerability criteria) with areas of partner interest and activity (as indicators of potential stakeholder and partner collaboration). Using this mapping and analysis approach, the team identified six potential focus areas in Maryland and Virgina--areas well-positioned for marsh adaptation projects (based on partner interest, activity, and subjective factors such as property attributes).

The team met with stakeholders and potential partners working in the six geographic areas to learn more about priorities, projects, and opportunities at the locations. The team presented considerations for each area to the steering committee to evaluate the overall compatibility of the potential locations with the goals of the project. Available funding for the Collaborative Tidal Marsh Adaptation Project necessitated narrowing the six potential focus areas to two – one in Maryland and one in Virginia – to continue supporting the development of the methodology and in-depth discussions in a workshop setting. The steering committee selected one location in each state that appeared to be the best fit for advancing to the workshop based on the process described below in the Analysis section.

The process for targeting focus areas for tidal marsh adaptation included the following steps:

1. Conduct outreach to stakeholders and potential partners using a questionnaire to identify organizational priorities and activity across tidal marshes in Maryland and Virginia.
2. Map location of stakeholder and partner activity, areas of interest, and opportunities in Collaborative Tidal Marsh Adaptation Mapper.
3. Perform a visual analysis within project area to identify areas of need that overlap with areas identified by partners as opportunity areas for marsh adaptation projects (results in potential focus areas).
4. Conduct additional outreach with stakeholders and partners and evaluate supplemental regional and local information to select two focus areas (selection of two not critical to methodology; necessary for current project due to available funding).

Outreach

The project team conducted stakeholder outreach using a questionnaire and small group and individual discussions to gather information about partner organizations' activities, expertise, and priorities around marsh adaptation in Chesapeake Bay, including marsh restoration, conservation, preservation, creation/migration, and management. Information compiled through the outreach created a comprehensive geographic representation (at the time) of locations where marsh adaptation project and research activities are planned, underway, and/or deemed critical for near term consideration and

adaptive measures. The outcomes of stakeholder outreach informed data analysis and the identification of regional focus areas where marsh adaptation efforts are needed.

Small group meetings with stakeholders were conducted to gather specific regional and local input. Outreach focused on potential partners, who provided more specific information about their organizational priorities (specifically around habitat, resilience, and community) to help the project team consider potential alignment between projects, partners, and funding opportunities in the six potential focus areas. Participants also recommended additional data sources associated with the priorities and specific locations to integrate in the mapper, and shared knowledge about local and regional partnerships, programs and initiatives, regulatory challenges, community capacity, funding considerations, additional stakeholders, and other valuable information to inform focus area selection.

See *Stakeholder Outreach Summary* in the Appendix for a detailed summary of outreach activities.

Data

During this phase, partner data was refined and integrated in the Tidal Marsh Adaptation Mapper to visualize spatial alignment between geographic areas of partner interest and activity with areas of need. The partner data collected during Phase 2 outreach (questionnaires and small group meetings) enabled the team to map 1) partner organizations or agencies currently working on projects (planning, implementation, or research activities), 2) areas where partners have identified need (based on their understanding of the communities, issues and/or conditions) or where partners are interested in working, and 3) areas where projects are underway and areas where need and partner interest have been indicated. The data collected from partner outreach and workshop findings[7] were then mapped according to:

- Location and type of activity
- Number of partners working at each location
- Specific partner working boundaries (i.e., VDWR property, Elizabeth River Watershed)
- Partner collaboration areas of focus (i.e., York River Roundtable/Middle Peninsula)

Analysis

Using the Tidal Marsh Adaptation Mapper, the project team examined areas that exhibited the following criteria to identify areas of need:

- Approximately 1,000 acres or more of contiguous marsh, or multiple areas with smaller marsh acreage in proximity totaling approximately 1,000 acres
- Susceptible to 2050 or 2090 sea level inundation
- Designated as a targeted ecological area
- Vulnerable or at risk (rated very high or relatively high FEMA Risk Index)
- Adaptive capacity potential (based on MMCE data)

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[7] The findings and outcomes of several collaborations such as the Wetland Workshop and Large-Scale Marsh workshop, which include specific locations for priority tidal marsh projects, were published after the initial research reviews conducted during Phase 1.

Additional criteria for consideration:

- Presence of some, if not all, extensive protected lands adjacent to or including marsh
- UVVR indicators near or below stability threshold

The team conducted a visual analysis to identify areas of need based on the above criteria and revealed overlapping locations with partner areas of interest and activity (see Figures 5, 6, and 7). The overlap of these criteria indicates potential opportunities for large-scale marsh adaptation projects. The team examined the scale and relationship between data to assess potential for marsh migration, locate opportunities for reducing social vulnerability, and consider alignment between stakeholders' priorities.

Overarching considerations for targeting potential focus areas within the areas of need included:

- Balance of urban versus rural areas
- Larger connected marsh networks versus smaller fragmented marshes
- Partner capacity to support existing work or expand into new areas
- Locations where partners are already working versus locations that need partnership building
- Mix of partner project types including migration, restoration and conservation projects and research needs
- Potential of management targets for both short term and long term (based on SLR) with long term potential
- Increased focus on areas with less resources such as funding and partner capacity
- Increased focus on areas that are the most vulnerable, according to FEMA National Risk Index score of Moderate and above

Although these considerations might differ across other projects, the methodology can be adapted and applied to target areas for marsh adaptation.

Focus Area Selection

A high-level visual comparison of adaptive capacity, ecological indices, social vulnerability, and partner activity across potential focus areas was created as a starting point for discussion with steering committee members to evaluate the options (see Figure 5). A low, medium, or high designation was assigned based on the presence of each data factor (see Figure 15). Considerations, pros, and cons for each of the potential focus areas were also documented, which informed the selection of the two focus areas to advance for additional support before and during the workshop.
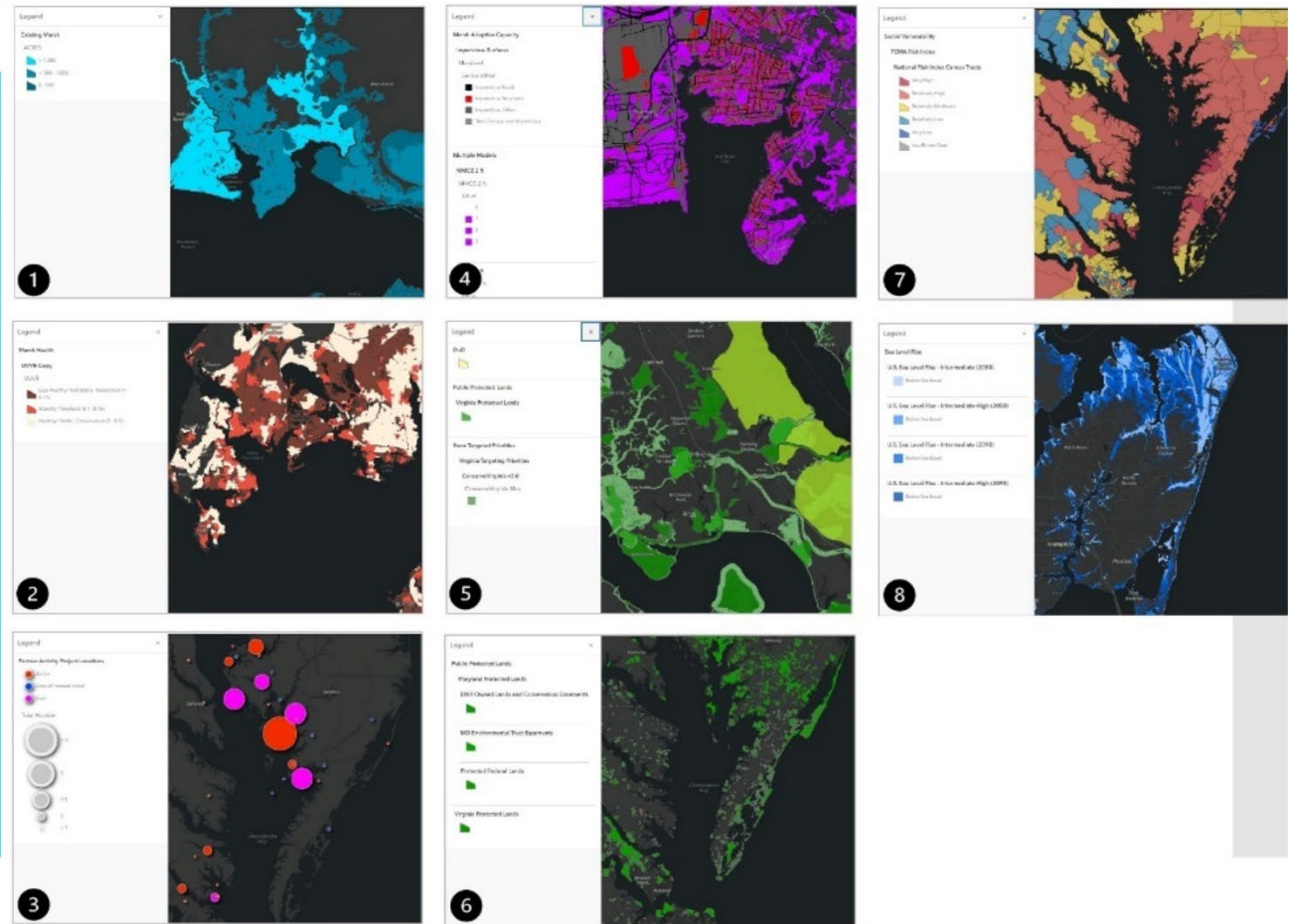
Figure 5. Example images to demonstrate visual analysis approach for targeting (see Project Approach and Focus Area Selection Presentation to Steering Committee, August 2, 2023, *in the Appendix). Individual map images can be found in the Appendix section:* Focus Area Visual Analysis High Resolution Images*.*

Phase 2 Partner Alignment Mapping - Project Findings

Phase 2 Outreach (Partner Questionnaire) Findings

The first outreach activity in Phase 2, a questionnaire, collected information from regional experts and potential partners about tidal marsh adaptation priorities, challenges, and project interest/activity locations across Maryland and Virginia. This information was gathered to supplement knowledge about tidal marsh areas identified as areas of need to increase the project team understanding of potential opportunities for marsh adaptation projects. The questionnaire results are summarized below (see *Stakeholder Outreach Summary* in Appendix for detailed information).

Twenty-one representatives from twenty organizations across Maryland and Virginia participated in the Tidal Marsh Adaptation Project questionnaire to provide information about their organizations' activities, expertise, and priorities around marsh adaptation in Chesapeake Bay. Participants represented federal, state, and regional government or quasi-government agencies, non-governmental organizations, academic and research institutions, and private practitioners actively engaged in tidal marsh activity in the Chesapeake Bay. Results are briefly described below.

Research and/or Restoration

Of the respondents, 57% focus more on implementation projects, and 43% focus on research, with a 24% deviation. Most respondents participate in a mix of activities between 25-80%, revealing a significant amount of overlap among those working on tidal marsh adaptation related efforts.

Potential Partners Areas of Activity and Interest

Respondents shared locations where their organizations focus and/or currently work, as well as locations where they are actively working on or focusing on marsh adaptation projects. Many of the locations identified by partners in Maryland and Virginia appear in clusters around areas most vulnerable to sea level rise where significant projects are in planning phases or underway, such as Crisfield, Maryland and Middle Peninsula, Virginia. See Figures 6 and 7 for preliminary mapping of partner activity.

Current Projects

Participants shared information about current projects, including locations, partners, and the types of services they are providing. The projects can be identified by GIS coordinates and data that includes the project name, partners working on the project, and phase (planned or active) on the Tidal Marsh Adaptation Mapper. The project types shared by respondents represent a range of marsh adaptation efforts, including:

- Shoreline stabilization
- Wetland restoration
- Plan development and policy guidance for wetlands restoration and marsh conservation
- Blue carbon and resilience crediting feasibility assessment
- Partnership building/collaborative planning events, programs, and workshops
- Community outreach, education, and support
- Marsh resilience and oyster population support through reef ball deployment
- Data pooling and evaluation

- Decision support tool development
- Large scale invasives treatment

Partnerships and Collaborations

Stakeholders are working across organizations and geographic boundaries to advance marsh adaptation in the Chesapeake Bay. Questionnaire participants represent 26 partners and programs, including federal and state agencies, coastal municipalities, research institutions, and non-profit organizations. Respondents indicate they are also involved in 21 collaborative working groups focused on regional areas and interests across the Bay. A complete list of collaborations, partners, and programs is available in Appendix H.

Types of Tidal Marsh Adaptation Services

Participant organizations provide a variety of services and a range of expertise around tidal marsh adaptation. Most respondents selected multiple types of project activities, ranked by popularity:

1. Multi-disciplinary marsh adaptation partnerships or other collaborative efforts
2. Community-focused education, engagement, or technical assistance
3. Marsh adaptation research or education
4. Shoreline protection or reinforcement projects
5. Marsh restoration or enhancement
6. Marsh protection, maintenance, or management
7. Policy focus (land use, development, environment)
8. Land acquisition or easements for conservation or protection
9. Mitigation credit banking (carbon, stormwater, other)
10. Infrastructure improvements
11. Monitoring or evaluation of marsh adaptation projects
12. Additional responses included:
    - Elementary education programs
    - Projects that overlap with marsh protection and human impacts in these environments (Sika deer hunting, reducing trash)
    - Evaluation of function and co-benefits of shoreline structures
    - Thin layer sediment placement and monitoring
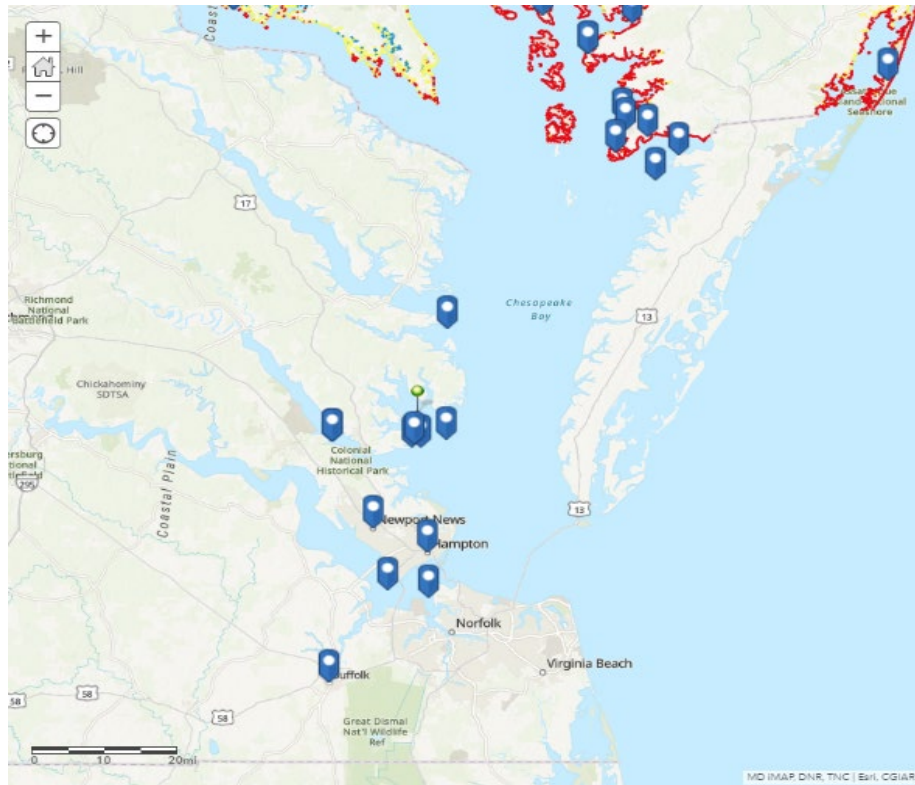   - Living shoreline financial and technical assistance and contractor/ agency training.
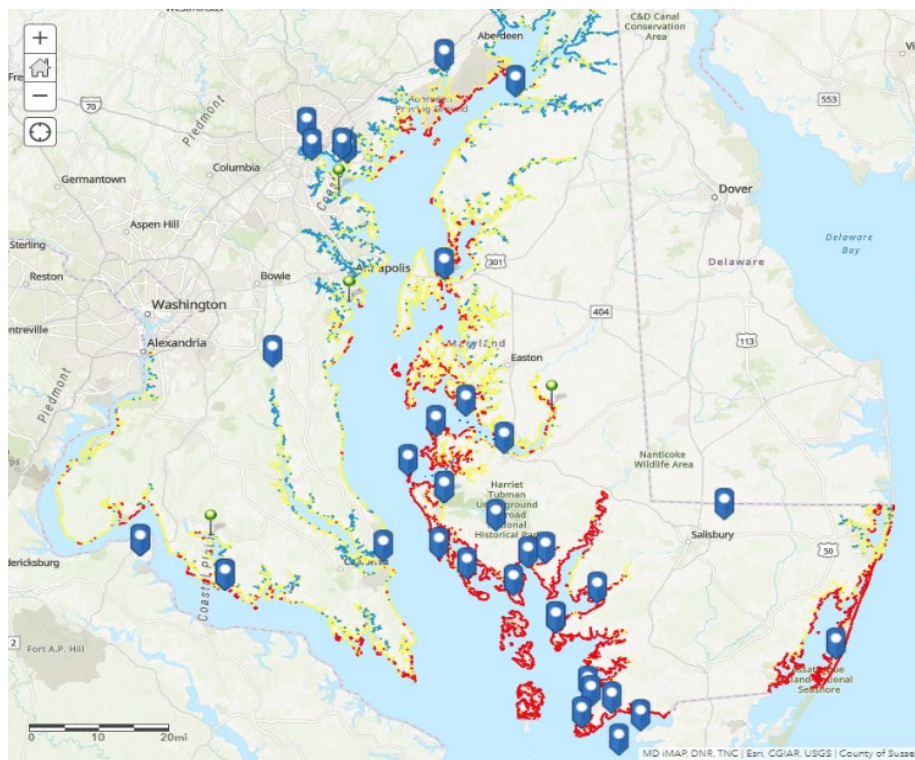
Figure 6. Virginia area of activity and focus

Figure 7. Maryland area of activity and focus, shown with MD Coastal Resiliency Assessment Shoreline Hazard Index

Phase 2 Data Analysis (Focus Area Identification) Findings

This information helped the team target geographic focus areas that are well positioned for marsh adaptation efforts, such as restoration and conservation projects, based on close alignment of data indicating *areas of need* (defined by resilience, ecological and social vulnerability criteria) with areas of partner interest and activity (as indicators of potential stakeholder and partner collaboration). Using this mapping and analysis approach, the team identified six potential *focus areas* in Maryland and Virgina-- areas well-positioned for marsh adaptation projects (based on partner interest, activity, and subjective factors such as property attributes).

The team met with stakeholders and potential partners working in the six geographic areas to learn more about priorities, projects, and opportunities at the locations, and presented considerations for each of the six focus areas to the steering committee for selection of two focus areas to advance for the Tidal Marsh Adaptation Project Workshop.

Potential focus areas were selected based on alignment of resilience, ecological indices, and social vulnerability criteria with locations characterized by partner interest/activity and other attributes (e.g., protection status, ownership, contiguous marsh acreage) deemed conducive to planning and implementing marsh adaptation projects. Stakeholder outreach conducted by a questionnaire and small group meetings provided input on partner priorities for tidal marsh restoration, research, and resilience goals including targeted areas, geographic information of ongoing and planned projects, and the purpose of restoration efforts. Through the feedback provided from stakeholders, the project team identified six regional focus areas conducive for marsh adaptation projects within Maryland and Virginia using the data factors that aligned with marsh adaptation opportunities (Figure 8). These six identified areas include:

1. Choptank River, MD
2. Wicomico River (Monie Bay to Deal Island, MD)
3. Pocomoke Sound Area (Crisfield, MD to Saxis, VA)
4. Middle Peninsula, VA
5. Middle Peninsula Tribal Lands (Mattaponi, Pamunkey)
6. Elizabeth River Watershed (Norfolk, Portsmouth, Chesapeake, Suffolk), VA

Figure 8. Map of six focus areas identified during Phase 2.

Considerations for the focus area targeting included:

- Wicomico River, MD
  - High level of existing partner activity (dredging Lower Wicomico and beneficial placement for wetland restoration at Deal Island)
  - Extensive protected lands adjacent to potential marsh migration areas
  - Significant SLR projections indicate value of marsh migration inland toward population center
- Middle Peninsula, VA
  - High level of partner activity; wetland action plan recently released
  - Small to medium scale marshes
  - Extensive protected lands and state targeted conservation areas
  - Includes extensive DOD land, active REPI projects focused on protection
- Choptank River, MD
  - Engaged local and regional partners (Envision the Choptank)
  - Smaller, disconnected marshes
  - Lower SLR projections inland, extensive marsh migration opportunities position area for potential persistent marsh
  - Migration potential surrounding Cambridge might increase resilience for vulnerable community
- Pocomoke Sound Area (Crisfield, MD to Saxis, VA)
  - High level of partner interest, particularly for habitat value (SAV)
  - Extensive protected lands and state targeted conservation areas (over 5,000-acre WMA in Saxis area)

- o Extensive potential marsh migration area and significant SLR projections (important short-term and long-term considerations)
- Middle Peninsula Tribal Lands (Mattaponi, Pamunkey)
  - o Tribal communities located in tidal area
  - o Protected marshes nearby
  - o Capacity building likely needed to support projects connected to tribes
- Elizabeth River Watershed (Norfolk, Portsmouth, Chesapeake, Suffolk), VA
  - o Pockets of highly vulnerable populations (environmental justice factors, Superfund sites, active industrial)
  - o Small to medium marshes, heavily developed, densely populated
  - o Local capacity with strong track record; engaged city partners, local organizations, private (corporate) partners
  - o Opportunity to support several smaller projects for large-scale impact

Figures 9 through 14 illustrate the Tier 1 criteria used for visual analysis to support the identification of the six focus areas with marsh adaptation needs. *See Project Approach and Focus Area Selection Presentation to Steering Committee, August 2, 2023,* in the Appendix for more details.
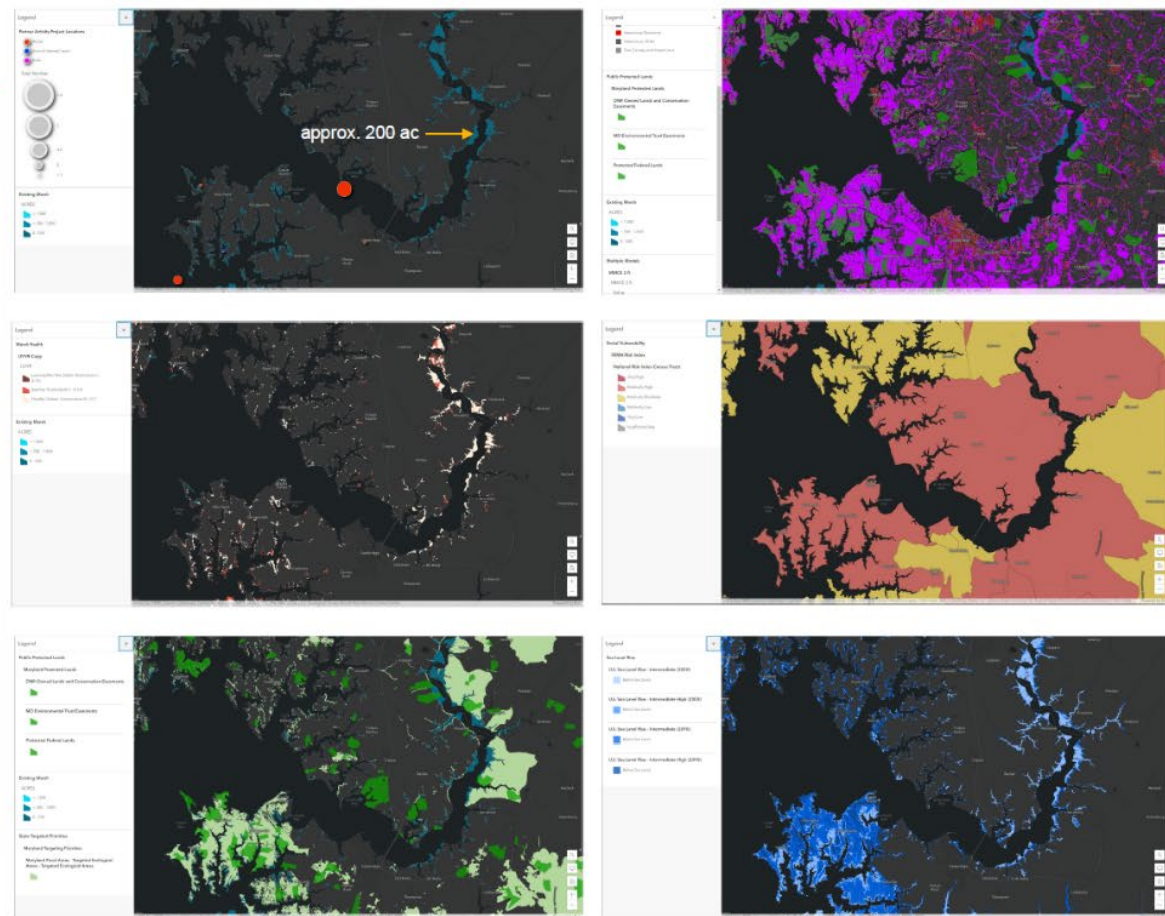
Figure 9. Choptank River, MD mapper image showing Tier 1 criteria for targeting marsh adaptation focus areas. Individual map images can be found in the Appendix section: Focus Area Visual Analysis High Resolution Images*.*

2. Wicomico River-Monie Bay, MD
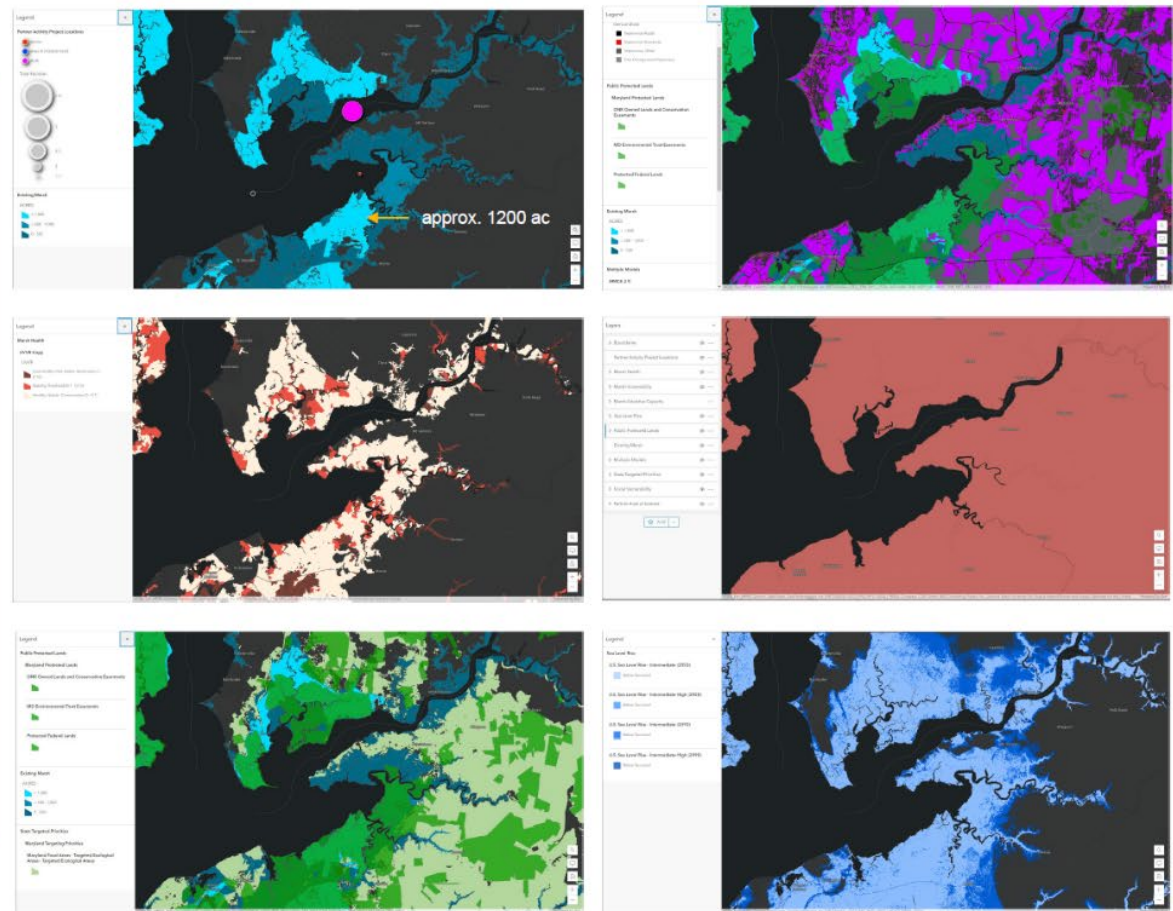### Tier 1 attributes

Figure 10. Wicomico River-Monie Bay, MD mapper image showing Tier 1 criteria for targeting marsh adaptation focus areas. Individual map images can be found in the Appendix section: Focus Area Visual Analysis High Resolution Images.
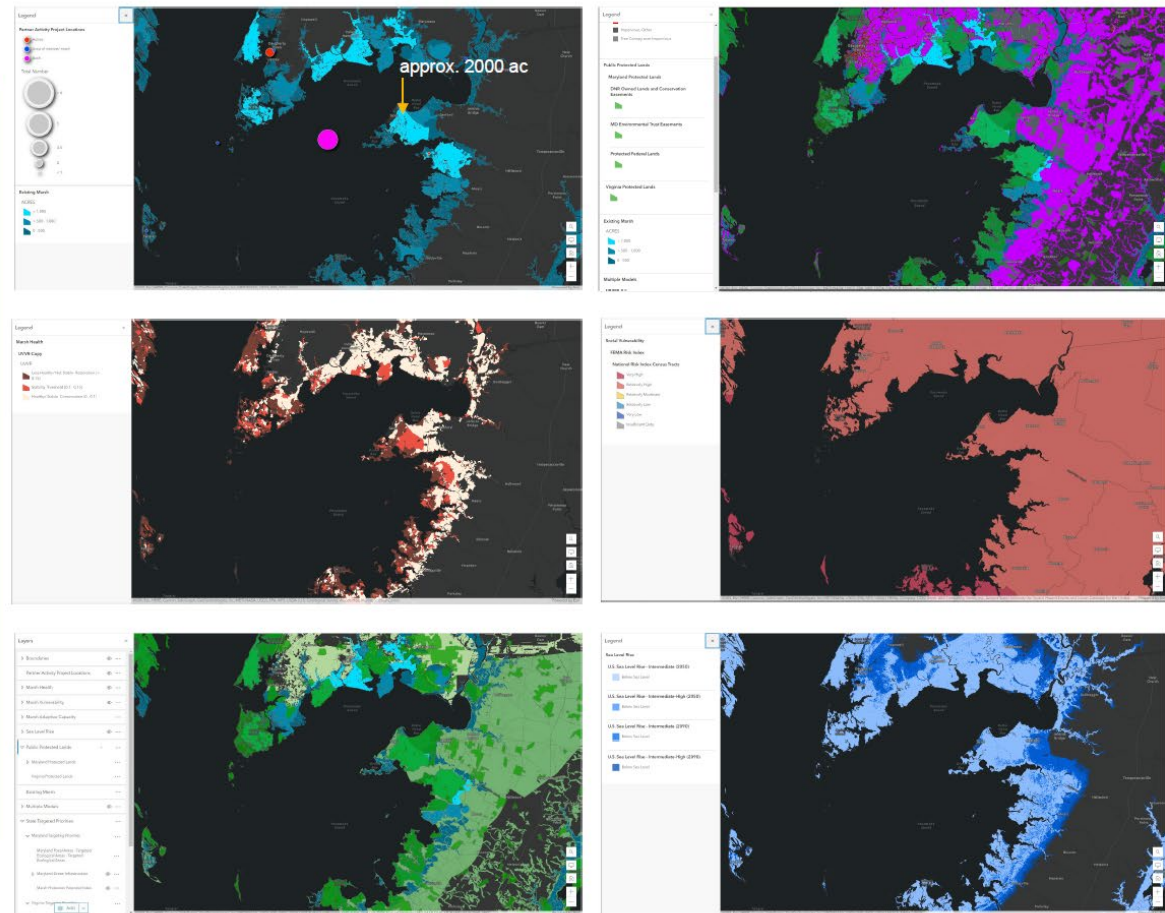
3. Pocomoke Sound, MD-VA
Tier 1 attributes

Figure 11. Pocomoke Sound, MD-VA mapper image showing Tier 1 criteria for targeting marsh adaptation focus areas. Individual map images can be found in the Appendix section: Focus Area Visual Analysis High Resolution Images.

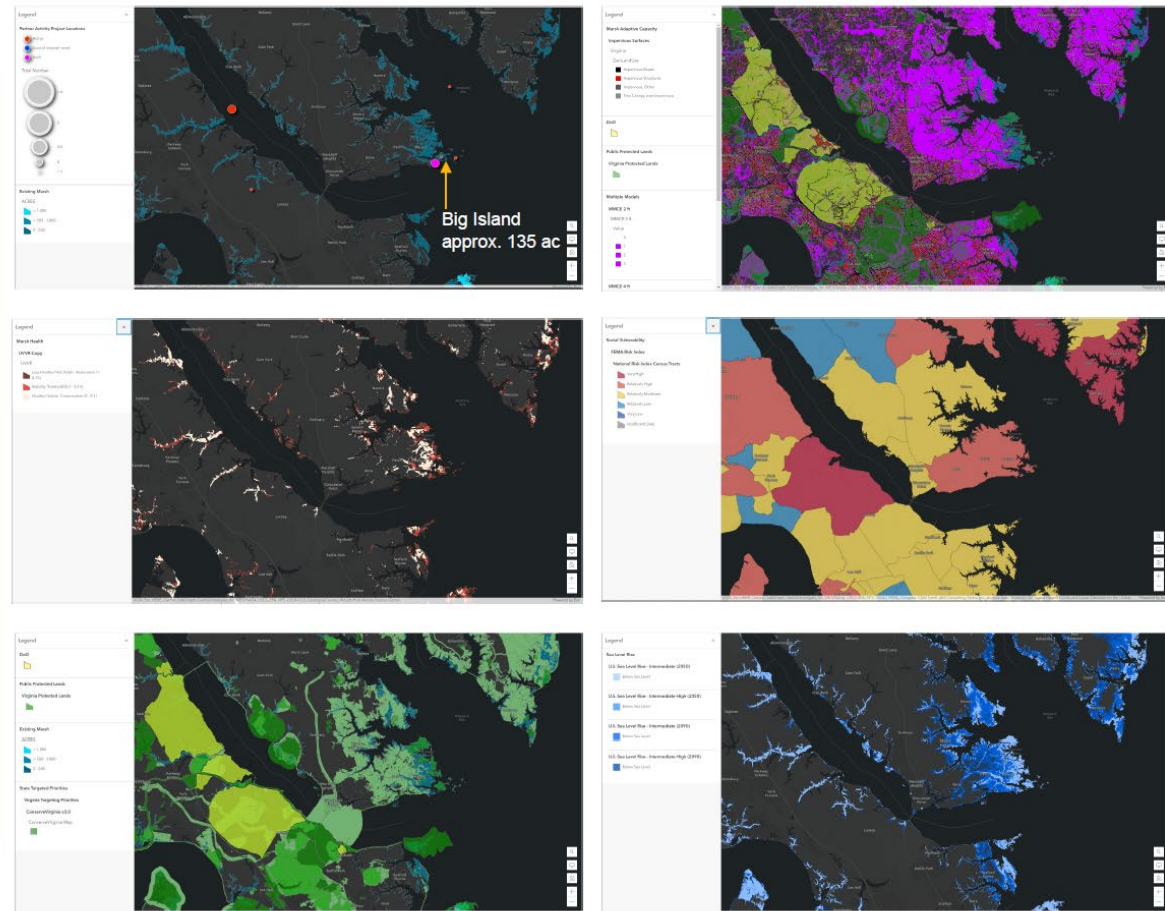## 4. Middle Peninsula, VA
Tier 1 attributes

Figure 12. Middle Peninsula, VA mapper image showing Tier 1 criteria for targeting marsh adaptation focus areas. Individual map images can be found in the Appendix section: Focus Area Visual Analysis High Resolution Images.

5. Pamunkey, Mattaponi Rivers (Tribal land), VA
Tier 1 attributes

Figure 13. Pamunkey, Mattaponi Rivers, VA mapper image showing Tier 1 criteria for targeting marsh adaptation focus areas. Individual map images can be found in the Appendix section: Focus Area Visual Analysis High Resolution Images.

6.
Elizabeth River Watershed (Norfolk, Portsmouth, Chesapeake, Suffolk), VA
Tier 1 attributes

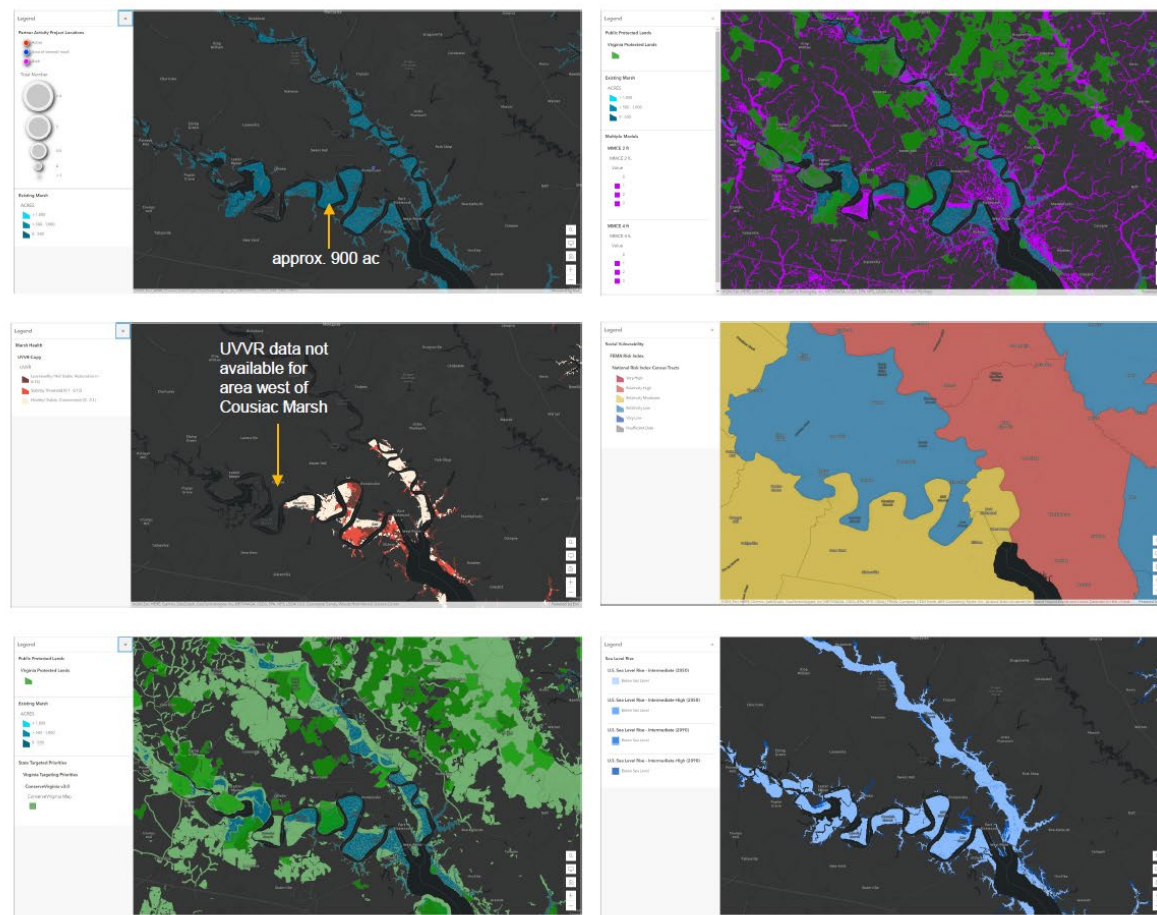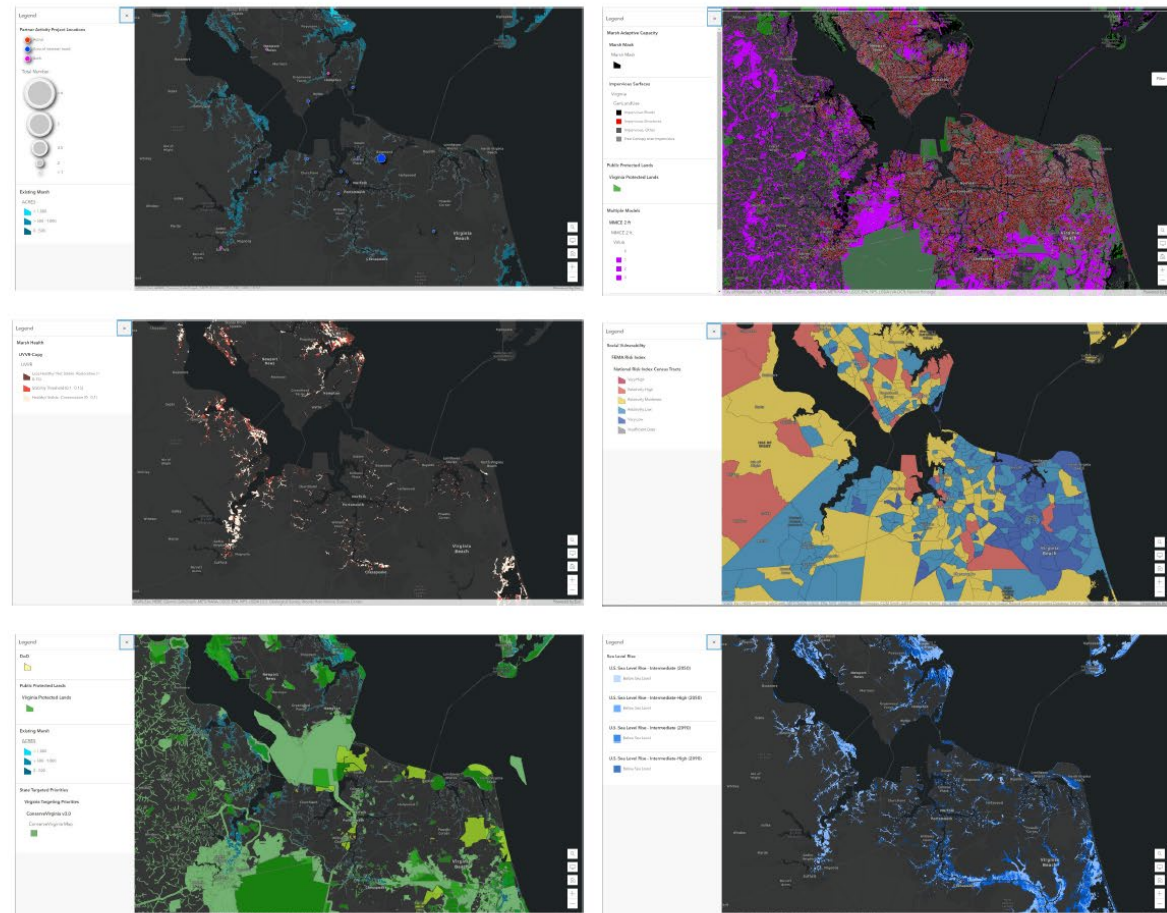Figure 14. Elizabeth River Watershed, VA mapper image showing Tier 1 criteria for targeting marsh adaptation focus areas. Individual map images can be found in the Appendix section: Focus Area Visual Analysis High Resolution Images.

Phase 2 Outreach (Small Group Meetings) Findings

Discussions with stakeholders and work groups working in potential focus areas helped the team gather additional information about potential alignment of the areas' opportunities, characteristics, and capacity considerations with the goals for the Tidal Marsh Adaptation project to guide the selection of two areas for the workshop. Work group meetings included a presentation of the mapper to glean information about additional data suggestions and input for improvements and application.

Social Vulnerability small group meeting

A discussion with stakeholders around social vulnerability provided input about important social vulnerability metrics and considerations for prioritizing tidal marsh adaptation activity in coastal communities across the Bay. Participants discussed the focus areas and suggestions for additional resources (tools, metrics) to support engagement with communities and local leaders as the project moves forward. Additional criteria suggested includes: One, sparsely populated, remote communities on front line of SLR (lacking resources of nearby population centers); two, culturally important places of importance to African American communities in MD, and VA (NPS has a project underway to identify locations), and three, vulnerable infrastructure such as water treatment facilities and transportation infrastructure that can add further risk to vulnerable populations if damaged by flooding. Participants also shared specific suggestions about more localized tools such as the Elizabeth River Project EJ Mapper and state road flooding resources.

Elizabeth River Project (ERP/Joe Reiger small group meeting)

In consideration of selecting focus areas, the meeting was planned to gather information from Joe Reiger with ERP to learn more about activities, projects and opportunities in Elizabeth River Watershed and surrounding areas relevant to tidal marsh adaptation management. ERP leads active programs within the watershed include educational outreach, Paradise Park, Learning Barge, Ryan Resilience Lab, and restoration projects (living shorelines, buffers, and reefs). A recent HUD grant of $135 million supports living shoreline implementation near underserved communities. Joe identified the significant opportunities presented by large industrial facilities, many of which are owned by corporations that support and invest in adaptive practices. Additional reasons suggested for prioritizing Elizabeth River watershed as a focus area:

- The City of Norfolk is a progressive partner for Green Infrastructure.
- Strong base of partners and stakeholders committed to innovative technologies.
- Strong performance track record.
- Local capacity.
- EJ and vulnerable communities on frontline of Superfund sites and SLR.

Virginia Department of Wildlife Resources/Ben Sagara small group meeting

Ben Sagara, wetland biologist with Virginia Department of Wildlife Resources (DWR) provided information about current tidal marsh adaptation activities and opportunities in Virginia focused on wildlife management areas. Ben shared suggestions for potential large-scale marsh adaptation projects:

- Idea 1: Saxis. Partners include CBP, Delmarva and TNC, and DWR could be restoration project sponsor. Currently no large plan in marsh; ghost forests are starting, and land is sinking. Offers opportunity to facilitate marsh migration because DNR owns land along marsh.

- Idea 2: Guinea Marsh. Working with Andrew Larkin/NOAA and Rachael Peabody (VRMC) Opportunity for thin layer placement project using GM as possible pilot to raise elevation and do shoreline protection on leading edge. Strong NE winds in winter hammer the shoreline causing erosion.
- Idea 3: Island creation like Poplar Island in VA where a large shorebird colony has been moved to barge near Hampton Bay Bridge Tunnel for nesting habitat; aligns with ACOE goals for beneficial reuse of dredge.
- Idea 4: Acquisition opportunities along inland waterways for increasing resilience.

Other suggestions include working with Department of Defense (DOD) which manages extensive land along Virginia coastline near wildlife management areas, as well as advancing thin-layer placement projects in Virginia.

Envision the Choptank Work Group meeting
Envision the Choptank work group, which is still working on regional mapping and prioritization, suggested ShoreRivers has identified potential projects that might align with tidal marsh adaptation efforts.

Fish Habitat Work Group
The Fish Habitat Work Group expressed strong support for selecting focus areas with contrasting community characteristics, land use and shorelines. Participants suggested prioritizing the Suffolk/Elizabeth River area, given the active engagement of stakeholders and widespread vulnerability characteristics. Additional input that informed the project included recommendations for fish habitat assessment data, which was integrated into the mapper, and outcomes of the Bay Enhancement Work Group (BEWG) analysis for Beneficial Use project locations, which provides context for considerations of beneficial use, a key topic in the workshop.

Phase 2 Analysis (Focus Area Selection) Findings
The project steering committee and stakeholders provided feedback on each of the six focus areas to select one for each state for further discussion in a workshop setting. Each of the options were compared and prioritized according to their adaptive capacity, ecological indices, social vulnerability, and partner activity. Additional considerations included the capacity and engagement of the local partners, the possibility of supporting large scale marsh projects, and infrastructure and development barriers (see Figures 15 and 16).

Wicomico River, Maryland and Middle Peninsula, Virginia were chosen based on the criteria and considerations evaluated during Phase 2 for further discussion in a workshop setting. Of the Maryland locations, the Wicomico River-Monie Bay area was selected because of the high level of existing partner activity (dredging Lower Wicomico and beneficial placement for wetland restoration at Deal Island), the extensive protected lands adjacent to potential marsh migration areas, and the significant SLR projections indicating value of marsh migration inland toward population centers.

Similarly, the Middle Peninsula region was selected among the Virginia locations because of the high level of partner activity (including a recently released collaborative wetland action plan), the presence of small to medium scale marshes, extensive protected lands and state targeted conservation areas, and

the proximity of extensive DoD land and active Readiness and Environmental Protection Integration (REPI) projects that focus on protection.
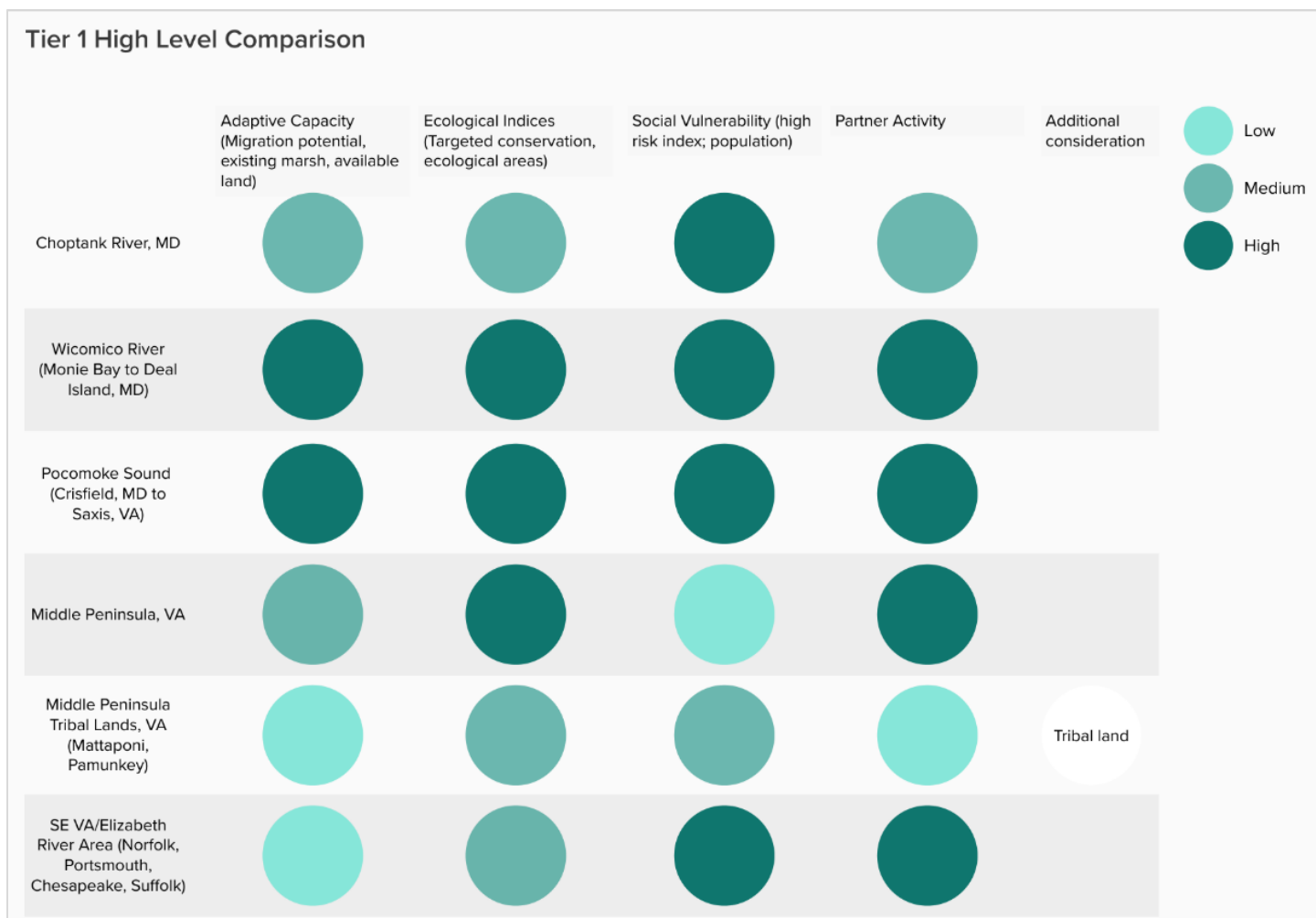

Figure 15. Focus Area Comparison

Focus Area Recap of Considerations

Focus Area	Considerations				Steering Committee - additional considerations and input				
Choptank River, MD	Engaged local and regional partners (Envision the Choptank)	Smaller, disconnected marshes	Lower SLR projections inland, extensive marsh migration opportunities position area for potential persistent marsh	Migration potential surrounding Cambridge might increase resilience for vulnerable community	More urban setting, could focus more on the community angle	Higher SLR vulnerability in MD than many areas	Higher social vulnerability because larger population	NG: USGS data suggests this is the least vulnerable area in terms of UVVR and lifespan	
Wicomico River (Monie Bay to Deal Island, MD)	High level of existing partner activity (dredging Lower Wicomico and beneficial placement for wetland restoration at Deal Island)	Extensive protected lands adjacent to potential marsh migration areas	Significant SLR projections indicate value of marsh migration inland toward population centers		Area was brought up during the SeaGrant workshop	Could be a primer to the workshop to highlight current efforts	Potential to focus on conservation if UVVR is showing current healthy marsh	Higher SLR vulnerability in MD than many areas	Great options for restoring degraded interiors of peninsulas, especially because the seaward fringes appear intact. Suggests longer term success
Pocomoke Sound Area (Crisfield, MD to Saxis, VA)	High level of partner interest, particularly for habitat value (SAV)	Extensive protected lands and state targeted conservation areas (over 5,000-ac WMA in Saxis area)	Extensive potential marsh migration area and significant SLR projections (important short-term and long-term considerations)		TNC working on Transformational Habitat grant proposal	Additional opportunities/locations for projects outside of TNC TH grant focus	Appears to have the most "traditional" geomorphic layout, with degraded marshes on the seaward edge, and more intact marshes moving landward. Great candidate for conservation of upland corridors.		
Middle Peninsula, VA	High level of partner activity; wetland action plan recently released	Small to medium scale marshes	Extensive protected lands and state targeted conservation areas, and national park service land and state parks	Includes extensive DOD land, active REPI projects focused on protection	Recent wetland plan identifies opportunities	Poquoson Marshes might offer opportunity (Plum Tree Island NWR) - Gloucester has received most attention	In our analysis, we group this as the Rappahannock and York, which both have relatively high proportions of vulnerable marshes as compared to the other tributaries.		
Middle Peninsula Tribal Lands (Mattaponi, Pamunkey)	Tribal communities located in tidal area	Protected marshes nearby	Capacity building likely needed to support projects connected to tribes						
Elizabeth River Area (Norfolk, Portsmouth, Chesapeake, Suffolk), VA	Pockets of highly vulnerable populations (environmental justice communities, Superfund sites, active industrial)	Small to medium marshes, heavily developed, densely populated	Local capacity with strong track record; engaged city partners, local organizations, private (corporate) partners	Opportunity to support several smaller projects for large-scale impact	Significant infrastructure and development barriers	Large-scale marsh project not possible	This is the most vulnerable area in terms of UVVR and lifespan, with lowest tide-normalized elevation marsh plains.		

Figure 16. Steering Committee Focus Area Feedback

Phase 3 Identify Project Opportunities - Methodology

Overview

Phase 3 activity centered around identifying specific tidal marsh issues, opportunities, and adaptation approaches in each of the two focus areas to support proposed projects and identify potential projects. This effort included scenario modeling and facilitating working sessions with active practitioners working in the locations. The culminating project workshop built on these activities to explore specific steps toward advancing tidal marsh adaptation projects in the two focus areas.

Phase 3 included the following key activities:

1. Develop scenarios to identify marsh restoration and protection opportunities.
2. Conduct outreach with stakeholders actively engaged in focus areas to gather information about regional and local programs and initiatives connected to restoration and conservation of marsh and adjacent lands, review supplemental data sets and tools, integrate supplemental regional and local data (Tier 2 data), and gather input to inform workshop topics and format.
3. Meet with focus area stakeholders to review marsh adaptation scenarios for each focus area. During the review, discuss scenario outcomes (potential project areas and adaptation strategies) discuss implications or findings for projects currently in planning phases.
4. Refine scenario methodology and provide stakeholders with specific data support for project planning and funding applications.

Scenario Design

The team developed marsh adaptation scenarios based on two recently developed resources: a USGS geospatial synthesis analysis decision matrix[8] correlating elevation and UVVR to guide marsh adaptation actions (see Figures 17 and 18) and the NOAA Landscape Scale Marsh Resilience Framework[9] (see Figure 19). The scenarios and strategies approach is outlined in the presentation titled *Marsh Adaptation Scenarios and Strategies Presentation for Workshop* in the Appendix.

The project team refined and documented the scenario design methodology in a worksheet to help practitioners apply the scenario modeling approach in other locations to consider marsh protection and restoration strategies. See the *Scenario Design Worksheet* in Appendix.

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[8] USGS Coastal Wetland Synthesis Products and Tools for Chesapeake Bay. Neil Ganju, Kate Ackerman, and Zafer Defne, Woods Hole Coastal and Marine Science Center U.S. Geological Survey. For more information see: https://d18lev1ok5leia.cloudfront.net/chesapeakebay/documents/Ganju_CRWG_Oct22_revised.pptx.pdf
[9] For more information about the NOAA Landscape Scale Marsh Resilience Framework, see https://www.nerra.org/landscape-scale-marsh-resilience/
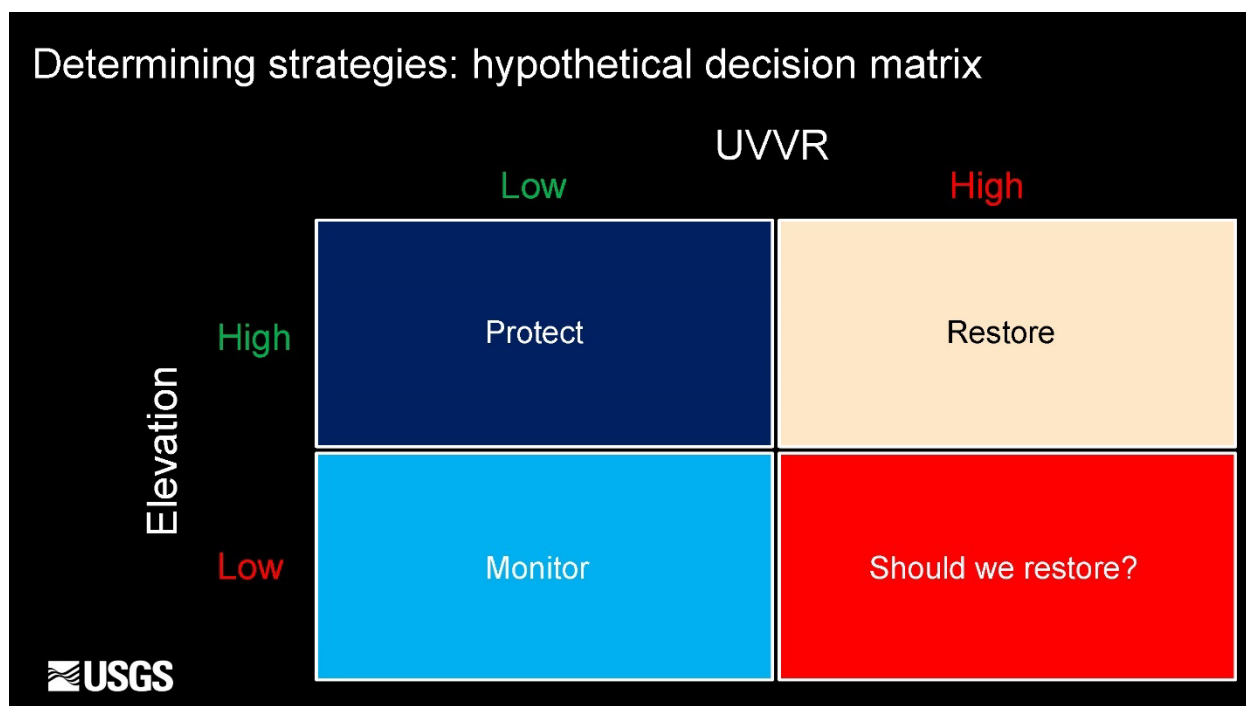
Figure 17. USGS geospatial synthesis analysis decision matrix correlating elevation and UVVR to guide marsh adaptation actions.
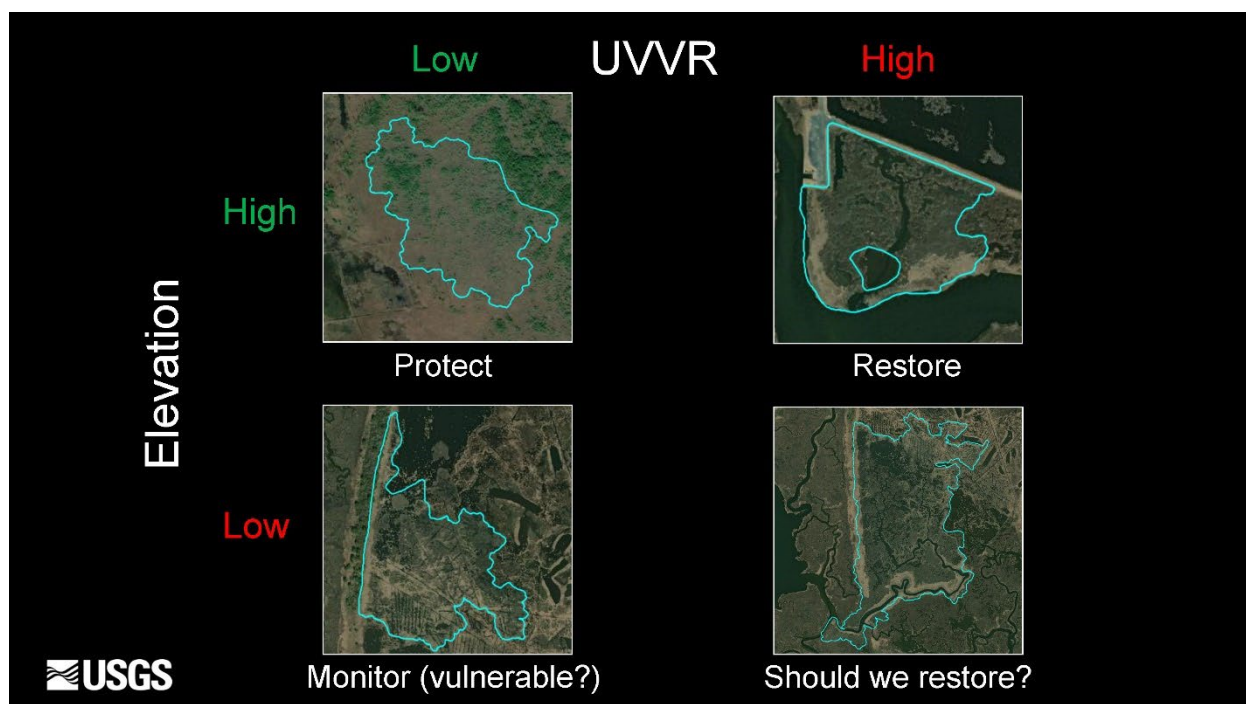

Figure 18. USGS geospatial synthesis analysis decision matrix correlating elevation and UVVR to guide marsh adaptation actions. USGS Coastal Wetland Synthesis Products and Tools for Chesapeake Bay. Neil Ganju, Kate Ackerman, and Zafer Defne, Woods Hole Coastal and Marine Science Center U.S. Geological Survey. For more information see:
https://d18lev1ok5leia.cloudfront.net/chesapeakebay/documents/Ganju_CRWG_Oct22_revised.pptx.pdf

Marsh Resilience Category			Interpretation		Management Options
Current condition	Vulnerability to sea level rise	Adaptive capacity			
High	Low	High	A marsh in good condition that will migrate inland naturally over the long-term.		Land protection or policy: Fee or conservation easement purchase of marsh or migration space. Managed relocation of structures in marsh or migration space.
High	High	High	A marsh in good condition that will adapt if it can out-pace current vulnerability to sea level rise.		Adaptation (sediment): Increase sediment supply to current marsh footprint though strategies like thin layer sediment placement and removal of barriers to hydrologic flow within the marsh.
High	Low	Low	A marsh in good condition that cannot maintain current footprint long-term without active management.		Adaptation (migration and land protection): Remove infrastructure or topographical barriers to inland migration. Protect marsh's current footprint.
High	High	Low	A marsh in good condition but also vulnerable to sea level rise and cannot maintain current footprint without active management.		Phased adaptation: Implement thin layer sediment placement, but only if barriers to inland migration are removed.
Low	High	Low	A marsh in poor condition marsh that will not persist in the future.		Test innovative science or abandon marsh: Limit investment in land protection or restoration activities as effectiveness will be relatively short-term.
Low	Low	Low	A marsh in poor condition not currently vulnerable to sea level rise, but cannot maintain current footprint without intervention.		Phased management (restore then adapt): Apply proven restoration techniques within current marsh footprint—e.g., invasive species management—but only if removal of barriers to migration are planned.
Low	High	High	A marsh in poor condition that has potential to migrate inland naturally, if it can out-pace sea level rise.		Phased management (restore then adapt): Apply proven restoration techniques within current marsh footprint that ideally also increase sediment supply to marsh, e.g. ditch remediation, tidal crossing restoration.
Low	Low	High	A marsh in poor condition that is not currently vulnerable to sea level rise and has potential to migrate inland naturally.		Restoration: Decrease current stressors to marsh e.g., *Phragmites* or invasive crab control. Mitigate water quality issues in surrounding watershed, e.g., reduce fertilizer application in residential and agricultural areas.

Figure 19. NOAA Landscape Scale Marsh Resilience Framework. For more information about the NOAA Landscape Scale Marsh Resilience Framework, see https://www.nerra.org/landscape-scale-marsh-resilience/

The two scenarios focus on protection and restoration:

Protection Scenario
Use data to identify *healthy marshes* that are susceptible to SLR and have the potential to migrate.

- Good Existing Marsh Integrity (UVVR)
- High Climate Change Risk (subject to SLR)
- High Adaptive Capacity (migration potential, public lands)

Indicator	Data Layer
High Marsh Integrity	UVVR
High Vulnerability to Sea Level Rise	Existing Tidal Marsh Layer NOAA Sea Level Rise Scenarios (2050 and 2090 Intermediate and Intermediate High) Sea Level Rise Inundation (NOAA) 2-4 ft
High Adaptive Capacity	Marsh Migration Models (MMCE) Protected Lands

Figure 20. Map image showing Protection Scenario example.

Restoration Scenario

Use data to identify *degraded marshes* that are susceptible to SLR and have the potential to migrate.

- Degraded Existing Marsh Integrity/Condition (UVVR)
- High Climate Change Risk (subject to SLR)
- High Adaptive Capacity (migration potential, public lands)

Indicator	Data Layer
Low Marsh Integrity	UVVR
High Vulnerability to Sea Level Rise	Existing Tidal Marsh Layer NOAA Sea Level Rise Scenarios (2050 and 2090 Intermediate and Intermediate High) Sea Level Rise Inundation (NOAA) 2-4 ft
High Adaptive Capacity	Marsh Migration Models (MMCE) Protected Lands

Marsh Health (UVVR) and Marsh Migration Corridor Envelope (2') with VA Protected Lands

UVVR
- Less Healthy/ Not Stable- Restoration (> 0.15)
- Stability Threshold (0.1 - 0.15)
- Healthy/ Stable - Conservation (0 - 0.1)

Marsh Migration Corridor
- Multiple Models - 2 ft Sea Level Rise

Virginia Protected Lands

1:54,093

0   0.35   0.7   1.4 mi

0   0.5   1   2 km

VGIN, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA

Map 4
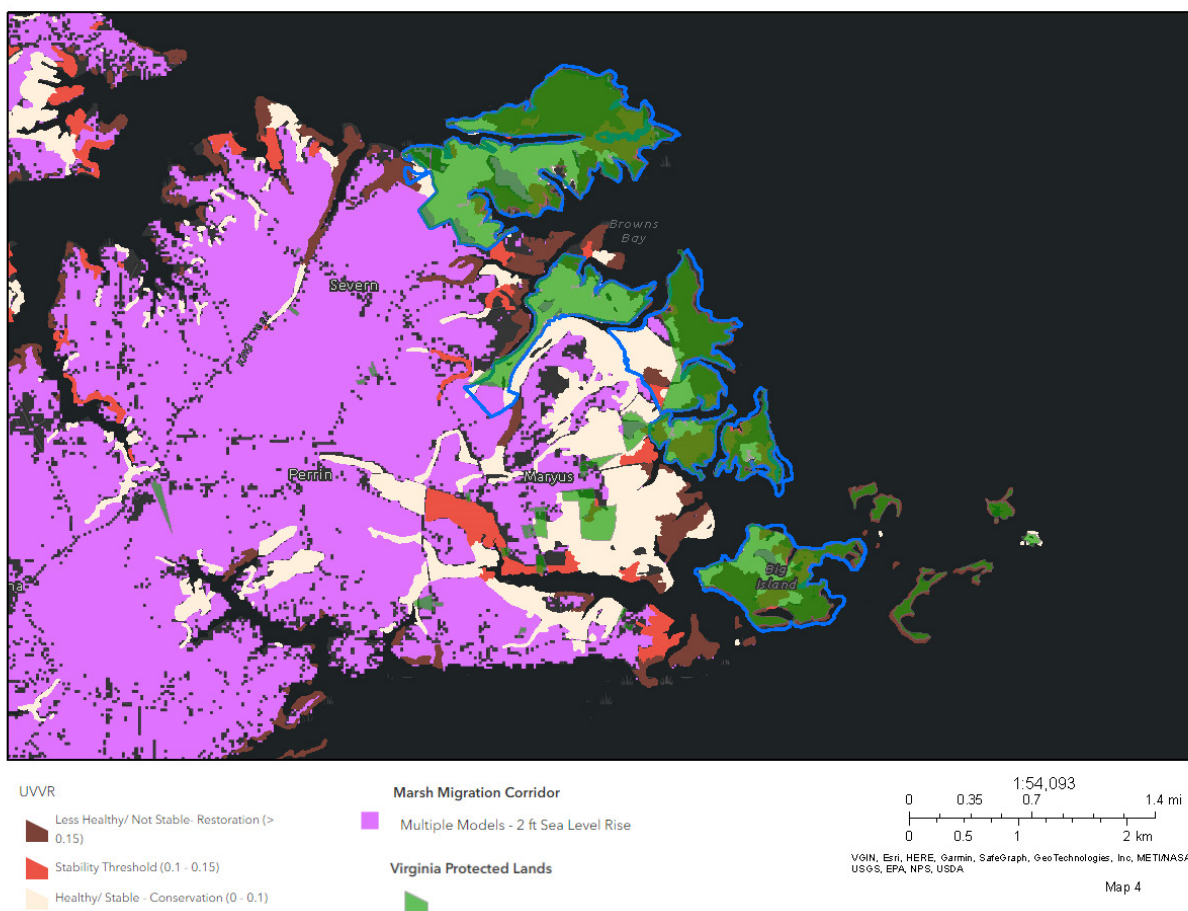
Figure 21. Map image showing Restoration Scenario example.

Social Vulnerability

Social vulnerability data is also considered to illustrate the increasing vulnerability of underserved communities as sea level rise leads to potential changes in land use, protection, infrastructure, and habitat. Relevant data to consider for social vulnerability include:

- Vulnerability/ Climate Change Risk
- Underserved Communities
- Adaptive Capacity
- Land Use
- Habitat

Indicator	Data Layer
Vulnerability	Sea level rise
Underserved Communities	VA EJ Screen FEMA Risk Index
High Adaptive Capacity	Marsh Migration Models (MMCE)
Land Use	Agriculture Development Forests
Habitat	Projected habitat transition, projected marsh change

FEMA Risk Index, NOAA SLR Int High (2050, 2090)

Figure 22. Map image showing Social Vulnerability example.

Outreach

A working session with experts actively planning marsh adaptation projects in a focus area provided hands-on experience using the mapper to access critical data for discussions and applying the marsh protection and restoration scenarios in areas where planning is underway. Input from participants helped the team refine the scenario design and understand opportunities to use the mapping and scenario design as resources to support proposals for funding.
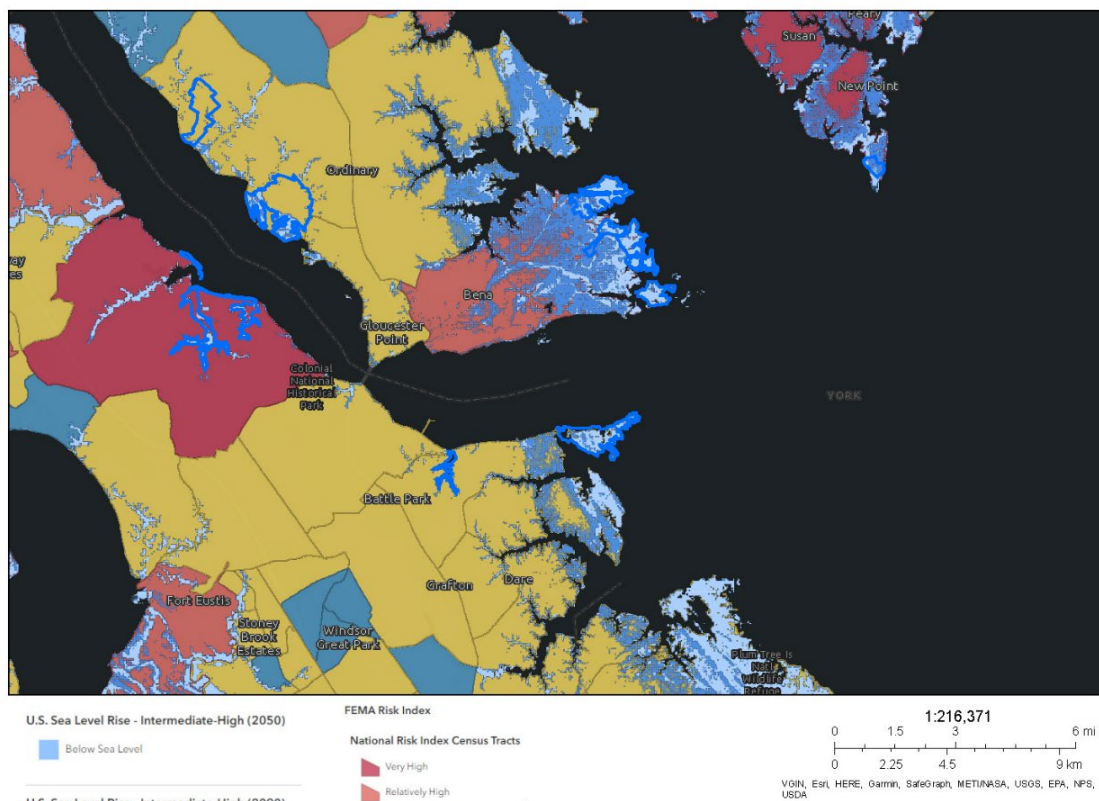
Additional meetings and conversations with stakeholders from each workgroup were conducted by phone and virtual meetings to identify additional data sets to support specific interests of potential partners working in the areas (i.e., fish habitat data) and tools that might be considered along with the Tidal Marsh Adaptation Mapper, such as the VIMS Nearshore Oyster Restoration Siting and Prioritization Tool, to provide additional insight in evaluating potential project opportunities.

Data Analysis

During this phase, Tier 2 data (supplemental regional datasets such as detailed site conditions, habitat features, and land attributes) was assembled to support analysis of potential projects and partnerships. Additions also included data relevant to proposed and planned projects near the potential focus areas. These additional datasets were integrated to identify projects aligned with specific opportunities, such as habitat priorities and funding tools, and to consider marsh adaptation scenarios based on restoration or protection needs. A list of all Tier 2 data layers can be found in the *Data Layer Spreadsheet* in the Appendix.

Using the marsh adaptation scenarios from Phase 1 and 2 and the Tier 1 and Tier 2 data in the mapper, worksheets were developed for the two focus areas to aid in the identification of marsh adaptation project related to restoration and protection opportunities prior to the workshop. See the *Guinea Marsh Complex Scenario Worksheet and Summary* and the *Wicomico River Area Scenario Worksheet and Summary* in the Appendix to review how the scenarios design was applied to the two focus areas.

Phase 3 Identify Project Opportunities - Project Findings

Phase 3 Data (Tier 2 Data) Findings

During Phase 3, the team examined additional regional data and tools suggested by stakeholders to date to supplement the research and data review, data compilation, and GIS mapping relevant to identifying marsh adaptation opportunities in the two focus areas. The following second tier data was assembled and integrated into the Tidal Marsh Adaptation Mapper. Tier 2 data includes:

Layer Group Name	Data Layers
Adaptative Capacity	MD Wetland Adaptation Areas
	Marsh Migration-SLAMM - 2' and 4'
	Marsh Migration-Invest - 2' and 4'
	Marsh Migration-NOAA SLR - 2' and 4'
Boundaries	Chesapeake Bay National Estuarine Research Reserves
	VA Locations of Oyster farms
Coastal Protection	MD Historic Shorelines
	MD Shoreline Inventory
	MD Coastal Resiliency Assessment: Marsh Protection Potential Index
	MD Flood Prevention Ecosystem Services Layer
	VA ERP Shoreline Points 1937-2017
Habitat	CBP Hardened Shoreline Layer Related to Fish Habitat Decline*
	Atlantic Coastal Fish Habitat Partnership (ACFHP)-Diadromous Fish Habitat Scores
	Atlantic Coastal Fish Habitat Partnership (ACFHP)-Mid-Atlantic Estuarine Analysis
	Land use - Agriculture
	Natures Network Conservation Design
	VA SAV layer: SAV 2017-2021
	MD Finfish data layers
	Land use - Forests
Communities	NOAA SLR Viewer Nuisance Flooding
	MD MDOT Nuisance Flood Layer
	FEMA Regulatory Floodplains (100 and 500yr)
	VA EJScreen-Low Income Communities, Communities of Color
	MD EJScreen EJScore (Census Tract)
Marsh Vulnerability	VA WetCAT Vulnerability
Water Quality	Trust Fund Priority Zones - Current

Customized for Marsh Adaptation Project

Phase 3 Outreach (Scenario Working Session) Findings

The project team conducted a working session with stakeholders who were actively planning project proposals in Middle Peninsula, Virginia to review how the marsh adaptation targeting methodology could support project proposals in development. During the meeting, participants applied the marsh adaptation scenarios (presented in Phase 3 Methodology) and used the Tidal Marsh Adaptation Mapper to identify specific locations exhibiting potential opportunities for marsh protection or restoration projects in and around the Guinea Marsh Complex (see *Guinea Marsh Complex Scenario Worksheet and Summary* in the Appendix for complete descriptions and targeting maps).

During the meeting, the Middle Peninsula project leaders also shared information about additional local and regional data and tools, such as the VIMS Nearshore Oyster Restoration Siting and Prioritization Tool (https://cmap22.vims.edu/OysterRestoration/index.html), to supplement the analysis of mapper data and provide additional insight in evaluating potential project opportunities. Observations about community and partner collaboration, regulatory challenges, existing partnerships, and capacity were also captured to support workshop planning. The project team refined the scenario design worksheet based on meeting input to support a project proposal for funding by identifying maps to inform areas for potential marsh adaptation projects that align with funding priorities ranging from shoreline protection to climate resilience.

Phase 3 Data Analysis (Marsh Adaptation Scenarios) Findings

Using the scenario design methodology, the project team developed marsh adaptation targeting maps for the Guinea Marsh Complex in Middle Peninsula and the Wicomico River area (including Deal Island) to support workshop discussions around marsh adaptation project planning and identification. The integration of Tier 2 data, such as CBP Hardened Shoreline Layer Related to Fish Habitat Decline, Atlantic Coastal Fish Habitat Partnership (ACFHP)-Diadromous Fish Habitat Scores and Mid-Atlantic Estuarine Analysis, and state-specific EJ Screens, expanded the capabilities of the team to use the mapper for more targeted habitat, resiliency, and social vulnerability analysis.

The targeting maps provide information that could support future proposal development in connection with climate resilience funding opportunities and serve as examples to demonstrate how stakeholders can apply the methodology in other focus areas to support marsh adaptation project considerations. See *Guinea Marsh Complex Scenario Worksheet and Summary* and *Wicomico River Area Scenario Worksheet and Summary* in the Appendix for detailed information about the mapping analyses.

One example of targeting developed through the working session (and highlighted in the worksheets) focused on assessing potential areas for property acquisition with data related to land use, projected marsh migration corridors, marsh condition, and land ownership to align with resilience funding considerations. For instance, areas where there is potential for marsh migration adjacent to publicly owned lands and healthy marshes (UVVR = 0-0.1) could be considered for acquisition to enhance coastal resilience and habitat over the long term (see Figure 23; see additional maps in *Guinea Marsh Complex Scenario Worksheet and Summary* in the Appendix).

Marsh Health (UVVR) and Marsh Migration Corridor Envelope (2') with VA Protected Lands

UVVR

▨ Less Healthy/ Not Stable- Restoration (>
0.15)

🟥 Stability Threshold (0.1 - 0.15)

▨ Healthy/ Stable - Conservation (0 - 0.1)

Marsh Migration Corridor

🟪 Multiple Models - 2 ft Sea Level Rise

Virginia Protected Lands

🟩

1:54,093
0   0.35   0.7   1.4 mi
0   0.5   1   2 km

VGIN, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA,
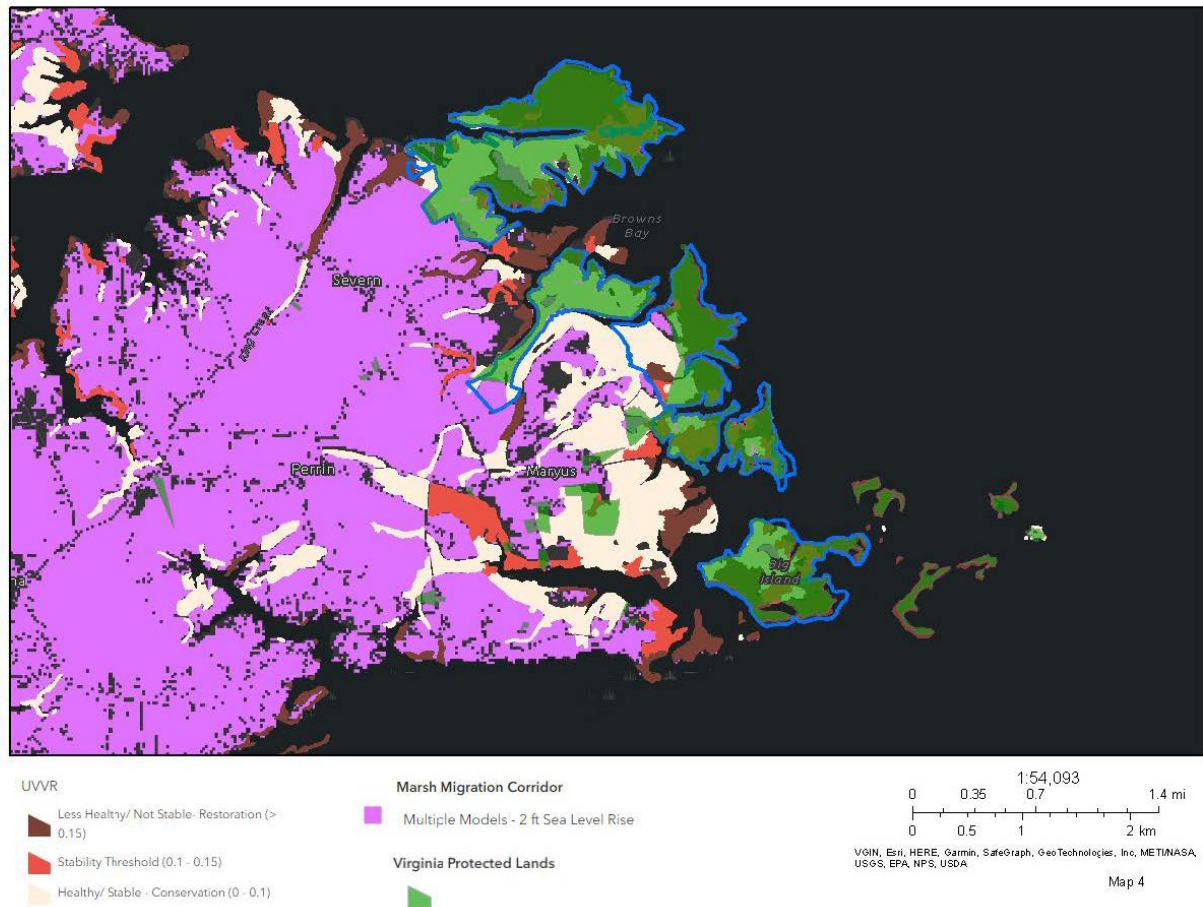USGS, EPA, NPS, USDA

Map 4

Figure 23. Guinea Marsh Complex mapping analysis overlaying marsh migration corridors, protected lands, and marsh condition (UVVR) to inform land acquisition considerations. The blue outlined polygons in the maps show areas of interest for restoration in the Guinea Marsh complex identified in the Coastal Wetland Plan for the York River, Piankatank River, and Mobjack Bay. See Guinea Marsh Complex Scenario Worksheet and Summary *in the Appendix for complete descriptions of targeting maps.*

An additional example of a targeting analysis using both the mapper and the VIMS Nearshore Oyster Restoration Siting and Prioritization Tool provided insights to support proposals in connection with living resource and shoreline protection priorities in resilience funding opportunities. These maps demonstrate data options that could be used to identify potential opportunities to align marsh adaptation, oyster restoration, oyster structure placement, shoreline protection, and fish habitat. The marsh adaptation maps viewed side by side with the Nearshore Oyster Restoration Siting and Prioritization Tool provide insights where oyster structures could be placed to protect vulnerable marsh habitat (see Figure 24).
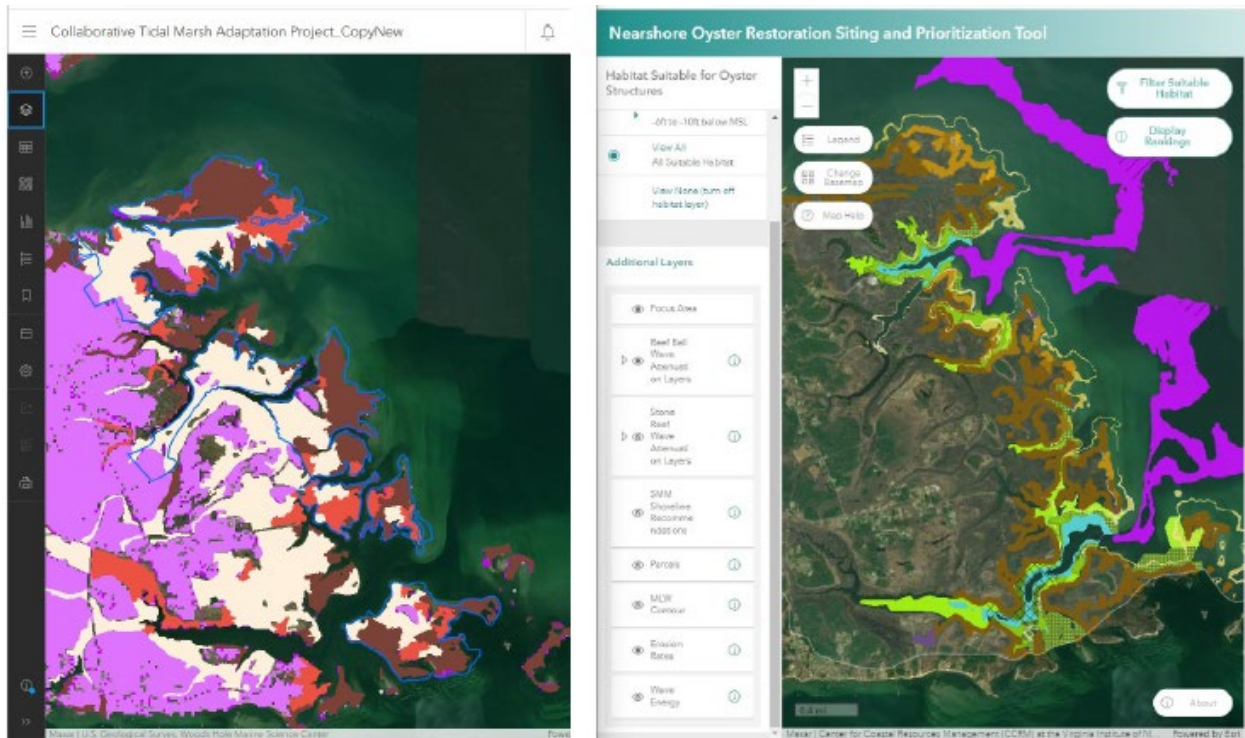
Figure 24. Guinea Marsh Complex marsh migration corridors (purple) and marsh condition (UVVR) (left) and habitat suitability from VIMS Nearshore Oyster Restoration and Prioritization Tool to inform living resources and habitat considerations for resilience funding. See Guinea Marsh Complex Scenario Worksheet and Summary *in the Appendix for complete descriptions and map set of targeting studies.*

An example of findings in the *Wicomico River Area Scenario Worksheet and Summary* is examining land use and potential marsh migration corridors on undeveloped privately owned tracts adjoining marshes with protected lands to inform where to target easements, partnerships, or land acquisition to support long-term coastal resilience (Figure 25).
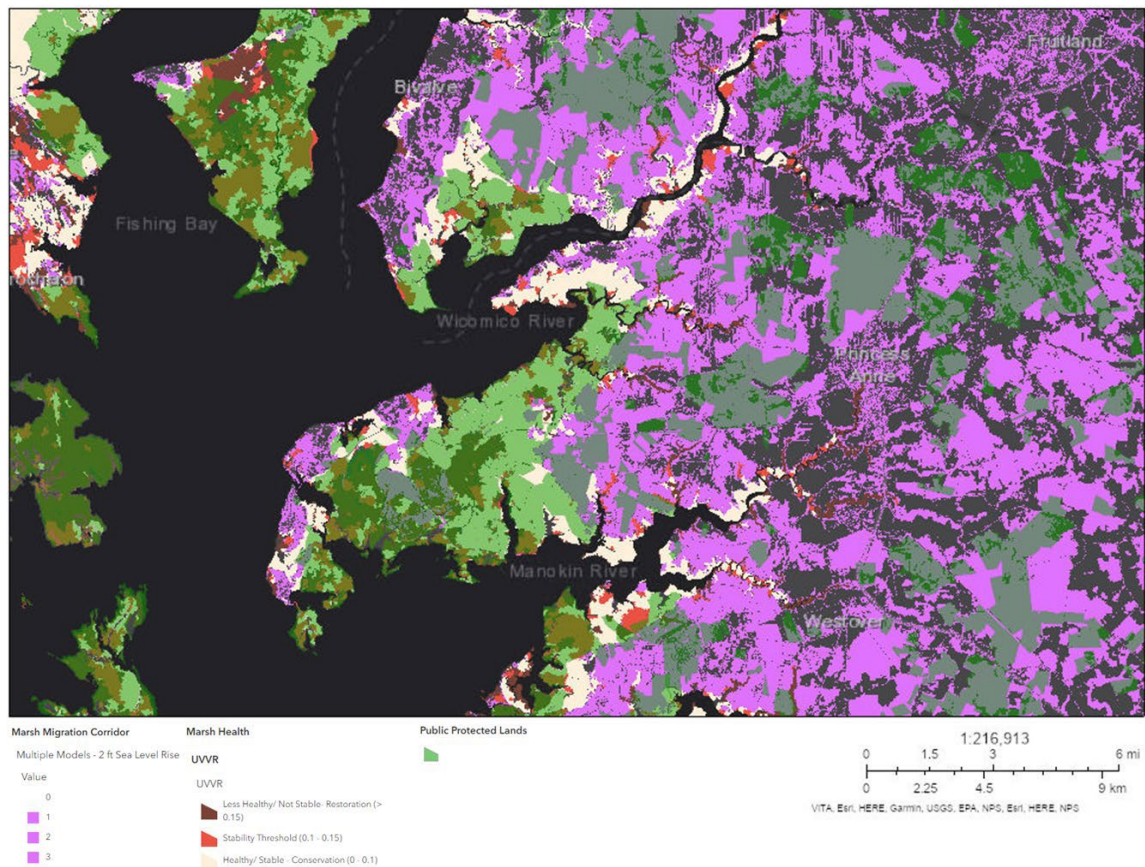
Figure 23. Wicomico River area map of marshes in protected lands and marsh migration corridors. See Wicomico River Area Scenario Worksheet and Summary *in the Appendix for detailed information about the map analysis.*

The *Wicomico River Area Scenario Worksheet and Summary* in the Appendix also provides maps demonstrating social vulnerability to connect with community resilience-related funding opportunities. Residents of communities within this focus area are more vulnerable to environmental impacts including pollution exposure, annual flooding, and sea level rise. The maps demonstrate that the higher social vulnerability coupled with the opportunities to implement marsh adaptation strategies align with the National Coastal Resilience Fund objectives.

Phase 4: Workshop - Methodology

Overview

Phase 4 focused on planning and facilitating a virtual workshop for more than 75 stakeholders engaged in the Wicomico River/Deal Island, MD and on the Middle Peninsula, VA focus areas to collaborate on advancing marsh adaptation implementation and research projects.

Stakeholder Selection

The project team and steering committee identified 120 stakeholders representing regional, state, and federal agencies, non-governmental organizations (NGOs), and research institutions actively engaged in the focus areas to include in the workshop.

Outreach

Workshop planning outreach included targeted emails to key participants to share an online registration survey and a website with links to project materials and resources, including the Tidal Marsh Adaptation Mapper to help participants prepare for the workshop. Steering committee members also reached out personally to specific stakeholders to encourage participation.

In the registration survey, participants Identified a range of priorities that included community health and safety, funding, habitat health, and restoration. Participants also identified their current and potential marsh adaptation projects, which include a combination of community engagement, implementation, permitting, and research efforts.

The team also reached out to specific stakeholders and project leaders in the two focus areas before the workshop to gather input about themes and topics they would like to discuss at the workshop related to marsh adaptation.

Workshop Planning

The project team developed a workshop agenda that included several discussion and presentation sessions to meet workshop goals of 1) identifying and advancing tidal marsh projects in each focus area, and 2) creating opportunities for shared learning about marsh adaptation technologies; planning and implementation challenges; research, regulatory and resource needs; and action items associated with the activity underway in the two focus areas.

Discussion sessions specific to each focus area were primarily designed to prompt discussions about project opportunities in the focus areas using the mapping and scenario resources. These project planning discussions organized participants by focus area, one for participants working in Middle Peninsula and one for participants working in the Wicomico River area.

The presentation sessions, which included the introduction, lightning talks and closing session, provided opportunities for shared learning between all participants. The project team and steering committee selected three speakers to present lightning talks prior to the focus group breakout sessions. Input from the registration survey informed the selection of topics. The lighting talk presentations included: *Strategic Conservation and Resiliency Planning, Beneficial Reuse of Dredge Material: Findings from Monitoring and Evaluation,* and *Easements as an Adaptation Strategy*. For more information about the workshop sessions, see *Workshop Agenda* in the Appendix.

Participant Resources

The project team planned the workshop to build on existing project planning and implementation efforts in the two focus areas. In doing so, the key workshop topics focused on addressing challenges and recognizing opportunities for project advancement in Wicomico River area and the Middle Peninsula, rather than potential project identification (which was identified as the primary workshop activity and outcome in the original project scope).

Key marsh adaptation planning resources developed throughout the project were shared on a web page (https://marshworkshop.skeo.com/) for review prior to the workshop to familiarize participants with the methodology, findings to date, and focus areas. These materials include the Tidal Marsh Adaptation Mapper (https://gis.chesapeakebay.net/climate/marshadaptation/tiers1-2/), scenario worksheets for the two focus areas (see *Guinea Marsh Complex Scenario Worksheet and Summary* and *Wicomico River Area Scenario Worksheet* in the Appendix), and other resources.

Documentation of Tier 1 and Tier 2 data (see *Data Layer Spreadsheet* in the Appendix) was finalized for participants to reference, and mapping scenarios were pre-loaded prior to the workshop to save time during the workshop to support discussion and real-time analysis during the workshop.

Phase 4: Workshop - Findings

Phase 4 Workshop Overview

The Collaborative Tidal Marsh Project workshop was a virtual one-day meeting to share knowledge, build partnerships, and identify actions necessary to advance marsh adaptation implementation and research projects that support coastal resilience, fish and wildlife habitat, and vulnerable communities in the two previously selected focus areas: Virginia's Middle Peninsula and Maryland's Wicomico River. The workshop presentations and discussion topics built on existing regional initiatives and previous marsh workshops and were designed to provide a collaborative exchange about imminent issues stakeholders face while working on project planning in the two areas.

The workshop was held on January 19th, 2024, from 9:30 AM to 2:00 PM. Over 75 people attended the virtual workshop. The agenda (Appendix G) consisted of a project overview by the project team, five to ten minute "lightning" talks by subject matter experts on beneficial use and using easements and adaptation tools, and breakout sessions for each focus area. The workshop culminated in a shared learning session that reconvened all participants. From the workshop discussions, recommendations emerged for advancing collaborative marsh adaptation projects.

Phase 4 Workshop Outreach Findings

In addition to using input about tidal marsh adaptation priorities and project activity gathered in the registration survey (see *Tidal Marsh Adaptation Workshop Participant List and Priority Areas of Interest* in the Appendix), the project team drew upon insights gathered from stakeholder discussions throughout the tidal marsh adaptation project to develop the following strategies to design the workshop to facilitate discussions and knowledge sharing to meet the project and workshop goals.

- **Identify opportunities for shared learning for innovating and advancing adaptation planning.** Stakeholder discussions revealed specific priorities critical for each of the two focus areas to address to advance potential adaptation projects. Participants suggested specific workshop topics for discussion and shared learning that would be valuable to advance their work in the focus areas, such as specific beneficial use complexities related to logistics and working with private landowners though new and existing incentive programs. Lightning talks and discussions were planned around these topics to share new research, ideas and information about relevant programs and resources.
- **Build on pre-existing plans and initiatives to collaboratively identify tidal marsh adaptation projects.** In the Middle Peninsula, stakeholders leveraged momentum from pre-identified projects listed in the timely *Middle Peninsula Coastal Wetlands Plan*. In the Wicomico River, stakeholders leveraged momentum from a timely Army Corps thin layer sediment placement project and a novel Audubon Marshes for Tomorrow Initiative.
- **Identify key challenges for project advancement and brainstorm solutions.** In the Middle Peninsula, several projects proposed remain stalled in the permitting phase. Participants shared a range of approaches and resources to work through the barriers. They also shared current initiatives that are underway to address relevant policies and practices.
  In the Wicomico River area, stakeholders working on existing marsh adaptation projects

highlighted specific issues to address while planning and advancing new projects. A discussion around collaborating and communicating with vulnerable communities and defining characteristics and metrics for dredge placement to support beneficial use led to specific ideas, such as appointing regional organizations to serve as lead communicators with communities.

During pre-workshop discussions, participants also expressed interest in learning about how to address specific priorities, including: 1) beneficial use of dredge material, 2) marsh migration planning tools and considerations, and 3) regulatory and logistical challenges to advance potential projects. These interests informed the selection of lighting talk speakers and topics which included: *Strategic Conservation and Resiliency Planning, Beneficial Reuse of Dredge Material: Findings from Monitoring and Evaluation,* and *Easements as an Adaptation Strategy*.

Phase 4 Workshop Key Themes

The discussion during the workshop highlighted key approaches and strategies, as well as challenges, to identifying potential marsh adaptation projects, converting opportunities into projects in a timely manner, improving project implementation, and encouraging collaborative efforts between partners and communities. The major themes and takeaways include the following:

Innovating Resilience Tools and Technologies. New approaches to marsh adaptation are needed to address the imminent effects of climate change, particularly sea level rise.

- Beneficial use projects[10]
  - Growing interest in beneficial use of dredge for thin layer placement as a method to increase resilience and create habitat highlights a need for coordination and collaboration to ensure successful projects and avoid unintended adverse consequences. State and federal government interest in prioritizing dredge materials for beneficial use at large scales has driven significant research and project funding over the last ten years to promote a coordinated approach to planning projects[11].
  - Regional practitioners recognize opportunities for beneficial use on a smaller scale to help private property owners bolster resilience and enhance habitat using material from smaller scale and privately funded dredging activity. Participants emphasized the need for better coordination and planning at both scales to convert opportunities to projects.
  - Due to the nuanced suitability for aligning dredge material with placement locations (due to factors including timing, volume, and sediment characteristics), capturing information in advance and sharing information through a database is necessary to match partners, placement opportunities, and available dredge material expediently.

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[10] Beneficial use refers to placement of dredged material to provide beneficial uses in the form of habitat enhancement and ecosystem benefits as well as social and economic benefits while minimizing potential adverse effects. The physical and chemical characteristics of the sediment, volume, and location are major factors in determining the suitability for beneficial use. The scale of project can range from millions of cubic yards of material dredged from shipping channels to small volumes dredged from canals or navigational channels for recreational use.

[11] For more information, see *State of Virginia Dredged Material Management Process Implementation Study: Preliminary Technical Results Interim Report of The Bay Enhancement Working Group 2022* prepared by Maryland Environmental Service.

- Maryland's experience implementing beneficial use projects provides opportunities for evaluation and improvement of project planning and delivery. Key topics from Wicomico area projects that inform new projects include:
  - Understanding when/where these projects are appropriate is key for future project identification and implementation.
  - Coordination among partners and collaboration between partners and communities is critical to address concerns and communicate impacts to community members before, during, and after project implementation.
  - Regional or local project partners, rather than federal partners, are the preferred communication leads with local communities.
  - Collaboration between federal and regional partners to agree on project goals, approach, and outcomes is necessary to set partners' expectations.
  - Virginia's extensive planning and limited implementation of beneficial reuse projects highlights several regulatory and permitting challenges that, once addressed, should streamline the process of advancing beneficial reuse projects to increase resilience and enhance habitat along the coast. The Coastal Zone Management Program (CZM FY23) project that is underway intends to create guidance for beneficial use that will clarify details for Virginia permitting.
- Determination of success for marsh adaptation projects varies by primary goals and conditions. However, project leaders have identified key metrics for success across recent projects: species, habitat, biomass, elevation, longevity. Stakeholders are continuing to refine metrics and develop new tools and methodologies to apply this developing set of knowledge to marsh adaptation planning. One example is the USGS geospatial synthesis analysis[12] which has developed metrics for considering marsh health and lifespan to support marsh adaptation planning and decision-making.
- Other marsh management tools and technologies such as creating runnels, ditch filling, ditch plugging, and edge stabilization can support marsh adaptation efforts. Ongoing research is needed to identify variables to guide technology selection for marsh adaptation projects based on site conditions and dynamics.
- Ongoing monitoring and shared learning from innovative marsh adaptation approaches in coastal areas is critical to improve marsh adaption project planning and success.

Managing Marsh Transition. Participants discussed considerations and challenges related to changing marsh conditions through marsh restoration or marsh migration efforts.

- Shifting plant and wildlife communities and habitat due to sea level rise.
  - Recognize and plan for potential trade-offs or conflicts between habitat goals and resilience goals in short term and long term. For example, phragmites growth might increase biomass quickly, but phragmites growth undermines many habitat goals for managing specific bird and native plant species.
  - Projects with specific habitat goals require planning, monitoring and maintenance due to the multiple variables and rapidly changing site dynamics associated with rising sea level.

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[12] https://d18lev1ok5leia.cloudfront.net/chesapeakebay/documents/Ganju_CRWG_Oct22_revised.pptx.pdf

- o Long term planning for marsh migration should occur in context of ensuring diverse habitats complexes of waters, marsh, beaches, uplands, islands, and forest.
- Land use conversion
  - o Enabling marsh migration requires planning with property owners and monitoring the effects on potential migration of changes in land use, particularly forest, agricultural, and recreation areas.
  - o Planning for forest and agricultural areas might include managed land use transition with incentives for planning harvests (forest) or changing crops (agriculture) to maximize benefits for landowners while providing ecosystem services.
- Protecting communities and preserving heritage
  - o The potential social, economic, and cultural transition associated with sea level rise and marsh migration requires planning with communities.
  - o Participants suggest a collaborative approach with communities to commit to protecting communities and coastal livelihoods in the short term, while collaborating on long term plans to protect human, plant and wildlife communities.
- Marsh transition management capacity
  - o Adaptive management of marsh expansion requires more resources for research and implementation to:
    - ▪ innovate interventions (such as runneling), and
    - ▪ advance knowledge of contributing site characteristics and dynamics to improve restoration and migration project planning.
  - o Resources are required for continuing critical maintenance functions such as invasive management.
  - o More wetland scientists are needed to plan, monitor, and support marsh migration projects.

Incentivizing Action. Participants express difficulty talking with communities about planning initiatives such as land use transition that affect private property rights. Incentive programs that create value for communities and landowners who participate in managing coastal properties for long term resilience can create opportunities for dialog and collaboration.

- Traditional tools such as easements, land use and land management incentives, credit programs, and cost share programs can be used to help coastal landowners adapt to climate change by helping to fund conservation, restoration, land management, alternative crop planting, land donations and other activities that align with long-term planning. The TNC Resilient Protection Frameworks uses easements as an adaptation strategy.
- Some programs, such as crop insurance coverage for flooding, should be remodeled to incentivize more sustainable farming practices and land use transition of flood prone agricultural land.
- Many specific incentive programs and resources for landowners exist at the state and federal levels, but the awareness of the programs is limited. Aggregating relevant program information and educational materials about the programs can support collaboration between landowners and practitioners, such as workshop participants, around planning projects to address the

effects of climate change along the coast. In addition to accessing information about the programs, capacity is needed on two fronts to support program engagement:
  - o outreach capacity to help landowners identify which incentives they might qualify for/might work for them, and
  - o implementation capacity to help landowners 'sign up' for the incentive and execute a project.
- Share information about and expand existing successful incentives. Examples suggested by participants include:
  - o Middle Peninsula Chesapeake Bay Public Access Authority program allows the property owners to decide if/when they would like to leave their property
  - o Cost share programs
    - ▪ USDA NRCS (less active in tidal areas)
    - ▪ Soil and Water Conservation Districts (living shorelines)
    - ▪ USACE (i.e., cost share partnership with VA DCR and VIMS)
  - o VA Agricultural BMP cost share program (agricultural Virginia Conservation Tax Credits
- New approaches to incentivizing landowners and adaptation activities should be considered in the *Beyond 2025* plan.

Short Term and Long-Term Planning Tracks to Address Marsh Loss. A portfolio-style approach is recommended to guide investments for short-term needs, such as protection of coastal communities and habitat areas, and long-term actions to increase coastal resilience.

- Compatibility issues between meeting funding parameters, implementing best management practices, and serving vulnerable communities lead to inevitable trade-offs. For example, protecting a community's heritage centered around a fishing economy would prioritize short-term protection and restoration of current marsh area and its ecosystem service functions, while a focus on minimizing marsh loss in the long-term would prioritize facilitation of marsh migration planning efforts, such as purchasing easements or acquiring land. [13]
- Many funding opportunities focus on near-term implementation and outcomes (some specify within five years). Dedicated funding resources are needed to incentivize long term planning and outcomes.
- Workshop participants encourage planning and discussion for the *Beyond 2025* planning effort.

Advancing Marsh Adaptation Projects. The development of innovative research and implementation project proposals in Virginia and Maryland focus areas often challenge or exceed existing regulatory and operational frameworks for planning and delivering adaptation projects, leading to delays, inconsistent

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[13] VIMS recently conducted a study that determined that marsh/living shoreline habitats are among most utilized and highest valued shoreline habitats for recreational fishers in this region. Trips to marshes and living shoreline habitats were found to generate the highest total benefits for Middle Peninsula anglers, yielding $6.42M in annual benefits. This represents only one of the recreational benefits derived by marshes in the region which is heavily natural-resource dependent for its local economy.

project execution and missed funding opportunities. Participants shared the following needs associated with advancing projects:

- (Project partners and supporting agencies) coordinate project proposals around key project contingencies such as permitting, and logistics.
  - Clarity around permitting requirements for beneficial use is needed between permitting departments and applicants, since beneficial use is a more novel approach that continues to evolve with new research and project experience (the Virginia CZM project is working to clarify Virginia permitting requirements). Particularly in Virginia, beneficial use projects stall during permitting.
  - Logistics issues, such as volume or distance thresholds for placement, also require early communication and negotiation among potential partners to streamline project planning.
- Improve use of data, tools, and research to align specific project strategies and outcomes with the parameters of large funding sources. New state-wide and regional resources that provide extensive data and maps relevant to wetland, habitat, marsh migration planning continue to evolve. A web-based resource to help funders, applicants and others navigate and access available Bay-wide tools and data for project planning could support this need.
- Update permitting processes to streamline project implementation and access to funding.
- Improve collaboration between federal, state, and regional partners for project planning, project delivery, and local communication.
- Clarify funding terms (such as "underserved communities") for proposals; clarify permitting requirements for moving projects toward implementation.

Project Coordination and Collaboration. Participants identified opportunities to improve project planning and implementation success through collaborative efforts.

- Regional: A project pipeline, which documents project opportunities, planning, and design phases can improve coordination of funding, permitting, and access to other resources. For example, discussion about beneficial use projects and challenges underscored the need to have potential projects identified to take advantage of opportunities for using dredge material, which is limited to a small window of opportunity by sediment characteristics, geographic distance, and timing.
- Local: Participants emphasize the importance of collaboration between project partners and communities during planning and implementation. Specifically, participants emphasized the need for:
  - Extensive community engagement before, during, and after projects.
  - A holistic project view to identify activity and impacts through the life of the project -- from the planning stage through implementation and management -- for all stakeholders. Participants urged partners to communicate openly and clearly with communities to ensure they understand all aspects of the projects, including an associated risks or uncertainties, to build trust.

Phase 4 Workshop Strategic Planning and Policy Findings

Workshop participants discussed challenges around planning and implementing tidal marsh projects. Participants shared resources they have found helpful, as well as ideas about actions or potential solutions. Several of the recommendations and actions listed below might be considered as potential initiatives a partner organization or collaborative could undertake if funding becomes available.

Challenge	Description	Recommendations/Actions
Coordinating Project Pipelines	Aligning project design, permitting, funding, and capacity is a challenge, particularly for beneficial use projects that have a limited window of time and geography for sediment placement.	• Create a matchmaking process between potential projects, shovel ready projects, and opportunities for sediment sources and funding. • Create a subregional network of potential projects and sources for beneficial use to reduce costs associated with distance and storage of moving sediment and efficiently align opportunities.
	Flexibility is needed for implementing beneficial use at multiple scales. Many smaller projects can benefit from beneficial use of available sediment.	• Coordinate sediment source/project, provide education, and research temporary storage options to meet needs. See DNR's BUILD Tool (Beneficial Use: Identifying Locations for Dredge) as an example of a tool in development to support this need (https://dnr.maryland.gov/ccs/Pages/beneficial-use.aspx) • Investigate how the Army Corps can adjust their engineering approach to spread sediment at different scales. • Utilize smaller-scale opportunities to match shallow draft sources of sediment with pre-identified needs of other agencies and organizations, underserved communities, and private property owners. The VA Waterway Maintenance Fund is a robust program that might support these types of projects.[14]
Planning and Permitting Challenges	Many planned projects remain delayed in the permitting process. Project leads request clarity about specific data requirements	• Facilitate working sessions with permitting agencies (NOAA, VMRC) to specify requirements for implementing beneficial use projects on public or private land; clarify data required for qualitative and quantitative

[14] Projects for which the Authority may award grant funding include (i) feasibility and cost evaluations, pre-project engineering studies, and project permitting and contracting costs for a waterway project conducted by the Commonwealth; (ii) the state portion of a nonfederal sponsor funding requirement for a federal project, which may include the beneficial use of dredged materials that are not covered by federal funding; (iii) the Commonwealth's maintenance of shallow-draft navigable waterway channel maintenance dredging and the construction and management of areas for the placement of dredged material; and (iv) the beneficial use, for environmental restoration and the mitigation of coastal erosion or flooding, of dredged materials from waterway projects conducted by the Commonwealth.

	to streamline the permitting process.	benefits, and dependencies and recipients; identify other permitting specifications to streamline application and approval process. • The Coastal Zone Management Program (CZM FY23) project that is underway intends to create guidance for beneficial use that will clarify details for Virginia permitting. • In Maryland, an effort to develop specific guidance on adaptive management plans and monitoring requirements for thin layer placement (TLP) projects can support practitioners.
	Regulatory flexibility is needed for research and innovation, particularly around beneficial use of sediment.	• Determine how the permitting process can be adjusted to support innovative approaches, and what is needed to increase regulatory sandboxing[15]. • Increase collaboration with fee simple and easement holding authorities for wetlands and wetland buffers. • Consider open permits for ongoing placement projects.
Working with Communities	Collaborating with communities during planning and implementation requires ongoing education, updates, and pre- and post-project support.	• Recommend that a regional or local partner (rather than a federal partner) serve as lead communicator with communities. • Recognize needs and differences within communities and adjust accordingly (i.e., inequities, sensitivities, trust, engagement, values, goals, experiential impacts). • Suggest the Army Corps model the partnership framework used at Poplar Island. • Provide outreach to educate communities and landowners about beneficial use, marsh function, dredge characteristics and more. More specifically, fostering dialogues with communities about beneficial use including benefits and tradeoffs is suggested.
	Planning with private property owners	• Improve planning and regulatory support to private landowners to address climate impacts via implementation of marsh projects. • Develop new easement language to increase flexibility and create new incentives for resilience building measures.

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[15] Regulatory sandboxes enable in a real-life environment the testing of innovative technologies, products, services or approaches, which are not fully compliant with the existing legal and regulatory framework. They are operated for a limited time and in a limited part of a sector or area.

		• Build trust, especially with Tribes and Black communities. Partnering with regional organizations that are actively working with communities (i.e., Shore Rivers, Wetland Watch, Elizabeth River Project) can guide stakeholder engagement.
Difficulty of Long-Term Marsh Adaptation Planning	Long-term planning broaches difficult topics, such as private property rights, relocation, and adapting community economies.	• Invest in near-term projects to protect the safety and livelihoods of existing communities, and work toward long term transition with landowners.

	Funding opportunities incentivize near term project planning and implementation. Many current, large funding opportunities require project delivery within 5 years. Additionally, many funding programs do not account for "lost cause" projects (projects with outcomes that are temporary in context of SLR, for example marsh restoration in an area without migration potential that will be underwater) in scoring criteria.	• Develop funding criteria and incentives for projects focused on addressing challenges over long term transitions (extending to 2100 SLR projections).
		   ○ Suggestion: include development of a monitoring/adaptive management framework for funders to 1) track previously funded projects, 2) provide additional resources to local partners as SLR impacts the site, and 3) establish triggers/tipping points for action.
		   ○ Suggestion: Integrate a mechanism that builds in periodic review of projects and adjustment as the ecological and human circumstances change.
		• Engage local, regional, state, and federal leaders in discussions about setting priorities that support long-term resilience, and methods for integrating those in policy and funding.

Phase 4 Lessons Learned for Future Workshops

Adapting workshop goals to align with project findings and participant needs

The Collaborative Tidal Marsh Adaptation Project's culminating workshop format, topics, and goals were adapted from the original plan to align with the different needs and separate trajectories of project identification and advancement for each of the two focus areas. Stakeholder outreach and engagement activity prior to the workshop provided an opportunity to learn about the status of existing tidal marsh adaptation planning initiatives, developing projects, and challenges in each location. The project team used this information to gather data and create specific maps and scenarios for the focus areas (and several pre-identified potential project areas), and to plan workshop discussions around imminent needs and challenges for supporting potential projects. The workshop prework and materials identified projects and funding opportunities that framed the discussions for each focus area. The workshop focused on what is needed to advance those projects and what the barriers are, such as permitting, staffing capacity, and/or coordination. The outcomes of the workshop centered around identifying

actions to address challenges and obstacles to planning, designing, implementing, funding and engaging partners on marsh adaptation projects. Adapting the workshop to align with project findings and participant needs led to value-added resources that can support ongoing project planning efforts. Examples include focus area maps and scenario design worksheets, as well as information sharing among participants about programs, funding opportunities, and other resources specific to needs and challenges.

Virtual meeting format

A virtual meeting format was selected to maximize participation of key stakeholders and create a forum for cross-region conversations between participants working in Maryland and Virginia. Stakeholders for the two focus areas work within an approximate five hour driving range, which could be time and cost prohibitive for many participants. Additionally, the meeting required planning around standing (annual) workshops and events that occur regionally, state-wide, and nationally. Because virtual meetings require a lesser commitment from participants, the planning required efficient, targeted use of time and tools to retain the attention of participants for a maximum of four hours. The short timeframe and heavy participation limited the extent and depth of conversation.

The virtual meeting featured live discussion, presentations, facilitated break out groups by focus area, and collaboration using a virtual whiteboard (Mural). Additionally, reconvening the full workshop for a shared learning discussion after the focus area breakout sessions added value to the workshop outcomes. This shared learning component gave facilitators the opportunity to share findings, challenges, experiences, and opportunities noted for each focus area, and continue those conversations with added perspectives. The discussion included available capacity and resources, and long-term needs for increasing adaptive capacity.

Pros:

The virtual workshop allowed many participants to share feedback and interact in discussions in multiple ways, including verbally, though the meeting chat, and providing comments on a virtual whiteboard. The range of options for participants to engage in during the focus area discussions allowed for increased participation across both groups.

- Strong participation (almost 80 stakeholders were able to join for the duration of the workshop)
- Lower cost for participants
- Focused discussions

Cons:

A smaller workshop size, or multiple breakout discussions for each focus area may have facilitated additional high-quality discussions, giving more participants the opportunity to engage with the spatial analysis and with other participants for in-depth discussions.

- Large groups create trade-offs for discussion and learning. More participants can learn from each other but facilitating discussions in which most participants can speak is difficult.
- The large group and virtual format also limited the effectiveness of using the Tidal Marsh Adaptation Mapper to identify project sites for both focus area groups.

- Lack of in-person presence inhibits face to face and peripheral dialog that is important for partnership building.
- Time limitations for virtual meetings (not recommended for more than 3 to 4 hours) restricted the length of the workshop from one day, which would have been more suitable for a collaborative approach with almost 80 participants.

Recommendations

Future workshops may require multiple sessions to provide additional time to address the project development and have discussions on the focus areas and specific adaptation projects. Dividing the workshop content across two virtual meetings, with one to two weeks in between, would allow more time for discussions. By introducing some of the topics, challenges, and resources in an initial session, and providing time for participants to consider those in context of their work, a dual meeting format can provide time for participants to absorb information shared during the workshops, consider discussion topics in more depth, and reconvene discussions with greater focus. The increased timeframe and dialog are likely to encourage side conversations between stakeholders about workshop topics and resources that support partnership building. Two workshop dates would also provide more flexibility to include smaller breakout groups, which would likely engage more participants.

Recommended Next Steps

The resources and findings produced during the Collaborative Tidal Marsh project can be used to advance current tidal marsh adaptation projects and future projects in focus areas and across the Bay. The approach and methodology can be replicated in other areas to identify potential tidal marsh adaptation project areas. The project team recommends the following next steps to extend the outcomes of the project:

Share project findings and promote use of marsh adaptation information
- Present the findings with workgroups of the CBP, including the Climate Resiliency Workgroup, Wetland Workgroup, Land Use Workgroup, Chesapeake Bay Trust's Tidal Wetland Strategic Plan Steering committee, and the *Beyond 2025* Steering Committee.
- Share final report with the regional focus area stakeholders and workshop participants and support discussions on potential follow-up actions for applying the marsh adaptation products to inform the siting and planning of restoration and protection projects.
- Pursue opportunities for agencies and organizations to utilize the project resources and tools to support funding requests/proposal and to support project planning -- such as applying the scenario worksheets to identify marsh restoration and protection implementation and research opportunities.
- Continue discussions initiated during the workshop with partners engaged in Wicomico River and Deal Island area to support identification of marsh adaptation implementation and research projects.
- Pursue resources and funding to expand the work to the other focus areas:
  - Choptank River, MD
  - Pocomoke Sound Area (Crisfield, MD to Saxis, VA)
  - Middle Peninsula Tribal Lands (Mattaponi, Pamunkey)
  - Elizabeth River Watershed (Norfolk, Portsmouth, Chesapeake, Suffolk), VA

Maintain and update project tools and resources
- Work with the CBP GIS Team to make the Tidal Marsh Adaptation Mapper available on CBP Targeting Tool and Chesapeake Data websites.
- Pursue funding and resources to maintain and update the Tidal Marsh Adaptation Mapper when new information or data layers become available or when other data layers are recommended by stakeholders to better relate marsh resilience and social vulnerability to their identified priorities to inform project siting and design.

Appendices

A. Tidal Marsh Adaptation Framing and Definitions
B. Project Approach and Focus Area Selection Presentation to Steering Committee, August 2, 2023
C. Focus Area Visual Analysis High Resolution Images
D. Marsh Adaptation Scenarios and Strategies Presentation for Workshop, January 19, 2024 (based on materials presented October 2023)
E. Data Layer Spreadsheet
F. Marsh Adaptation Scenario Design Worksheet
G. Guinea Marsh Complex Scenario Worksheet and Summary
H. Wicomico River Scenario Worksheet and Summary
I. Tidal Marsh Adaptation Workshop Agenda
J. Tidal Marsh Adaptation Workshop Participant List And Priority Areas of Interest
K. Stakeholder Outreach Summary
L. Projects, Partners, and Opportunities Spreadsheet
M. Tidal Marsh Resilience Research Summary