Workshop Summary

Climate Smart Habitat Restoration Workshop: SAV & Tidal Wetlands/Black Duck
A workshop in support of the CBT Project: Cross-Goal Climate Resiliency Analysis and Decision-Making Matrix and Implementation Methodology

National Conservation Training Center
Shepherdstown, WV
November 15-16, 2016

Introduction

Project Background

A goal of the Climate Resiliency workgroup is to develop a structured, science-based framework through which the principles of climate-smart adaptation planning can be effectively applied to the existing 29 management strategies in the Watershed Agreement. To further this goal, this project was initiated to work toward developing an analysis & decision-making matrix and implementation methodology for the Chesapeake Bay Program (CBP) that utilizes climate smart principles and can be applied to all Chesapeake Bay Agreement Goals and Outcomes. We are starting with the Adaptation Design Tool (West et al. 2017) that is being developed EPA's Exposure Analysis and Risk Characterization Group (EARCG) scientists with NOAA and Tetra Tech, as an ecosystem-specific application of the generic climate smart approach. This Tool worked in the context of coral reef management, and is highly applicable for incorporating climate change vulnerability considerations into other ecosystem types and resource management contexts. This project applies the tool for the CBP for the purposes of developing a tailored, CBP-specific climate-smart framework and associated set of climate change adaptation decision matrices.

Development and testing of a framework is proceeding through interactions with two 'pilot' goal Implementation teams (GITs) or workgroups which were identified during initial phases of the project – the SAV workgroup and the black duck-wetlands action team/workgroup. Objectives of this project are to:

- Advance climate resilience objectives for Chesapeake Bay Agreement, including application of Climate-Smart conservation.
- Use a regionally developed framework/methods to integrate climate change into CBP management strategies and actions.
- Engage with the 2 selected GITs/workgroups as case studies.
- Work toward development of a matrix methodology that will work across all Chesapeake Bay Agreement Goals and Outcomes through implementation by select CBP GITs & workgroups.

Workshop

A 2 -day workshop was convened at the USFWS National Conservation Training Center (NCTC) in Shepherdstown, WV on November 15-16, 2016. It was a benchmark activity in the process of developing a CBP matrix methodology. The objectives of the workshop were to have participating experts:

- Apply the Adaptation Design Tool to CBP restoration targets.
- Use Black Ducks/Wetlands & SAV groups as case studies.
- Run a set of strawman management actions as examples through the Adaptation Design Tool.
- Begin the process of refining the Tool for the CBP context.

Workshop participants included members of the CBP's Submerged Aquatic Vegetation (SAV) (see Acronym table below for this and all other acronyms used in this report) and the Wetlands workgroups, and the Black Duck Action Team. It included interested participants from the Climate Change workgroup, the CBSSC, the CRC, CBP staff and representatives of partnering agencies including MD DNR, VA DGIF, the US EPA, NOAA, and Tetra Tech. A list of workshop participants with contact information is provided in Attachment 1.

The goal of the project is to support the integration of climate smart principles throughout the CBP: at multiple levels, from place-based management actions to restoration strategies and development of partnerships. We are exploring the Adaptation Design Tool as basis for developing such a unified approach. At the workshop, we started with a set of relatively specific Chesapeake Bay restoration actions and took them, as examples ('strawmen'), through the Design Tool, expecting that a broader understanding of how the process relates to the decision contexts within which Chesapeake Bay restoration takes place would emerge. The inputs and insights we gained are summarized in this report. We will use the information from this exercise to assess and revise the Tool for the CBP context.

To achieve objectives, the workshop started on the first day with an overview presentation recapping the approach and general principles of climate-smart conservation and of the process of utilizing the Adaptation Design Tool, all of which had been presented in more detail during a pre-workshop webinar (November 1, 2016). This was followed in subsequent morning and afternoon break-out sessions with facilitators leading each of the 2 case study groups in taking 2-4 strawman management/restoration actions through Activity 1 of the Adaptation Design Tool. On the second day of the workshop, further break-out group facilitation was used to explore Activity 2 of the Tool, and to discuss how to apply the Tool to work they do in their respective workgroups. The workshop was wrapped up with a full-group discussion of potential applications of this process to other groups and at other levels, including perceived roadblocks or issues, as well as potential project directions and recommended next steps. The workshop agenda is included for reference as Attachment 2. Presentations made at the workshop are included for reference in this summary (Attachment 3). The descriptions of the strawman scenarios and actions used for each of the SAV and Black Duck/Wetland breakout groups to put through the draft climate smart decision support tool, as well as the completed decision tables as revised based on inputs at and following the workshop, are presented in Attachment 4. A compilation of notes from the workshop breakout sessions is included in Attachment 5. Key messages from the workshop are summarized below. Acronyms used in this summary are defined in the following table.

Acronyms used in this summary report.

CRC	Chesapeake Research Consortium
CBSSC	Chesapeake Bay Sentinel Site Cooperative
CBP	Chesapeake Bay Program
EARGC	Exposure Analysis and Risk Characterization Group
ESA	Endangered Species Act
GIT	Goal Implementation Team
MD DNR	Maryland Department of Natural Resource
NCTC	National Conservation Training Center

ORD	Office of Research & Development
SAV	Submerged Aquatic Vegetation
U.S. EPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
USGS	United States Geologic Survey
USACE	United States Army Corp of Engineers
VA DGIF	Virginia Department of Game & Inland Fisheries

Summary of Key Messages from the Workshop

Considerations for Modifying the Process and Tool

We need to be able to use this tool from the top down as much as from the bottom up. Consider how to take what we learned from this workshop to apply at a higher (broader) level, inform new goals and outcomes or revise our goals and outcomes.

- To envision what this tool can do to help the CBP and associated groups, recognize that the CBP makes decisions at different level.
- Continue discussions with workgroups about higher-level (goal, outcome, management strategy, management approach, work plan) applications of this process.
- The Adaptation Design Tool was not designed to answer the question of what is realistic as far the goals themselves, but rather organizes information that can be brought to bear on such questions, and helps identify trade-offs and other considerations.
- Consider GIT-level insights, overarching issues, what data and support are needed from the Climate Resiliency Workgroup.

Inputs on CBP goals & objectives:

- Many of the CBP environmental goals & outcomes, from 2014, may have to accept changes, including future (ongoing) habitat changes.
- Consider goals within a larger regional context rather than just bay-specific
    - NA LCC funded a synthesis of all the 13 northern state wildlife action plans, refreshed them to consider shifting distributions due to climate change that would cut across state boundaries.
    - Increase outreach to coastal communities, for issues like ESA; can help by connecting northern states to prepare for migration, how to plan for species coming in (shifting species distributions due to climate change).
    - Have CBP leadership appreciate the regional endeavor more, be aware that range shifts may occur.
- CBP goals dominated by water quality questions, TMDL's. Complement with minimum wildlife daily needs. May not be able to save everything all the time, but try to assure sufficient habitat.
    - Example - Pocomoke river reconnection project – a climate smart choice, successful; reconnecting 4000 acres of floodplain.

- Consider pros/cons of species-based focus vs systems approach. Consider 'conserving the stage' rather than the species.
- Not a static landscape, need to incorporate dynamic changes in plans/goals.
- Consider how to trade off system level issues with ESA needs, the value of retaining populations, etc.

What would be other possibilities for applying this process? Prompted questions? A template? A facilitated process? An example should be provided.

- To facilitate ease of use of the tool, consider using a checklist rather than a table format.
  - The matrices are very time-intensive; a checklist might be a more useable format.
  - The table columns could become the checklist questions that each group asks themselves for their own projects.
  - Should include an example of how to help answer these questions.
  - Possibly two tables? A simplified one for folks with less expertise, and then a more comprehensive one for detailed expert audience.
- Understand what decisions the GITs are making, their needs, to understand how this process should be applied.
- Consider what the pathway is ('How to draw the line') from case studies (finer level) to the GIT's planning continuum (higher level).

Consider how to facilitate greater collaboration between workgroups, and implications of that for using results of the Tool.

- Agencies are stove piped. There is collaboration, but perhaps this process can help bring forward common objectives. The way that agencies and institutions have been built is not conducive to collaboration.
- There are functional (process and ecological) interconnections across GITs, need cross-workgroup interactions as a formal process, coordinate with the existing cross-workgroup coordinator.
- Cross-GIT interactions and mapping cross-GIT priorities would provide a good lens for climate smart needs; e.g., which outcomes (across groups) are most critically affected by climate change?
- Identify shared priorities; could apply this process to that cross-GIT process to reprioritize actions with respect to climate change effects on those project, areas that are specific to multiple goals, etc.
- Goals & objectives for using the process – make things climate smart, or encourage collaboration?
- If one group is doing something that affects a primary stressor of another group, give credit for something that matters in the synergy process. For certain goals and outcomes, climate change could be very important, for others, not so much. For example, in terms of SAV, in an urban area, if the principle stressor is water quality, climate isn't the biggest stressor, so shouldn't be ranked as high.

- Consider working with other GIT and workgroups at their meetings to exchange information and coordinate actions regarding a process to incorporating climate change impacts.
- How would you apply what you've learned in the context of the workgroup?
    - If workgroups are familiar with this process, they can provide some input to partners regarding the effectiveness of these projects, and considerations for future projects.
    - How can the Climate Resiliency Workgroup help other workgroups?

Perceived benefits of the Tool.

- This process would help inter-group collaboration, move toward common goals and with a climate change lens.
- Makes consideration of climate change effects explicit, which groups have previously been thinking about but informally.
- Good at the higher level, making things climate smart through resilience, interconnectedness; but not good without making the actions climate smart as well.

Issues with using the Tool.

- Using this process to set priorities and thus 'target' restoration actions would be great, but for the wetlands workgroup, project identification is entirely opportunity driven.

How do we address an apparent disconnect or gap between projects being done and what is needed to achieve CBP goals?

- The outcomes often have a numerical goal. The management strategies and work plans are the difficult part with no detailed steps of how to achieve those goals.
- It might be best to talk to the workgroups about their outcomes, discuss on the ground projects and what could be done to get closer to achieving the goal.
- Consider what is covered in each plan, and using the climate smart strategies as categories of possible additional actions to take, consider what other activities might be needed.
- Need the Adaptation Design Tool's second activity to help figure out how to achieve actual outcomes, e.g., what else needs to be done.
    - But this overall concept is outside the role of this workshop, though you can't be completely climate smart without having these considerations.

Other Considerations.

- Include characterization of uncertainty; possibly general guidance similar to what USACE does regarding ranges of considerations for climate-related concerns.
- Monitoring helps to validate these projects and demonstrate success.
    - Much of the monitoring is short term, and a lot of these projects are aimed at long term success; need to think about ways in which monitoring should be utilized.

- So much is dependent on monitoring, but monitoring is difficult to start and continue. Is there a way to deal with this, e.g., a "lighter" monitoring program without heavy institutional support?

- Sentinel site data can be used to help fill data gap/needs of other workgroups.

Wetland/Black Duck Goals, Considerations

- Climate smart could be specifically incorporated in the language of the black duck and other strategies.
    - Primary objective is to have a conservation landscape capable of supporting that number of ducks (not having that number of ducks).
    - Tension of choosing this as a poster species – a great poster bird, but because so much influences where they are found, maybe not a wise choice. Could create opportunity to look at other resident birds that are habitat dependent.
    - Could make sense to have a diff mascot. Saltmarsh sparrow using marshes to nest, affected by SLR.
    - The black duck group already has an adaptive management approach, incorporating climate into this adaptive management process would be the best way to bring climate into it.
        - Is there was a plan to make this happen, or what could the Climate Resiliency Workgroup do to help facilitate? Potentially put forward to the black duck group on two levels - implementation/field level and higher management level.
- Thinking more about restoring converted wetland back to native saltmarsh.
    - Is it wise to be giving up water control structures? Black rails doing well in coastal impoundments. Getting rid of them may doom that species.
    - Most of the time it's about having populations of species the public would want (i.e. not just natural habitat).
    - Large impoundments, but a small overall percentage of total marsh.
    - Question is how long would native marsh last? Most are managed as freshwater impoundments, but could be high saltwater marsh as well. Not enough high marsh in Chesapeake Bay, see impoundments as the only option.
    - Why not adapt to these changes rather than fight them?

SAV Goals, Considerations

- The SAV Technical Synthesis 3 is coming out and will have climate considerations in it, a chapter on climate effects on SAV. Neither wetlands nor black ducks have anything similar.

Observations Regarding the Case Studies and Worksheets

- There was more comfort discussing the studies they felt were "real". If the group felt they weren't "real", people got hung up on case studies vs. real-world projects.
- Some of the case studies were very large; needed to be broken out to get the insights intended with this tool.

- Doesn’t necessarily makes sense for workgroups to apply this tool to all actions in their work plans, e.g., some of the research and education/outreach efforts, which this tool was not designed for.
- There was a strong need to understand the current permitting situation.
- Historical data was a helpful component of developing management strategies. Historical data has strongly influenced the current standards, but now we’re in new territory with climate change.
- Need more information about how the columns work, etc.
- Hard when don’t have the right experts in the room to answer needed questions.

Worksheet 1A

- In tailoring the matrices for the CBP, revise the title of the stressor column (A3) to clarify differences between existing stressors in the environment and stressors specifically related to the management action and which the management action can address.
    - There could be a column for why we are trying to restore SAV, but the purpose for the general case study could ask what the original stressors of concern are.
- In completing this process, it is important to review points that are immediately urgent and perhaps less on points that are more uncertain. There may even be prioritization within each column as well.
- Some of the strawman actions used in the exercise, e.g., the conservation easement projects, are big, hard to do the specific thinking that is required for this process. It might have been easier (and might be recommended for the future) to examine pieces of such projects separately.

Worksheet 1B

- Use of this worksheet highlighted questions related to potential conflicts between the goals of one working group (or GIT) and another, or with broader CBP goals (e.g., water quality improvement). For example, is water quality improvement an overarching objective that should be considered in evaluating the success of, and the climate change effects on, habitat-specific (e.g., SAV) restoration actions?
    - SAV group discussed possibly creating a new column for “dependencies”.
- Use of this worksheet (particularly columns B3-B6) seemed useful in encouraging thought about what constitutes success, e.g., what relation immediate success of SAV restoration has to bigger-picture success of Chesapeake Bay water quality goals, and how climate change influences these (including in terms of resilient results).
- Making a connection between the actions and water quality could be helpful, but the purview of the workgroup is really confined to SAV. The goal of SAV restoration is to accelerate expansion of restoration.
- May also need columns for outreach and education.

Activity 2 (what to add to existing work plans)

- Existing set of projects too limited, partners do projects that are too site-specific; need to expand, consider climate change.
- Working on BMPs on how to aid marsh migration; think about degradation upstream.

- Think about how to use stateside data next to site specific data – this process would help.

Other Considerations

- Where does everyone go to get information?
    - It's easier to put information where people already go, and not train them to use a different resource
    - May be helpful to link body of knowledge to other workgroup sites?
- What else could be gained by further discussion among GIT chairs to develop linkages?
    - Some kind of facilitated discussion could be necessary to get the ball rolling
- The publication of TS3 (Technical Synthesis III of SAV in the Bay) guidelines will have climate integrated within it
    - The TS3 would be used as an input for climate considerations

Recommendations

Key Points from Workshop Related to Moving Forward with Method Development

- Design (modify) the tool to support introduction of climate smart principles at higher levels of organization/decision making as well as to actions (to 'climatize' a range of CBP practices and processes). Preliminarily suggesting the following 3 levels:
    - Goals/outcomes
    - Management Strategies
    - Work Plans/Key Actions
- Simplify format of the matrix method (Adaptation Design Tool) to the extent possible (e.g., potentially use a checklist instead of tables) and provide more guidance.
- Design (modify) the framework to encourage and help direct (facilitate) needed cross-group interactions/collaboration.

Next Steps

Draft 3 levels of matrices:

- Draft a set of questions for each level in a way that guides the user to gather or generate relevant and specific climate change, program, and environmental information in a step-wise, structured fashion (as in the Adaptation Design Tool tables).
    - For example, the action-level Adaptation Tool utilizes a series of questions about the stressors that are targeted by a restoration action and how those stressors and the action itself are affected by location-specific climate changes in a way the leads the practitioner to being able to recognize and define modifications of the action that would allow it to function effectively under anticipated climate change conditions (i.e. be climate smart).
    - A similar approach for the CBP goals/outcomes level might include:
        - Initial question(s) about the main stressors or problems impacting the resource that is the target of the CBP (GIT or workgroup, etc.) goal under consideration.
        - Question(s) about the key climate change impacts on that resource target.
        - Question(s) about any relevant non-climate and climate change stressor interactions.

        - Question(s) about whether climate change influences are directly on the resource target or mediated through other ecosystem components (potentially relevant to whether the goal targets are directly management-sensitive or not).
            - An example this concept was derived from is the suggestion during the first workshop to 'conserve the stage', i.e. to manage (as a goal) for enough good black duck habitat rather than to manage for a specific number of black ducks.
        - Question(s) about uncertainties and the range of variation expected in the resource or ecosystem, or in thresholds and system changes that may be expected.
            - Would support climate-smart revisions to higher planning level goals/objectives or strategies including managing for change, or managing for a range instead of a single number.
- Questions should be reviewed, revised and expanded by the project team as needed.
- Questions can then be formatted (a guided checklist, tables/matrices, etc.) for ease of application.
- Interact with a variety of representatives of a range of GITs/workgroups/action teams to get inputs on relevant questions, question format, and method/process. The outreach/involvement should include but extend beyond the case study workgroups (black duck/wetlands and SAV) who participated in the first workshop.
- Need to include in this methods structure a prescribed (recommended) set of inter-group interactions/collaborations:
    - Some interactions identify or generate needs of one group from another at a higher level (goal to strategy), e.g., water quality needs of SAV or other fish/wildlife groups.
    - Identify 'entry points' in the planning process and in utilization of this framework where specific interactions between GITs/workgroups would generate information or actions that would be useful.

Revise the Action (Project)-Level Tables Based on Workshop Inputs

- Clarify 'target stressors' (Column A3, Worksheet 1A) with respect to typical CBP projects.
    - Clarify differences between **existing stressors in the environment and stressors specifically related to the management action and which the management action can address.**
    - For example, original stressors causing loss or impairment, versus what will be achieved (what condition addressed) by the action. In SAV restoration example, original stressors may have included nutrient and sediment runoff (poor water quality), but is replanting an SAV bed being done to improve water quality (though SAVs have water quality influence), or to provide fish/wildlife habitat, protection to marshes and shorelines, etc.?
    - A corollary question needing clarification is what metrics to use to measure project success. In the original conception of Worksheet 1A, such metrics would be linked to the stressors or conditions being addressed by the action.

    - Clarification might include an additional column (or question in a checklist) to define the proximal goal of the action (e.g., to create acres of habitat) in addition to documenting the original stressors.
    - Clarification may also include differentiating between stressors that contributed to the original loss and how the lost habitat affects the CB system.
- In worksheet 1A (or possibly 1B), may need an additional column called 'dependencies', to recognize influences of one group (e.g., water quality) on the success or functioning of an action of another group (e.g., SAV).
- May need column(s) for outreach, education.
- Need to revise and consider the more effective application of Activity 2 within a CBP-tailored action-level method, because the scope of existing projects is too limited to achieve stated goals.
    - This may integrate with the processes for the other levels.
- Improve guidance on what the content/intent of each column is supposed to be.
- (Potentially) revise format from table to checklist (consistent with what is done above for other levels).

Plan for the next workshop

- Include but extend beyond the case study workgroups (black duck/wetlands and SAV) who participated in the first workshop.
- Schedule to have enough time for a reasonable round of 'one-on-one' interactions with GIT/workgroup.
- Focus on broader development of the method rather than 'going deeper' with the existing case studies, including review/application of the 3 levels of 'matrices' (checklists), and the framework.

Next Steps

- Project timeline: synthesis and results write-up due by September 1, 2017.
- The next step is to move through another set of workshops in the spring that will serve to refine the tool and build off of what was completed during this workshop. Other ideas included following up via a webinar and continue to receive feedback on the process and tool.
    - What should the focus of this second set of workshops be? The organizers will be reaching out from the workshop regarding summaries and notes. The feedback may help to best determine what the best next step is in the context of the larger program.
    - What to accomplish during 2nd set of workshops – continue to refine matrix with black ducks and tidal wetlands? Further process with other groups? Or something else?
    - Hammer out next steps for applying this process more broadly.
- Different formats for the workshop being implemented were discussed. One was a reproduction of what was done here (those in more of the climate camp), and one that is lighter for those planners or managers who many not have the background to run through the entire process as well.
- Think about how to pare down the tool and the tables, then give guidance on how to apply it to other workgroups,

    - Make a goal for the climate group to work with a set number of workgroups on it in the future.
- Look at current management practices and processes and “climatize” it. See Attachment 5 for sample of “climatized” SAV management strategy. The concern from workgroups re: this process is that they aren’t open to reopening their management strategies to redefine them.
- Value in history of thought in developing strategies from this workshop.
- Understanding how to manage a risk and manage the process would be useful moving forward.
- This may be a paradigm shift and would involve more capacity building like adding additional trainings.

Attachment 1

CBP Climate Smart Habitat Restoration Workshop

Participant List

CBP Climate Smart Habitat Restoration Workshop

Participant List

Name	Affiliation	E-mail
Project Team		
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Attachment 2

CBP Climate Smart Habitat Restoration Workshop

Agenda

Chesapeake Bay Program
Climate Smart Habitat Restoration Workshop: SAV & Tidal Wetlands/Black Duck

A workshop in support of the CBT Project: Cross-Goal Climate Resiliency Analysis and Decision-Making Matrix and Implementation Methodology

National Conservation Training Center
698 Conservation Way
Shepherdstown, WV 25443

Main Room - Instructional East Room #114

Breakout Groups – Room #103 (SAVs) & 107 (Wetlands/Black Ducks)

AGENDA

Day 1: Tuesday, November 15, 2016

9:30 – 10:00 AM	**Sign-in, distribute materials**	***Main Room (114)***
10:00 – 10:15 AM	**Welcome & Introduction to Workshop** *Zoe Johnson (CBP/NOAA) & Anna Hamilton (Tetra Tech)*	***Main Room (114)***
	[No formal break – refreshments available]	
10:30 – 11:00 AM	**Overview of Climate Smart, Adaptation Design Tool** *Anna Hamilton (Tetra Tech) & Jennie Hoffman (Adaptation/Insight)*	***Main Room (114)***
10:45 AM – 12:00 PM	**Breakout Groups: Work through Adaptation Design Tool/Activity 1 for 2-4 management actions** **SAVs** **Wetlands/Black Ducks** *Facilitators: Jennie Hoffman (Adaptation/Insight) & Hope Heron (Tetra Tech)*	 ***Room 103*** ***Room 107***
12:00 – 1:20 PM	**LUNCH (Cafeteria available on-site)**	
1:20 – 1:30 PM	**Reconvene & Brief Check-in** *Anna Hamilton (Tetra Tech)*	***Main Room***
1:30 – 2:45 PM	**Continue Breakout Group Work** **SAVs** **Wetlands/Black Ducks** *Facilitators: Jennie Hoffman (Adaptation/Insight) & Hope Heron (Tetra Tech)*	 ***Room 103*** ***Room 107***
2:45 – 3:00 PM	**BREAK**	
3:00 – 4:00 PM	**Continue Breakout Group Work** **SAVs** **Wetlands/Black Ducks** *Facilitators: Jennie Hoffman (Adaptation/Insight) & Hope Heron (Tetra Tech)*	 ***Room 103*** ***Room 107***
4:00 PM – 5:00 PM	**Reconvene, Brief Report-outs, Compare Key Outcomes** *Anna Hamilton (Tetra Tech), Jennie Hoffman (Adaptation/Insight) & Hope Heron (Tetra Tech)*	***Main Room***

Day 2: Wednesday, November 16, 2016

9:00 – 9:20 AM	**Recap of Key Outcomes from Activity 1 Matrices** *Anna Hamilton (Tetra Tech)*	***Main Room***
9:20 – 10:15 AM	**Breakout Groups: Explore Activity 2 of the Design Tool, Other types of management actions** **SAVs** **Wetlands/Black Ducks** *Facilitators: Jennie Hoffman (Adaptation/Insight) & Hope Heron (Tetra Tech)*	 ***Room 103*** ***Room 107***
10:15 – 10:30 AM	**BREAK**	
10:30 – 12:00 PM	**Breakout Groups: Emerging Insights from the Design Tool exercise (information gaps, successes/issues, topics not covered, cross-over between workgroups)** **SAVs** **Wetlands/Black Ducks** *Facilitators: Jennie Hoffman (Adaptation/Insight) & Hope Heron (Tetra Tech)*	 ***Room 103*** ***Room 107***
12:00 – 1:15 PM	**LUNCH (Cafeteria available on-site)**	
1:15 – 2:00 PM	**Breakout Groups: Decision context, applying results to decisions** **SAVs** **Wetlands/Black Ducks** *Facilitators: Jennie Hoffman (Adaptation/Insight) & Hope Heron (Tetra Tech)*	 ***Room 103*** ***Room 107***
2:00 – 2:15 PM	**BREAK (FLEXIBLE)**	
2:15 – 3:45 PM	**Reconvene, Group Comparisons; Factors to Consider Across Grps** *Anna Hamilton (Tetra Tech), Jennie Hoffman (Adaptation/Insight) & Hope Heron (Tetra Tech)*	**M*ain Room***
3:45 – 4:00 PM	**Wrap Up: Project Timeline & Next Steps** *Zoe Johnson (CBP/NOAA)*	

Attachment 3

Relative Wetland Vulnerabilities Workshop

Presentations

PRESENTATIONS INCLUDED:

CBP Workshop Intro-Overview 11.14.16.pdf

CBP Workshop 2nd Day.pdf

CBP Workshop Intro-Overview 11.14.16.pdf

CBP Climate Resiliency Workgroup

CLIMATE SMART HABITAT RESTORATION WORKSHOP

USFWS Conservation Training Center
November 15, 2016

Introduction

Introductions
Project Team

- Zoe Johnson, CBP Technical Lead
  Susan Julius, EPA Technical Lead
  Anna Hamilton, Tetra Tech Project Manager
  Jennie Hoffman, Adaptation Insight, Facilitator
  Hope Herron, Tetra Tech, Facilitator
- Jordan West, EPA
-
  David Gibbs, EPA
  Paige Hobough, EPA
  Melissa Merritt, CBP
  Kyle Hinson, CBP

Introductions
Workshop Participants

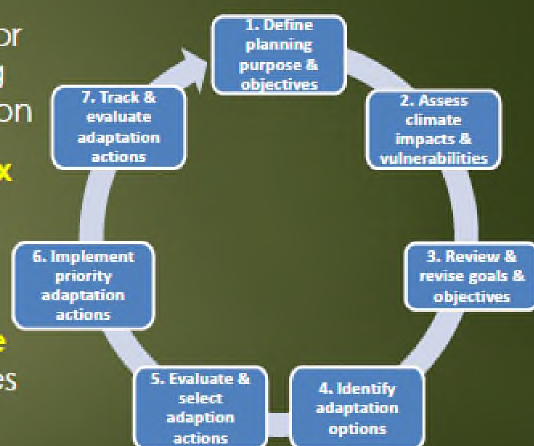
- Name/affiliation/interest
- Perspective for the workshop

Climate Resiliency Goals
Why 'Climate Smart' & This Process?

- Climate change is affecting our work and living resources at multiple scales
- We need to address this reality to achieve our goals
- How the heck do we do that??

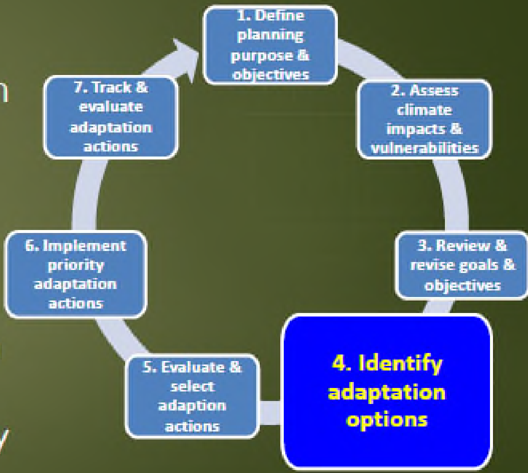
Project Objectives

- **Advance climate resilience objectives** for Chesapeake Bay Agreement – including application of Climate-Smart conservation
- Working toward **development of a matrix methodology** that will work across the GITs/workgroups
- Use a regionally developed framework/methods to **integrate climate change** into CBP management strategies and actions
- Engage with selected GITs/workgroups as **case studies**



Workshop Objectives

- Start the process through exploratory use of the Adaptation Design Tool to CBP restoration targets
  - Case study groups - Black Ducks/Wetlands & SAVs
  - Example management actions to take through the Adaptation Design Tool
  - This is the start - won't get all the way there in this workshop



Workshop Approach

- Start at the bottom, work up…
- Gain 'emerging insights" –
  - Does it make sense in the context of what different GITs/workgroups do?
  - Relevance to other steps in the planning cycle –goals, influencing factors, scale of vulnerability information

Workshop Process

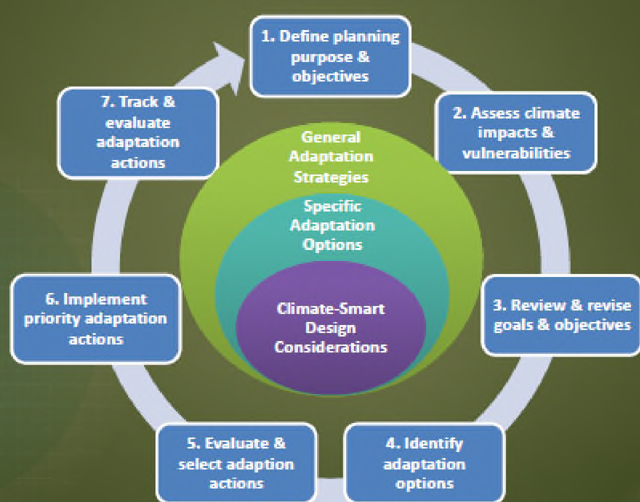
- First – a little recap of the Climate Smart & Design Tool principles from the pre-workshop call
- Breakout groups to do the 'real work'
- Today's breakouts on Activity 1(see agenda)
  - Familiarize you with the example management actions
  - Work on Tables 1A & 1B
  - End today with a check in on progress/outcomes
- Tomorrow
  - Breakout to work on Activity 2, emerging issues & insights, and the decision context
  - Close by reconvening to consider issues across GITs/workgroups & next steps

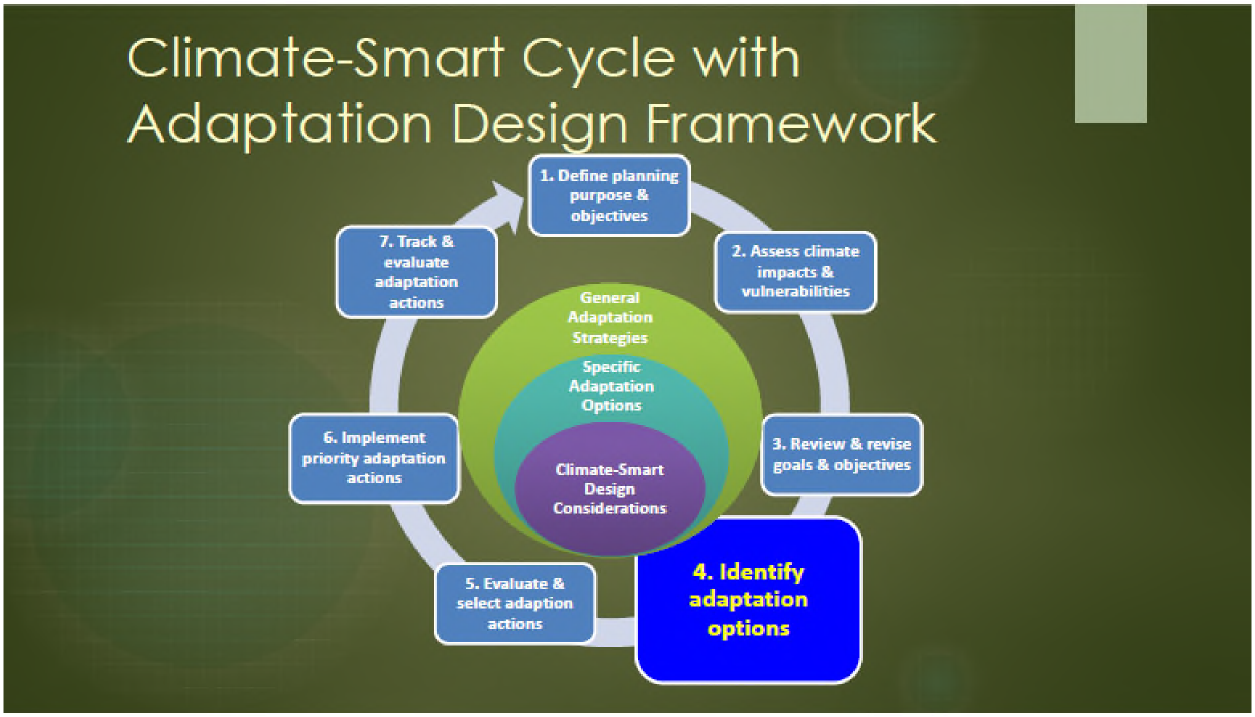
Next Steps

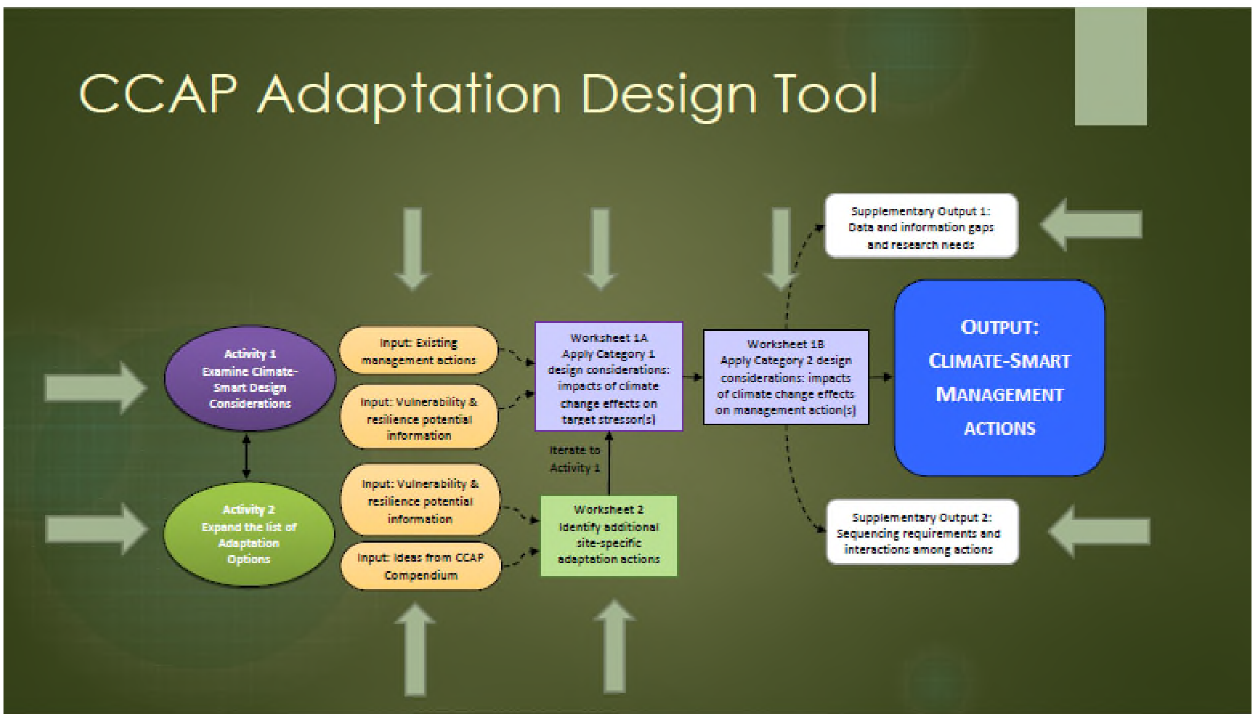
- Summarize what we learned from this workshop
- Use workshop results and further engagement to:
  - Revise the Tool / develop the framework
  - Consider applicability across different GITs/workgroups
  - Consider applicability at multiple levels

Overview

Climate-Smart Cycle with Adaptation Design Framework




Climate-Smart Cycle with Adaptation Design Framework
1. Define planning purpose & objectives
2. Assess climate impacts & vulnerabilities
3. Review & revise goals & objectives
4. Identify adaptation options
5. Evaluate & select adaption actions
6. Implement priority adaptation actions
7. Track & evaluate adaptation actions
General Adaptation Strategies
Specific Adaptation Options
Climate-Smart Design Considerations


CCAP Adaptation Design Tool
Activity 1 Examine Climate-Smart Design Considerations
Activity 2 Expand the list of Adaptation Options
Input: Existing management actions
Input: Vulnerability & resilience potential information
Input: Vulnerability & resilience potential information
Input: Ideas from CCAP Compendium
Worksheet 1A Apply Category 1 design considerations: impacts of climate change effects on target stressor(s)
Iterate to Activity 1
Worksheet 2 Identify additional site-specific adaptation actions
Worksheet 1B Apply Category 2 design considerations: impacts of climate change effects on management action(s)
Supplementary Output 1: Data and information gaps and research needs
OUTPUT: CLIMATE-SMART MANAGEMENT ACTIONS
Supplementary Output 2: Sequencing requirements and interactions among actions

Worksheet 1A

A1	A2	A3	A4	A5	A6	A7
Action number	Existing management Action	Target stressor(s)	Climate change effects on stressors (direction, magnitude, mechanism, uncertainty)	Timing of climate change effects	Implications of A4 & A5 for effectiveness metrics & how to measure them	Notes
1	Install terraces adjacent to dirt roads	Sediment/ nutrients	Heavy rainfalls after dry periods will lead to increased runoff; changing seasonal patterns less understood (moderate magnitude, high uncertainty)	Longer dry periods already occurring, trends of increasing summer heavy rainfall events observed	Monitoring will have to be timed/located to catch effects of extreme events coupled with dry periods	More info needed on spatial patterns of drying and rainfall and location of worst erosion

Worksheet 1B

B1	B2	B3	B4	B5	B6	B7	B8
Action number	Existing Management Action	Changes in effectiveness of management action due to: climate impacts on target stressor	Changes in effectiveness of management action due to: climate impacts on management action	Time frame or constraint for using the action (e.g., urgency, longer or shorter term)	What changes are needed to adapt the action (place, time, and engineering design)	Climate-Smart Management Action	Notes
1	Install terraces adjacent to dirt roads	Heavy rainfall events following dry periods may overwhelm capacity of terraces	Terraces themselves could be destroyed by extreme events	Life of these practices is 5-10 yrs; need to plan ahead for strategic placement in combination with other actions	Need to adapt action spatially, design terraces to withstand extreme events	Install terraces resistant to extreme events adjacent to targeted roads	How heavy a rainfall event will destroy a standard terrace?

Worksheet 2

1	2	3	4	5
General Adaptation Strategy	Definition	Potential New Site-Specific Action	Key Vulnerabilities Addressed	Notes
Protect key ecosystem features	Focus management on structural characteristics (e.g., geophysical stage), organisms, or areas (e.g., spawning sites) that represent important "underpinnings" or "keystones" of the current or future system of interest)	• Expand or duplicate the herbivore replenishment areas in reefs in the 5 watersheds and adjacent source areas in Olowalu, North Kihei • Protect some of the most durable reef areas (reefs that have survived multiple stressors) as being resilient to multiple stressors	Coral bleaching impacted reefs in 2014 – 2015	Attention to adjacent source areas in addition to the managed reefs associated with the 5 watersheds may extend the area of managed reefs, may require review of goals & objectives

Expectations

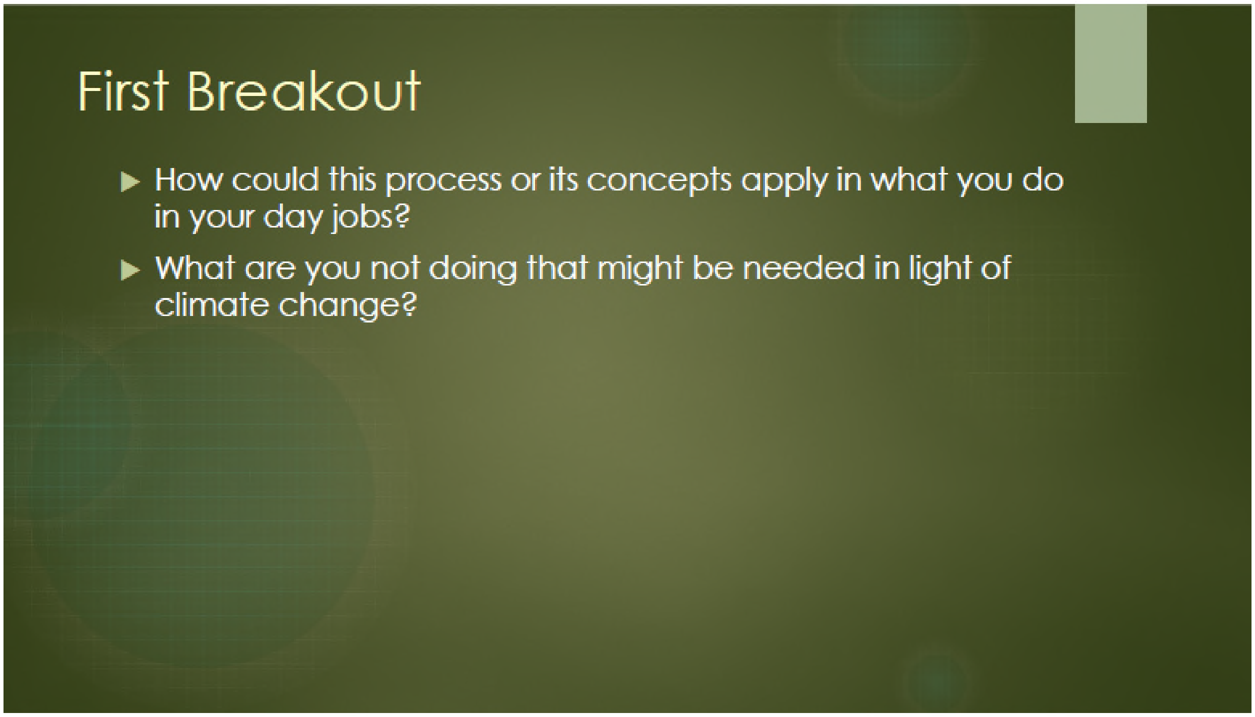
- The input info should be realistic, but doesn't have to be perfect
  - Insights, not answers
  - Expertise in the room is real and critical
- Acting under uncertainty identified as roadblock
  - This Tool: identify but don't go deep (park it in Notes)
  - Deciding how to handle it happens later
- Workshop materials are posted under the "Meetings" Tab on: http://www.chesapeakebay.net/groups/group/climate_change_workgroup

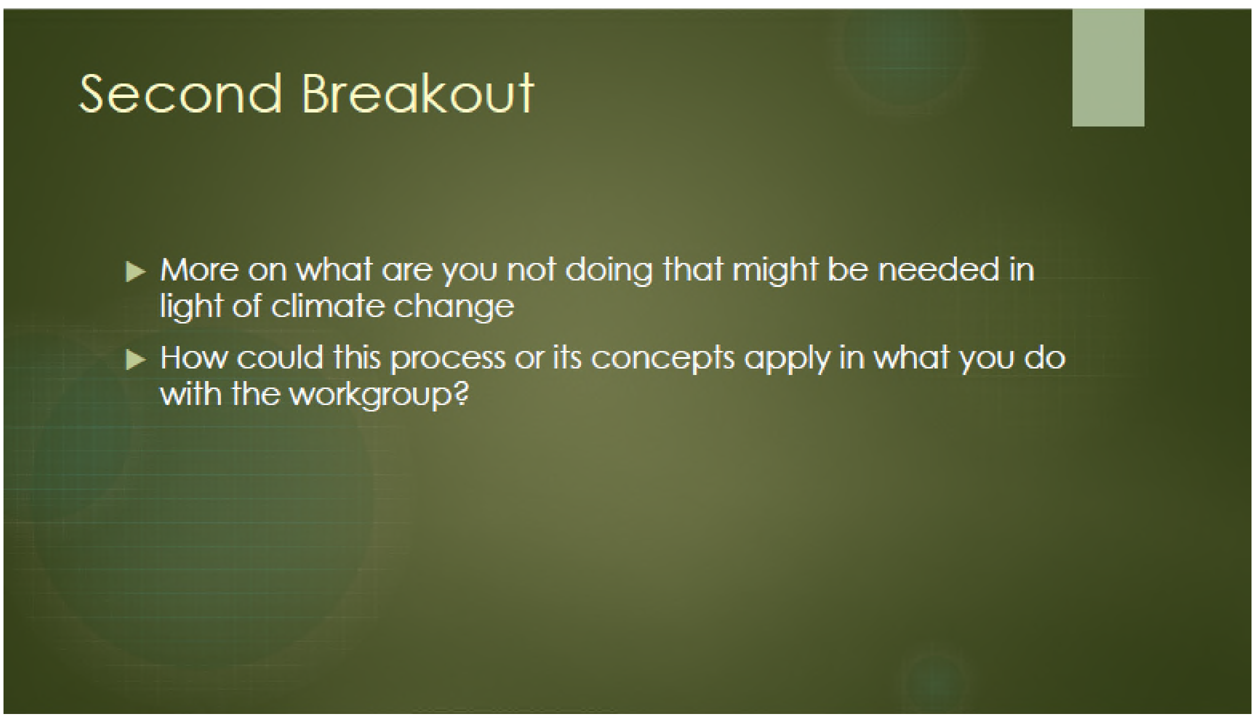
Breakout Group Assignments

SAVs		
Name	**Affiliation**	**Interest**
Andrew Winn	EPA Region 3	general
Bob Murphy	Tetra Tech	SAV
Brooke Landry	MD DNR	SAV
Christopher Spaur	USACE	SAV/wetlands
Jennifer Greiner (1)	CRC	general
Kristy Beard	NOAA	SAV
Kyle Runion	CRC	general
Mark Bennett	USGS	process
Rebecca Swerida	MD DNR	SAV
Stan Kollars	Earthlink	SAV

Black Ducks/Wetlands		
Name	**Affiliation**	**Interest**
Alicia Berlin	USFWS	black duck
Benjamin Lewis	VA DGIF	black ducks
Bill Harvey (1)	MD DNR	black ducks
Darlene Finch	NOAA	wetlands
David Whitehurst	DGIF	Wildlife
Erin McLaughlin	MD DNR	wetlands
Gary Constanza	VA DGIF	black ducks
Josh Homyak	MD DNR	black ducks
Kathy Boomer	TNC	wetlands
Mike Slattery	USFWS	black ducks
Nicole Carlozo (1)	MD DNR	wetlands
Regina Poeske	EPA Region 3	wetlands
Sarah Wilkins	CBSSC	Wetlands
Tim Jones	USFWS	black duck

CBP Workshop 2nd Day.pdf





Plenary

- Report-out on each workgroups' potential applications of this process
- How can the climate resiliency workgroup help you?
- How do you work with the other workgroups (synergies, opportunities)?

Attachment 4

Relative Wetland Vulnerabilities Workshop

Compilation of Breakout Session Notes

Black Duck Scenarios & Strawman Actions

Scenario 1: Chesapeake Rivers Conservation Phase II

Background: This is Phase II of four anticipated NAWCA proposals that contribute to a long-term, landscape-scale effort to protect and restore wetland habitat in the Choptank, Nanticoke, Wicomico, and Pocomoke River watersheds, four of the most pristine watersheds of the Chesapeake Bay in Maryland. These watersheds are renowned for verdant tidal and non-tidal wetland complexes that support notable plant and wildlife biological diversity, including a significant number of rare species. These watersheds encompass four Waterfowl Focus Areas for the Atlantic Coast Joint Venture (ACJV), primarily due to the large expanses of coastal marshes and submerged aquatic vegetation beds that provide excellent shelter and forage for migrating waterfowl like American black duck and several other high priority species. The Blackwater-Nanticoke River Focus Area alone supports 35% of all wintering waterfowl using the Atlantic Flyway. The major historical shift from forest to agriculture on the Delmarva Peninsula, and the accompanying wetland drainage, has resulted in significant opportunity to restore prior-converted agricultural lands.

The project affects 856 acres of estuarine wetlands, 359 acres of palustrine forested wetlands, and 40 acres of palustrine emergent wetlands – all declining wetland types. Following are examples of priority species that will benefit from these habitats: Waterfowl – American black duck, northern pintail, wood duck, and mallard, Neotropical Migrants – prothonotary warblers, Kentucky warblers, wood thrush, and worm-eating warblers, Others – American woodcock, Delmarva fox squirrel, Atlantic and shortnose sturgeon.

Strawman Project: The goal of the Chesapeake Rivers Conservation II partnership is to provide an additional 2,284 acres of permanently protected high quality stopover and nesting habitat for migratory waterfowl and neotropical migrants. It will add 386 acres of conservation easements to the Blackwater National Wildlife Refuge (the Green, Wells, and Wheatle tracts), secure perpetual conservation easements on another 1,898 acres of private lands (the Leese, Harding, and Quantico tracts), and restore important wetlands on another 38.5 acres (the Choptank Watershed Wetland Restoration Program).

Information and considerations: With agriculture as the dominant land use, these Focus Areas are considered rural when compared to nearby metro-areas, but recent human population growth trends are concerning. The average population growth rate of Eastern Shore counties between 1990 and 2004 was 20% which was 4% higher than the population growth of the entire state of Maryland. Projected growth rates for the Eastern Shore through 2030 are even higher at over 32%. Considering this, it is unsurprising that a primary conservation recommendation by the ACJV WIP is reducing the threat of residential development, both to immediate habitat and downstream aquatic resources like submerged aquatic vegetation (SAV) beds and marshes, by protecting existing rural lands.

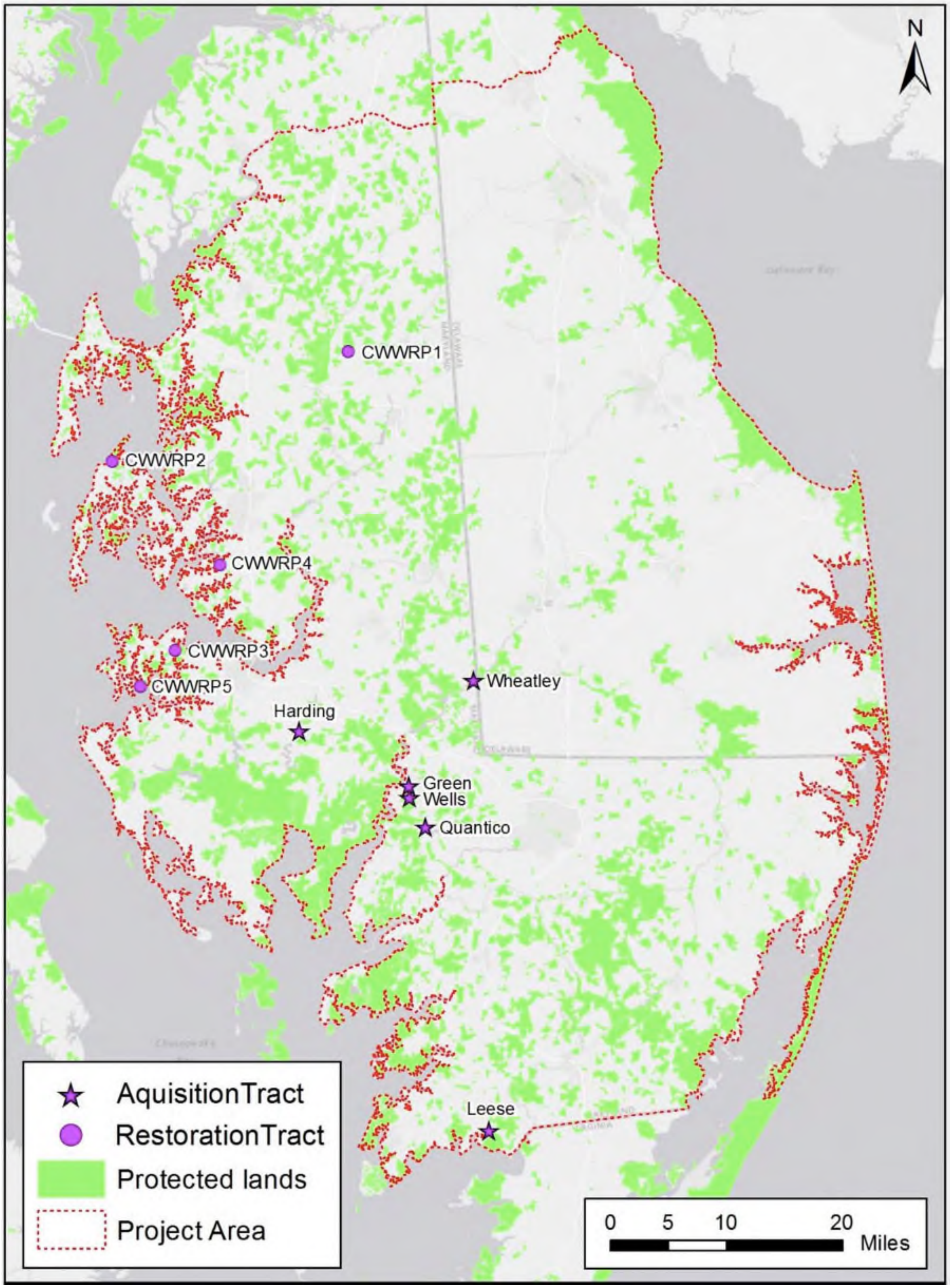
The Leese tract contains 807 acres of significant declining wetland habitat within an area identified by the Black Duck Decision Support Tool as priority black duck habitat in the Chesapeake Bay. The tract is adjacent to the 900-acre Pocomoke Sound State Wildlife Management Area, and sits on Marumsco Creek, a tributary of Kitts Creek, whose waters are protected as a 1,000-acre state oyster sanctuary that also supports large numbers of wintering and migrating waterfowl.

The 420-acre Harding tract is located in a critical corridor between the sprawling city of Cambridge and the Blackwater NWR, and it is directly adjacent to several other protected properties. The Harding tract contains 44 acres of palustrine forested wetlands that border The Nature Conservancy's Blackwater River matrix forest block which is defined as an area that, if protected and allowed to regain its natural condition, would serve as a critical source area for all species requiring interior forest conditions.

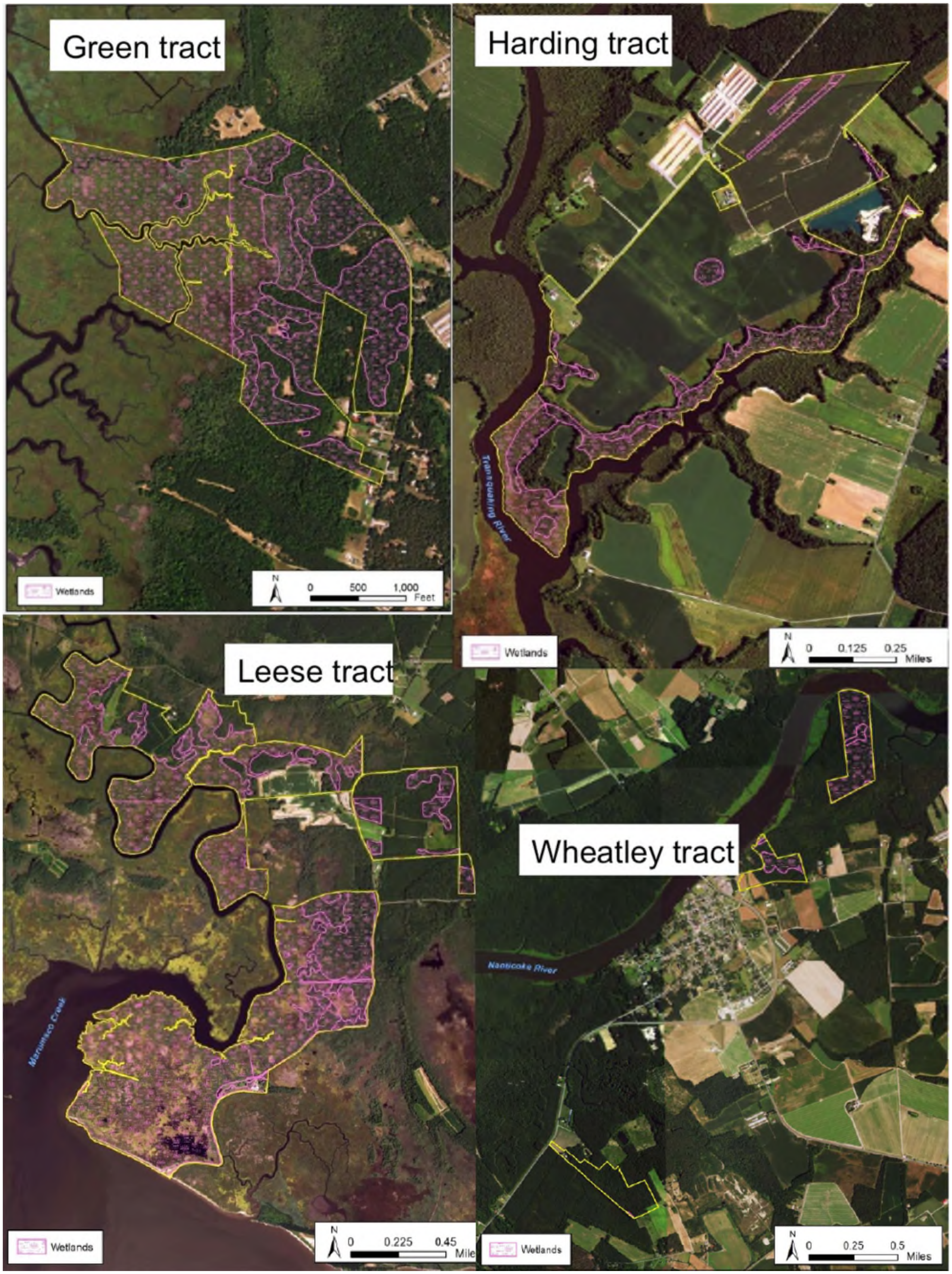
The 478-acre Quantico tract consists of 52 acres of forested wetlands, 64 acres of emergent wetland, and 130 acres of forested upland, and abuts the state owned Nanticoke River Wildlife Management Area. Protection of the Quantico tract will create an important wildlife corridor of native forest and adjacent farmland which will provide habitat for the recently delisted Delmarva fox squirrel as well as numerous neotropical migratory songbirds and raptors

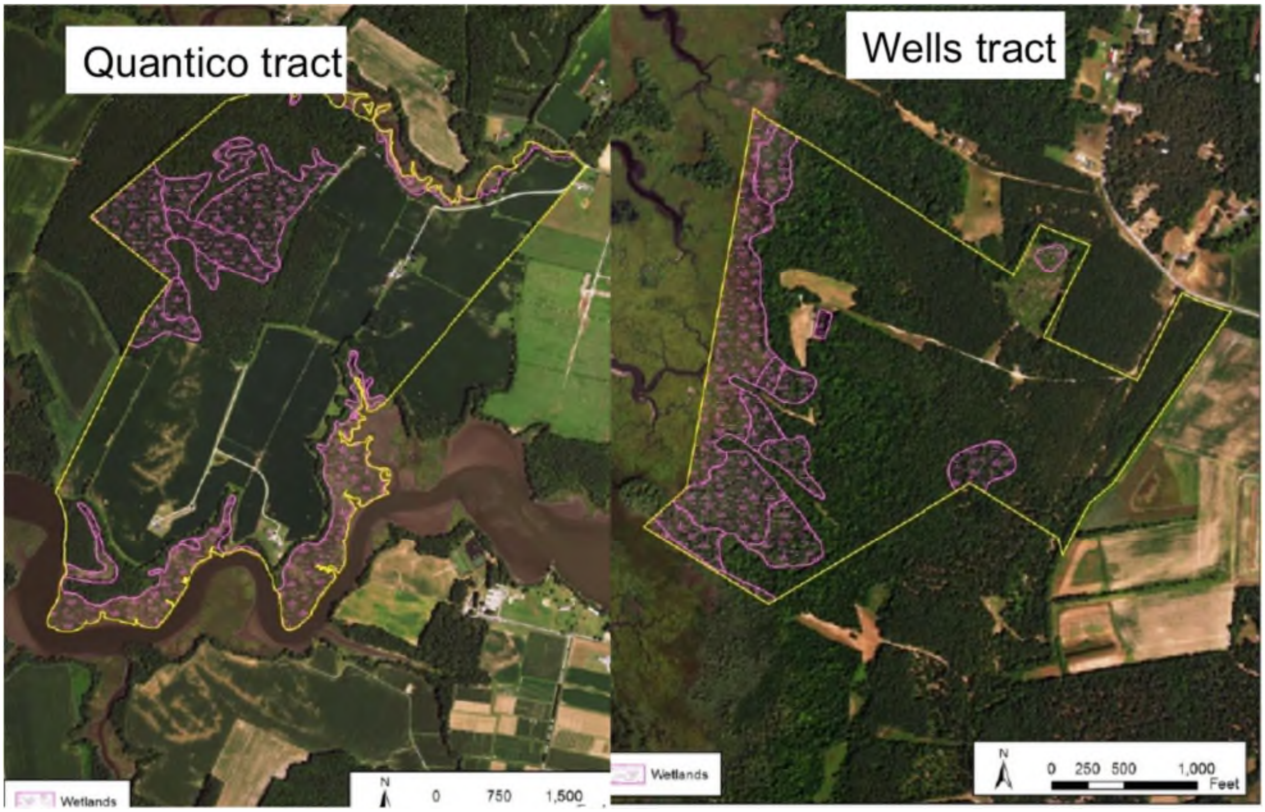
The Green, Wells, and Wheatley tracts are all located within Blackwater NWR's acquisition boundary along the Nanticoke River. One of the last relatively pristine, major watersheds on Maryland's lower Eastern Shore, the Nanticoke River watershed comprises low-lying marshlands, wooded swamps, floodplain forests, loblolly pines, and floodplain agricultural fields. It is the least developed segment of a major river valley in the state, and harbors the largest intact pine forest on the Delmarva Peninsula. The three tracts combined contain 243 acres of tidal and non-tidal marshes and wooded swamps. Conservation easements held by the USFWS will be placed on all three tracts in order to protect key wildlife and wetland habitats. Blackwater NWR, to which these easements will be incorporated, is important primarily as migrating and wintering habitat for waterfowl, and is also one of the Chesapeake Bay's most productive estuarine assets, supporting diverse aquatic and emergent plant and animal communities.

The Choptank Watershed Wetland Restoration Program (CWWRP) sites in this proposal include five individual restoration projects which are part of Ducks Unlimited's (DU) CWWRP. These five projects collectively total nearly 39 acres of restored wetland and adjacent buffers. All five projects restored prior-converted agricultural lands to native emergent wetland. Restoration techniques included discontinuing active agriculture, removing drainage mechanisms (ditches or drainage tile), constructing low berms, minor contouring of wetland interior, installation of water control structures, and planting adjacent buffers. Landowners at each of these tracts have signed 30-year agreements committing to managing the restored areas as moist-soil, emergent wetland for the benefit of migratory waterfowl. These projects also reduce transport of excess nutrients and sediment from agricultural runoff into tidal tributaries of the Chesapeake Bay, resulting in downstream habitat and water quality improvements.



Project area, grant tracts, and protected lands. Project area is combined boundaries of the Choptank, Nanticoke, Wicomico, and Pocomoke River watersheds.


Green tract
Wetlands
N
0 500 1,000
Feet
Harding tract
Transquaking River
Wetlands
N
0 0.125 0.25
Miles
Leese tract
Marumsco Creek
Wetlands
N
0 0.225 0.45
Mile
Wheatley tract
Nanticoke River
Wetlands
N
0 0.25 0.5
Miles



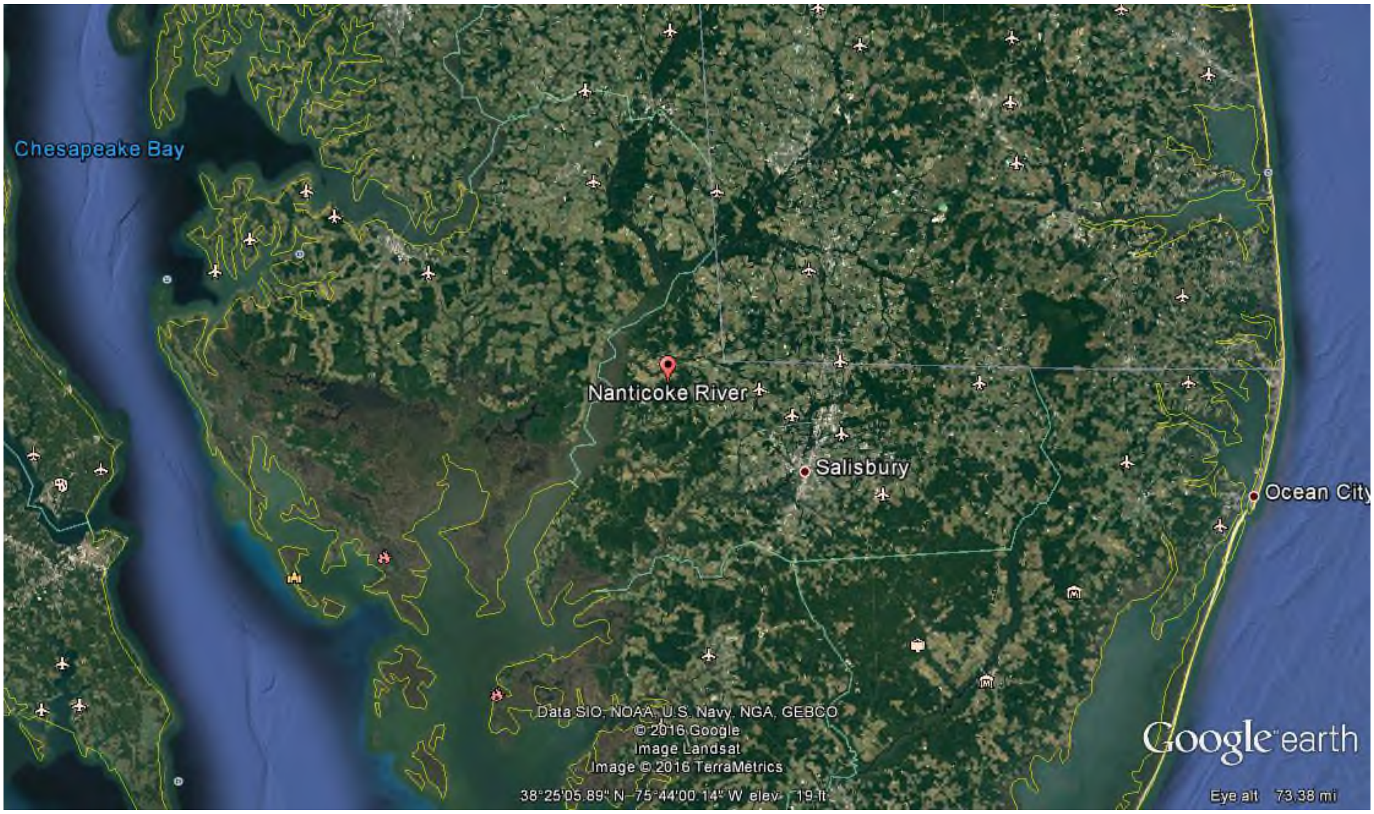
Aerial images of property boundaries for each tract (yellow) with national wetland inventory overlay to denote wetland habitats on each property.

Scenario 2: Nanticoke Watershed Improvement Project (Maryland)

Background: The Nanticoke River is a major tributary of the Chesapeake Bay on the Delmarva Peninsula. The River remains one of the most diverse and intact in the Chesapeake Bay watershed. The River's coastal marshes have long been recognized for their significance in providing habitat for a wide variety of flora and fauna. A trip along the bottomland forests could yield abundant opportunities to see a number of wading birds and waterfowl, as the marshes are extremely productive and support a wide variety of birds. Bald eagles frequent the River in search of food. Home to hundreds of rare, threatened and endangered species, the Nanticoke provides some of few places you can find some globally rare plant and animal species in Maryland, including Harper's beakrush, Parker's pipewort, wild lupine and box huckleberry, and unique plant communities - such as Atlantic white cedar non-tidal wetlands and xeric sand ridge forest. However these fragile ecosystems and their biodiversity are at threat from a noxious reed, *Phragmites australis*. *Phragmites* is a non-native, invasive perennial plant that grows in wetlands and along roadsides and shorelines throughout the Chesapeake Bay watershed. Following hurricane Sandy in 2012, *Phragmites* began to invade the once pristine wetlands of the Nanticoke River.

Strawman Project: In order to perpetuate and improve waterfowl use of this River during migration, this project will result in the eradication of *Phragmites* on 1,500 acres of public and private lands along the Nanticoke River. It will improve the long-term health of marsh vegetative communities, resulting in more resilient tidal wetland systems, and will improve wetland habitat by increasing areas of wild rice, a high energy food for migrating waterfowl. Treatment of *Phragmites* flare-ups will use aerial and ground herbicide applications. The control work will be conducted by certified contractors specializing in wetland invasive plant management.

Information and considerations: A helicopter will be used to apply herbicide as it is the most efficient and effective means of application. The broad-spectrum herbicide, glyphosate (which is commercially available as Rodeo®, among others,), is known to control *Phragmites* and is approved by the U.S. Environmental Protection Agency for wetland use. Given historic results, the employment of glyphosate is preferred for this application. MD DNR staff and the helicopter pilot will use maps produced via GIS to fly transacts within the Nanticoke watershed and apply herbicide onto the selected stands of *Phragmites* that are monopolizing the landscape in important wildlife areas. The project will benefit current and future Refuge lands located within the Nanticoke River Unit of the Chesapeake Bay Marshlands National Wildlife Refuge Complex. All eradication operations will take place within the acquisition boundary of the Nanticoke Unit of the Refuge which will result in improved water quality and wetland function within the Nanticoke watershed and at the adjacent Blackwater Unit of the Chesapeake Marshlands NWR.



Chesapeake Bay
Nanticoke River
Salisbury
Ocean City
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2016 Google
Image Landsat
Image © 2016 TerraMetrics
38°25'05.89" N 75°44'00.14" W elev 19 ft
Google earth
Eye alt 73.38 mi

Scenario 3: Rappahannock River Conservation Partnership Phase I

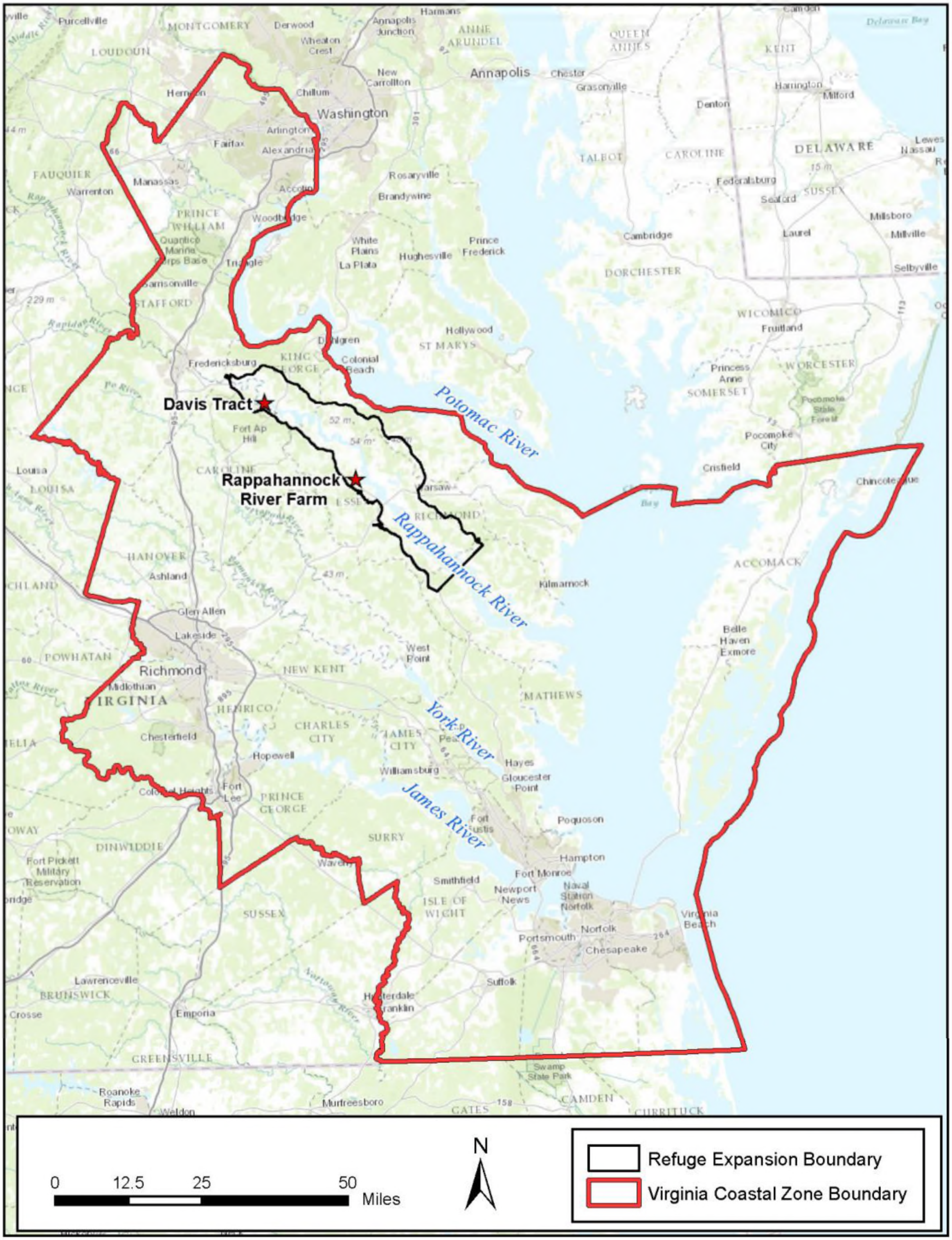
Background: This is the first of several project phases to permanently protect strategic coastal properties, consisting of diverse wetland and upland habitats in the project area, which is defined as the entire coastal zone of Virginia, spanning 29 counties and 19 independent cities. Specifically, this proposal seeks to secure 3,888 acres of perpetual conservation easements on strategic properties situated along the Rappahannock River, within the Rappahannock River National Wildlife Refuge expansion boundary. This project, which will advance adaptation and resilience in the face of climate change, is located in the Atlantic Coast Joint Venture's (ACJV) Rappahannock River Waterfowl Focus Area, as well as a RAMSAR wetland of international importance, and significantly contributes to the goals of the national and regional bird conservation plans. The Rappahannock River supports six priority species: American black duck, mallard, northern pintail, greater and lesser scaup, and the southern James Bay population of Canada goose. Other priority species found within the project area include: wood duck, canvasback, redhead, ring-necked duck, and American widgeon. Other species observed during mid-winter or other aerial surveys include: gadwall, American green-winged teal, blue-winged teal, shoveler, goldeneye, bufflehead, ruddy duck, scoters, sharp-tailed duck, hooded, red-breasted, and common mergansers, snow goose, and tundra swan.

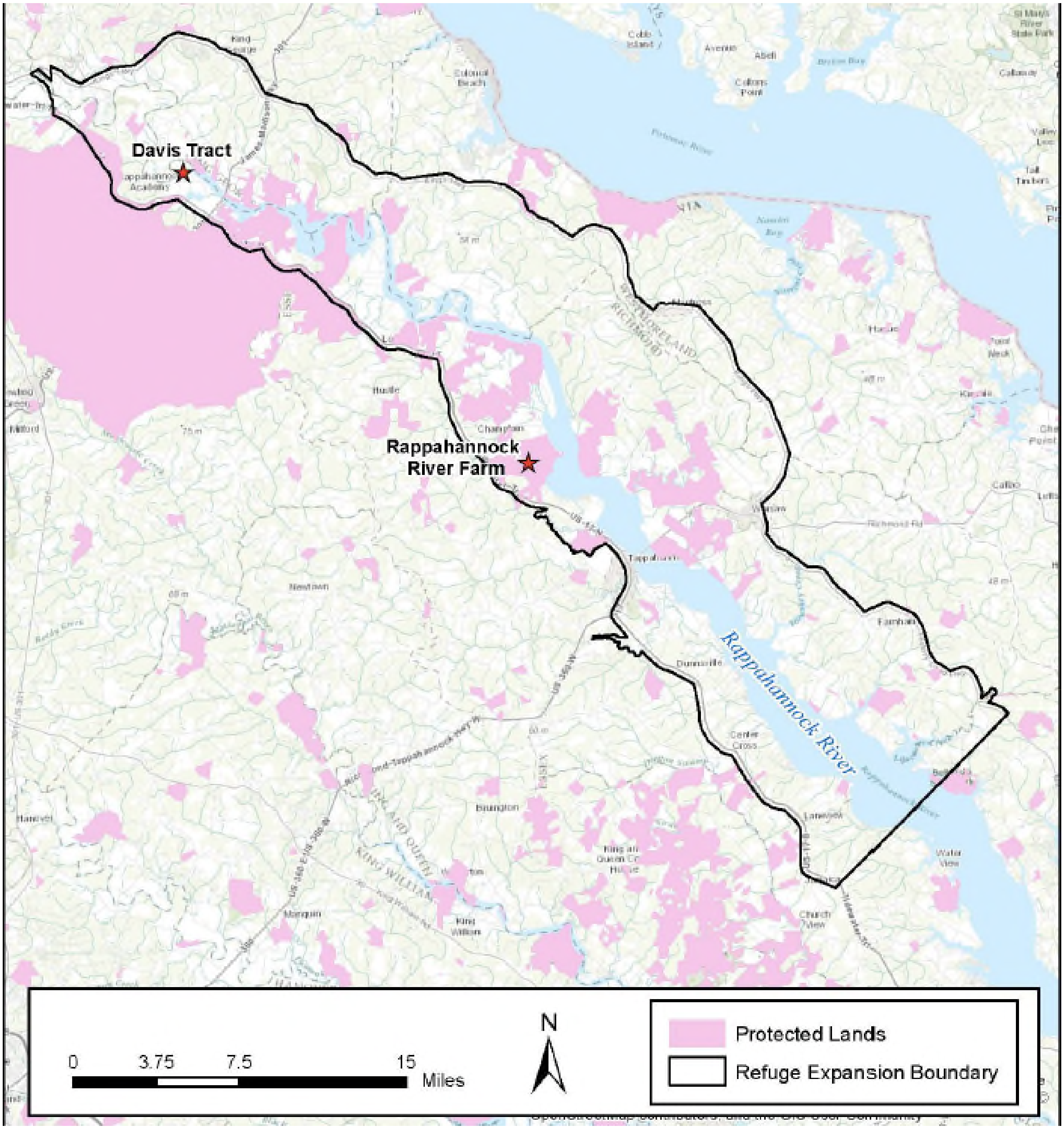
Strawman Project: Perpetually protect over 3,888 acres within the Rappahannock River Valley National Wildlife Refuge expansion boundary. This includes the 488-acre Davis Farm tract and the 3,434-acre Rappahannock Farm Tract. The Davis Farm tract, which includes 201 acres of declining wetlands, 31 acres of palustrine emergent wetlands, 160 acres of palustrine forested wetlands, 10 acres of palustrine shrub scrub wetlands) and 279 acres of associated forested upland habitat, will be protected via perpetual easement to benefit breeding, migrating and wintering birds following the conservation recommendations and goals of the ACJV and the North American Bird Conservation Initiative. The Rappahannock River Farm tract will protect 256 acres of declining wetlands (5 acres of palustrine emergent wetlands, 103 acres of palustrine forested wetlands, 480 acres of palustrine shrub scrub wetlands), 652 acres of estuarine wetlands, and 2,492 acres of upland. Future project phases will protect additional tracts within the Rappahannock River NWR Expansion Boundary, as well as other strategic properties within the project area.

Information and considerations. The Rappahannock River Valley provides productive habitat for a diverse array of flora and fauna. Some of this species diversity can be attributed to the fact that the Rappahannock River watershed lies at the geographic southern limits for many northeastern species, and at the northern limits for many southeastern species. The Rappahannock River Valley is strategically located along the Atlantic Flyway and is a major tributary to the Chesapeake Bay.

The 3,434 acre Rappahannock River Farm tract is comprised of 720 acres of agricultural fields (a portion of which are maintained as wildlife food plots) and 1,772 acres of mixed hardwoods/pine forest, with wetlands on the Rappahannock River, Sluice Creek, Lewis Creek, Quioccasin Creek, Farmer's Hall Creek, and Broad Creek. The property contains a total of 9.8 miles of riparian corridors as a result of extensive water frontage. A tidal oligohaline marsh system is located along Broad Creek. The property perpetually protects 908 acres of diverse wetland types and contains numerous drainages and several ponds. The farm is operated in a small grain rotation, with extensive areas managed for quail and wildlife habitat. The farm is used as a hunting preserve with various forms of hunting conducted on the property including quail hunts, duck hunts, deer hunts, and sport clay shooting. Several areas are managed for duck hunting with wildlife planting and seasonal water impoundments.

The Davis tract protects 2.3 miles of riparian habitat along the Rappahannock River. Emergent wetlands will provide forage and nesting habitat for dabbling ducks like mallards and American black ducks and protected riparian shoreline provides sheltered loafing and foraging areas for all waterfowl. The purchase of the Davis tract will be broken into two phases as the tract is comprised of four tax parcels owned by the same land owner. The first 126 acre phase (Davis Phase 1 in the work plan) will be protected via a perpetual easement. A perpetual conservation easement over the remaining acreage will be purchased with grant and match funds provided by the Department of Defense, Readiness and Environmental Protection Integration (DOD, REPI) Program. Virginia Outdoors Foundation (VOF) will hold both easements and a NAWCA notice of grant requirements will be placed over both easements. Easement acquisition of the Davis tract will help ensure that incompatible land uses, including development, do not encroach upon the Rappahannock River NWR and other protected lands along the Rappahannock River.


Davis Tract
Rappahannock River Farm
Potomac River
Rappahannock River
York River
James River
Washington
Annapolis
Richmond
0 12.5 25 50 Miles
N
Refuge Expansion Boundary
Virginia Coastal Zone Boundary



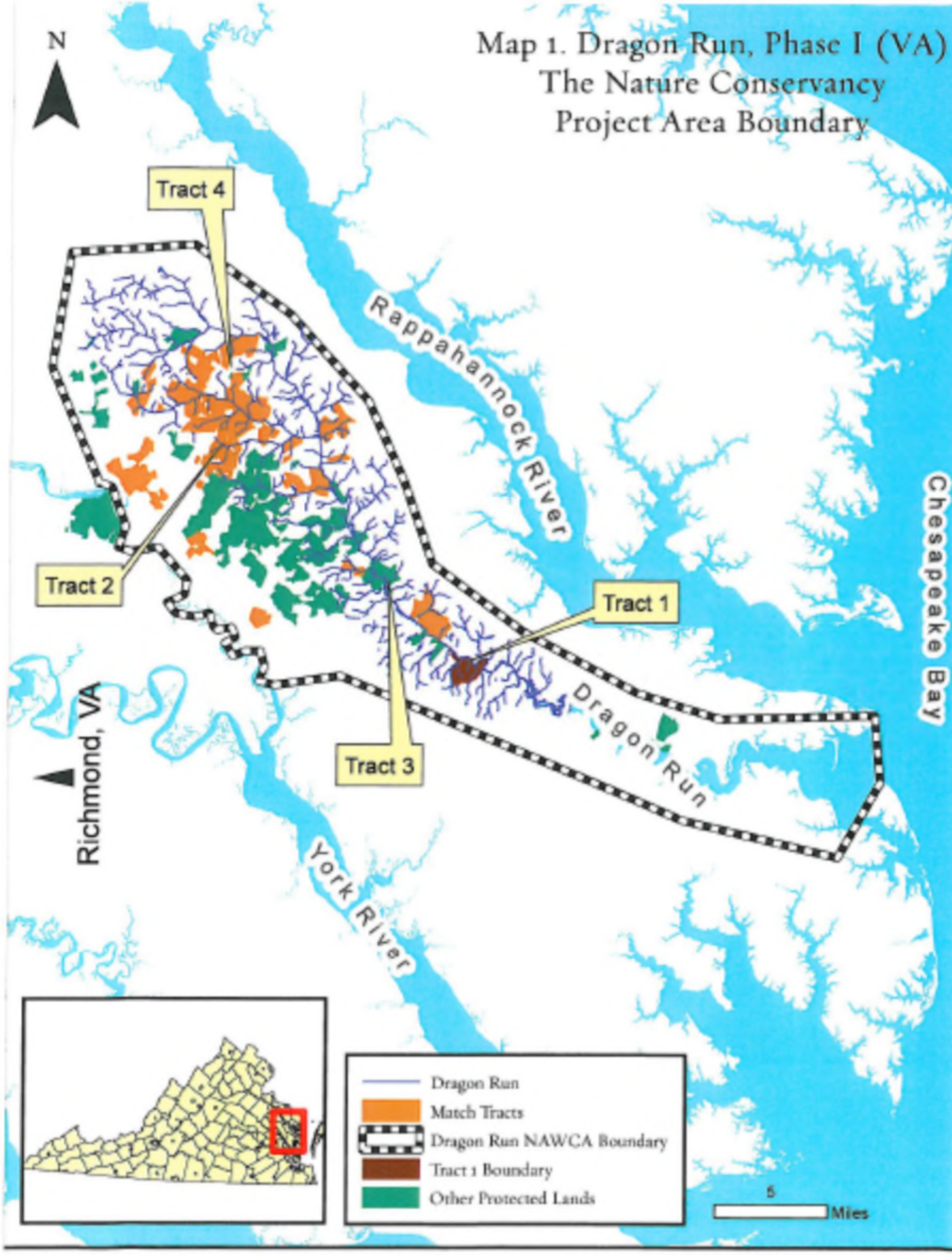
Davis Tract
Rappahannock River Farm
Rappahannock River
0
3.75
7.5
15
Miles
N
Protected Lands
Refuge Expansion Boundary

Scenario 4: Dragon Run, Phase I (Virginia).

Background: This proposal is the first phase of a multi-year project to protect bottomland hardwood (bald cypress) swamps and forests and adjacent upland forested habitat in Dragon Run for the benefit of waterfowl, wetland-associated bird species and other wildlife. Dragon Run is the best and northernmost example of a tidal and non-tidally influenced Bald cypress swamp system on the East Coast. Located in the Coastal Plain of Virginia and on the Western shore of the Chesapeake Bay, the project area represents the largest relatively unfragmented forest and swamp community in the lower Chesapeake Bay. More than 28,000 acres of wetlands and uplands have been protected by The Nature Conservancy and its partners in the project area. Located between the Rappahannock River Valley National Wildlife Refuge and the James River National Wildlife Refuge, Dragon Run provides an ecological link between U.S. Fish and Wildlife Service National Wildlife Refuges and priority focus areas for waterfowl, migratory birds and aquatic species. The major threat to the project area is the conversion and fragmentation of forest and bottomland systems for residential and non-forest use (including hardwood tree harvesting). The conservation easement will limit residential development; provide restrictions on agricultural production and timber management while protecting intact riparian buffers.

Strawman Project: TNC will acquire a conservation easement on and protect a 1132-acre property in Dragon Run (Gloucester County, Virginia), containing mature forested wetlands (Bald cypress swamp), emergent marsh, pine plantation and mixed uplands forest habitat. The conservation easement will limit development, allowing no more than three divisions & permitting no more than three (2-ac) home sites. Development would be located outside of a 100-ft buffer from streams & wetlands. Timber management is not permitted within the buffer. The agricultural lands on the property may be leased for farming. Hunting on the property will be permitted subject to lease provisions.

Information and considerations: The project area is an important site for nesting, foraging and migrating neotropical birds, waterfowl and resident priority bird species. Specifically, this project will conserve habitat for two high priority waterfowl species (American Black Duck and Mallard), three other priority waterfowl species (Wood Duck, Canvasback and American Widgeon), several other waterfowl (e.g., Green-winged Teal, Gadwall), and more than a dozen wetland-dependent bird species (e.g., Prothonotary Warbler, Kentucky Warbler). The protection of the 1132-acre project tract is complemented by the protection of a 13,272-acre match tract, which is encumbered by a single deed of conservation easement as well as two additional match tracts of 11.63 acres and 112.40 acres. The project area connects conservation projects funded by the North American Wetlands Conservation Act (NAWCA) and other grant programs, and completed by the US Fish and Wildlife Service and its conservation partners on the Rappahannock River and James River. The Nature Conservancy and its partners have been working in the Dragon Run project area since 1986 and this project builds on conservation work completed in the Dragon Run project area. While more than 28,000 acres have been protected to date, effective conservation of the project area and its habitats will require additional conservation action.


Map 1. Dragon Run, Phase I (VA)
The Nature Conservancy
Project Area Boundary
N
Tract 4
Tract 2
Tract 1
Tract 3
Rappahannock River
Chesapeake Bay
Dragon Run
York River
Richmond, VA
Dragon Run
Match Tracts
Dragon Run NAWCA Boundary
Tract 1 Boundary
Other Protected Lands
5
Miles

Scenario 5: Chesapeake Rivers Conservation Phase I

Background: This is Phase I of four anticipated NAWCA proposals that contribute to a long-term, large landscape-scale effort to protect and restore wetland habitat in the Choptank, Nanticoke, Wicomico, and Pocomoke River watersheds, four of the most pristine watersheds of the Chesapeake Bay in Maryland. Originating in the swamps and forests of southern Delaware, these rivers flow south through Queen Annes, Talbot, Caroline, Dorchester, Wicomico, Worcester, and Somerset counties in Maryland prior to discharging into the Chesapeake Bay (Figure 1). These watersheds are renowned for verdant tidal and nontidal wetland complexes that support notable plant and wildlife biological diversity, including a significant number of rare species. The lower reaches of these rivers encompass three waterfowl Focus Areas for the Atlantic Coast Joint Venture (ACJV), primarily due to the large expanses of coastal marshes and submerged aquatic vegetation beds that provide excellent shelter and forage for migrating waterfowl like American black duck and several other high priority species. The proposal renews the highly successful NAWCA partnership of the U.S. Fish and Wildlife Service, Chesapeake Bay Field Office (CBFO), Maryland Department of Natural Resources (MD DNR), and The Nature Conservancy (TNC) from the Pocomoke River Conservation Partnership Phases I, II, and III, which protected over 3,600 acres of Chesapeake Bay river habitat, with over 450 acres restored.

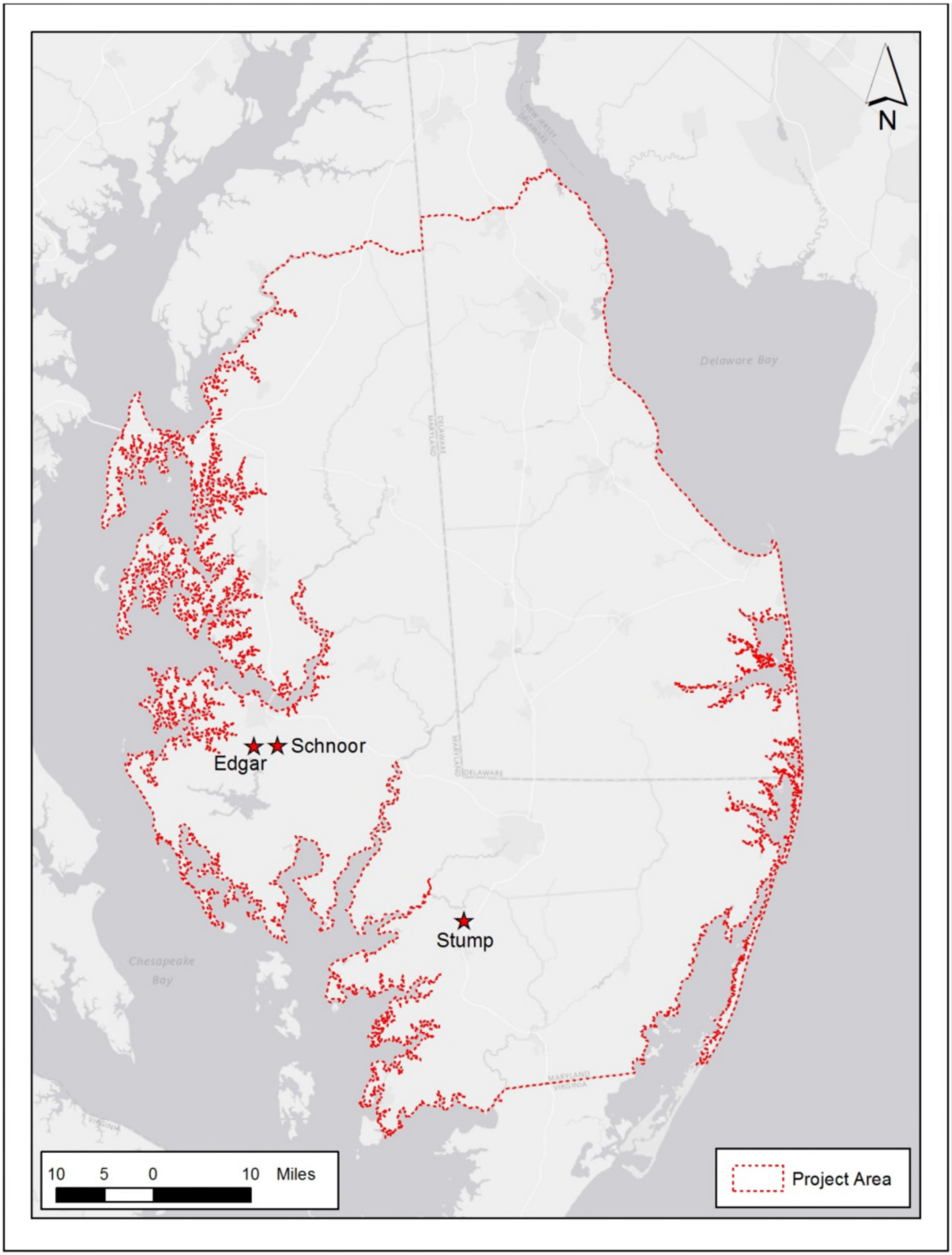
Strawman Project: Chesapeake Rivers Conservation Phase I will add 2,605 acres of permanently protected high quality stopover and nesting habitat for migratory waterfowl and neotropical migrants. The overall goal for the Chesapeake Rivers tracts is to protect them from development and intensive silviculture land uses to insure a healthy native Coastal Plain forest and wetland complex in perpetuity. This will include 1,400 acres of permanently protected wetland/upland migratory bird habitat to the Maryland's State Forest System, and place conservation easements on another 1,205 acres. A total of 1,976 acres, or 76 percent, of the project area are declining palustrine forested, emergent, and scrub-shrub wetland habitats.

Information and considerations:

This project will protect a total of 1,983 acres of non-tidal forested bottomland, scrub-shrub, and emergent wetland habitat and 622 acres of adjacent forested uplands and farmland on the Little Blackwater River in the Nanticoke – Blackwater Drainage and Monie Creek, a major tributary of the Wicomico River. Currently, 1,097 acres of waterfowl habitat on the Stump property is degraded by intensive agricultural and forestry practices and threatened by residential development. Completion of the Chesapeake Rivers project will allow degraded wetlands and forests to recover, providing stable, high quality nesting, wintering, and/or migration habitat for 11 NAWMP priority waterfowl species in perpetuity. Seven additional waterfowl species of importance to the ACJV and/or (BCR30) also will benefit. It is anticipated that the water quality and aquatic habitat of the Little Blackwater, Blackwater, and Nanticoke rivers and Monie Creek, Wicomico Creek, Monie Bay, and the Wicomico River will show improvement because almost 2,400 acres of healthy forest and wetlands will buffer sediment and nutrient laden runoff from adjacent agricultural and residential land use. Water quality benefits will translate downstream throughout the ACJV Blackwater – Nanticoke River waterfowl focus area, improving water quality and habitat for submerged aquatic vegetation beds, oyster beds, marshes, and the waterfowl that depend on them for foraging and other life history requirements. Species benefited include priority waterfowl species such as the American black duck, northern pintail, wood duck, and mallard. The wetland-dependent American woodcock will also directly benefit from the project. Specific neotropical migrants which will benefit from protected habitat include prothonotary warblers, Kentucky warblers, wood thrush, and worm-eating warblers.

The 1,400 acre Stump property, located in the headwaters of Monie Creek, a tributary of the Wicomico River, will be purchased for permanent protection; MD DNR will own and manage the property for migratory waterfowl, songbirds and other forest interior wildlife as part of its State Forest system. Once purchased, all agriculture and intensive silviculture activities will cease and the property will be managed as native Chesapeake Bay wetland/upland habitat. A conservation easement will be purchased over the 825 acre Schnoor property, located outside of Cambridge, Maryland, in close proximity to the major metropolitan areas of Baltimore, MD, Dover, DE, and Washington, DC where there is a high level of development pressure. Protection of Schnoor would create a 2,700-acre contiguous wildlife corridor protected from development. A conservation easement will be purchased over the 380 acre Edgar tract, located along 1.5 miles of the Little Blackwater River, and containing 139 acres of palustrine emergent, forested, and scrub-shrub wetlands, 22 acres of upland forest, and 219 acres of farmland.

The Edgar property is directly adjacent to a 121-acre protected property owned by the Dorchester County, and provides passive recreation and canoe/kayak access to the Little Blackwater River. Due to its location on the Little Blackwater River directly upstream from the Blackwater National Wildlife Refuge, the Edgar property serves as a valuable wildlife corridor for migratory waterfowl, songbirds, and raptors to nest and forage. The current land owner has observed bald eagles nesting on the property, as well as the recently delisted Delmarva fox squirrel foraging in the forested area.



N
Delaware Bay
Chesapeake Bay
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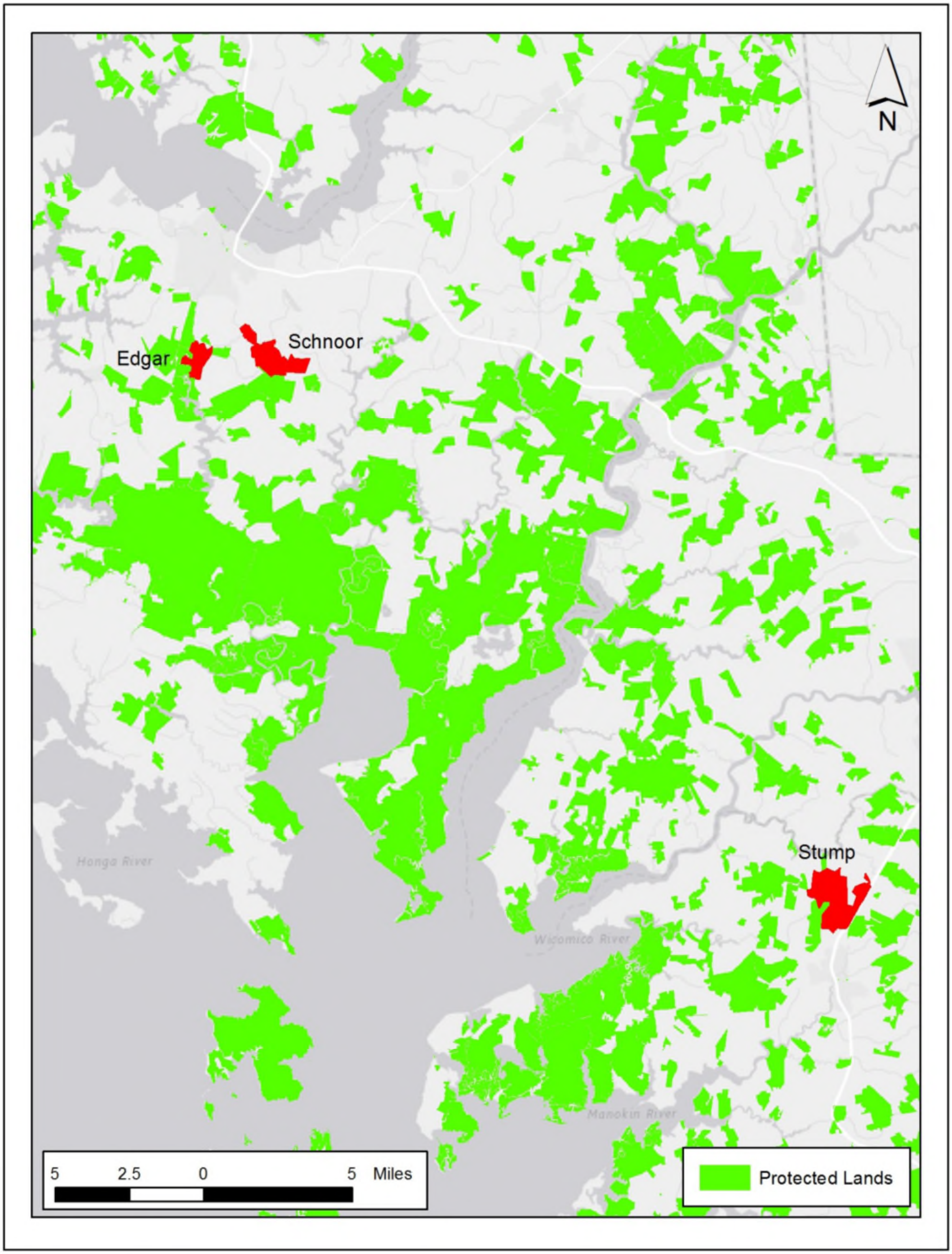
Schnoor
Stump
10 5 0 10 Miles
Project Area



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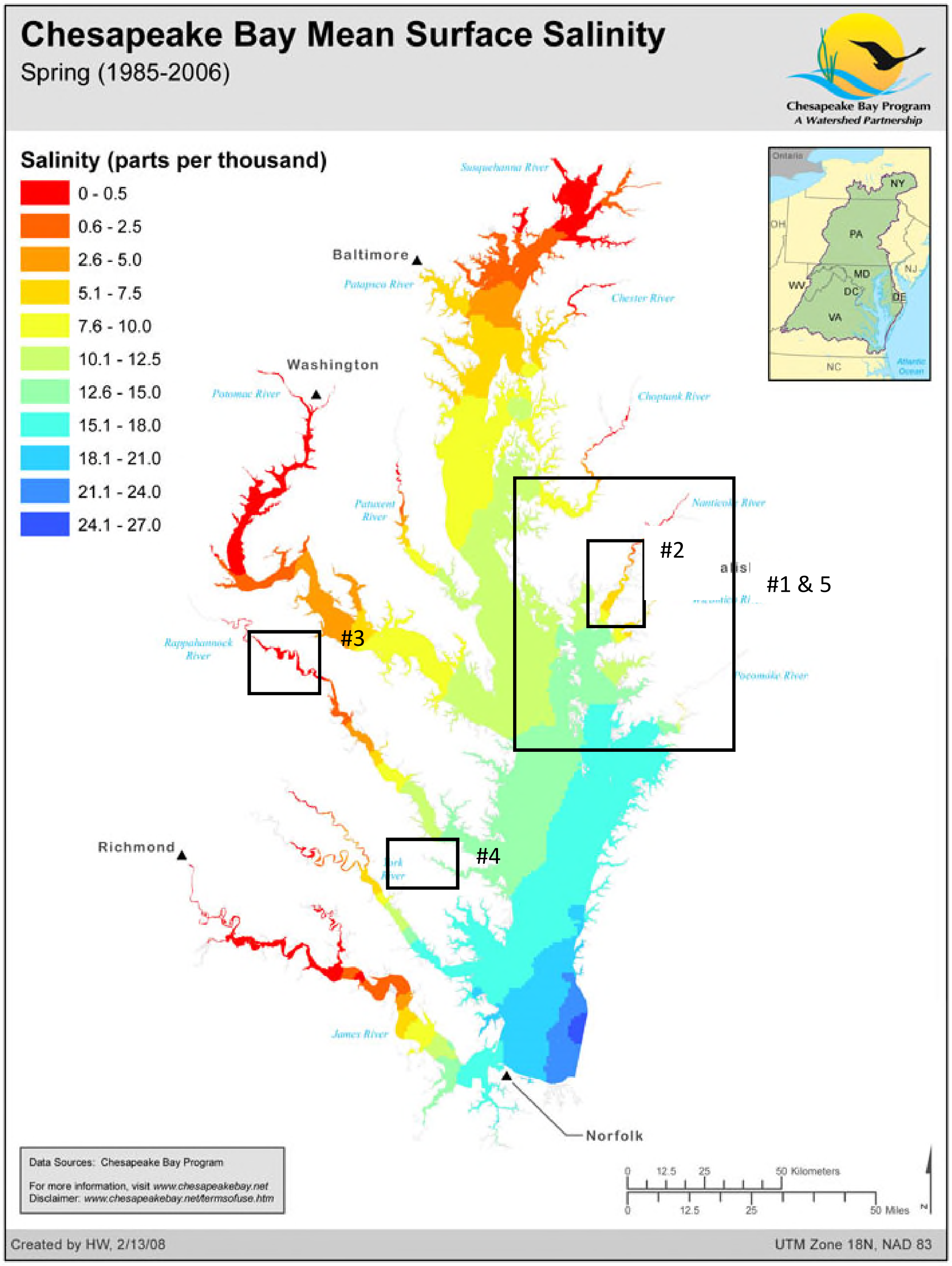
5 2.5 0 5 Miles
Protected Lands


Chesapeake Bay Mean Surface Salinity
Spring (1985-2006)
Chesapeake Bay Program
A Watershed Partnership
Salinity (parts per thousand)
0 - 0.5
0.6 - 2.5
2.6 - 5.0
5.1 - 7.5
7.6 - 10.0
10.1 - 12.5
12.6 - 15.0
15.1 - 18.0
18.1 - 21.0
21.1 - 24.0
24.1 - 27.0
Susquehanna River
Baltimore
Patapsco River
Chester River
Washington
Potomac River
Choptank River
Patuxent River
Nanticoke River
Rappahannock River
Pocomoke River
Richmond
James River
Norfolk
#1 & 5
#2
#3
#4
Ontario
NY
OH
PA
NJ
MD
WV
DC
DE
VA
NC
Atlantic Ocean
Data Sources: Chesapeake Bay Program
For more information, visit www.chesapeakebay.net
Disclaimer: www.chesapeakebay.net/termsofuse.htm
0 12.5 25 50 Kilometers
0 12.5 25 50 Miles
N
Created by HW, 2/13/08
UTM Zone 18N, NAD 83

CLIMATE-SMART ADAPTATION DESIGN – CBP STRATEGIES/MANAGEMENT APPROACHES OR GOALS/OUTCOMES

Fill this out last

Climate-informed ~~strategies/mgmt. approaches~~ (or goal/outcome) – Documentation of Results *Check the appropriate box*	
☐	Keep existing strategies/approaches (or goal/outcome) without modification *If yes, provide reasoning*
☐	Use existing strategies/approaches (or goal/outcome) but with minor modifications *If yes, note modifications and the reasoning behind them*
X	Use new strategies/approaches (or goal/outcome) or significantly adjust existing ones. *If yes, provide the reasoning* Change the focus of the goal/outcome from the direct management of numbers of black ducks to quantity of viable black duck habitat, though including monitoring methods to confirm black duck use of the habitat.

Climate Smart Adaptation Design at the ~~CBP Strategy/Mgmt. Approach~~ (or Goals/Outcomes) Level

Current Strategy	*What is the CBP strategy/ (or goal/outcome) being considered?*	
	Current strategy/mgmt. approach (or goal/outcome)	**Vital Habitats Goal**: Restore, enhance and protect a network of land and water habitats to support fish and wildlife, and to afford other public benefits, including water quality, recreational uses and scenic value across the watershed. **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.
Step 1 Screening	*Will the strategy (or goal) be influenced by climate change?*	
	Screening for strategies (or goals)[1]. If yes (influenced by climate change), proceed; if no, set aside the strategy (check the first box in the check list above).	Yes, this goal & outcome is vulnerable to both direct and indirect climate change effects (proceed with subsequent questions).

[1] This is a screening question to identify and set aside (not proceed with climate smart revision) strategies/approaches (or goals/outcomes) not likely to be affected by climate change. For example, education or outreach efforts will not themselves be directly influenced by climate change, although it would be desirable to include climate change information into these types of efforts. Therefore, it would not be necessary to apply this process directly to revision of such strategies. It should be noted that strategies such as development of energetic, system, planning, or other models also are not directly impacted by climate change; however, if climate change effects have not heretofore been considered in the model, then redesign of the model would be recommended.

<table>
<tr><td rowspan="4">Step 2: Category 1 Considerations:
Climate change effects on the stressors and systems</td><td colspan="2">What stressor(s), characterized by source if appropriate, are addressed by or accounted for in the strategy?</td></tr>
<tr><td>Specific stressor(s) and source(s). [List separately, include uncertainty and relative sensitivity (low, medium, high.]</td><td>• Loss of food/foraging habitat (vegetation, tubers, bivalves). High magnitude, medium uncertainty.
• Loss of wintering (& breeding) habitat (wetlands, especially tidal marshes) lost via conversion to open water accompanying ongoing sea-level rise, as well as to development and other direct anthropogenic land use conversions (though this source considered nominal). High magnitude, medium uncertainty.
• Human development that results in habitat fragmentation, loss of connectivity; proximity to human disturbance. Medium magnitude, low uncertainty.
• Invasive species (e.g., reed grass (Phragmites) and purple loose strife), resulting in degradation of habitat quality for black ducks. Medium magnitude, high uncertainty.
• Interspecific competition with native invasive species (mallard and possibly resident Canada geese). Low magnitude, medium uncertainty.
• Historically hunting/overharvesting was an important impact, though regulation has now made hunting largely sustainable. Low magnitude, low uncertainty.</td></tr>
<tr><td colspan="2">What are the key climate change impacts (direction, magnitude, mechanism, uncertainty) on the stressor(s)/source(s), relevant to the resource?[2]</td></tr>
<tr><td>Key climate influences on stressor(s)/sources(s)</td><td>• Although wetland-based foods (vegetation) are generally covered under changes in habitat quality, black ducks also utilize bivalves as an important food source. The same climate change influences of SLR, altered precipitation & storms, and temperature increases that will drive wetland quantity & quality changes are expected to impact Bay bivalve population, causing population losses and/or range shifts that will reduce food availability and alter foraging locations for black ducks.
• Climate change is not likely to have a direct effect on the extent (or progression) of human development.
• Increasing temperatures and altered precipitation patterns are expected to favor invasive species, including Phragmites, which represents poor foraging and wintering habitat for black ducks,
• Climate change is not likely to have a direct effect on the extent of duck hunting activities, particularly since duck hunting is regulated, with the possibility of adapting duration of the hunting season or permissible take if, for instance, changing temperatures extended the hunting season.</td></tr>
</table>

[2] Incorporate information from the notes section of any action-level climate smart decision matrices completed on issues, lessons, or spatial or temporal considerations emerged that might be common across other sites, or be relevant Bay-wide, and how these affect higher levels of planning (strategies, approaches).

<table>
<tr><td rowspan="8"></td><td colspan="2">What are the key climate change impacts directly affecting the resource (direction, magnitude, mechanism, uncertainty)?</td></tr>
<tr><td>Key climate influences on target resource(s)</td><td>• Accelerated rates of SLR in the absence of adequate accretion, which would inundate tidal wetlands and thus reduce available acreage (quantity) or quality for black duck wintering habitat. High magnitude, medium uncertainty in SLR projections (though we now have high certainty of substantial tidal wetland habitat loss in upcoming decades principally as consequence of acceleration in rate of SLR but also affected by migration space limits (topography and land use)).
• Storm surge combined with SLR (as well as increases in precipitation) that increase wetland flooding and reduce overwintering wetland habitat availability. Medium magnitude, medium uncertainty. [Note: Consideration of storm surge effects is complicated, because storm surge absent accelerated SLR is often considered a plus for tidal marshes, delivering mineral sediment loads further inland than would otherwise occur. In addition, storm surge only temporarily increases flooding, unless a marsh system is already failing due to inadequate accretion.]
• SLR, combined with storm surge and increases in precipitation that cause saltwater intrusion, pushing salinity zones up-Bay and resulting in salt marsh migration.
• Large storm events that contribute to marsh break-up and habitat loss (for foraging and over-wintering); consider mainly as a source of ‘acute’ marsh loss (in contrast to chronic loss due to accelerated SLR coupled with inadequate accretion). Medium magnitude, medium to high uncertainty. Grid ditch marshes – loss of sediment
• Regional changes in temperature patterns that result in changing black duck migration patterns and/or shifts in wintering range. Medium magnitude, high uncertainty.</td></tr>
<tr><td colspan="2">Over what timeframe will key climate change impacts affect targeted resources? Are there seasonal patterns or other short- or long-term temporal factors of the climate change effects of concern?</td></tr>
<tr><td>Timing of climate change effects</td><td>• Accelerated rates of SLR are already occurring and will continue to increase.
• Temperature increases are already occurring and will continue to increase.
• Seasonal timing of rainfall/runoff is already changing, with increased rainfall in winter, decreased in summer.
• More intense storms are already occurring and are likely to increase, though confidence in ability to project these changes is low.</td></tr>
<tr><td colspan="2">How is progress toward strategy/mgmt. approach (or goal/outcome) measured?</td></tr>
<tr><td>How is implementation being tracked (e.g. indicators, metrics?</td><td>• Not clear; apparently by tracking acres of available wetland wintering habitat, though the target is specified in number of black ducks supported (and winter bird surveys are used to estimate the winter black duck population).</td></tr>
</table>

	How will climate change alter the ability to carry out progress measurement or monitoring protocols?	• Current methods for black duck winter surveys may become ineffective if the range (spatial distribution) of black ducks changes with climate conditions and habitat/food availability & distribution.

<table>
<tr><td rowspan="10">Step 3: Category 2 Considerations:
CC implications for strategies</td><td colspan="2">How will climate change impacts on the resource itself change the condition (affect the quality or quantity) of and/or trends in the target resource?</td></tr>
<tr><td>Direct effects on resource condition</td><td>Direct effects of climate change on black ducks could include:
• For black ducks, lower temperatures increase metabolic food demands; it would therefore be expected that with climate change, increasing temperatures would decrease metabolic needs, which could be a benefit to black duck populations. In addition, increasing temperatures could increase the activity of some prey and could increase the SAV growing season, making both food sources more readily available.
• Increased incidence of disease or parasitism, with associated increases in mortality;
• Decreases in breeding/nesting success due to altered temperatures, and increased winter precipitation, increased storm intensity.</td></tr>
<tr><td colspan="2">How will climate change impacts on the stressor(s) impact the strategy/approach (or goal/outcome)?</td></tr>
<tr><td>Indirect effects on strategy/approach (or goal/outcome)</td><td>• Climate changes resulting in to reduced total available tidal wetland habitat for wintering/foraging, as well as replacement of prime habitat with Phragmites, will likely cause declines in black duck population size. It also will shift the range of wetland types by salinity classification up-Bay, changing the location of preferred wetland types.</td></tr>
<tr><td colspan="2">How will climate change impacts directly on the strategy/approach (or goal/outcome) impact how realistic, achievable, or effect the strategy/approach (or goal/outcome) is?</td></tr>
<tr><td>Direct effects on strategy/approach (or goal/outcome)</td><td>• The key influences on black duck losses due to climate change appear to operate through impacts on wintering/foraging habitat quality & quantity, although some direct effects of climate change on black ducks will occur. In addition, black ducks can be difficult to accurately enumerate year to year, especially due to their movement and potential changes in specific locations utilized. Thus it might be recommended to manage and set outcome targets based on black duck habitat quantity & quality.</td></tr>
<tr><td colspan="2">What are climate change-related time frame considerations or constraints on achieving or implementing the strategy/mgmt. approach (or goal/outcome) [e.g., urgency, synergies or dependencies on other strategies/mgmt.. approaches]?</td></tr>
<tr><td>Time frame considerations</td><td>• Opportunities for wetland habitat of black ducks to be preserved or restored are typically opportunistic, dependent on landowner interest/cooperation.</td></tr>
<tr><td colspan="2">What changes are needed to modify the strategy/mgmt. approach (or goal/outcome) to accommodate the combination of direct and indirect climate change effects or the target periods for implementing the strategy? Or are there other ideas for strategies suggested by these results?</td></tr>
<tr><td>Climate-driven adaptations needed</td><td>• Change the focus of the goal/outcome from the direct management of numbers of black ducks to quantity of viable black duck habitat, though including monitoring methods to confirm black duck use of the habitat.
• Use the black duck energetics model along with SLR mapping and/or modeling to estimate where preferred wetland types for black duck habitat and food resources might persist in the future given accelerated rates of SLR and other climate change influences. Use the results to promote, to the extent possible, a spatially targeted</td></tr>
</table>

		approach to the black duck outcome. In addition, use the results to estimate what quantity of preferred wetland habitat can realistically be expected to persist in the future with climate change, estimate what population magnitude of black ducks this would be capable of supporting, and if prudent, revise the black duck quantitative target accordingly. •

Step 4: Climate-Designed Strategy	***Climate Smart Strategy/Management Approach (or Outcome)***	
	Description	• By 2025, restore, enhance and preserve [xx] acres of black duck wetland habitat that support a sustainable wintering population of black ducks (estimated as ~100,000 black ducks), a species representative of the health of tidal marshes across the watershed. Focus initially on high tidal marsh where substantial engineered or natural accretion occurs; potentially transition in the future to a focus on non-tidal marsh when losses of tidal marsh due to the high magnitude of future SLR lead to unaddressable landscape-scale collapse of the tidal marsh system. Use modeling of shifting range locations of preferred tidal marsh habitat and black duck energetics requirements to target restoration locations. Refine population targets through 2025 based on best available science.

Notes: What are the information/data gaps and research needs to better understand climate impacts or uncertainties, social or ecological effects, design needs, etc.

Notes on interactions needed with other GITs/Workgroups that are key to the planned strategies/approaches
With wetlands workgroup to project areas within the Bay of wetland losses and range shifts, and coordinate on targeting, evaluation and selection of wetland protection/restoration projects.

*Are there any key strategies/approaches or (goal outcomes) missing?**

* *Strategies/approaches that may be needed to more comprehensively address the climate change impacts identified. The purpose is to identify any key vulnerabilities that are not sufficiently addressed in the existing plan and to craft additional strategies/approaches to fill those gaps. The ecologically-oriented list of general adaptation strategies from the Climate Smart guide can be used to help in brainstorming these. Start by listing any new strategies/management approaches listed in the last question of Step 3.*

SAV Scenarios & Strawman Actions

Scenario 1: Homeowner initiated SAV restoration project.

Background: The homeowner is very environmentally-minded and has a large piece of property on Kirwans Landing Lane on Kent Island, MD. He has contacted DNR on several occasions to express interest in restoring SAV along his shoreline. Should this action be adopted and implemented, and if so, how can we help this homeowner take climate change into consideration when restoring sea grass?

Strawman Project: Implement SAV restoration, focusing on *Ruppia maritima*, along the shoreline of the property on Kirwans Landing Lane on Kent Island, MD. The primary method will be seeding of *Ruppia*. Associated habitat restoration could include removal of rip-rap and replacement with hybrid/natural shoreline.

Information and considerations:

1. Kirwan Creek is a small tributary off Eastern Bay, south of Kent Island.

2. The region in question is mesohaline.

3. Agriculture dominated land-use in watershed.

4. Part of the peninsula on which the homeowner lives is armored with riprap.

5. He is considering removing the riprap and replacing with hybrid/natural shoreline

6. There is a large stand of invasive *Phragmites* on the property which he is actively controlling in hopes of eradication with aerially released herbicides.

7. SAV is naturally recovering in Eastern Bay.

8. Multiple species may be recovering, but we're only certain that *Ruppia maritima* is present. Other species information is anecdotal and undocumented.

9. This project represents a partnering opportunity - the homeowner is willing to pay for the restoration (seeds, not manpower, though he and his friends will help) and has financed other restoration efforts.

10. Based on the property-owner's description, there is suitable sediment and depth for active restoration efforts.

11. Stingrays are often seen in this vicinity – stingrays love to forage in SAV beds.


SAV Monitoring Program
Enter address
Small Map
FAQ
More...
Basemap
Layer List
Layer Visibility
2015
SAV Imagery
SAV Beds
SAV Density
2010-2014 SAV Composite
1971-2012 SAV Composite
Comparison Year
Layers
Kent Island
Prospect Bay
Eastern Bay
Grasonville
VITA, Esri, HERE, DeLorme, Intermap, USGS, NGA, NPS, USD...
5 km
3 mi


Kirwans Landing Ln
Hog Island
© 2016 Google
Google earth
Imagery Date: 10/23/2014
38°57'30.51" N 76°15'59.33" W elev 4 ft
Eye alt 8449 ft

Scenario 2: Eelgrass restoration in Virginia Coastal Bays

Background: *Zostera marina*, or eelgrass, suffered a massive die off throughout the Bay in the early to mid 1900's. The plant was absent from the Virginia Coastal Bays until VIMS began an active restoration program. Millions of dollars and thousands of man-hours have been spent planting this SAV via seed and vegetative plantings. The effort has been successful and *Zostera* has spread throughout the bays in which restoration is active. This effort has been expensive and time-consuming. How can this venture continue successfully while accounting for climate change?

Strawman Project: Continue to restore SAV beds in the Virginia Coastal Bays. One way to incorporate climate change into this project is to but consider switching from seed and vegetative plantings of *Zostera marina,* a cold-preference species, to *Halodule wrightii*, a sub-tropical species. *Halodule wrightii* has been observed in small but persistent populations in North Carolina.

Information and considerations

1. The region in question is polyhaline.

2. *Zostera marina* is the dominant plant in the polyhaline region.

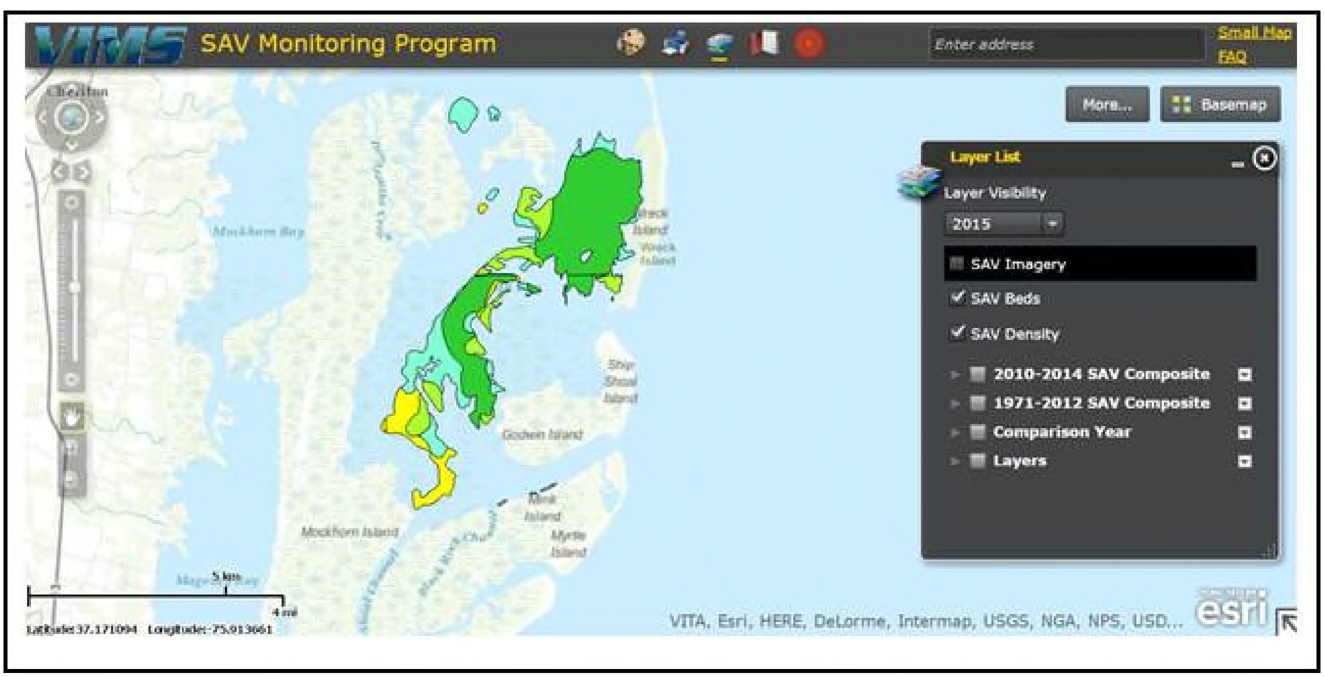
3. We are near the southern limit of the plant's geographic range – it is a cold water plant.

4. Many species of native fish and invertebrates use *Zostera* as habitat and refuge.

5. *Ruppia maritima* co-occurs with eelgrass but it's more ephemeral.

6. Sub-tropical species have never made it to the Chesapeake or Atlantic coastal bays.

7. *Halodule wrightii*, a sub-tropical species, has been observed in small but persistent populations in North Carolina.



Scenario 3: Protection of the Susquehanna Flats SAV bed

SAV in the Flats was severely reduced in the late 1900, but has recovered in the last decade or so and exhibited impressive resiliency. In 2015, there were over 5500 acres of SAV in one contiguous bed, with a few thousand acres in smaller nearby beds also within the Flats. Because of the ecological significance of this bed, there is strong interest in setting it aside as an Estuarine Protected area with strict regulations on boating and fishing to reduce physical damage and preserve it for decades to come. How can this be done in a way that incorporates climate change?

Strawman Project: Designate as an Estuarine Protected Area selected replicate areas of the existing Susquehanna Flats SAV beds, including sufficiently large contiguous areas to provide ecosystem services & benefits such as wildlife habitat and water quality improvement. Protections in this protected area will include regulations on boating and fishing to reduce physical damage.

Information and considerations:

1. The region in question is oligohaline.

2. There are at least 11 species of SAV in the Flats.

3. Coverage of SAV in this area was reduced but withstood the affects of Hurricane Irene and Tropical Storm Lee in 2011 (increased wave energy, sedimentation, burial, turbidity).

4. The bed has been expanding outwards from the center since 2012 – recovering from those storms through both seeds and vegetative expansion.

5. The SAV beds in the Flats are prime fisheries habitat and thousands of fishermen flock to the area each summer.

6. Prop scars are fairly prevalent as the Flats are quite shallow.

7. There are navigation channels surrounding the Flats SAV bed for easy boating access.


VIMS
SAV Monitoring Program
Enter address
Small Map
FAQ
More...
Basemap
Layer List
Layer Visibility
2015
SAV Imagery
SAV Beds
SAV Density
2010-2014 SAV Composite
1971-2012 SAV Composite
Comparison Year
Layers
Charlestown
Perryville
Havre de Grace
Aberdeen
Aberdeen Proving Ground
Elk Neck State Park
5 km
3 mi

Scenario 4: SAV and conflicting uses of potential shallow water habitat

The shallow waters of the Chesapeake Bay and its tributaries are home to a number of SAV species, which function as habitat and a source of food for a number of recreationally and commercially important species. A number of fishery practices occur directly within and adjacent to SAV beds. These practices can potentially damage SAV. In the mesohaline portion of Maryland's tidal waters, SAV is afforded protection from a few fishery practices, including hydraulic clam dredging and shellfish aquaculture. Can the current regulations adequately protecting SAV in the face of climate change effects?

Strawman Project: Designate SAV beds dominated by widgeon grass in the mesohaline portion of the Maryland Bay on the eastern shore, in the vicinity of the mouth of the Choptank and the Tred Avon Rivers, for implementation of fishing regulations. Regulations should include, but may not be limited to, protections from hydraulic clam dredge use and oyster aquaculture. Determine whether the regulations are protective based on degree of protection afforded the SAVs.

Information and considerations:

1. The area of conflicting use is the mid to lower mesohaline portion Maryland's Chesapeake Bay.

2. This area is dominated by widgeon grass.

3. Commercial clammers use a hydraulic clam dredge to harvest mostly soft shell clams (and some hard clams in lower portions).

4. Hydraulic dredges use jets of waters to stir up the bottom which can uproot SAV and cause turbidity.

5. Oyster aquaculture can either be on bottom (on shell, in cages) or in the water column (floats).

6. SAV impacts from aquaculture include direct burial, shading, and turbidity from harvesting.

7. SAV protection zones from clamming include some areas which have been vegetated for the last 3 years.

8. SAV protection zones from shellfish aquaculture include all areas where SAV has been present for the past 5 years.

9. SAV protection zones from clamming are updated every 3 years and delineated from the annual SAV aerial survey.

10. SAV protection zones from aquaculture are updated annually and delineated from the annual SAV aerial survey.


Aquaculture Siting Tool

CLIMATE-SMART ADAPTATION DESIGN – CBP WORK PLAN/KEY ACTIONS

Fill this out last

Climate-informed actions and performance targets – Documentation of Results *Check the appropriate box*	
☐	Keep existing actions and performance targets without modification. *If yes, provide reasoning.*
X	Use existing actions and performance targets but with minor modifications *If yes, note modifications and the reasoning behind them.* This project can remain viable with modest additional considerations.
☐	Use new actions/performance targets or significantly adjust existing ones. *If yes, provide the reasoning.*

Climate-Smart Adaptation Design at the CBP Work Plan/Key Actions Level

Current Action	*What is the CBP action being considered?*	
	Current key action or specific performance target	(Case study project): Restore submerged aquatic vegetation (SAV) along the shoreline of Kirwans Landing Lane on Kent Island, Maryland
Step 1: Screening for Actions	*Will the action be substantially influenced by climate change?*	
	Screening for actions.[3] If yes (influenced by climate change), proceed; if no, set aside the action (check the first box in the check list below).	Yes, this action is vulnerable to both direct and indirect climate change effects (proceed with subsequent questions).

[3] This is a screening question to identify and set aside (not proceed with climate-smart revision) actions not likely to be affected by climate change. For example, model improvement efforts will not themselves be directly influenced by climate change, although it would be important to include climate change into CBP models used for planning purposes.

<table>
<tr><td rowspan="12">Step 2: Category 1 Considerations:
Climate change effects on the stressors and systems</td><td colspan="2">What stressor(s), characterized by source if appropriate, are addressed by or accounted for in the action?</td></tr>
<tr><td>Specific stressor(s) and source(s). [List separately, include uncertainty and relative sensitivity (low, medium, high.]</td><td>• Sediment and nutrient runoff from agricultural land and septic systems (results in excess algal growth that reduces water clarity). High magnitude, medium uncertainty.
• Direct destruction (from aquaculture activities, hydraulic clam dredging, propeller scarring). Low magnitude, low uncertainty.
• Armored (riprap) shoreline. Medium to high magnitude, low uncertainty.
• Invasive Phragmites marsh grasses. Low magnitude, low uncertainty.</td></tr>
<tr><td colspan="2">What are the key climate change impacts (direction, magnitude, mechanism, uncertainty) on the stressor(s)/source(s)?</td></tr>
<tr><td>Key climate influences on stressor(s)/sources(s)</td><td>• Sediment and nutrient runoff from adjacent agricultural lands may increase with increasing projected winter rainfall. However, reduced summer rainfall may produce a seasonal decrease in turbidity and eutrophication. Medium magnitude, medium uncertainty.
• Sea level rise (SLR) will increase coastal erosion and sedimentation in SAV habitat, increasing sediment loads. Medium magnitude, low uncertainty.
• SLR will increase water depths, causing loss of optimal SAV habitat. Habitat loss will be a particular problem where shoreline hardening in response to sea level rise (SLR) and storms prevents habitat migration. High magnitude, low uncertainty.
• Phragmites invasions may increase with increasing temperatures. However, SAV abundance is positively correlated with presence of adjacent shoreline vegetation, and it is not clear whether it matters if that is native or invasive marsh. Low magnitude, high uncertainty.</td></tr>
<tr><td colspan="2">What is the expected timing of climate change impacts on the action? This could include seasonal patterns or temporal trends of the climate change effects of concern.</td></tr>
<tr><td>Timing of climate change effects</td><td>• Seasonal timing of rainfall/runoff is already changing, with increased rainfall in winter, decreased in summer.
• SLR is already occurring and will continue to increase.
• More intense storms are already occurring and are likely to increase, though confidence in ability to project these changes is low.</td></tr>
<tr><td colspan="2">Implications for how effectiveness of actions or progress towards performance targets is measured.</td></tr>
<tr><td>How is implementation being tracked (e.g. indicators, metrics)?</td><td>•</td></tr>
<tr><td>How will climate change alter the ability to carry out progress measurements or monitoring protocols?</td><td>•</td></tr>
</table>

<table>
<tr><td rowspan="8">Step 3: Category 2 Considerations:
CC implications for functionality of actions</td><td colspan="2">How will climate change impacts on the stressor(s)/source(s) impact effectiveness of the action?</td></tr>
<tr><td>Indirect effects on action</td><td>• Increased sediment and nutrient loads in winter and during larger episodic storms may increase turbidity and promote algal blooms, and thus decrease the viability of restored SAV beds.
• Larger storms could release riprap from shore, rolling rocks over SAV beds.
• Invasive marsh grass Phragmites may become more successful, replacing native marsh grass, with unknown consequences for SAV.</td></tr>
<tr><td colspan="2">How will climate change impacts directly on the action impact effectiveness of the action?</td></tr>
<tr><td>Direct effects on action</td><td>Protection of SAV could fail due to direct impacts on SAV including:
• Exacerbation of exposures to mobilized sediments with increasing winter rainfall and runoff could cause mortality of SAV in some areas.
• Increasingly severe winter storms could directly uproot/destroy SAV in some areas.</td></tr>
<tr><td colspan="2">What are climate change-related time frame considerations or constraints on achieving or implementing the action [e.g., urgency, synergies or dependencies on other actions /work plans]?</td></tr>
<tr><td>Time frame considerations</td><td>• Opportunity to partner with shoreline landowner generates urgency.</td></tr>
<tr><td colspan="2">What changes are needed to adapt the action to accommodate the combination of direct and indirect climate change effects over the target periods for implementing the action? Or are there other ideas for actions suggested by these results?</td></tr>
<tr><td>Climate-driven adaptations needed</td><td>• Work with Chesapeake Bay workgroups responsible for upland restoration of agricultural lands to minimize increases in sediment and nutrient runoff associated with changes in precipitation patterns and larger episodic storm events.
• Along shorelines selected for SAV replanting, restore natural shoreline/marsh where hard structures (riprap) currently exist, to the extent possible, to allow migration of shallow SAV habitat in response to SLR and avoid potential physical damage to restored beds.</td></tr>
</table>

<table>
<tr><td rowspan="2">Step 4: Climate-Designed Action</td><td colspan="2">Climate-Smart Work Plan/Action</td></tr>
<tr><td>Description</td><td>• Implement SAV restoration along natural or restored (riprap removed) shorelines, including fringing marshes, of the property on Kirwans Landing Lane on Kent Island, MD. The primary method will be seeding and re-seeding of Ruppia maritima, due to its robust performance in a range of salinity and temperature regimes. Encourage concomitant restoration of agricultural land in the adjacent watershed to minimize increases in sediment and nutrient runoff that is otherwise projected to occur due to climate change. Define success over multiple time frames.</td></tr>
</table>

Notes: What are the information/data gaps and research needs to better understand climate impacts or uncertainties, social or ecological effects, design needs, etc.
• Uncertainty of SAV restoration effectiveness needs to be addressed. • What SAV species are expected to do best under climate change conditions at Kent Island? • What species of SAV are most temperature- and salinity-tolerant? • Need more information/ research on the potential application of floating wave-attenuation or similar devices in SAV beds as a means of boosting resistance to physical damage from storms.

Notes: What issues, lessons, or spatial or temporal considerations emerged that might be common across other sites, or Bay-wide? How might these affect higher levels of planning (strategies, approaches)?
• Challenge and importance of long term monitoring and coverage is emphasized. • SAV resilience to SLR is high if there is space available for landward migration.

Notes: interactions needed with other GITs/Workgroups that are key to the actions
Interaction with WQ, any other workgroup responsible for addressing sediment/nutrient runoff from uplands (agricultural), to coordinate protections against the negative impacts to restored SAVs from expected increased sediment runoff from climate change increases in precipitation and or increases in episodic storms.

*Are there any key actions missing?**

* *Actions that may be needed to more comprehensively address the climate change impacts identified. The purpose is to identify any key vulnerabilities that are not sufficiently addressed in the existing plan and to craft additional actions to fill those gaps. The ecologically-oriented list of general adaptation strategies from the Climate-Smart guide can be used to help in brainstorming these, though actions relevant to implementing those strategies/approaches in your specific management/ecosystem context may need to be brainstormed and/or researched in the literature. Start by listing any new actions listed in the last question of Step 3.*

CLIMATE-SMART ADAPTATION DESIGN – CBP STRATEGIES/MANAGEMENT APPROACHES OR GOALS/OUTCOMES

Fill this out last

Climate-informed strategies/mgmt. approaches (or goal/outcome) – Documentation of Results *Check the appropriate box*	
☐	Keep existing strategies/approaches without modification *If yes, provide reasoning*
X	Use existing strategies/approaches but with minor modifications *If yes, note modifications and the reasoning behind them* This remains a viable strategy, with incorporation of spatially explicit assessments of where SAV habitat will remain (or become) optimal for siting of restoration efforts, and of projections for acreage targets.
☐	Use new strategies/approaches or significantly adjust existing ones. *If yes, provide the reasoning*

Climate Smart Adaptation Design at the CBP Strategy/Mgmt. Approach ~~(or Goals/Outcomes)~~ Level

Current Strategy	*What is the CBP **strategy**/ (or goal/outcome) being considered?*	
	Current **strategy**/mgmt. approach (or goal outcome)	MA3: Restore SAV where possible, targeting sites with suitable water quality and high potential to benefit living resources. Related strategies as modified at workshop: • Plant, at min, 20 acres of SAV seeds and propagules in appropriate high quality/clarity areas each year until the goal is reached with placement taking into consideration fisheries use, climate change considerations, and spatial proximity to other living resources. • Look for opportunities to optimize conditions that would allow for the natural or assisted restoration of SAV when possible and appropriate in the course of completing other non-SAV specific projects • Develop spatially explicit information on where to restore SAV taking into account climate change effects and land use practices on environmental conditions o Ensure there is up-to-date, high resolution data (currently VIMS data) tool ▪ Update current shoreline shapefile with latest data (1m res) Assess future availability of migration corridors for SAV considering shoreline modification and SLR.
Ste	*Will the strategy (or goal) be influenced by climate change?*	

	Screening for strategies (or goals)[4]. If yes (influenced by climate change), proceed; if no, set aside the strategy (check the first box in the check list above).	Yes, this strategy is vulnerable to both direct and indirect climate change effects (proceed with subsequent questions).

[4] This is a screening question to identify and set aside (not proceed with climate smart revision) strategies/approaches (or goals/outcomes) not likely to be affected by climate change. For example, education or outreach efforts will not themselves be directly influenced by climate change, although it would be desirable to include climate change information into these types of efforts. Therefore, it would not be necessary to apply this process directly to revision of such strategies. It should be noted that strategies such as development of energetic, system, planning, or other models also are not directly impacted by climate change; however, if climate change effects have not heretofore been considered in the model, then redesign of the model would be recommended.

<table>
<tr><td rowspan="4">Step 2: Category 1 Considerations:
Climate change effects on the stressors and systems</td><td colspan="2">What stressor(s), characterized by source if appropriate, are addressed by or accounted for in the strategy?</td></tr>
<tr><td>Specific stressor(s) and source(s). [List separately, include uncertainty and relative sensitivity (low, medium, high.]</td><td>• Impaired water clarity from excess algal growth driven by eutrophication is principal stressor to SAV. With water clarity improvements, it is anticipated that SAV will recover to historic distributions. There may be some need for active restoration efforts in areas where seed banks are diminished and seed sources are not naturally available. SAV will be sensitive to this stressor but uncertainty, particularly with regard to the spatial distribution of these effects, is medium.
• Physical impacts to beds from aquaculture and dredging, as well as from propeller scarring in shallow SAV areas, is a spatially variable stressor. Hydraulic clam dredging and establishment of aquaculture leases in existing beds are both regulated under the Clean Water Act permitting procedures. Propeller scarring is regulated but common in heavily trafficked areas with shallow water SAV beds. Low magnitude, low uncertainty.
• Bottom disturbance due to herbivory. Low to medium magnitude, medium uncertainty.
• Loss of suitable shallow-water habitat due to shoreline hardening, Medium magnitude, low uncertainty.
• Invasive species. Low magnitude, medium uncertainty.</td></tr>
<tr><td colspan="2">What are the key climate change impacts (direction, magnitude, mechanism, uncertainty) on the stressor(s)/source(s), relevant to the resource?[5]</td></tr>
<tr><td>Key climate influences on stressor(s)/sources(s)</td><td>• Decreases in WQ, including decreasing water clarity (increasing turbidity) and increased nutrient loading, due to increases in precipitation, and increased frequency and/or severity of storms. Medium magnitude, medium uncertainty.
• Climate change is not likely to directly affect the various forms of human physical disturbance to SAV bottoms (e.g., dredging, fishing), but it may contribute to altering locations or frequency of occurrence, There is uncertainty as to whether some activities such as fishing or boating activities may increase or decrease due to climate change; such changes may differ among locations.
• Climate change may affect biological disturbance to SAV bottoms, e.g., from manta rays or herbivory; the direction of this effect is not clear. Low magnitude, high uncertainty.
• Climate change may increase the motivation to install hardened shorelines as SLR increases inundation & erosion. Medium magnitude, high uncertainty.
• Climate change increases in temperature and changes in precipitation is expected to increase invasive species, including Phragmites;</td></tr>
</table>

[5] Incorporate information from the notes section of any action-level climate smart decision matrices completed on issues, lessons, or spatial or temporal considerations emerged that might be common across other sites, or be relevant Bay-wide, and how these affect higher levels of planning (strategies, approaches).

		however, it is not clear whether SAV beds themselves are negatively impacted or remain successful adjacent to *Phragmites* marshes. Low magnitude, high uncertainty.
	What are the key climate change impacts directly affecting the resource (direction, magnitude, mechanism, uncertainty)?	
	Key climate influences on target resource(s)	• SLR that alters habitat conditions, by increasing water depth, especially where shoreline hardening prevents inland migration. Medium magnitude, low uncertainty. • SLR and other climate change effects on salinity. Medium magnitude, moderate uncertainty. • Increasingly severe storms could do direct physical damage to SAV beds. Medium magnitude, medium uncertainty. • Increasing water temperatures – may cross thresholds for some species. Medium magnitude, low uncertainty.
	Over what timeframe will key climate change impacts affect targeted resources? Are there seasonal patterns or other short- or long-term temporal factors of the climate change effects of concern?	
	Timing of climate change effects	• SLR is already occurring and will continue to increase. • Seasonal timing of rainfall/runoff is already changing, with increased rainfall in winter, decreased in summer. • More intense storms are already occurring and are likely to increase, though confidence in ability to project these changes is low.
	How is progress toward strategy/mgmt. approach (or goal) measured?	
	How is implementation being tracked (e.g. indicators, metrics?	• Acres of SAV restored (each year),
	How will climate change alter the ability to carry out progress measurement or monitoring protocols?	• Not clear that climate change will substantially affect how this metric is tracked.

Step 3: Category 2 Considerations:
CC implications for strategies

How will climate change impacts on the resource itself change the condition (affect the quality or quantity) of and/or trends in the target resource?	
Direct effects on resource condition	• Increasingly severe storms could directly uproot/destroy SAV in some areas. • On a local level, larger storms could release riprap from hardened shorelines, rolling rocks over SAV beds. • SLR will increase water depths, which will decrease habitat suitability in existing SAV areas. In areas of natural shoreline where landward shoreline migration can occur, the location of suitable SAV habitat may change, Near hardened shorelines, SAV habitat may be lost. • SLR will also result in saltwater intrusion, changing the salinity profile of the Bay, and thus altering SAV habitat conditions, which will change the ranges of SAV species within the Bay. • Increasing water temperatures will also change the distributions of suitable SAV habitat within the Bay, and may cross survivable thresholds for species near the edge of their distributional range, such as for the northern species *Zostera*.
How will climate change impacts on the stressor(s) impact the strategy/approach (or goal/outcome)?	
Indirect effects on strategy/approach (or goal/outcome)	• Throughout Chesapeake Bay, increases in precipitation, and especially increases in the frequency and/or severity of storms, is expected to increase sediment and nutrient loads to the Bay. Some areas may be more susceptible to this, such as larger and/or steeper watersheds where runoff due to a rain event might be larger; or areas with more land disturbance (e.g., agricultural or urban/suburban development) where increases in sediment/nutrient loading might be higher per unit runoff. Even though WQ in Chesapeake Bay has been, on the average, improving, these effects may increase turbidity locally and/or regionally, and promote algal blooms, and thus decrease the viability of protected or restored SAV beds. • Invasive marsh grass *Phragmites* may become more successful, replacing native marsh grass, with unknown consequences for SAV.
How will climate change impacts directly on the strategy/approach (or goal/outcome) impact how realistic, achievable, or effect the strategy/approach (or goal/outcome) is?	
Direct effects on strategy/approach (or goal/outcome)	• [same as direct effects on resource condition]
What are climate change-related time frame considerations or constraints on achieving or implementing the strategy/mgmt. approach [e.g., urgency, synergies or dependencies on other strategies/mgmt.. approaches]?	
Time frame considerations	• Opportunities for SAV restoration are increasing due to management-induced improvements in Bay WQ; however climate changes that impact SAVs (as discussed above) are already happening, and these will affect the locations around the Bay where optimal SAV habitat will persist in the future with climate change.x

		• Some restoration (or preservation) opportunities are based on land-owner interest and associated opportunities to partner with shoreline landowners, which generates urgency.
	What changes are needed to modify the strategy/mgmt. approach (or goal/outcome) to accommodate the combination of direct and indirect climate change effects or the target periods for implementing the strategy? Or are there other ideas for strategies suggested by these results?	
	Climate-driven adaptations needed	The strategy of restoring SAV where possible, targeting sites with suitable water quality and high potential to benefit living resources will now have to consider where worsening WQ due to increased sediment/nutrient runoff will be the worst. This will have to overlain with modeling estimates of where other SAV habitat requirements (particularly water depth and salinity) will be impacted by SLR so that areas that will remain suitable for SAV restoration can be targeted. Factors that reduce ability to cope with SLR/increasing water depth, particularly harden shorelines, will have to be mitigated or considered as a negative factor in site selection. It is recommended that a Bay-wide simple GIS/SLR model be used to define areas where optimal SAV habitat will persist. This can be overlain with locations of harden shoreline and other impediments to migration, as well as with areas expected to be most greatly impacted by climate-increased WQ concerns. It is not clear whether the quantitative target of at seeding at least 20 acres per year for SAV restoration is based on quantitative considerations that might be impacted by climate change, or is simply chosen (and limited) by practical considerations (i.e. couldn't realistically be increased). Otherwise, it should be noted that the timing considerations for climate change impacts are relatively urgent (the climate change effects are already occurring and will continue or increase); and that current SAV coverage in the Bay is at most 40% of the overall target of 185,000 acres, leaving at least 111,000 acres to be restored. At 20 ac/yr this would take over 5,500 years. Obviously this is a gross overestimate of time, because, assuming each 20-ac of direct restoration is successful, further growth of the SAV and expansion beyond the original 20 acres will contribute to the overall acreage goal. It will also cumulatively expand the spatial distribution of SAV seed sources, which will also accelerate natural re-establishment of SAVs. Still, this annual target for SAV reseeding should be reviewed. In addition, the possibility that reseeding will become less effective due to greater storm and runoff disturbance of seeds should be reviewed, and consideration given to the possible need to conduct more placement of seedlings, even though this is a more costly approach. [Summary – review, where, how much, and how to restore SAV each year,]

Step 4: Clim ate-	***Climate Smart Strategy/Management Approach (or Outcome)***

	Description	MA3: Restore SAV where possible, targeting sites with suitable water quality and high potential to benefit living resources.
		
		Related strategies as modified at workshop:
		• Plant, at min, 20 acres of SAV seeds and propagules in appropriate high quality/clarity areas each year until the goal is reached with placement taking into consideration the projected locations of optimal SAV habitat conditions in the future with climate change, similar considerations with regard to climate change influences on fisheries use, and spatial proximity to other living resources.
		• Look for opportunities to optimize conditions that would allow for the natural or assisted restoration of SAV when possible and appropriate in the course of completing other non-SAV specific projects. Give particular consideration to watershed restorations that will reduce sediment and nutrient runoff from increased precipitation and/or increasingly severe storms.
		• Develop spatially explicit information on where to restore SAV, focusing on defining where optimal SAV habitat will persist in the future considering changing water depths and salinity due to SLR, and taking into account climate change effects and land use practices water quality conditions.
		  o Ensure there is up-to-date, high resolution data (currently VIMS data) tool
		    ▪ Update current shoreline shapefile with latest data (1m res), and include information on locations of shoreline hardening or other impediments to inland migration of shoreline/shallow water habitat with SLR (if such information is available).
		• Assess future availability of migration corridors for SAV considering shoreline modification and SLR.

Notes: What are the information/data gaps and research needs to better understand climate impacts or uncertainties, social or ecological effects, design needs, etc.

Notes on interactions needed with other GITs/Workgroups that are key to the planned strategies/approaches
• Need to work with the climate change workgroup and modelers to project SLR effects on locations of SAV habitat in the future with climate change. • Need to interact with various fish and wildlife workgroups to coordinate on preferred locations for SAV restoration considering suitable habitat conditions under climate change. • Need to interact with the WQ workgroup to assess likely locations that are most susceptible to increased WQ degradation (sediment and nutrient loading) due to climate change.

*Are there any key strategies/approaches or (goal outcomes) missing?**

* *Strategies/approaches that may be needed to more comprehensively address the climate change impacts identified. The purpose is to identify any key vulnerabilities that are not sufficiently addressed in the existing plan and to craft additional strategies/approaches to fill those gaps. The ecologically-oriented list of general adaptation strategies from the Climate Smart guide can be used to help in brainstorming these. Start by listing any new strategies/management approaches listed in the last question of Step 3.*

CLIMATE-SMART ADAPTATION DESIGN – CBP STRATEGIES/MANAGEMENT APPROACHES OR GOALS/OUTCOMES

Fill this out last

Climate-informed strategies/mgmt. approaches – Documentation of Results *Check the appropriate box*	
☐	Keep existing strategies/approaches without modification *If yes, provide reasoning*
X	Use existing strategies/approaches but with minor modifications *If yes, note modifications and the reasoning behind them* Need to re-evaluate the future potential locations and total acreage of SAV habitat due to climate changes in order to redefine the target SAV acreage specified in the outcome.
☐	Use new strategies/approaches or significantly adjust existing ones. *If yes, provide the reasoning*

Climate Smart Adaptation Design at the CBP ~~Strategy/Mgmt. Approach~~ (or Goals/Outcomes) Level

Current Strategy	*What is the CBP strategy/ (or* ***goal/outcome****) being considered?*	
	Current strategy/mgmt. approach (or goal outcome)	**Vital Habitats Goal**: Restore, enhance and protect a network of land and water habitats to support fish and wildlife, and to afford other public benefits, including water quality, recreational uses and scenic value across the watershed. **Submerged Aquatic Vegetation (SAV) Outcome**: Sustain and increase the habitat benefits of SAV (underwater grasses) in the Chesapeake Bay. Achieve and sustain the ultimate outcome of 185,000 acres of SAV Bay-wide necessary for a restored Bay. Progress toward this ultimate outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025.
Step 1 Screening	*Will the strategy (or goal) be influenced by climate change?*	
	Screening for strategies (or goals)[6]. If yes (influenced by climate change), proceed; if no, set aside the strategy (check the first box in the check list above).	Yes, this goal & outcome are vulnerable to both direct and indirect climate change effects (proceed with subsequent questions).

[6] This is a screening question to identify and set aside (not proceed with climate smart revision) strategies/approaches (or goals/outcomes) not likely to be affected by climate change. For example, education or outreach efforts will not themselves be directly influenced by climate change, although it would be desirable to include climate change information into these types of efforts. Therefore, it would not be necessary to apply this process directly to revision of such strategies. It should be noted that strategies such as development of energetic, system, planning, or other models also are not directly impacted by climate change; however, if climate change effects have not heretofore been considered in the model, then redesign of the model would be recommended.

<table>
<tr><td rowspan="4">Step 2: Category 1 Considerations:
Climate change effects on the stressors and systems</td><td colspan="2">What stressor(s), characterized by source if appropriate, are addressed by or accounted for in the strategy?</td></tr>
<tr><td>Specific stressor(s) and source(s). [List separately, include uncertainty and relative sensitivity (low, medium, high.]</td><td>• Impaired water clarity from excess algal growth driven by eutrophication is principal stressor to SAV. With water clarity improvements, it is anticipated that SAV will recover to historic distributions. There may be some need for active restoration efforts in areas where seed banks are diminished and seed sources are not naturally available. SAV will be sensitive to this stressor but uncertainty, particularly with regard to the spatial distribution of these effects, is medium.
• Physical impacts to beds from aquaculture and dredging, as well as from propeller scarring in shallow SAV areas, is a spatially variable stressor. Hydraulic clam dredging and establishment of aquaculture leases in existing beds are both regulated under the Clean Water Act permitting procedures. Propeller scarring is regulated but common in heavily trafficked areas with shallow water SAV beds. Low magnitude, low uncertainty.
• Impairment or loss of suitable near-shore habitat due to shoreline hardening. Medium to high magnitude, low uncertainty.
• Invasive species. Low magnitude, low uncertainty.</td></tr>
<tr><td colspan="2">What are the key climate change impacts (direction, magnitude, mechanism, uncertainty) on the stressor(s)/source(s), relevant to the resource?[7]</td></tr>
<tr><td>Key climate influences on stressor(s)/sources(s)</td><td>• Decreases in WQ, including decreasing water clarity and increased nutrient loading, due to increases in precipitation and increased frequency and/or severity of storms. Medium magnitude, medium uncertainty.
• Climate change is not likely to directly affect the various forms of human physical disturbance to SAV bottoms (e.g., dredging, fishing), but it may contribute to altering locations or frequency of occurrence. There is uncertainty as to whether some activities such as fishing or boating activities may increase or decrease due to climate change; such changes may differ among locations.
• Climate change may affect biological disturbance to SAV beds, e.g., from the transition to sub-tropical habitat and arrival of sub- tropical species; the direction of this effect is not clear. Low magnitude, high uncertainty.
• Climate change may increase the motivation to install hardened shorelines as SLR increases inundation & erosion. High magnitude, high uncertainty.
• Climate change increases in temperature and changes in precipitation is expected to increase invasive species, including Phragmites; however, it is not clear whether SAV beds themselves are negatively</td></tr>
</table>

[7] Incorporate information from the notes section of any action-level climate smart decision matrices completed on issues, lessons, or spatial or temporal considerations emerged that might be common across other sites, or be relevant Bay-wide, and how these affect higher levels of planning (strategies, approaches).

		impacted or remain successful adjacent to *Phragmites* marshes. Low magnitude, high uncertainty.
	What are the key climate change impacts directly affecting the resource (direction, magnitude, mechanism, uncertainty)?	
	Key climate influences on target resource(s)	• SLR that alters habitat conditions, by increasing water depth, especially where shoreline hardening prevents inland migration. High magnitude, low uncertainty. • SLR and other climate change effects on salinity. Medium magnitude, moderate uncertainty. • Increased frequency/severity of storms, which can cause direct physical damage to SAV beds. Medium magnitude, medium uncertainty. • Increasing water temperatures – may surpass temperature thresholds for some species. Medium magnitude, low uncertainty.
	Over what timeframe will key climate change impacts affect targeted resources? Are there seasonal patterns or other short- or long-term temporal factors of the climate change effects of concern?	
	Timing of climate change effects	• SLR is occurring and the rate of SLR is accelerating. • Seasonal timing of rainfall/runoff is already changing, with increased rainfall in winter, decreased in summer. • More intense storms are already occurring and are likely to increase, though confidence in ability to predict these changes is low.
	How is progress toward strategy/mgmt. approach (or goal) measured?	
	How is implementation being tracked (e.g. indicators, metrics?	• Baywide SAV distribution is monitored using aerial photography and mapped (each year). Total acres and segment-specific acreage are reported annually.
	How will climate change alter the ability to carry out progress measurement or monitoring protocols?	• Baywide SAV monitoring methodology will not change based on climate change, but the ability to observe and accurately map SAV from aerial photography may be affected by increased turbidity and cloud cover.

<table>
<tr><td rowspan="8">Step 3: Category 2 Considerations:
CC implications for strategies</td><td colspan="2">How will climate change impacts on the resource itself change the condition (affect the quality or quantity) of and/or trends in the target resource?</td></tr>
<tr><td>Direct effects on resource condition</td><td>• Increasingly severe storms could directly uproot/destroy SAV in some areas.
• SLR will increase water depths, which will decrease habitat suitability in existing SAV areas. In areas of natural shoreline where landward shoreline migration can occur, the location of suitable SAV habitat may change. Near hardened shorelines, SAV habitat may be lost as SAV will be unable to migrate inland.
• SLR will also result in saltwater intrusion, changing the salinity profile of the Bay, and thus altering SAV habitat conditions, which may change species distribution in areas of the Bay.
• Increasing water temperatures will also change the distributions of suitable SAV habitat within the Bay, and may cross survivable thresholds for species near the edge of their distributional range, such as for the cold-water species Zostera marina.</td></tr>
<tr><td colspan="2">How will climate change impacts on the stressor(s) impact the strategy/approach (or goal/outcome)?</td></tr>
<tr><td>Indirect effects on strategy/approach (or goal/outcome)</td><td>• Throughout Chesapeake Bay, increases in precipitation, and especially increases in the frequency and/or severity of storms, is expected to increase sediment and nutrient loads to the Bay. Some areas may be more susceptible to this, such as larger and/or steeper watersheds where runoff due to a rain event might be larger; or areas with more land disturbance (e.g., agricultural or urban/suburban development) where increases in sediment/nutrient loading might be higher per unit runoff. Even though WQ in Chesapeake Bay has been, on the average, improving, these effects may increase turbidity locally and/or regionally, and promote algal blooms and epiphytic algae, and thus decrease the viability of protected or restored SAV beds.
• Invasive marsh grass Phragmites may become more successful, replacing native marsh grass, with unknown consequences for SAV.</td></tr>
<tr><td colspan="2">How will climate change impacts directly on the strategy/approach (or goal/outcome) impact how realistic, achievable, or effect the strategy/approach (or goal/outcome) is?</td></tr>
<tr><td>Direct effects on strategy/approach (or goal/outcome)</td><td>• [same as direct effects on resource condition]</td></tr>
<tr><td colspan="2">What are climate change-related time frame considerations or constraints on achieving or implementing the strategy/mgmt. approach [e.g., urgency, synergies or dependencies on other strategies/mgmt.. approaches]?</td></tr>
<tr><td>Time frame considerations</td><td>• Opportunities for SAV recovery and restoration are increasing due to management-induced improvements in Bay WQ; however climate change impacts to SAV (as discussed above) are already happening, and these will affect the distribution and abundance of some SAV species.</td></tr>
</table>

		• Some restoration (or preservation) opportunities are base]d on land-owner interest and associated opportunities to partner with shoreline landowners, which generates urgency.
	What changes are needed to modify the strategy/mgmt. approach (or goal/outcome) to accommodate the combination of direct and indirect climate change effects or the target periods for implementing the strategy? Or are there other ideas for strategies suggested by these results?	
	Climate-driven adaptations needed	• The SAV outcome of achieving 185,000 acres sustained in Chesapeake Bay is based on the historical distribution of SAV. However, with climate change, historic knowledge of SAV abundance may not be an appropriate predictor of its potential future distribution and abundance. The combination of climate change impacts (SLR, altered precipitation and storms, and increased temperatures) with existing limitations on adaptive capacity, such as hardened shorelines, may lead to alterations in where suitable and/or restorable SAV habitat will occur overall and by species. Further analysis is needed to estimate how SLR along with altered temperatures and salinities, and storm-associated degradation of WQ will shift locations of future suitable SAV habitat, and whether this will be zero-sum game, or whether along with the spatial shift, there will be a concomitant decrease in total potential SAV habitat. Based on this analysis (largely a GIS/SLR modeling exercise), the feasibility of a 185,000 acre target should be reviewed and potentially modified. Recommended to add spatially-explicit targets of key locations for SAV restoration based on analysis results. • The goal of restoring 20 acres of SAV per year is arguably more important socially; will serve to create and maintain academic and agency expertise and provide opportunity for public involvement. Actual accomplishment (successful acres established) highly uncertain and likely to be no different from if no action (i.e., no restoration) undertaken. The social and educational benefits of undertaking the 20 acre goal would be as much or more of the benefit than on-the-ground acreage produced. • With regard to the goal of "...enhancing and protecting a network of land and water habitats to support fish and wildlife", targeting preferred locations for SAV protection or restoration will also need be coordinated with the corresponding fish/wildlife groups projections of climate change effects on preferred locations for those species should also be considered.

Step 4: Clim ate-	***Climate Smart Strategy/Management Approach (or Outcome)***

	Description	**Vital Habitats Goal**: Restore, enhance and protect a network of land and water habitats to support fish and wildlife, and to afford other public benefits, including water quality, recreational uses and scenic value across the watershed. • **Submerged Aquatic Vegetation (SAV) Outcome**: Sustain and increase the habitat benefits of SAV (underwater grasses) in the Chesapeake Bay. Achieve and sustain the ultimate outcome of-185,000 acres of SAV Bay-wide necessary for a restored Bay. Progress toward this ultimate outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025.

Notes: What are the information/data gaps and research needs to better understand climate impacts or uncertainties, social or ecological effects, design needs, etc.

Notes on interactions needed with other GITs/Workgroups that are key to the planned strategies/approaches
Need to work with the climate change workgroup and modelers to project SLR effects on locations of SAV habitat in the future with climate change. Need to interact with various fish and wildlife workgroups to coordinate on preferred locations for SAV restoration considering suitable habitat conditions under climate change. Need to interact with the WQ workgroup to assess likely locations that are most susceptible to increased WQ degradation (sediment and nutrient loading) due to climate change.

*Are there any key strategies/approaches or (goal outcomes) missing?**

* *Strategies/approaches that may be needed to more comprehensively address the climate change impacts identified. The purpose is to identify any key vulnerabilities that are not sufficiently addressed in the existing plan and to craft additional strategies/approaches to fill those gaps. The ecologically-oriented list of general adaptation strategies from the Climate Smart guide can be used to help in brainstorming these. Start by listing any new strategies/management approaches listed in the last question of Step 3.*

Attachment 5

Relative Wetland Vulnerabilities Workshop

Compilation of Breakout Session Notes

Compilation of Workshop Notes

Introductory Comments/Insights

- Important to begin from particular actions and work from the bottom up to capture emergent insights; in dealing with the specifics first we can begin to see how it applies to the whole cycle and the general context.
- The climate-smart framework allows us to park a lack of specific information that may not be currently known and still develop strategies that allow for resilient management in the face of uncertainty.
- The framework helps consider uncertainty within decision making. You can also act by trying to determine how the uncertainty affects your vulnerability.
    - The magnitude of uncertainty could help us to weight decisions in the framework cycle.
    - One focus of the workshop activities is to think about where the uncertainties are, and how they could possibly weight your decisions.
- The immediate goal is to figure out how this (climate change vulnerabilities and associated uncertainty) applies to your kinds of projects, and then move up to broader points of insight.
    - The goal is insight, not answers. The focus is really the process.

Compilation of Notes from the Breakout Group Discussions

SAV Workgroup

Taking Strawman Actions through Activity 1 of the Adaptation Design Tool Matrices

- The purpose of the Climate Smart general adaptation strategies is to provide a general understanding of management strategies. For adaptation in general, would want to try and reduce climate change stressors.
    - The purpose of these definitions is to put a climate stress on them, but are not necessarily prescriptive.
- The strength in the case studies is that they give us a common set to discuss and build from.

Strawman Action #1 Homeowner initiated SAV restoration project

Brief Project Description: An environmentally-minded homeowner with a large piece of property on Kirwans Landing Lane on Kent Island, MD expressed interest to DNR in restoring SAV along his shoreline. The homeowner is willing to pay for restoration materials (seeds, not manpower, though he and his friends will help) and has financed other restoration efforts. It is noted that SAV is naturally recovering in Eastern Bay. The strawman project is to implement SAV restoration, focusing on *Ruppia maritima*, along the shoreline of the property on Kirwans Landing Lane on Kent Island, MD. The primary method will be seeding of *Ruppia*. Associated habitat restoration could include removal of rip-rap and replacement with hybrid/natural shoreline. There is a large stand of invasive *Phragmites* on the property which he is actively controlling with aerially released herbicides in hopes of eradication. Kirwan Creek is a small tributary off Eastern Bay, south of Kent Island. The region is mesohaline; landuse in the watershed is primarily agricultural.

Breakout Group Discussion Notes:

- Everything was negative, and there could be some benefits such as changes in precipitation patterns (decrease in rainfall produces less sediment and greater clarity).

  - Could be counterbalanced by increased storm intensity.
- Focus on cownose rays which is independent of these direct factors, but could be important to understand species competition.
- A positive point indicator was the increase of CO_2 concentrations that could help to fertilize and compensate for the heat stress, specifically with regards to eelgrass.
- Macroalgae growth, as well as cyanobacteria are also points that must be accounted for.
- Question about the predictive ability of large storms to negatively affect SAV ecosystems.
  - Many people agreed that the large storms like Tropical Storm Lee and Hurricane Agnes have the capability to scour and deposit enormous amounts of sediment that harm SAV beds.
- Comment that the trends of water depth should also be examined and could alter the photic requirements of SAV beds.
- Question about the 'wish list' of SAV knowledge and the known data gaps.
  - Comment talked about the tolerance of species as one piece of a long list; mentioned the report "Managing Seagrasses for Resilience to Climate Change".

Worksheet 1A (attached below)

- The overall objective is testing this process that allows us to determine how existing management actions could be tweaked or strengthened to adjust for climate change impacts
- Beyond global climate change issues, this is a point where local SAV is almost completely controlled by Bay-wide issues. Less capability for individuals to control success of local restoration because of factors outside of their control. It's unclear at the Bay scale if restoration results in any difference from no action taken. Good educational opportunity, but important to lay out the tough path for the homeowner ahead of time.
- Part of the management strategy is outreach and education, a mandate of an additional 20 acres/year.
- Herbicide application was added to a target stressor in the worksheet; as was further stressors from recreational boating, septics.
- Surprise that temperature changes were not on the list of stressors, and although it could be a potential future threat, R*uppia* is currently known to be a more resilient species of SAV.
- Sediment and nutrient runoff is likely a stressor, but the planting of SAV does not remove that stress.
  - The management action would focus on the propagule material, this is not dealing with the stressor but is more of an education and outreach opportunity.
  - The efforts of the landowner in the first example may best be served for education and outreach rather than habitat restoration of SAV.
- There was a large increase in SAV abundance in the study area in 2015, and the possibility of a positive feedback loop.
- These are existing stressors in the environment, not necessarily to the management action.
  - Originally, stressor column was used in a broader way, specific actions that were taken to address the stressor; in this case using SAV in a more general sense, key reason a positive habitat function. There could be a broader way of addressing this issue.

- The name of the column as target stressors should be revisited in tailoring this tool for the CBP.
- There could be a column for why we are trying to restore SAV, but the purpose for the general case study could ask what the original stressors of concern are.
- The propagation of moving more southern species to an environment within the Chesapeake Bay was also floated.
    - This raises issues of whether we have sufficient genetic or phenotypic variability to maintain an evolutionary potential. There needs to be an assessment of source propagules and understanding this for *Ruppia* and other species would be critical for integration. This could be mentioned in the climate change effects on propagation species, but then move it through the process as well.
- Climate change affects agricultural runoff and septic systems differently, and it was asked how impacts of climate change could affect septic runoff.
    - Higher water tables, and increased intensity could more rapidly overflow the septic systems.
    - Perhaps increased ground temperatures could increase biotic processes and encourage nitrification over longer time periods throughout the year, and could serve as a net benefit.
- Review of climate change effects on stressors, and the timing of climate change effects.
- One thing that is currently occurring is related to temperature stress, but has not produced noticeable (measureable) changes yet, and they may not impact the species prevalent in the study area.
- There may be an increased prevalence of shoreline hardening because of more frequent storm surge resultant from climate change, a perception of safety; a ripple effect occurs based on a single landowner implementing hardening.
    - Question of environmental peer pressure encouraging other landowners to remove hardening measures.
- Increased storm intensity should be considered despite overall decreases in precipitation in particular seasons.
- In completing this process, it is important to review points that are immediately urgent and perhaps less on points that are more uncertain. There may even be prioritization within each column as well.
- Column 6 - evaluation of implications for effectiveness - would we be interested in secondary effects beyond SAV planting?
- It can be helpful to ask about the expected efficacy, the assets, and the liabilities.
- To help determine effectiveness it is imperative to continue water quality monitoring and discharge measurements. Furthermore, SAV coverage, health, density, and persistence over time are also better qualifiers to help measure the efficacy of plantings. This is an important challenge outlined as it relates to long-term coverage.
- The capability of expanding coverage to other species is also important as part of the cycle.

Worksheet 1B (attached below)

- There was discussion of the role that herbicides may play as they runoff from *Phragmites* habitat to an aquatic environment. Also a tradeoff perceived between the ability of the species to hold soil and improve water quality for SAV.
- What is the capacity of SAV to adjust to sea level rise if they are given space?
    - If space is available, then they can adjust rapidly to changes in the photic zone.
- Improving education and outreach on living shorelines issues is a key component moving forward. Ideally this would occur during the permitting response, but discussion made it sound as if this was wanting.
- Extreme changes in salinity could affect *Ruppia*, but such changes could be unlikely.
- Longer growing seasons from earlier germination could potentially be positive; this was added to the column of the changes in effectiveness of management action due to climate impacts.
- In the time frame or constraints for using the action and implementation column, a point was added regarding the timing of the restoration actions (sequential or seasonal).
- There may be a list of changes that are needed, but it is also beneficial to determine how important they are to the end goal of the project.
- In ranking and prioritizing what's needed, it's important to break down some of the critical linkages.
- The risk isn't too great not to take action because of climate change, but are there things that we should be working towards making management actions more resilient?
- A question asked about the long-term connectivity of SAV beds and the benefits of having large beds versus smaller scattered beds.
    - Research over the history of SAV bed data indicates that there is the potential for far greater SAV connectivity throughout the Bay.
- Could the optimal patch size be influenced differently by stronger storms moving forward?
    - What is the tipping point where some significant safety has been built into the management action?
- Are the changes that are needed to adapt the action outlined in column 6 meant to address the changes in effectiveness stated in columns 3 and 4? (yes).
- How did we initially define success? If success is two years of SAV growth, and after 5 years the water quality has worsened, then perhaps the way that we defined success wasn't sufficient to produce resilient results.
- To encourage management actions that respond to dynamism of SAV growth, perhaps it would be better to support natural processes. Would this involve pieces like regular seeding or would you search for types of tipping points?
- Is there technical guidance that could be provided to encourage the success of the project in the case study?
    - Modification of agricultural land as part of the climate-smart management action was removed from column 7.
- Making a connection between the actions and water quality could be helpful, but the purview of the workgroup is really confined to SAV. The goal of SAV restoration is to accelerate expansion of restoration.
- The sixth column is really a stepping stone to the seventh which hits some of the key highlights outlined.

- Communicating priority issues to the landowner was added to the climate smart management action so that they further understand what to really look for. Additionally, the seeding and long-term monitoring was added to the column.
- If the principal benefit is education and the opportunity for involvement, then an assessment of how to best spend funds should also be taken into account so that others can also be involved elsewhere.
- It could also be important to ask if there are elements that could go beyond SAV restoration and help to produce some sort of research findings.
- We must tailor the species to the salinity regime as well based on the particular case study.

Strawman Action #2 (Scenario 4): SAV and conflicting uses of potential shallow water habitat
Brief Project Description: The shallow waters of the Chesapeake Bay and its tributaries are home to a number of SAV species, which function as habitat and a source of food for a number of recreationally and commercially important species. A number of fishery practices occur directly within and adjacent to SAV beds. These practices can potentially damage SAV. In the mesohaline portion of Maryland's tidal waters, SAV is afforded protection from a few fishery practices, including hydraulic clam dredging and shellfish aquaculture. Commercial clammers use a hydraulic clam dredge to harvest mostly soft shell clams (and some hard clams in lower portions). Hydraulic dredges use jets of waters to stir up the bottom which can uproot SAV and cause turbidity. Oyster aquaculture can either be on bottom (on shell, in cages) or in the water column (floats). SAV impacts from aquaculture include direct burial, shading, and turbidity from harvesting. The strawman project is to designate SAV beds dominated by widgeon grass in the mesohaline portion of the Maryland Bay on the eastern shore, in the vicinity of the mouth of the Choptank and the Tred Avon Rivers, for implementation of fishing regulations. Regulations should include, but may not be limited to, protections from hydraulic clam dredge use and oyster aquaculture. SAV protection zones from clamming include some areas which have been vegetated for the last 3 years, and are updated every 3 years and delineated from the annual SAV aerial survey. SAV protection zones from shellfish aquaculture include all areas where SAV has been present for the past 5 years, and are updated annually and delineated from the annual SAV aerial survey.

Breakout Group Discussion Notes:

Worksheet 1A (attached below)

- Stressors include direct physical destruction from dredging, increased turbidity, and shading.
- Climate change effects on the stressors.
  - Increased magnitude of coastal storms
  - Location changes and time of year for clam dredging. Do clams and oysters perform less well at higher temperatures?
  - If oysters and clams perform better, then they could shade more
  - Water temperature increases also exacerbate the growth of phytoplankton and that could serve as a secondary effect.
- We can expect species (phytoplankton?) composition changes in a warmer environment as well.
- There are nutrient reduction effects that could be improved by increased aquaculture.
- What should the regulations be to help protect SAV? Implications for effectiveness could also include the siting policy guidelines and permit conditions based on the presence of SAV.
- Could filtering by aquaculture serve to benefit the photic zone for SAV?

- Capture in the notes the weighting of changing permitting and whether there are other routes to help provide those benefits as part of the process.

Worksheet 1B (attached below)

- Metrics to assess points could focus on trends that are not currently captured in regulations. Historic is all that is currently considered, not trends.
    - When someone applies to the state and Corps of Engineers for a permit for aquaculture, the lease area must be changed if there is documented presence of SAV within the past 5 years.
    - In the context of climate change, how could that number be altered? Some suggested that the full historical record of SAV extent should be what governs the regulation, but that could be politically untenable and hard to pass by aquaculture. Advocating for looking at future trends to incorporate climate change could benefit this planning.
- If policy or permitting is designed in a flexible manner, climate can be better incorporated into management decisions. It is important to remember that current regulations and policies could be used to adequately protect resources, and altering them could add in aspects that are unwanted.
- Climate change impacts could be altered for clam bed dredging based on modified habitat.
    - Clams were removed from consideration of this case study.
- Regarding oyster restoration:
    - It would be politically infeasible to limit oyster aquaculture to all points with prior SAV habitat.
    - How to bring in climate impacts on oyster aquaculture? There are impacts of depth of water, acidification, among others. There could potentially be less available shallow water area for oyster aquaculture.
    - Relationships to fisheries management to aquaculture were also added to the notes.
    - Would the climate smart management action include additional study or other options?
        - One of the major deficiencies could be an induced growth of SAV that may not be captured in the 5 year history.
    - The climate change impacts to both SAV and the oyster fisheries are intertwined and the impacts on both are necessary to identify for the species now
    - If we're looking for management actions to continue this work, perhaps the VIMS survey should be of first importance.
    - Keep abreast of changes in oyster aquaculture, work with VIMS to acquire funding, and consider developing future projections of SAV trends.

Worksheet 1A. Examine Category 1 Climate-Smart Design Considerations: *Climate change effects on Target stressors*

SAVs

A1	A2	A3	A4	A5	A6	A7
Action number	**Existing Management Action**	**Target Stressor(s)**	**Climate change effects on stressor(s): (direction, magnitude, mechanism, uncertainty)**	**Timing of climate change effects**	**Implications for effectiveness metrics and how to measure them**	**Notes**
1	**Homeowner initiated SAV restoration project**: SAV restoration along the shoreline of the property on Kirwans Landing Lane on Kent Island, MD.	• Sediment & nutrient runoff agricultural land • Habitat destruction • Armored (rip-rap) shoreline • Invasive *Phragmites* • Herbicides from invasive management • Home owners use of dock and pier • Septic systems	• Sediment & nutrient runoff from adjacent ag lands may increase with increasing rainfall/runoff projected for the winter. However, reduced rainfall & runoff during the summer may allow for a seasonal decrease in turbidity & eutrophication. • Increased storm intensity and hurricanes threaten direct destruction of SAV habitat. • SLR will increase water depths in SAV habitat, decreasing habitat suitability, and will be a particular problem where shoreline hardening prevents habitat migration. • Success of *Phragmites* invasion may increase with climate change (particularly increasing temperatures). However, SAV abundance is positively correlated with presence of adjacent shoreline marsh (Patrick et al. 2014), and it is not clear whether it matters if that marsh is composed of native or invasive species. • Groundwater changes, saltwater intrusion, microbe activity increase with temperature increase	• Seasonal timing of rainfall expected to change, with increased rainfall in winter, decreases in summer. Similar seasonal changes in sediment and nutrient delivery expected. • SLR is already occurring and will continue to increase, threatening SAV (*Zostera*) habitat. • More intense storms & hurricanes are already occurring & are likely to increase, though confidence in ability to project these changes is low.	**Effectiveness metrics:** Acres of SAV, positive SAV growth rates, inter-annual persistence of SAV beds. Measuring habitat metrics (e.g., water depth, turbidity, others) may also be valuable in identifying contributing factors influenced by climate change to any changes in SAV success. **Target(s) for effectiveness metrics:** is there a desirable % SAV coverage to be achieved? **Implications for how to measure effectiveness metrics:** Monitoring SAV status following major storms and subsequent recovery period would help distinguish chronic (press) from episodic (pulse) disturbances.	Other beneficial reasons for the project such as citizen involvement and education. Uncertainty of SAV restoration effectiveness. Challenge and importance of long term monitoring and coverage. Potential to expand considerations to other species.
4	**SAV and conflicting uses of potential shallow water habitat**: Implement protective fishing regulations in designate SAV	• Direct physical damage from use of hydraulic clam dredges, where use of jets of waters to stir up the bottom can uproot SAV and cause turbidity.	• Increased magnitude of coastal storms • Location changes, time of year • More direct sunlight results in more direct shading. • Phytoplankton may become more intense	• More diverse species with increased temperature •	**Effectiveness metrics:** Acres of SAV, area of aquaculture, historical record & future projections, how does it tie into the regulatory approach	Uncertainty What regulations are required to reach our desired protection?

	beds in the mesohaline portion of the Maryland Bay in the vicinity of the mouth of the Choptank and the Tred Avon Rivers.	• Direct damage from oyster aquaculture, where floats placed directly over SAV beds can cause direct burial, shading, and turbidity from harvesting. • Shading	•		**Target(s) for effectiveness metrics** **Implications for how to measure effectiveness metrics:**	Aquaculture permit condition already ensures protection for SAV Spacing design to allow for SAV beds within aquaculture Protection between permit and regulatory How would you need to use policies and regulations to adequately protect

Worksheet 1B. Examine Category 2 Climate-Smart Design Considerations: *Impacts of Climate Change on Management Actions*

SAVs

B1	B2	B3	B4	B5	B6	B7	B8
Action number	**Existing management action**	**Changes in effectiveness of management action due to: climate impacts on target stressor**	**Changes in effectiveness of management action due to: climate impacts on management action**	**Time frame or constraint for using the action and implementation (e.g., urgency, longer or shorter term)**	**What changes are needed to adapt the action (place, time, and engineering design)**	**Climate-Smart Management Action**	**Notes**
1	**Homeowner initiated SAV restoration project**: SAV restoration along the shoreline of the property on Kirwans Landing Lane	• WQ of Ches Bay has been improving to the point of supporting some natural SAV recovery; however, increased introduction of sediments & nutrients especially in winter, and during larger episodic storms may degrade WQ, increase turbidity, encourage algal blooms and epiphyte growth,	• More frequent/intense storms and hurricanes can be expected to do greater/more frequent physical damage to restored SAV beds, potentially destroying the SAV	• A current partnering opportunity • Timing (sequential, seasonal) of the restoration actions	• Work with the WQ and other GITs/workgroups responsible for upland restoration of agricultural lands to minimize increases in sediment & nutrient runoff associated with climate changes in	Implement SAV restoration, focusing on *Ruppia maritima*, along natural or restored (riprap removed) shorelines, including fringing marshes, of the property on Kirwans Landing Lane on Kent Island, MD. The primary method will be seeding and re-	• Implementation of 'living shoreline' restorations, including 'mixed shorelines', reduces available habitat for (occupies the same space as) SAV, and the human demand for living shorelines are likely to increase with climate

B1	B2	B3	B4	B5	B6	B7	B8
Action number	Existing management action	Changes in effectiveness of management action due to: climate impacts on target stressor	Changes in effectiveness of management action due to: climate impacts on management action	Time frame or constraint for using the action and implementation (e.g., urgency, longer or shorter term)	What changes are needed to adapt the action (place, time, and engineering design)	**Climate-Smart Management Action**	Notes
	on Kent Island, MD.	and thus decrease the viability of restored SAV beds • Water depths of the SAV beds will (continue to) increase over time, reducing optimal habitat conditions, including for light penetration. This may be less of a problem if existing riprap is replaced with natural shoreline, but even mixed shoreline may inhibit shoreward migration of SAV. • *Phragmites* may become more successful, making replacement with native marsh more difficult. Having bordering marsh is correlated with successful SAV beds, so removal of *Phragmites*, or a higher probability of native marsh loss, may threaten SAV success. • SAV resilience/potential with sea level rise is high (with open habitat)	beds or at least decreasing the resilience of the SAVs. • Earlier germination of seeds would likely be positive		precipitation patterns and larger episodic storm event. • Along shorelines selected for SAV replanting, restore natural shoreline/marsh where hard structures (riprap) currently exist, to the extent possible.	seeding of *Ruppia*. Encourage concomitant restoration of agricultural land in the adjacent watershed to minimize increases in sediment & nutrient runoff that is otherwise projected to occur due to climate change. Communicate to the landowner any priority issues. Define success by multiple time frames. Tailor species to salinity regime.	change increases in SLR and storm frequency & intensity. • May need to develop more information/ research on the potential application of floating wave-attenuation or similar devices in SAV beds as a means of boosting the resistance of restored (or existing) beds to physical damage from storms. • Benefits of *Phragmites*? Management strategies may differ •
4	**SAV and conflicting uses of potential shallow water habitat**: Implement	• Dredging in historical SAV areas illegal • Dredging will affect nearby waterways ability to grow SAV •	• Less habitat area for SAV. Depth considerations for oyster vs. SAV habitat. •	•	•	Guidance to address how issues are changing and regulatory Monitor and data gathering to inform future management actions	Broken into two different management actions between clams and other aquaculture Water depth overlap with habitat use considerations

B1	B2	B3	B4	B5	B6	B7	B8
Action number	Existing management action	Changes in effectiveness of management action due to: climate impacts on target stressor	Changes in effectiveness of management action due to: climate impacts on management action	Time frame or constraint for using the action and implementation (e.g., urgency, longer or shorter term)	What changes are needed to adapt the action (place, time, and engineering design)	Climate-Smart Management Action	Notes
	protective fishing regulations in designate SAV beds in the mesohaline portion of the Maryland Bay in the vicinity of the mouth of the Choptank and the Tred Avon Rivers.						Relationship to fisheries management New management action: work towards protection for expanding beds Requires knowledge of oyster CC impacts in order to manage the interactions between the two. SAV workgroup should coordinate with the Fish GIT to stay informed here. SAV beds growing to overlap with oyster lease area Coordinate with VIMS regarding the updated funding cycle New strategy: consider future projections with historical data

Black Ducks/Wetlands

Breakout 1: Taking Strawman Actions through Activity 1 of the Adaptation Design Tool Matrices

- One request to focus on things that are financially possible and feasible. In brainstorming, even with impractical options, it helps to open up to all ideas to whittle down the things that could surprisingly solve the problem.
- If you have projects that go after physical restoration, then you're really going after the principal demise of the resource. But with SAV, nutrient loading is so large, if it's not dealt with, no other options will work. This speaks to required prioritization of ideas.
- Determine how resilient these functions could remain in the future. Landscape connectedness at the heart of our decision-making.

Strawman Scenario #1: Chesapeake Rivers Conservation Phase II: Conservation easements and habitat protection & restoration.

Brief Project Description: The goal of the Chesapeake Rivers Conservation II partnership is to provide an additional 2,284 acres of permanently protected high quality stopover and nesting habitat for migratory waterfowl and neotropical migrants. It will add 386 acres of conservation easements to the Blackwater National Wildlife Refuge (the Green, Wells, and Wheatle tracts), secure perpetual conservation easements on another 1,898 acres of private lands (the Leese, Harding, and Quantico tracts), and restore important wetlands on another 38.5 acres (the Choptank Watershed Wetland Restoration Program). The project affects 856 acres of estuarine wetlands, 359 acres of palustrine forested wetlands, and 40 acres of palustrine emergent wetlands – all declining wetland types. Priority species that will benefit from these habitats include: Waterfowl – American black duck, northern pintail, wood duck, and mallard; Neotropical Migrants – prothonotary warblers, Kentucky warblers, wood thrush, and worm-eating warblers; Others – American woodcock, Delmarva fox squirrel, Atlantic and shortnose sturgeon. This is Phase II of four anticipated NAWCA proposals that contribute to a long-term, landscape-scale effort to protect and restore wetland habitat in the Choptank, Nanticoke, Wicomico, and Pocomoke River watersheds, four of the most pristine watersheds of the Chesapeake Bay in Maryland, encompassing four Waterfowl Focus Areas for the Atlantic Coast Joint Venture (ACJV), primarily due to the large expanses of coastal marshes and submerged aquatic vegetation beds that provide excellent shelter and forage for migrating waterfowl like American black duck and several other high priority species. The Blackwater-Nanticoke River Focus Area alone supports 35% of all wintering waterfowl using the Atlantic Flyway. The major historical shift from forest to agriculture on the Delmarva Peninsula, and the accompanying wetland drainage, has resulted in significant opportunity to restore prior-converted agricultural lands.

Breakout Group Discussion Notes:

Worksheet 1A (attached below)

- Stressors –SLR, related stressors of salinity (question – are we going to parse out saltwater intrusion?), invasive species (*Nutria*, *Phragmites*).
- What are the predicted changes in agriculture for this area? Summers will be drier, will curtail some of the agricultural expansion. There might be a bigger increase of saltwater intrusion due to increased use of irrigation. Longer growing season, investment in (increasing demand for) irrigation –more pressure of increasing agriculture.

- Changes in runoff/precipitation would change habitat quality.
- Restoration funding by farm bill programs – disincentive for reducing agriculture. No political will to restrict irrigation or agriculture, can't see what to do about that. Water withdrawals (not sure if it's a problem here) can increase subsidence. National economics versus local agricultural decisions.
- Will we have an opportunity to engage with local land owners about where they want future conservation opportunities?
- This project was created with significant climate considerations in mind; looked at a series of climate global circulation models and suitability of habitat, avoiding areas of heavy climate impacts. Unsure what has changed. The worksheet questions can help target adjustments to the project.
- The ground we're covering here will apply to the other scenarios; common theme discussed – apply to other projects.
- Other considerations - pore water salinity in the soils, vegetation distribution/abundance – relate to carrying capacity.
- Ecological flow paths, migration corridors – looked at where marsh migration could take place, where inundation would be less, chose parcels accordingly. Retire agricultural land in path of marsh migration. If irrigation increases value of marginal agricultural land, it increases the cost of conservation. In this particular project the agricultural people have irrigation mostly.

Worksheet 1B (attached below)

- The acquisitions in this example were either in terms of perpetuity or 30 year easements.
- Doing conservation easement same way may not be worth it because SLR will put it underwater; or it might be the best available habitat and still worth it. Maybe change some techniques, due to SLR.
- Sea level is going to rise, shave some idea of where it will be worse, could map a strategy for installing practices in the right places for black duck.; allow for a shifting mosaic of function.
- We are progressing to being more targeted/less opportunistic, though still need willing landowners, and only a few land owners willing.
- For black ducks not just acreage but habitat quality – are they producing the food/energy for ducks. In this case- what is being planned and what could be done differently?
- Most species do better in unfragmented areas, and there are factors that are added now, intactness scores, ecological integrity scores, etc. This could help find trends in ecological integrity of land.
- Patch size is one metric – characterize a successful habitat for black ducks, measure average size of patches with those qualities over time. Measure whether patch size increasing over time, e.g., habitats with more interior, less fragmentation.
- Score places based on ecological integrity, resilience, other factors, impacted scores, ecological flows, etc. not just acreage, but trends over times in these scores.
- One of the metrics is for the quality of the wetland for black ducks.

- If want to maintain some high marsh, will need to manage for it; e.g., with dikes/berms and water control structures. Perhaps do more experimental removal of trees to allow migration of high marsh.
- Don't focus just on high marsh that isn't threatened by something that could be prevented by purchasing an easement (e.g., a hunting tract), but on those threatened by development, etc.
- Can change the goal for that particular location, can help change objectives to better categorize the goals for the project.
- What specifically do you value in this tract? This brings us back to the objective column in the worksheet.
- Could consider trading one tract of land for another if one is more important based on existing habitat characteristics (e.g., presence of high marsh). There is no shortage in this example of people wanting to sell the property; but the prioritization is based on acquiring land most vulnerable to urbanization. A lot of these wetlands are located in agricultural land, which can compete with the incentives for conservation practices, or can actually increase the cost of those conservation practices.
- Is there any mechanism to account for the quality of marsh as time goes on, including climate change and runoff? No, these things are not taken into account.
- Wetlands are a cheap stormwater treatment option.
- NRCS design guidelines should be added to the worksheet, because that can be manageable. This idea involves a scope outside of just this project; a different conversation.
- These conservation easement projects are big, hard to do the specific thinking that is required for this process. Might have been easier to talk about just one restoration piece. This example was very difficult to focus on site-specific ideas and concerns.
- Would need engineering design changes to weirs, dikes, etc. to accommodate climate changes in rainfall/runoff.
- Consider policy shifts that would impact climate smart – farm bill restoration investments not generally targeted, typically opportunistic. A policy shift that accelerates targeting to follow climate smart considerations would be a big change.
- May not be able to target sites/actions, but maybe be more strategic in which ones we fund.
- Changes needed; get standard engineering design from NRCS, but making changes would require changing the standards, not just site-specific design. Also changes in how/where parcels are acquired.

Strawman Scenario #2: Nanticoke Watershed Improvement Project (Maryland): Phragmites eradication.
Brief Project Description:

Breakout Group Discussion Notes: The Nanticoke River, a major tributary of the Chesapeake Bay on the Delmarva Peninsula, is one of the most diverse and intact in the Chesapeake Bay watershed. The River's coastal marshes are marshes are extremely productive and provide habitat for a wide variety of flora and fauna, including bald eagles, and numerous rare, threatened and endangered species, including Harper's beakrush, Parker's pipewort, wild lupine and box huckleberry, and unique plant communities - such as Atlantic white cedar non-tidal wetlands and xeric sand ridge forest. These fragile ecosystems and their biodiversity are threatened by the non-native, invasive perennial reed, *Phragmites australis*. *Phragmites* grows in wetlands and along roadsides and shorelines throughout the Chesapeake Bay watershed. Following hurricane Sandy in 2012, *Phragmites* began to invade the once pristine wetlands of the Nanticoke River. In order to perpetuate and improve waterfowl use of this River during migration, this project will seek to eradicate *Phragmites* on 1,500 acres of public and private lands along the Nanticoke River. It will improve the long-term health of marsh vegetative communities, resulting in more resilient tidal wetland systems, and will improve wetland habitat by increasing areas of wild rice, a high energy food for migrating waterfowl. Treatment of *Phragmites* flare-ups will use aerial and ground herbicide applications. The control work will be conducted by certified contractors specializing in wetland invasive plant management.

A helicopter will be used to apply herbicide as it is the most efficient and effective means of application. The broad-spectrum herbicide, glyphosate (which is commercially available as Rodeo®, among others), is known to control *Phragmites* and is approved by the U.S. Environmental Protection Agency for wetland use. Given historic results, the employment of glyphosate is preferred for this application. MD DNR staff and the helicopter pilot will use maps produced via GIS to fly transacts within the Nanticoke watershed and apply herbicide onto the selected stands of *Phragmites* that are monopolizing the landscape in important wildlife areas. The project will benefit current and future Refuge lands located within the Nanticoke River Unit of the Chesapeake Bay Marshlands National Wildlife Refuge Complex. All eradication operations will take place within the acquisition boundary of the Nanticoke Unit of the Refuge which will result in improved water quality and wetland function within the Nanticoke watershed and at the adjacent Blackwater Unit of the Chesapeake Marshlands NWR.

Worksheet 1A (attached below)

- Stressors- temperature, CO_2, nutrient addition make habitats more hospitable for *Phragmites*.
- What about SLR? Point beyond which inundation will help inhibit *Phragmites;* also can't tolerate above a certain salinity.
- Runoff /sediments – *Phragmites* loves nutrients. Positive benefit of *Phragmites*. May/may not be positive to this project, but consider.
- Monotypic stands produce fewer *Phragmites* seeds.
- Not getting replacement where spraying for *Phragmites*, so marsh is breaking up. Maybe natural marsh rebuilding can't keep up with SLR, maybe plant natives immediately. This brings up an idea of managing smaller areas, but managing it better with seeding, better success. Or perhaps leave water edge, spray behind it go to native; however, conventional thinking is that if don't eradicate all of it, it just comes back.
- Listed *Phragmites* as a nuisance species so that landowners are required to deal with it as a noxious weed. But this idea died quickly. *Phragmites* is a good elevation builder, better at coping with SLR than natives. Will *Phragmites* elimination give us what we want?
- In terms of black duck habitat, how does native *Phragmites* help or contribute? Not very much according to the group.

Worksheet 1B (attached below)

- Removal of *Phragmites* – lead to loss due to erosion. Measure how much erosion is there post-eradication of *Phragmites* (the invasive plant, not the native). Metrics – amount of *Phragmites*, replacement with natives, how much erosion post eradication, density of native plants. There is native *Phragmites*.

- Temperature affects effectiveness of glyphosphate. As growing season expands, selectiveness to *Phragmites* would decrease. Could move spraying to later than October, when *Phragmites* is still growing but other (native) plants not so much. Also fly when can limit conditions of drift – storminess might affect this. Play the weather, don't apply before rain (applied with a surfactant).
- Changes – monitor to make sure something else grows after eradication. Need a plan to minimize erosion (planting something else). Monitor how selective we are being to see if time of application shift is advisable.
- Dennis Whigham suggested leaving large areas of *Phragmites*, only treating smaller patches. This might not be the best project if it was surrounded in *Phragmites*. But because this project is early in the invasion of *Phragmites*, it might be better remediated.
- This project – at least add monitoring, if no colonization by natives, go in and plant.
- The use of climate data – need to know the SLR scenarios to have greater certainty about need for post eradication planting. Prioritize areas with slower SLR, use planting in higher SLR areas.
- Removing the *Phragmites* and roots is more effective than spraying, but it lowers marsh level, and replacement species must be planted. This is much more labor intensive. MD also has a fill in requirement for the 50-50 high-low marsh ratio. This is something to think about in terms of climate change and SLR; also a cost-benefit analysis issue.
- Need to evaluate the need for additional management/monitoring, to avoid budgeting all money for eradication.

Worksheet 1A. Examine Category 1 Climate-Smart Design Considerations: *Climate change effects on Target stressors*

Black Ducks-Wetlands

A1	A2	A3	A4	A5	A6	A7
Action number	**Existing Management Action**	**Target Stressor(s)**	**Climate change effects on stressor(s): (direction, magnitude, mechanism, uncertainty)**	**Timing of climate change effects**	**Implications for effectiveness metrics and how to measure them**	**Notes**
1	**Chesapeake Rivers Conservation Phase II**: Conservation easements and habitat protection & restoration.	Loss of habitat due to: • Residential development & habitat fragmentation • Drainage of wetlands for agriculture	• There is little direct effect of climate changes on human residential development & habitat fragmentation, but the projected increase in frequency and intensity of rainstorms could increase effects of development, e.g.: o Flashier runoff from impervious surfaces. o Increased runoff of sediments from disturbed land (including agricultural lands contained within the project area). • There is little direct effect of climate change on agricultural drainage in this area.	• Climate changes in precipitation, runoff, and severe storms are already occurring.	**Effectiveness metrics:** Acres of wetland habitat remaining undeveloped. Some measure of wetland function or quality, e.g species diversity, sediment accretion. Number of nesting or feeding waterfowl. **Targets for metrics:** **Implications for how to measure metrics**: Monitoring protocols with fixed timing or locations may need to be modified to account for shifts in habitat use or changes in phenology.	
2	**Nanticoke Watershed Improvement Project (Maryland)**: *Phragmites* eradiation.	• Invasion by *Phragmites australis*			**Effectiveness metrics:** **Targets for metrics:** **Implications for how to measure metrics:**	

Worksheet 1B. Examine Category 2 Climate-Smart Design Considerations: *Impacts of Climate Change on Management Actions*

Black Ducks-Wetlands

B1	B2	B3	B4	B5	B6	B7	B8
Action number	Existing management action	Changes in effectiveness of management action due to: climate impacts on target stressor	Changes in effectiveness of management action due to: climate impacts on management action	Time frame or constraint for using the action and implementation (e.g., urgency, longer or shorter term)	What changes are needed to adapt the action (place, time, and engineering design)	Climate-Smart Management Action	Notes
1	**Chesapeake Rivers Conservation Phase II**: Conservation easements and habitat protection & restoration.	• There is little direct effect of climate changes on development, but increases in frequency and intensity of rainstorms may increase effects of development and agriculture.	A variety of climate change impacts including flooding, salt marsh migration, salinity changes, large storm events, sea level rise, could affect quality, area, and location of wetlands & upland habitats intended for preservation	• The urgency comes primarily from the threat of development.	• Plantings need to account for changing climate conditions.		
2	**Nanticoke Watershed Improvement Project (Maryland)**: *Phragmites* eradiation.					.	

Attachment 5

CBP Climate Smart Management Strategy – SAV Case Study

CBP Climate Smart Management Strategy – SAV Case Study

Submerged Aquatic Vegetation (SAV) Outcome: Sustain and increase the habitat benefits of SAV (underwater grasses) in the Chesapeake Bay. Achieve and sustain the ultimate outcome of 185,000 acres of SAV Bay-wide necessary for a restored Bay. Progress toward this ultimate outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025.

Management Approach: The Partnership will work together to carry out the following actions and strategies to achieve the SAV outcome. These approaches seek to address the factors affecting our ability to meet the goal and the gaps identified above. The following four strategies have been identified as critical to the success of SAV restoration goals.

Management Approach #1: Advocate for actions that will Restore Water Clarity in the Bay

1. Continue work to achieve water clarity/SAV standards in areas designated for SAV use
    a. Consider WQ standards for different SAV populations (existing vs. recovering) and assess ongoing research that would support these efforts.
    b. Continue dialogue about Bay-wide standards vs wider scale enhanced standards
2. Continue to improve the SAV component of shallow water model
    a. Consider climate change influence on turbidity.
3. Explore linkages between climate change trends in water clarity and SAV
4. Have CBP monitoring team to present mid-point assessment modeling results
    a. Asses mid-point modeling results for WQ data gaps (shallow water)

Management Approach #2: Protect existing SAV considering historical trends and future climate change

5. Evaluate and enhance current statues and regulations that protect existing SAV in the Bay also considering future climate change threats
    a. Identify supporting data that can justify decisions
6. Monitor SAV throughout the Bay, including the impacts of extreme events as a monitoring parameter
    a. Develop climate monitoring parameters to detect ecological trends

Monitor stressors influence on SAV (secchi depth, chlorophyll a, climate change, and land use changes)

7. Manage current and potential invasives that are considered detrimental to existing SAV populations. Work towards determining the economic value of SAV ecosystem services

    a. Incorporate research that examines ecosystem services into strategic planning and consider future climate impacts

8. Develop spatially explicit information on where to protect SAV taking into account climate change effects on environmental conditions
9. Explore opportunities to protect key refugia in the gradient of salinity zones (e.g. Susquehanna Flats)

Management Approach #3: Restore Submerged Aquatic Vegetation

10. Plant, at min, 20 acres of SAV seeds and propagules in appropriate high quality/clarity areas each year until the goal is reached with placement taking into consideration fisheries use, climate change considerations, and spatial proximity to other living resources
11. Look for opportunities to optimize conditions that would allow for the natural or assisted restoration of SAV when possible and appropriate in the course of completing other non-SAV specific projects
12. Develop spatially explicit information on where to restore SAV taking into account climate change effects and land use practices on environmental conditions
    a. Ensure there is up-to-date, high resolution data (currently VIMS data) tool
        i. Update current shoreline shapefile with latest data (1m res)
    b. Assess future availability of migration corridors for SAV considering shoreline modification and SLR

Management Approach #4: Enhance Research, Citizen Involvement, and Education

13. Advance knowledge in the fields of SAV biology, ecology, and genetics.
    a. Identify gaps specific to climate change for research with a focus on applied responses that would support management decisions.
14. Advance knowledge regarding the effects of human induced stressors on SAV, including those of climate change, associated feedback loops
15. Advance knowledge of SAV restoration techniques in light of climate change stressors
16. Complete and publish TS3
    a. Collaborate with the climate workgroup to disseminate climate related chapters to appropriate partners
17. Develop a communication strategy that enhances the public's knowledge of and appreciation for SAV in the Bay, similar to the models used to advance oyster and other wildlife restoration efforts
    a. Develop visualization tools as a communication strategy