

## National Picture

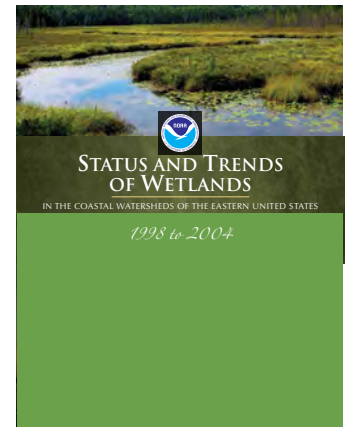
Coastal wetlands provide important ecosystem services that are vital to the health and well-being of our nation. They serve as buffers, protecting coastal areas from storm damage and sea level rise. They are vital to the health of commercially and recreationally important fisheries resources, providing food and essential fish and shellfish habitat. Wetlands also serve as nesting and foraging habitat for birds and other wildlife. As “living filters,” wetlands improve water quality by removing pollutants, nutrients, and sediments. Furthermore, coastal wetlands provide direct value to people in other ways, such as minimizing erosion of upland, protecting infrastructure and supporting the tourism, hunting, and fishing sectors of the economy.

There are a number of threats to coastal areas, in particular wetland habitats. The most significant threats include conversion of wetlands to other land uses and climate change, in particular, sea level rise and increases in hurricane intensity and frequency. In some regions wetlands are being converted to open water due to land subsidence.

Numerous recent reports have examined coastal wetland loss and potential strategies to address threats like climate change. The Association of State Wetland Managers (ASWM, 2009) recommended a national wetland and climate change initiative. The report contains measures to reduce impacts and adapt coastal/estuarine wetlands to climate change. The U.S. Army Corps of Engineers (Army Corps) and the National Oceanic and Atmospheric Administration (NOAA) both published frameworks to guide how they will consider impacts of climate change and sea level rise as they implement restoration activities, including those in coastal wetlands (Army Corps, 2009; NOAA, 2010a).

NOAA and the U.S. Fish and Wildlife Service (USFWS) analyzed the status and trends of wetland acreage along the Atlantic Coast, Gulf of Mexico, and the Great Lakes to provide an estimate of losses or gains that occurred in those coastal watersheds. Their report, released in 2008, found that 361,000 acres of coastal wetlands were lost in the Eastern United States alone between 1998 and 2004 (Stedman and Dahl, 2008). This amounts to an average net decrease of 59,000 acres each year. The vast majority of the loss (82 percent) occurred in freshwater wetlands, both tidal and non-tidal. Nearly 60 percent of the total loss of coastal freshwater wetlands is attributed to “other

development,” which includes conversion of wetlands to unknown or undetermined land uses (Figure 1). There were also losses of saltwater tidal wetlands to open water (deeper than 2 meters), particularly in the Mid-Atlantic region. The 2008 NOAA and USFWS Status and Trends report did not examine the loss of wetland condition or function.



In response to these reports, EPA established a two-part Coastal Wetlands Initiative. The first part is the Coastal Wetlands Team, which is a joint effort between EPA’s Wetlands Division and the Oceans and Coastal Protection Division. The team’s goals are: 1) confirming wetland loss and better understanding contributing stressors; 2) identifying and disseminating tools, strategies, policies, and information to protect and restore coastal wetland resources; and 3) raising awareness of the functions and values of coastal wetlands, threats to these resources, and opportunities to protect and restore coastal wetlands.

To achieve its goals, the Coastal Wetlands Team met with stakeholders in the Mid-Atlantic, South Atlantic, Gulf of Mexico, and North Atlantic regions (see Figure 2). For each of these

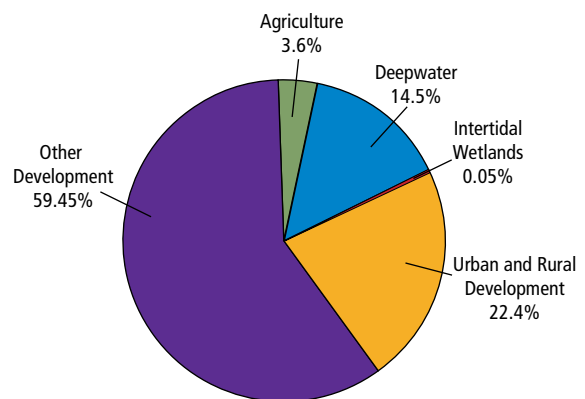
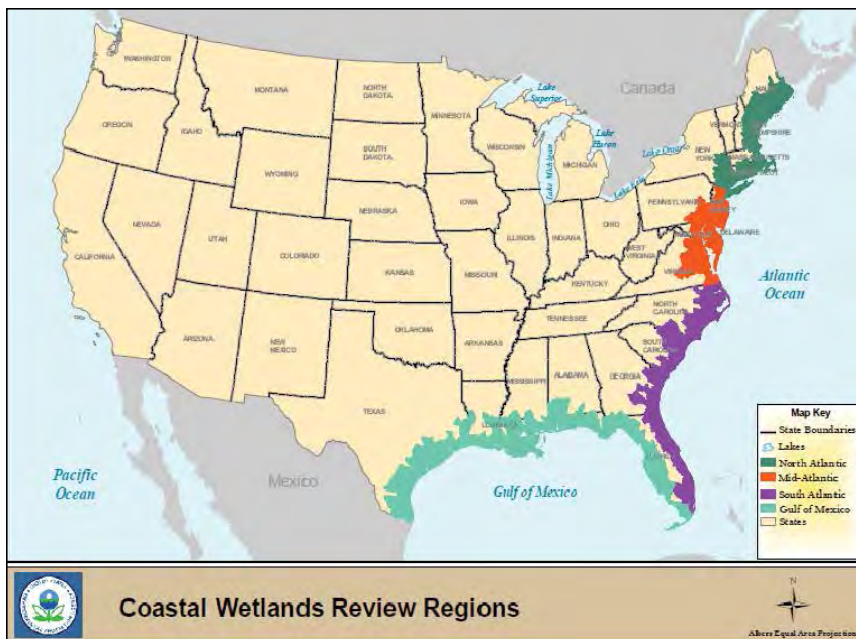


Figure 1. Wetland loss and changes in land cover, 1998-2004: Atlantic, Gulf of Mexico, and Great Lakes. Source: Stedman and Dahl, 2008.





Consistent with other federal agencies, EPA is defining “coastal wetlands” as saltwater and freshwater wetlands\* within HUC-8 watersheds that drain to the Atlantic, Pacific, or Gulf of Mexico. “Coastal wetland loss” is defined as “a decline in the areal extent and/or ecological integrity\*\* of wetlands in coastal watersheds” (Figure 2).

**Figure 2.** Coastal wetlands regions identified in EPA’s Coastal Wetlands Initiative.

Coastal Wetland Reviews (CWRs), the team identified key stressors; examined regulatory and voluntary efforts at the federal, regional, state, and local level to reduce or reverse coastal wetland loss; and assessed whether successful strategies can be replicated elsewhere. The information from the reviews could be used to help inform policy decisions, influence program direction, and develop projects to reduce or reverse coastal wetland loss nationally. The results of these CWRs are provided in a report distributed to the respective participants, and will also be posted on EPA’s website. This document is the CWR report for the South Atlantic region.

The second part of the Coastal Wetlands Initiative is the federal Interagency Coastal Wetlands Workgroup, which is composed of members from EPA, NOAA, USFWS, the U.S. Geological Survey, the U.S. Department of Agriculture’s Natural Resources Conservation Service, the Army Corps, and the Federal Highway Administration. The Interagency Coastal Wetlands Workgroup serves in an advisory capacity to EPA’s Coastal Wetlands Team by helping to identify CWR watersheds, participating in the CWR on-site discussions, and providing input on the reports.

**EPA Coastal Wetland Regional Reviews**

EPA conducted these CWRs to identify and better understand the stressors on coastal wetlands and the strategies needed to protect and restore them. EPA’s Coastal Wetlands Team is interested in identifying the cause(s) of losses in the areal extent of wetlands, as well as examining losses in wetland function and/or ecological integrity. Though quantifiable data on functional loss are limited in availability, EPA recognizes

that it is an issue in many watersheds and included qualitative information to reflect this concern where appropriate. EPA coordinated with the Interagency Coastal Wetlands Workgroup and stakeholders to gather information on available tools and strategies used to address wetland function and condition within the region(s) of interest. The CWRs and the subsequent regional reports will not be used to evaluate specific wetland assessment tools or methodologies, but rather to describe which tools are being used and discuss participants’ views on their experiences and relative success with such tools.

The purpose of the CWRs was to facilitate dialogue among stakeholders who share a vested interest in coastal wetland resource protection such that continued local, regional, and national efforts to stem coastal wetland losses can be increasingly effective. They are not considered a commitment of future resources to address issues identified during the review process. Each CWR is intended to provide information on a particular focal watershed or region and should not be considered a final assessment of the study area. Instead, each review should be considered a baseline reconnaissance to aid in moving the entire Coastal Wetlands Initiative forward.

This report contains points raised during the course of the discussions with stakeholder groups. EPA affords participants an opportunity to comment on CWR notes and draft reports in order to provide the broadest perspective possible. EPA also endeavors to supplement these perspectives with documentation (e.g., relevant references, citations), but it is not possible to do so for every comment provided. Thus, the information presented in this report cannot be considered the definitive and most comprehensive presentation of issues within the region or

\* For the purposes of this initiative, “wetlands” means those areas meeting the definition of wetlands in: Cowardin, L., et al. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS 79/31. 131 pp  
 \*\* EPA recognizes that there are limited quantifiable data currently available regarding loss of wetland ecological integrity.

within specific focal watersheds. Instead, it can serve as a starting point for identifying priority stressors, tools and strategies to address them, and key information and data gaps that need to be filled in order to reduce wetland loss in the future.

The process for the CWRs was intended to be flexible and encouraged participation from a diverse and representative group of stakeholders in each of the focal watersheds. Four steps were followed for each CWR:

### 1. Identify focal watersheds.

USFWS identified candidate watersheds for the CWRs based on observed wetland loss in the USFWS/NOAA Status and Trends report. These are generally areas where the most wetland loss has occurred, due to development, other human actions, or where losses were attributed to inundation or other coastal processes.

The Coastal Wetlands Team further refined this larger candidate watershed to focus in on specific eight-digit HUC watersheds (“HUC 8 watersheds”). The focal watersheds selected for analysis are based on existing wetland conditions assessments, available data, a variety of efforts to protect and restore coastal wetlands, and the willingness of local stakeholders to participate.

The HUC 8 watersheds identified may correspond directly to National Estuary Program (NEP) study areas (the geographic boundary in which the NEPs work to improve estuary health). In other words, the CWRs often occur in the same watersheds as the NEP study areas or a sub-set thereof.

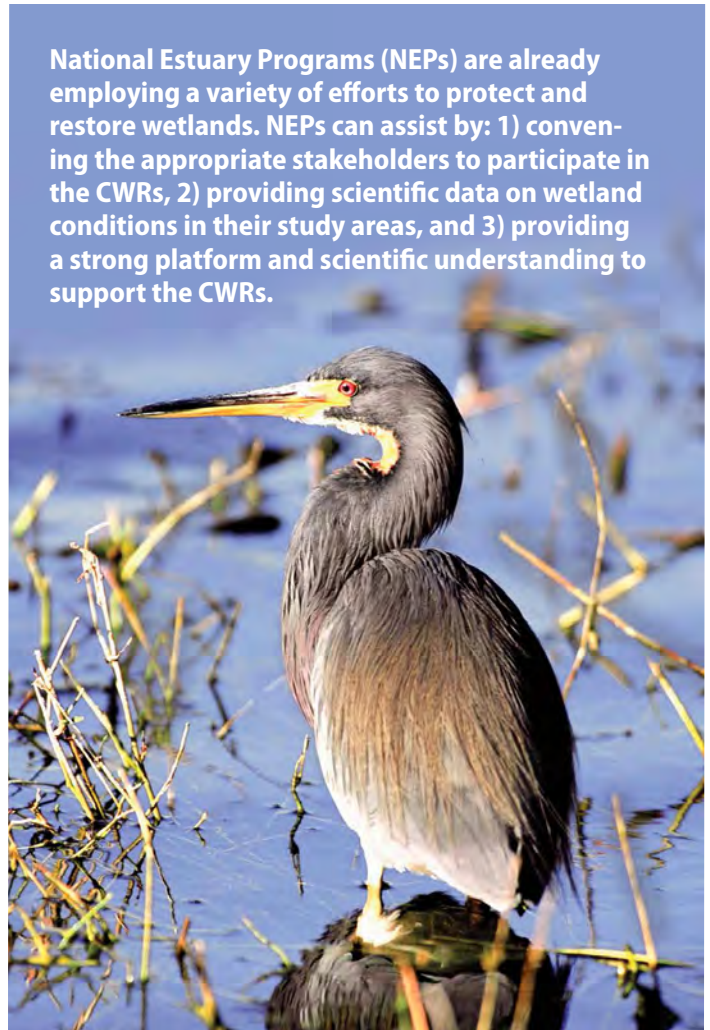
NEPs provide an effective mechanism to assist the CWRs in a few important ways. They consist of broad-based stakeholder groups that work in close partnership to protect and restore habitats in their study area. These groups represent a wide range of interests and expertise at local, state, and federal levels (e.g., general public, state natural resource agencies, academics, local governments, watershed groups). EPA uses stakeholder lists from the NEPs along with contacts provided by the Interagency Coastal Wetlands Workgroup to invite participants to attend the CWRs.

NEPs and their partners create and implement a management plan that is based on scientific characterization of the study area, and contains actions to address habitat loss and modification. This characterization is a collection of scientific information that includes an assessment of extent and condition of habitats such as wetlands. These data can help provide key information for the CWR assessments and reports.

### 2. Conduct a review of current, readily available information.

For the selected review area, the Coastal Wetlands Team gathered more specific existing information on coastal wetland loss, stressors contributing to coastal wetland loss, tools and

**National Estuary Programs (NEPs) are already employing a variety of efforts to protect and restore wetlands. NEPs can assist by: 1) convening the appropriate stakeholders to participate in the CWRs, 2) providing scientific data on wetland conditions in their study areas, and 3) providing a strong platform and scientific understanding to support the CWRs.**



strategies used to protect and restore coastal wetlands, and key information gaps that, if addressed, could help reverse the trend of wetland loss. Information was gathered from the Internet, reports provided by the “host” organization, and CWR invitees or participants in advance of the local stakeholders discussions. In addition, to estimate coastal wetlands loss, the Coastal Wetlands Team consulted with NOAA’s Coastal Change Analysis Program (C-CAP), which uses satellite imagery to measure land cover change in coastal areas. The Team also requested permit data from the Army Corps and state agencies, where applicable, in order to quantify authorized losses and associated mitigation gains for wetlands under the jurisdiction of Section 404 of the federal Clean Water Act (CWA) or similar state programs. When made available by the relevant agency, these data were provided in the CWR report. Due to database limitations, permit data provided by the Army Corps did not cover the same time frame as C-CAP (1996-2006) and therefore it was not possible to compare the magnitude of losses identified by each. See Appendices C and D for more information on the CWA Section 404 program and C-CAP, respectively.

### Questions posed during stakeholder discussions:

1. What are the root causes of coastal wetland loss in your area? Are there differences between fresh and saltwater stressors? Which are the top three stressors?
2. What are the current regulatory and non-regulatory protection and restoration tools being used to adapt to or mitigate wetland loss in your area?
3. What are the successful strategies being employed to protect and restore coastal wetlands in your area?
4. What information gaps would be most helpful to address loss, and how can these gaps be addressed?



### 3. Conduct stakeholder discussions.

EPA sought an entity to serve as the “host” of each review and to help identify a broad range of local stakeholders to participate in the discussions. The host organization (such as an NEP) helped to arrange the meeting logistics and used their partnerships to invite all the appropriate participants to that dialogue. Invited participants included a broad cross-section of business, environmental, academic, and government representatives. Invitee lists were collected from the organization hosting the event, as well as suggestions from the Interagency Coastal Workgroup (which includes their regional representatives).

The Coastal Wetlands Team convened a stakeholder forum of the invitees in each selected focal watershed. These one- or two-day facilitated dialogues provided additional insights about on-the-ground (existing) condition of coastal wetlands within the focal watershed and growing pressures within the region; i.e., issues often best identified by those with the most vested interest in the outcome of such efforts. Attendees were asked to provide information on threats to coastal wetlands (including reduction in acreage as well as function and conditions) and tools and techniques used locally to reduce or reverse wetland loss. The term “stressor” was not defined for participants in advance of the reviews. While stressors are traditionally limited to “physical, chemical, or biological entities, or processes that adversely affect the ecological condition of a natural ecosystem” stakeholders in every CWR also identified programmatic issues as stressors related to loss or degradation of coastal wetlands. While state and federal regulatory programs are tools for wetland protection, limits to regulation are captured in the report under the “Stressors” sections in accordance with commonly expressed stakeholder input. EPA acted as a neutral facilitator and captured the discussion in meeting notes. While there may be disagreements among parties regarding the validity of the data presented or provided, EPA considered all documented sources of information. EPA also recognized that reference documents will not be available for all points raised by participants in the discussion.

To coincide with the stakeholder discussions, EPA scheduled  
**Coastal Wetlands Initiative: South Atlantic Review**

a visit to nearby wetland protection, restoration, or mitigation projects when feasible. This enabled EPA to obtain a first-hand view of local stressors or approaches being employed to address wetland loss in that watershed. Collection and analysis of raw field data is outside the scope of these field visits.

### 4. Assemble a coastal wetland regional review summary.

Once the notes from the stakeholder discussions were vetted with the participants, they were combined with the available data collected in Step 2 to form the basis of a regional report. Although these reports are not exhaustive and only reflect readily available, existing documentation and the viewpoints of participating stakeholders, EPA believes they are a good indicator or snapshot of wetland issues in the focal watersheds.

The results of the South Atlantic review are summarized below, and are also presented in Tables 1 and 2 and the “Conclusion” section of this report.

- Major stressors:
  - » Development.
  - » Hydrologic alterations.
  - » Limitations of regulations.
  - » Sea level rise and climate change.
- Major tools and strategies:
  - » Wetland mitigation banking programs.
  - » Restoration of impounded or converted wetlands.
  - » Integrated management practices with the potential for multiple benefits.
  - » State wetlands regulatory programs.
  - » Voluntary programs.
- Major gaps:
  - » Adequate staffing and wetlands program funding.
  - » Lack of accurate coastal wetland loss characterization/evaluation.



**Figure 3.** South Atlantic focal watersheds.

- » A complete and centralized repository or database of wetland-related data and metrics to enable comparison of data for the tracking of wetland impacts.
- » Methods to streamline permitting and document wetland impacts outside of wetland regulatory programs.
- » Information regarding predicted climate change impacts on coastal wetlands.
- » Improved collaboration between state and federal regulatory agencies and external partners.
- » Increased public and stakeholder education and outreach.

## South Atlantic Review

The South Atlantic region stretches from North Carolina to the southern tip of the Atlantic-facing coast of Florida. Within this region, two focal watersheds were chosen by the Interagency Workgroup for review: the Indian River Lagoon Estuary watershed in Florida and the Middle and Lower Neuse River watersheds within the Albemarle-Pamlico Sound in North Carolina (Figure 3). Both of these watersheds are within the geographic scope of National Estuary Programs and enjoy an active and engaged constituency. These watersheds are also important from an ecological perspective, have a rich array of tools and

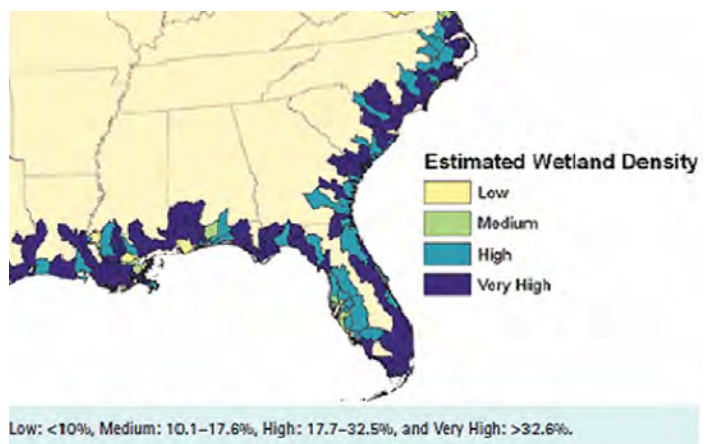
strategies employed to protect and restore their coastal wetland resources, and serve as good examples of the region.

The South Atlantic region has the highest wetland density of the entire East Coast (Stedman and Dahl, 2008) (Figure 4) and hosts a variety of coastal wetlands not found in other parts of the United States, including pocosins, Carolina bay wetlands, cypress swamps, and mangrove forests (Dahl, 1999). These coastal wetlands are vital to maintaining the health of coastal and marine ecosystems supporting vibrant commercial and recreational fishing industries, as well as coastal tourism and recreation industries. Commercially important species, including shrimp, flounder, blue crab, and menhaden are highly dependent on the wetlands of this region (Lellis-Dibble et al., 2008). From 2000 to 2008, commercial landings in the South Atlantic totaled almost \$1.5 billion, with estuarine-dependent species accounting for a majority of that total (NMFS, 2010).

When considered individually, each state in the South Atlantic region contributes uniquely to this ecological diversity. For example, although Florida has lost more wetland acres than any other state, it is still home to more than 10 percent of the remaining wetlands in the conterminous United States—more than 11 million acres (EPA, 1996). Georgia contains the shortest coastline in the South Atlantic region, yet it is home to over one-third of the Atlantic coast’s remaining coastal marshland (GA DNR and NOAA, 1997). The coastal wetlands of South Carolina provide critical nursery habitat for many commercially important species, such as shrimp and blue crab (Boylan and Wenner, 1993; Wenner et al., 1990). North Carolina boasts the very rich and diverse Albemarle-Pamlico sound, the second largest lagoonal estuary in the United States, on which over 90 percent of commercial fisheries landings in North Carolina depend (Street et al., 2005).

## South Atlantic Coastal Wetland Stressors

Historically, coastal wetland losses in this region have been primarily due to forestry, agriculture, and hydrologic modifications (ditching, draining, and diversions) for mosquito control



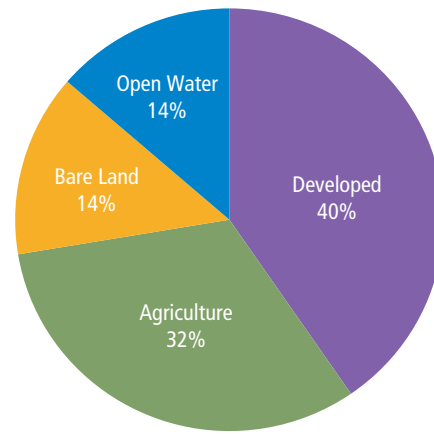
**Figure 4.** South Atlantic estimated coastal wetland density. Source: Stedman and Dahl, 2008.

impoundments and flood control. While agriculture and forestry remain significant stressors on coastal wetlands, recent losses are increasingly due to development pressures along the coast. Among the four South Atlantic states, Florida and North Carolina have experienced the greatest wetland losses. Florida lost 46 percent of its wetlands and North Carolina lost almost half (49 percent) of its total wetlands by the 1980s (Mitsch and Gosselink, 1993). A USFWS study (1999) of South Carolina's wetlands showed an average annual net loss of nearly 3,000 acres from 1982 to 1989. Most of these wetland losses occurred in freshwater forested wetlands, and most were due to forestry (31 percent), agriculture (28 percent) and urbanization (22 percent). The remaining 19 percent of losses were attributed to conversion to open water and rural development (Dahl, 1999). A status and trends study of Florida (Dahl, 2005) showed an average annual loss of 5,000 acres of wetlands from 1985 to 1996 (compared to an average annual loss of 26,000 acres the previous decade), the vast majority of which have occurred in freshwater wetlands. Only about 500 acres of intertidal wetlands were lost during the study's 1985–1996 period. Overall, losses were attributed to agriculture (28 percent), rural development (44 percent) and urbanization (28 percent).

The above data show that although the rate of wetland acreage loss is slowing, losses nonetheless continue to occur and the majority of the losses occur in freshwater wetlands. For the purpose of this report, it is important to examine all types of coastal wetland losses occurring within the watershed. This includes both freshwater and saltwater, and tidal and non-tidal wetlands.

In addition to data available in studies, data from NOAA's C-CAP were used to estimate acreage losses of coastal wetlands for the South Atlantic Region from 1996 to 2006 (see Appendix D for more information on C-CAP methodology). C-CAP examines overall land use change, including wetlands (excluding submerged aquatic vegetation), for the coastal regions of the United States.

The data set currently reports changes in wetland acreage only and does not measure change in wetland function. The C-CAP data was used in order to be consistent across all regions when comparing wetland loss. According to C-CAP, approximately 128,000 acres were lost in the region during the 10-year period, for an annual average loss of approximately 12,800 acres. The majority (72 percent) of all the wetland losses were attributed to conversion to agriculture and development (Figure 5). Almost 33 percent of changes to developed land for the region occurred in Biscayne Bay, Florida, where nearly



**Figure 5.** Wetland loss and changes in land cover, 1996-2006: South Atlantic Region. Source: NOAA, 2010b.

17,000 acres were converted during the study period.

Based on the literature reviewed (Appendix B), several wetland stressors were identified in the region:

- Hydrologic alterations, including ditching and diking for mosquito control and flood control diversions.
- Residential and commercial development.
- Infrastructure impacts, including stormwater and water withdrawals.
- Agricultural and forestry practices.
- Sea level rise leading to conversion of wetlands to open water; salt-water intrusion and changes in salinity.
- Storm events causing shoreline and beach erosion.
- Invasive vegetation.

In both of the focal watershed reviews, hydrologic alterations were identified as major stressors.

These alterations come in the form of draining for mosquito control, agriculture, and forestry, as well as impoundments for waterfowl, mosquito control, and flood control. Studies in North Carolina (Poulter et al., 2008) identified ditching of wetlands as possible conduits for saltwater intrusion, especially with rising sea levels. In Florida, much of the state's salt marsh was impounded by the early 1970s to control mosquito populations (Brockmeyer et al., 1997). More recently, Florida has begun to restore the natural hydrology of these impoundments and has implemented integrated management practices to optimize the wetlands' multiple



human and ecological benefits, including fishing, invasive vegetation control, birding, mosquito control, and flood control.

Coastal development was cited as another dominant stressor in the South Atlantic region. Over the past few decades, the region has become a destination for job-seekers and retirees, thereby increasing demand for residential development and associated commercial and recreational uses. From 1995 to 2000, Georgia, Florida, and South Carolina experienced the highest levels of in-migration in the United States (Franklin, 2003). From 1980 to 2003, the coastal population density in the region increased by 70 percent, and while the economic downturn has recently occurred, regional growth is expected to continue. Coastal development was identified in both focal watershed reviews as a serious threat to coastal wetlands due to impacts from residential and commercial development, associated recreational development (e.g., golf courses, marinas), and infrastructure such as shoreline armoring, roads, and utilities.

### South Atlantic Tools and Strategies

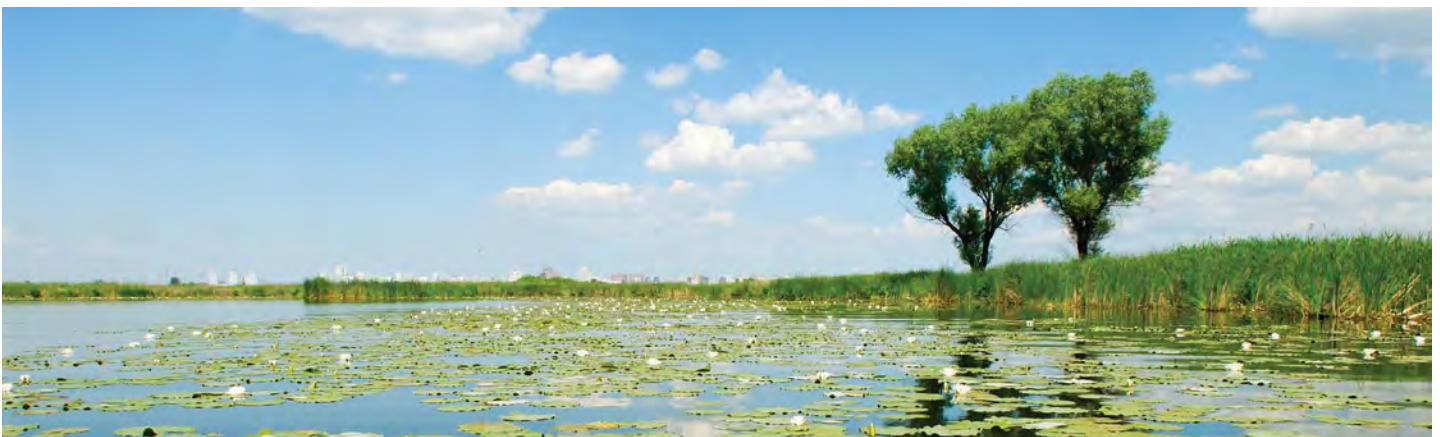
The South Atlantic states manage the above stressors on coastal wetlands using a range of tools and strategies. Regulatory programs in the region include local, state, and federal wetland permitting programs, which include mitigation requirements, compliance monitoring, and enforcement. Also important are non-regulatory programs: land acquisition and conservation, public education and outreach, and wetland restoration, monitoring, assessment, and mapping.

The four South Atlantic states use their regulatory tools in slightly different ways. Wetland mitigation is an example of a regulatory tool that has been used in different capacities across the South Atlantic region. North Carolina and Florida have state-level wetland mitigation programs with established methods and protocol for addressing wetland impacts. Florida focuses on wetland function in its mitigation program, while North Carolina tracks wetland impacts in terms of acreage (though it is moving toward a functional wetland assessment methodology). North Carolina's Ecosystem Enhancement Program provides in-lieu fee mitigation and has been recognized as one of the most innovative government programs in

the country due to its proactive, watershed-based approach. A number of mitigation banks are also present in North Carolina. South Carolina and Georgia address mitigation on a case-by-case basis, working closely with the Army Corps.

Of particular note are strategies under development within the region to address threats of coastal erosion, storm surges, and sea level rise. In order for the region to begin addressing projections for sea level rise over the next century, alternatives to hardening such as conservation or rolling easements are gaining more traction (Titus, 1998; CCSP, 2009; Climate Ready Estuaries website, 2010). Allowing wetlands to migrate inland is a method of sea level rise adaptation, which ensures that coastal wetlands are maintained. Inland migration of wetlands can be accomplished through setbacks, density restrictions, and land acquisition. Regulatory rolling easements refer to a broad range of legal mechanism used to prevent property owners from armoring their shoreline while allowing other uses of the property. Rolling easements work by automatically moving or "rolling" the restriction landward with rising sea level. This allows sediment transport to move inland and wetlands to migrate naturally. Rolling easements prevent armoring of the shoreline regardless of how threatened the structure is by rising sea level. If erosion threatens the structure, the owner has two choices: either relocate the building or allow it to succumb to the encroaching sea (Titus, 1998). EPA's Climate Ready Estuaries program has developed a "Rolling Easements Primer" which identifies regulatory and non regulatory options for implementing rolling easements (Titus, 2011).

The use of natural approaches to shoreline protection is growing in popularity in the South Atlantic states, particularly in North Carolina. Instead of constructing seawalls and other hard structures to prevent erosion of estuarine and ocean shores, states and nonprofit organizations are encouraging the use of "Living Shorelines." This science-based method evaluates the erosion potential of a given shoreline area and employs a combination of the most environmentally compatible materials to maximize stability and the natural buffering capacity of vegetated shorelines. It has been promoted as an effective way to protect against the effects of sea level rise and storm events



and restore water quality and wildlife habitat (NCCF, 2004).

### South Atlantic Gaps and Needs

In addition to identifying tools and strategies, the Coastal Wetlands Team gathered baseline information related to needs and gaps to improve coastal wetland protection in this region. In general, there appeared to be a need for:

- Increasing resources (staffing and funding) to administer regulatory programs, conduct monitoring and assessment, ensure accurate wetland mapping, and conduct effective outreach programs.

- Developing a comprehensive, central repository for wetland-related data as well as a common set of metrics to allow standardization and comparison of data.
- Evaluating regulatory programs to determine and address gaps in protection while identifying ways to streamline the permitting process.

Tables 1 and 2 summarize key stressors, tools, and strategies to address them, and gaps and needs for both focal watersheds in the South Atlantic region:

**Table 1.** Stressors, Tools and Strategies, and Gaps Identified by Participants During the Indian River Lagoon CWR

Stressors	Tools and Strategies	Gaps and Needs
<b>Hydrologic modifications</b>	<ul style="list-style-type: none"> <li>• Mosquito impoundment restoration</li> </ul>	<ul style="list-style-type: none"> <li>• Data and data management tools (ecological services data, rapid assessment methods, central database, predictive tools, etc.)</li> </ul>
<b>Population growth and coastal development</b>	<ul style="list-style-type: none"> <li>• Low-impact development and stormwater retrofits</li> <li>• Local ordinances (buffers, smart growth, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• Consistent wetland regulation interpretation</li> <li>• Evaluate permitting rules</li> </ul>
<b>Wetland mitigation limitations</b>	<ul style="list-style-type: none"> <li>• Mitigation banking and mitigation assessment method</li> <li>• Unified Mitigation Assessment Method</li> </ul>	<ul style="list-style-type: none"> <li>• Additional research and training on functional wetland assessment methodologies</li> </ul>
<b>Invasive vegetation</b>	<ul style="list-style-type: none"> <li>• Invasive species control programs, including volunteer-based efforts</li> </ul>	<ul style="list-style-type: none"> <li>• Transfer invasive species management programs to private lands</li> </ul>
<b>Climate change and sea level rise</b>	<ul style="list-style-type: none"> <li>• Coordination between agencies</li> <li>• Collaboration between governmental and non-governmental groups</li> <li>• Rolling easements</li> </ul>	<ul style="list-style-type: none"> <li>• Funding and staff</li> </ul>

**Table 2.** Stressors, Tools and Strategies, and Gaps Identified by Participants During the Lower and Middle Neuse CWR

Stressors	Tools and Strategies	Gaps and Needs
<b>Limitations of regulations</b>	<ul style="list-style-type: none"> <li>• Interagency collaboration</li> <li>• Monitoring, assessment, and mapping</li> </ul>	<ul style="list-style-type: none"> <li>• Funding and staff</li> <li>• Central repository for wetland information and data</li> </ul>
<b>Population growth and coastal development</b>	<ul style="list-style-type: none"> <li>• Low-impact development</li> </ul>	<ul style="list-style-type: none"> <li>• Marketing and incentives for living shorelines and low-impact development</li> </ul>
<b>Cumulative Impacts</b>	<ul style="list-style-type: none"> <li>• Monitoring, assessment, mapping</li> </ul>	<ul style="list-style-type: none"> <li>• Central repository for wetland information and data</li> </ul>
<b>Forestry impacts</b>	<ul style="list-style-type: none"> <li>• Forestry best management practices</li> </ul>	<ul style="list-style-type: none"> <li>• Monitoring all wetland restoration projects; examine whether forestry practices are changing drainage patterns and altering wetlands</li> </ul>
<b>Agricultural impacts</b>	<ul style="list-style-type: none"> <li>• Restoration of prior converted croplands</li> <li>• Watershed-based nutrient management strategies</li> </ul>	<ul style="list-style-type: none"> <li>• Nutrient management plans for all land uses</li> </ul>
<b>Climate change and sea level rise</b>	<ul style="list-style-type: none"> <li>• Living shorelines</li> <li>• Public education and outreach</li> </ul>	<ul style="list-style-type: none"> <li>• Higher-resolution mapping</li> </ul>



## Focal Watershed Review: Indian River Lagoon, Florida

### Introduction

The Indian River Lagoon (HUCs 03080201, 03080202, 03080103) is a low-lying estuarine system along the Atlantic coast of Florida. Three sub-watersheds make up the greater Indian River Lagoon watershed: the Cape Canaveral watershed, the Daytona–St. Augustine watershed, and the Vero Beach watershed (Figure 6). These three watersheds straddle about 200 miles of Florida’s east coast, from the southern boundary of Duval County, south to Jupiter Inlet in Palm Beach County. The estuary system contains three water bodies: Mosquito Lagoon, Banana River, and Indian River Lagoon.

The Indian River Lagoon is the most diverse estuary in America, with over 4,300 species of plants and animals, including over 50 federally endangered or threatened species (SJRWMD, 2007). Nearly one-third of the nation’s endangered manatee population depends on the lagoon (SJRWMD, 2007). It should come as no surprise that this incredible natural resource was designated as an estuary of national importance in 1990 and admitted into the National Estuary Program (NEP).

In preparation for the focal watershed review, the EPA Coastal Wetlands Team worked with the NOAA Coastal Change Analysis Program (C-CAP) to develop a general characterization of wetland changes in the Indian River Lagoon watersheds between 1996 and 2006.

The NOAA C-CAP program examines overall land use change, including wetlands, for the coastal regions of the United States. The C-CAP tool was used in order to be consistent across focal watersheds when comparing wetland loss. The data set currently reports changes in wetland acreage only and does not measure changes in wetland function.

Table 3 and the accompanying pie chart displaying NOAA’s C-CAP<sup>1</sup> data (Figure 7) are based on the area of the three 8-digit HUCs that were the focus of the coastal wetland review in the Indian River Lagoon watersheds. According to the C-CAP analysis, the vast majority (over 12,000 acres or about 90 percent) of wetlands lost in the focal watersheds between 1996 and 2006 were non-tidal, with the greatest impacts occurring from conversion of wetlands to development.

### Stressors

The Indian River Lagoon watershed is a prime example of an area that has undergone significant anthropogenic

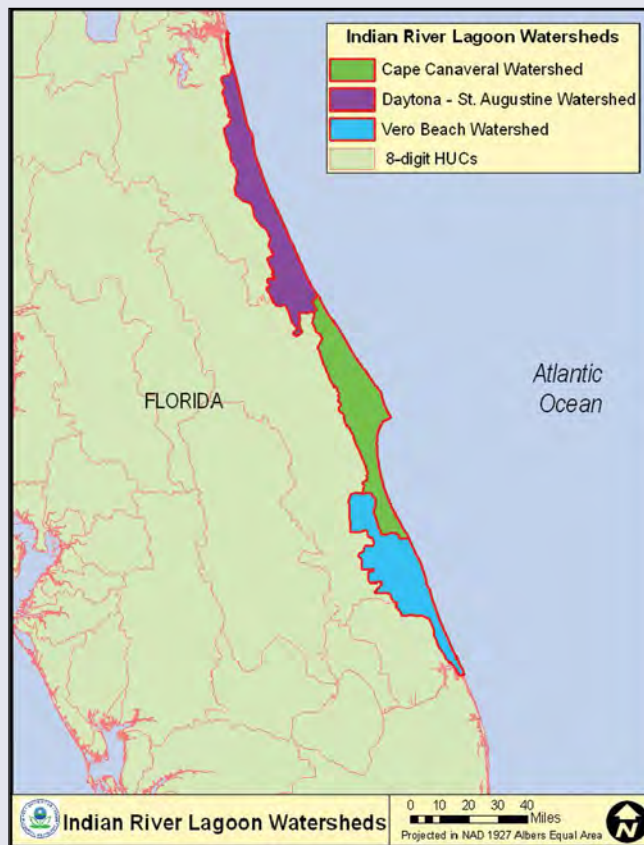


Figure 6. Indian River Lagoon watersheds. Data Source: NOAA.

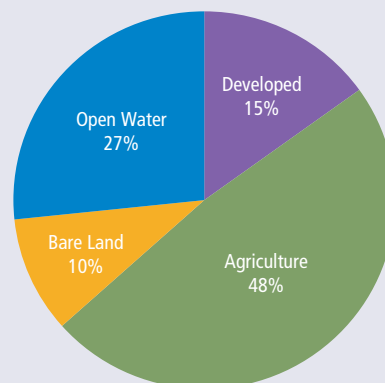


Figure 7: Wetland loss and changes in land cover, 1996-2006: Indian River Lagoon watersheds. Source: NOAA, 2010b.

manipulation over the years. The watershed has experienced and continues to experience a variety of stressors that contribute to loss of coastal wetlands. Discussion at the Indian River CWR focused on the following key contributors to coastal wetland loss and confirmed, as well as added to, the list of stressors identified during the literature review.

1 A more detailed description of the C-CAP data set is available in Appendix D.

**Table 3.** Change in Wetland Land Use Type (Acres) From 1996 to 2006, HUCs 03080201, 03080202, and 03080103

Wetland Types*	Developed	Agriculture	Bare Land	Open Water	Total
Palustrine forested	5,392.86	1,617.48	1,654.84	270.43	8,935.61
Palustrine scrub	752.81	70.72	411.43	78.51	1,313.46
Palustrine emergent	773.71	401.87	114.76	669.41	1,959.74
Estuarine forested	3.78		32.47	1.33	37.58
Estuarine scrub	5.56	0.67	9.12	33.58	48.93
Estuarine emergent	318.91	6.00	5.34	284.22**	614.48
Unconsolidated shore	19.13		744.36	29.13	792.62
<b>Total</b>	<b>7,266.76</b>	<b>2,096.74</b>	<b>2,972.31</b>	<b>1,366.62</b>	<b>13,702.42</b>

Source: NOAA, 2010b.

\* See Appendix D for wetland classification descriptions.

\*\* The estuarine emergent losses to open water are actually a misclassification in one of the dates of C-CAP data and should be ignored (they are unconsolidated bottom areas that were called marsh in one data and water in another).

**Hydrologic modifications.** Mosquito control impoundments are an example of a historical stressor (see the “Highlight” box on the next page) that has significantly affected coastal wetlands in the Indian River Lagoon watersheds. Past mosquito control practices involved the use of large excavators called draglines to cut ditches through the marshes (Figure 8). These dragline ditches were intended to interrupt the life cycles of mosquitoes, but also had the unintended consequence of significantly altering the wetland ecosystem. Mosquito control projects impounded nearly 70 percent of coastal wetlands, affecting more than 40,000 acres of salt marsh and mangrove habitat in the Indian River Lagoon watershed (Rey and Kain, 1989). These impoundments resulted in severe impairment of the condition and function of the affected coastal wetlands, resulting in loss of habitat, invasion of non-native species, and decline in ecological productivity. Recognition of these negative impacts has resulted in the restoration of over 70 percent of the historical mosquito control impoundments, and progress is being made on restoring or managing remaining impoundments.

**Population growth and coastal development.** Population growth and associated development have been dramatic in Florida, causing major changes to the landscape and natural ecosystems. Participants identified coastal development as an over-arching stressor that is the root cause of most other stressors in the watershed. CWR participants observed that large-scale private development projects, as well as public projects, are having significant impacts on coastal wetlands. Increasing development in coastal areas results in water quality and hydrologic impacts from stormwater runoff;

It should be noted that the information below is based on the opinions and observations of participants, who provided feedback on draft versions of this document and supplemented statements with documentation, where available.

altered hydrology and salinity levels from drinking water withdrawals and flood control projects; increases in boating and fishing pressure; and the direct physical alteration of the coastal wetland ecosystem, including impacts to fish communities, shoreline habitats, and benthic communities.

- **Shoreline hardening.** Shoreline stabilization using seawalls and other man-made structures can have significant impacts on coastal wetlands. Shoreline hardening results in loss of wildlife habitat, reduced water quality, and further erosion of adjacent coastal wetlands. Shoreline hardening also prevents inland migration of wetlands and directly impacts submerged aquatic vegetation (SAV) by changing wave energies and water depths thereby decreasing SAV recruitment and growth (Sime, 2005).
- **Water management projects.** According to participants, the water release schedule of Lake Okeechobee has significant impacts on Indian River Lagoon. The ecology of the St. Lucie Estuary, which feeds into the Indian River Lagoon, is negatively affected by the water discharged from Lake Okeechobee, which is managed for competing objectives including fisheries, recreation, flood control, potable water, and irrigation. Regulated releases from the lake cause water quality degradation during the dry season, when approximately 80 percent of the flow comes

### Highlight: Historical Context of Mosquito Control in Indian River Lagoon

Mosquito control in Florida began with the spraying of DDT in Brevard County in 1943. Ten years later, DDT-resistant mosquitoes presented a new problem and the County, with over 50,000 acres of high marsh available to breeding mosquitoes, began flooding high marshes to prevent the deposition of larvae. By the 1960s, mosquitoes were posing a threat to NASA operations at Cape Canaveral and an agreement with County Mosquito Control allowed for mosquito control on over 11,500 acres. The following decades saw many of the dikes breached due to lack of maintenance or a purposeful return to the natural flow. In 1989, 192 impoundments covering nearly 40,000 acres remained in use. Over two-thirds of the impoundments were in Merritt Island National Wildlife Sanctuary (26,923 acres), which surrounds the Kennedy Space Center. The remaining impoundments were distributed between Brevard (3527), Indian River (2,769), Volusia (1,578), Martin (625), and Flagler (300) counties. By 1989, 81 percent of these acres were public lands (Patterson, 2004).



**Figure 8.** Historical mosquito control practice of using draglines to cut ditches through marsh areas. Source: Volusia County Mosquito Control.

from the lake and 20 percent comes from the Indian River Lagoon watershed (during the wet season the flow distribution between these two sources is about equal).

» Human manipulation of water resources alters the natural variation in water levels. Since many species have adapted to the naturally occurring wet and dry seasons, artificial changes to the hydrologic regime can negatively impact wildlife that relies on the water body for feeding, nesting, and habitat. Hydrologic modifications can also negatively impact emergent and submerged vegetation and can create opportunities for invasive vegetation to compete against indigenous species. During the dry years, negative ecological impacts include changes in the vegetation community and soil oxidization.

- **Stormwater runoff.** Discharges from urban (as well as agricultural) runoff contain nutrients, sediments, pesticides, and other contaminants that degrade water quality. These discharges can result in changes in turbidity, changes in salinity, smothering of benthic organisms, changes to aquatic food webs, changes in wetland composition, and eutrophication (FL DEP, 2010; Sime, 2005). These changes have both direct and indirect impacts on coastal wetland condition and function. It is difficult to precisely determine the impact of runoff on coastal wetlands, and to address each source, because runoff is a diffuse, nonpoint source of pollution.



**Limitations of wetland mitigation.** While generally embracing the concept of wetland mitigation and wetland banking (see Appendix C), CWR participants voiced differing opinions about the effectiveness of mitigation in assuring no net loss of wetlands.

- The Florida mitigation program emphasizes wetland function. Therefore, several acres of low-quality wetlands could be mitigated with a few acres of higher-quality wetlands within a mitigation bank. Some participants fear that insufficient data are available to adequately assess the functional value of a wetland area. The lack of adequate data makes it difficult to determine appropriate compensatory mitigation for balancing the loss of wetland area against the gain in the function of coastal wetlands.<sup>2</sup>
- Concern was expressed over the lack of effective mitigation requirements for isolated wetlands, which, as of November 2010, were protected throughout the state. However, some private, single-family residences may alter an isolated wetland without any mitigation if designed and constructed in accordance with the noticed general environmental resource permits (Florida Administrative Code, Chapter 62-341.475[1][f]).<sup>3</sup> When the state processes individual permits for activities in isolated wetlands less than a half-acre in size, evaluation criteria are limited to effects on water quality (FL DEP and Northwest Florida Water Management District, 2010, Section 10.2.2.1). These potential small, unmitigated acreage losses of isolated wetlands can add up to significant losses over time.

**Invasive vegetation.** Although participants attending the review agreed that invasive species are currently one of the best-managed stressors in the Indian River Lagoon watersheds, invasive vegetation continues to be a main cause of coastal wetland functional loss, requiring continued vigilance and attention. These losses are associated with loss of species diversity, structural changes in the vegetation community, changes in nutrient cycling, and habitat changes along the coast. The degree of infestation is proportional to the impact that invasive vegetation can have on coastal wetlands. For example, in the Indian River Lagoon, broad-leaved paper bark (*Melaleuca quinquenervia*) has minimal impacts at low levels of coverage (10 to 25 percent), but at higher coverage levels (65 percent), negative impacts increase greatly. Some participants suggested

that developers or private landowners may have an incentive to allow invasive infiltration into wetlands, since infiltration means loss of function, which means less mitigation required for development in the wetland area.

**Climate change and sea level rise.** The impacts of climate change are already becoming apparent in the Indian River Lagoon watersheds and these impacts will be compounded by the presence of historical and current stressors. Some of the issues likely to be exacerbated by climate change and sea level rise include erosion, salt water intrusion, changes in salinity regimes, and changes in species composition and distribution. Sea level rise and increasing intensity and frequency of storm events are two projected threats to coastal wetlands. However, other impacts such as changes in precipitation patterns, timing and delivery of water and sediments, increases in atmospheric carbon dioxide, and higher temperatures could also affect these resources (Scavia et al., 2002). The extent of these impacts on coastal wetlands will depend on their ability to adapt to change and the degree to which human activities impair these natural adaptive capacities (Scavia et al., 2002). For example, inland migration is one means wetlands have of adapting to rising sea levels. However, shoreline hardening can prevent wetlands from migrating and therefore results in acreage loss of wetlands due to inundation. Wetland response to climate change and sea level rise will vary and will depend upon the interactions of various processes and the magnitude of the changes.

- **Storm frequency and intensity.** Climate change will impact the frequency and intensity of storm events in the future. One potential result of more frequent and intense storms is worsening of sand overwash after hurricanes, which leads to smothering of mangrove wetlands. Storms also put low-salinity wetlands at risk, causing salt burn from salt water intrusion, and eroding organic marsh substrates (Scavia et al., 2002).
- **Sea level rise.** Sea level rise is another stressor for Florida coastal wetlands including those in the Indian River Lagoon. Research suggests that over the past 70 years the sea level has risen approximately nine inches in Florida, contributing to coastal erosion and inundation (Hauserman, 2006). In addition, sea level rise contributes to change in wetland type (e.g., conversion of high marsh to high-low marsh hybrid). Florida's coastal wetlands will be highly susceptible to sea level rise in the future,

2 The Army Corps' Jacksonville District contends that, under Section 404 permitting regulations, an appropriate level of mitigation is required.

3 Prior to 2010, the Northwest Water Management District (managing the Florida "Panhandle") did not claim jurisdiction over isolated wetlands that were not connected via wetlands, surface waters, or manmade waterbodies to other waters (see Florida Administrative Code, Chapter 62-340, for detailed definition).

## Focal Watershed Review: Indian River Lagoon, Florida (continued)

which is predicted to range from 7 to 23 inches in the next century (IPCC, 2007). A sea level rise of 15 inches would inundate approximately 50 percent of salt marsh and 84 percent of tidal flats statewide. In the Indian River Lagoon watersheds, a 15-inch rise would lead to a loss of 49 percent of the area's ocean beach and an 11 percent loss of hardwood swamp (Glick and Clough, 2006; Figure 9).

### Tools and Strategies

A number of effective tools and strategies exist or are under development in the Indian River Lagoon watersheds to address the above stressors. The focal watershed session highlighted the following:

**Tools for restoring natural hydrology of altered coastal wetlands.** As mentioned in the “Stressors” section, hydrologic modifications in the Indian River Lagoon watersheds have occurred for over 50 years. Review participants mentioned ongoing strategies to move away from historical practices and manage mosquito control projects for multiple benefits:

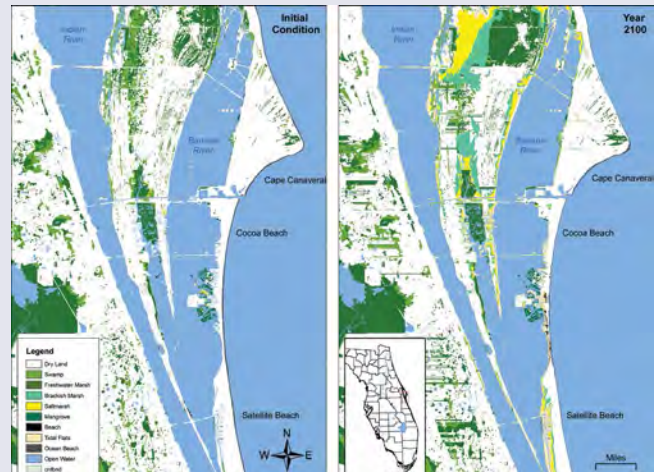
- **Integrated management practices.** St. Lucie County is applying integrated management practices to restore previously impounded wetlands and manage them for multiple uses (see the “Highlight” box).

These practices are being implemented to restore and enhance wetland function and manage mosquito control projects for multiple uses by attempting to restore more natural hydrology. Participants submitted studies that investigate how impounded mangrove swamps compare to open mangrove swamps. While there is not uniform agreement regarding the wetland values of “managed” mangroves, the restoration methods for reconnecting formerly impounded coastal wetlands are generally viewed as a positive restoration strategy (Harrington and Harrington, 1961, 1982; Middleton et al., 2008; Rey et al., 2009; McKee et al., 2009).

- **Dragline ditch wetland restoration.** In addition to management of impounded wetlands, efforts are underway to fully restore previously impacted wetlands in Volusia County. The USFWS National Coastal Wetlands Grant Program awarded the County half a million dollars in 2009 to restore 600 acres of dragline ditch wetlands. Volusia County Mosquito Control is responsible for implementing

Projected Effects of a 15-inch Rise in Sea Level for Indian River Lagoon by 2100

- ◆ 49% loss of ocean beach
- ◆ 15% loss of dry land
- ◆ 11% loss of hardwood swamp
- ◆ Significant increase of saltmarsh, brackish marsh and tidal flats.



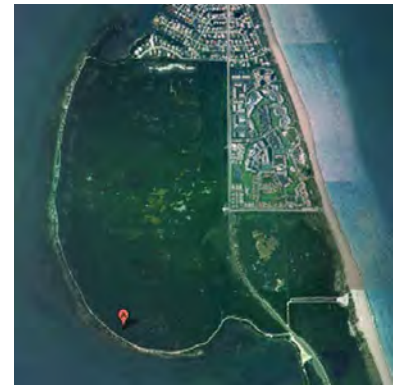
“An Unfavorable Tide,” National Wildlife Federation and Florida Wildlife Federation, June 2006

**Figure 9.** Projected effects of sea level rise in Indian River Lagoon. *Source: Glick and Clough, 2006.*

### Highlight: St. Lucie County Mosquito Impoundment Integrated Management

Current mosquito control practices still rely on impoundments, but incorporate more adaptive management strategies to help manage areas for multiple uses. St. Lucie County's Mosquito Control District has won several state and national awards for its management approach. The county contains approximately 4,000 acres of coastal mosquito impoundments and 41 miles of dikes and perimeter canals. Unlike historical impoundments, these impoundments are open to natural tides most of the year but are kept flooded (partly closed, with constant water exchange) during the summer breeding season to minimize the amount of exposed mud available for mosquito egg laying, a procedure known as rotational impoundment management (<http://www.stlucieco.gov/mosquito/>). The Mosquito Control District's land acquisition/mitigation/donation program is a critical component of its impoundment management effort and

has included acquisition of Bear Point Sanctuary, Vitolo Family Park, Blind Creek Park (ocean to river), Ocean Bay, Queens Island, Kings Island, Indrio Blueway, Harbor Branch Preserve, and Wildcat Cove. Bear Point is also a state- and federal-approved mitigation bank that has been selling credits since 2005.



**Figure 10.** Bear Point impoundment and mitigation bank, Ft. Pierce, Florida. *Source: Google Maps.*

## Focal Watershed Review: Indian River Lagoon, Florida (continued)

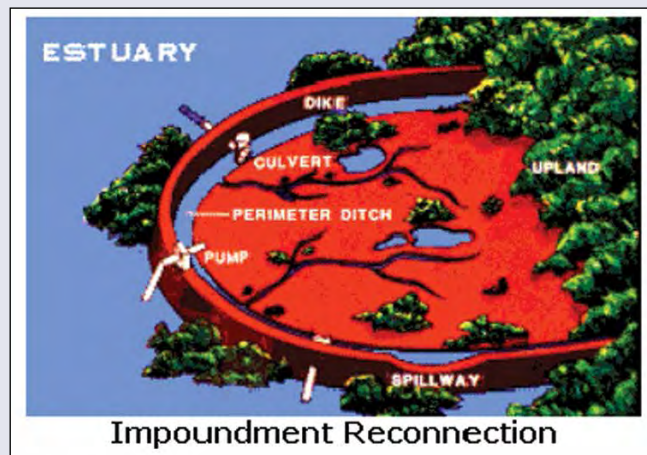
the project and is using amphibious low-bearing weight machinery particularly suited for working in submerged areas. Phase I of the project is currently underway; in early 2010, approximately 120 acres of formerly ditched wetlands were restored (SJRWMD, 2010). Dragline ditch restoration sites throughout the St. Johns River Water Management District have been monitored by the University of Central Florida over the last several years for signs of native vegetation and restored wetland functions (SJRWMD, 2010).

**Tools to address stormwater.** Both regulatory and non-regulatory programs addressing stormwater were mentioned during the review. Low-impact development (LID) standards and Florida's draft stormwater rules are two noteworthy regulatory tools. Non-regulatory programs include:

- **Retrofitting.** Retrofitting stormwater outfalls by redesigning them or installing pollution control devices helps implement Total Maximum Daily Loads (TMDLs) for restoring water quality. Counties are using grant monies to implement stormwater retrofits. The Army Corps has also allowed retrofitting stormwater outfalls as part of its mitigation for submerged aquatic vegetation (SAV) to help reduce toxins, hydrocarbons, and sediment discharging into SAV beds in the Indian River Lagoon. These pollutant reductions can lead to better coastal wetland condition and function by improving water quality.
- **Best management practices (BMPs).** BMPs to improve stormwater quality include silt fencing, turbidity barriers, staked hay bales, vegetated swales, and infiltration methods. Improved stormwater management, including retrofitting existing infrastructure, helps maintain wetland hydrology and helps reduce pollutant loading to wetlands, thereby improving their overall function.
- **Comprehensive Everglades Restoration Plan (CERP).** As part of the CERP, the IRL-South Restoration Project is designed to reverse some of the damage inflicted by stormwater runoff and unnaturally large freshwater discharges into the lagoon. Project features include water storage reservoirs, stormwater treatment areas, natural storage and water treatment areas, diversions of existing watershed flows (from reservoirs and stormwater treatment areas) and muck remediation (U.S. Army Corps of Engineers, 2010).

### Tools to address population growth and development.

Review participants noted several regulatory programs they viewed as successful:



**Figure 11.** This illustration shows how previously diked wetlands are reconnected to the estuary by constructing a system of culverts, pumps, and spillways to regulate flow between the wetlands and receiving waters. Flow is monitored and regulated to optimize management for multiple uses, including mosquito control. Source: University of Texas, Center for Space Research.

- **Local ordinances.** Some counties have enacted their own wetland minimum standards, and some cities/towns within those counties have as stringent or more stringent ordinances in place. For example, mitigation for wetland acreage losses may be required at the county level even if federal and state governments do not.
- **Buffers.** Some counties are using buffer requirements in order to protect sensitive aquatic areas. For example, St. Lucie and Volusia Counties have established minimum 25 foot buffer areas around wetlands. Also in Volusia County, aquatic preserves, Outstanding Florida Waters, and Natural Resource Management Areas have minimum buffers of 50 feet to provide even greater protection for these specially designated areas.
- **Smart growth.** Volusia County uses smart growth principles and incentives to cluster development away from sensitive natural areas such as wetlands. St. Lucie County has been a leader in sustainable development. The County passed a bond referendum in 1994 to acquire and manage environmentally significant lands and has protected over 7,000 acres to date. The County has also implemented a variety of sustainable land use programs and policies. The 2002 update of the County's Comprehensive Plan incorporated smart growth policies and, in 2006, the County approved new regulations for sustainable development in the North County area, called Towns, Villages and the Countryside (TVC). The TVC overlay district incorporates development criteria consistent with smart growth and sustainable development practices, including transect-based neighborhood planning with grid transportation

networks, interconnected greenways and blueways, and LID standards. Plans for development of a new village must identify specific transect zones ranging from urban cores at the center of the village to countryside around the perimeter (St. Lucie County Land Development Code, 2006). Although these types of ordinances do not target wetlands, there are potentially indirect benefits for wetlands by having lower nutrient loads in the runoff as a result of these planning principles. For more information, see <http://www.stlucieco.gov/gogreen/greenprint.htm>.

- **Environmental Resources Permit (ERP) program.**

Florida’s state wetlands protection laws are implemented through the ERP program. While the Florida Department of Environmental Protection (DEP) issues certain permits, most state wetland permitting is done by Water Management Districts. Key components of the ERP program include wetland mitigation requirements, a statewide system of wetland banks, and a compliance program, discussed below.

- **Wetland mitigation.** Despite the critiques of mitigation noted in the “Stressors” section, participants also recognized that mitigation can be a tool for protecting coastal wetlands and articulated some of the strengths of the program. In their experience, preservation, restoration, and enhancement are the most common forms of mitigation in Florida, and creation is the least common type used to satisfy the Florida DEP’s mitigation requirements. State-federal coordination on mitigation requirements is strong between ERP and the federal 404 program. Mitigation banks are the Army Corps’ preferred form of mitigation because they are generally considered environmentally preferable. Mitigation banks cover large areas and they have lower risk and uncertainty than mitigation for which permittees are responsible. Additionally, restoration and enhancement are preferred over creation due to their higher success rate compared to creation.

- » Participants felt that mitigation banks, which are widespread throughout Florida (Figure 12), tend to receive more compliance/enforcement oversight than other wetlands mitigation projects because of their high public visibility.

- » The Uniform Mitigation Assessment Method (UMAM) is a statewide method to determine the amount of mitigation required to offset wetland impacts. The method includes formulas for determining the loss of function of a wetland (e.g., for fish and

wildlife habitat) that would result from a proposed impact, and includes formulas for calculating how much proposed mitigation would be needed to offset the impacts.

- » “Ecological lift” is a term that is used to describe improved wetland function when rehabilitation steps are undertaken (see Florida Administrative Code, Chapter 62-345). Ecological lift can be quantified and given credit toward a mitigation project. Some participants cited it as an innovative way to improve wetland function, providing incentives for wetland management activities such as invasive species removal.

- **Compliance.** Participants identified compliance and enforcement programs as important tools with insufficient resources (see the “What’s Needed? What’s Missing?” section). Budget and staffing resources have always been an issue for the enforcement program, but with increasing budget cuts concerns were expressed that the limitations of enforcement and compliance programs will worsen.

- » Compliance concerns were expressed regarding wetlands protected via conservation easements. One specific area of concern noted by participants was that easement landowners commonly believe they can clear, fill, and mow on their property, resulting in numerous violations.

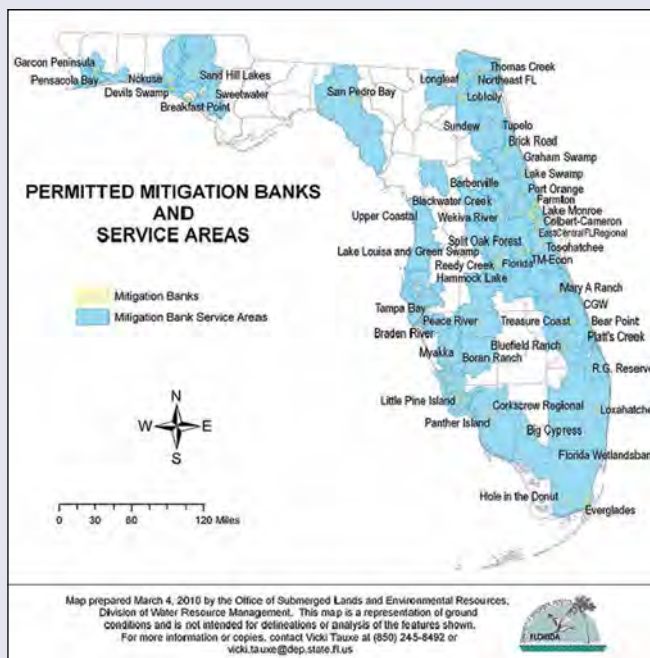


Figure 12. Florida wetland mitigation bank sites. Source: FL DEP, 2010.

## Focal Watershed Review: Indian River Lagoon, Florida (continued)

- » Wetland mitigation proposals for mitigation banks and in-lieu-fee programs (see Appendix C) go through a state/federal mitigation review (by the Interagency Review Team) and are held to standards laid out in the Federal Mitigation Rule.<sup>4</sup> Mitigation banks must have an “instrument” approved by the Interagency Review Team that lays out exactly what milestones must be achieved in order to receive credits. There is a monetary consequence for noncompliance (outside civil penalties for traditional noncompliance). Because Army Corps and state staff are very limited, they must be highly selective in choosing sites to spend time on to get the biggest environmental return for their effort; mitigation banks provide that.
- **Coordination.** Coordinating permitting and compliance was cited as an important tool that allows for shared expertise and a more efficient regulatory process.

Example of interagency compliance coordination:

- » Compliance with Essential Fish Habitat (EFH) Conservation consultation requirements. The Magnuson-Stevens Fishery Conservation and Management Act requires National Marine Fisheries Service (NMFS) and regional Fishery Management Councils to identify and protect important marine and anadromous fish habitat. Rules finalized in 2002 (50 CFR Sections 600.805–600.930) establish procedures to promote the protection of EFH through interagency coordination. Federal agencies are required to consult with NMFS regarding projects that fund, permit, or implement activities that may adversely affect EFH. Consultations are required for federally funded projects or projects requiring a federal permit. A standard operating plan establishes a process for collecting pre- and post-construction information to determine if EFH conservation recommendations provided by NMFS and implemented by federal action agencies have resulted in sufficient protection of EFH. EFH conservation recommendations are evaluated to develop the knowledge

necessary to improve the conservation recommendations.

Examples of interagency permitting coordination:

- » The Efficient Transportation Decision-Making Team is a group of individuals located across Florida state agencies brought together by the Florida Department of Transportation to work on transportation projects. The team, throughout the planning and permitting process, pays attention to potential environmental consequences. The team’s efforts lead to a more streamlined permitting process with fewer consequences for the natural environment.
- » The South Florida Water Management District’s (SFWMD’s) Water Resources Advisory Commission serves as an advisory body to the SFWMD Governing Board and the South Florida Ecosystem Restoration Task Force to improve public participation and decision-making about water resources in the region (<http://www.sfwmd.gov>).

**Tools to address invasive vegetation.** Managed lands such as state and local parks have invasive species control programs in place that monitor and employ mitigation strategies to control the spread of invasive plants.

- **Nationwide Permit 27.** The Army Corps is an active partner in programs to address invasive vegetation. The Army Corps uses Nationwide Permit 27 for wetland restoration, which streamlines the permitting process for invasive vegetation removal projects.<sup>5</sup>
- **USFWS wetland grant program.** In 2006, and again in 2008, funding was provided by this program (authorized under the North American Wetlands Conservation Act) to eradicate the Brazilian pepper tree from prime migratory bird habitat in the Indian River Lagoon, portions of the Merritt Island National Wildlife Refuge, and Sebastian Inlet State Park. The project includes 20 acres of mangroves and 15 acres of other coastal wetlands in the lagoon. As part of the project, 3,000 red mangrove saplings will be planted along the shoreline of the lagoon

4 73 FR 19670, April 10, 2008. Available at <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=fecbc52d45dabc8c29c8ad4e50f0dea&rgn=div5&view=text&node=33:3.0.1.1.39&idno=33>.

5 Nationwide Permit 27 includes activities associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas and the restoration and enhancement of non-tidal streams and other non-tidal open waters, provided those activities result in net increases in aquatic resource functions and services. Activities authorized by this nationwide permit include, but are not limited to: the removal of accumulated sediments; the installation, removal, and maintenance of small water control structures, dikes, and berms; the installation of current deflectors; the enhancement, restoration, or establishment of riffle and pool stream structure; the placement of in-stream habitat structures; modifications of the stream bed and/or banks to restore or establish stream meanders; the backfilling of artificial channels and drainage ditches; the removal of existing drainage structures; the construction of small nesting islands; the construction of open water areas; the construction of oyster habitat over unvegetated bottom in tidal waters; shellfish seeding; activities needed to reestablish vegetation, including plowing or disking for seed bed preparation and the planting of appropriate wetland species; mechanized land clearing to remove non-native invasive, exotic, or nuisance vegetation; and other related activities. Only native plant species should be planted at the site.



## Focal Watershed Review: Indian River Lagoon, Florida (continued)

(<http://www.fws.gov/birdhabitat/Grants/NAWCA/Small/>).

- **Florida Exotic Pest Plant Council (FLEPPC).** This inter-agency team identifies invasive plants and develops strategies for eradication. Some plants are prohibited by the state for sale and distribution. Local governments may also use the FLEPPC list to prohibit, exempt, or otherwise regulate the installment or removal of FLEPPC-listed plants. Pest plants identified and categorized (by invasive properties) by the FLEPPC are used in the regulatory arena (e.g., the presence of these plants determines wetland function in UMAM scoring and their removal is considered mitigation for addressing wetland function loss).

### Tools to address multiple wetland stressors.

- **Land acquisition and conservation.** Protection of coastal wetlands by acquiring wetland areas was noted as a successful tool. Two notable programs were mentioned:
  - » The USFWS National Coastal Wetlands Grant Program provides funding for projects benefitting fish and wildlife in coastal habitats (see, for example, “Tools for restoring natural hydrology of altered coastal wetlands”).
  - » The Florida Forever Program (operated by the Florida DEP) has acquired more than 650,000 acres since the program’s inception in 2001, including 276,070 acres of functional wetlands. The Florida state legislature allocates funds to Florida Forever, which then distributes the money to various state agencies and programs to purchase public lands. For example, the St. Johns River Water Management District has purchased nearly 53,000 acres of environmentally sensitive land, including coastal wetlands within the Indian River Lagoon watershed (<http://www.sjrwmd.com/itsyourlagoon/>).
- **Public education.** Review participants felt that educating the public was an important strategy in fostering volunteerism and individual actions to protect wetland resources. Wetland education occurs through school programs and living shoreline workshops. Some highlights include:
  - » **School environmental programs to raise awareness.** Volusia County targets K–12 students through the St. John’s River Water Management District Legacy Program. There are 18 schools currently participating: seven elementary, six middle, and five high schools reaching 4,200 students per year.
  - » **Living shorelines workshops.** Workshops sponsored by NOAA and USFWS have been held in Port Orange and Volusia County. These workshops were intended to

aid in development of standard permit plans for living shoreline approaches, which contractors currently view as more difficult to permit than seawall construction.

- **Volunteer programs.** Volusia County and the Indian River Lagoon National Estuary Program—as well as other entities—are conducting a very impressive and wide range of volunteer efforts in the Indian River Lagoon watersheds. Volunteers participate in invasive species removal, water quality sampling and monitoring, and restoration activities including:
  - » The Brevard County Pepper-Busting Campaign (i.e., removal of Brazilian pepper trees).
  - » Volusia County’s adopt-an-estuary program, which will include voluntary monitoring of estuarine wetlands (program is currently in development).
- **Collaboration.** Participants felt that one of the Indian River Lagoon’s most remarkable assets is the very strong culture of collaboration between all levels of government and non-governmental entities. This collaborative culture has been a large contributor to successful coastal wetland protection and has given rise to numerous volunteer groups working hand-in-hand with government agency staff. Positive, long-term working relationships are a distinctive characteristic of the Indian River

### Highlight: Volusia County’s CIA

Volusia County has a volunteer-based invasive plant removal team called the Counter Invasive Agents (CIA). The program educates the public on how to remove exotic species through pilot plant-removal projects in local parks. These projects then allow the public to transfer their exotic plant-removing techniques to their own backyards. Interested members of the public can sign up on Volusia County’s website: <http://volusia.org/environmental/enviromet/cia/default.htm>.

The screenshot shows a webpage for the Counter Invasive Agents (CIA) program. At the top left is the Volusia County logo. The main heading is "Environmental Management" with a sub-heading "Exotic Plant Removal". The title of the page is "The Counter Invasive Agents". Contact information for Michelle (Shelly) Webster is provided: 386-736-5927 ext 2330 and [mwebster@co.volusia.fl.us](mailto:mwebster@co.volusia.fl.us). A call to action says "Become a Member of the CIA". Below this is a paragraph explaining the problem of exotic plants and the program's goal to educate residents. A photo shows a person in a blue shirt working on a plant. At the bottom, it says "A proactive outcome of this education program will be".

## Focal Watershed Review: Indian River Lagoon, Florida (continued)

Lagoon watershed. Strong partnerships have fostered a shared work ethic and strong professional network. Many people have been working together in the area for over 30 years, which has led to a very strong community spirit centered on protection of the Indian River Lagoon. Some examples of successful collaboration include:

- » **National Estuary Program.** The Indian River Lagoon National Estuary Program (NEP) was mentioned as a good example of the many interagency collaboration efforts underway in the lagoon (see the “Highlight” box). The NEP is currently working with the city of Satellite Beach (in Brevard County) to assess municipal vulnerability to sea level rise and identify critical municipal assets, with results to date summarized in a report by RWParkinson Consulting (2010). The work is being funded by a \$25,000 grant from EPA’s Climate Ready Estuaries Program (EPA, 2009).
- » **Planning.** State and local authorities collaborate through existing programs and planning groups (the Surface Water Improvement and Management Program, the Comprehensive Conservation and Management Plan, and Aquatic Resources Plans) to ensure that the plans are compatible and implementable by all involved agencies.
- » **Florida Coordinating Council on Mosquito Control.** The Council is composed of academics, district representatives, and local/state/federal officials. The technical advisory committee meets quarterly, conducts site visits, and develops adaptive management strategies for specific wetlands through multi-agency participation.

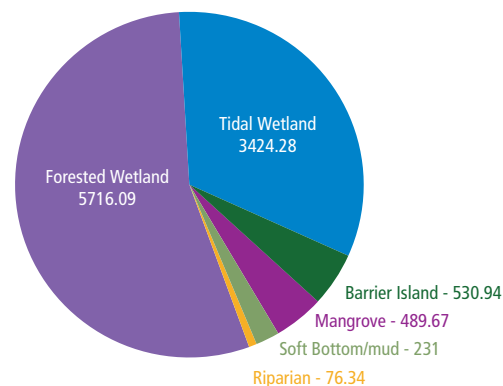
### What’s Needed? What’s Missing?

Despite the above array of tools and strategies to address stressors to coastal wetlands in the Indian River Lagoon watersheds, participants identified several gaps in resources and regulations. They expressed the need to address these gaps to enable more effective application of tools and strategies to protect and restore the watersheds’ wetlands. Most gaps applied to all coastal wetland programs.

**Gaps in data sharing and information on ecological services.** A shared, comprehensive database would bolster existing collaboration efforts between state agencies, federal agencies, and the public. It would provide information needed to identify key issues and help managers address them in a systematic, science-based approach. The data would serve to track wetland changes, identify specific stressors, and evaluate program success. Participants noted that it would be very helpful to have a specific tool

### Highlight: Indian River Lagoon NEP Partnerships

Indian River Lagoon NEP Wetland-Related Efforts  
10,468.32 Acres Protected and Restored 2007–2009



**NEP works with many partners on impounded wetland restoration, drag-line ditched wetland restoration and shoreline and fringing mangrove restoration, including:**

- St. John’s River Water Management District
- Volusia County Mosquito Control USFWS/Merritt Island National Wildlife Refuge
- National Park Service/Canaveral National Seashore
- St. Lucie County Mosquito Control
- Brevard County Mosquito Control
- Indian River County Mosquito Control
- Florida Department of Environmental Protection—S.E. Aquatic Preserve Program

Source: SJRWMD, 2011

to measure, classify, and assess coastal wetlands in order to gain a better understanding of how they are being impacted.

- A statewide database is needed with a GIS interface in order to spatially assess cumulative wetland impacts. Information should include state and federal permitting data, mitigation sites, water quality data, hydrologic data, etc. Such a centralized wetland information system would allow watershed-based monitoring of wetland status and trends to help set priorities for wetland protection and restoration. The system would enable an assessment of wetland acreage loss/gain, wetland function, and wetland restoration. Water quality data, TMDLs of pollutants, and NPDES information on surface water discharge

## Focal Watershed Review: Indian River Lagoon, Florida (continued)

permits could support better assessments of water quality impacts on wetland function, and a better understanding of the effects of agricultural and urban runoff and the effectiveness of mitigation and restoration efforts.

- This system could build on a University of Miami/DEP pilot database for central and southeast Florida, which will include permit information and wetland loss data. The pilot should be evaluated to identify and resolve issues over transferability, data entry responsibilities and details on QA/QC process. Ideally, the system would be developed with a format that could be shared among agencies to aid in interagency collaboration.
- Participants identified the need for more information on ecological services provided by wetlands to enable more accurate assessments of project impacts.
  - » Functional assessment techniques should be based on adequate science to quantify ecological functions.
  - » Rapid assessment methodology (uniform and replicable) should be developed and implemented for field assessment.
  - » Predictive tools based on ecological function of wetlands could facilitate assessment of stormwater management systems, mosquito impoundment projects, and shoreline hardening; evaluate the impact of nutrients on flora and fauna; perform economic valuation of wetlands; and support statewide ecological goods and services survey (potentially scaled down to regional/local level).

**Gaps in resources to protect coastal wetlands.** Both personnel and funding are needed to address the loss of coastal wetlands and employ strategies to protect and restore them.

- **Staff.** Review attendees were concerned about limited regulatory staff resources. Limited regulatory staff resources make enforcement of permit conditions and enforcement of unpermitted actions difficult.
- **Funding.** Additional monies are needed for education and outreach to target youth and land developers. Research money for evaluating techniques to help determine best practices is also lacking. Another important source of funding, the state Wetland Grant Program, has not been increased despite growing demands, contributing to further resource limitations.

**Gaps in coordinating federal, state, and local wetland regulations.** Participants felt that federal, state, and local governments should more closely coordinate wetland regulations to avoid redundancy and ensure consistent interpretation. Each level of government has similar project review processes, but different rules, policies, and regulations. This may result in redundant processes and different outcomes for permit applicants.

**Gaps in evaluating permitting rules.** Review of the Florida DEP's ERP rules would allow state officials to evaluate program effectiveness and help determine ways of making sure that best practices are being implemented. For example, it would be important to ensure that rules are designed to permit new, innovative techniques such as progressive



## Focal Watershed Review: Indian River Lagoon, Florida (continued)

stormwater management projects and living shorelines projects. Other suggestions for improved permitting included:

- Holding periodic meetings between state, federal, and county officials to share information and strengthen relationships. This would help to expand upon the collaboration and coordination efforts that are already noted as important tools (see the “Tools and Strategies” section).
- Creating a step-by-step process for integrated permitting that would enable simultaneous review of all permits needed for a project to ensure cross-program coordination and avoid the pressure some agencies feel when impacts not allowable under their regulations have been approved under previously obtained permits.
- More cross-training for wetland assessment should occur between federal, state, and local agencies to improve consistency in how the UMAM is used.

**Gaps in wetland mitigation.** More information and research is needed on the relationship between wetland function and acreage in order to ensure that sufficient mitigation is being done to compensate for wetland losses.

- **Mitigation banks.** Concerns were expressed that the widespread availability of mitigation banks may provide a disincentive to “avoid and minimize” impacts. Some participants questioned how agencies determine sufficient “avoidance and minimization,” prior to allowing the use of wetland mitigation banking credits. Stakeholders presented this as a concern despite the recognition that, regardless of the presence or absence of any permittee-responsible or third party mitigation option(s), pursuant to the CWA 404(b)(1) guidelines, impacts must first be avoided and minimized to the maximum extent practicable before compensation for unavoidable impacts is considered. In accordance with the Compensatory Mitigation Rule (see Appendix C), mitigation banks are the first mitigation alternative in the preference hierarchy because banks, along with in-lieu-fee programs, usually involve consolidation of compensatory mitigation projects where ecologically appropriate, reduce temporal losses of functions, and reduce uncertainty about project success.
- **Effectiveness.** Participants questioned whether the performance of mitigation sites was being adequately assessed to determine full compensation of function and value. In addition, within this region no mitigation is required for certain activities that generate losses of SAV,

an important fisheries habitat composed of underwater plants often found in the intertidal zone adjacent to coastal wetlands.

- **Uniform Mitigation Assessment Method.** Despite being a practical tool to address mitigation, some have suggested that UMAM needs to be improved to increase its effectiveness in protecting wetlands. Some participants provided literature (Costanza et al., 1997; Brown and Lant, 1999; Robertson, 2003) supporting their concerns about UMAM’s reliability in fully characterizing wetland function, calculating mitigation accurately, and ensuring that tradeoffs truly result in no net loss of wetlands. Specific concerns:
  - » Although SFWMD holds UMAM training and workshops, UMAM has not been peer-reviewed or validated as a model.
  - » The potential for onsite “ecological lift” (the degree of wetland improvement in function) is not adequately assessed. Some participants voiced reservations about allowing ecological lift as compensation for loss of acreage because it is difficult to determine the added functional or qualitative value compared to quantitative areal loss.
  - » While Chapter 62-345 of the Florida Administrative Code has guidelines for scoring wetland mitigation, professional judgment is often used in determining the scores. Small variations in scoring could result in less mitigation. Concerns were expressed that applicants might be “gaming the system” by trying to under-assess the value and functions of impact areas and over-assess the value and function of the mitigation areas, to reduce mitigation requirements. However, it was also noted that the project manager reviewing the project has the final say in the scoring, not the applicant.

### Gaps in transferring strategies from public to private land to increase effectiveness of invasive species management.

Invasive species control strategies need to be applied on private as well as public land. Currently, most of the invasive plant programs are implanted on public lands, and participants cited the need to transfer those successful public land management practices to the private sector for more effective, comprehensive invasive species control throughout the watershed. More programs like Volusia County’s CIA will help increase the awareness of the public in removing exotic species from their own properties (see the “Tools and Strategies” section).

## Focal Watershed Review: Middle and Lower Neuse River Watershed

### Introduction

North Carolina's approximately 5,000 miles of estuarine shoreline and over 300 miles of ocean shoreline are host to a variety of wetland types—marsh, swamps, forested wetlands and pocosins, to name a few. Unfortunately, North Carolina has lost 50 percent of its original 11.1 million acres of wetlands. Between 1950 and 1980, wetland conversion<sup>6</sup> in the North Carolina coastal plain was due largely to forestry (52.8 percent of total area altered), followed by agriculture (42.2 percent) and development, such as urbanization (5 percent) (Cashin et al., 1992). Despite these losses, the majority of the remaining wetland is located in the coastal plain (Dorney et al., 2004; Street et al., 2005).

The northern portion of North Carolina's coastal zone is distinguished by a long strand of barrier islands (the Outer Banks). With only a few inlets, these barrier islands have created the largest lagoonal estuarine system in the United States (EPA, 2007). The coastal wetlands in the region are a critical resource for the state's commercial fishing, recreational fishing, and tourism industries. Jobs and businesses in the region depend on a healthy coastal wetland ecosystem.

The Neuse is one of six river basins that drain into the Albemarle-Pamlico Sound (Figure 13). The Neuse River, which flows 250 miles starting in the North Carolina Piedmont, has experienced water quality degradation over the last few decades due to a variety of factors, including agricultural runoff. By the mid-1980s, the Neuse estuary saw an increase in excessive levels of nutrients, harmful algal blooms, low oxygen levels, fish kills, and other symptoms of stress in the aquatic biota (NC DWQ, n.d.). In the mid-1990s, expansions of concentrated animal feeding operations contributed further to nutrient loading in the river. More recently, the explosion of development in the Piedmont and inner-coastal areas has exacerbated already serious water quality issues. This combination of stressors prompted American Rivers to name the Neuse one of the nation's 10 most endangered rivers in 2007 (American Rivers, 2007).

In preparation for the focal watershed review, the EPA Coastal Wetlands Team worked with the North Carolina Division of Water Quality (NC DWQ) and NOAA C-CAP to develop a general characterization of wetland changes in the Middle and Lower Neuse over the past 10 or so years, as



**Figure 13.** Albemarle-Pamlico Sound and the mid- and lower Neuse River watersheds (cross-hatched).

reported by both agencies. NOAA C-CAP examines overall land use change, including wetlands, for the coastal regions of the United States. The NC DWQ program tracks site-specific impacts to wetlands regulated under the 401 Water Quality Certification program, which is closely coordinated with the 404 permitting program administered by the Army Corps. Because of differences in scale, timeframe, and geographical boundaries, the two data sets are not directly comparable. NOAA C-CAP does not differentiate between permitted wetland losses and losses occurring outside the permitting programs. It provides a general, “high-level” snapshot of the nature and scope of wetlands changes from an analysis of 30-meter-resolution imagery from Landsat (a form of remote sensing). NC DWQ tracks the extent of wetland losses that are permitted and mitigated through the state wetland permitting program, which requires at least 1:1 mitigation, and most commonly 2:1 mitigation. Both state and federal data sets currently report changes in wetland acreage only and do not measure changes in wetland function.

Table 4 displays Middle and Lower Neuse (HUCs 03020202, 03020204) wetland impacts and mitigation data for 2000 to 2009 provided by NC DWQ. The data were assembled using county boundaries and therefore do not reflect the focal watershed review area exactly. The calculations do not include impacts associated with 404 nationwide permits (NWP) 12, 27, and 33, or any impacts that may be occurring outside the regulatory programs.<sup>7</sup> The

<sup>6</sup> For purposes of the CWR effort, conversion is defined to not only include those scenarios where wetlands are converted to non-wetlands, but also scenarios where conversion takes place from one wetland type to another wetland type.

<sup>7</sup> The Army Corps' Wilmington District tracks all permits, and documents Clean Water Act Section 404 violations as well as all compensatory mitigation by wetland type using the Corps' Operation and Maintenance business information link, Regulatory Module (ORM) system. A preliminary review of Army Corps' Wilmington District data shows that in 2000–2004 approximately 60 acres of mostly non-riparian wetlands were impacted within the counties containing the Neuse River study area. Approximately 135 acres of wetland mitigation was required to compensate for these impacts.

## Focal Watershed Review: Middle and Lower Neuse River Watershed (continued)

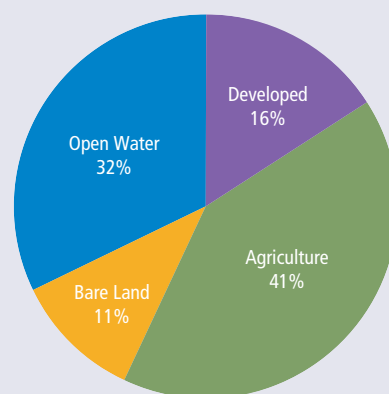
“Total Compensatory Mitigation” values include total wetland acres preserved, enhanced, created, and restored. The numbers for the Middle and Lower Neuse reveal the majority of mitigation in the last decade has been in the form of restoration and creation as compared to preservation and enhancement. Based on these numbers, there has been a small net gain in wetland acres in the study area from 2000 to 2009. The total number of acres mitigated is higher than the total number of acres impacted because the state’s mitigation ratios for preservation and enhancement are higher than those for restoration and creation (e.g., the ratio of acres preserved to acres impacted is 5:1).

Table 5 and the accompanying pie chart displaying NOAA’s C-CAP<sup>8</sup> data (Figure 14) are based on the area of the two 8-digit HUCs that were the focus of the CWR in the Middle and Lower Neuse watersheds. According to the C-CAP analysis, over 98 percent of wetlands lost in the focal watersheds between 1996 and 2006 were non-tidal, with the greatest impacts occurring from conversion to agriculture.<sup>9</sup> As mentioned earlier, however, there are several factors making the NC DWQ and NOAA wetland impact data difficult to compare. This type of variation represents one of the biggest challenges for understanding and addressing coastal wetland loss. Determining the scope of quantitative and qualitative wetland loss is valuable information that

**Table 4.** Lower and Middle Neuse Impacts and Mitigation

Calendar Year	Impacts (acres)	Total Compensatory Mitigation (acres)	Compensatory Mitigation: Restoration and Creation (acres)
2000	2,182	0	0
2001	6,335	8.25	8.25
2002	17,215	7.88	7.88
2003	16,646	81.14	66.98
2004	5,475	9.88	9.88
2005	3,754	2.70	2.70
2006	6,113	6.85	6.85
2007	3,403	6.06	6.06
2008	41,392	55.67	55.67
2009	11,665	14.8	7,462.9
<b>Total</b>	<b>114.18</b>	<b>193.23</b>	<b>171.7329</b>

Source: NC DWQ.



**Figure 14:** Wetland loss and changes in land cover, 1996-2006: Middle and Lower Neuse watersheds. Source: NOAA, 2010b.

**Table 5.** Change in Wetland Land Use Type (Acres) From 1996 to 2006, HUCs 03020202, 03020204

Wetland types*	Developed	Agriculture	Bare land	Open water	Total
Palustrine forested	364.95	889.58	207.72	409.87	1,872.12
Palustrine scrub	13.79	80.28	35.81	58.93	188.81
Palustrine emergent	4.23	21.35	17.12	259.98	302.68
Estuarine scrub	0	0	0	0	0
Estuarine emergent	0	0	0.44	0	0.44
Unconsolidated shore		0.44	6.45	34.69	41.59
<b>Total</b>	<b>382.96</b>	<b>991.66</b>	<b>267.54</b>	<b>763.48</b>	<b>2,405.65</b>

Source: NOAA, 2010b.

\* See Appendix D for wetland classification descriptions.

8 A more detailed description of the C-CAP data set is available in Appendix D.

9 According to the Army Corps’Wilmington District, converting wetland areas to agricultural production would require a Clean Water Act Section 404 permit. Over the past 10 years, no major permits (greater than 1 acre) have been issued for conversion of wetlands to agricultural production within the Neuse River study area.

It should be noted that the information below is based on the opinions and observations of participants, who provided feedback on draft versions of this document and supplemented statements with documentation, where available.

can inform and potentially improve decision-making. While both data sets acknowledge wetland loss, the differences between the two highlight the difficulty in obtaining and comparing high-quality wetland data sets when data is collected for different reasons using different parameters. These two datasets, although not directly comparable, help identify where more information and data may be needed, and helps to inform the discussion with participants about these data challenges and about losses that may be occurring outside the purview of permitting programs.

### Stressors

Participants at the review discussed key issues contributing to coastal wetland loss. They focused on the following key issues contributing to coastal wetland loss and confirmed, as well as added, to the stressors identified during the literature review. The two most important coastal stressors identified by participants during the review are listed first, followed by (in no particular order) other top stressors.

**Increased coastal development.** From 2000 to 2010, the population in North Carolina increased by 18.5 percent (U.S. Census Bureau, 2012). In coastal communities, seasonal populations increased by more than 50 percent from 1990-2000. Over that same timeframe populations in the Neuse River Basin increased by 40 percent (Street et al., 2005).

- **Residential development.** Population growth in the area has driven the demand for residential development. In addition to residential development projects, there are associated development activities that contribute to acreage losses and/or degradation of coastal wetlands such as shoreline armoring for storm/erosion protection, increased boating activity and boating infrastructure, shopping centers, and golf courses.

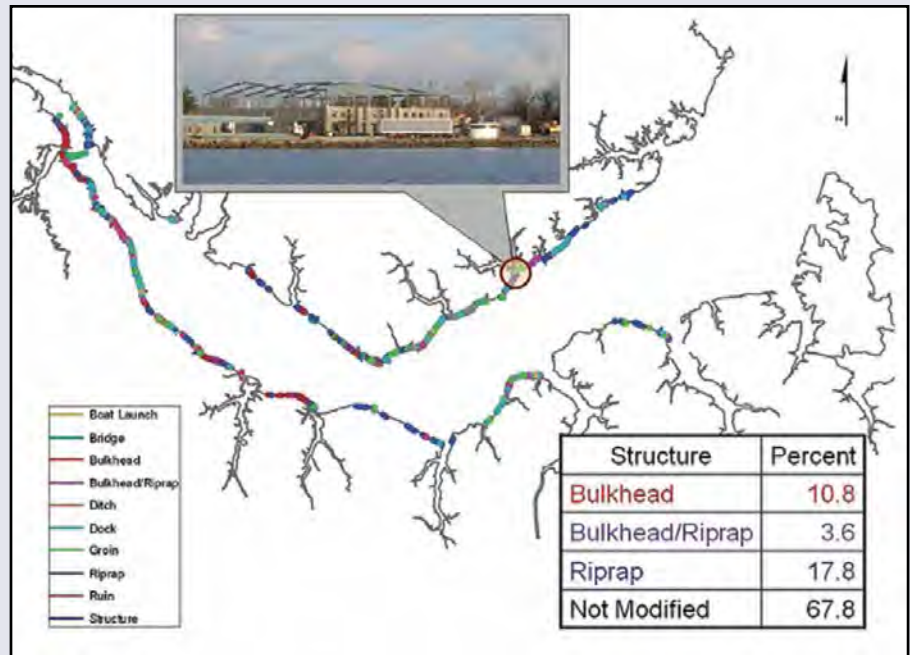


Figure 15. Map of shoreline hardening along the trunk of the Neuse River Estuary in December 2007. Source: Corbett et al., 2008.

- **Small wetland impacts.** Several review participants expressed the view that unauthorized private land conversion of less than 1/10th of an acre were occurring and would continue to lead to larger cumulative impacts unless detected and regulated. Impacts of less than 1/10th of an acre are covered by nationwide permit #18 and are regulated under Section 404 of the Clean Water Act.<sup>10</sup> However, the Army Corps noted that for wetland losses of 1/10th acre or less that require pre-construction notification their District Engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. According to the Army Corps' Wilmington District, of 45 general permits issued in the Lower and Middle Neuse watersheds in 2006–2008, approximately 30 were for impacts less than 1/10th of an acre (amounting to a total impact of approximately 1.7 acres, and approximately 8 acres mitigated).

- **Shoreline hardening.** Shoreline stabilization structures such as seawalls and bulkheads are permitted along the estuarine shoreline in North Carolina. Mapping efforts in 2007 identified over 30 percent of the shoreline of the Neuse River as hardened via bulkhead, rip-rap, or a combination (Figure 15; Corbett et al., 2008). Hardened structures along the shore may exacerbate erosion and prevent landward migration of coastal wetlands.

<sup>10</sup> Additionally activities covered under this nationwide permit are limited to 25 cubic yards (cy) of material below the ordinary high water mark or high tide line.

## Focal Watershed Review: Middle and Lower Neuse River Watershed (continued)

- **Limited areas for mitigation sites.** Some areas (e.g., upper Piedmont HUCs of the Cape Fear basin) may be difficult to identify suitable watershed-based mitigation sites. There are a number of factors that contribute to this difficulty in locating suitable mitigation sites, including terrain, soils, or overdevelopment. This could be a problem in the Neuse watershed in the future, should development pressures continue to increase.

**Limitations of regulations.** Issues regarding jurisdiction as well as non-compliance due to lack of consistent enforcement were identified by participants as stressors.

- **Jurisdiction.** A number of jurisdictional issues may be contributing to coastal wetland loss:
  - » Field delineations of non-tidal wetlands performed by private consultants are valid for five years. Concerns were expressed about the accuracy and consistency of some of those delineations and the possibility that wetland areas may be underestimated. It was noted, however, that the Army Corps regularly conducts field checks of the delineations done by private consultants before signing off on the delineations.<sup>11</sup> Stakeholders suggested that they had a higher level of confidence in the accuracy of tidal wetlands delineations.
  - » Participants at the Neuse River Coastal Wetland Review noted that the Army Corps is constrained by jurisdictional limitations imposed by the Rapanos Supreme Court decision. However, although the Army Corps' Wilmington District would agree that the



“burden” of documenting jurisdiction has increased, they see no evidence that the Rapanos decision has significantly changed exerted limits of waters of the United States within the area of review. It was further noted by other Neuse River CWR participants, that few sites have been determined not subject to Clean Water Act Section 404 jurisdiction and, in most instances, North Carolina’s isolated wetland rule would provide NC DWQ with jurisdiction over these wetlands.

- **Enforcement.** Some review participants believed that low and infrequently collected penalties for violations of wetland regulations were contributing to noncompliance by not deterring violators.<sup>12</sup>

**Cumulative impacts.** Concern was expressed that small, incremental wetland impacts may be untracked and difficult to characterize. They may result from inaccurate wetland delineations, unauthorized wetland impacts, or water quality degradation of wetlands. These small, disparate impacts result in substantial cumulative acreage losses when considered in total.

**Agricultural impacts.** In addition to the historic filling and draining of wetlands for agricultural uses, ongoing and expanding agricultural activities can impact the function and condition of coastal wetlands by increasing nutrient and sediment input. Review participants identified row crops, livestock, and poultry as having impacts on wetlands in the Neuse watershed.

- **Nutrient runoff.** Despite reductions in nitrogen loads mandated by the Neuse River Basin Water Quality Plan, it was noted that water quality data so far do not indicate any significant decrease in actual nutrient levels in the estuary. This is the case despite the agricultural community’s approximate 45 percent reduction in nitrogen loss from cropland and pastureland (NC DWQ, 2009). Additionally, the Neuse River TMDL estimated the nitrogen impact of over 500 hog farms at zero, yet there has been an increase of leachate and airborne nitrogen into the estuary (Burkholder et al., 2007). This type of divergent information exemplifies the challenges of determining impacts from nonpoint sources of pollution.
- **Ditching.** Ditching is a method to drain wetlands for

11 Based on a review by the Army Corps’Wilmington District on their delineation data, the District has verified approximately 50-75% of their wetland delineations during the 2000-2010 timeframe.

12 According to the Army Corps’Wilmington District, typically enforcement actions are resolved either by after-the-fact (ATF) permitting, restoration, or a combination of the two. If the unauthorized activity is permitted ATF, all appropriate and practicable compensatory mitigation should be provided. In the case of restoration, the District typically requires a detailed restoration plan and monitoring of the area.



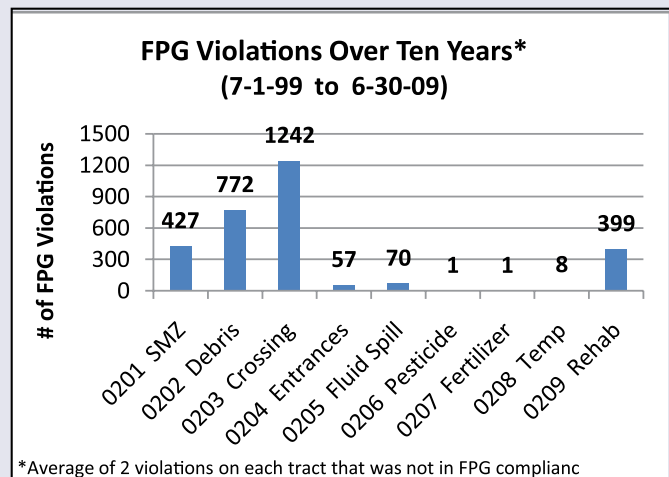
## Focal Watershed Review: Middle and Lower Neuse River Watershed (continued)

agriculture and development. Along the coast, ditches may act as conduits for saltwater intrusion, in particular during storms and with rising sea levels. Saltwater intrusion has been shown to have a potentially negative effect on regeneration of marshes (Middleton, 2009).

- **Poultry.** Comparison of poultry production information from NC Agriculture Statistics for individual counties in the Neuse River Basin from 1996 to 2006 indicates that turkey production has decreased from 27,200,000 to 19,230,000, broiler production has increased from 77,000,000 to 80,700,000, and other poultry (layers, etc.) has decreased from 3,820,000 to 3,005,700 (personal communication, Vernon Cox, NC Department of Agriculture and Consumer Services). Review participants expressed concern over the lack of information on farm location and the potential for these farms to be located adjacent to wetlands where runoff could lead to water quality degradation and impaired wetland function.

**Forestry impacts.** Participants had differing opinions about the impacts of forestry practices on wetlands. Some believed that forestry exemptions and the lack of enforceable BMPs were contributing to impacts to coastal wetland. Others disputed this claim, citing the lack of current wetlands mapping and land use data.

- **Stream crossings.** Skid trail stream crossings have been documented as the most frequent forestry activity triggering a violation of North Carolina's Forest Practices Guidelines Related to Water Quality (Figure 16).
- **Minor drainage.** Minor drainage is an allowable forestry activity that is exempted from permitting under Section 404(F) of the Clean Water Act. However, participants still had questions as to what constitutes "minor" drainage versus more significant drainage.
- **Harvesting methods and timing.** In recent years, concerns have arisen about the timing of timber harvests in certain wetland areas, related to the availability of natural seed or stump sprouts to regenerate the harvested wetland in a relatively short period of time after harvest. Additionally, some review participants believed that skidders used for harvesting can create small ditches in the landscape, which, when subject to forces of erosion, can widen ditches into channels that can drain wetlands. Another issue was raised about harvesting determinations: the difficulty of establishing the appropriate setback rules. Harvesting setback rules for tidal areas are



**Figure 16.** Data on statewide Forest Practices Guidelines (FPG) violations, 1999–2009. Source: NC DFR, 2009.



**Figure 17.** Dark blue shading represents land that is predicted to be under water with a 1-meter rise in sea level, expected in 65 to 200 years. Source: Poulter et al., 2009.

determined at the high-water mark, a difficult criterion in a tidal estuary. In non-tidal areas (largely freshwater), the setback mark may be set at the lowest (dry period) mark which allows for wetland harvesting of cypress and tupelo species.

**Climate change impacts.** Although not yet attracting a great deal of attention, participants noted that studies have shown that coastal wetlands are likely to be seriously altered by predicted rates of sea level rise (Figure 17).

### Tools and Strategies

A number of effective tools and strategies exist or are under development in the Middle and Lower Neuse watersheds to address the above stressors. The focal watershed session identified the following as “tools and strategies.”

#### Tools to address coastal development impacts.

- **Living shorelines.** Living shorelines is a management practice that addresses shoreline erosion through the strategic placement of vegetation, stone, sand, and other structural and organic materials (see Figure 18). The living shorelines methodology considers parameters such as fetch, water depth, vegetation, height of bank, and existing erosion condition, and produces the most effective shoreline stabilization method given a site’s characteristics. The Division of Coastal Management (NC DCM) provides guidance on implementing living shorelines projects and has hosted training workshops and site visits to promote the practice. The North Carolina Division of Soil and Water provides a cost-share of up to 70 percent for living shoreline projects along the estuarine shore. Despite the potential of living shorelines, several limitations have slowed more widespread utilization of this technique. The state of North Carolina has had a ban on the construction of permanent erosion control structures since 2003 (House Bill 1028/S.L. 2003-427). However, in 2011, the state passed Senate Bill 110/S.L. 2011-387, which allows the Coastal Resources Commission to permit the construction of four terminal groins along the coastline.

- **Permitting.** Though not currently in practice, participants believe streamlined permitting would encourage increased use of living shorelines. The permitting system is more streamlined for hardened structures such as bulkheads and seawalls as compared to living shoreline alternatives. A Coastal Area Management Act (CAMA) General Permit exists for rock sills (rock or oyster shell sills are often part of living shorelines projects in order to protect marsh plantings), but for some applications, the Army Corps’ Wilmington District requires an individual permit for case-specific review. Primary concerns of the District that warrant requiring case-specific reviews for these activities include potential impacts to public safety and navigation, potential impacts to EFH, and impacts to submerged aquatic vegetation and shallow water habitat. In contrast, installing a bulkhead or seawall along the estuarine shore can be approved with a significantly less-intensive general permit review.
- **Education.** Public and contractor education is an important part of a living shorelines strategy; however, there are social issues that are also important to consider in the education strategy. For example, it was noted that some landowners prefer the “clean” look of a bulkhead. Landowner decisions are also strongly influenced by whether neighbors have already installed bulkheads, leading to continuation of the practice.
- **Mapping.** NC DCM is tracking estuarine shoreline status and is in the process of mapping hardened structures.



Figure 18. Example of living shoreline, Beaufort, N.C. (Photo Courtesy of Arleen O'Donnell, ERG)

## Focal Watershed Review: Middle and Lower Neuse River Watershed (continued)

- **Low-impact development.** LID, similar to living shorelines, presents an alternative approach to traditional stormwater management practices that can reduce impacts on wetlands from development by simulating more natural hydrology of a particular site. LID methods include grassed swales and other vegetated features (instead of culverts), pervious pavement, infiltration devices, reducing impervious surfaces, and recharging as much on-site stormwater as possible. Stormwater permitting requirements have become more stringent, and BMPs to manage stormwater in accordance with these requirements have led to LID. Local communities (e.g., the city of Wilmington, Brunswick County, New Hanover County) have adopted LID resolutions.

To promote LID and other means of sustainable development, the North Carolina Division of Soil and Water has an award program for sustainable building, and the North Carolina Wildlife Resources Commission is working on developing a wildlife-friendly green development certification. Some participants felt that the economic base of an area will determine how viable green development programs will be. Sustainable development is happening more and more on the coast, but not broadly within the Neuse Basin yet. Craven County has adopted a “Green Craven” development protocol in order to promote better development and planning practices.

### Tools to increase effectiveness of regulatory programs.

- **Interagency collaboration.** Participants in the review felt that collaboration is particularly strong among NC



DCM, the Division of Marine Fisheries, the Army Corps, and NC DWQ on the Coastal Habitat Protection Plan. Other collaboration occurs through an interagency review team, which reviews Ecosystem Enhancement Program projects and other mitigation projects. Project development teams are used for projects that require an Environmental Impact Statement such as beach renourishment projects. Reviewers believed that the Army Corps’ Wilmington District, NC DWQ, NC DCM, Division of Land Resources, Division of Forest Resources, and the Natural Resources Conservation Service (NRCS) have good working relationships and knowledge of one another’s programs, which allows for a high level of cooperation in alerting the appropriate agency to unauthorized activities as well as collaboration on some enforcement matters where multiple agencies have jurisdiction.

- **Monitoring, assessment, and mapping.**
  - » **Wetlands Assessment Method.** This rapid assessment method, when implemented, will allow a functional assessment on any impacted wetland so that mitigation can be based on function in addition to areal extent. Information on the method is available at <http://portal.ncdenr.org/web/wq/swp/ws/pdu/ncwam>.
  - » **National assessment.** The state is working with EPA on a national wetland condition assessment to help determine coastal wetland indicators. Several sample plots throughout the state will be used to develop the national protocol. The same methodology may be used on mitigation sites in the future.
  - » **Impact mitigation mapping.** NC DWQ will be undertaking a mapping project documenting Section 401 and 404 permitted impacts and mitigation, as well as Ecosystem Enhancement Program mitigation statewide. The maps generated will aid the state in determining where mitigation and impacts are occurring (e.g., rural or urban areas) and whether mitigation is actually accounting for impacts within each watershed.
  - » **Determination of the success of mitigation.** NC DWQ is completing a study on the success rates of wetland and stream mitigation based on a statewide, random sample. Once this study is complete, these data will be used to improve wetland mitigation practices in the state.

- » **North Carolina Coastal Region Evaluation of Wetland Significance (NC-CREWS).** The wetland functional assessment model used by NC DCM assesses the function of wetlands on a watershed basis.

### Tools to address agricultural impacts.

- **Wetland restoration.** Review participants identified a growing focus on restoring prior converted croplands back to their original wetland state as a good example of strategies to address agricultural impacts to coastal wetlands in general and for improving water quality in the estuary, in particular. Restoration efforts in the Neuse have emphasized recreating wetland function in addition to acreage (see the “Highlight” box at right).
- **Funding.** An important component of all restoration efforts is securing funding for the project. Some examples of funding sources used in the Neuse watersheds are the Farm Bill and Conservation Reserve Enhancement Program. Farm Bill funds the Wetlands Reserve Program to pay for acquisition, easements, and restoration of prior converted lands. Conservation Reserve Enhancement Program money is also available for prior converted land restoration within the Albemarle-Pamlico Estuary river basins.

### Tools to address forestry impacts.

- **Forest Practices Guidelines.** The North Carolina Sedimentation Pollution Control Act of 1989 regulates the impact of forestry on water quality through the development of “Forest Practices Guidelines (FPGs) Related to Water Quality.” The FPGs are nine mandatory performance standards outlined in North Carolina Administrative Code regulations, which went into effect in 1990. The FPGs are most effectively met through the implementation of BMPs (Figure 20). The state’s Forestry Best Management Practices Manual to Protect Water Quality, amended in

### Highlight: North River Farms

North River Farms is a 6,000-acre restoration site in Carteret County, managed by the North Carolina Coastal Federation (NCCF) (Figure 19). It is one of several large-scale restoration sites in the state. Negotiations over the property began in 1998, when NCCF acquired 1991 acres at the rear of the property with the help of a \$1 million grant from the North Carolina Clean Water Management Trust Fund. At the time, approximately 808 acres were being used as farmland with the remainder designated prior converted cropland. Through a partnership with the Ecosystem Enhancement Program (see below for more on the Program) and North Carolina State University, as well as funding from EPA, NOAA, and USFWS, the entire area was restored at a cost of approximately \$1,100 per acre. A few years later, in 2000, a private mitigation banking company (Restoration Systems LLC) purchased 400 acres adjacent to the NCCF property while NCCF negotiated the purchase of the remaining farm acreage (3,568 acres) for around \$1,400 per acre. NCCF was approached by 1804 Wildlife Partners, a private hunting club, for purchase of 1,400 of the 3,568 acres. NCCF agreed in return for 1804 Wildlife Partners’ commitment to enroll the acres in NRCS’s Wetland Restoration Program (WRP). With the partnership in place, NCCF applied for, and was successful in receiving \$3 million from the Clean Water Management Trust Fund to make the purchase in 2002. Part of the second acquisition included a farm lease on 2,100 of the acres through 2012 and NCCF has just begun mapping out the restoration strategy for the area. Meanwhile 1804 Wildlife Partners has successfully enrolled in the WRP and completed restoration of its 1,400 acres. Restoration Systems has also enrolled in the WRP. In a few years’ time, the entire farm will be restored to wetlands (NCCF website; personal communication, Todd Miller).

The project has been supported financially by numerous agencies, partnerships, and organizations including the Clean Water Management Trust Fund, the Ecosystem Enhancement Program, NOAA’s Community-Based Restoration Program, Restore America’s Estuaries, the North American Wetlands Conservation Act, Fish America Foundation, the North Carolina Attorney General’s Office Environmental Enhancement Grant, USFWS, the National Fish and Wildlife Foundation, 1804 Wildlife Partners, Restoration Systems, the North Carolina Coastal Land Trust, the North Carolina Natural Heritage Program, The Nature Conservancy, and Open Grounds Farm. North River Farms has also acted as a public education tool, helping the North Carolina coastal agricultural community gain a better understanding of restoration as an option for their land.



Figure 19. North River Farms restoration project. Source: North Carolina Coastal Federation.

September 2006, is available online at [http://www.dfr.nc.gov/water\\_quality/bmp\\_manual.htm](http://www.dfr.nc.gov/water_quality/bmp_manual.htm). The Division of Forest Resources is the lead agency that monitors compliance with these regulations. Enforcement of FPG violations are administered by four state agencies, including the Division of Forest Resources, depending on the nature of the violation.

Recent monitoring and surveys of BMP implementation have indicated that BMP usage rates are currently in the mid-80-percent range along the coastal plain region of North Carolina and overall compliance with the FPG regulations exceed 97 percent (Raval, 2005). In addition, an ongoing watershed study is evaluating the effectiveness of forestry BMPs and the Neuse riparian buffer rule will add to the base of knowledge on how forestry practices may (or may not) influence water quality. Implementation and monitoring survey data are being updated. Future BMP surveys are planned as an ongoing assessment of forestry harvests and the usage of BMPs. (see “What’s Needed? What’s Missing?”).

- **Mandatory riparian buffers.** Forestry activities are additionally regulated within a 50-foot zone alongside designated streams, water channels, and bodies of water within the Neuse River basin in accordance with state regulations commonly called the “riparian buffer rules” (specifically Administrative Code 15A NCAC 02B .0233). These riparian buffer rules are supplemental to the required streamside management zone buffers as defined within the FPGs. The Neuse River riparian buffer rule went into effect in 2000. An ongoing paired-watershed study in the upper Neuse River basin led by the Division of Forest Resources is currently evaluating the effectiveness of the riparian buffer rule for forest harvest activities.
- **Stream crossings.** Continued efforts to promote the use of portable bridge mats and thorough pre-harvest planning remain vital tools to educate and inform landowners, loggers, and timber buyers about the issues related to crossing streams.

**Watershed-based nutrient and sediment management strategies.** North Carolina is a leader in watershed planning. The state wetland in-lieu fee program (the Ecosystem Enhancement Program) is watershed-based, and has a very high rate of compliance (99.76 percent for riparian wetlands, 98.64 percent for non-riparian wetlands, and 100 percent for coastal marsh) (NC DENR, 2009).



**Figure 20.** Photo of a forested wetland swamp in Craven County, six years after a clearcut timber harvest. The harvest was done in 2004 and was in compliance with FPGs and the Neuse riparian buffer rule. Photo: North Carolina Division of Forest Resources.



**Figure 21.** Vegetated filter strips in the Neuse River Basin help trap sediments and decrease nitrogen loads to the river.

- **Neuse River Management Strategy (1997) (Figure 21).** The Neuse was the first river basin with mandatory point and nonpoint nitrogen reduction targets. The target was 30 percent nitrogen reduction from 1991 to 1995. By 2007, a 39 percent reduction had been achieved at a cost of \$12 million (EPA, 2005; Neuse Agricultural Basin Oversight Committee, 2007) through a combination of strategies including implementation of BMPs and installation of riparian buffer strips. Wetland buffers are particularly valuable for nutrient reduction. Researchers in North Carolina (Evans et al., 1996) have estimated that that movement of agricultural runoff through riparian wetlands reduced the nitrate-nitrogen content of the runoff nearly 85 percent annually. They

also estimated that 85 to 90 percent of the sediment remained trapped in forested wetlands adjacent to the farm fields and never reached receiving waters. Partners involved in funding and implementing the strategy include EPA, NRCS, the North Carolina Department of Environment and Natural Resources (NC DENR), the North Carolina Farm Bureau, North Carolina Soil and Water Conservation, the Neuse River Foundation, and Duke University.

**Public education and outreach.** All participants noted public education and outreach as critical to the success of the coastal wetland protection program, components that complement and strengthen regulatory programs. They will become increasingly important in the future as ways to help inform the public about the impacts of climate change and sea level rise (see the “Stressors” and “What’s Needed? What’s Missing?” sections). Work by Carteret Catch, NC Sea Grant, Albemarle-Pamlico National Estuary Program, and National Estuarine Research Reserves (Rachel Carson, Currituck Banks, Zeke’s Island, Masonboro Island) was mentioned during the review as prime examples of effective public outreach.

- **Sturgeon City.** Located in Jacksonville, Sturgeon City is an environmental education center located in an old wastewater treatment plant that used to discharge into Wilson Bay, former habitat to the native sturgeon. Sturgeon City is working to restore habitat in Wilson Bay for the fish as well as host educational programs for youth and adults.
- **Carteret Catch.** Carteret Catch is a marketing program developed to try and sustain the livelihood and heritage of the Carteret County fishing industry. The program educates the public on local seafood and helps market it to local restaurants, ensuring the continued existence of county fishermen.

**Tools to address impacts of sea level rise.** Although it has received little attention to date (see “Stressors,” above), a state sea level rise forum was held in January 2010 where participants agreed on a rate of rise for decision-making purposes (1 meter by 2100). Participants in that forum also agreed that the most immediate need was education of the public because currently the science is ahead of public awareness. It is expected that more activity around this issue will occur within the coming months, as the public is made aware of the threats to coastal wetlands.

### What’s Needed? What’s Missing?

The following major gaps and needs were identified by review participants:

#### Gaps in addressing coastal development impacts.

Although they noted public outreach as an important tool, participants acknowledged that more targeted audience outreach efforts are needed. A high priority should be targeting landowners to educate them about living shorelines, wetland functions and values, and wetland regulations to encourage compliance and better development practices. Outreach and education related to regulatory programs and planning should target developers, consultants, and property owners (especially home buyers). Direct interaction approaches, such as public tours of projects or sites, were viewed as most effective. Other examples included:

- **Marketing of LID and living shorelines.** No centralized effort currently exists for marketing LID, living shorelines, or sustainable development principles. The long-term economics of these practices could also help promote them. For example, living shoreline projects often have higher start-up costs compared to hardened structures, but in the long term they tend to last longer and have lower maintenance costs.
- **Incentives.** More incentives need to be offered to sustain the types of voluntary programs mentioned in the “Tools and Strategies” section.
- **Ecosystem services.** Communication to the public regarding ecosystem services has been insufficient. While local outreach is important, statewide outreach is critical in order to emphasize the connectivity of ecosystems—i.e., getting the public to understand that impacts upstream can have negative ramifications in coastal areas.
- **Dissemination.** The university system should be used to help with research and disseminating information. For example, participants noted that USDA has already established a strong relationship with the university system and EPA and other federal agencies could consider using these or other channels for information dissemination.
- **Living shorelines.** There is the potential for resolving issues with living shoreline permitting between Army Corps and state agencies. At the next nationwide permit reauthorization, there is an opportunity for EPA and other federal agencies working with the Corps to revisit the nationwide permits for bulkheads and to consider providing incentives for living shorelines methods.

### Gaps in regulations.

- **Stronger nutrient management plans/nutrient plans for other land uses.** While significant progress was noted in the implementation of the Neuse nutrient management plan, participants thought that more aggressive reductions are necessary (including, possibly, revising TMDLs) to realize water quality improvements at the mouth of the river, and that controls are needed to comprehensively address all contaminant sources impacting the Neuse River Basin.
- **LID retrofits.** LID is being used in both developed areas (retrofitting) and new development, however participants noted that more needs to be done to promote retrofitting of existing development in order to realize more significant water quality benefits.

**More staffing.** Lack of sufficient staffing hinders the state's ability to enforce and monitor wetland regulations and permit conditions.

- **Enforcement.** Reviewers were concerned that resource limitations translate into reduced field presence, compliance checks, and enforcement. Concern was expressed that NC DENR only has five or six wetland compliance and enforcement staff to cover the entire state.

**Gaps in addressing forestry and agricultural impacts.** Wetland impacts that fall outside of the wetland regulatory system complicate the determination of wetland impacts and acreage loss. Lack of current wetland mapping and land use data was cited as one current limitation to the ability to evaluate impacts of forestry and agricultural practices.

- **Forestry.** Additional documentation of what happens to areas that are clear-cut and how they regenerate is needed, as well as the impact of forestry practices on wetlands. Opportunities should be explored for developing online tools to provide public access to information such

as aerial photos and other information and data regarding forestry activities. In addition, a more thorough compilation of data regarding the over 20 years of forestry site inspections would allow more analysis of trends observed regarding compliance. Sustained staffing is needed to continue the intensive BMP surveys and BMP effectiveness study.

- **Monitoring wetland restoration and prior converted cropland.** State oversight of wetland restoration is quite thorough, but monitoring of community-based wetland restoration projects should be improved. Participants also noted that improvements should be made in tracking of prior converted croplands. In some cases the land has reverted back to wetland communities, and exhibits wetland characteristics, but is still considered "prior converted" land (determination made by NRCS). A benefit of tracking prior converted cropland would help identify potential wetland restoration opportunities.

### Gaps in data and mapping.

- **Water quality data.** There are a lot of people collecting water quality data but no central repository for easily accessing and analyzing the data. Additionally, consistent data standards and protocols are needed for data collection and analysis.
- **Mapping.** Participants acknowledged that better mapping is needed to capture wetland loss. National Wetlands Inventory data were viewed as inadequate due to their low resolution. Newer LiDAR data have a higher resolution, with single pixels representing 30 to 100 square feet. Higher-resolution data create the potential for developing models to identify and classify wetlands and to develop statistical algorithms capable of detecting even small cumulative impact wetland areas. LiDAR will also provide an opportunity to more easily resolve jurisdictional issues and predict impacts from sea level rise.

## Conclusion

The South Atlantic coastal wetland review is the second in a series that the EPA Coastal Wetlands Team conducted. The team has been able to gain a greater understanding of coastal wetland loss in the region, including important insights into the causes of these losses. Several common themes have emerged from the focal watershed reviews:

- Development pressures are a growing concern for directly and indirectly causing coastal wetland acreage loss and degradation.
- Hydrologic alterations including water diversions, mosquito impoundments, and ditching and draining for agriculture and forestry are important historic and current stressors.
- The limitations of regulations and lack of accurate characterization of coastal wetland losses are important issues that hinder the protection of coastal wetlands.
- The impact of sea level rise and other climate change issues were raised in both focal watershed reviews as stressors of concern; participants noted that more information is needed to assess the impacts of climate change stressors.

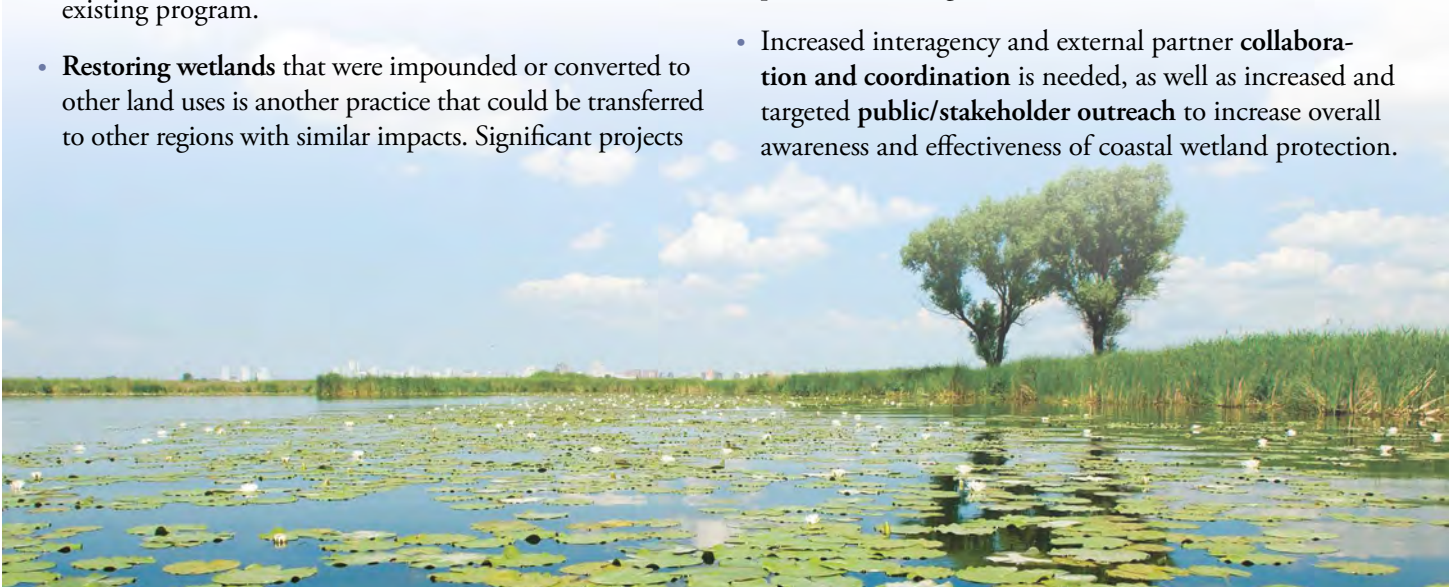
A number of tools and strategies were suggested that could effectively address the major stressors discussed on the previous pages, and could be transferred to other watersheds and regions:

- Both North Carolina and Florida have extensive **wetland mitigation banking programs**—Florida’s is based on functional mitigation, while North Carolina’s has been based on wetland area. North Carolina is moving toward a **functional assessment methodology** to supplement its existing program.
- **Restoring wetlands** that were impounded or converted to other land uses is another practice that could be transferred to other regions with similar impacts. Significant projects

are occurring in Florida and North Carolina to restore wetlands previously impounded for mosquito control or previously converted for agricultural use. These restoration efforts introduce **integrated management practices that can result in multiple benefits** to wetlands historically modified for a single purpose (e.g., mosquito control).

The participants identified key gaps that need to be filled to reduce the stressors and more effectively use these tools and strategies. Most commonly, they cited the following:

- **Resources** (staffing and funding) are needed to administer regulatory programs, conduct monitoring and assessment, ensure accurate wetland mapping, and conduct effective outreach programs.
- A comprehensive **central repository or database** for wetland-related data, as well as a common set of metrics to allow standardization and comparison of data, is needed to better track wetland impacts.
- **An evaluation** should be conducted to determine and address gaps in protection while identifying ways to streamline the permitting process and better document wetland impacts that occur outside wetland regulatory programs. Examples include assessing the effectiveness of forestry best management practices to minimize wetland impacts and assessing the effectiveness of mitigation programs.
- While some information is available on **predicted climate change impacts** on coastal wetlands, it would be helpful to have a better sense of how to use new as well as existing information to set priorities for land acquisition, design restoration projects, and implement such practices as living shorelines.
- Increased interagency and external partner **collaboration and coordination** is needed, as well as increased and targeted **public/stakeholder outreach** to increase overall awareness and effectiveness of coastal wetland protection.





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*For more information on the Coastal Wetlands Initiative, contact:*

Jennifer Linn  
Linn.Jennifer@epa.gov

Nancy Laurson  
Laurson.Nancy@epa.gov

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## Appendix A: Lower and Middle Neuse River Watershed and Indian River Lagoon Participant Lists

### SOUTH ATLANTIC FOCAL WATERSHED REVIEW PARTICIPANTS

#### Lower and Middle Neuse Participants

Larry Baldwin, Lower Neuse Riverkeeper  
Gail Bledsoe, N.C. Division of Forest Resources  
Mark Brinson, East Carolina University  
Dean Carpenter, Albemarle-Pamlico National Estuary Program (APNEP)  
Colleen Charles, USGS  
Lisa Cowert, NOAA  
Vernon Cox, N.C. Department of Agriculture and Consumer Services  
Carolyn Currin, NOAA  
Thomas Dahl, USFWS  
Molly Ellwood, N.C. Wildlife Resources Commission  
Donald Field, NOAA  
Tom Gerow, N.C. Division of Forest Resources  
John Jacobson, Neuse Riverkeeper Foundation  
Jimmy Johnson, representing Bill Crowell, APNEP  
David Jones, N.C. Division of Forest Resources  
Sarah King, N.C. Clean Water Management Trust Fund  
Scott McLendon, Army Corps, Wilmington District  
Todd Miller, North Carolina Coastal Federation  
Amanda Mueller, representing John Dorney  
N.C. Division of Water Quality  
Jessie O'Neal, N.C. Division of Marine Fisheries  
Charles Peterson, University of North Carolina  
Gloria Putnam, North Carolina Sea Grant,  
N.C. State University  
Dennis Register, N.C. Division of Forest Resources,  
New Bern District Water Quality Forester  
Lisa Schiavinato, North Carolina Sea Grant  
Ron Sechler, NOAA  
Susan Marie Stedman, NOAA  
Jack Thigpen, North Carolina Sea Grant,  
N.C. State University  
Christina Voss, University of North Carolina  
Tom Walker, Army Corps, Wilmington District  
Loren Wehmeyer, USGS North Carolina Water Science Center

#### Indian River Lagoon Participants

Linda Anderson, FL Department of Transportation (DOT)  
Jeff Beal, FL Fish and Wildlife Conservation Commission  
Tara Boujoulian, Volusia County  
Ronald Brockmeyer, St. Johns River Water Management District

Tony Cabbedge, St. Johns County  
Tamy Dabu, Army Corps Jacksonville District  
Jim David, St. Lucie County Mosquito Control  
Jennifer Derby, US EPA  
Donna Devlin, Florida Atlantic University  
Jessica Dostal, FL Fish and Wildlife Conservation Commission  
Kimberly Eisele, FL DEP  
Warren Falls, ORCA  
Aphidalin Fancon, City of Titusville  
Erin Gawera, USFWS Jacksonville  
Rick Gleeson, Guana Tolomato Matanzas NERR  
Steve Gornak, FL Fish and Wildlife Conservation Commission  
Kurtis Gregg, South Florida Water Management District  
Boyd Gunsalus, South Florida Water Management District  
David Gunter, Indian River Farms WCD  
Paul Haydt, St. Johns River Water Management District  
Hannah Hernandez, FL DOT D5  
Kathy Hill, St. Johns River Water Management District  
- IRL Program  
Brandon Howard, NOAA Fisheries WPB  
Stan Howarter, USFWS/Merritt Island NWR  
Eric Hughes, US EPA  
Charles Kelso, USFWS  
Drew Kendall, US EPA Region 4  
Linda Knoeck, Army Corps Palm Beach  
Nicole Love, FL DEP/CAMA/Guana Tolomato Matanzas NERR  
Nicole Martin, FL DEP  
Beth McMillen, Marine Resources Council  
Mark Mercadante, NASA  
Sean Meehan, NOAA  
Erik Neugaard, RS&H/FL DOT D4  
Bruce Peery, Indian River Mosquito Control District  
Lynne Phillips, NASA  
Lisa Prather, FL DEP  
Troy Rice, IRL NEP  
John Shaffer, NASA  
Erik Shilling, National Council for Air and Stream Improvement, Inc.  
Lauren Staly, FL DEP  
Susan-Marie Stedman, NOAA  
John Tucker, St. Lucie County  
Georgia Zerlin, Volusia County

## Appendix B: Background Documents

Document/Study Title	Author (Date)
<b>FLORIDA AND INDIAN RIVER LAGOON</b>	
Independent Scientific Review of the Indian River Lagoon – South	Bartell, S.M., J.J. Burns, D.G. Fontane, W.H. McAnally, L.H. Motz, R.R. Twilley (2004)
Rehabilitation of Impounded Estuarine Wetlands by Hydrologic Reconnection to the Indian River Lagoon, Florida (USA)	Brockmeyer, R.E., J.R. Rey, R.W. Virnstein, R.G. Gilmore, L. Earnest (1997)
Fact Sheet: Florida Waters	Clean Water Network (Undated)
Florida's Wetlands: An Update on Status and Trends 1985 to 1996	Dahl, Thomas USFWS, (2005)
Emerging Issues in Wetland Loss Mitigation	Duke University, Nicholas School, Tamara Hill (2006)
State Wetland Program Evaluation: Phase II	Environmental Law Institute (2003)
Measuring the Benefits of Federal Wetland Programs,	Scodari, P. (Environmental Law Institute) (1997)
National Estuary Program Coastal Condition Report - Chapter 4: Southeast National Estuary Program Coastal Condition, Indian River Lagoon National Estuary Program	EPA OWOW (2007)
Threats to Wetlands Fact Sheet	EPA OWOW (2001)
Florida Coastal and Ocean Policy Report Card	Florida Coastal and Ocean Coalition (2009)
Florida Numeric Nutrient Criteria History and Status	FLDEP (2009)
Environmental Resource Permitting (ERP) and Sovereign Submerged Lands (SSL) Rules - Statewide Stormwater Treatment Rule Development Background	FLDEP (2008)
Summary of the Wetland and Other Surface Water Regulatory and Proprietary Programs in FL	FLDEP (2007)
CZMA Section 319 Final Assessment and Strategies FY 2006 – 2010	FLDEP, FL Coastal Management Program (2006)
FACT Florida Assessment of Coastal Trends 2000	FLDEP, FL Coastal Management Program (2000)
Florida State of the Coast Report 1998	FLDEP, FL Coastal Management Program (Prepared by: Apalachee Regional Planning Council 1998)
Indian River - Malabar to Vero Beach Aquatic Preserve	FLDEP (Undated)
Preparing for a Sea of Change in Florida – A Strategy to Cope with the Impacts of Global Warming on the State's Coastal and Marine Systems	Florida Ocean and Coastal Commission (2008)
Florida Numeric Nutrient Criteria History and Status Summary	FLDEP (2009)
Florida's Aquatic Preserves – Protecting Our Most Valued Resources: A Program Overview	FLDEP, Office of Coastal and Aquatic Managed Areas (2006)

Document/Study Title	Author (Date)
<b>FLORIDA AND INDIAN RIVER LAGOON</b>	
Florida's Aquatic Preserves – Management Review Process website	FLDEP Office of Coastal and Aquatic Managed Areas (Undated)
1990 Coastal Population in Florida – A Report to Florida's Coastal Managers	FL State University, Institute of Science and Public Affairs (1998)
South Atlantic Regional Research Project: Developing Research Priorities: Process and Partnerships and South Atlantic Regional Research Plan	Alber and Laporte, GA Coastal Research Council, (2009)
Marsh Dieback Workshop Proceedings	GA Coastal Research Council (2004)
U.S. Ocean Policy Report Card 2007	Joint Ocean Commission Initiative (2007)
Sea Level Rise and Coastal Impacts - Presentation	Leatherman, S., International Hurricane Center, Florida International University (Date unknown)
Shoreline Protection Program [website]	Marine Resources Council (2007)
Restoration of Coastal Wetlands in Southeastern Florida	Milano, G.R., Miami-Dade Department of Environmental Resources (1999)
The Nature Conservancy Indian River Lagoon Preserve Overview	Nature Conservancy (Undated)
Minimum Flows and Levels Method of the St. Johns River Water Management District, Florida, USA	Neubauer, C.P., G.B. Hall, E.F. Lowe, C.P. Robison, R.B. Hupalo, L. W. Keenan (2008)
Indian River Lagoon Newsletter Quarterly Update	SJWMD (Quarterly 2007, 2008, 2009)
Mapping the Distribution and Abundance of Macroalgae in the Indian River Lagoon	SJWMD, Prepared by Nova Southeast University Oceanographic Center (2009)
Mapping the Distribution and Vertical Extent of Muck in the Indian River Lagoon	SJWMD, Prepared by Nova Southeast University Oceanographic Center (2009)
The Canal 1 Rediversion Project (Fact sheet)	SJWMD (2009)
Update to the Indian River Lagoon CCMP	SJWMD Indian River Lagoon NEP (2008)
Petition to Designate Florida Outstanding Waters – Matanzas River Basin	SJWMD Memorandum From Tara Boonstra, Assistant General Counsel (2008)
Indian River Lagoon Economic Assessment and Update	SJWD (2008)
Indian River Lagoon – An Introduction to a National Treasure	SJWMD (2007)
Indian River Lagoon Surface Water Improvement and Management (SWIM) Plan	SJWMD and SFWMD (2002)
Historical Imagery Inventory and Sea Grass Assessment Indian River Lagoon	SJWMD, Indian River Lagoon National Estuary Program, Prepared by Woodward Clyde Consultants, Marshall McCully Associates and Natural Systems Analysts, Inc, (1994)
Loading Assessment of the Indian River Lagoon	SJWMD, Indian River Lagoon National Estuary Program, Prepared by Woodward Clyde Consultants, Marshall McCully Associates and Natural Systems Analysts, Inc, (1994)

Document/Study Title	Author (Date)
<b>FLORIDA AND INDIAN RIVER LAGOON</b>	
Non-Governmental and Governmental Programs for the Indian River Lagoon	SJWMD, Indian River Lagoon National Estuary Program, Prepared by Woodward Clyde Consultants, Marshall McCully Associates and Natural Systems Analysts, Inc, (1994)
Status and Trends Summary for the Indian River Lagoon	SJWMD, Indian River Lagoon National Estuary Program, Prepared by Woodward Clyde Consultants, Marshall McCully Associates and Natural Systems Analysts, Inc, (1994)
Indian River Lagoon CCMP	SJWMD Indian River Lagoon National Estuary Program, 2008 Update (2008)
St. John's River District Water Management Plan	SWJMD (2005)
Aquatic Grasses Fact Sheet	SJWMD (2003)
Minimum Flows and Levels Fact Sheet	SJWMD (2001)
Maps of Lands Vulnerable to Sea Level Rise: Modeled Elevations along the U.S. Atlantic and Gulf Coasts	Titus, J. G. and C. Richman (originally published in Climate Research (2001)
Coastal Wetlands of the Indian River Lagoon	University of Florida - IFAS (2009)
Florida's Wetland Threats and Loss	University of Florida IFAS Extension
Florida's Wetlands – Education Programs	University of Florida IFAS Extension (Undated)
Final Report: Coastal Wetland Indicators	Morris, J. T. et al., University of South Carolina, Marine Biological Laboratory (2006)
Indian River Lagoon - South (Fact sheet)	Army Corps (2008)
Central and Southern Florida Project Indian River Lagoon – South Final Integrated Project Implementation Report and Environmental Impact Statement	Army Corps Jacksonville District and South Florida Water Management District (2004)
Comprehensive Everglades Restoration Plan List of Projects	Army Corps and SFWMD (2010)
Historical Trends in Wetlands Loss and Efforts to Intervene (Presentation)	US Forest Service T. Leininger and P. Hamel (2007)
Southern Forest Resource Assessment	US Forest Service Southern Region (2003)
South Carolina's Wetlands: Status and Trends, 1982-1989	USFWS (1999)
Wetlands Inventory Status and Trends [website]	USFWS (Undated)
Florida's Wetlands Fact Sheet	US Geological Survey Marine and Coastal Geology Program (1996)
Global Climate Impacts in the US; Regional Climate Impacts in Southeast US	USGCRP (2009)
Wetland Losses in the US: Scope, Causes, Impacts, and Future Prospects	USGCRP Seminar (1997)

Document/Study Title	Author (Date)
<b>MIDDLE AND LOWER NEUSE RIVER WATERSHEDS</b>	
Critical Areas Chapter Pamlico Sound Summary	Adams, D. (NC State Univ.) et al.
Revised Framework for Mitigation Review in NC - April 22, 2008	Army Corps (2008)
Wetlands Mitigation Map	Army Corps (2010)
Integrated Feasibility Report and Environmental Impact Statement for the Neuse River Basin, North Carolina	Army Corps (2005)
An Estuary of National Significance [website]	Albemarle-Pamlico National Estuary Program (2009)
Soundings Newsletter	Albemarle-Pamlico National Estuary Program (January, 2009)
Soundings Newsletter	Albemarle-Pamlico National Estuary Program (July, 2009)
Work Plan for the Cooperative Agreement Between The US Environmental Protection Agency and NC Department of Environment and Natural Resources – Albemarle-Pamlico Estuary Program October 1, 2009 – September 30, 2010	Albemarle-Pamlico National Estuary Program (2008)
Albemarle-Pamlico National Estuary Program Outreach and Communication Strategy 2008-2010	Albemarle-Pamlico National Estuary Program (Undated)
Clean Water for the 21st Century – Fact Sheet	Albemarle-Pamlico National Estuary Program (Undated)
Albemarle-Pamlico Estuarine System – Technical Analysis of Status and Trends	Albemarle-Pamlico Estuarine Program (1991)
Proceedings of the Workshop on Remote Sensing and GIS for Use in Managing AP Sound	Albemarle-Pamlico National Estuary Program (1987)
Recommendation for Appropriate Shoreline Stabilization Methods for the Different North Carolina Estuarine Shoreline Types	Bendell, B.M et al.
Impacts of Global Climate Change on North Carolina's Coastal Economy Poster	Bin O, et al. (2007)
Hydrology and nutrient gradients in North Carolina peatlands	Bridgham, S. D., and C.J., Richardson (1993)
Global climate change and sea-level rise: estimating the potential for submergence of coastal wetlands	Cahoon, D.R., J.W. Day, R.S. Young and D.J. Reed (1998)
Factors affecting coastal wetland loss and restoration: synthesis of U.S. Geological Survey science for the Chesapeake Bay ecosystem and implications for environmental management	Cahoon, D.R. (2007)
Wetland alteration trends on the North Carolina coastal plain	Cashin, G. E., J. R. Dorney, and C.J. Richardson (1992)
Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research	Climate Change Science Program (CCSP) (2009)
The Ecology of Albemarle Sound, North Carolina: An Estuarine Profile	Copeland, B.J., R.G. Hodson, S.R. Riggs, and J.E. Easley, Jr, (1983)
Albemarle-Pamlico Summary	Copeland, B.J. NC State University (Undated)



Document/Study Title	Author (Date)
<b>MIDDLE AND LOWER NEUSE RIVER WATERSHEDS</b>	
Shoreline change within the Albemarle-Pamlico Estuarine System, North Carolina. East Carolina University	Corbett, D.R., et al.
Survey of State Freshwater Wetland Protection Programs	Christy, D. (Undated)
Rapid shoreward encroachment of salt marsh cordgrass in response to accelerated sea-level rise	Donnelly, J.P. and M.D. Bertness (2001)
State Wetland Programs: North Carolina	Dorney, J., D. Hugget, and R. Ferrell (2004)
The puzzle of global sea level rise	Douglas, B.C. and E.R. Peltier (2002)
Coastal Pollution from Septic Tank Drainfields	Duda, A.M. and K.D. Cromartie (1982)
Increasing destructiveness of tropical cyclones over the past 30 years	Emanuel, K. (2005)
State Wetland Program Evaluation: Phase I	Environmental Law Institute (2005)
Section 319 Nonpoint Source Program Success Story: North Carolina	EPA, Office of Water (2006)
Wetland Program Development Grants (WPDGs) Case Studies	EPA (undated)
National Estuary Program Coastal Condition Report, Chapter 4: Southeast National Estuary Program Coastal Condition, Albemarle-Pamlico National Estuary Program	EPA (2007)
Ecosystem Enhancement Program Update Presentation at the 10th Annual Mitigation and conservation Banking Conference	Gilmore, W. 2007
Water-Quality Trends in the Neuse River Basin, North Carolina, 1974-2003	Harned, D. (2003)
Water-quality trends and basin activities and characteristics for the Albemarle-Pamlico estuarine system, North Carolina and	Harned D., and M.S. Davenport (1990)
Duke set to give N.C. coast \$1 million	Henderson, B. (March 3, 2009)
Summary for policymakers: Contribution of working group I to the fourth assessment report of the Intergovernmental Panel on Climate Change	IPCC (2007)
Stormwater Success Along the Neuse	Loughner, L. (Nov-Dec 2004)
A coupled geomorphic and ecological model of tidal marsh evolution	Kirwan, M.L. and A.B. Murray (2007)
North Carolina statistical data [Web site]	Log in to North Carolina (2009)
Water-Quality Assessment of the Albemarle-Pamlico Drainage Basin, North Carolina and Virginia – Environmental Setting and Water-Quality Issues	McMahon, G. and O. Lloyd (1995)
Response of wetlands to rising sea level in the lower coastal plain of North Carolina	Moorehead, K.K. and M.M. Brinson (1995)
Presentation of NC Coastal Wetland Regulations	Moye, D.



Document/Study Title	Author (Date)
<b>MIDDLE AND LOWER NEUSE RIVER WATERSHEDS</b>	
Billion Dollar Climate and Weather Related Disasters (1980-2009)	National Climatic Data Center (2009)
Make a Tide Prediction, State and Region Listing: North Carolina	NOAA (2008)
Barrier Island Ecology of Cape Lookout National Seashore and Vicinity, North Carolina	NPS (2004)
Annual Progress Report on the Neuse Agricultural Rule	Neuse Agricultural Basin Oversight Committee (2007)
Living Shorelines Project [Web site] & Living Shorelines Fact Sheet	North Carolina Coastal Federation (2004)
NC Clean Water Management Trust Fund Fact Sheet	North Carolina Coastal Federation (2004)
North River Farms Fact Sheet	North Carolina Coastal Federation (2004)
State of the Coast Report 2009	North Carolina Coastal Federation (2009)
Beaufort County Joint CAMA Land Use Plan 2006 Update	North Carolina Coastal Management Program (2008)
Agricultural Statistics - Summary of Commodities by County [website]	North Carolina Department of Agriculture and Consumer Services (2009)
Ecosystem Enhancement Program, 2009 Annual Report	NC DENR (2009)
Ecosystem Enhancement Program, 2009 Quarterly Report April-June 2009	NC DENR (2009)
North Carolina Coastal Region Evaluation of Wetland Significance	NC DCM (1999)
Guide to the North Carolina Wetlands Restoration Program's	NC DENR (2001)
Wetlands: Restoration [website]	NC DCM (2008)
Summary of DCM's Wetland Mapping Products	NC DCM (2003)
A Guide to Implementing Neuse River Basin and Tar-Pamlico River Basin Riparian Buffer Rules for Forest Management Activities	NC DFR (2009)
Neuse River Basinwide Water Quality Plan	NC DWQ (2009)
Neuse River Basinwide Water Quality Plan Executive Summary	NC DWQ (2009)
NC Wetland Assessment Method – A new world for wetland permitting and mitigation - Presentation	NC DWQ (2009)
Nonpoint Source Management Program: Tar-Pamlico Nutrient Strategy [website]	NC DWQ (2009)
Isolated Wetlands Permitting Effective April 1 2003	North Carolina General Assembly (2003)
15A NCAC Subchapter 7H- State Guidelines for Areas of Environmental Concern section .0100 – Introduction and General Comments	North Carolina General Assembly (1974)

Document/Study Title	Author (Date)
<b>MIDDLE AND LOWER NEUSE RIVER WATERSHEDS</b>	
SECTION .0200 – The Estuarine and Oceans System Management Program	North Carolina General Assembly (1998)
SECTION .1300 – Discharges to Isolated Wetlands and Isolated Waters	North Carolina General Assembly (2003)
Developing a Management Strategy for North Carolina's Coastal Ocean: Draft Report for Public Comment	NC Ocean Policy Steering Committee (2009)
Executive Order 122 – Establishment of a Program Office in Support of the Albemarle-Pamlico NEP	Governor Easley, State of North Carolina (2007)
Neuse Riverkeepers Annual Meeting Report 2009	Neuse Riverkeeper (2009)
Neuse River Stressors	NRDC (1998)
Rivernotes August 2007	NRF (2007)
Rivernotes Fall 2009	NRF (2009)
Agriculture Riparian Buffers	Osmond, D.L. (Undated)
Agriculture and the Neuse River Basin	Osmond, D.L., D. Hardy, L.H. Johnson, W.G. Lord, R.H. Pleasants, M.E. Regans (Undated)
Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise	Pfeffer, W.T. (2008)
Sea Level Rise Research and Dialogue in North Carolina: Creating Windows for Policy Change	Poulter, B, et al. (2009)
Applications of network analysis for adaptive management of artificial drainage systems in landscapes vulnerable to sea level rise	Poulter, B., J.L. Goodall, P.N. Halpin (2008)
Raster modeling of coastal flooding from sea-level rise	Poulter, B. and P.N. Halpin (2007)
North Carolina's Coasts in Crisis: A Vision for the Future	Riggs, S.R. et al.
Effect of Storms on Barrier Island Dynamics, Core Banks, Cape Lookout National Seashore, North Carolina	Riggs, S.R. and D.V. Ames (2007)
Drowning the North Carolina Coast: Sea-level Rise and Estuarine Dynamics	Riggs, S.R. and D.V. Ames (2003)
Influence of inherited geologic framework on barrier shoreface morphology and dynamics	Riggs, S.R., W.J. Cleary and S.W. Snyder (1995)
Habitat Connections: Wetlands, Fisheries and Economics	Stedman, S. and J. Hanson (Undated)
Wetland development trends in coastal North Carolina, USA, from 1970 to 1984	Stockton, M., B. and C.J. Richardson (1987)
North Carolina Coastal Habitat Protection Plan	Street, M.W., A.S. Deaton, W.S. Chappell and P.D. Mooreside (2005)
Wetlands Protection in the Face of Sea-level Rise: Developing a Local Land Use Tool Kit – Presentation	Stiles, S. (2008)
State of the Beach Report – North Carolina	Surfrider website (Undated)
DCM wetland mapping in coastal North Carolina	Sutter, L. (1999)

Document/Study Title	Author (Date)
<b>MIDDLE AND LOWER NEUSE RIVER WATERSHEDS</b>	
Greenhouse effect, sea level rise, and coastal wetlands (EPA 230-05-86-013)	Titus, J.G. (ed.) (1988)
Maps of land vulnerable to sea level rise: modeled elevations along the U.S. Atlantic and Gulf Coasts	Titus, J.G. and C. Richman (2001)
Maps of Lands Close to Sea Level along the Middle Atlantic Coast of the United States: An Elevation Data Set to Use While Waiting for LIDAR. Section 1.1 in: Background Documents Supporting Climate Change Science Program Synthesis and Assessment Product 4.1.	Titus J.G. and J. Wang (2008)
Coastal Wetlands and Coastal Change	USGS (1997)
Environmental Injustice in North Carolina's Hog Industry	Wing, S., D. Cole and G. Grant (2000)
Model for Geospatial Vegetation, Impervious Surfaces, Soils, and Topographic Analysis (VISSTA)	Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) (2008)

## Appendix C: Section 404 of the Clean Water Act

**Overview:** Section 404 of the Clean Water Act establishes a permit program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Activities in waters of the United States regulated under this program include fill for associated with development, water resource projects (such as dams and levees that are not part of the construction of federal projects specifically authorized by Congress), infrastructure development (such as highways and airports) and mining projects.

Under a rule promulgated pursuant to Section 404(b)(1) of the Clean Water Act, no discharge of dredged or fill material may be permitted if: (1) a practicable alternative exists that is less damaging to the aquatic environment so long as that alternative does not have other significant adverse environmental consequences or (2) the nation's waters would be significantly degraded. Section 404 permitting ensures that dredge and fill projects only proceed if an applicant first has shown that steps have been taken to avoid impacts to wetlands, streams, and other aquatic resources; that potential impacts have been minimized; and — only after the first two measures have been taken — that compensation is provided for all remaining unavoidable impacts.

**Permits:** Proposed activities are regulated through a permit review process. An **individual permit** is required for projects with more than minimal adverse effects. Individual permits are reviewed by the Army Corps, which evaluates applications under a public interest review, as well as the environmental criteria set forth in the Section 404(b)(1) Guidelines promulgated by EPA in conjunction with the Army Corps. However, for most discharges that will have only minimal adverse effects, a **general permit** may be suitable. General permits are issued on a nationwide, regional, or state basis for particular categories of activities. The general permit process eliminates individual review and allows certain activities to proceed with little or no delay, provided that the general, regional, and any special conditions for the general permit are met. For example, minor road activities, utility line backfill, and bedding are activities that can be considered for a general permit. For more information, see: <http://water.epa.gov/lawsregs/guidance/cwa/dredgdis/> and <http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits.aspx>.

**Jurisdiction:** Though a number of activities may impact the nation's waters, Section 404 applies to **dredge and fill activities** only (Section 402 of the Clean Water Act regulates point source discharges of pollutants into waters of the United States). Additionally, the Clean Water Act only applies to **"waters of the United States."** EPA and the Army Corps have issued regulatory definitions of "waters of the United States" to include waters that are: traditionally navigable;

interstate; could affect interstate commerce if used, degraded, or destroyed; territorial seas; impoundments of jurisdictional waters; tributaries of jurisdictional waters; and wetlands adjacent to jurisdictional waters. The agencies' regulatory definition of "waters of the United States" provides exclusions for waste treatment systems and prior converted cropland. U.S. Supreme Court decisions in *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers* and *Rapanos v. United States* and subsequent agency guidance have provided further interpretation of which waterbodies are protected by the Clean Water Act. For the most recent guidance on Clean Water Act geographic jurisdiction, see: <http://water.epa.gov/lawsregs/guidance/wetlands/CWAwaters.cfm>. Lastly, the **regulatory definition of wetlands**, "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions," may exclude some areas which are defined as wetlands for other purposes (e.g., under the Cowardin classification system).

**Exemptions:** In general, Section 404 of the Clean Water Act requires permits for the discharge of dredged or fill material into waters of the United States, including wetlands. However, certain activities are exempt from permit requirements under Section 404(f). These include dredge and fill activities related to established (ongoing) farming, silviculture, or ranching practices; certain temporary activities; and certain maintenance activities (e.g., of drainage ditches, farm ponds, or stock ponds). The exemptions are limited in their application. For example, a permit must be obtained for an activity whose purpose is to convert an area of the waters of the United States into a use to which it was not previously subject, where the flow or circulation of waters of the United States may be impaired, or the reach of such waters reduced (33 CFR 323.4). Some projects are also required to implement Best Management Practices in order to remain exempt. See <http://water.epa.gov/type/wetlands/outreach/fact20.cfm> for more information regarding Section 404 exemptions.

**Mitigation:** Compensatory mitigation involves actions taken to offset unavoidable adverse impacts to wetlands, streams, and other aquatic resources authorized by Section 404 permits and other Department of the Army permits. Compensatory mitigation can be carried out through four methods: the restoration of a previously existing or degraded wetland or other aquatic site, the enhancement of an existing aquatic site's functions, the establishment (i.e., creation) of a new aquatic site, or the preservation of an existing aquatic site. For impacts authorized under Section 404, compensatory mitigation is not considered until after all appropriate and practicable steps have been taken to first avoid and then minimize

## Appendix C: Section 404 of the Clean Water Act

adverse impacts to the aquatic ecosystem. For more information, see: [http://water.epa.gov/lawsregs/guidance/wetlands/wetlandsmitigation\\_index.cfm](http://water.epa.gov/lawsregs/guidance/wetlands/wetlandsmitigation_index.cfm).

**Compensatory Mitigation Rule:** In 2008, the Army Corps and EPA issued regulations governing compensatory mitigation for activities authorized by permits issued by the Department of the Army (see [http://water.epa.gov/lawsregs/guidance/wetlands/upload/2008\\_04\\_10\\_wetlands\\_wetlands\\_mitigation\\_final\\_rule\\_4\\_10\\_08.pdf](http://water.epa.gov/lawsregs/guidance/wetlands/upload/2008_04_10_wetlands_wetlands_mitigation_final_rule_4_10_08.pdf)). The regulations establish performance standards and criteria for the use of permittee-responsible compensatory mitigation, mitigation banks, and in-lieu programs to improve the quality and success of compensatory mitigation projects for permitted activities. This rule improves the planning, implementation, and management of compensatory mitigation projects by emphasizing a watershed approach in selecting compensatory mitigation project locations, requiring measurable, enforceable ecological performance standards and regular monitoring for all types of compensation, and specifying the components of a complete compensatory mitigation plan, including assurances of long-term protection of compensation sites, financial assurances, and identification of the parties responsible for specific project tasks. Since a mitigation bank must have an approved mitigation plan and other assurance in place before any of its credits can be used to offset impacts, this rule establishes a preference for the use of mitigation bank credits, which reduces some of the risks and uncertainties associated with compensatory mitigation.

**Mitigation Bank:** Mitigation banking involves off-site compensation activities generally conducted by a third-party mitigation bank sponsor. A mitigation bank is a site, or suite of sites, where aquatic resources (e.g., wetlands, streams, riparian areas) are restored, established, enhanced, and/or preserved for the purpose of providing compensatory mitigation for impacts authorized by Department of the Army permits. In general, a mitigation bank sells compensatory mitigation credits to permittees to meet their requirements for compensatory mitigation. The value of these “credits” is determined by quantifying the aquatic resource functions or acres restored or created. The bank sponsor is ultimately responsible for the success of the project.

**In-lieu Fee Mitigation:** In-lieu fee mitigation involves off-site compensation activities generally conducted by a third party in-lieu fee program sponsor. Through an in-lieu fee program, a governmental or non-profit natural resources management entity collects funds from multiple permittees in order to pool the financial resources necessary to build

and maintain the mitigation site or suite of sites. The in-lieu fee sponsor is responsible for the success of the mitigation. In-lieu fee mitigation typically occurs after the permitted impacts.

**Permittee-Responsible Mitigation:** Permittee-responsible mitigation is the restoration, establishment, enhancement, or preservation of aquatic resources undertaken by a permittee in order to compensate for impacts resulting from a specific project. The permittee performs the mitigation after the permit is issued and is ultimately responsible for implementation and success of the mitigation. Permittee-responsible mitigation may occur at the site of the permitted impacts or at an off-site location within the same watershed.

### Roles & Responsibilities:

**Federal Agencies:** The roles and responsibilities of the federal resource agencies differ in scope. The Army Corps administers the day-to-day aspects of the program, makes individual and general permit decisions, and makes determinations regarding the extent and location of jurisdictional waters of the United States. The Army Corps and EPA jointly develop policy and guidance, such as the environmental criteria used in evaluating permit applications. EPA determines the scope of geographic jurisdiction and applicability of exemptions; approves and oversees state and tribal assumption; reviews and comments on individual permit applications; has authority to prohibit, deny, or restrict the use of any defined area as a disposal site; and can elevate specific cases under Section 404(q). In addition to jointly implementing the Section 404 program, EPA and the Army Corps share Section 404 enforcement authority, which is delineated in a 1989 Memorandum of Agreement. The Army Corps acts as the lead enforcement agency for all violations of Corps-issued permits. The Army Corps also acts as the lead enforcement agency for unpermitted discharge violations that do not meet the criteria for forwarding to EPA. EPA acts as the lead enforcement agency when an unpermitted activity involves repeat violator(s), flagrant violation(s), where EPA requests a class of cases or a particular case, or the Army Corps recommends that an EPA administrative penalty action may be warranted.

The U.S. Fish and Wildlife Service (USFWS) and NOAA's National Marine Fisheries Service evaluate impacts on fish and wildlife of all new federal projects and federally permitted projects, including projects subject to the requirements of Section 404 (pursuant to the Fish and Wildlife Coordination Act), and can elevate specific cases or policy issues pursuant to Section 404(q).

## Appendix C: Section 404 of the Clean Water Act

**States and Tribes:** States and tribes also have a role in Section 404 decisions, through state program general permits, water quality certification, or program assumption. Under Section 401 of the Clean Water Act, a federal agency may not issue a permit or license for an activity that may result in a discharge to waters of the United States until the state or tribe where the discharge would originate has granted or waived Section 401 certification. Pursuant to Section 401, a state or tribe may grant, grant with conditions, deny or waive 401 certification. States and tribes make their decisions to deny, certify, or condition permits or licenses based in part on the proposed project's compliance with EPA-approved water quality standards. Through 401 certifications, states and tribes can limit dredge and fill activities or require additional protective requirements.

State programmatic general permits (SPGPs) may be issued by the Army Corps in coordination with states or tribes to allow a state or tribe to review Section 404 permit applications and verify activities without additional Army Corps review, provided the activities have no more than minimal adverse effects individually and cumulatively. SPGPs are often limited to specific activities, geographic areas, resource types, and/or sizes of impacts and can provide a more streamlined permitting process for these activities.

In addition, the Clean Water Act gives states and tribes the option of assuming administration of the federal Section 404 permit program in certain waters within state or tribal jurisdiction. State/tribal assumed programs must be at least as comprehensive as the federal program.

Furthermore, more than a dozen states have developed their own permit programs, which they operate in coordination with the federal program. In some cases, state programs may protect a greater number of aquatic resources than fall under federal jurisdiction as waters of the United States. States may also have their own wetland mitigation, enforcement, and monitoring programs.

### Data & Information:

**Public Notice:** The Army Corps issues public notices to alert the public to new applications for Section 404 permits. Contained in this notice is a project description including the location, the activity, the estimated impacted acres, and details on the conceptual mitigation plan. Subsequent to the release of a public notice, the Army Corps initiates a comment period, usually lasting about 30 days, where the public can submit written comments or request a public hearing. Public notices are posted on the website of the issuing Army Corps District.

**Permits:** Permit records can be used to summarize and track wetland losses and gains in an area of interest, and to confirm the compliance of a particular dredge and fill project. For this reason, final Section 404 permit information is stored in a database operated by the Army Corps ("Operation and Maintenance Information Business Link Regulatory Module 2," or ORM2). ORM2 has been in operation since 2007. Some states with permit programs operate similar databases which can supplement federal permit information.

**Mitigation:** The "Regulatory In-lieu fee and Bank Information Tracking System" (RIBITS) is an online database developed by the Army Corps with support from EPA and USFWS to provide better information on mitigation and conservation banking and in-lieu fee programs across the country. RIBITS allows users to access information on the types and numbers of mitigation and conservation bank and in-lieu fee program sites, associated documents, mitigation credit availability, service areas, as well as information on national and local policies and procedures that affect mitigation and conservation bank and in-lieu fee program development and operation. For access, see: <http://geo.usace.army.mil/ribits..>

## Appendix D: NOAA Coastal Change Analysis Program

The Coastal Change Analysis Program (C-CAP) produces a nationally standardized database of land cover and land change information for the coastal regions of the United States. C-CAP products provide inventories of coastal intertidal areas, wetlands, and adjacent uplands, with the goal of monitoring these habitats by updating the land cover maps every five years.

C-CAP products are developed using multiple dates of Landsat (30-meter resolution) imagery and consist of raster based land cover maps for each date of analysis, as well as a file that highlights what changes have occurred between these dates and where the changes were located. C-CAP land cover is produced through documented, repeatable procedures using standard data sources, and includes extensive field sampling, validation, and standard quality control review procedures. It provides the “coastal expression” of the National Land Cover Database, a contribution to the Earth Cover layer of the National Spatial Data Infrastructure.

C-CAP data sets are not jurisdictional or intended for use in litigation. While efforts have been made to ensure that these data are accurate and reliable within the limits of current technology, NOAA cannot assume liability for any damages or misrepresentations caused by inaccuracies in the data, or as a result of the data to be used on a particular system. NOAA makes no warranty, expressed or implied, nor does the fact of distribution constitute such a warranty.

The intended use is in identifying regional landscape patterns and major functional niches (habitat), and for environmental impact assessment, urban planning, and zoning applications. C-CAP data will not identify individual species. This is a national and regional data set that should be used only as a screening tool for very local or site specific management decisions. Small features and changes should be verified with a higher resolution data source.

### C-CAP Wetland Classifications

Wetlands are areas dominated by saturated soils and often standing water. Their vegetation is adapted to withstand long-term immersion and saturated, oxygen-depleted soils. Wetlands are divided into two salinity regimes: palustrine for freshwater wetlands and estuarine for saltwater wetlands; they are further divided into forested, shrub/scrub, and emergent wetlands. Unconsolidated shores are also included as wetlands.

**Palustrine forested wetland:** Includes all tidal and non-tidal wetlands dominated by woody vegetation at least 5 meters in height, as well as all such wetlands in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent.

*Characteristic species:* Tupelo (*Nyssa*), cottonwood (*Populus deltoides*), bald cypress (*Taxodium distichum*), American elm (*Ulmus americana*), ash (*Fraxinus*), and tamarack.

**Palustrine scrub/shrub wetland:** Includes all tidal and non-tidal wetlands dominated by woody vegetation less than 5 meters in height, as well as all such wetlands in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent. The species present could be true shrubs, young trees and shrubs, or trees that are small or stunted due to environmental conditions.<sup>1</sup>

*Characteristic species:* Alders (*Alnus spp.*), willows (*Salix spp.*), buttonbush (*Cephalanthus occidentalis*), red osier dogwood (*Cornus stolonifera*), honeycup (*Zenobia pulverenta*), spirea (*Spiraea douglassii*), bog birch (*Betula pumila*), and young trees such as red maple (*Acer rubrum*) and black spruce (*Picea mariana*).

**Palustrine emergent wetland (persistent):** Includes all tidal and non-tidal wetlands dominated by persistent emergent vascular plants, emergent mosses, or lichens, as well as all such wetlands in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Plants generally remain standing until the next growing season. Total vegetation cover is greater than 80 percent.

*Characteristic species:* Cattails (*Typha spp.*), sedges (*Carex spp.*), bulrushes (*Scirpus spp.*), rushes (*Juncus spp.*), saw grass (*Cladium jamaicense*), and reed (*Phragmites australis*).

**Estuarine forested wetland:** Includes all tidal wetlands dominated by woody vegetation at least 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent. Total vegetation coverage is greater than 20 percent.

*Characteristic species:* red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*).

<sup>1</sup> Reference: Cowardin, L. M., V. Carter, F. C. Golet, and E. T. Laroe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31. U. S. Department of the Interior, Fish and Wildlife Service.



## Appendix D: NOAA Coastal Change Analysis Program

**Estuarine scrub/shrub wetland:** Includes all tidal wetlands dominated by woody vegetation less than 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent. Total vegetation coverage is greater than 20 percent.

*Characteristic species:* Sea-myrtle (*Baccharis halimifolia*) and marsh elder (*Iva frutescens*).

**Estuarine emergent wetland:** Includes all tidal wetlands dominated by erect, rooted, herbaceous hydrophytes (excluding mosses and lichens), and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is at least 0.5 percent and that are present for most of the growing season in most years. Perennial plants usually dominate these wetlands. Total vegetation cover is greater than 80 percent.

*Characteristic species:* Cordgrass (*Spartina spp.*), needlerush (*Juncus roemerianus*), narrow-leaved cattail (*Typha angustifolia*), southern wild rice (*Zizaniopsis miliacea*), common pickleweed (*Salicornia virginica*), sea blite (*Suaeda californica*), and arrow grass (*Triglochin maritimum*).

**Unconsolidated shore:** Unconsolidated material such as silt, sand, or gravel that is subject to inundation and redistribution due to the action of water. Characterized by substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves and currents produce a number of landforms representing this class.

*Characteristic land cover features:* Beaches, bars, and flats.

**Barren land:** Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other accumulations of earth material. Generally, vegetation accounts for less than 10 percent of total cover.

*Characteristic land cover features:* Quarries, strip mines, gravel pits, dunes, beaches above the high-water line, sandy areas other than beaches, deserts and arid riverbeds, and exposed rock.

**Open water:** All areas of open water, generally with less than 25 percent cover of vegetation or soil.

*Characteristic land cover features:* Lakes, rivers, reservoirs, streams, ponds, and ocean.

**Palustrine aquatic bed:** Includes tidal and non-tidal wetlands and deepwater habitats in which salinity due to ocean-derived salts is below 0.5 percent and which are dominated by plants that grow and form a continuous cover principally on or at the surface of the water. These include algal mats, detached floating mats, and rooted vascular plant assemblages. Total vegetation cover is greater than 80 percent.

*Characteristic vascular species:* Pondweed, horned pondweed (*Zannichellia palustris*), ditch grass (*Ruppia*), wild celery, waterweed (*Elodea*), riverweed (*Podostemum ceratophyllum*), water lilies (*Nymphaea*, *Nuphar*), floating-leaf pondweed (*Potamogeton natans*), water shield (*Brasenia schreberi*), and water smartweed (*Polygonum amphibium*).

*Floating surface species:* Duckweeds (*Lemna*, *Spirodela*), water lettuce (*Pista stratiotes*), water hyacinth (*Eichhornia crassipes*), water nut (*Trapa natans*), water fern (*Salvinia spp.*), and mosquito ferns (*Azolla*).

*Floating below-surface species:* Bladderworts (*Utricularia*), coontails (*Ceratophyllum*), and watermeals (*Wolffia*).

**Estuarine aquatic bed:** Includes tidal wetlands and deepwater habitats in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent and which are dominated by plants that grow and form a continuous cover principally on or at the surface of the water. These include algal mats, kelp beds, and rooted vascular plant assemblages. Total vegetation cover is greater than 80 percent.

*Characteristic species:* Kelp (*Macrocystis* and *Laminaria*), rockweeds (*Fucus* and *Ascophyllum*), red algae (*Laurencia*), green algae (*Halimeda* and *Penicillus*, *Caulerpa*, *Enteromorpha* and *Ulva*), stonewort (*Chara*), turtle grass (*Thalassia testudinum*), shoal grass (*Halodule wrightii*), manatee grasses (*Cymodocea filiformis*), widgeon grass (*Ruppia maritime*), sea grasses (*Halophila spp.*), and wild celery (*Vallisneria americana*).

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
EPA	Clean Water State Revolving Fund (CWSRF)	<p>CWSRF programs fund water quality protection projects for wastewater treatment, non-point source pollution control, and watershed and estuary management via low-interest loans. SRF fundable projects include wetland protection and restoration, as well as creation of constructed wetlands for stormwater or wastewater treatment (which can include adequate capacity to ensure habitat values as well as treatment of effluents).</p> <p><a href="http://water.epa.gov/grants_funding/cwf/cwsrf_index.cfm">http://water.epa.gov/grants_funding/cwf/cwsrf_index.cfm</a></p>
EPA	Ecological Research Program	<p>The Ecological Research Program in EPA's Office of Research and Development is studying ecosystem services to gain a better understanding of how to enhance, protect, and restore the services of nature. Scientists are providing the methods, models, and tools needed by policy decision-makers to make clear how our choices affect the type, quality, and magnitude of the services we receive from ecosystems. The primary objective in the wetland research focus area is to document the range and quantity of wetland services and determine how their position on the landscape alters the provision of ecosystem services.</p> <p><a href="http://www.epa.gov/research/npd/ecoresearch-intro.htm">http://www.epa.gov/research/npd/ecoresearch-intro.htm</a></p>
EPA	Five Star Challenge Grants Program	<p>The purpose of the program is to support community-based efforts to restore wetlands, river streams/corridors, and coastal habitat; build diverse partnerships within the community; and foster local stewardship of resources through education, outreach, and training activities.</p> <p><a href="http://www.nfwf.org/fivestar/">http://www.nfwf.org/fivestar/</a></p>
EPA	National Estuary Program (NEP)	<p>This program works to restore and maintain the water quality and ecological integrity of estuaries of national significance. EPA provides funding and technical assistance to NEPs to create and implement a Comprehensive Conservation and Management Plan (CCMP) to address problems facing their estuary and surrounding watershed. NEPs involve community members and other key federal, state, and local partners/stakeholders to articulate goals and actions to address the wide range of issues in their CCMP. Key CCMP focus areas include protecting and restoring habitats such as wetlands. There are 28 NEPs along the coasts each guided by a director and staff.</p> <p><a href="http://water.epa.gov/type/oceb/nep/index.cfm">http://water.epa.gov/type/oceb/nep/index.cfm</a></p>
EPA	Nonpoint Source Management Grants (Section 319 Grants)	<p>Nonpoint source management grants support states, territories, and Indian tribes with a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects, some of which include coastal wetland restoration projects. A state/territory/tribe's Nonpoint Source Management Program serves as the basis for how funds are spent.</p> <p><a href="http://www.epa.gov/owow_keep/NPS/cwact.html">http://www.epa.gov/owow_keep/NPS/cwact.html</a></p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
EPA	Wetlands Program Development Grants (WPDG)	<p>The Wetlands Program Development Grants give eligible applicants an opportunity to conduct projects that promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution. While WPDGs can be used by recipients to build and refine any element of a comprehensive wetland program, priority will be given to funding projects that address the three priority areas identified by EPA: developing a comprehensive monitoring and assessment program; improving the effectiveness of compensatory mitigation; and refining the protection of vulnerable wetlands and aquatic resources. States, tribes, local governments, interstate associations, intertribal consortia, and national nonprofit, non-governmental organizations are eligible to apply.</p> <p><a href="http://water.epa.gov/grants_funding/wetlands/grantguidelines/index.cfm">http://water.epa.gov/grants_funding/wetlands/grantguidelines/index.cfm</a></p>
FHWA	Project Funds	<p>All federal highway projects require mitigation for unavoidable wetland impacts. FHWA mitigation regulations require a net gain of wetland acres for new project impacts as well as retroactive for past project impacts.</p>
FHWA	Surface Transportation Environment and Planning Cooperative Research Program (STEP)	<p>STEP is a federally administered research program authorized in the “Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users” (SAFETEA-LU). It improves the understanding of the relationship between surface transportation, environment and planning. STEP implements a national research agenda reflecting national priorities based on input and feedback from partners and stakeholders. STEP funds identify, address, and reassess national research priorities for environment, planning and realty, and develop tools to support these areas. STEP environmental emphasis areas include air quality and global climate change; and water/wetlands/vegetation/wildlife habitat/brownfields.</p> <p><a href="http://www.fhwa.dot.gov/hep/step/">http://www.fhwa.dot.gov/hep/step/</a></p>
FHWA	Transportation Enhancements	<p>Transportation Enhancement (TE) activities offer funding opportunities to help expand transportation choices and enhance the transportation experience through 12 eligible TE activities related to surface transportation, including landscaping and scenic beautification and environmental mitigation.</p> <p><a href="http://www.fhwa.dot.gov/environment/te/">http://www.fhwa.dot.gov/environment/te/</a></p>
FWS	Coastal Barrier Resources Act (CBRA)/ Coastal Barrier Resources System (CBRS)	<p>CBRA discourages development on 3.1 million acres of coastal barrier and associated aquatic habitat by prohibiting most federal expenditures (e.g., flood insurance, road construction, new channel dredging). These areas are designated on maps adopted by Congress as the John H. Chafee Coastal Barrier Resources System. In addition to providing a level of protection to 3.1 million acres, CBRA is estimated to have saved taxpayers over \$1 billion.</p>
FWS	Coastal Program	<p>Voluntary partnership program to protect, restore, and enhance priority coastal habitat that benefits federal trust species on public and private lands. It provides technical and financial assistance through partnerships with federal, state, local governments; tribes; organizations; academic institutions; and private landowners. The program is delivered through a network of field staff in 23 priority coastal watersheds around the country. Assistance instruments are primarily cooperative agreements but grant agreements and wildlife extension agreements are also used. Decisions regarding partnerships are made at the landscape level. Since 1994, the Coastal Program has executed over 2,000 agreements to restore 295,000 acres of coastal habitat and 1,700 stream miles, and protect close to 2 million acres of coastal habitat.</p> <p><a href="http://www.fws.gov/coastal">http://www.fws.gov/coastal</a></p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
FWS	Cooperative Endangered Species Conservation Fund	<p>The Cooperative Endangered Species Conservation Fund (CESCF; Section 6 of the Endangered Species Act) is the component of the FWS Endangered Species program that provides grant funding to states and territories for species and habitat conservation actions on non-federal lands, including habitat acquisition, conservation planning, habitat restoration, status surveys, captive propagation and reintroduction, research, and education. Many of these grants involve coastal areas and wetland habitat.</p> <p><a href="http://www.fws.gov/endangered/grants/grant-programs.html">http://www.fws.gov/endangered/grants/grant-programs.html</a></p>
FWS	Endangered Species Conservation Grants	<p>Provides financial assistance to states and territories to implement conservation projects for listed species and at-risk species. Funded activities include habitat restoration, species status surveys, public education and outreach, captive propagation and reintroduction, nesting surveys, genetic studies, and development of management plans.</p> <p><a href="http://www.fws.gov/endangered/grants/grant-programs.html">http://www.fws.gov/endangered/grants/grant-programs.html</a></p>
FWS	Endangered Species HCP Land Acquisition Grants	<p>Provides funding to states and territories to acquire land associated with approved Habitat Conservation Plans (HCP). Grants do not fund the mitigation required of an HCP permittee; instead, they support conservation actions by the state or local governments that complement mitigation.</p> <p><a href="http://www.fws.gov/endangered/grants/grant-programs.html">http://www.fws.gov/endangered/grants/grant-programs.html</a></p>
FWS	Endangered Species Program	<p>The Endangered Species Program conserves imperiled plant and animal species and the ecosystems upon which they depend, while promoting the voluntary conservation of other vulnerable wildlife and their habitat. The program strives to ensure a strong scientific basis for decisions on threatened and endangered species, facilitate large-scale planning to accommodate land use and wildlife habitat, and promote innovative public/private partnerships. Components of the program include technical assistance, outreach and education, grant assistance, and regulatory actions. Many activities involve efforts to conserve coastal areas and wetlands provide important habitat for threatened or endangered species, species at risk of becoming threatened or endangered.</p> <p><a href="http://www.fws.gov/endangered/">http://www.fws.gov/endangered/</a></p>
FWS	Endangered Species Recovery Land Acquisition Grants	<p>Provides funds to states and territories for acquisition of habitat for endangered and threatened species in support of draft and approved recovery plans. Acquisition of habitat to secure long-term protection is often an essential element of a comprehensive recovery effort for a listed species.</p> <p><a href="http://www.fws.gov/endangered/grants/grant-programs.html">http://www.fws.gov/endangered/grants/grant-programs.html</a></p>
FWS	Migratory Bird Conservation Fund	<p>Provides the DOI with financing for the acquisition of migratory bird habitat, including wetlands. Decisions regarding purchases of land and water areas by FWS are made by the Migratory Bird Conservation Commission based on recommendations from the Service. The Small Wetland Program allows the proceeds from the sale of Federal Duck Stamps to be used to protect waterfowl habitat in perpetuity through fee-title acquisition or easement. The habitat protected consists of small wetlands, and surrounding grassland habitat in the Prairie Pothole Region. Since its creation 50 years ago, the program has protected nearly 3 million acres of habitat.</p> <p><a href="http://www.fws.gov/duckstamps/Conservation/mbcc.htm">http://www.fws.gov/duckstamps/Conservation/mbcc.htm</a></p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
FWS	National Coastal Wetlands Conservation Grant Program	<p>Authorized by the Coastal Wetlands Planning, Protection, and Restoration Act of 1990. Co-administered by the Coastal Program and the Wildlife and Sport Fish Restoration Program. Annually provides grants of up to \$1 million to coastal states, including Great Lakes states, to acquire and restore coastal wetlands. Coastal states are eligible applicants. Program requires cost share of between 50 and 75 percent of the grant request depending on whether the state has an open-space conservation program. Ineligible activities include planning, research, monitoring, and construction or repair of structures for recreational purposes. A national ranking panel made up of FWS biologists recommends a list of projects for funding to the Director.</p> <p><a href="http://www.fws.gov/coastal/CoastalGrants/">http://www.fws.gov/coastal/CoastalGrants/</a></p>
FWS	National Fish Passage Program	<p>Voluntary program that provides technical and financial assistance to fish passage barrier removal or bypass projects. The goal of the program is to restore native fishes and other aquatic species to self-sustaining levels by reconnecting habitat that has been fragmented by barriers. Project applications are reviewed and prioritized on a regional basis. Financial assistance is delivered through the regional and local Fish and Wildlife Conservation Offices. The program strives to achieve a 50 percent match overall, including in-kind contributions. Non-federal funds are typically leveraged at a 3:1 ratio. The program uses the National Fish Passage Decision Support System, which catalogues fish passage barriers nationally. Fish passage projects are not eligible for funding if they are eligible for any federal or state compensatory mitigation or if fish passage is a condition provided by existing federal or state regulatory programs. Since 1999, the program has worked with over 700 different partners to remove 749 barriers, and reopen 11,249 miles of river and 80,556 acres to fish passage, benefitting over 85 federal trust fish and other aquatic species.</p> <p><a href="http://www.fws.gov/fisheries/fwco/fishpassage">http://www.fws.gov/fisheries/fwco/fishpassage</a></p>
FWS	National Wetlands Inventory (NWI)	<p>Provides information on the characteristics, extent, and status of U.S. wetlands and deep-water habitats and other wildlife habitats. NWI produces periodic reports on the status and trends of wetlands in the conterminous U.S., which is used for policymaking, assessment, and monitoring. NWI has developed a series of topical maps to show wetlands and deep-water habitats. This geospatial information is used by Congress; federal, state, and local agencies; academic institutions; and the private sector to inform natural resource planning, management, and project development. The NWI website provides a portal to the Wetlands Geodatabase and the Wetlands Mapper, which provide technological tools that allow the integration of large relational databases with spatial information and map-like displays. The Service's wetland data forms a layer of the National Spatial Data Infrastructure.</p> <p><a href="http://www.fws.gov/nwi">http://www.fws.gov/nwi</a></p>
FWS	National Wildlife Refuge System (NWRS)	<p>180 of the 552 refuges in the NWRS manage 121 million acres of marine or coastal habitat. Approximately one-quarter of the 150 million-acre NWRS consists of wetlands. The NWRS protects, restores, maintains, and conducts research on these wetlands. The NWRS sustains wetlands to support healthy populations of federal trust species, including threatened and endangered species, migratory birds, interjurisdictional fish, some marine mammals, and many plants. Wetlands in the NWRS provide opportunities for research and outdoor recreational pursuits for the American public.</p> <p><a href="http://www.fws.gov/refuges">http://www.fws.gov/refuges</a></p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
FWS	Natural Resource Damage Assessment and Restoration Program (NRDAR)	<p>The NRDAR program restores wetland acres that have been harmed by the release of contaminants from hazardous waste sites, and oil and chemical spills. Where possible, FWS partners with other federal agencies, other FWS programs, states, tribes, or non-governmental organizations to enlarge these restoration efforts, which enhances the value of the restoration to fish and wildlife. In FY 2009, the NRDAR program was responsible for the restoration and enhancement of over 23,000 wetland acres and for the protection of nearly 41,000 wetland acres. In addition, the program restored or enhanced 186 riparian stream miles and managed or protected 383 riparian stream miles. The Division of Environmental Quality provides approximately \$1.5 million in toxicology, ecology, and habitat restoration expertise to EPA and other federal and state partners to minimize impacts to wetlands during the cleanup of contaminated areas.</p> <p><a href="http://www.fws.gov/contaminants/Issues/Restoration.cfm">http://www.fws.gov/contaminants/Issues/Restoration.cfm</a></p>
FWS	North American Waterfowl Management Plan—Joint Ventures	<p>Collaborative, regionally based partnership of U.S. and Canadian agencies, nonprofit organizations, corporations, tribes, or individuals that conserves habitat for priority bird species within a specific geographic area. Designed to achieve the regional conservation goals identified in the North American Waterfowl Management Plan. 18 habitat joint ventures and three species specific joint ventures. Activities include biological planning, conservation design, and prioritization; project development and implementation; monitoring, evaluation, applied research; communications, education, and outreach; funding support for projects. To date, joint ventures have invested \$4.5 billion to conserve 15.7 million acres of waterfowl habitat.</p> <p><a href="http://www.fws.gov/birdhabitat/nawmp">http://www.fws.gov/birdhabitat/nawmp</a></p>
FWS	North American Wetlands Conservation Grants (NAWCA)	<p>Supports activities under the North American Waterfowl Management Plan, an international agreement that provides a strategy for the long-term protection of wetlands and associated upland habitats needed by waterfowl and other wetland-associated migratory birds in North America. Provides competitive grants to non-governmental organizations, states, local governments, tribes, and individuals to carry out wetland conservation projects in the United States, Canada, and Mexico for the benefit of wetland-associated migratory birds and other wildlife. Projects must provide long-term protection, restoration, and enhancement of wetlands and associated upland habitats. Mexican partnerships may also develop training, educational, and management programs and conduct sustainable-use studies.</p> <p>Standard grants: From FY 1990 to June 2010, some 3,850 partners in 1,518 projects have received more than \$1.03 billion in grants. They have contributed another \$2.06 billion in matching funds to affect 25.5 million acres of habitat and \$1.14 billion in non-matching funds to affect 230,900 acres of habitat. Small grants: From FY1990 to FY 2009, some 1,160 partners in 455 projects have received more than \$22.9 million in grants. They have contributed another \$101 million in matching funds to affect 172,600 acres of habitat and \$57.4 million in non-matching funds to affect 7,400 acres of habitat.</p> <p><a href="http://www.fws.gov/birdhabitat/Grants/NAWCA">http://www.fws.gov/birdhabitat/Grants/NAWCA</a></p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
FWS	Partners for Fish and Wildlife Program	<p>Voluntary partnership program to restore and enhance priority fish and wildlife habitat on private lands. Provides technical and financial assistance through partnerships with landowners. Delivered through locally based field biologists in each state. Assistance instruments are primarily cooperative agreements. Decisions regarding partnerships are made at the landscape level. Since 1987 the Program has worked with over 42,000 private landowners and restored 975,000 acres of wetlands, 3,000,000 acres of uplands, and 8,700 miles of stream habitat. Statutory authority: Partners for Fish and Wildlife Act of 2006.</p> <p><a href="http://www.fws.gov/partners">http://www.fws.gov/partners</a></p>
NOAA	Coastal and Estuarine Land Conservation Program (CELCP)	<p>CELCP, part of the Coastal Zone Management Program, was established in 2002 to protect coastal and estuarine lands considered important for their ecological, conservation, recreational, historical or aesthetic values. The NOAA Ocean Service program provides state and local governments with matching funds to purchase significant coastal and estuarine lands, or conservation easements on such lands, from willing sellers. Lands or conservation easements acquired with CELCP funds are protected in perpetuity so that they may be enjoyed by future generations.</p> <p><a href="http://coastalmanagement.noaa.gov/land/welcome.html">http://coastalmanagement.noaa.gov/land/welcome.html</a></p>
NOAA	Coastal Zone Management Program	<p>The Coastal Zone Management Program supports state planning and programs to protect coastal resources, including wetlands. The NOAA Ocean Service program is a voluntary partnership between the federal government and U.S. coastal and Great Lakes states that takes a comprehensive approach to coastal resource management by balancing the often competing and occasionally conflicting demands of coastal resources use, economic development, and conservation.</p> <p><a href="http://coastalmanagement.noaa.gov/programs/czm.html">http://coastalmanagement.noaa.gov/programs/czm.html</a></p>
NOAA	Coastal Zone Enhancement Program (CZARA Section 309)	<p>The Coastal Zone Enhancement Program, a part of the NOAA Ocean Service Coastal Zone Management Program, is designed to encourage states and territories to develop program changes in one or more of the nine coastal zone enhancement areas of national significance, including wetlands. Every five years, state coastal management programs conduct self-assessments of their programs' activities within the nine enhancement areas to help target the Section 309 funds toward program needs.</p> <p><a href="http://coastalmanagement.noaa.gov/enhanc.html">http://coastalmanagement.noaa.gov/enhanc.html</a></p>
NOAA	Coastal Zone Nonpoint Pollution Program (CZARA Section 6217)	<p>The Coastal Zone Nonpoint Pollution Program, a part of the NOAA Ocean Service Coastal Zone Management Program, establishes a set of management measures for states to use in controlling polluted runoff from six main sources, including wetlands and vegetated shorelines. State policies and actions to develop coastal nonpoint pollution control programs ensure implementation of the program at the state level.</p> <p><a href="http://coastalmanagement.noaa.gov/nonpoint/welcome.html">http://coastalmanagement.noaa.gov/nonpoint/welcome.html</a></p>
NOAA	Community-based Restoration Program	<p>The Community-based Restoration Program, a part of the NOAA Fisheries Habitat Conservation Program, invests funding and technical expertise in high-priority habitat restoration projects that instill strong conservation values and engage citizens in hands-on activities. Through the program, NOAA, its partners, and thousands of volunteers are actively restoring coastal, marine, and migratory fish habitat across the nation. <a href="http://www.habitat.noaa.gov/restoration/programs/crp.html">http://www.habitat.noaa.gov/restoration/programs/crp.html</a></p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
NOAA	Damage Assessment, Remediation, and Restoration Program (DARRP)	<p>The NOAA Ocean Service Damage Assessment, Remediation, and Restoration Program collaborates with other agencies, industry, and citizens to protect and restore coastal and marine resources threatened or injured by oil spills, releases of hazardous substances, and vessel groundings. The program provides permanent expertise within NOAA to assess and restore natural resources injured by release of oil and hazardous substances, as well as by physical impacts such as vessel groundings in National Marine Sanctuaries.</p> <p><a href="http://www.darrp.noaa.gov/">http://www.darrp.noaa.gov/</a></p>
NOAA	Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Act	<p>Marine fish depend on healthy habitats to survive and reproduce. Throughout their lives fish use many types of habitats including seagrass, salt marsh, coral reefs, kelp forests, and rocky intertidal areas among others. Various activities on land and in the water constantly threaten to alter, damage, or destroy these habitats. NOAA Fisheries, regional Fishery Management Councils, and federal and state agencies work together to address these threats by identifying EFH for each federally managed fish species and developing conservation measures to protect and enhance these habitats.</p> <p><a href="http://www.habitat.noaa.gov/protection/efh/index.html">http://www.habitat.noaa.gov/protection/efh/index.html</a></p>
NOAA	Great Lakes Habitat Restoration Program	<p>The Great Lakes Habitat Restoration Program, a part of the NOAA Fisheries Habitat Conservation Program, plans, implements, and funds coastal habitat restoration projects throughout the Great Lakes region. The program works to protect and restore coastal habitats through recovery of damages from natural resource damage claims, which are used to implement community-based restoration efforts. Much of NOAA's work in the region is focused on supporting community-identified restoration priorities in Areas of Concern, environmentally degraded areas within the Great Lakes basin.</p> <p><a href="http://www.habitat.noaa.gov/restoration/programs/greatlakes.html">http://www.habitat.noaa.gov/restoration/programs/greatlakes.html</a></p>
NOAA	Habitat Conservation Program	<p>The Habitat Conservation Program, composed of the Habitat Protection Division, a Restoration Center, and the Chesapeake Bay Office, protects, restores, and promotes stewardship of coastal and marine habitat to support our nation's fisheries and preserve our coastal communities for future generations. The Program carries out various management and research efforts to develop national and regional policies, programs, and science to conserve wetlands.</p> <p><a href="http://www.habitat.noaa.gov/index.html">http://www.habitat.noaa.gov/index.html</a></p>
NOAA	National Estuarine Research Reserve System (NERRS)	<p>The NERRS is a network of 28 areas representing different biogeographic regions of the United States that are protected for long-term research, water-quality monitoring, education, and coastal stewardship. Established by the Coastal Zone Management Act of 1972, as amended, the reserve system is a partnership program between NOAA and the coastal states. NOAA's Ocean Service provides funding, national guidance, and technical assistance. Each reserve is managed on a daily basis by a lead state agency or university, with input from local partners. Reserve staff work with local communities and regional groups to address natural resource management issues, such as non-point source pollution, habitat restoration and invasive species. Through integrated research and education, the reserves help communities develop strategies to deal successfully with these coastal resource issues.</p> <p><a href="http://www.nerrs.noaa.gov/">http://www.nerrs.noaa.gov/</a></p>



## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
NOAA	Pacific Coastal Salmon Recovery Fund (PCSRF)	<p>The PCSRF was established by Congress in FY 2000 to protect, restore, and conserve Pacific salmon and steelhead populations and their habitats. Under the PCSRF, NOAA Fisheries manages a program to provide funding to states and tribes of the Pacific Coast region.</p> <p><a href="http://www.nwr.noaa.gov/Salmon-Recovery-Planning/PCSRF/Index.cfm">http://www.nwr.noaa.gov/Salmon-Recovery-Planning/PCSRF/Index.cfm</a></p>
Army Corps	Clean Water Act 404 Program	<p>Army Corps manages the nation's wetlands through a regulatory program requiring permits for the discharge of dredged and fill material into jurisdictional water of the United States. This important regulatory program helps maintain the wetland base so other federal programs can achieve gains. EPA shares regulatory responsibility with Army Corps under this program.</p>
Army Corps	Continuing Authorities Program (CAP)	<p>Standing Authorities to study/build water resource projects for specific purposes and with specified federal spending limits and cost share requirement. CAP project funding varies by program and purpose. There are 10 commonly referenced nationwide programs. Three of these specifically involve ecosystem improvement: the 206 Program is for aquatic ecosystem restoration, the 1135 Program is for project modifications for improvement of the environment, and the 204 Program is for beneficial uses of dredged material. There are also several geographically restricted Regional Programs that relate to environmental infrastructure projects.</p>
Army Corps	Engineer Research and Development Center (ERDC)	<p>The Wetlands Research and Technology Center (WRTC) consolidates administrative, technological, and research skills in the area of wetland science and engineering that are available at the ERDC. The ERDC has long been recognized as a center for wetland expertise, conducting extensive environmental research in wetland systems. The WRTC provides a single point of contact for wetland research and development, guidance, support, and technology transfer. The WRTC provides access to an array of technical specialists and interdisciplinary teams in research areas that emphasize the interrelationships of biological, physical, and chemical environments in order to provide fundamental understanding of ecological processes and dynamics in wetland ecosystems. The WRTC serves the U.S. Army Corps of Engineers, other Department of Defense agencies, other government agencies, academia, industry and the general public.</p> <p><a href="http://el.erc.usace.army.mil/wetlands/wetlands.html#wrtc">http://el.erc.usace.army.mil/wetlands/wetlands.html#wrtc</a></p>
Army Corps	General Investigations	<p>Studies for project authorization that are undertaken in response to either a study-specific authority or a general authority; these are typically larger, complex projects. The reconnaissance phase is 100 percent federally funded, the feasibility phase is cost-shared 50/50, the preconstruction engineering and design phase is cost-shared 75/25, and the construction/implementation for Ecosystem Restoration Projects is cost-shared 65/35. The maximum cost limit per project is set for each phase. Major projects include the Florida Everglades Restoration, the Upper Mississippi River Restoration, the Louisiana Coastal Area project, the Missouri River Recovery, and the Lower Columbia River and Tillamook Bay Ecosystem Restoration.</p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
USDA FSA	Conservation Reserve Program (CRP)	<p>CRP provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program is funded through the Commodity Credit Corporation. CRP is administered by the Farm Service Agency (FSA), with NRCS providing technical land eligibility determinations, conservation planning and practice implementation. CRP reduces soil erosion, protects the nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices.</p> <p><a href="http://www.nrcs.usda.gov/programs/crp/">http://www.nrcs.usda.gov/programs/crp/</a></p>
USDA NRCS	Conservation Technical Assistance Program (CTA)	<p>Through conservation technical assistance, NRCS and its partners help land users address opportunities, concerns, and problems related to the use of natural resources and make sound natural resource management decisions on private, tribal, and other non-federal lands. This assistance may be in the form of resource assessment, practice design, resource monitoring, or follow-up of installed practices. Although the CTA program does not include financial or cost-share assistance, clients may develop conservation plans, which may serve as a springboard for those interested in participating in USDA financial assistance programs. CTA planning can also serve as a door to financial assistance and easement conservation programs provided by other federal, state, and local programs.</p> <p><a href="http://www.nrcs.usda.gov/programs/cta/">http://www.nrcs.usda.gov/programs/cta/</a></p>
USDA NRCS	Emergency Watershed Protection Program (EWP)	<p>The purpose of the Emergency Watershed Protection (EWP) program is to undertake emergency measures, including the purchase of flood plain easements for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood, or any other natural occurrence is causing or has caused a sudden impairment of the watershed.</p> <p><a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/ewp">http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/ewp</a></p>
USDA NRCS	Environmental Quality Incentives Program (EQIP)	<p>EQIP provides a voluntary conservation program for farmers, ranchers, and owners of private, non-industrial forest land that promotes agricultural production, forest management, and environmental quality as compatible national goals. EQIP offers financial and technical assistance to help eligible producers install or implement conservation practices on eligible agricultural land. EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practice(s) and a maximum term of 10 years. Owners of land in agricultural production or persons who are engaged in livestock or agricultural production on eligible land may participate in the EQIP program. Program practices and activities are carried out according to a plan of operations, developed in conjunction with the producer, that identifies the appropriate conservation practice or measures needed to address identified natural resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. EQIP may provide payments up to 75 percent of the estimated incurred costs and income foregone of certain conservation practices and conservation activity plans.</p> <p><a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip">http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip</a></p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
USDA NRCS	Farm and Ranchlands Protection Program (FRPP)	<p>FRPP provides matching funds to help purchase development rights to keep productive farm and rangeland in agricultural uses. Working through existing programs, USDA partners with state, tribal, or local governments and non-governmental organizations to acquire conservation easements or other interests in land from landowners. USDA provides up to 50 percent of the fair market easement value of the conservation easement. To qualify, farmland must be part of a pending offer from a state, tribe, or local farmland protection program; be privately owned; have a conservation plan for highly erodible land; be large enough to sustain agricultural production; be accessible to markets for what the land produces; have adequate infrastructure and agricultural support services; and have surrounding parcels of land that can support long-term agricultural production. Depending on funding availability, proposals must be submitted by the eligible entities to the appropriate NRCS State Office during the application window.</p> <p><a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/farmranch">http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/farmranch</a></p>
USDA NRCS	Grasslands Reserve Program (GRP)	<p>GRP is a voluntary conservation program that emphasizes support for working grazing operations, enhancement of plant and animal biodiversity, and protection of grassland under threat of conversion to other uses. Participants voluntarily limit future development and cropping uses of the land while retaining the right to conduct common grazing practices and operations related to the production of forage and seeding, subject to certain restrictions during nesting seasons of bird species that are in significant decline or are protected under federal or state law. A grazing management plan is required for participants.</p> <p><a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/grassland">http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/grassland</a></p>
USDA NRCS	Swampbuster	<p>The Highly Erodible Land Conservation and Wetland Conservation Compliance provisions (Swampbuster) were introduced in the 1985 Farm Bill, with amendments in 1990, 1996, and 2002. The purpose of the provisions is to remove certain incentives to produce agricultural commodities on converted wetlands or highly erodible land, unless the highly erodible land is protected from excessive soil erosion. It withholds federal farm program benefits from any person who converts a wetland by clearing, drainage, dredging, leveling, or any other means for the purpose of making agricultural commodity production possible, or who plants a commodity on a converted wetland.</p> <p><a href="http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/alphabetical/camr/?&amp;cid=stelprdb1043554">http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/alphabetical/camr/?&amp;cid=stelprdb1043554</a></p>
USDA NRCS	Wetlands Reserve Enhancement Program (WREP)	<p>WREP is a voluntary conservation program which is a component of WRP. Under WREP, NRCS enters into agreements with eligible partners (states and local units of government, Indian tribes, and non-governmental organizations) to help enhance conservation outcomes on wetlands and adjacent lands. WREP targets and leverages resources to carry out high-priority wetland protection, restoration, and enhancement activities and improve wildlife habitat. Once NRCS selects a partner's proposal, landowners within the selected project area may submit an application directly to NRCS for participation in WRP.</p> <p><a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands">http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands</a></p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
USDA NRCS	Wetlands Reserve Program (WRP)	<p>This voluntary program restores and protects wetlands on private lands to cost-effectively maximize wildlife benefits and wetland functions and values that have been degraded or impacted as a result of the production of food and fiber. Since 1992, WRP has restored approximately 2.2 million acres on 11,758 properties. WRP enrollment options include permanent easement, 30-year easement, restoration agreement, 30-year contract on tribal lands, and reserve grazing rights pilot. The perpetual easement option pays landowners 100 percent of the WRP easement value and 100 percent of the costs to restore the wetlands and associated habitats on the land. The 30-year easement and 30-year contracts options provide 75 percent of the easement values and restoration costs. The restoration agreement only option provides 75 percent of the restoration costs and requires the restored habitat to be maintained for a period of 10 years.</p> <p><a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands">http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands</a></p>
USDA NRCS	Wildlife Habitat Incentives Program (WHIP)	<p>WHIP is a voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land. NRCS administers WHIP to provide both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP cost-share agreements between NRCS and the participant generally last from one year after the last conservation practice is implemented but not more than 10 years from the date the agreement is signed.</p> <p><a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/whip">http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/whip</a></p>
USGS	National Wetlands Research Center	<p>The National Wetlands Research Center is a source and clearinghouse of science information about wetlands in the United States and the world for fellow agencies, private entities, academia, and the public at large. Staff members obtain and provide this information by performing original scientific research and developing research results into literature and technological tools. They then disseminate that information through a variety of means. The Center solves wetland-related problems and conducts status and trends inventories of wetland habitats, evaluates wetland problems, and conducts field and laboratory research on wetland issues. Center research includes a broad array of projects on wetland ecology, values, management, restoration and creation, plus research on the ecology of a wide variety of plant and animal species and communities that are found in wetlands.</p> <p><a href="http://www.nwrc.usgs.gov/">http://www.nwrc.usgs.gov/</a></p>
USGS	Other scientific research	<p>USGS also conducts scientific studies on other areas related to wetland health, including carbon sequestration, long shore transport processes, water level fluctuations, climate change, and sea level rise.</p> <p><a href="http://www.usgs.gov/">http://www.usgs.gov/</a></p>

## Appendix E: Federal Agency Programs That Support Coastal Wetland Protection, Restoration, and Management

AGENCY	PROGRAM	DESCRIPTION
EPA/ FWS/ NOAA/ USDA/ Army Corps	Coastal Wetlands Planning, Protection and Restoration Act (CWP PRA)	<p>CWPPRA is funded by the Aquatic Resources Trust Fund, which was established in 1990 and is authorized until 2019. The fund is created from excise taxes on fishing equipment and on motorboat and small engine fuels. The Louisiana Coastal Wetlands Conservation and Restoration Task Force receives 70 percent of the funds; the North American Wetlands Conservation Act Program and the National Wetlands Conservation Grant Program receive 15 percent each. Funding distributed to the Louisiana Coastal Wetlands Conservation and Restoration Task Force is used to design and construct projects to preserve, re-establish, and enhance Louisiana's coastal landscape.</p> <p><a href="http://www.lacoast.gov/new/About/Default.aspx">http://www.lacoast.gov/new/About/Default.aspx</a> <a href="http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm">http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm</a> <a href="http://www.fws.gov/coastal/coastalgrants/">http://www.fws.gov/coastal/coastalgrants/</a></p>
EPA/ FWS/ NOAA/ USDA/ Army Corps	Estuary Restoration Act (ERA)	<p>The purpose of ERA is to promote the restoration of estuary habitat; to provide federal assistance for estuary habitat restoration projects; to develop a national Estuary Habitat Restoration Strategy for creating and maintaining effective partnerships within the federal government and with the private sector; and to develop and enhance monitoring, data sharing, and research capabilities. Under ERA, NOAA developed and maintains a restoration project database, the National Estuaries Restoration Inventory, and established standards for restoration monitoring.</p> <p><a href="http://www.era.noaa.gov/">http://www.era.noaa.gov/</a></p>