For Review

Albemarle-Pamlico
National Estuary Partnership

DRAFT

Comprehensive Conservation and Management Plan

2025 – 2029

A Collaborative Strategy

for the Protection, Restoration, and Management of the

Albemarle-Pamlico Estuarine Ecosystem

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Albemarle-Pamlico National Estuary Partnership

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Mission

To understand, protect and restore the significant resources of the Albemarle-Pamlico estuarine system

Acknowledgments

The Staff and the Management Conference for the Albemarle-Pamlico National Estuary Partnership extend their sincere appreciation to the organizations, businesses, agencies, and many individuals who contributed to the production of this plan and its supporting documents. Such dedication to engaging partners in the understanding, protection, and restoration, of the Albemarle-Pamlico ecosystem will continue to make our combined collaborative efforts a success.

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This document is intended to be consistent with Section 320 of the *Federal Water Pollution Control Act Amendments of 1987* (Clean Water Act), 33 USC § 1330, § 320, as well as amendments under the *Protect and Restore America's Estuaries Act*, (2021, Public Law 116–33). It adheres to the regulatory frameworks established by these laws to safeguard water quality and promote the restoration and protection of ecosystems in the Albemarle-Pamlico Watershed.

The contents of this document do not necessarily reflect the views and policies of EPA, NC-DEQ, the State of North Carolina or the Commonwealth of Virginia, or specific partners.

During the planning process, APNEP collaborated with regional partners essential for implementing its recommended actions and referenced numerous partner plans. This collaboration with key implementers necessitated the use of acronyms in this document. State agencies are identified by the prefixes NC- and V, while federal agencies and other organizations are referred to by their well-known acronyms. For convenience, a table of acronyms and abbreviations is provided at the end of this document along with glossary of terms and definitions.

Table of Contents

EXECUTIVE SUMMARY

A Strategic Plan

A Comprehensive Conservation and Management Plan (CCMP) is a strategic document developed by each of the 28 National Estuary Programs under the US Environmental Protections Agency's National Estuary Program (NEP) established under the federal Clean Water Act (CWA). A CCMP outlines priorities for activities, research, and funding to protect and restore congressionally designated estuaries of national significance and their watersheds. It serves as a blueprint to guide future decisions and addresses a wide range of environmental issues, such as water quality, habitat protection and restoration. Each CCMP is based on a scientific assessment of the estuary and is developed with input from a broad coalition of stakeholders, including community members. It is essentially an action plan for maintaining and improving the health of these vital ecosystems.

This document updates the 2012-2022 CCMP developed by staff under the direction to the Management Conference and regional partners to provide targeted guidance for the Albemarle-Pamlico National Estuary Partnership (APNEP) in understanding, protecting, and restoring the Albemarle-Pamlico estuarine system. The update builds upon the previous version and covers a shorter management horizon from 2025-2029. While minor changes were made to the narrative body of the document, substantive changes were made to the actions and objectives in the CCMP Action Plan section. Details on the process that guided the changes in this update can be found in Appendix I.

This CCMP documents the efforts of the Management Conference of APNEP to characterize priority issues in the estuaries and supporting watersheds, to list and describe actions to address those problems, and to identify partners and entities to implement those actions. The CCMP is crafted to meet the specific and often unique needs within our watershed and provide a guide for governments, businesses, non-governmental organizations, and everyday citizens in the stewardship of the Albemarle-Pamlico estuarine system. The CCMP aims to sustain these vital resources and ecosystem functions for future generations.

This update to the CCMP aligns with the NEP guidance and recommendations developed for all NEPs and continues to support goals and strategies introduced in the 2012 CCMP. Our strategy utilizes an ecosystem-based management (EBM) perspective and its adaptive management framework. This allows for consideration of both human and natural systems collectively in natural resource management. We also prioritize

meaningful engagement with citizens to identify effective environmental management and policy solutions.

The actions in the CCMP have been informed by the current state of the science in consideration of climate stressors that affect the estuary such as warming waters, increased storminess, and sea level rise. The CCMP actions address various climate vulnerabilities in the estuary, and the actions that serve as adaptation strategies to mitigate the identified climate risks to the Albemarle-Pamlico estuarine system are identified within the document. Some actions address climate change directly, and others incorporate knowledge of the climate stressors into their implementation. All CCMP actions, including those carried over from the 2012 CCMP, were assessed by APNEP staff for their vulnerability to climate stressors and found to have low risk .

As a National Estuary Program, CCMP implementation relies on collaborative partnerships and leveraged resources in environmental and natural resource management, sustainability, and resilience across the region. Many CCMP objectives and actions depend on the involvement of key governmental, academic, non-governmental organizations, and other partners. The success of the partnership is contingent on maintaining these relationships, making an engaged partnership critical to our success.

A comprehensive review of nearly 50 conservation-oriented plans and initiatives in the region helped refine the 2012 CCMP and insure consistency and compatibility with shared goals and objectives for protection of the region. Newly adopted or updated plans were considered during the development of this updated CCMP. Key initiatives include the Currituck Sound Coalition Marsh Conservation Plan, NC Coastal Habitat Protection Plan, NC Aquatic Nuisance Species Management Plan, NC Natural and Working Lands Action Plan, NC Climate Risk and Resiliency Plan, NC & VA Wildlife Action Plans, VA Coastal Master Plan, resources developed by the NC and VA Natural Heritage Programs, VA Healthy Waters Initiative, and watershed planning efforts from the NC Division of Water Resources and the NC Division of Mitigation Service. This is not an exhaustive list, and APNEP strives to identify where gaps can be filled, avoid duplication of effort, and support partner led initiatives.

Since the adoption of APNEP's original CCMP in 1994, many scientific and management developments have occurred. With this updated plan, APNEP continues its citizen-driven ecosystem-based management approach to achieving its mission. Unlike many areas of the country, this region has made significant strides in integrating environmental information into its protection efforts. However, more work remains. Within our citizen-driven adaptive EBM framework, it's crucial to regularly review and identify actions and

policies that will guide the Partnership's management of the watershed over the next five years.

APNEP staff are currently facilitating a stakeholder-driven initiative to develop a strategy for monitoring the ecosystem health and status of the Albemarle-Pamlico region. This initiative is driven by the members of APNEP's Monitoring and Assessment Teams, who represent diverse governmental, academic, and non-governmental organizations in the region. These groups are working with APNEP to develop a set of ecosystem indicators that will be monitored and analyzed to produce an overall assessment of the health of the estuarine system.

This ecosystem assessment process will allow APNEP and our partners to better understand how our efforts to protect and restore the system are impacting the estuary, and to adapt our priorities and focus accordingly. The last full ecosystem assessment was published in 2012 and analyzed a range of biotic and abiotic components of the estuarine system.

While this updated CCMP continues to support EBM practices, the Partnership has adopted several focus areas and activities to guide CCMP implementation to maximize APNEP's limited resources and large geographic area. As such, APNEP will focus on these themes for the next five years:

- Water Quality,
- Submerged Aquatic Vegetation,
- Wetlands,
- Oyster Habitats, and
- Community Resilience.

The CCMP remains organized by asking and then answering the following four basic questions:

1) What is a healthy Albemarle-Pamlico estuarine system?
2) What is the current condition of the system?
3) What are the most significant challenges facing the system over the next five years? and
4) What actions should be implemented to best achieve a healthy estuarine system?

The three overarching goals established in 2012 remain to support achievement of the APNEP mission:

Goal 1: A region where human communities are sustained by a functioning ecosystem

Goal 2: A region where aquatic, wetland, and upland habitats support viable populations of native species

Goal 3: A region where water quantity and quality maintain ecological integrity

The goals, outcomes, objectives, and actions build upon the 2012 CCMP, which was carefully crafted through a systems-based analysis of the regional ecosystem with input from the Management Conference and partners. The core of this updated CCMP lies in updated Action Plan (see Question 4). This update included a review of the status of the 2012 CCMP's objectives and actions, and conversations with many partners. Facilitated workshops were held with the Leadership Council and Management Conference members to refine the CCMP from 2020 through 2024.

FY22-FY27 Bipartisan Infrastructure Law Work Plan & Budget

Implementation of this updated CCMP will be supported by additional funding provided under a cooperative agreement and grants from the EPA under the Infrastructure Investment and Jobs Act, which was passed by Congress in November of 2021. This Act, also known as the Bipartisan Infrastructure Law (BIL), is designed to be a significant investment in the nation's infrastructure and resilience.

The BIL references EPA's underlying authority under Section 320 of the CWA to fund the implementation of the National Estuary Programs' (NEPs) CCMPs. As with annual appropriations distributed to NEPs to implement CWA §320, the funds distributed under the BIL must be directed to implement a management conference and approved CCMP and work plan. The BIL funding was allocated to the NEPs to accelerate and more extensively implement CCMPs. The significant and multi-year expansion of funds through the BIL provides an opportunity for NEPs to execute long-term projects within the communities they serve, leverage additional resources, and work with their management conferences and other key stakeholders to advance a wide range of projects identified in CCMPs. The BIL funding is available to the NEPs until fully expended and will be distributed over five years.

APNEP's long-term strategy for these funds and associated Equity Strategy were approved by the EPA in 2023. The Leadership Council identified priority actions for BIL implementation, which are noted in this CCMP update below and identified in the FY22-27 Workplan and Budget, which will be updated annually until funds are fully expended.

What's New in this Updated CCMP?

Significant effort was made to refine and streamline the objectives and actions in the CCMP. See Planning Process and the CCMP Update and the Index of Actions in Appendix I for more detail. Highlights are noted below:

- Actions in the 2012 CCMP were organized under five categories: Identify, Protect, Restore, Engage, and Monitor. The categories, Protect and Restore have been combined into one theme (Protect & Restore) in this update.
- The total number of CCMP Objectives was reduced from 12 to 11.
- The total number of CCMP Actions was reduced from 58 to 32.
- 1 new CCMP Action- was developed.
- Several existing Actions were consolidated or moved to different categories that more accurately represent updated implementation strategies. See Planning Process and the CCMP Update and the Index of Actions in Appendix I.
- # 2012 CCMP Actions have been completed and retired.
- 9 BIL Priority Actions identified by the Leadership Council. These are identified under each relevant action.

INTRODUCTION

The System

The Albemarle-Pamlico watershed spans over 31,000 square miles, with a management area of 23,803 square miles (76% of the total basin), excluding parts of the Roanoke and White Oak basins. It is the largest unit in the National Estuary Program and encompasses two million acres of estuarine waters and 10,000 miles of streams and rivers (Figure 1). Its headwaters extend from the Appalachian Mountains of Virginia to the North Carolina piedmont, encompassing wetlands, forests, farms, and cities downstream to the estuary, and the ocean.

The Albemarle-Pamlico estuarine system comprises eight major bodies of relatively shallow water known as "Sounds" in coastal North Carolina and Virginia. The two largest, Albemarle Sound and Pamlico Sound, are complemented by smaller yet significant waterbodies: Bogue Sound, Croatan Sound, Currituck Sound, Core Sound, Roanoke Sound, and Back Bay.

Some areas, such as urban waterways and low-elevation regions, are particularly vulnerable to environmental degradation. To safeguard the sounds for future generations, it is essential to protect and restore the entire ecosystem - its water, air, land, and communities.

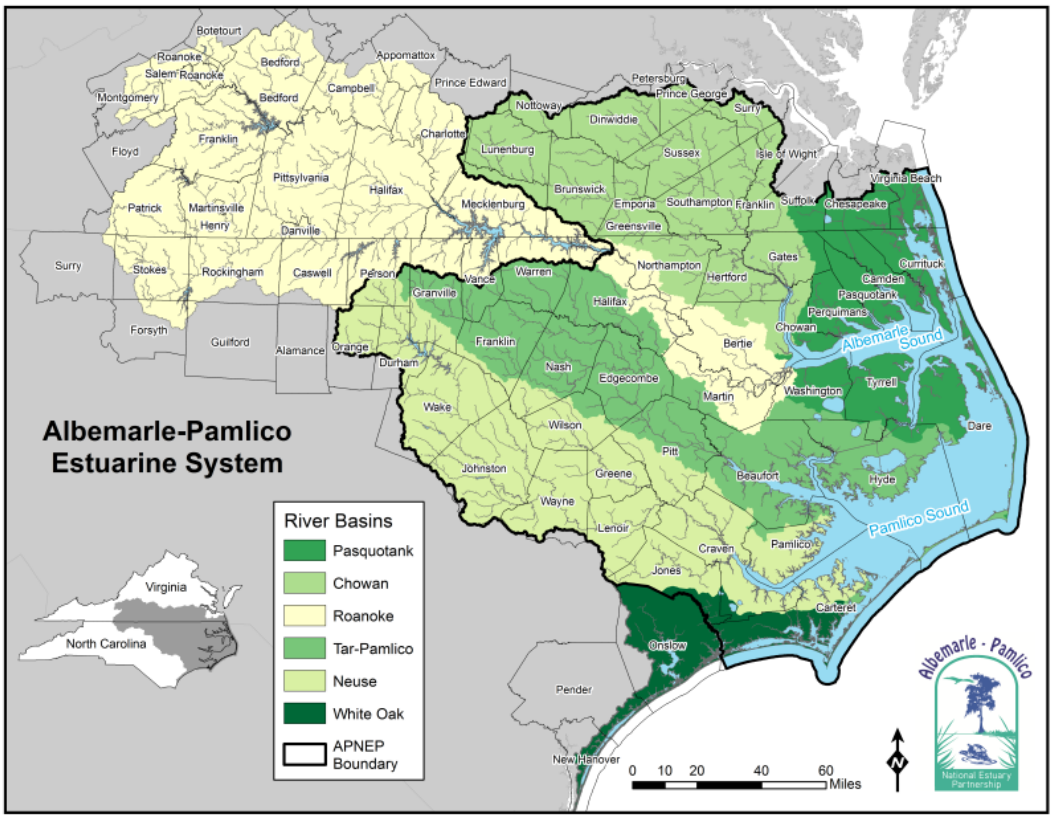

Figure 1: River basins and sounds of the Albemarle-Pamlico estuarine system.

History

Archaeological evidence indicates that Indigenous peoples have been living in the Albemarle-Pamlico region for over 15,000 years. Before the first settler ships arrived on this continent, the area was home to three Indigenous Language Groups: the Iroquoian, Algonquian, and Siouan families. The APNEP region and the Coastal Plain more generally supported large and diverse Indigenous populations who farmed, hunted, fished, traded, and lived throughout the region. Indigenous communities are not static, and major disruptions connected to colonization prompted communities to forge and re-forge political identities and allegiances over time. Indigenous communities today may descend from a single group that existed at first contact with Europeans, or they may be amalgamations of groups who survived war, disease, and colonial violence centuries ago. Indigenous peoples inhabiting areas of what is now the Virginia and North Carolina coast were hosts to the first English-speaking explorers and settlers.

The APNEP region in present-day Virginia and North Carolina comprises shared homelands for large Indigenous populations (more than 150,000 people) that still live in these two states today. Several large tribal communities are presently based in each state, and these Tribes represent the full spectrum of recognition statuses. Some Tribes with ties to the APNEP region have full federal recognition, some are recognized by states, and some tribal communities have no state or federal recognition.

More information regarding present day and ancestral Tribal communities with ties to the region can be found through APNEP's Tribal Coastal Resilience Connections Phase I Report. This is an ongoing initiative co-led by APNEP in partnership with Tribal liaisons, organizations, and researchers which seeks to build capacity to support Tribal communities in the Albemarle-Pamlico region with considering climate risk and resilience into planning and community engagement processes.

The Albemarle-Pamlico National Estuary Partnership

Overview

APNEP is dedicated to understanding, protecting, and restoring the Albemarle-Pamlico estuarine system. This mission is supported by its Management Conference, advisory committees, and strong regional partnerships. Together, they implement the CCMP using a citizen-driven adaptive management approach within the Ecosystem-Based Management (EBM) framework. EBM considers both human and natural systems, incorporates adaptive management, and prioritizes meaningful engagement to develop

environmental solutions. With this updated plan, APNEP continues to build on EBM principles to advance its mission as outlined in the 2012 CCMP.

APNEP is a cooperative effort hosted by the NC Department of Environmental Quality, in partnership with the Virginia Secretary of Natural Resources. Direct financial support is primarily provided by the EPA and the State of North Carolina. Currently, North Carolina Governor's Executive Order #250 (February 18, 2022) provides the Management Conference advisory structure consisting of a Leadership Council and two advisory committees (Science and Technical, and Citizen).

APNEP's Leadership Council and advisory committees provide active participation and support to the Partnership on the implementation of measures to understand, protect and restore the region's significant resources. These Management Conference bodies represent a diverse cross-section of governmental, societal, economic, educational, and scientific interests. These members also act as ambassadors for APNEP within their own positions, interest groups, and agencies. With their guidance and support, APNEP collaborates with dozens of agencies and organizations to further understand and manage the significant resources of the region.

An *Estuary of National Significance*

In recognition of the numerous benefits provided by the Albemarle and Pamlico Sounds, the United States Congress designated the Albemarle-Pamlico estuarine system an "estuary of national significance." In 1987, The *Albemarle-Pamlico Estuarine Study* (APES) was among the first of 28 National Estuary Programs established by the EPA through amendments to the *Federal Water Pollution Control Act Amendments of 1972*, commonly known as the *Clean Water Act*.

From 1987 to 1994, the Estuarine Study sponsored nearly one hundred research initiatives in the Albemarle-Pamlico region, each designed to give scientists and managers a better understanding of how this ecosystem functions and to evaluate its health. These research initiatives culminated in the development and implementation of the region's first CCMP. Upon adoption of the initial CCMP in 1994, the program became known as the Albemarle-Pamlico National Estuary Program (APNEP) as it broadened its mission to include applied conservation, management, and engagement initiatives.

Since its inception, APNEP has led or contributed to scores of conservation efforts in the region. APNEP's first CCMP (1994) called for the creation of several important environmental management initiatives that came to fruition in the form of the Partnership for the Sounds' Estuarium, the Center for Geographic Analysis, and the NC Clean Water Management Trust Fund (now the NC Land and Water Trust Fund). Restoration and

demonstration projects have improved habitats and water quality throughout the estuarine system. APNEP continues its proud tradition of facilitating applied scientific research and assessments that began during the APES period. Additionally, outdoor classrooms funded by APNEP dot the region, improving water quality while giving students a place to learn about the natural world. Numerous educator training opportunities have provided training and resources to hundreds in the region. These are just a few of the many ways APNEP continues to benefit the sounds and the ecosystems that include them.

Management Approach

Since the release of the 1994 CCMP, APNEP has consistently implemented a management approach anchored by two key tenets: a watershed approach and collaborative partnerships. With this CCMP, APNEP reaffirms its commitment to these principles while further pursuing its EBM approach that began with the 2012 CCMP.

First, APNEP implements a whole-basin approach to protecting and restoring the estuarine system. Consistent with this practice, management efforts have been directed from river headwaters to the sounds throughout the region. This ecological approach helps APNEP ensure that issues are addressed in a holistic way, and that APNEP has standing with its partners to address issues throughout the basin.

Second, APNEP takes a collaborative partnership approach to achieve its mission. Developing and implementing management actions in such a large region is an enormous undertaking, and the resources are limited. APNEP seeks to overcome this hurdle by leveraging partnerships among governments, non-governmental organizations, academia, and the public to make significant improvements to ecosystem and thus benefit local communities. Most notably, North Carolina and Virginia are parties to a 2020 Memorandum of Understanding (MOU) to manage the shared resources in the basin. As a result of its broad reach, APNEP is well positioned to fill gaps and identify synergies among its partners.

Overview of Comprehensive Conservation and Management Plan

Plan authority and scope

As detailed in Section 320 of the federal Clean Water Act, the guiding document for APNEP, as for all other National Estuary Programs, is its *Comprehensive Conservation and Management Plan*. The CCMP provides direction and offers objectives and actions designed to understand, protect, and restore the Albemarle-Pamlico estuary through collaborative actions. Since the adoption of APNEP's original CCMP in 1994, many scientific and management developments have occurred. With this updated plan, APNEP continues its citizen-driven ecosystem-based approach to achieving its mission.

This ecosystem-based plan charts the course for the Partnership's activities for a five-year period. It incorporates scientific and planning advances into a plan that serves as a potential model for broad-scale ecosystem-based management efforts. The plan further provides a statement of common purpose across the watershed and forms the basis for cooperation and collaboration among implementing partners. Ultimately, the Partnership's annual work plan directs funding actions for CCMP implementation.

Ecosystem-based planning

The CCMP is built upon a framework that represents efforts to incorporate citizen-driven ecosystem-based principles into the plan. Management objectives and actions were developed through a systems-based analysis of the regional ecosystem. The plan is further structured to support adaptive management, which will allow APNEP to improve its approach as both successes and shortcomings are documented. Ultimately, APNEP is working to introduce more accountability into the environmental management process through assessments and by monitoring the ecosystem, setting management targets, and critically evaluating progress (Figure 2.).

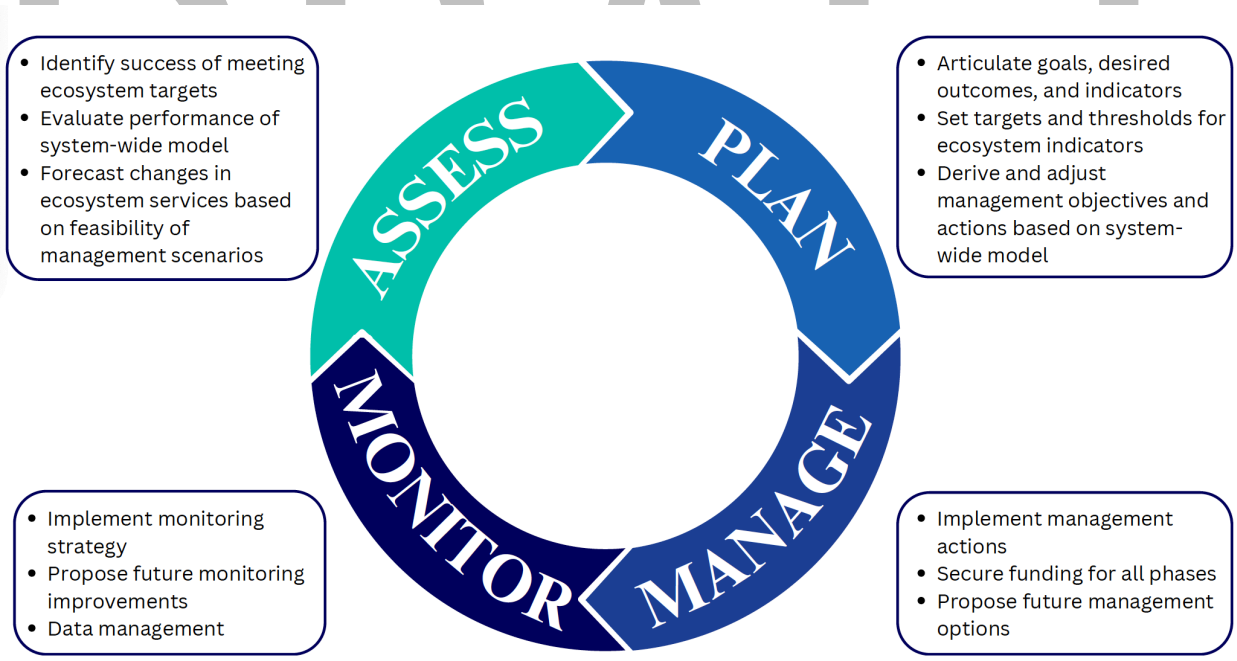

Figure 2: APNEP's adaptive management cycle.

For a more detailed description of the CCMP update and EBM planning process, see Appendix I.

Engagement

The Partnership is committed to active engagement throughout the watershed. By addressing environmental inequities through continual reevaluation of our partnerships, protection and restoration efforts, and engagement processes through the lens of increasing diversity, equity, and inclusion throughout the Albemarle-Pamlico estuarine system. As such, the Partnership adopted the following Diversity, Equity, and Inclusion Statement in 2020:

Our partnerships with governmental, academic, community, and nonprofit organizations are the foundation of how we work; through our funding processes, representation within citizen advisory groups, strategic planning efforts, and long-term ecosystem priorities, we can foster a Partnership that is inclusive of the diverse perspectives within the region and which works to identify, protect, and restore the region's significant natural resources in ways that increase equity among its communities. By facilitating communication and collaboration among different organizations throughout the region, APNEP seeks to leverage its resources and those of its partners to accomplish more together than any individual organization could alone. This can only be accomplished with a diverse array of perspectives and voices.

Increasing diversity, equity, and inclusion through our work is integral to our ecosystem-based management perspective, which views human communities as a vital component of the overall ecosystem. We are committed to approaching this work in a way that is inclusive of diverse connections to the environment, inclusive of perspectives that may otherwise be unheard, and increases equity through ecosystem protection and restoration efforts. We are also dedicated to broad inclusion in our educational and engagement efforts.

Specifically, we commit to:

1. *Engage communities and stakeholders that are representative of the broader populations within our programmatic boundaries to implement the 2012-2022 CCMP and the Partnership's Mission.*
2. *Incorporate diversity, equity, and broad community inclusion as an ecosystem outcome(s) with associated objectives and actions into the 2022-2032 revision of the CCMP.*
3. *Work to engage diverse communities and populations in the organization's decisions and diversify the perspectives represented within all of Partnership's management and citizen advisory groups.*
4. *Conduct an internal organizational diversity, equity, and inclusion self-assessment and provide externally facilitated training for management and citizen advisory groups and staff as warranted.*
5. *Report annually on actions taken to enact these commitments in our Annual Work Plan.*

Plan Organization

This updated plan builds upon the format of the 2012 CCMP and remains organized around four basic questions. By systematically considering each of the first three questions, APNEP developed its management objectives actions and presents them in its treatment of Question 4. Each question is discussed in a separate following chapter. The questions:

Question 1: What is a healthy Albemarle-Pamlico estuarine system?

Allows a diverse group of stakeholders to articulate the characteristics of a healthy Albemarle-Pamlico system. These characteristics serve as the environmental goals and outcomes sought by the plan.

Question 2: What is the status of the Albemarle-Pamlico estuarine system?

Offers insights into the current state of the ecosystem. It further allows for the identification of environmental trends and shows areas where progress is most desirable.

Question 3: What are the greatest challenges facing the Albemarle-Pamlico estuarine system?

Addresses the significant environmental challenges identified by the stakeholders that must be overcome to achieve the goals set forth in Question 1.

Question 4: What actions should be taken to move toward a healthier Albemarle-Pamlico estuarine system?

After formally considering these three questions and working through a systems-based model to address them, APNEP presents management objectives and actions for a healthier estuarine system.

The heart of this management plan rests in addressing Question 4, in the form of an Action Plan. For organizational purposes, the actions developed for the plan were grouped together as appropriate. Closely related actions were categorized as objectives, and closely related objectives were categorized into four broad categories entitled **Understand**, **Protect & Restore**, **Engage,** and **Monitor.**

For each action, APNEP has identified *key implementers* that will be engaged for implementation. Key Implementers were determined by their mission, statutory mandate, published materials, or by consultation with the partner.

Appropriate outcomes and outputs were developed as metrics for measuring success. Outcomes are changes in status of condition. Examples include changes in environmental measurements or new management processes. Outputs are the tangible things the action intends to produce. Examples include a plan, a training program, a report, acres restored, or a constructed feature.

It is vital that both outcomes and output have defined metrics and tracking mechanisms to ensure progress toward achieving deliverables according to plan. If the progress deviates from the plan, adaptative actions need to be taken to ensure positive ecosystem results from management actions.

These questions often have complex answers, including changing demographic trends, different environmental pressures, and advancements in ecosystem science. In this CCMP, APNEP proposes their best solutions (Actions) to these questions, with the realization that these answers may change over time. While much remains to be achieved, this plan provides guidance for APNEP and its partners as they respectively strive to carry out our mission. Each of the four questions will be further explored in the following sections.

Question 1: What is a healthy Albemarle-Pamlico estuarine system?

Defining a healthy ecosystem over more than 31,000 square miles of land and water is a complex task. It's essential to reach agreement among a vast array of stakeholders on environmental goals to improve ecosystem health. Planning for such a large area also means addressing many competing interests and ensuring fair management practices. In short, APNEP needs to clearly define environmental goals before creating a plan to achieve them.

APNEP has developed a vision for a healthy Albemarle-Pamlico estuary that accounts for the various interests found within the region. This vision of ecosystem health is communicated through three overarching goals, each of which is articulated further in measurable ecosystem outcomes. The CCMP management actions outlined in Question 4 are each predicated on effectively pursuing the goals established during the strategic planning process.

Three goals have been established that, if fully met, would reflect a healthy Albemarle-Pamlico estuarine system. To assess progress in reaching each goal, a set of ecosystem outcomes has been developed. These ***ecosystem outcomes*** are qualitative statements of what a healthy ecosystem should look like. Each outcome will be supported by a set

of measurable **indicators** and associated **ecosystem targets**, which are currently under development. Establishing these indicators and targets is the first action in implementing this CCMP. An example of these indicators is displayed in Table 1. These candidate indicators are physical, biological, or chemical conditions that can be measured to provide data about the status of the ecosystem.

As part of the implementation process, APNEP will regularly consult with its Management Conference and partners to ensure that ecosystem outcomes remain relevant and to adjust management targets to balance competing priorities. Furthermore, as monitoring capabilities improve, APNEP will work with representative stakeholders to develop, refine, and agree upon new targets and benchmarks, which are the most precise expression of these ecosystem goals. Ultimately, the development of measurable indicators and benchmarks for the Albemarle-Pamlico estuarine system enables APNEP, through monitoring, to determine whether environmental progress has been made, adjust management actions when necessary, and report on the state of the ecosystem to partners, stakeholders, and the public.

The goals and associated outcomes for the Partnership have not changed in this updated CCMP:

Goal 1: A region where human communities are sustained by a functioning ecosystem

Ecosystem Outcomes:

a. *Waters are safe for personal contact.*
b. *Designated surface and ground water supplies are safe for human consumption.*
c. *Surface hydrologic regimes sustain regulated human uses.*
d. *Fish and game are safe for human consumption.*
e. *Opportunities for recreation and access to public lands and waters are protected and enhanced.*

Goal 2: A region where aquatic, wetland, and upland habitats support viable populations of native species

Ecosystem Outcomes:

a. *The biodiversity, function, and populations of species in aquatic, wetland, and upland communities are protected, restored, or enhanced.*
b. *The extent and quality of upland, freshwater, estuarine, and near-shore marine habitats fully support biodiversity and ecosystem function.*
c. *Non-native invasive species do not significantly impair native species' viability or function, nor impair habitat quality, quantity, and the processes that form and maintain habitats.*

Goal 3: A region where water quantity and quality maintain ecological integrity

Ecosystem Outcomes:

a. *Appropriate hydrologic regimes support ecological integrity.*
b. *Nutrients and pathogens do not harm species that depend on the waters.*
c. *Toxics in waters and sediments do not harm species that depend on the waters.*
d. *Sediments do not harm species that depend on the waters.*

Table 1. Management goals, ecosystem outcomes, supporting CCMP actions, and example indicators.

Goal	Ecosystem Outcome	CCMP Supporting Actions	Example Indicator
1: Human Communities A region where human communities are sustained by a functioning ecosystem	1a: Waters are safe for personal contact.	A1.1, 1.2, 1.3, B1.2, 1.3, 2.1, 2.2, 2.5, 2.6, C1.1, 2.2, 3.1,3.2; D1.1, 1.2, 1.3	Harmful algal blooms
	1b: Designated surface and ground water supplies are safe for human consumption.	A1.1, 1.2, 1.3, B1.2, 1.3, 2.1, 2.2, 2.6, C1.1, 2.2, 3.1,3.2; D1.1, 1.2, 1.3	Water column fecal (surface waters)
			Salinity (aquifers)
	1c: Surface hydrologic regimes sustain regulated human uses.	A1.1, 1.2, 1.3, B1.2, 1.3, 3.3; C3.1,3.2; D1.1, 1.2, 1.3	Natural hydrology & flow
	1d: Fish and game are safe for human consumption.	A1.1, 1.3, B1.2, 1.3, 2.1, 2.2, 2.5, 2.6; C1.1, 12.1, 2.2, 3.1,3.2; D1.1, 1.2, 1.3	Toxicants in species
			Human pathogens in species
	1e: Opportunities for recreation and access to public lands and waters are protected and enhanced.	A1.1, 1.2, 1.3, B1.2, 1.3, C1.1, 1.2, 2.13.1,3.2; D1.1, 1.2, 1.3	Recreation resources
2: Native Species A region where aquatic, wetland, and upland habitats support viable populations of native species	2a: The biodiversity, function, and populations of species in aquatic, wetland, and upland communities are protected, restored, or enhanced.	A1.1, 1.2, 1.3, B1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.3, 3.1, 3.3, 4.1, 4.2, 4.3; C1.1, 1.2, 2.1, 3.1,3.2; D1.1, 1.2, 1.3	Bivalve mollusks
			Diadromous Fishes
			Wetland birds
			Herpetofauna
			Terrestrial vegetation
			Terrestrial insects
	2b: The extent and quality of upland, freshwater, estuarine and near-shore marine habitats fully support biodiversity and ecosystem function.	A1.1, 1.2, 1.3, B1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.3, 2.4, 2.5, 2.6, 2.7, 3.1, 3.2, 3.3, 4.1, 4.2,4.3; C1.1, 1.2, 2.1, 3.1,3.2; D1.1, 1.2, 1.3	Submerged aquatic vegetation (native species)
			Fish habitat
	2c: Non-native invasive species do not significantly impair native species' viability or function, nor impair habitat quality, quantity, and the processes that form and maintain habitats.	A1.1, 1.3, B1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4, 2.6; C1.1, 1.2, 2.1, 3.1,3.2; D1.1, 1.2, 1.3	Submerged aquatic vegetation (non-native invasive species)
			Non-native invasive wetland vegetation
			Non-native invasive terrestrial vegetation
3: Water Quantity & Quality A region where water	3a: Appropriate hydrologic regimes support ecological integrity.	A1.1, 1.2, 1.3, B1B1.2, 1.3, 3.1, 3.2, 3.3, 4.3; C3.1, 3.2; D1.1, 1.2, 1.3	Dissolved oxygen
			Natural hydrology & flow
		A1.1, 1.2, 1.3,	Total nutrients

quantity and quality maintain ecological integrity	3b: Nutrients and pathogens do not harm species that depend on the waters.	B1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 3.1, 3.2; C1.1, 2.1, 3.1,3.2; D1.1, 1.2, 1.3	Microbiota
	3c: Toxics in waters and sediments do not harm species that depend on the waters.	A1.1, 1.2, 1.3, B1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5; C1.1, 3.1,3 .2; D1.1, 1.2, 1.3	Harmful algal blooms
			Dissolved metals
	3d: Sediments do not harm species that depend on the waters.	A1.1, 1.2, 1.3, B1.1, 1.2, 1.3, 2.3, 2.4, 2.7, 3.1, 3.2; C3.1,3 .2; D1.1, 1.2, 1.3	Sediment condition
			Water column transparency

This table illustrates the linkage between the CCMP goals and ecosystem outcomes, the CCMP management actions (Question 4), and example ecosystem indicators by which success can be measured.

Question 2: What is the status of the Albemarle-Pamlico estuarine system?

Understanding the condition of the estuarine system is essential for setting measures to reach desired goals (Question 1). The gap between the status of an ecosystem indicator and the preferred state informs the time and resources required to reach that goal. Thus, ecosystem status and trends should be considered in identifying challenges and threats (Question 3) and before establishing and refining CCMP management actions (Question 4).

APNEP's 1991 *Albemarle-Pamlico Estuarine Study Status and Trends Report* established the foundation for adaptive management in the region and led to development of the 1994 CCMP. While further assessments were expected after 1991, APNEP was unable to conduct coordinated evaluations for over two decades. Since then, state, and federal partners have performed several large-scale assessments, each providing valuable insights into key ecosystem metrics.

The 2012 Albemarle-Pamlico Ecosystem Assessment, released alongside the 2012-2022 CCMP, has guided APNEP's adaptive management efforts. This assessment covered 24 important ecosystem indicators, some of which were also in the 1991 report, allowing for comparisons over time. These indicators are essential to the further development of APNEP's integrated monitoring strategy.

The integrated monitoring strategy aims to create a coordinated framework for monitoring in the Albemarle-Pamlico region. Existing monitoring efforts often lack scope, geographic coverage, or interagency coordination. The updated strategy will outline necessary monitoring actions to support adaptive practices and ecosystem-based management aligned with APNEP's mission. It will also identify gaps or redundancies in the current monitoring framework to ensure effective data collection for assessing ecosystem indicators.

Data from this integrated monitoring network is vital for evaluating ecosystem status and trends. As APNEP implements CCMP actions, it will periodically assess ecosystem indicators and management actions. These assessments will inform the CCMP and guide annual budgets and work plans, enabling APNEP to adapt its management approach as needed.

Question 3: What are the greatest challenges facing the Albemarle-Pamlico estuarine system?

The estuarine system links air, land, water, and people, so protecting and restoring the sounds and its watershed involves tackling various, and sometimes, competing challenges. APNEP seeks to understand the status of the ecosystem (Question 2) and assess how much it needs to improve to meet desired goals (Question 1). The next step is to identify the specific challenges that must be addressed for the estuarine system to thrive.

In parallel with efforts to develop the Partnership's 2012 CCMP, staff worked with partners to develop a proof-of-concept ecosystem assessment of the Albemarle-Pamlico estuarine system, featuring the assessments of 24 indicator metrics. APNEP continues to refine its indicators and monitoring strategy, and a more comprehensive regional ecosystem assessment is planned during this CCMP implementation horizon to influence future CCMP editions.

Priorities for research, management, and policy cannot be developed effectively without a better understanding of how the ecosystem may be changing. Increasing impacts to the region's natural resources require those interested in the health and long-term resilience of the region to better understand environmental and resource conditions. Information from these assessments, based on high quality scientific information, will help address seven key policy policy-based questions of condition, diagnosis, and forecast for any ecosystem component related to CCMP outcomes:

- **Magnitude**: What is the condition of the ecosystem component?
- **Extent**: Over what geographic area does the component extend?
- **Trend**: How has condition and range of the component changed over time?
- **Cause**: What stressors are believed to be responsible for changing trends?
- **Source**: What agents are responsible for stressor intensity?
- **Vulnerability**: What is the likelihood of stressors causing a loss in human well-being or ecological integrity over the coming decade and beyond?
- **Solutions**: What combination of approaches and tools are the most effective and efficient to reduce impacts from stressors?

These integrated assessments will support APNEP's planning and program processes and other regional, state, and local policy and program planning activities. To evaluate the success of Partnership efforts guided by this plan, APNEP needs to provide a reliable environmental baseline of the ecosystem. Most importantly, however, these assessments will help answer two of four basic stakeholder questions posed here in the CCMP:

• What is the status of the Albemarle-Pamlico estuarine system?

• What are the greatest challenges facing the Albemarle-Pamlico estuarine system?

APNEP intends that ecosystem assessments and future monitoring efforts can aid the region by:

- Integrating information from both natural and social science;
- Facilitating ecosystem-based management;
- Evaluating the compatibility of policies established by institutions at different scales;
- Integrating economic, environmental, social, and cultural aspirations;
- Deepening understanding of the relationship and linkages between ecosystems and human well-being; and
- Demonstrating the potential of ecosystems to contribute to poverty reduction and
- enhanced well-being.

APNEP's *1991 Albemarle-Pamlico Estuarine Study Status and Trends Report* highlighted concerns such as fish diseases, fish kills from low oxygen, declining fisheries productivity, habitat loss, and toxicant effects. While some issues have improved, many remain critical challenges. Since the 1991 report, the region's population has grown by about 69%, leading to increased changes in land use and development impacts. New challenges, such as non-native invasive species, forever chemicals, and impacts associated with a changing climate have emerged.

To be effective, this plan must continue to address environmental stressors stemming from various human activities, including agriculture, forestry, development, mining, waste disposal, and fishing. APNEP recognizes the value these industries bring and will pursue a balanced approach to achieving the plan's goals.

Given limited resources, APNEP developed a qualitative model to prioritize the biological, chemical, physical, and human factors that most influence each CCMP outcome. This model highlights the key challenges facing the Albemarle-Pamlico ecosystem.

Addressing these challenges is complex and requires thoughtful dialogue, creativity, resources, and commitment. Difficult choices may be necessary, but the beauty, culture, and unique natural history of the Albemarle-Pamlico region are worth preserving. The following chapter outlines an action plan which describes how the Partnership will tackle the most significant challenges facing the estuary and the broader region.

Question 4: What actions should be taken to move toward healthier Albemarle-Pamlico estuarine system?

A Plan for Action

To address the previous three questions and working through a systems-based model to address them, APNEP presents a set of management objectives and actions crafted to meet the specific and often unique needs within the watershed for a healthier estuarine system in the form of the ***Action Agenda*** below. This CCMP update is mainly centered on these actions.

This section updates the 2012 CCMP Objectives and Actions to provide targeted guidance for APNEP implementation of actions in understanding, protecting, and restoring the Albemarle-Pamlico estuarine system. The update builds upon the previous version and covers a shorter management horizon from 2025-2029. Minor changes were made to the narrative body of this section, with the most substantive changes made to the refinement of objectives and actions. Details regarding the process that guided the changes in this update can be found in Appendix I.

Actions have been informed by the current state of the science in consideration for the state of the ecosystem and of stressors that affect the estuary. The CCMP actions address various stresses and vulnerabilities in the estuary, and the actions that serve as adaptation strategies to mitigate the identified climate risks to the Albemarle-Pamlico estuarine system are identified within the document.

All CCMP actions, including those carried over from or modified from the 2012 CCMP, were assessed for their vulnerability to climate stressors and found to have low risk during a CCMP vulnerability assessment performed by staff in 2020. As such most actions address climate impacts indirectly incorporating knowledge of the climate stressors into their implementation.

Successful CCMP implementation relies on collaborative partnerships and leveraged resources. Implementation of these objectives and actions depend on the engagement of key governmental, academic, non-governmental organizations, and other partners. The success of the partnership is contingent on maintaining these relationships, making an engaged partnership critical to our success.

For organizational purposes, the actions developed for the Action Agenda were grouped together as appropriate. The actions are not in a prioritized list. Closely related actions were categorized as objectives, and closely related objectives were organized into four broad themes titled **Understand**, **Protect & Restore**, **Engage,** and **Monitor.** Each of these themes address key challenges in managing the ecosystem health of the

Albemarle-Pamlico region while involving communities in a systems-based approach. They align with the APNEP mission, the adaptive management cycle, and a collaborative engagement approach.

These objectives and actions aim to achieve environmental outcomes at the watershed scale and address the complex relationships between ecological and human factors in the estuarine ecosystem. They also target major threats to ecosystem health and function.

Each theme begins with an assessment of the **current situation**, providing a rationale for action and a set of broad **objectives**. These objectives are supported by specific **actions** that detail the initiatives APNEP, and its partners will implement. Implementation steps will be outlined in APNEP's annual work plans.

> **A: Understand** the gaps in our knowledge. APNEP will implement a focused scientific program with priorities for monitoring and research to improve understanding of the ecosystem and measure the effectiveness of implementation actions.
>
> **B: Protect & Restore** the existing ecosystem processes, structures, and functions that sustain the Albemarle-Pamlico estuarine system. Avoiding problems before they occur is the best and most cost-effective approach to maintaining ecosystem health.
>
> **C: Engage** the public in sustained and coordinated efforts to increase public awareness and encourage individual stewardship. Greater awareness, citizen engagement and planning are critical for maintaining the ecosystem processes, structures, and functions, including its human communities.
>
> **D: Monitor** the ecosystem. Tracking and understanding changes in the ecosystem (outcomes) will require the establishment of a coordinated monitoring strategy to detect, measure, track, and assess changes in the ecosystem.

Additionally, the Partnership has adopted several focus areas and activities to guide implementation that maximize limited resources across a large geographic area. As such, the objectives and actions in each organizational theme focus on the following for the next five years:

- Water Quality,
- Submerged Aquatic Vegetation,
- Wetlands,
- Oyster Habitats, and
- Community Resilience.

In addition, the Leadership Council identified priority actions for BIL implementation, which are noted under each relevant Action in the following the Action Agenda section.

Timeframe & Key Milestones

Each action notes when important milestones are expected to be reached. Many of the actions have already been initiated, and implementation is simply ongoing. In some cases, the timing of specific projects is contingent on several factors, particularly funding availability.

Costs and Funding of Implementation

Each action includes a general estimate of implementation cost over five years using symbols to provide a range and identifying possible sources of funding. A key to the symbols used to estimate cost levels for each action is below. Ranges are broad, given the breadth of actions, variety of partners involved in implementing them, and extent of unknowns over the 5-year timeframe. The symbols ($) are based on best professional judgment and current known costs provided by partners and may not fully capture the full costs likely to be funded by other programs for other reasons (e.g., the construction of a wastewater treatment plant).

Key to Estimated Costs	
Symbol	**Range**
$	Less the $25K
$$	$25 - $100 K
$$$	$100 - $ 500K
$$$$	Over $500K

Possible sources of funding are identified based largely on past experiences and knowledge of funding sources among the Partnership. APNEP funding is a potential source of funding for any of the strategies in the CCMP. However, it is identified mainly as such for strategies that traditionally have been heavily reliant on it, because of the central role these strategies play in meeting NEP requirements, and/or because they are unlikely to be funded in other ways. An overall Finance Strategy will be developed to support implementation of this CCMP. As a companion document, it will contain more details on funding and support.

DRAFT

Action Agenda

A: Understand

To understand knowledge gaps in the Albemarle-Pamlico estuarine system, APNEP will implement a focused scientific program prioritizing monitoring and research. This effort aims to enhance understanding of the ecosystem and evaluate the effectiveness of CCMP actions.

To fulfill its mission, APNEP must continuously work to better understand and assess the regional ecosystem by identifying trends and evaluating planning, management, and policy decisions. Comprehensive monitoring will provide the essential data for these assessments, ensuring progress in addressing key issues.

Current Situation

From 1987 to the publication of the original CCMP in 1994, APNEP supported extensive data collection and scientific research during the *Albemarle-Pamlico Estuarine Study*. These efforts significantly enhanced knowledge of the region's resources and provided environmental professionals with crucial insights into the estuarine ecosystem. The findings contributed to the 1991 Status and Trends Report, establishing an environmental baseline for the 1994 CCMP. While APNEP's activities have expanded since the early 1990s, promoting science-based management and policy remains a core principle. The 2012 Ecosystem Assessment analyzed various biotic and abiotic components, and subsequent Ecosystem Indicator and Metric Reports have updated the conditions in the watershed.

Today, APNEP's mission and ecosystem-based approach facilitate broad research initiatives to support regional management efforts. APNEP staff collaborate with the Science and Technical Advisory Committee (STAC), the Citizen Advisory Committee (CAC), partner organizations, and project-specific contractors on diverse research projects. This network enables APNEP to consistently apply advanced scientific knowledge in strategic areas. Additionally, natural resource managers and partner organizations often identify knowledge gaps, which, if addressed, could enhance the management of the ecosystem's resources.

Rationale for Action

Effective research, management, and policy priorities require a clear understanding of ecosystem condition and change. The increasing impact of population growth and land-use changes, along with technological advancements, necessitates a call for regular

integrated resource assessments grounded in high-quality scientific information, as outlined under Question 3. These integrated assessments will support APNEP's planning and program processes and other regional, state, and local policy and program planning activities.

Objectives and Actions

A1: Assess the condition of and potential impacts to targeted ecosystems

The estuarine ecosystem is sensitive to both localized and systemic changes. Key stressors include population growth, climate related impacts, sea level rise, increasing freshwater demand, invasive species, and pollution. There is a need for further research to understand the condition of these ecosystems, the individual and cumulative effects of stressors, and to identify thresholds for ecosystem resilience.

A1.1: Facilitate mapping the distribution of significant ecological, hydrologic, bathymetric, geologic, demographic, and cultural features. (BIL Priority).

Collaborate with partners to collect data and map significant natural and cultural features, providing accurate and timely information for environmental management decisions. Activities will focus on mapping submerged aquatic vegetation (SAV), estuarine shorelines, oyster habitats, wetlands, impaired waters, disadvantaged communities, and resilience attributes.

Action: *Lead mapping activities for targeted resources, habitats, and features and engage with local communities to prioritize management actions and incorporate the results in planning efforts.*

***Key Implementers**: APNEP, NC-DEQ, NC-DMF, NC-DACS SECAS, USDA, USFWS, USGS, NOAA, NC-DLWS, NC-DCM, NC-WRC, NC-NHP, VNHP*

***CCMP Outcomes Supported**: 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 3a, 3b, 3c, 3d*

Outputs: *Maps and GIS data for incorporation in state, regional, or local planning efforts.*

Results: *Quality and timely environmental data to support resource management decisions*

Timeline/Milestones: *Ongoing*

Cost: *$$$*

Potential Funding Source:

A1.2: Facilitate improved projections of land and water use, and climate related impacts on the ecosystem to enhance the coordination of multi-scale planning, management, and community resiliency. (BIL Priority)

Forecasting potential impacts to land and water will enable managers to take proactive measures and implement effective environmental management initiatives. Collaboration among partners will enhance the capabilities of federal, state, regional, and local governments in supporting ecosystem resilience planning and management in the region.

Action: *Collaborate with partners to develop and prioritize projects or actions that enhance projections of land and water use, integrating ecosystem considerations, climate impacts, and resilience into regional planning and management.*

Key Implementers: APNEP**,** EPA, SECAS, NOAA, USFWS, USFS, NC-DEM, NC-DLWS, NCORR

CCMP Outcome Supported: 1a, 1b, 1c, 1e, 2a, 2b, 3a, 3b, 3c, 3d

Outputs: Threat/risk models; land and water use projections

Results: Quality science-based threat assessments and other data to support resource management decisions

Timeline/Milestones: *Ongoing*

Cost: *$$$*

A1.3: Develop and refine a regional ecosystem assessment and supporting assessments such as indicator metric reports and syntheses.

The first APNEP ecosystem assessment (2012) emphasized the importance of environmental assessments and defined their role within APNEP, suggesting next steps to gain support for both the initial assessment and future improvements. Although some progress has been made in creating additional indicator reports since then, it's clear that ongoing efforts and resources are necessary to achieve APNEP's vision for ecosystem assessment

Action: Updated and expanded Ecosystem Assessments

Key Implementers: APNEP, NC-DEQ, NC-DCNR, VDEQ, VDCR, SECAS, EPA, NOAA, USGS

CCMP Outcomes Supported: 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 3a, 3b, 3c, 3d

Outputs: Ecosystem Assessments

Results: Quality environmental data to support resource management decisions

Timeline/Milestones: *Completion target 2029, ongoing effort*

Cost: *$$$*

B: Protect & Restore

Protecting and restoring the ecosystem processes, structures, and functions that sustain the Albemarle-Pamlico estuarine system is essential for the resilience of both natural and human communities. Preventing issues before they arise is the most cost-effective way to maintain environmental health, while restoration focuses on repairing lost ecosystem functions to support both human and ecological needs. Comprehensive regional assessments will guide the implementation and long-term success of integrative restoration projects

Current Situation

Over the past 400 years, the Albemarle-Pamlico estuarine system has been significantly altered as large, undisturbed ecosystems have been replaced by human development. Land uses such as forestry, farming, industry, mining, and urban development dominate the region, impacting aquatic ecosystems both directly and cumulatively. Additionally, the presence of dams and water-dependent structures affects waterways directly. If not properly managed, these activities can damage the essential processes that support healthy ecosystems. Furthermore, increasing development and impacts associated with rising water, recurrent flooding, a changing climate are likely to exacerbate these challenges. To maintain the ecosystem's structure and function, it is crucial to identify and preserve its key functional features.

Current environmental protection measures often fall short of sustaining ecosystem processes and structures because they typically address only individual components of the system. Additionally, these measures are often focused on site-specific issues, lacking a broader perspective on the whole ecosystem. Since the 1970s, federal, state, and local governments have implemented various protective measures, including regulations, land use planning tools, property acquisition, incentive programs, and education initiatives. These efforts aim to safeguard the environment and mitigate the impacts of population growth and land cover changes. However, many activities continue to disrupt habitats across the watershed, putting the ecosystem at greater risk of degradation.

The region has made significant progress in integrating environmental data into protection and restoration efforts through initiatives like the NC Coastal Habitat Protection Plan, NC Natural and Working Lands Action Plan, NC Climate Risk and Resiliency Plan, NC & VA Wildlife Action Plans, VA Coastal Master Plan, VA Healthy Waters Initiative, and floodplain planning by NC Division of Mitigation Services. These efforts identify key resources for protection and restoration that provide crucial ecological and water quality benefits. However, much work remains to preserve and restore inland aquatic habitats more comprehensively. Improving the delivery of this information to resource managers and local governments, especially through advances in mapping technology is critical.

Additionally, given the estuarine region spans the NC-VA border, integrating data from both states is essential.

Protection and restoration efforts are interconnected, as they address common ecosystem functions and sources of decline. Landscape changes to accommodate homes, businesses, and infrastructure have increased runoff, leading to more polluted water entering rivers and sounds. Activities such as vegetation removal, ditching, and the loss of riparian areas have heightened erosion and degraded habitats for both aquatic and upland species. Dams have obstructed the migration of diadromous fish, concentrated contaminates, fostered algal blooms, and impacted numerous native species.

However, the Albemarle-Pamlico region is well-positioned to benefit from coordinated restoration efforts. Urban areas are incorporating low-impact development (LID) approaches to reduce runoff and improve water quality. Farmers and foresters continue implementing best management practices (BMP) that enhance the viability of working lands while improving water quality. Innovative projects using nature-based solutions (NBS) are restoring critical components of the ecosystem, such as coastal hydrology, oyster reefs, and degraded shorelines. Ultimately, these efforts will lead to cleaner water, healthier ecosystems, and greater benefits for the region's residents.

Rationale for Action

Protecting high-quality ecological areas is more cost-effective and efficient than repairing or recreating damaged ones. Preserving existing land cover is crucial for enhancing water quality and supporting the survival of key species and maintaining connected habitats across estuarine, riverine, and upland systems. It is crucial to evaluate remaining habitats on a larger scale to identify and prioritize the most valuable areas for protection. Tools such as property purchases, conservation easements, incentive programs, and regulations are available, but adaptive strategies are needed to align these conservation methods with the most important and vulnerable areas.

In addition to safeguarding critical ecosystem components from future impacts, strategic restoration efforts are necessary to achieve ecosystem goals. While protection initiatives are vital for maintaining key functions, targeted restoration is essential for environmental improvement amid growing population pressures.

As in other sections, restoration actions are linked to CCMP outcomes through an ecosystem-based management approach. APNEP aims to select projects that consider the broader ecosystem, including habitat connectivity and the potential climate effects. Restoration efforts should also address specific challenges such as wetland loss and nutrient pollution. The most effective restoration initiatives will tackle these issues

holistically, enhancing both ecosystem quality and the quality of life for the region's residents.

Objectives and Actions

B1: Protect and restore areas containing significant natural communities and habitats

The natural communities and habitats of the Albemarle-Pamlico region support a diverse array of species. These ecosystems provide essential services, including shelter, food sources, spawning and nesting areas, travel corridors, and vital habitats for both economically and ecologically important species. Habitat loss or fragmentation can lead to severe and potentially irreversible impacts on the ecosystem and its dependent species.

B 1.1: Refine and implement a submerged aquatic vegetation (SAV) protection and restoration strategy. (BIL Priority)

Collaborate with partners to protect and restore submerged aquatic vegetation (SAV) habitats through monitoring (Objective D1), assessing water quality and habitat issues, as well as rules, regulations, and policies, and developing educational programs. This effort will involve studying effective restoration techniques, including bathymetric mapping (A1.1) and water quality monitoring. APNEP will continue to facilitate its SAV Team in developing and promoting a SAV protection and restoration strategy.

Action: APNEP will continue to fund and support collaborative development of a SAV protection and restoration strategy

Key Implementers: APNEP, USFWS, NCCF, NC-DCM, NC-DMF, NC-DWR, NC-WRC, VIMS, UNCW, USACE

CCMP Outcomes Supported: 2a, 2b, 2c, 3b, 3d

Outputs: Collaborative SAV protection and restoration strategy

Results: Collaborative planning and management action prioritization, to support the management of water quality and ecosystem biodiversity and ecological integrity for SAV habitats

Timeline/Milestones: *Completion target 2026*

Cost: *$$$*

B 1.2: Refine and implement a regional wetland protection and restoration strategy (BIL Priority)

Collaborate with partners to identify, protect, and restore wetland habitats through mapping, monitoring (Objective D1), and assessing permitting requirements, water quality, and habitat issues. APNEP will continue to support

its Wetland Resources Monitoring and Assessment Team in developing and promoting a wetland protection and restoration strategy.

Action: Support development of a regional wetland protection and restoration strategy. Promote incorporation of local government comprehensive planning.

Key Implementers: APNEP**,** NOAA, USFWS, NCCF, NC-DCM, NC-DMF, NC-DMS, NC-NHP, VNHP, NC-WRC, SASMI, VMRC, VIMS, USACE, USGS

CCMP Outcomes Supported: 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 3a, 3b, 3c, 3d

Outputs: Collaborative wetland protection and restoration strategy for inclusion in watershed and local government planning.

Results: Improved coordination and planning to support the management of water quality and ecosystem biodiversity and ecological integrity

Timeline/Milestones: *Completion target 2029*

Cost: *$$$*

B 1.3: Protect and restore targeted natural communities, habitats, and ecosystem processes. (BIL Priority)

Collaborate with the Management Conference and other partners to identify and prioritize areas for protecting, restoring, and managing targeted natural communities and ecosystem processes. Key habitats include submerged aquatic vegetation (SAV), wetlands, nursery habitats, oyster habitats, floodplains, riparian areas, wetland buffers, and Significant Natural Heritage Areas. Active government support for private landowners—homeowners, farmers, foresters, and businesses—is essential for the protection and restoration of the Albemarle-Pamlico estuarine ecosystem, given their significant land use in the region.

Action: APNEP will work with its Management Conference and partners to identify and prioritize natural communities and habitats, and to develop action plans for the protection and restoration of priority habitats and natural communities.

Key Implementers: APNEP, NC-WRC, NC-NHP, NC-DLWS, NC-DMF, SECAS, CTNC, TNC, NC-SWC, VDSM, USFWS, USDA, SASMI

CCMP Outcomes Supported: 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 3a, 3b, 3c, 3d

Outputs: Incentives for easements and other land protection efforts. Workshops and engagement materials for federal, state, regional and local land conservation, and planning efforts.

Results: Increase in protected and/or restored natural communities, habitats, and ecosystem process or sites

Timeline/Milestones: *Ongoing*

Cost: *$$$$*

B 1.4: Facilitate the development of policies to minimize dredge and fill activities in naturalized areas and sensitive habitats.

Some sections of the extensive drainage network in several coastal counties have naturalized, providing crucial habitats for fish and wildlife. APNEP will collaborate with partners to develop policies that ensure these habitats are considered in drainage maintenance and to restore natural processes where possible.

Action: APNEP will collaborate with partners to assess the status of naturalized areas and propose policies that ensure these habitats are considered in drainage maintenance.

Key Implementers: APNEP, NC-DMS, NC-DMF, NC-DCM, NC-DWR, USACE, VDEQ, NC-WRC, USFWS, EPA, UNC-IMS, CSI, VIMS

CCMP Outcomes Supported: 2a, 2b, 2c

Outputs: Assessment of current policies and regulations regarding dredge and fill activities, draft policies, and regulations to address gaps. Coordinated policies and regulations regarding dredge and fill activities

Results: Improved policies to support managing water quality and ecological integrity

Timeline/Milestones: *Completion target 2029*

Cost: *$$*

B 1.5: Refine for federal approval and facilitate the implementation of a *North Carolina Aquatic Nuisance Species (ANS) Management Plan*.

An approved *North Carolina Aquatic Nuisance Species (ANS) Management Plan* will enhance North Carolina's ability to address aquatic invasive and nuisance species, aiming to prevent and control their introduction, spread, and harmful effects. Federal approval of the plan will enable the state to seek additional federal funding for plan implementation.

Action: Update plan for state and federal approval

Key Implementers: APNEP**,** NC-DEQ, NC-WRC, NC-DACS, NC-DNCR, USFWS, NOAA

CCMP Outcomes Supported: 2a, 2b, 2c

Outputs: A State supported, and federally approved North Carolina integrated aquatic invasive species management plan

Results: Coordinated prevention and control strategies leading to reduced adverse impacts associated with aquatic nuisance species

Timeline/Milestones: *Completion target 2025*

Cost: *$*

B 1.6: Facilitate the construction of new native oyster habitats.

Where conditions are optimal for native oyster habitat, APNEP will provide funding for replanting cultch material and seed oysters. Additionally, APNEP will collaborate with partners to develop oyster sanctuaries and shellfish management areas to support the continued propagation of wild oysters.

Action: APNEP will fund or support the construction of new wild oyster habitats and provide letters of support for the construction or expansion of existing habitats.
Key Implementers: APNEP, NC-DMF, NCCF, TNC, NOAA, USACE, NC-DCM, IMS,
CCMP Outcome Supported: 2a, 2b
Outputs: Oyster habitat restoration projects,
Results: Increased oyster habitats, improved water quality, and ecological integrity
Timeline/Milestones: *Ongoing*
Cost: *$$$$*

B2: Protect and restore water quality by minimizing or eliminating targeted sources of water pollution

The Albemarle-Pamlico estuarine system includes many degraded and polluted streams and waterbodies. Those that fail to meet water quality standards are classified by the State as "impaired". Ideally, this designation prompts the development and implementation of contaminant management strategies, including restoration efforts to improve damaged riparian and estuarine shorelines and reduce spills from wastewater treatment facilities. Existing developments and infrastructure that contribute significant polluted runoff will be prioritized for retrofitting with low-impact development practices to mitigate environmental impacts on receiving waters.

B2.1: Support the development of water quality standards and any subsequent development of new management strategies for estuarine waters. (BIL Priority)

APNEP will continue to support the establishment and implementation of the NC Nutrient Criteria Development Plan (NCDP) for the Albemarle Sound as an important first step to develop new standards for estuarine waters.

Action: Continue participating in the NCDP process for estuarine waters and support additional scientific investigations to address any emerging questions, such as identifying water clarity metrics and modeling.
Key Implementers: NC-DWR, APNEP, VDEQ, NC-DEQ, EPA, NC-DACS, NC-SWC, VDSM, UNC-IMS, USGS
CCMP Outcomes Supported: 1a, 1b, 1d, 2a, 3b, 3c
Outputs: Coordinated development of contaminant management strategies

Results: Improved protections and restoration of water quality and ecological integrity; fewer impaired waters.
Timeline/Milestones: *Ongoing*
Cost: *$$$$*

B2.2: Facilitate the implementation of existing contaminant management strategies.

Collaborate with partners to fully implement existing water quality management strategies for pathogens, toxics, and nutrients by supporting regulatory agencies, stakeholders, local governments, and other partners as needed.

Action: APNEP will fund or support actions for implementation of existing contaminant management strategies.
Key Implementers: APNEP, NC-DWR, NC-DCM, VDEQ, VDCR, NC-LWTF, NC-SWC, EPA, USGS
CCMP Outcomes Supported: 1a, 1b, 1d, 3b, 3c
Outputs: Coordinated implementation of management strategies
Results: Improved water quality and ecological integrity
Timeline/Milestones: *Ongoing*
Cost: *$$$$*

B2.3: Protect, restore, and enhance targeted shorelines and riparian buffers to reduce and treat runoff, and to support ecosystem function/services. (BIL Priority)

Vegetated riparian buffers trap and filter polluted runoff, preventing sediments, nitrogen, phosphorus, pesticides, and other contaminants from entering our waters. APNEP will lead collaborative management activities along shorelines and riparian buffers to reduce runoff and support ecosystem functions. APNEP will work with its Management Conference and other partners to identify areas and assist in developing and implementing management plans. Where feasible, bulkheads and riprap will be replaced with living shorelines or erosion control structures that minimally impact natural shoreline functions.

Action: APNEP will collaborate with its Management Conference and partners to identify areas and assist in developing and implementing shoreline projects to protect, restore, and enhance targeted shorelines to reduce and treat runoff.
Key Implementers: APNEP, NC-DWR, NC-DCM, VDCR, NC-WRC, NC-LWTF, VWQIF, VOF, CTNC, NC-DMS, NC-SWC, VDSM, USACE, NC-DMS, NCCF, USFWS, NOAA, TNC, NFWF, NRCS, VDCR, DU, UNC, CSI, Sea Grant
CCMP Outcomes Supported: 2a, 2b, 2c, 3b, 3c, 3d

Outputs: Actions and projects to protect or restore riparian buffers to support natural shoreline ecosystem functions and facilitation of prioritization plans for regional and local management.
Results: Improved water quality, habitat availability and ecological integrity
Timeline/Milestones: *Ongoing*
Cost: *$$$$*

B2.4: Facilitate voluntary retrofitting of existing development and infrastructure to reduce runoff.

Collaborate with partners to identify and improve existing stormwater systems to reduce runoff. In areas with a high percentage of impervious surfaces, encourage the implementation of low-impact development practices. APNEP can offer workshops, letters of support, or grants for retrofitting existing developments and infrastructure.

Action: Provide grants, workshops, or letters of support to replace infrastructure to reduce runoff.
Key Implementers: APNEP, EPA, NC-DWR, NC-DWI, VDCR, NOAA, NC-LWTF, VWQIF, NCCF, Sea Grant, CSI, NC Cooperative Extension
CCMP Outcomes Supported: 2b, 2c, 3b, 3c, 3d
Outputs: Implementation of stormwater retrofitting projects / green infrastructure / nature-based solutions to reduce runoff
Results: Reduced runoff leading to improved water quality and ecological integrity
Timeline/Milestones: *Ongoing, 2O25 target, 2O26, 2O27, 2O29, 2029*
Cost: *$$$*

B2.5: Minimize the introduction of toxics into receiving waters by facilitating the use of approved best management to marinas, boatyards, stormwater discharges and wastewater facilities.

APNEP will support the implementation of best management practices (BMPs) to reduce the introduction of toxic materials into the estuarine system. Targeted sources of toxic pollution include new marinas, boatyards, stormwater discharges, and wastewater treatment facilities, all aimed at improving water quality to protect and restore SAV and oyster habitats.

Action: APNEP can provide grants for BMP implementation, host targeted workshops and participate in educational opportunities.
Key Implementers: APNEP, NC-DWR, NC-DWI, VDEQ, VDCR, EPA, NC-LWTF, VWQIF
CCMP Outcomes Supported: 1a, 1d, 2b, 3c
Outputs: Implementation of nature-based solutions to remove toxics

Results: Widespread BMP adoption leading to reduced toxics concentrations within targeted waterbodies
Timeline/Milestones: *Ongoing*
Cost: *$$$*

B2.6: Minimize contaminant loads to receiving waters through wastewater management and system upgrades.

Reducing contaminants in the estuarine system enhances ecosystem integrity and resilience. Aging wastewater infrastructure and recurrent flooding present significant challenges in limiting pollutant loads, including nutrients, bacteria, and viruses. Collaborate with municipalities needing repairs or upgrades to their wastewater infrastructure. APNEP will primarily work with the NC Division of Water Infrastructure to support upgrades to wastewater treatment facilities and infrastructure that address future risks.

Action: APNEP will continue collaborating with NC-DEQ, NC-DWI, and other partners to support upgrades to wastewater treatment facilities and infrastructure, protecting and restoring receiving waters
Key Implementers: NC-DWI, NC-DWR, VDEQ, NC-DMF, NC-DCM, EPA, NC-LWTF, VWQIF, SRF
CCMP Outcomes Supported: 1a, 1b, 1d, 2b, 2c, 3b
Outputs: Wastewater treatment systems upgrade projects. Additional pollution control measures, upgraded infrastructure, BMPs implemented
Results: Improved water quality and ecological integrity. Reduction in pathogens and other contaminates within targeted water bodies
Timeline/Milestones: *Ongoing*
Cost: *$$$$*

B2.7: Facilitate the use of approved best management practices (BMPs) on targeted agricultural and silvicultural lands to improve water quality for the protection, and restoration of SAV and oyster habitats.

Best management practices (BMPs) encompass various methods to reduce pollutant runoff from modified lands. APNEP and its partners may target BMP applications to address urgent water quality issues. APNEP will promote BMPs through educational resources, workshops, and demonstration projects to improve water quality, as well as SAV and oyster habitats. APNEP has facilitated BMP implementation by funding updates to BMP manuals for stormwater and silviculture and hosting training workshops.

Action: Targeted BMP application to benefit APNEP focus areas
Key Implementers: NC-DACS**,** APNEP, NC-SWCD, VDSM, NC-NCFS, VDOF, NC-DWR, NC Cooperative Extension, NC-DACS, NRCS. NC & VA Assn. of Soil & Water Conservation Districts.

CCMP Outcomes Supported: 2b, 3b, 3d
Outputs: Background information and guidance to adopt tested/approved BMPs for agricultural and silvicultural activities
Results: Increased use of BMPs leading to improved water quality and aquatic biodiversity
Timeline/Milestones: *Ongoing, 2029*
Cost: *$$*

B3: Ensure hydrological processes in rivers and estuaries support significant natural communities and ecosystem functions

Hydrology in many areas of the AP region is significantly altered. Increased impervious surfaces have led to greater runoff and higher erosion rates. Streams have been physically modified and diverted, often eliminating habitats, and creating unfavorable conditions for natural growth.

B3.1: Facilitate the development and implementation of coordinated landscape-scale hydrological restoration strategies.

Much of the region's lowland agricultural areas feature modified drainage networks with ditches and pumps. A coordinated hydrologic strategy is essential for large-scale restoration. Continue facilitating coordinated landscape-scale efforts, including the Scuppernong Regional Water Management Study on the northern Albemarle-Pamlico peninsula.

Action: Lead or participate in collaborative landscape-scale hydrological restoration planning efforts.
Key Implementers: APNEP**,** SECAS, USFWS, TNC, NCCF**,** USFWS, EPA, NOAA, USACE, NC-LWTF, NC-DWR, NC-DCM, NC-WRC, NC-DMS, NC Cooperative Extension, NC-DSWC, USGS
CCMP Outcomes Supported: 2a, 2b, 3a, 3b, 3d
Outputs: Coordinated landscape-scale hydrological restoration strategies
Results: Development, adoption, and implementation of strategies leading to improved water quality and ecological integrity
Timeline/Milestones: *Ongoing,*
Cost: *$$$*

B3.2: Facilitate the hydrologic restoration of floodplains and streams.

Floodplain restoration will focus on enhancing wetland function and planting riparian vegetation. Removing channelization and improving stream banks can help restore altered streams. Continue collaborating with partners to support hydrologic restoration of floodplains and streams, offering project support letters and grants.

Action: Provide funding or support for hydrologic restoration of floodplains and streams in targeted areas.
Key Implementers: APNEP**,** NC-DMS, TNC, NCCF, USFWS, EPA, USACE, NC-WRC, VDCR, NOAA, NC-LWTF, NC-DWR, NC-DCM, NC-DSWC, VDSWC
CCMP Outcomes Supported: 2b, 3a, 3b, 3d
Outputs: Letters of support and funding for floodplain restoration projects
Results: Completed restoration projects leading to improved water quality, hydrology, and ecological integrity
Timeline/Milestones: *Ongoing*
Cost: *$$$$*

B3.3: Develop and refine ecological flow requirements for each major river for inclusion in basin-wide water management plans.

Many fish, aquatic plants, and other species in the estuarine system rely on sufficient flowing water for survival. Identifying these ecological flow regimes is essential for their protection. APNEP will aim to provide scientific information and engage regional stakeholders in developing and implementing water management plans that balance human and ecological needs.

Action: Continue supporting the development of ecological flow requirements for each major river.
Key Implementers: APNEP, NC-DWR, USFWS, USGS, NC-WRC, VDCR, VDEQ, USACE, SECAS
CCMP Outcomes Supported: 1c, 2a, 2b, 3a
Outputs: Hydrologic models of each river basin and associated ecological flow requirements to support better resource management decisions. Draft management plans establishing minimum in-stream flows.
Results: Science-based management of in-stream flows to support both human and ecological demands and management of river flows that support ecological integrity.
Timeline/Milestones: *Ongoing*
Cost: *$$$*

B4: Restore spawning areas for diadromous fish

Many rivers and streams in the Albemarle-Pamlico region have been modified for water supply, irrigation, flood control, and development, often harming diadromous fish, including eels that rely on both rivers and the ocean. An impassable barrier can block access to miles of suitable habitat. APNEP will work with partners to identify and remove barriers where feasible to facilitate fish movement and restore degraded habitats.

B4.1: Facilitate the installation of fish bypass infrastructure and operations protocols on existing dams and other permanent barriers.

Fish ladders and eel-ways can maintain passage across dams that provide essential services like drinking water and electricity. APNEP will collaborate with the Management Conference and partners to support the siting, construction, and maintenance of passage mechanisms for fish and eels around in-stream barriers. APNEP will also seek funding for these projects and can provide letters of support or grants for installing fish ladders and eel-ways.

Action: Provide funding or support for installing fish bypass infrastructure in targeted areas.

Key Implementers: APNEP, NC-WRC, VDWR, USACE, NOAA, USFWS, NFWF, SECAS, American Rivers, NC-DMF, NCCF, TNC, NC-DWR, NCSU, USGS.

CCMP Outcomes Supported: 2a, 2b

Outputs: Fish ladders and eel-ways to bypass instream obstacles

Results: Improved fish populations and ecological integrity

Timeline/Milestones: *Ongoing*

Cost: *$$$*

B4.2 Facilitate the removal of dams, culverts, and other in-stream barriers.

In-stream barriers slated for replacement present opportunities to enhance fish passage with new technologies. Structures that have exceeded their intended lifespan will be prioritized for removal. APNEP will seek funding to support the removal of unnecessary barriers and offer letters of support or grants as needed.

Action: Provide funding or support for removing in-stream barriers in targeted areas.

Key Implementers: APNEP**,** NC-WRC, VDWR, NC-DMF, USACE, NOAA, USFWS, SECAS, NC-SWC, VDSM, NFWF, NC-DMS, American Rivers, NC-DOT, VDOT, FHA, SEPA, NC-DCM, NCWF.

CCMP Outcomes Supported: 2a, 2b

Outputs: In-stream barrier removal projects

Results: Improved fish populations and ecological integrity

Timeline/Milestones: *Ongoing*

Cost: *$$$$*

B4.3 Restore degraded anadromous fish spawning habitats.

Anadromous fish spawning habitat relies on appropriate current velocities, adequate dissolved oxygen levels, and low turbidity. APNEP will support suitable

hydrologic flows and restore submerged aquatic vegetation in streams and rivers with anadromous species. To implement the NC and VA Wildlife Action Plans and the NC Coastal Habitat Protection Plan, APNEP can provide partners with letters of support or grants to promote the restoration of anadromous fish spawning habitat.

Action: Provide funding or support to restore degraded anadromous fish spawning habitats.
Key Implementers: APNEP, NC-DMF, NC-WRC, VDWR, USACE, NOAA, USFWS, NFWF, NC-DCM, CTNC, TNC, NCCF
CCMP Outcomes Supported: 2a, 2b, 3a
Outputs: Spawning habitat restoration projects
Results: Improved spawning habitat leading to greater fish populations and ecological integrity
Timeline/Milestones: *Ongoing*
Cost: *$$$*

C: Engage

Engaging partners and fostering active collaboration are essential for achieving positive environmental outcomes. To meet its program goals, APNEP works closely with partners to focus activities and resources on the most urgent issues. Many existing programs and regulations governing watershed activities were established individually to address specific problems. Improved coordination of land use, water supply, ecosystem protection, transportation, and restoration planning will allow us to tackle issues more effectively at an ecosystem level.

APNEP will continue to engage partner organizations and the public to raise awareness and understanding of the environmental challenges facing the Albemarle-Pamlico region. Additionally, APNEP will promote individual and collective stewardship of the region's resources, supporting the planning, policies, and actions needed to sustain the Albemarle-Pamlico ecosystem and its human communities.

Current Situation

Most management efforts in the Albemarle-Pamlico estuarine system are not designed to protect the entire ecosystem. Instead, they tend to focus on individual components, such as fisheries, soil, and water, leading to a fragmented approach to restoration and protection. For instance, many land use and permitting decisions are made without fully considering their broad-scale impacts on land, water, species, and human well-being. Additionally, these decisions often overlook factors like disadvantaged communities, land use, climate change, and sea level rise forecasts.

Our review of environmental initiatives in the region shows that many individuals, organizations, and agencies are working to improve the area. However, the capacity to address issues at an ecosystem scale remains low, despite decades of effort and progress. Fully integrated approaches to restoring and sustaining the Albemarle-Pamlico estuarine system have yet to be achieved. Knowledge and resource transfer for implementing strategic actions is uneven, and coordination of management initiatives needs significant improvement.

Rationale for Action

APNEP is well-positioned to coordinate stewardship, environmental education, and management efforts across state lines and among various government levels and stakeholder groups. Its advisory committees strengthen community ties throughout the region, while partners actively engage in outreach activities. With its mission to protect the entire estuarine ecosystem, APNEP can identify opportunities to integrate and improve engagement efforts on a regional scale, which would be impossible without its partners.

Objectives and Actions

C1: Foster watershed stewardship

The Albemarle-Pamlico region is rich in its beauty, natural resources, and opportunities for people to interact with the ecosystem. APNEP will engage in targeted education and communication efforts to encourage people to reduce their environmental impact and foster meaningful opportunities for ecosystem protection and restoration. Additionally, APNEP will identify areas of mutual benefit among citizens, businesses, and governments for resource protection and restoration.

C1.1: Communicate the importance of stewardship and offer opportunities for volunteerism to further APNEP's mission.

APNEP will continue advocating for environmental stewardship and partnering to provide meaningful volunteer opportunities that enhance the environment and educate about the Albemarle-Pamlico estuarine system. APNEP can offer grant funding for projects and assist partners in promoting stewardship and volunteer initiatives.

Action: Incorporate into APNEP's Engagement Strategy methods to communicate the importance of stewardship and offer opportunities for volunteerism to further APNEP's mission.

Key Implementers: APNEP, NC-DEQ, NC-OEE, VOEE, VDCR, VADEQ, NCCF, TNC, EPA, NOAA, PfS, IMS, CSI, VIMS, NC-NERR, NC-AQ, VAMSC

CCMP Outcomes Supported: 1a, 1b, 1d, 1e, 2a, 2b, 2c, 3b, 3c
Output: Workshops and engagement materials on stewardship and volunteer opportunities
Results: Increase in voluntary citizen action to protect and restore the Albemarle-Pamlico estuarine system
Timeline/Milestones: *Ongoing*
Cost: *$$*

C1.2: Provide and promote opportunities for outdoor experiences that connect individuals with the Albemarle-Pamlico ecosystem.
A meaningful and educational outdoor experience can transform how individuals perceive the natural world. Those connected to the estuarine system are more likely to take steps to ensure its health. APNEP will continue collaborating with partners to provide and promote opportunities for impactful outdoor experiences. We will also support partners in implementing watershed-scale activities in the region, such as Shad in the Classroom.

Action: Provide funding and promote opportunities for public outdoor experiences.
Key Implementers: APNEP**,** NC-DNCR, VDCR, NC-NERR, NC-WRC, PfS, VOEE, NC-ODMSA, USFWS, NPS, NCCF, NC-DOC, VDOC, NC-DACS, NC-AQ, VAMSC
CCMP Outcome Supported: 1e, 2a, 2b, 2c
Outputs: Activities for the public to become engaged in experiencing the Albemarle-Pamlico ecosystem
Results: Increased public awareness, engagement, and stewardship of the Albemarle-Pamlico ecosystem.
Timeline/Milestones: *Ongoing*
Cost: *$$*

C2: Conduct targeted environmental education efforts regarding estuarine habitats, water quality, and ecosystem services.
Environmental education enhances knowledge and awareness of environmental challenges while developing the skills needed to address them. It fosters attitudes and motivations that encourage informed decision-making and responsible action. APNEP is dedicated to educating both children and adults about the natural resources of the Albemarle-Pamlico ecosystem, aiming to increase ecological understanding and equip individuals to tackle environmental issues effectively.

C2.1: Provide environmental education training opportunities for educators.

By educating teachers about the Albemarle-Pamlico region and its environmental issues, and providing science-based resources, APNEP partners to enhance the education of thousands of students each year. APNEP will continue to offer training opportunities for educators in the region.

Action: Provide funding for environmental education training opportunities for educators that support the APNEP mission and CCMP implementation.
Key Implementers: APNEP, NC-NERR, PfS, NCCF, NC-DPR, Sea Grant, NC-MNS, NC-ODMSA, VOEE, VIMS, CSI, UNC, NC-AQ, VAMSC
CCMP Outcome Supported: 1e, 2a, 2b, 2c, 3b
Outputs: Workshops and materials for educators
Results: Increased awareness and engagement via CCMP implementation.
Timeline/Milestones: *Ongoing*
Cost: *$$*

C2.2: Increase public understanding of the relationship between ecosystem health and human health advisories relating to water, fish, and game.

The connections between the environment, human activity, and health advisories can be difficult to understand. APNEP will collaborate with partners to help individuals recognize these links and act against pollution sources. Additionally, APNEP will continue to produce and support educational materials and fund studies and programs, such as ecosystem metric reports, swim guides, and the NC Recreational Water Quality Monitoring, to enhance public understanding.

Action: Develop and implement a strategy to enhance understanding of the link between ecosystem health and human health advisories.
Key Implementers: APNEP, Sea Grant, USFWS, NC-WRC, EPA, NC-DWR, NC-DMF, VDH, NC-DPH, UNC-IE
CCMP Outcome Supported: 1a, 1b, 1d
Outputs: Outreach, events, and educational materials
Results: Public policies to support improved water, fish, and game quality resulting in improved public health
Timeline/Milestones: *Ongoing*
Cost: *$$$*

C3: Provide tools and training to support ecosystem-based management.

Many decisions impacting the estuarine ecosystem are made at the local level, where residents may have little incentive to consider broader effects. Regional and local leaders must navigate various political, economic, and social factors, often placing environmental concerns on the back burner. Recognizing this, APNEP aims to provide government officials with tailored information for informed environmental decision-making. APNEP will collaborate with partners to ensure local and state governments have access to quality educational resources, mapping tools, and other relevant information to make sound environmental and natural resource decisions.

C3.1: Develop and implement a strategy to improve decision-makers' understanding of the return on investments in environmental protection, restoration, planning, and monitoring.

While the costs of environmental protection are easily visible, the benefits are often harder to quantify. APNEP will collaborate with partners to provide government and the public with science-based information on the monetary and non-monetary value of ecosystem services, helping them integrate this information into decision-making. Additionally, APNEP will continue to support the development of ecosystem services assessments and economic evaluations.

Action: Perform ecosystem services assessments and economic evaluations and promote incorporation into regional and local planning efforts.

Key Implementers: APNEP, NC-DCM, NC-DWR, NC-DWR, IOG, COGs, PDCs, APA, Sea Grant, IOG, NC-NHP

CCMP Outcomes Supported: 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 3a, 3b, 3c, 3d

Outputs: Communication strategy and materials on ecosystem services for incorporation into regional and local planning efforts.

Results: Informed decisions by environmental management

Timeline/Milestones: *Completion target 2028, ongoing effort*

Cost: *$$$*

C3.2: Enhance the coordination of targeted ecosystem management by federal, state, regional, Tribal, and local governments, and communities by assisting with the incorporation of resilience, climate change and sea level rise considerations into planning processes. **(BIL Priority)**

APNEP will continue to collaborate with local governments and Tribal communities to integrate climate considerations into their planning processes. This includes developing tools and resources to promote natural and nature-based infrastructure for enhancing community and ecosystem resilience. APNEP will also work across

sectors to identify and leverage mutually beneficial climate adaptation opportunities and facilitate collaboration across jurisdictional boundaries.

Action: Implement activities to help partners integrate ecosystem resilience, climate adaptation, sea level rise and recurrent flooding considerations into their planning processes.

Key Implementers: APNEP, Sea Grant, NC-DCM, NC-DMF, NC-DEM, NCORR, EPA, SECAS, VCZM, USFWS, NC-WRC, NOAA, NC-DOT, NC-DHHS, IOG

CCMP Outcomes Supported: 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 3a, 3b, 3c, 3d

Outputs: State, regional, and local plans that address resiliency, risk and vulnerability including rising water levels and recurrent flooding.

Results: Improved resiliency for human and natural communities.

Timeline/Milestones: *Ongoing*

Cost: *$$$*

D: Monitor

Monitoring the environment and the management actions of APNEP and its partners are critical to an ecosystem-based management approach.

First, APNEP will focus on monitoring various indicators of ecosystem condition. Establishing a coordinated monitoring strategy is essential for detecting, measuring, tracking, and assessing changes in the ecosystem. Without consistent monitoring, resources may be wasted on ineffective initiatives, and the benefits of successful management approaches may go unrecognized.

Second, APNEP will collaborate with its partners to monitor the implementation of management actions. If actions are not fully executed, APNEP will identify and address barriers to implementation. If these barriers prove difficult to overcome, APNEP will revisit the management process to explore more effective actions for achieving environmental outcomes.

This monitoring and reassessment are vital for promoting accountability and evaluating progress toward environmental goals. Information from monitoring efforts will be presented in an accessible format to ensure transparency and support cooperative adaptive management.

Current Situation

The region's monitoring infrastructure is sparse, lacking an integrated ecological monitoring network. Until recently, there has been little coordination among local, state, and federal monitoring efforts, which are often tied to legal mandates or specific grant programs.

While recent federal and state initiatives aim to organize monitoring efforts, they may not provide the consistency and scale needed to address issues across the Albemarle-Pamlico ecosystem. These actions will help clarify who is monitoring the environment, what is being monitored, whether programs are effective, and what changes may be needed to better support ecosystem-based approaches in the region.

Rationale for Action

A rigorous and relevant monitoring program is essential for the success of APNEP and its partner organizations. However, the complexity of ecological systems makes designing, constructing, and maintaining monitoring efforts challenging. Nonetheless, residents of the region deserve accountability and information about their environment. To meet this obligation, APNEP plans to develop and implement a comprehensive, integrated environmental monitoring strategy.

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Objectives and Actions

D1: Develop and maintain an integrated monitoring network to collect and disseminate information for assessment of ecosystem outcomes and management actions associated with CCMP implementation

Implementing CCMP actions should yield positive outcomes for the regional ecosystem, and monitoring must be designed to confirm these changes. Establishing a coordinated and integrated monitoring strategy is essential for measuring progress toward desired outcomes. These monitoring actions will enhance the understanding of the region's environment, as reported by APNEP's assessments.

> **D1.1: Facilitate the development and implementation of an integrated monitoring network through the guidance of regional monitoring and assessment teams. (BIL Priority)**
>
> APNEP's resource-themed teams (SAV, aquatic fauna, water, wetlands, terrestrial, air, human dimensions) will ensure that ecosystem outcomes from environmental management efforts are measurable and that management initiatives can be tailored based on assessment results. APNEP will continue to collaboratively develop integrated ecosystem monitoring to support CCMP implementation.

Action: Create plans to establish an integrated monitoring network.
Key Implementers: APNEP, NC-DEQ, NC-DNCR, VDEQ, VDCR, SECAS, EPA, NOAA, USGS
CCMP Outcomes Supported: 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 3a, 3b, 3c, 3d
Outputs: Regional integrated monitoring network
Results: Enhanced spatial and temporal data to help detect the status and trends of APNEP indicators for ecosystem assessments and resource management decisions.
Timeline/Milestones: *Completion target 2029, ongoing effort*
Cost: *$$$$*

D1.2: Facilitate the expansion of volunteer monitoring into a core element of the integrated monitoring network.

Evaluate and, where feasible, incorporate a volunteer monitoring component for active ecosystem and management indicators. Implementing a rigorous quality assurance protocol will enhance the usefulness of volunteer-collected data in APNEP assessments. Continue integrating volunteer monitoring into the Partnership's integrated monitoring network strategy.

Action: Include a volunteer monitoring component in monitoring strategies where feasible.
Key Implementers: APNEP, NC-MNS, NCCF, NOAA, USFWS, USGS, NC-DEQ, NC-DRP, NC-NHP, VDEQ, VDCR
CCMP Outcomes Supported: 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 3a, 3b, 3c, 3d
Outputs: High-quality volunteer monitoring data for select ecosystem and management indicators
Results: An improved and effective monitoring network to support management decisions
Timeline/Milestones: *Completion target 2029, ongoing effort*
Cost: *$$$$*

D1.3: Develop and maintain an online resource that clearly conveys regional information in support of ecosystem-based management.

Along with creating a regional database, ensure APNEP deliverables are easily accessible to partners and the public. Continue evaluating media to effectively share regional ecosystem information (maps, reports, metric reports, etc.) with partners and stakeholders.

Action: Development of accessible environmental information systems.
Key Implementers: APNEP**,** SECAS, NC-WRC, NC-DLWS, NOAA, NC-DEQ, NC-DNCR

CCMP Outcomes Supported: 1a, 1b, 1c, 1d, 1e, 2a, 2b, 2c, 3a, 3b, 3c, 3d
Outputs: Publicly accessible (external) and partner-accessible (internal) environmental information systems
Results: More informed management decisions and public knowledge based on current shared data and assessments.
Timeline/Milestones: *Completion target 2029, ongoing maintenance*
Cost: *$$$*

Terms and Definitions

The terms and definitions below are meant to introduce various concepts and to convey the meaning of technical terms in a straightforward, plain language manner. More precise definitions are available by consulting other references or literature sources.

303(d) list – A list of the most seriously impaired waters in the region developed to comply with the federal Clean Water Act.

anadromous – Aquatic species that must reproduce in rivers but live much of their life in the ocean.

aquatic system – The interconnected surface streams, rivers, lakes, sounds, and ocean in the Albemarle-Pamlico watershed.

bathymetry – The study of the depth and contours of underwater surface features.

best management practices (BMP) – Practices applied in different sectors (including agriculture, forestry, stormwater management, and energy development, among others) that minimize adverse environmental impacts.

catadromous – Aquatic species that breed in the ocean and live most of their life in fresh and brackish waters.

conservation atlas – An integrated collection of maps and geographic information, presented online, that can be used in support of environmental decision-making.

Citizen Advisory Committee (CAC) – A group of watershed residents, stakeholders, and community members who provide input and feedback on the management and conservation of the estuary. The CAC serves as a bridge between ANEP and the region's communities, ensuring that local voices and perspectives are engaged in decision-making processes.

contaminant management strategy – The full array of management measures which may be employed to reduce contaminants that enter the estuarine system.

designated use – A categorization of water bodies based on their most appropriate use. Associated with each designated use are various water quality standards which should be met to support that use.

diadromous - Migratory fish species, including eels, that depend on both the river and the ocean for parts of their life cycle. This term includes both anadromous and catadromous species.

ecological flow – The amount of stream flow necessary to maintain ecological integrity in aquatic river systems. See N.C.G.S. § 143-355(o)(1)(a).

ecological health – A synonym for ecological integrity that compares the function of an ecosystem to that of the human body.

ecological integrity – The ability of an ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to prevailing ecological conditions and, when subject to disruption, to recover and continue to provide the natural goods and services that normally accrue from the system.

ecosystem – All living organisms in an area and the nonliving physical environment with which they interact.

ecosystem-based management – An environmental management approach that recognizes the full array of interactions within an ecosystem, including humans.

geographical information system (GIS) – Mapping software that allows geographically referenced information to be displayed, managed, and analyzed.

hardened shorelines – Areas along a waterfront that are stabilized by structures that prevent or retard erosion, including bulkheads and riprap, and which may restrict interchange with the adjacent aquatic ecosystems, including species access.

hydrologic processes – The ways in which water moves through the ecosystem.

hydrologic regime – The movement, distribution, and quality of water in the ecosystem.

impaired waters – Bodies of water or stream segments in which at least one surface water quality standard is not met for its designated use.

indicator – A numerical value derived from actual measurements of a pressure, state or ambient condition, exposure, ecological condition, or measure of human health or well-being over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment in the Albemarle-Pamlico region.

Leadership Council – A governing body that provides oversight and direction for the Partnership's activities and initiatives and budget. This group typically includes high-level representatives from key stakeholder organizations, such as federal and state agencies, local governments, non-governmental organizations, and sometimes business leaders or community representatives as well as members of the CAC and STAC. Membership is established by a NC Governor's Executive Order.

living shorelines – Stabilization techniques to minimize erosion that use natural habitat elements to protect shorelines from erosion while also providing critical habitat for estuarine species.

low-impact Development (LID) – An approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. This practice employs principles such as preserving and recreating natural landscape features, minimizing, or eliminating pollutants in storm water through natural processes, and maintaining pre-development hydrologic characteristics, such as flow patterns, surface retention, and recharge rates.

Management Conference (MC) – A collaborative of diverse stakeholders involved in the management and protection of estuarine and coastal resources. This conference typically consists of representatives from federal, state, and local governments, non-governmental organizations s, community groups, academia, and the private sector. For APNEP the management conference includes members of the Leadership Council, Science and Technical Advisory Committee, Citizen Advisory Committee, and members of various ad-hoc workgroups engaged in CCMP planning and implementation. The Management Conference plays a critical role in ensuring that the interests and needs of all stakeholders are considered in decision-making processes.

National Estuary Program (NEP) – Established by section 320 of the Clean Water Act, the National Estuary Program is administered by EPA and protects 28 "estuaries of national significance" throughout the United States. The Albemarle-Pamlico estuary was among the first in the nation to become a part of this program.

Nature-based solutions (NBS)– Activities that leverage nature and the power of healthy ecosystems to protect people, optimize infrastructure and safeguard a stable and bio-diverse future. Nature-based solutions implementation can also be referred to as "green infrastructure" or "natural infrastructure."

pathogens – Viruses, bacteria, or other microorganisms that cause disease in humans or other plant or animal species.

Policy Board – Precursor to the current Leadership Council (LC)

Resilience / Resiliency – The ability of an individual, community, ecosystem, or system to withstand, adapt to, and recover from stressors, disturbances, or changes. In ecological contexts, it describes how well an ecosystem can absorb shocks, maintain its essential functions, and recover from events such as natural disasters, climate change, or human activities. In broader terms, resilience can also apply to individuals or communities in how they cope with challenges and bounce back from adversity.

Science and Technical Advisory Committee (STAC) – A group of experts and stakeholders that provides scientific and technical guidance to the Partnership on measures to restore and protect the natural resources of the Albemarle-Pamlico region.

submerged aquatic vegetation (SAV) – Rooted vascular plants that live below the water surface in large meadows or small patches in coastal and estuarine waters. Also known as SAV, aquatic grasses, or grass beds, they can be further classified by the range of salinity of the waters in which they are found.

toxics – Chemicals that have adverse health or ecological effects when released into the environment.

watershed – The area of land where all water that is under it or drains from it goes to the same place. The Albemarle-Pamlico watershed describes the land and rivers that drain into the Albemarle and Pamlico Sounds.

Acronyms and Abbreviations

APA- American Planning Association

APES- Albemarle-Pamlico Estuarine Study

APNEP- Albemarle-Pamlico National Estuary Partnership

BMP- best management practices

CAC- APNEP Citizens Advisory Committee

CAMA- Coastal Area Management Act

CCMP- Comprehensive Conservation and Management Plan

CHPP- Coastal Habitat Protection Plan (NC)

COG- Council(s) of Governments

CSI- University of North Carolina Coastal Studies Institute

CTNC- Conservation Trust for North Carolina

DU- Ducks Unlimited

EBM- ecosystem-based management

EPA- United States Environmental Protection Agency

FHA- Federal Highway Administration

GIS- geographic information system

IMS- University of North Carolina Institute of Marine Sciences

IOG- University of North Carolina Institute of Government

LID- low-impact development

MAC- APNEP Management Advisory Committee

NC- North Carolina

NCCF- North Carolina Coastal Federation

NCORR- North Carolina Office of Recovery & Resilience

NC-AQ - North Carolina Aquariums

NC-CWMT F- Clean Water Management Trust Fund (NC)

NC-DACS - North Carolina Department of Agriculture and Consumer Services

NC-DCM- North Carolina Division of Coastal Management (NC-DEQ)

NC-DEM - North Carolina Division of Emergency Management

NC-DEQ - North Carolina Department of Environmental Quality

NC-DHHS- North Carolina Department of Health and Human Services

NC-DMF- North Carolina Division of Marine Fisheries (NC-DEQ)

NC-DMS- North Carolina Division of Mitigation Services (NC-DEQ)

NC-DNCR – North Carolina Department of Natural and Cultural Resources

NC-DOC- North Carolina Department of Commerce

NC-DPH- North Carolina Division of Public Health

NC -DPR- North Carolina Division of Parks and Recreation (NC-DNCR)

NC-DWR- North Carolina Division of Water Resources (NC-DEQ)

NC-EPPC- North Carolina Exotic Pest Plant Council

NC-MNS- North Carolina Museum of Natural Sciences (NC-DNCR)

NC-NCDOT- North Carolina Department of Transportation

NC-NCFS- North Carolina Forest Service

NC-NHP- North Carolina Natural Heritage Program (NC-DNCR)

NC-NERR- North Carolina Coastal Reserve and National Estuarine Research Reserve

NC-DLWS- North Carolina Office of Conservation, Planning, and Community Affairs (NC-DEQ)

NC-OEEPA- North Carolina Office of Environmental Education and Public Affairs (NC-DEQ)

NC-PRTF- North Carolina Parks and Recreation Trust Fund

NC-DSWC- North Carolina Division of Soil and Water Conservation (NC-DACS)

NC-WRC- North Carolina Wildlife Resources Commission

NEMO- Non-point Education for Municipal Officials

NFWF- National Fish and Wildlife Foundation

NGO-non-governmental organization

NMFS- National Marine Fisheries Service

NOAA- National Oceanic and Atmospheric Administration

NRCS- Natural Resources Conservation Service

PDC- Planning District Commission

PfS- Partnership for the Sounds

SAFMC- South Atlantic Fishery Management Council

SECAS- Southeast Conservation Adaptation Strategy

SAV- submerged aquatic vegetation

SEPA- Southeast Power Administration

SHA- Strategic Habitat Area

SRF- North Carolina and Virginia State Revolving Funds

STAC- APNEP Science and Technical Advisory Committee

TNC- The Nature Conservancy

UNC- The University of North Carolina at Chapel Hill

USACE- United States Army Corp of Engineers

USDA- United States Department of Agriculture

USFS- United States Forest Service

USFWS- United States Fish and Wildlife Service

USGS- United States Geological Survey

VA – Virginia

VAMSC- Virginia Aquarium and Marine Science Center

VCZM- Virginia Coastal Zone Management Program (VDEQ)

VDCR- Virginia Department of Conservation and Recreation

VDEQ- Virginia Department of Environmental Quality

VDWR- Virginia Department of Wildlife Resources

VDSM- Virginia Division of Stormwater Management (VDCR)

VNHP- Virginia Natural Heritage Program (VDCR)

VOEE- Virginia Office of Environmental Education (VDEQ)

VDACS- Virginia Department of Agriculture and Consumer Services

VVDH- Virginia Department of Health

VDOC- Virginia Department of Commerce

VDOF- Virginia Department of Forestry

VDOT- Virginia Department of Transportation

VMRC- Virginia Marine Resources Commission

VOF- Virginia Outdoors Fund

VWWP- Virginia Office of Wetlands and Water Protection (VDEQ)

VWQIF- Virginia Water Quality Improvement Fund

VIMS- Virginia Institute of Marine Science

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