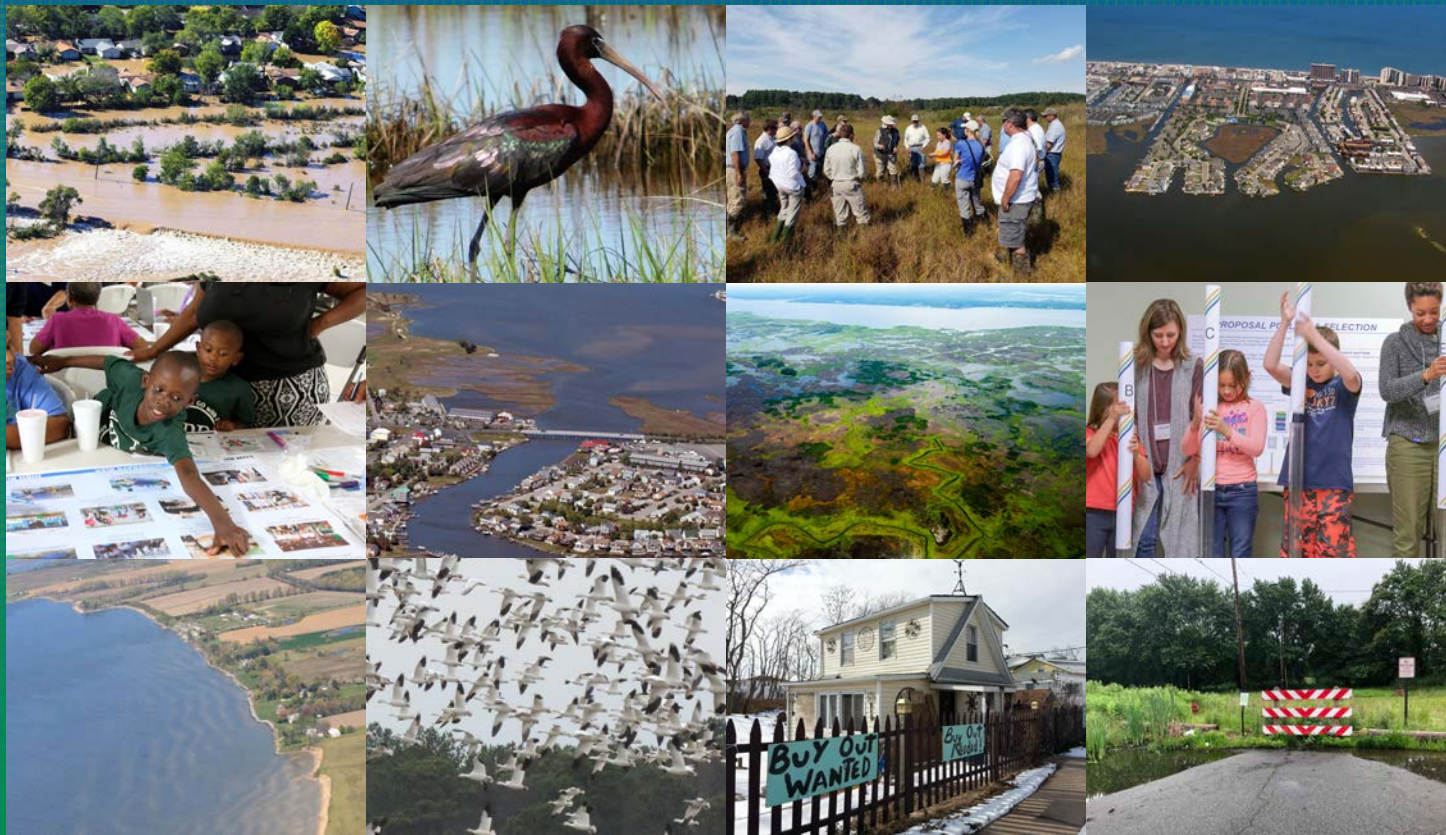


# Managing the Retreat from Rising Seas

## Blackwater National Wildlife Refuge, Maryland: Blackwater 2100



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## Authors

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# Managing the Retreat from Rising Seas: Lessons and Tools from 17 Case Studies

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## About This Report

As seas continue to rise and disaster events and extreme weather increase in frequency and intensity, climate change is driving state and local policymakers to evaluate strategies to adapt to various risks affecting many communities. In addition to protection (e.g., hard shoreline armoring) and accommodation (e.g., elevating or flood-proofing structures) measures, coastal governments and communities are increasingly evaluating managed retreat, where appropriate, as a potential component of their comprehensive adaptation strategies. Managed retreat is the coordinated process of voluntarily and equitably relocating people, structures, and infrastructure away from vulnerable coastal areas in response to episodic or chronic threats to facilitate the transition of individual people, communities, and ecosystems (both species and habitats) inland.

The aim of managed retreat is to proactively move people, structures, and infrastructure out of harm's way before disasters occur to maximize benefits and minimize costs for communities and ecosystems. For example, policymakers may maximize opportunities for flood and risk reduction by conserving wetlands and protecting habitat migration corridors and minimize the social, psychological, and economic costs of relocation by making investments in safer, affordable housing within existing communities.

This report is composed of 17 individual case studies. Each one tells a different story about how states, local governments, and communities across the country are approaching questions about managed retreat. Together, the case studies highlight how different types of legal and policy tools are being considered and implemented across a range of jurisdictions — from urban, suburban, and rural to riverine and coastal — to help support new and ongoing discussions on the subject. These case studies are intended to provide transferable lessons and potential management practices for coastal state and local policymakers evaluating managed retreat as one part of a strategy to adapt to climate change on the coast.

Collectively, these case studies present a suite, although not an exhaustive list, of legal and policy tools that can be used to facilitate managed retreat efforts. Legal and policy tools featured include: planning; hazard mitigation buyouts and open space acquisitions, as well as other acquisition tools like land swaps and reversionary interests; land use and zoning; and Transfer of Development Rights programs. The case studies also highlight various policy tradeoffs and procedural considerations necessitated by retreat decisions. Each jurisdiction is confronting different challenges and opportunities and has different, perhaps even competing, objectives for retreat. In addition, stakeholders in each of these cases are attempting to balance multiple considerations, including:

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protecting coastal ecosystems and the environment; fostering community engagement and equity; preparing “receiving communities” or areas where people may voluntarily choose to relocate; and assessing public and private funding options and availability. The case studies included in this report were selected to reflect the interdisciplinary and complex nature of retreat decisions and underscore the need for comprehensive solutions and decisionmaking processes to address these challenging considerations.

Where possible, all of the case studies share a consistent organizational format to allow easier cross-comparison of strategies, processes, and takeaways:

- The **Background** section introduces state or local context for each case study, including the risks and hazards facing each jurisdiction and its road to considering or implementing managed retreat strategies.
- The **Managed Retreat Examples** section focuses on the legal and policy tools that have been designed and implemented to support managed retreat strategies on the ground.
- The **Environment** section highlights how floodplains and coastal ecosystems have been restored, conserved, and protected as a part of comprehensive managed retreat strategies to provide ecosystem and community benefits, like reducing flood risk and creating community assets such as parks and trails.
- The **Community Engagement** section summarizes how affected residents have been contributing to planning and decisionmaking processes for climate adaptation and managed retreat.
- The **Funding** section identifies how the programs, plans, and projects discussed have been funded by federal, state, and local government and private sources.

- The **Next Steps** section captures the anticipated future actions that jurisdictions may take in implementing these managed retreat strategies.
- The **Considerations and Lessons Learned** section concludes with the primary takeaways from each example that other coastal state and local policymakers and communities may consider when developing or implementing their own managed retreat strategies using these legal and policy tools.

The case studies in this report were informed by policymakers, practitioners, and community members leading, engaging in, or participating in the work presented in this report. No statements or opinions, however, should be attributed to any individual or organization included in the *Acknowledgements* section of this report. It is also important to note that the programs and planning processes described in each case study are ongoing and the content included in this report is current as of early 2020. Future updates about these case studies will be captured in Georgetown Climate Center’s online resources on managed retreat.

These case studies were written to support Georgetown Climate Center’s Managed Retreat Toolkit, which also includes additional case study examples and a deeper exploration of specific legal and policy tools for use by state and local decisionmakers, climate adaptation practitioners, and planners. For future updates about these and other case studies and the Managed Retreat Toolkit, please visit the **Managed Retreat Toolkit** and the **Adaptation Clearinghouse**.

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# Blackwater National Wildlife Refuge, Maryland: Blackwater 2100

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## Executive Summary

In 2013, The Conservation Fund, National Audubon Society, and U.S. Fish and Wildlife Service partnered to produce a “salt marsh persistence” report for Blackwater National Wildlife Refuge (NWR) titled *Blackwater 2100* to address marsh migration in response to sea-level rise and tidal erosion. Blackwater NWR is a wildlife sanctuary and wetland area of high ecological importance located in Dorchester County, Maryland. Since the 1930s, over 5,000 acres of marsh have been lost at Blackwater NWR. The objectives of the report are to identify areas of current tidal marsh most resilient to sea-level rise and of the highest value to salt marsh bird species as well as future locations that may support marsh migration corridors. The report’s authors utilized several tools, including the Sea-Level Rise Affecting Marshes Model (SLAMM), to select one of three different adaptation strategies for wetland areas within Blackwater NWR to create a comprehensive management plan. The three adaptation strategies include: (1) in-place restoration actions targeted at improving existing tidal marsh health and productivity; (2) strategic conservation in priority marsh migration corridors; and (3) actions supporting the transition of uplands into marsh. *Blackwater 2100* can provide a useful example for natural resources, open space, and coastal managers to plan for minimizing coastal habitat loss due to sea-level rise by evaluating the tradeoffs of different adaptation strategies; and building partnerships with stakeholder groups and the community to examine marsh migration on an ecosystem scale that necessitates public and private land acquisitions and involvement. It may also serve as a model that can be adapted for other coastal locations with different management criteria or priorities.



**Wetlands at Blackwater National Wildlife Refuge.**

Wetlands cover Blackwater National Wildlife Refuge in Dorchester County, Maryland on June 5, 2018.

Credit: Will Parson, Chesapeake Bay Program, U.S. Fish and Wildlife Service.



**Snow Geese.**

Snow geese are one of several migratory bird species that visit Blackwater National Wildlife Refuge every winter as they migrate south from Canada.

Credit: Betty Whetzel (Courtesy of U.S. Fish and Wildlife Service).

## Background<sup>1</sup>

Blackwater National Wildlife Refuge (NWR) — located in Dorchester County, Maryland — is a migratory bird sanctuary and ecologically important area spanning more than 29,000 acres. Blackwater NWR consists of three major habitats — forest, marsh, and shallow water — and contains one-third of Maryland’s tidal wetlands. Blackwater NWR was established in 1933 as a waterfowl sanctuary for birds and continues to provide an important resting and feeding area for migrating and wintering birds including waterfowl and Canada geese using the Atlantic Flyway. Blackwater NWR also supports one of the largest natural populations of Delmarva fox squirrels and the largest nesting population of American bald eagles on the Atlantic coast. The U.S Fish and Wildlife Service (USFWS) manages the refuge with the goal of maintaining and enhancing productive habitat for a healthy diversity of wildlife species. Since the 1930s, over 5,000 acres of marsh have been lost at Blackwater NWR from a combination of factors including sea-level rise, saltwater intrusion, land subsidence, and invasive species. Maryland is particularly vulnerable to sea-level rise because of its geographic location, elevation, and geology; and these factors have influenced all actions related to adapting, preserving, and restoring marshes in the refuge under the marsh persistence strategy.

## Managed Retreat Examples

### Planning for Retreat

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*Blackwater 2100* is a strategic plan or guidance document created through a public-private partnership to comprehensively restore and manage migrating wetlands. In 2013, The Conservation Fund and Audubon Maryland–D.C., in collaboration with USFWS and Maryland



Department of Natural Resources, published the *Blackwater 2100* report on strategies to address marsh loss in an era of climate change. The *Blackwater 2100* report used science and predictive tools to outline key strategies to help slow the rate of marsh loss, improve marsh health, and ensure that marshes have room to migrate inland and reestablish with rising tides. Changes in tidal marsh area and habitat type were modeled using the Sea-Level Rise Affecting Marshes Model (SLAMM).<sup>2</sup> SLAMM shows a visual model of a marsh's future under different sea-level rise scenarios. SLAMM helped to identify which areas of current tidal marsh were most resilient to sea-level rise and which locations may support tidal marsh in the future as “marsh migration corridors.” Modeling was also used to identify the marshes of highest value for seven focal salt marsh bird species so that wetland conservation strategies could be targeted to preserve the best habitat for salt marsh birds.

The report's authors acknowledge that, given the cost and logistical challenges of marsh restoration, such as large areas of already eroded marsh, dredging volume requirements, and accessibility issues, it would be infeasible to attempt to preserve all tidal marshes in Blackwater NWR. Instead, the report's authors identify key areas of existing marsh where management actions are likely to yield the greatest long-term conservation benefits, focusing primarily on enhancing areas of marsh that are still largely intact. To complement SLAMM projections, additional factors were also incorporated in designating desirable marsh migration corridors including road network density, current and future land use, water flow and ponding information, and protected land status.

As a result of these findings, a new conservation approach has been implemented in Blackwater NWR focused on supporting “salt marsh persistence,” based on the *Blackwater 2100* report. The report identifies three different adaptation strategies to comprehensively manage wetlands in Blackwater NWR:

1. Build resilience of existing marsh areas;
2. Facilitate inland marsh migration; and
3. Support the transition of upland areas into marsh.

This three-pronged conservation approach, discussed in more depth below, is intended to collectively reduce tidal marsh loss in Blackwater NWR due to sea-level rise projected through the end of the century, improve marsh health, and support marsh migration and the transition of uplands into marsh as the tide rises.

### Build Resilience of Existing Marsh Areas

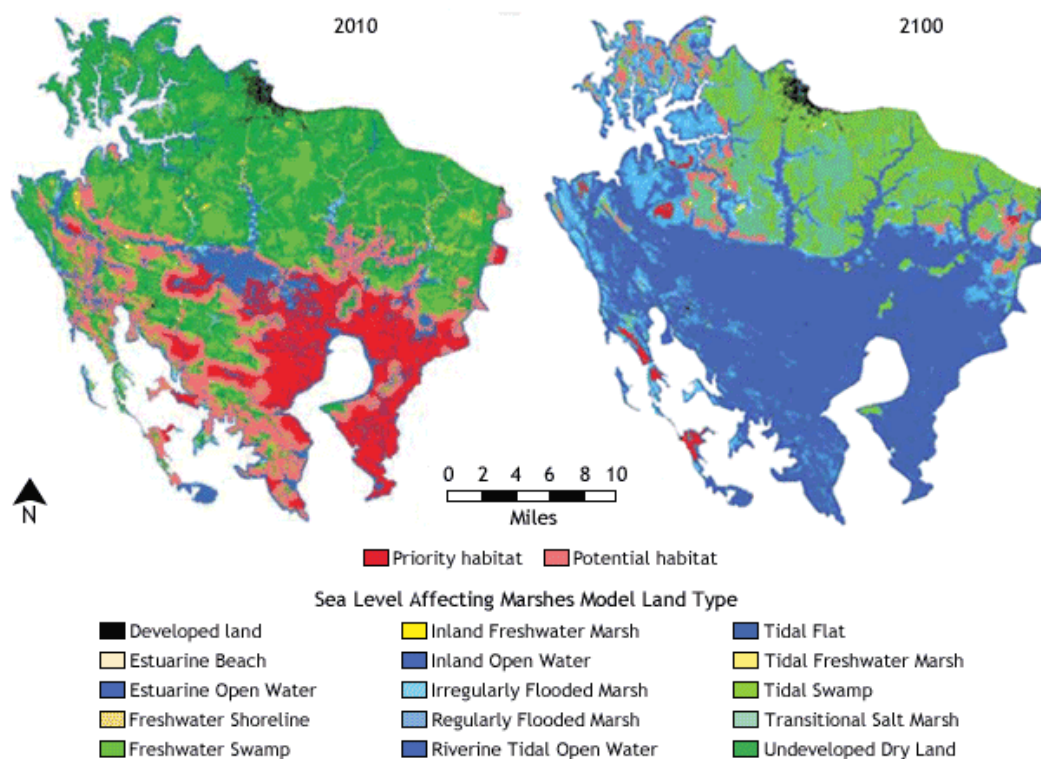
The first strategy in *Blackwater 2100* calls for efforts to preserve and build the resilience of existing, strategically selected marsh areas. Recommended actions include protecting and restoring brackish marsh habitat, using on-site material for marsh restoration, stabilizing shorelines, and reducing saltwater intrusion. The marsh areas targeted in this strategy were identified for their contribution to Blackwater NWR's wildlife protection mission, specifically, the salt marsh bird “specialists” — a suite of species that depend on high tidal marsh for a significant part of their life cycles. Protection efforts have also involved



American Bald Eagle.

Blackwater National Wildlife Refuge is home to the largest nesting population of American bald eagles on the Atlantic coast.

Credit: U.S. Fish and Wildlife Service.



### Projected Impacts of Sea-Level Rise on Blackwater National Wildlife Refuge This Century.

By 2100, nearly all the tidal marshland (in blue on the 2100 map) in Blackwater National Wildlife Refuge could be submerged by a three-foot rise in sea level. A three-foot rise in sea level is notable because it would impact the refuge's priority and potential future bird habitat (in red and pink, respectively on the 2010 map).

Credit: Daniel Strain, *The Future of Maryland's Blackwater Marsh*, CLIMATE.GOV, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Jan. 14, 2015), available [here](#) (Map adapted from *Blackwater 2100: A Strategy For Salt Marsh Persistence in an Era of Climate Change*).

wildlife management actions including reducing the population of resident Canada geese, which devour newly planted crops and marsh plants, controlling *phragmites*, and maintaining a program to eradicate the invasive species, nutria.

To implement this adaptation strategy, project partners established a Marsh Conservation Zone (MCZ) in the refuge that, among other factors: has a favorable underlying geology and important salt marsh bird habitat; is proximate to identified marsh migration corridors; is largely in protected land status; and where management intervention is most likely to secure additional decades of high quality tidal marsh habitat. It is important to note that the MCZ was determined based on these specific factors because the strategy of building existing marsh resilience is not suitable — or practical — for all areas of marsh within Blackwater NWR. This demonstrates the careful considerations about location and priority-based decisionmaking in the report that other resource, land, and coastal managers can consider when developing their own approaches to adapt coastal ecosystems to the effects of climate change.

During fall 2016, The Conservation Fund, National Audubon Society, and USFWS completed one large-scale adaptation project in the MCZ. This project saw 26,000 cubic yards of sediment taken from the Blackwater River and spread thinly across a 40-acre section of the salt marsh that showed signs of decline due to rising water levels. Most of the site was left to naturally regenerate vegetation via native marsh grass rhizomes in sediment. Marsh grasses were planted in former marsh “holes” — areas where vegetation had collapsed and become open water ponds — to hold the sediment in place and retain the increased elevation. Only native marsh grasses were utilized and a deliberate effort was made to restore *Spartina patens* high marsh vegetation that was most suitable for the desired salt marsh birds. The restoration experiment was designed to boost plant productivity and prolong the expected life of the marsh ecosystem and the habitat for birds. This project was the first “thin-layer” and revegetation project in the Chesapeake watershed and the largest wetland restoration effort ever undertaken in Blackwater NWR. As of 2019, the project outcomes are still being monitored and evaluated; however, initial results exceeded expectations with



added sediment settling out to targeted levels, existing native grasses flourishing, new plants taking root, and wildlife returning to the site.

### Facilitate Inland Marsh Migration

For marshes not selected to be managed by in-place restoration to build their resilience (see above), the *Blackwater 2100* report includes recommendations for identifying and protecting areas for inland marsh migration, such as migration corridors. In Blackwater NWR, existing marshes cannot keep pace with sea-level rise by increasing their elevation through natural sediment supplies and have thus begun to migrate inland. As a result, some of the former agricultural fields and forested areas within Blackwater NWR have already transitioned into tidal marsh as rising bay waters inundate or increase the salinity of soils. Facilitating the migration of marsh habitats has become a management priority in Blackwater NWR and involves the acquisition and protection of priority marsh areas and adjacent upland buffers. SLAMM projections have been used to identify and assess potential marsh migration corridors, particularly those adjacent to conservation lands in and surrounding the refuge, allowing for consistent management of large, contiguous marsh areas.

To implement this strategy, USFWS, the state, and other nonprofit partners are working to acquire land and conservation easements in the two priority migration corridors. In 2016, USFWS acquired 410 acres of new land for Blackwater NWR from The Nature Conservancy to provide more habitat for bird species and space to accommodate projected future marsh migration. Thousands of acres have also been acquired through conservation easements in the two primary migration corridors. Conservation easements are owned by private landowners, Maryland Department of Natural Resources, and other entities. Strategic additions to these land conservation areas are planned to ensure that successful adaptation continues.



### Support the Transition of Upland Areas into Marsh

For former agricultural fields and forests within Blackwater NWR that are already transitioning into tidal marshes, the *Blackwater 2100* report identifies a number of techniques to help these upland areas transform more rapidly and effectively into functioning tidal marsh. These techniques include *Phragmites* control using targeted herbicide application to prevent invasive plants from out-competing marsh grasses preferred by salt marsh birds, removing dead trees to increase the effective habitat area for salt marsh birds, and planting transition crops, such as salt-tolerant grass species, that can improve water quality by preventing nutrients and other pollutants from entering the Chesapeake Bay.

## Community Engagement

To develop *Blackwater 2100*, The Conservation Fund, Audubon Maryland–D.C., Maryland Department of Natural Resources, and USFWS engaged the public to help assess the value of tidal marshes for different stakeholders. These entities have also engaged surrounding communities

### Educating and Engaging Stakeholders at Blackwater National Wildlife Refuge.

In 2018, 33 participants from U.S. Fish and Wildlife Service, state agencies, nonprofits, and private landowners attended a workshop to learn about wetland management in the refuge. This is one example of how U.S. Fish and Wildlife and its partners work together to educate different stakeholders about the value of wetlands, in addition to the challenges of managing seasonally flooded and migrating wetlands. This level of engagement can create new stewards to protect and conserve these important resources into the future as the ecosystem changes due to climate change.

Credit: U.S. Fish and Wildlife Service.

to support wetland stewardship and climate adaptation projects including to replant marsh grasses. They have also organized several project tours at the thin layer marsh elevation project site and at Farm Creek Marsh, an Audubon-owned sanctuary nearby. Other public meetings have been held at the Refuge Visitors Center for a variety of stakeholders. A technical working committee was established to provide advice and feedback to further refine the report. While *Blackwater 2100* is primarily focused on preserving bird habitat and marsh persistence, the report also highlights the important cultural and economic values of Blackwater NWR and how management efforts should simultaneously benefit humans.

## Funding

Early in the process to draft *Blackwater 2100*, project proponents determined that it would be too expensive to restore all of the wetlands threatened in Blackwater NWR. Funding for projects has thus been focused on activities that will allow marshes to persist (by building their resilience) and migrate inland. In-place marsh restoration has been funded with federal grants for coastal resiliency projects offered following Hurricane Sandy. Investments in restoring the marsh ecosystem will provide economic benefits including inland flood protection, habitat for commercial fish species, and filtering pollutants. The Migratory Bird Conservation Commission has also granted USFWS and its partners \$2.2 million in funding for land acquisition projects.

## Next Steps

The identification and implementation of future projects, including locating funding, will continue to proceed on an individual, project-by-project basis in coordination with all of the report's partners.

## Considerations and Lessons Learned

*Blackwater 2100* provides a useful example of an adaptation plan that addresses sea-level rise impacts to coastal habitats. Developed through a partnership with stakeholders and the community, the report evaluates the tradeoffs of different adaptation strategies for preserving marshes facing rising seas. First, adaptation plans and projects at Blackwater NWR involve ongoing efforts for in-place marsh restoration, marsh migration, and transition of uplands. These approaches may serve as a model for other land managers and policymakers weighing varying options for how to develop and use science-based, comprehensive strategies to prioritize marsh adaptation. This model may be replicated or adapted in other marsh locations depending on different management priorities and scales, among other factors like funding, land availability, and existing and future development.

Second, the *Blackwater 2100* report highlights that deploying this combination of strategies requires not only the collaboration of policymakers and state and federal agencies but the active engagement of private landowners and the public. This partnership approach has been critical to the success of the adaptation efforts underway at the refuge and ongoing project development. Moreover, partners are acquiring and adding land surrounding Blackwater NWR to the refuge by leveraging non-federal conservation efforts to address marsh migration on a larger ecosystem scale. In addition, project partners are actively pursuing funding collaboratively as a team and in accordance with the strategic plan set by *Blackwater 2100*. Reports or plans like *Blackwater 2100* can communicate a larger, cohesive vision to potential funders and ideally increase the success of efforts to preserve important coastal habitats in the face of rising seas.



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## Endnotes

- 1 Note that information and factual support for this case study was sourced from AUDUBON MD.-D.C. & THE CONSERVATION FUND, *BLACKWATER 2100: A STRATEGY FOR SALT MARSH PERSISTENCE IN AN ERA OF CLIMATE CHANGE* (2013), *available at* [https://www.conservationfund.org/images/projects/files/Blackwater-2100-report\\_email.pdf](https://www.conservationfund.org/images/projects/files/Blackwater-2100-report_email.pdf); and interviews with representatives from The Conservation Fund and U.S. Fish and Wildlife Service.
- 2 Georgetown Climate Ctr., *Sea-Level Rise Affecting Marshes Model (SLAMM)*, ADAPTATION CLEARINGHOUSE (APR. 9, 2010), <https://www.adaptationclearinghouse.org/resources/sea-level-rise-affecting-marshes-model-slam.html>.

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