

# Climate Ready Estuaries 2011 PROGRESS REPORT





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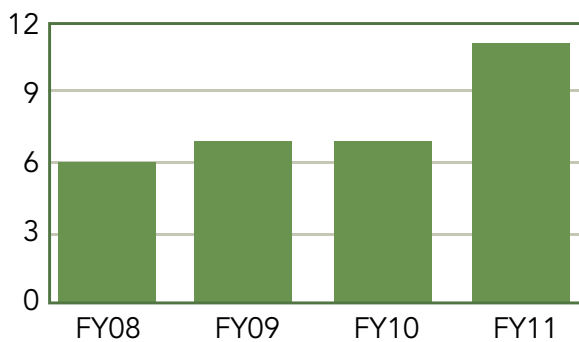
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# INTRODUCTION

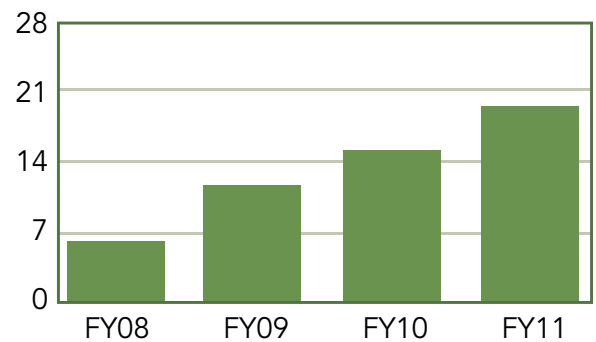
Climate change continues to be a leading challenge to reaching Clean Water Act goals in our country's estuaries.<sup>†</sup> New impacts are being observed on U.S. coastlines, and many already pressing problems (such as sea level rise and wetlands loss) are worsening. Climate Ready Estuaries (CRE) is a partnership between the U.S. Environmental Protection Agency (EPA) and the National Estuary Programs (NEPs) to address those challenges.

2011 marks the fourth year in which CRE has supported climate change adaptation activities in NEP study areas. From 2008–2010, CRE sponsored 20 projects with 15 different NEPs. In 2011, CRE supported another 11 projects, including work with four new NEPs.

### CRE Projects by Year



### Cumulative NEPs With Projects



EPA's Climate Ready Estuaries is one of a few federal climate change adaptation programs that work with external partners to help meet their needs. Consequently, CRE projects with NEPs are among the top examples of coastal community-based adaptation planning in the United States. CRE has been cited by many authorities for this achievement, and the program intends to build on this success.

This document highlights the projects that 19 NEPs around the United States have undertaken to help their watersheds and communities adapt to some of the pressing challenges that are emerging. The newest projects are featured in the section **2011 CRE Projects** (page 4). Projects initiated during

2008–2010 are highlighted in the **Climate Change Risk Management** section of this report (page 7). Risk management is an approach for addressing the potential impacts and uncertainty of climate change. CRE projects are illustrative of steps along the entire risk management spectrum, from starting to think about impacts to implementing responses, and collectively serve as an example of how risk management can be applied.



<sup>†</sup>White House Council on Environmental Quality. Final Recommendations of the Interagency Ocean Policy Task Force. July 19, 2010.

U.S. Climate Change Science Program. 2008. Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources.



In addition to the activities that CRE supports with the NEPs, the program produces resources that support climate change planning. In 2011, CRE published a pamphlet on lessons learned from NEP partners (page 15); a fact sheet for king tide education campaigns (page 17); and a primer on rolling easements, which was downloaded 40,000 times in June–September 2011 (page 18). Finally, this progress report also highlights the program’s use of new media to educate the coastal management community about climate adaptation.

## ACCOMPLISHMENTS AT A GLANCE

- Partnered with four new NEPs in 2011; CRE has now supported projects with a total of 19 NEPs.
- Sponsored 11 new projects in 2011; CRE has now supported a total of 31 climate adaptation projects.
- Joined with EPA’s Climate Ready Water Utilities Program on three projects in 2011.
- Published the Rolling Easements primer.
- Kicked off the king tide sea level rise education campaign.
- Used Twitter and webcasts to educate the public about coastal adaptation.

Photo courtesy of John McShane



High water flooding in Washington, D.C.

Photo courtesy of Holly Greening



A king tide in Fort De Soto Park, Florida

# 2011 CLIMATE READY ESTUARIES PROJECTS

CRE projects on coastal adaptation to climate change are examples for use by the entire coastal management community. In 2011 EPA provided technical assistance and funding for 11 adaptation projects with 10 NEPs. EPA is very pleased to welcome four new NEPs as CRE partners this year:

- **Morro Bay National Estuary Program (California)**
- **Narragansett Bay National Estuary Program (Rhode Island)**
- **New York–New Jersey Harbor Estuary Program**
- **Tillamook Estuaries Partnership (Oregon)**

As the NEPs continue to examine how climate change will affect water quality, natural resources, and uses of their estuaries, CRE projects will contribute to the body of knowledge about adapting to climate change in coastal watersheds.

## *Sea Level Rise and Storm Surge Adaptation Analysis*

The **Casco Bay Estuary Partnership** and the **Piscataqua Region Estuaries Partnership** are working with the New England Environmental Finance Center to evaluate the vulnerability of communities in their watersheds to sea level rise and storm surge through the COAST model (**CO**astal **A**daptation to **S**ea level rise **T**ool). They will work closely with stakeholder groups to identify hazards scenarios and appropriate adaptation options for analysis. These projects will support ongoing climate adaptation planning in the region by examining costs and benefits of various adaptation measures. NEP involvement will also help to refine COAST for future application in other locations.



## CRE AND EPA'S CLIMATE READY WATER UTILITIES

In 2011 EPA's two "Climate Ready" programs began cooperating on climate change adaptation projects. Climate Ready Water Utilities (CRWU) supports the implementation of plans and adaptation strategies at drinking water and wastewater utilities.

CRWU's Climate Resilience Evaluation and Assessment Tool (CREAT) is one way that utilities can evaluate potential impacts of climate change and adaptation options. NEPs, local utilities, and CRWU are working together to test and improve CREAT. These cooperative efforts help identify adaptation measures that benefit water utilities and the environment.

The **Albemarle-Pamlico National Estuary Program** (APNEP) will work with CRWU to provide technical assistance on climate change impacts to a North Carolina water utility in its study area. The project team will use CREAT to assess short, medium, and long-term climate risks to the utility's infrastructure and to the surrounding natural environment. The CREAT output will identify possible adaptation options. This project will also develop APNEP's expertise in using CREAT and facilitate further consultations with other utilities in the region.



## Assessment of Climate Change Adaptation Measures for the Lower Pawtuxet River, Rhode Island

The Pawtuxet River watershed experienced severe flooding impacts from record-breaking March rains in 2010, and many dams and in-stream structures were at risk of failure. This problem is anticipated to become more severe, as the intensity of precipitation is projected to increase in New England due to climate change. The **Narragansett Bay Estuary Program** will analyze and report on dams and other in-stream structures in the Pawtuxet River watershed regarding their vulnerability to climate change and flooding, as well as possible impacts on watershed restoration efforts.



## Assessing Opportunities for Climate Change Resilience at Public Access Sites

Public access sites feature diverse human uses and habitats and are vulnerable to climate change impacts, especially from rising sea levels and coastal storms. The **New York–New Jersey Harbor Estuary Program** will expand a vulnerability assessment protocol piloted by New Jersey Sea Grant and others to identify public access points that are vulnerable to climate change impacts. The Harbor Estuary Program will work with municipal planning departments, engineers, and local boating organizations to refine the vulnerability assessments and tailor specific strategies for increasing the resilience of each case study site. A final report will focus on the application of methods in other coastal areas.



The **Morro Bay National Estuary Program** will work with CRWU and a local water purveyor group to develop information for a climate risk assessment focusing on drinking water supplies in the watershed. CREAT and a ground water flow model (SEAWAT) will be used to gauge climate change risk to surface water and ground water supplies and assess adaptation options. Results will inform area ground water basin and adaptive management plans.



The **New York–New Jersey Harbor Estuary Program** has been working with CRWU and the North Hudson (N.J.) Sewerage Authority since early 2011 to evaluate potential impacts of climate change and examine adaptation options for the sewerage authority. The utility serves the northern part of Hudson County, New Jersey, and operates about 100 miles of sewer mains and two wastewater treatment facilities providing both primary and secondary treatment. The system treats an average of 24.5 million gallons of water per day, and effluent is discharged into the Hudson River. Sea level rise and flooding are climate change issues of particular concern.



## Using Living Shorelines to Protect Tidal Marsh Habitat as Sea Level Rises



The Partnership for the Delaware Estuary (PDE) is examining best practices for a living shoreline approach to maintaining ecological quality in its tidal wetlands and watershed. PDE and partners will conduct on-the-ground assessments for preserving tidal wetlands in light of climate change, especially sea level rise. They will develop a strategy for implementing living shoreline demonstration projects that evaluates various tactics, assesses impediments and obstacles to action, and recommends approaches for local projects. A best-practices manual will be developed to guide restoration planning in the PDE system and to serve as a model for other NEPs.

## Addressing Sea Level Rise in the Sarasota Bay NEP Region



In an earlier CRE project, the **Sarasota Bay Estuary Program** (SBEP) developed an online sea level rise viewer (<http://www.sarasotabay.org/slr-web-map/>). This work has provided valuable experience and insight into using creative, practical approaches for introducing basic climate change science and stimulating positive responses. To build on that project, SBEP and its partners will prepare a guide on tips and early lessons learned from introducing the Web viewer. The focus of this guide will be on the experiences gained through working with local governments, businesses, and community leaders, as well as other interested organizations.

## Gulf Coast Community Handbook



The **Tampa Bay Estuary Program** will coordinate a cooperative effort by the Gulf of Mexico NEPs, as well as regional participants from the National Estuarine Research Reserve System and other coastal restoration groups, to contribute their knowledge to a "Gulf Coast Community Handbook." The handbook will use case studies from the Gulf of Mexico area to illustrate on-the-ground approaches and lessons learned about incorporating climate change resiliency into habitat restoration and protection plans.

## NEW PARTNER Assessing Climate Change in the Tillamook Estuaries Watershed



The **Tillamook Estuaries Partnership** will review and summarize studies of climate change in the region to produce an assessment of likely climate change effects in its watershed. This study will bring together the current understanding of how climate will change and the associated environmental impacts. This report will be used for local environmental education and to support a potential update of its Comprehensive Conservation and Management Plan.



## CRE Adaptation Projects and the Risk Management Process

The U.S. Environmental Protection Agency and its partners in the National Estuary Program (NEP) have collaborated on 20 Climate Ready Estuaries (CRE) adaptation projects in the program's first three years, from 2008–2010. As CRE builds a critical mass of project success stories, opportunities are arising to do more than collect and relate anecdotes about individual projects. The program has the chance to synthesize stories about climate adaptation.

This section of the Climate Ready Estuaries 2011 Progress Report examines how CRE projects illustrate and support the risk management paradigm for climate change adaptation. Collectively, the NEP partners demonstrate how risk management can be successfully applied to address environmental challenges in our country's coastal areas.

### Risk management

Climate change will pose a range of challenges to the nation's coasts. Some of the challenges will be new, while other ongoing problems will be exacerbated by climate changes. All areas will: (1) face a unique set of impacts, (2) assess consequences differently, and (3) have distinctive resources that can be brought to bear on the problems. Due to the sheer variety of potential place-based challenges and responses, the federal Interagency Climate Change Adaptation Task Force (in its October 2010 Progress Report), as well as the U.S. Government Accountability Office, the Intergovernmental Panel on Climate Change, and the National Research Council, have all recently described adaptation to climate change impacts as a problem that is suited to a risk management approach.

Risk management is a process that helps an organization minimize the risks that may keep it from reaching its goals. Risk management also guides decision making by systematically leading an organization to determine what risks are important and need to be addressed.

Risk management is particularly useful in planning for climate change. The likelihood and timing of future climate changes cannot be precisely known. Further, the types and severity of impacts cannot be exactly defined. This does not mean that organizations should walk away from an impossible problem: it means they should take prudent steps to avoid or minimize risks associated with unwanted outcomes.

## Risk management framework

The leading risk management guidance documents recommend a sequence of activities similar to the one described in the ISO 31000 standards on risk management.<sup>1,2</sup> These steps are outlined here and described in subsequent sections of this report.

A cookie cutter approach for addressing climate change that will work everywhere does not exist. This is why a risk management approach that lets organizations work within their own contexts to identify and address the risks that affect their own goals is such a useful tool.

<sup>1</sup> ISO (2009). *Risk Management—Principles and Guidelines*. ISO 31000:2009 (E).

<sup>2</sup> IEC/ISO (2009). *Risk Management—Risk Assessment Techniques*. IEC/ISO 31010.

## The Risk Management Framework from ISO 31000

- 5.2 Communication and consultation
- 5.3 Establishing the context
- 5.4 Risk assessment
  - 5.4.2 Risk identification
  - 5.4.3 Risk analysis
  - 5.4.4 Risk evaluation
- 5.5 Risk treatment
  - 5.5.2 Selection of risk treatment options
  - 5.5.3 Preparing and implementing risk treatment plans
- 5.6 Monitoring and review

## CRE projects and risk management

Every area along the U.S. coast has different characteristics, and the NEP partners vary in important respects. Each NEP has tackled the piece of the climate change adaptation puzzle that it has believed to be appropriate for its current situation. In early meetings with NEP partners, two of the lessons that were distilled were to start small and to move forward with the data available. So CRE projects have short circuited the risk management guidance in ISO 31000 (page 17) that explains, “The aim... is to generate a comprehensive list of risks based on those events that might create, enhance, prevent, degrade, accelerate or delay the achievement of objectives....” and “Comprehensive identification is critical....”

Many NEPs have targeted their efforts on specific, known problems instead of looking across the universe of possible threats. Although a few projects have looked broadly at a suite of local climate risks, no one CRE partner has taken a risk management process from start to finish. A high proportion of CRE projects match with the early steps of the risk management process: stakeholder communications, establishing contexts, and risk identification are well represented.

The following sections present examples from CRE’s first 20 projects to illustrate the steps of the risk management framework. While the 20 projects all are illustrative of one or more steps, the following sections highlight aspects of projects that are particularly good examples of the step under discussion. Using a tenet of geographical analysis that space might serve as a surrogate for time, projects at separate NEPs collectively demonstrate how risk management could support a program of coastal climate change adaptation.

## Communication and consultation

This step is intended to communicate why a vulnerability assessment is necessary, what the process will be like, and what to expect going forward. Involving internal and external stakeholders will ensure that their concerns, interests, perceptions, and views are considered in subsequent risk management steps. Consulting with them helps to build understanding and support for the subsequent steps.

## Establishing the context

Every organization exists in a cultural, political, financial, regulatory, and ecological situation. Every organization also has a reason for being (i.e., its mission) and has goals that it pursues. The internal and external context in which climate impacts will act helps set the scope for the risk management process.

Many CRE partners are working to increase communication and education about climate change impacts and adaptation among stakeholders and establish the context in which they will move forward. Various contexts call for different approaches. Some NEP projects work directly with the general public, while others are oriented to key stakeholders.

## Communicating with the public

- The **Albemarle-Pamlico National Estuary Program** (APNEP), in partnership with the Albemarle-Pamlico Conservation and Communities Collaborative (AP3C), hosted seven public listening sessions to hear residents' concerns about sea level rise and population growth, elicit their ideas about solutions, and provide recommendations to improve outreach and education projects. In February 2009, APNEP and AP3C produced a report, "Public Listening Sessions: Sea Level Rise and Population Growth in North Carolina," describing the design, findings, and recommendations from the sessions. Following the public listening sessions, APNEP identified key audiences with whom to follow up. These included underprivileged communities, local officials, schools, and coastal communities. Additionally, the public listening sessions identified the need for more detailed information and discussion of sea level rise.
- The **Long Island Sound Study NEP**, in partnership with ICLEI and the city of Groton, Connecticut, held three stakeholder workshops in 2010 to discuss local climate change vulnerability and options for improving resilience. The first workshop focused on potential climate change impacts, while later sessions focused on developing, prioritizing, and modeling the costs of a suite of adaptation options. The city of Groton will use a report summarizing workshop outcomes to begin implementing adaptation strategies and to develop an adaptation plan.
- In collaboration with the Jacques Cousteau National Estuarine Research Reserve (New Jersey), the **Barnegat Bay Partnership** held a conference, "Preparing Your Community in the Face of Climate Change," in April 2010 to assess local stakeholder knowledge and support for climate change action. Additional public listening sessions and a stakeholder survey were used to further gauge regional knowledge, attitudes, and interest in local issues related to climate change.

## Program directors and key stakeholders

- The **Casco Bay Estuary Partnership** developed a climate change stakeholder outreach plan that integrated ecosystem resilience into broader messages about climate change. Since many Maine



organizations and agencies are engaged in efforts to encourage local decision-makers to incorporate climate change into their day-to-day decisions and long-term planning, CBEP chose to focus its efforts on adaptation outreach. Through consultation with stakeholders, CBEP identified two key audiences for targeted outreach efforts: the land conservation community and the water resources and water infrastructure community.

- In an effort to incorporate climate change considerations into its Comprehensive Conservation and Management Plan, the **Lower Columbia River Estuary Partnership** (LCREP) coordinated with its Estuary Partnership Science Work Group and Board of Directors throughout the process. The focus was on identifying existing actions that address impacts of climate change, actions that can be modified to address climate change, and additional necessary actions. In June 2011, LCREP hosted the 5th annual Science to Policy Summit: Climate Change—Adapting Our Actions, at which stakeholders discussed potential adaptations for the lower Columbia River region.

## Risk identification

Risk identification is the process of identifying what might affect the ability of an organization to achieve its goals. ISO 31000 says, “The aim of this step is to generate a comprehensive list of risks based on those events that might create, enhance, prevent, degrade, accelerate or delay the achievement of objectives.”

CRE partners have approached the step of risk identification in a variety of ways. Some have commissioned or performed broad assessments of how climate change may affect their watersheds. As explained earlier, a few have focused on smaller slices of the spectrum, such as particular ecosystems or hazards. Others have looked at climate change in the context of the other frameworks in which they operate.

### Broad assessment

- The **Casco Bay Estuary Partnership** published a report in December 2009, “Climate Change in the Casco Bay Watershed: Past, Present, and Future,” which looked at historic and projected trends for eight indicators in the Casco Bay watershed. To generate future projections, simulated temperature and precipitation data from four climate models were fitted to local, long-term weather observations.
- The **Charlotte Harbor National Estuary Program** conducted a broad vulnerability assessment for its seven-county southwest Florida study area which contributed to the development of a set of climate change indicators.
- The **Albemarle-Pamlico National Estuary Program** conducted a broad assessment of its vulnerabilities and research needs. The assessment was informed by a series of public listening sessions, and the results were published in a September 2010 report titled “Climate Ready Estuaries: A Blueprint for Change.”

### Particular ecosystems

- The **Massachusetts Bays Program** and the **San Francisco Estuary Program** worked in partnership with the EPA Office of Research and Development to use expert elicitation as a methodology for

identifying climate change-related risks. In these pilot studies, two groups of experts focused on key ecosystem processes related to sediment retention in mudflats and salt marshes. In the San Francisco Bay system, the experts focused on ecological interactions of wading shorebirds and their food sources. In Massachusetts, they focused on nesting habitat for salt marsh sparrows. The experts were guided through a series of questions to help identify key processes and their interrelationships. Different pathways were analyzed to identify where major shifts might be likely in order to determine how the systems are sensitive to climate changes.

- The **Santa Monica Bay Restoration Commission** identified the Ballona Wetlands as an area of particular concern regarding climate change impacts. The commission is using downscaled climate scenarios in a watershed hydrology model to assess the impacts of changes in temperature, precipitation, and sea level.

### Particular hazards

- The **Sarasota Bay Estuary Program** (SBEP) is focusing specifically on sea level rise and its potential impacts to Sarasota and Manatee Counties. SBEP developed and launched a sea level rise visualization tool (<http://www.sarasotabay.org/slr-web-map>), which allows users to see how different magnitudes of sea level rise affect their communities. SBEP has conducted focus groups with its Citizens Advisory Committee, Technical Advisory Committee, Management Board, and Policy Board, as well as Sarasota County and Manatee County staff and citizens, to test and introduce the sea level rise Web visualization tool.
- The **Piscataqua Region Estuaries Partnership** focused its initial vulnerability assessment efforts on inland flooding, specifically the potential impact of increased stormwater runoff and flooding on stormwater drainage systems in the Oyster River watershed. Under-road culverts were of particular interest.

### Using existing frameworks

- The **Puget Sound Partnership** applied an existing methodology for developing indicators of ecosystem health to the context of climate change. An additional set of indicators specific to climate change and Puget Sound is ready to be recommended for incorporation into the regional monitoring network.
- The **Tampa Bay Estuary Program** focused on identifying climate change risks to the restoration of coastal habitat, which is one of the key goals of the NEP. A toolkit of recommendations and options drawn from local experience will help to ensure the success of future habitat restoration projects.

## Risk analysis

Risk analysis is the process of understanding a risk, which includes identifying causes of the risk, assessing the likelihood (probability) of it occurring, and assessing the consequences if it were to occur. Risk analysis is essential to making decisions about which risks will become organizational priorities.

As potential problems have been identified, NEPs have taken various approaches to assessing their severity. Some have turned to monitoring to detect whether climate impacts are starting to affect their systems. Others have consulted scientists and other experts to evaluate specific threats, or they have used GIS and related modeling to assess the magnitude of important climate risks.

## Using monitoring

- The Sentinel Monitoring for Climate Change in Long Island Sound initiative was developed to show how Long Island Sound is changing and provide scientists and managers with a way to determine appropriate adaptation strategies for these impacts. In summer 2011, the **Long Island Sound Study NEP** released an updated report, “Sentinel Monitoring for Climate Change in the Long Island Sound Estuarine and Coastal Ecosystems of New York and Connecticut,” and launched a website that provides additional information on the new climate change early warning system (<http://longislandsoundstudy.net/research-monitoring/sentinel-monitoring/>).

## Using experts

- Following the risk identification process described previously, the expert elicitation process with the **Massachusetts Bays Program** and the **San Francisco Estuary Program** continued to link process variables to management actions that could reduce the negative impacts of climate change. Experts in various fields based their judgments on the body of scientific evidence using information ranging from direct experimental evidence to theoretical insights.
- The **Partnership for the Delaware Estuary** has engaged experts throughout its tri-state region to conduct an assessment of the vulnerabilities and adaptation options for three key resources: tidal wetlands, drinking water, and bivalve shellfish. The case studies will help guide adaptation options in the region and were published in a May 2010 report, “Climate Change and the Delaware Estuary: Three Case Studies in Vulnerability and Adaptation Planning.”

## Using models

- As part of the Oyster River Culvert Analysis Project described above in the Risk Identification section, the **Piscataqua River Estuaries Partnership** (PREP) used a Geographic Information System (GIS) watershed model to analyze how specific culverts would perform in several climate change and land use scenarios. PREP ranked individual culverts according to vulnerability and safety issues in order to provide decision makers with a prioritized schedule for planning culvert upgrades.
- The **Partnership for the Delaware Estuary** released a report in March 2010, “Application of Ecological and Economic Models of the Impacts of Sea Level Rise to the Delaware Estuary.” This study utilized a modeling approach coupling the Sea Level Affecting Marshes Model (SLAMM) and Habitat Equivalency Analysis (HEA) to estimate gains and losses of different marsh types under a variety of sea level rise scenarios and to project how the changing landscape would affect the provisioning of ecosystem services.
- The **Indian River Lagoon National Estuary Program** conducted a vulnerability assessment of the city of Satellite Beach, Florida, using a GIS platform to construct a three dimensional model of the city. Land elevation was added to the base map using LiDAR topographic data and aerial photographs. The assessment identified critical assets in Satellite Beach that would be vulnerable to different sea level rise scenarios. The Indian River Lagoon NEP also specifically assessed the vulnerability of wetlands to sea level rise by using SLAMM. The NEP and consultants employed a methodology similar to one used previously by the Partnership for the Delaware Estuary. This information is being used to identify priorities for habitat restoration and conservation.



## Risk evaluation

This is the process of cross-referencing the risk assessment with the organization's context to decide which risks are of concern, and then to prioritize problems. Decisions about whether or not risks need further action are outcomes of this step.

Earlier this report pointed out that NEPs tend to start with risks about which they were already concerned. In essence, they have already performed a risk evaluation, and they know they will continue to work on issues that are important in their context. When more comprehensive risk identification is available and many risks have been found to be worthy of attention, then a prioritization of further action is needed.

- The **Charlotte Harbor Estuary Program** (CHNEP) used stakeholder judgment to rank multiple risks. A survey was developed to determine which risks were of highest priority for stakeholders. The survey results and subcommittee helped narrow the list of candidate indicators to 18. Then CHNEP's Management Conference approved a final set of five indicators: changes to precipitation trend/patterns (including extreme precipitation), sea level rise, water temperature, phenology, and habitat migration.

## Selection of risk treatment options

After risks are evaluated in the prior step, some will have been assigned for further action. This step—the development of an adaptation plan—is the process of selecting strategies that will be used to avoid risks or lessen their impact.

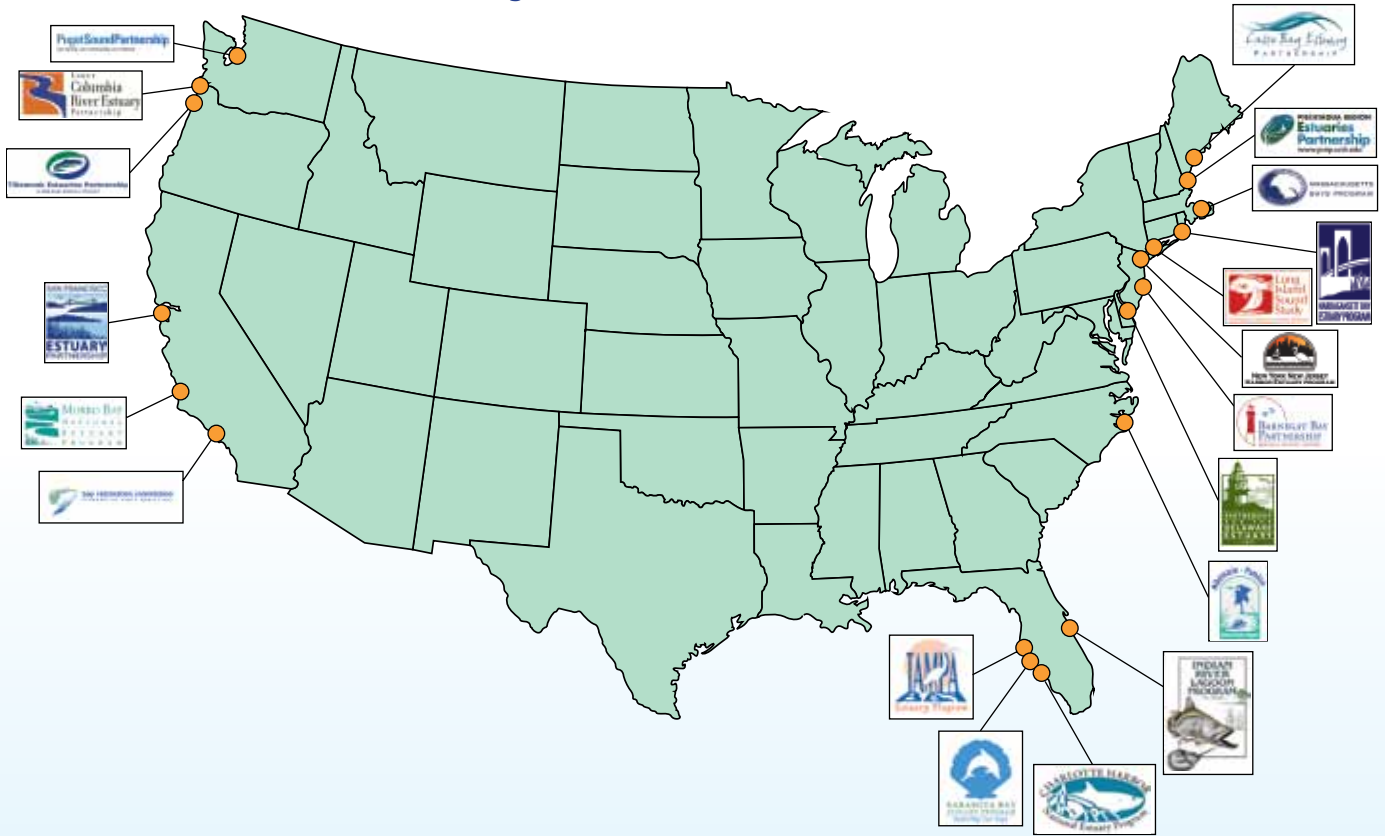
## Preparing and implementing risk treatment plans

This is the step where an adaptation plan will be put into action. Risks will be mitigated or adaptations to unavoidable impacts will be implemented.

Most CRE partners are working on projects that correspond to steps earlier in the risk management process. As they continue to assess climate change in their watersheds, more NEPs will reach the step of deciding that they have an opportunity or a need to respond.

- The **Partnership for the Delaware Estuary** (PDE) focused on three risk areas from the beginning and intended to address adaptation measures for them regardless of other potential risks, so they did not engage in the previous risk evaluation step. PDE used expert consultation to determine adaptation options. As described in the June 2010 report, "Climate Change and the Delaware Estuary: Three Case Studies in Vulnerability Assessment and Adaptation Planning," scientists and managers with expertise in each of the case study areas identified and ranked their concerns and recommended adaptation options, which are leading to follow-on work.
- In some instances, the work that NEPs did in their CRE projects has led their stakeholders to continue the adaptation process. Punta Gorda, Florida, developed a climate change adaptation plan for the city through its partnership with the **Charlotte Harbor National Estuary Program**. The **Piscataqua Region Estuaries Partnership** has worked with government groups in their watershed to address the problems that were raised through its Oyster River Culvert Study.

## Climate Ready Estuaries Partners, 2008–2011



Albemarle-Pamlico National Estuary Program

Barnegat Bay Partnership

Casco Bay Estuary Partnership

Charlotte Harbor National Estuary Program

Indian River Lagoon National Estuary Program

Long Island Sound Study

Lower Columbia River Estuary Partnership

Massachusetts Bays Program

Morro Bay National Estuary Program

Narragansett Bay Estuary Program

New York–New Jersey Harbor Estuary Program

Partnership for the Delaware Estuary

Piscataqua Region Estuaries Partnership

Puget Sound Partnership

San Francisco Estuary Partnership

Santa Monica Bay Restoration Commission

Sarasota Bay Estuary Program

Tampa Bay Estuary Program

Tillamook Estuaries Partnership

# CLIMATE READY ESTUARIES AND THE ADAPTATION COMMUNITY

## Interagency Climate Change Adaptation Task Force

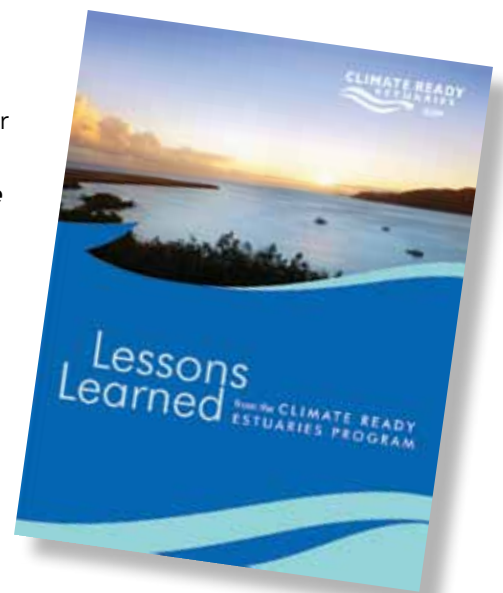
The White House Council on Environmental Quality acknowledged Climate Ready Estuaries as one of the current federal efforts in support of adaptation in its **Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy (October 5, 2010)**. The Adaptation Task Force published eight Guiding Principles for Adaptation, which, as this CRE progress report attests, correspond very well with the approach this program has taken.

- Adopt Integrated Approaches
- Prioritize the Most Vulnerable
- Use Best-Available Science
- Build Strong Partnerships
- Apply Risk-Management Methods and Tools
- Apply Ecosystem-Based Approaches
- Maximize Mutual Benefits
- Continuously Evaluate Performance

The report is available at: <http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation>.

## Lessons Learned From the Climate Ready Estuaries Program

CRE produced a pamphlet on lessons learned from NEP partners that is based on the Climate Ready Estuaries 2010 Progress Report. It is organized around four themes: Vulnerability Assessment, Stakeholder Engagement, Climate Change Indicators and Monitoring, and Adaptation Planning. **Lessons Learned from the Climate Ready Estuaries Program** is available at: <http://www.epa.gov/cre/downloads/CRE%20Lessons%20Learned%20508.pdf>.



## Media Features

### The Coastal Society Bulletin

EPA was interviewed about CRE for The Coastal Society's summer 2011 edition of the **TCS Bulletin**. The article describes CRE and recent accomplishments:

<http://www.thecoastalsociety.org/pdf/bulletin/Summer2011v4.pdf>.

### Marine Protected Areas Connections

An "Interview with the Barnegat Bay Program and the Jacques Cousteau National Estuarine Research Reserve on the Climate Ready Estuary Program" appeared in a special issue of **MPA Connections** focused on climate change:

[http://www.mpa.gov/pdf/helpful-resources/connections/connections\\_dec10.pdf](http://www.mpa.gov/pdf/helpful-resources/connections/connections_dec10.pdf).



# PUBLIC EDUCATION

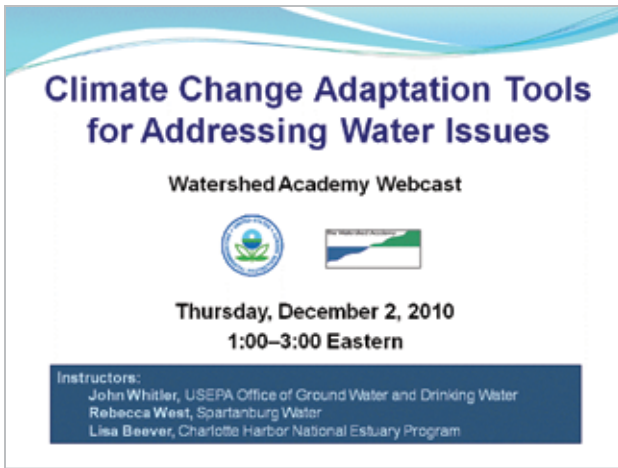
## Twitter

Since November 2010, CRE has been posting weekly "Climate Friday" tweets through the EPA Office of Wetlands, Oceans & Watersheds (OWOW) Twitter account. By August 2011 the EPAowow account on Twitter had more than 10,000 followers who have voluntarily signed up to receive news from OWOW. Through the power of new Web communication tools, thousands of people get a short CRE update about climate adaptation every week.

<http://twitter.com/EPAowow>

Hash tag: #crenews





## Watershed Academy

In December 2010, CRE and CRWU presented a live EPA Watershed Academy Webcast to nearly 600 participants. “Climate Change Adaptation Tools for Addressing Water Issues,” focused on facilitating climate adaptation in the water sector. Speakers from EPA, Spartanburg Water, South Carolina and the Charlotte Harbor National Estuary Program, Florida discussed their on-the-ground adaptation efforts. An archived version of the webcast is available at: <http://water.epa.gov/learn/training/wacademy/archives.cfm#change>.

## King Tides

CRE has been busy planning for how the NEPs can use the king tide as an opportunity to engage the public about sea level rise. A king tide is the highest predicted high tide of the year at a coastal location. It is a proxy for sea level rise because sea level rise will make today's king tides become the future's everyday tides.

CRE has been promoting king tide education campaigns, specifically the use of documentary photography, with partners in the NEP. EPA also worked with NOAA to prepare a fact sheet to describe king tides.



High water flooding in Washington, D.C.

Photo courtesy of Jamal Kadri



# CLIMATE READY ESTUARIES PRODUCT: ROLLING EASEMENTS

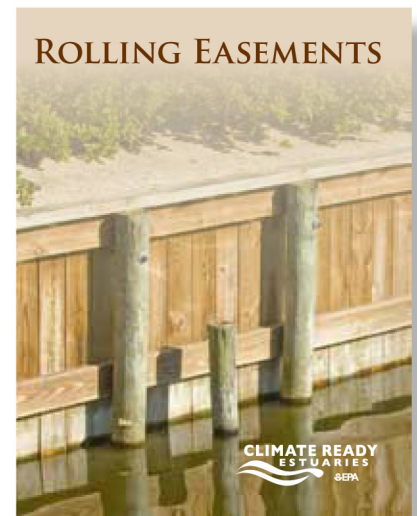
**“A rolling easement is a legally enforceable expectation that the shore or human access along the shore can migrate inland instead of being squeezed between an advancing sea and a fixed property line or physical structure.”**

Rising sea level is inundating low-lying lands, eroding beaches, and exacerbating coastal flooding. Governments and landowners usually respond by protecting developed areas from the rising sea, either by adding sand to eroding beaches or by erecting dikes, seawalls, revetments, and other shore protection structures. A wide variety of information and assistance programs are available to support these “shore protection” efforts. However, shore protection may not always be appropriate. Defending coastal development from the rising sea would expose many people to the hazard of living below sea level, would prevent wetlands and beaches from migrating inland, and may cost more than the property being protected is worth.

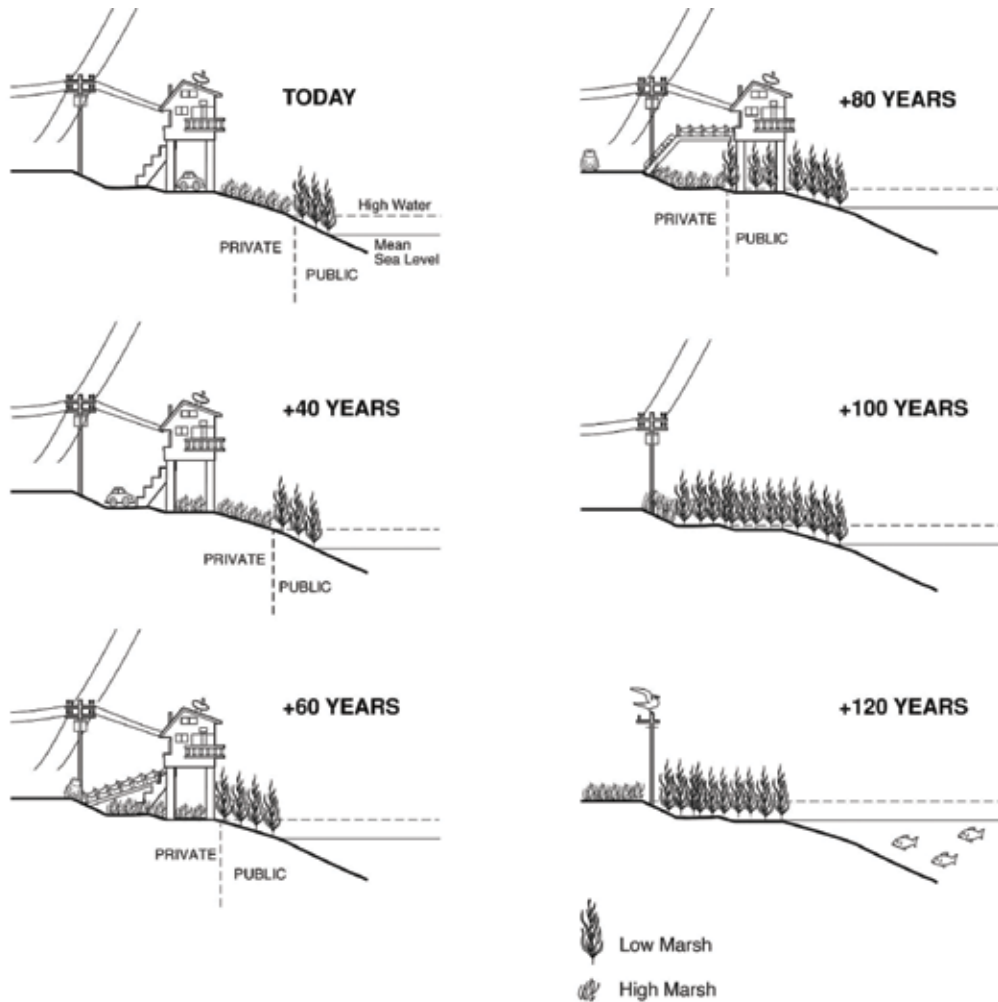
In 2011, CRE released a primer entitled **Rolling Easements** (<http://epa.gov/cre/downloads/rollingeasementsprimer.pdf>) that presents an alternative vision: base future development of low-lying coastal lands on the premise that eventually the land must give way to the rising sea. The primer examines more than a dozen approaches for ensuring that wetlands and beaches can migrate inland, including:

- Conservation easements that prohibit shore protection
- Future interests in land that transfer ownership from a homeowner to a land trust when sea level reaches a specified level
- Covenants and easements between neighbors
- Boundaries between private landowners that migrate as the shore retreats
- Zoning that prohibits shore protection
- Transferable development rights that promote the landward migration of barrier islands.

Many of those measures would ensure that access along the shore is not lost as a beach erodes. **Rolling Easements** examines options designed specifically to preserve access, such as adding permit conditions that preserve access along new shore protection structures, ensuring that shoreline easements are rolling easements, and precisely defining the inland boundary of public access in those states where courts have not yet done so. The primer also provides perspectives on the legal implications of retreating shores and the tax consequences of donating a rolling easement.



### Migration of Wetlands and Boundary between Public and Private Land, with a Property Subject to a Rolling Easement



A rolling easement allows construction near the shore, but requires the property owner to recognize nature's right-of-way by allowing wetlands and the public access way to advance inland as sea level rises. In the sample case depicted, the high marsh encompasses the footprint of the house 40 years later. Because the house is on pilings, it can still be occupied, assuming that it is hooked to a sewerage treatment plant. (A flooded septic system would probably fail, because the drain field must be a minimum distance above the water table.) After 60 years, the marsh has advanced enough to require the owner to park her car along the street and construct a catwalk across the front yard. After 80 years, the marsh has taken over the entire yard and has reached the street; moreover, the footprint of the house is now seaward of mean high water, and hence is on public property. At this point, additional reinvestment in the property is unlikely. Twenty years later, the particular house has been removed, although other houses on the same street may still be occupied. Eventually, the entire area returns to nature.



# PROJECT PARTNERS

## Albemarle-Pamlico National Estuary Program

[www.apnep.org](http://www.apnep.org)

## Lower Columbia River Estuary Partnership

[www.lcrep.org](http://www.lcrep.org)

## Barnegat Bay Partnership

[bbp.ocean.edu](http://bbp.ocean.edu)

## Massachusetts Bays Program

[www.mass.gov/envir/massbays](http://www.mass.gov/envir/massbays)

## Casco Bay Estuary Partnership

[www.cascobay.usm.maine.edu](http://www.cascobay.usm.maine.edu)

## Morro Bay National Estuary Program

[www.mbnep.org](http://www.mbnep.org)

## Charlotte Harbor National Estuary Program

[www.chnep.org](http://www.chnep.org)

## Narragansett Bay Estuary Program

[www.nbep.org](http://www.nbep.org)

## Indian River Lagoon National Estuary Program

[www.sjrwm.com/itsyourlagoon](http://www.sjrwm.com/itsyourlagoon)

## New York–New Jersey Harbor Estuary Program

[www.harborestuary.org](http://www.harborestuary.org)

## Long Island Sound Study

[www.longislandsoundstudy.net](http://www.longislandsoundstudy.net)

## Partnership for the Delaware Estuary

[www.delawareestuary.org](http://www.delawareestuary.org)

## **Piscataqua Region Estuaries Partnership**

[www.prep.unh.edu](http://www.prep.unh.edu)

## **Puget Sound Partnership**

[www.psp.wa.gov](http://www.psp.wa.gov)

## **San Francisco Estuary Partnership**

[www.sfestuary.org](http://www.sfestuary.org)

## **Santa Monica Bay Restoration Commission**

[www.santamonicabay.org](http://www.santamonicabay.org)

## **Sarasota Bay Estuary Program**

[www.sarasotabay.org](http://www.sarasotabay.org)

## **Tampa Bay Estuary Program**

[www.tbep.org](http://www.tbep.org)

## **Tillamook Estuaries Partnership**

[www.tbnep.org](http://www.tbnep.org)

Moving forward on climate change adaptation will require the combined efforts of numerous partners that can contribute energy and resources. Climate change is a multifaceted problem that requires engagement from all sectors of coastal management.

CRE examples and lessons inform other adaptation efforts and help build the coastal climate adaptation community. In an effort to strengthen this group, CRE encourages the NEPs to work with other federal, state, and local partners on adaptation projects.

In their 2011 CRE project work plans the NEPs identified partners from NERRS, state Sea Grants, NRCS, universities, environmental NGOs, philanthropic organizations, professional societies, local governments, emergency management agencies, land trusts, water utilities, corporations, state agencies, and regional planning commissions.

CRE values all who have joined in and contributed to program success.





Office of Water  
Office of Air and Radiation  
EPA-842-R-11-004  
December 2011

