

Summary of Coastal Program Initiatives that address Sea Level Rise as a result of Global Climate Change



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Cover photos: Visualizations of Newport, R.I., depicting high tide (July 2007), high tide + 3’ sea level rise; spring tide + 3’ sea level rise. A.J. Wilson, Rhode Island Sea Grant

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Overview

Across the nation, state and local officials are assessing programs and policies to address the clear consequences of climate change. For coastal communities, a significant concern is the documented acceleration of sea level rise globally, and the resulting erosion and inundation of coastal resources and communities. The Coastal Zone Management Act (CZMA) notes that, “because global warming may result in a substantial sea level rise with serious adverse effects in the coastal zone, coastal states must anticipate and plan for such an occurrence.” As various state and local governments confront these issues, there is a genuine need to identify and share the approaches and strategies that emerge.

Therefore the CZMA further acknowledges this challenge to “minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion-prone areas and in areas likely to be affected by or vulnerable to sea level rise, land subsidence, and saltwater intrusion, and by the destruction of natural protective features such as beaches, dunes, wetlands, and barrier islands.”

With this goal in mind, the R.I. Coastal Resources Management Council requested assistance to review these issues locally. In efforts to provide input to the policy development process, the Rhode Island Sea Grant College Program and Coastal Resources Center at the University of Rhode Island collaborated with the National Oceanic and Atmospheric Administration Office of Ocean and Coastal Resource Management (NOAA/OCRM), Coastal Program Division, to conduct a desktop review of state Coastal Programs that have incorporated or are in the process of incorporating anticipated sea level rise into planning and regulatory processes or are engaging in initiatives regarding sea level rise, climate change, or other relevant hazards. The steps involved in compiling the information included:

- a. A request for input on sea-level-rise policy initiatives, through electronic list servers and directed communication to Sea Grant and Coastal Management Program specialists in natural hazards related fields;
- b. Website review, and;
- c. Direct input, review, and validation from state Coastal Management Program and Sea Grant specialists.

The following summary is one result of this initiative and is intended to provide an information base for dialogue among managers, policy makers, and researchers engaged in managing and mitigating potential impacts to the coastal zone. Information from this effort has already been insightful for developing state coastal policy in Rhode Island and providing preliminary findings to the Coastal States Organization’s (CSO) Report, *The Role of Coastal Zone Management Programs in Adaptation to Climate Change, Final Report of the CSO Climate Change Work Group, September, 2007*. Where appropriate, information from the CSO report has been included in this summary paper.

Part I of this report, Climate Change Initiatives, includes policies and initiatives aimed specifically at addressing the effects of climate change and sea level rise. Part II of this report, Coastal Hazard Initiatives, is a more general designation, which includes policies and initiatives devised for general coastal hazard mitigation. While the primary goal of this study was to investigate information related to sea-level-rise policy and climate change initiatives, we have included Part II to provide the information that our respondents offered on relevant hazards initiatives. *This does not constitute a comprehensive summary of state coastal hazards initiatives, since that is beyond the scope of this particular study.*

The 2007 Intergovernmental Panel on Climate Change concluded that “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.”¹ As we move forward to identify management responses and implement adaptation strategies to meet this management challenge, we can look to the tools and measures already in place that help mitigate the impacts to our dynamic shoreline. The measures in place today, however, are likely insufficient for addressing the accelerated rates of sea level rise and other potential impacts of future global change. We must develop new adaptation strategies to meet the challenges of accelerated change.

“There are many known and proven reasons to take actions that will mitigate potential climate change impacts. We should not let the public be confused by the uncertainty and seeming controversy of the climate change debate. We need to do the right thing because of what we know and can prove. Potential climate change impacts only make taking those actions more compelling.” (S. Rogers, personal communication, April 26, 2007)

The authors would like to thank the dozens of program specialists in the Sea Grant and Coastal Program networks that generously provided their input, review, and validation to the information listed here. . The authors would also like to acknowledge the active support of Carrie Hall and Sarah van der Schalie of the NOAA/OCRM Coastal Program Division, who assisted in coordinating input from the numerous Coastal Management Programs in their network.

Please feel free to send additions to rubi@crc.uri.edu and visit the Rhode Island Sea Grant webpage at <http://seagrant.gso.uri.edu/ccd/haz.html> to download this document and view updated information.

¹ IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Part I – Climate Change Initiatives

The information gathered by this study related to sea-level-rise and other climate-change initiatives is presented below for each state or territory covered by the NOAA/OCRM program. Table 1 provides an overview of the various efforts associated with five subcategories that describe the effort: Working Groups, Commissions, and Committees; Outreach; Information for Decision Makers; Implementable Policy; and Plans, Strategies, and Recommendations for Action. This information is summarized in the table below². These seven subcategories include only climate-change and sea-level-rise initiatives and do not include those advances listed under the more general Coastal Hazards initiatives summarized in Part II.

Alabama

1. At this time, the Alabama Coastal Program does not have sea-level-rise policies or initiatives specific to climate change. The Alabama Coastal Area Management Program (ACAMP) is initiating a revision of its program documents and the issue of sea level rise may be incorporated into the upcoming revisions. However, according to the Alabama Department of Conservation and Natural Resources, relative sea level rise is not a large concern in Alabama when compared to Louisiana and Texas, where subsidence and erosion are major issues. Additionally, the state's major estuarine system—the Mobile-Tensaw River Delta—is sediment rich, and also is stable and/or actively prograding. While sea level rise may be addressed in the ACAMP document revisions, major policy or regulatory changes are not foreseen at this time.

Alaska

1. At this time, the Alaska Coastal Program does not have sea-level-rise policies or initiatives specific to climate change. Much of southern and southeastern Alaska (the area of the state with the highest population density) is experiencing a well-documented drop in sea level due to isostatic rebound that is occurring faster than sea level rise due to climate change.

American Samoa

1. At this time the American Samoa Coastal Program does not have sea-level-rise policies or initiatives specific to climate change.

California

The California Coastal Commission, in partnership with coastal cities and counties, is one of the statewide agencies responsible for planning and regulating land and water use in the California coastal zone and is part of California's Coastal Program. In June of 2001, the commission published an *Overview of Sea Level Rise and Some Implications for Coastal California*, which

² These seven subcategories purposefully do not include those policies and initiatives listed under the category of general Coastal Hazards initiatives, which might otherwise fall into these subcategories.

provides an overview of geologic and historic changes in sea level in an effort to put future sea level change projections into context. The report discusses factors affecting global and local changes in sea level and the differences between mean sea level and the various tidal components. It also discusses sea level trends, possible consequences from increasing sea levels, and various possible responses to future increases in sea level.

For more information on the *Overview of Sea Level Rise and Some Implications for Coastal California*, go to: www.coastal.ca.gov/climate/SeaLevelRise2001.pdf.

1. The San Francisco Bay Conservation and Development Commission (BCDC) is the state coastal management agency for the San Francisco Bay area of the California coastal zone and is part of California's Coastal Program. The San Francisco Bay Plan was initially completed in January 1969 and is regularly updated. The plan specifically addresses sea level rise within the discussion of "Safety of Fills" (page 33). The policy states:

"To prevent damage from flooding, structures on fill or near the shoreline should have adequate flood protection including consideration of future relative sea level rise as determined by competent engineers. As a general rule, structures on fill or near the shoreline should be above the wave runup level or sufficiently set back from the edge of the shore so that the structure is not subject to dynamic wave energy. In all cases, the bottom floor level of structures should be above the highest estimated tide elevation."

The program document also provides policies to guide management of flood protection structures and tidal restoration projects.

For more information on the San Francisco Bay Plan, go to: www.bcdc.ca.gov/pdf/planning/plans/bayplan/bayplan.pdf.

2. In 2006, the BCDC also initiated the Climate Change Planning Project. Goals of this initiative are to:

"Identify the findings and policies in the San Francisco Bay Plan pertaining to climate change, such as the findings and policies on sea level rise, and update other relevant Bay Plan policies to incorporate new information about the impacts of climate change."

Sea-level-rise models of the bay indicate that a 30 cm rise in sea level would shift the 100-year coastal flood event to once every 10 years. With each flood event, the bay area stands to lose valuable real estate, critical public infrastructure, and natural resources. Accordingly, the BCDC, through its sea level rise mapping project, has identified shoreline areas likely to be impacted by a sea level rise of one meter (www.bcdc.ca.gov/index.php?cat=56). The one meter estimate was based on the 2006 *California Climate Action Team Report*, which projected that mean sea level will rise between 10 and 90 cm by the year 2100.

For more information on the Climate Change Planning Project and the *California Climate Action Team Report*, go to: www.bcdc.ca.gov/index.php?cat=56.

For more information on general climate change policies in California, viewable on the California Climate Change Portal, go to: www.climatechange.ca.gov/index.html.

Connecticut

1. The Connecticut Coastal Program's *Assessment and Enhancement Strategy, FY 2006 - 2010*, submitted to NOAA in accordance with Section 309 of the Coastal Zone Management Act, includes a strategy to develop a coastal hazards plan to guide proper siting of development and address anticipated inundation of existing structures and infrastructure. The plan will identify adaptation strategies for structures and facilities that will be inundated over time and assess whether statutory changes will be necessary and, if so, which changes will be necessary.
2. Initial discussions are underway within the Connecticut Coastal Program regarding the potential ramifications of sea level rise on future marsh restoration programs. With new high-resolution maps, there may be an opportunity to study and identify marine transgression refugia sites for a range of inundation scenarios.

Delaware

1. The state is putting together a working group to investigate sea level rise. The issue has been raised throughout the past two decades. In 1988, the *Environmental Legacy Report* acknowledged that sea level rise is an indicator of potential future environmental stress and highlighted the impacts of erosion of the ocean shoreline, which is a key economic resource. A 2004 publication, *Striking a Balance: A Guide to Coastal Dynamics and Beach Management in Delaware*, incorporates sea level rise as one factor in the need to effectively manage beaches. The publication outlines four management options, including costs and benefits, for beach erosion control and property protection. The options analyzed are taking no action, shoreline hardening, strategic retreat, and beach nourishment.

For more information on *Striking a Balance: A Guide to Coastal Dynamics and Beach Management in Delaware*, go to:

www.dnrec.state.de.us/dnrec2000/Divisions/Soil/dcmp/StrikeBalance.pdf.

2. The Delaware Sea Grant Marine Advisory Service has worked extensively with the Delaware Department of Natural Resources and Environmental Control (DNREC) on sea-level-rise issues. This includes hosting workshops on sea level rise and coastal inundation (e.g., a recent series called "Delaware Coastal Issues"), initiating coastal resiliency programs, as well as hosting several presentations on sea level rise for the general public.
3. The Delaware DNREC Division of Soil and Water Conservation (Shoreline and Waterway Management Section) has conducted outreach work on topics related to sea level rise and shoreline change. Additionally, the DNREC Flood Mitigation Program has worked over the past several years to incorporate the concept of sea level rise into flood mitigation planning.

4. The DNREC, using a “Whole Basin Management” approach, has developed the *Inland Bay/Atlantic Beach Ocean Basin Assessment Report*. The recommendations in the 2001 assessment include “prepar[ing] for climate change and sea-level rise by practicing retreat” and “setback requirements should be increased along the shoreline.”

For more information on the *Inland Bay/Atlantic Beach Ocean Basin Assessment Report*, go to:

[www.dnrec.state.de.us/DNREC2000/admin/wholebasin/inlandbays/assessment/DOCUMENT/Inland%20Bays%20Assessment%20\(Text%20Only\).pdf](http://www.dnrec.state.de.us/DNREC2000/admin/wholebasin/inlandbays/assessment/DOCUMENT/Inland%20Bays%20Assessment%20(Text%20Only).pdf).

5. In October 2007, the Delaware Coastal Program began funding a project to evaluate inundation modeling as well as expanding flood elevation levels and sediment accretion rates.

Florida

1. The South Florida Regional Planning Council (SFRPC) completed a study in 2005 on the effects of long-term sea level rise on seven coastal counties. The research objective of the Sea Level Rise Project was to describe what South Florida might look like in 200 years if global warming causes sea levels to rise significantly. The project was based on the U.S. Environmental Protection Agency’s (EPA) estimate of a five-foot rise in sea level over a 200-year period. Inundation maps for each of the seven coastal counties in southeast Florida from Monroe County to Indian River County were generated.

For more information on the Sea Level Rise Project on the SFRPC website, go to:

www.sfrpc.com/gis/slr.htm.

Georgia

1. At this time the Georgia Coastal Program does not have sea-level-rise policies or initiatives specific to climate change. A 2005 Executive Order charged the Department of Community Affairs with the development of a comprehensive master plan for the coastal Georgia region. The draft plan, released in October 2007, references sea level rise peripherally and states that rising sea levels will affect coastal development and flood wetland forests with salt water.

Guam

1. At this time the Guam Coastal Program does not have sea-level-rise policies or initiatives specific to climate change.

Hawaii

1. At this time the Hawaii Coastal Program does not have sea-level-rise policies or initiatives specific to climate change. The Hawaii Coastal Program is currently addressing climate

change through ongoing projects related to Hawaii's historical hurricanes and the effects of hurricanes on the built environment, as well as inundation mapping. These projects include updating the state and county civil defense evacuation maps based on updated computer modeling of tsunami run-up as well as the creation of an *Atlas of Natural Hazards in the Hawaiian Coastal Zone, Climatic Atlas of Tropical Cyclones over the Central North Pacific* and the development of Hawaii and Maui county wind speed maps, a building code amendment, and the *Hawaii Hazard Mitigation Plan*. These will enhance the mitigation tools for reducing damage impacts, as well as improve mitigation and emergency management.

Indiana

1. At this time the Indiana Coastal Program does not have lake-level-change policies or initiatives specific to climate change. The state has not incorporated language in its floodplain regulations to address such situations. The individual lakefront communities may have coastal standards separate from their floodplain standards, however.

Louisiana

1. At this time the Louisiana Coastal Program does not have sea-level-rise policies or initiatives specific to climate change.
2. The public awareness campaign, America's Wetland: Campaign to Save Coastal Louisiana, builds on the interrelationship between climate, energy, and coastal resources. The campaign includes sustainable development and coastal restoration goals, noting that the issues of sea level rise, subsidence, natural ecology, sustaining fisheries and commerce, and hurricane protection are paramount. Included in a range of outreach activities, the campaign will hold summits on climate, energy, and the coast.

For more information on the awareness campaign, go to:

www.americaswetland.com/custompage.cfm?pageid=2 or
www.americaswetland.com/article.cfm?id=484&cateid=1&pageid=3&cid=17.

Maine

1. Chapter 355 of the Natural Resources Protection Act (Code of Maine Rules - The Coastal Sand Dune Rules, Maine Department of Environmental Protection (DEP), 2006; first adopted: 1983) regulates the construction of structures within the coastal sand dune system. These rules, which were revised in 2006, recognize that many of the sandy beaches and dunes along Maine's coastline are eroding, in part due to a scientifically documented rise in relative sea level. Acknowledging that the extent to which sea level will change in the future is uncertain, the Maine DEP anticipates that sea level will rise approximately two feet in the next 100 years (as quoted see *Impacts of Future Sea Level* below from the introduction to Ch. 355; also Section 3).

“The department recognizes the dynamic nature of coastal sand dune systems in response to the changing conditions of water levels, waves, and winds. The extent to which sea level will change in the future is uncertain. However, the department

anticipates that sea level will rise approximately two feet in the next 100 years. Under any scenario of increasing sea level, the extensive development of sand dune areas and the construction of structures increase the risk of harm, to both the coastal sand dune system and the structures themselves.” (Ch. 355, Sec. 1)

There are several excerpts from the revised rules that specifically relate to sea level rise. The definition of an erosion hazard area (EHA) was added in 2006. The revised rules define EHAs as areas within the coastal sand dune system where new or reconstructed structures must be elevated on posts to account for erosion and sea level rise. The EHA definition (Section 3P) is:

“Any portion of the coastal sand dune system that can reasonably be expected to become part of a coastal wetland in the next 100 years due to cumulative and collective changes in the shoreline from:

- (1) Historical long-term erosion;
- (2) Short-term erosion resulting from a 100-year storm; or
- (3) Flooding in a 100-year storm after a two-foot rise in sea level,

or any portion of the coastal sand dune system that is mapped as an AO flood zone by the effective FEMA Flood Insurance Rate Map, which is presumed to be located in an Erosion Hazard Area unless the applicant demonstrates based upon site-specific information, as determined by the department, that a coastal wetland will not result from either (1), (2), or (3) occurring on an applicant’s lot given the expectation that an AO-Zone, particularly if located immediately behind a frontal dune, is likely to become a V-Zone after 2 feet of sea level rise in 100 years.”

Section 5C of the rules discusses shoreline change and the potential damages to projects over the next 100 years, and explicitly states:

“A project may not be permitted if, within 100 years, the property may reasonably be expected to be eroded as a result of changes in the shoreline such that the project is likely to be severely damaged after allowing for a two-foot rise in sea level over 100 years. Beach nourishment and dune restoration projects are excluded from this requirement.”

Additionally, Section 5D limits the size of structures that can be built to less than 35 feet and 2,500 square feet unless an applicant can demonstrate that the site will remain stable after allowing for a two-foot rise in sea level over 100 years. The intended result of this provision is to insure that structures can be easily moved in the future should erosion or flooding in the future become problematic.

If shoreline changes (caused by sea level rise, erosion, or other coastal processes) result in a permitted structure’s foundation being located within the intertidal zone for a period of six consecutive months, then the structure must be removed from the beach:

“If the shoreline recedes such that a coastal wetland, as defined under 38 M.R.S.A. §480-B(2), extends to any part of the structure, including support posts, but excluding seawalls, for a period of six months or more, then the approved structure along with appurtenant facilities must be removed and the site must be restored to natural conditions within one year.” (Ch. 355, Sec. 10-A)

This contingency is applied to all projects that receive a permit for construction in the coastal

sand dune system and is appended to the property deed and passed on to subsequent property owners when a title is transferred.

The full text of the revised coastal sand dune rules can be read online at:
www.maine.gov/sos/cec/rules/06/chaps06.htm.

2. In response to the new definition for an EHA, the Maine Geological Survey (MGS) is currently completing the creation of GIS layers that map the landward extent of the EHA along Maine's sandy beaches. These layers are being developed in conjunction with revised and constrained frontal and back dune boundaries, which were originally mapped in 2001. The remapping efforts use more recent aerial photographs (2003) along with available NOAA LIDAR (2004) and field-measured shoreline changes from recent years.
3. In 2006, MGS published a report, *Impacts of Future Sea Level Rise on the Coastal Floodplain*, in which LIDAR was used to model a two-foot rise in sea level for an area of the Rachel Carson National Wildlife Refuge, located in Wells, Maine. The basis for the two-foot estimate is as a
 "Response to documented and predicted rises in sea level for the global oceans and the Gulf of Maine, including data collected at the City of Portland tide gauge between 1912 and 2002, which documents an approximate 0.2 m (0.6 ft) rise in sea level, in addition to Intergovernmental Panel on Climate Change (IPCC, 2001) projections of 0.5 m of global average sea level rise by 2100."

Subsequently, the MGS developed GIS coverages and datasets that identify and quantify the impacts of the projected rise in sea level within the defined study area. Since release of this report, MGS created similar GIS layers that simulate the potential impacts of two feet of sea level rise during times of highest annual tide and assessed impacts to existing marsh communities adjacent to its sandy beach communities. Results of the report were made available to the public in 2007.

For more information on the *Impacts of Future Sea Level Rise on the Coastal Floodplain*, go to: www.maine.gov/doc/nrimc/mgs/explore/marine/sea-level/contents.htm.

4. Maine Sea Grant, in collaboration with Oregon Sea Grant, has recently initiated a new two-year project to help coastal communities prepare for climate change. Supported by NOAA's Sectoral Application Research Program, the project aims to develop and test a model of public outreach about climate change. One premise of the project is that decision makers and residents need to better understand the challenges of adapting to climate variability locally in order to lessen its effects and make their communities more resilient. With this in mind, outreach will involve public and private decision makers such as city managers, county planners, private developers, bankers, and realtors. Surveys, focus groups, and interviews will be used to determine information needs and strategies. Collaboration between the two states is expected to yield insights about critical information needs and effective outreach strategies that may be applicable to other states.
5. The first systematic assessment of Maine's vulnerability to warming-induced sea level rise

was published by the EPA in 1995. *Anticipatory Planning for Sea-Level Rise along the Coast of Maine* consists of a vulnerability assessment and possible adaptive response strategies the state might adopt to mitigate negative impacts of global climate change. This assessment included:

- a. Relative costs and benefits of selected preliminary response strategies for one specific case study;
- b. The responsiveness of existing state and federal laws and policies to address the most significant negative impacts on coastal resources identified by the vulnerability assessment;
- c. The legal considerations for Maine's policy response including potential legal challenges to regulatory tools; and
- d. Approaches already adopted or evaluated by other states for coastal erosion or coastal hazard mitigation.

While the report is not itself a formal plan, it does provide background information and a set of preliminary recommendations to facilitate the future development of a more formal plan.

For more information on *Anticipatory Planning for Sea-Level Rise along the Coast of Maine*, go to: www.epa.gov/climatechange/effects/downloads/maine_3.pdf.

For more information on EPA's assessments related to sea level rise, go to: www.epa.gov/climatechange/effects/coastal/slrreports.html.

Maryland

1. The state's Department of Natural Resources published *A Sea Level Rise Response Strategy for the State of Maryland* in 2000. The report articulates specific policy targets including amendments to the Flood Hazard Management Act mandating that all counties adopt standards requiring a freeboard of two feet or more in tidally influenced floodplains, expand critical area buffers, and update policy from the Wetlands and Riparian Rights Act. The report references past studies that estimate a two- to three-foot sea level rise by the year 2100. The report emphasizes that rising sea levels pose a very real threat, and policy interventions will soon become necessary. The Maryland Coastal Program is using the strategy document to guide its current sea-level-rise planning efforts. Overall, this document includes an overview of:
 - a. Data and research;
 - b. An assessment of Maryland's vulnerability to flooding;
 - c. Erosion;
 - d. Inundation and saltwater intrusion;
 - e. An analysis of the state's existing response capability and planning needs; and
 - f. A proposed strategy for developing a coordinated interagency response to sea level rise.

For more information on *A Sea Level Rise Response Strategy for the State of Maryland*, go to: www.dnr.state.md.us/Bay/czm/sea_level_rise.html.

2. On April 20, 2007, Maryland's governor signed an executive order establishing a Commission on Climate Change to advise the governor and Maryland's General Assembly on matters related to climate change. The commission is charged with developing a plan of action that will address both the drivers and consequences of climate change, particularly those associated with sea level rise and coastal hazards. Three working groups, comprised of a broad set of stakeholders and representatives of all levels of government, will work together to develop the plan of action. The Scientific and Technical Working Group will develop a comprehensive climate change impact assessment, and the Greenhouse Gas and Carbon Mitigation Working Group will develop a comprehensive greenhouse gas and carbon footprint reduction strategy. Finally, the Adaptation and Response Working Group (ARWG) will develop a comprehensive strategy for reducing Maryland's vulnerability to climate change. The comprehensive strategy:
 - a. Will include strategies for reducing the vulnerability of the state's coastal, natural and cultural resources and communities to the impacts of climate change, with an initial focus on sea level rise and coastal hazards (e.g., shore erosion, coastal flooding). Specific tasks outlined for the ARWG in the executive order are directly related to ongoing sea level rise and coastal hazard planning efforts currently being administered by the Coastal Program.
 - b. Will build upon the policy recommendations set forth in the Maryland sea-level-rise response strategy (see #1 above). The ARWG will be recommending draft legislation and policy options directly related to sea-level-rise adaptation in April 2008. Additionally, the ARWG will be working with local governments to identify the capacity of local governments to plan for and adapt to sea level rise as well as developing appropriate guidance to assist local governments with identifying specific measures (e.g., local land-use regulations and ordinances) in order to adapt to sea level rise and increasing coastal hazards.

The plan, including recommendations and draft legislation, will be presented to the governor and General Assembly in April 2008.

For more information on the Maryland Commission on Climate Change, go to:
www.mde.state.md.us/air/mccc/.

3. The Maryland Coastal Program is currently working on the development of sea-level-rise planning guidance for three coastal counties: Dorchester, Somerset, and Worcester. The guidance is intended to lay out the process, methodology (i.e., draft language), and timeline for incorporating sea-level-rise and coastal hazard-response planning into local planning processes and frameworks. Each guidance document is being tailored to meet the specific needs of the coastal county. In general, however, the documents will address four phases of sea-level-rise and coastal hazards planning:
 - a. Vulnerability and impact assessment;
 - b. Long-range and comprehensive planning;
 - c. Code, regulation and development standards; and
 - d. Public education and outreach.

Recommendations for sequencing and integrating the four planning phases will be included

and financial and technical assistance needs will be identified. Products are expected to be completed in September 2008.

4. The Maryland Coastal Program and local partners recently acquired high-resolution topographic LIDAR data for the majority of the state's coastal counties. This data is now being used to develop sea-level-rise inundation models that demonstrate both the impact of gradual sea-level-rise inundation over time as well as impacts associated with increased storm surge from episodic flood events. Sea-level-rise modeling has been completed for Worcester and Dorchester counties as well as pilot areas within Anne Arundel and St. Mary's counties.
5. The Maryland Coastal Program has recently completed historic shoreline position maps, a statewide calculation of historic erosion rates, a comprehensive inventory of shoreline features and conditions for Maryland's coast, and a sea level rise economic cost study. The program recently launched an interactive web portal, Shorelines Online, which centralizes information and data on coastal hazards management and sea level rise in Maryland.

For more information on Shorelines Online, go to: shorelines.dnr.state.md.us/.

6. According to the Coastal States Organization's 2007 report, *The Role of Coastal Zone Management Programs in Adaptation to Climate Change*, Maryland has an advanced set of sea-level-rise and coastal hazard planning objectives through ongoing state and local planning and policy initiatives. To date, sea-level-rise issues have been addressed in the NEP Management Plan (1999), the Chesapeake 2000 Bay Agreement, the Baltimore and Prince George's County Hazard Mitigation Plans, the Coastal Bays Hazards Initiative (2004) and the Worcester County Comprehensive Plan (2006).³

Massachusetts

1. As recently as 2003, the Cape Cod Commission (CCC) revised their *Regional Policy Plan: County of Barnstable*, a regulatory framework for community planning efforts. Coastal resources is one of many issue areas, and consideration of sea level rise is stressed for all coastal planning and development activities. The plan states that sea levels will rise as a result of global climate change and cites an EPA estimate of a one-foot rise in the next 25 to 50 years. Additionally, the report acknowledges that existing land-use and building regulations are minimum standards that fail to address the effects of sea level rise, and calls for the application of more stringent standards in the coastal zone. Goal 2.2.2 limits development in areas subject to coastal storm flows and relative sea level rise, provides an extensive list of performance standards, and outlines specific policies in which sea level rise is considered, specifically in the:
 - a. Development in flood hazard zones;
 - b. Reconstruction of existing structures;

³ Coastal States Organization, *The Role of Coastal Zone Management Programs in Adaptation to Climate Change: Synthesis Report from the CSO Climate Change Work Group* (September, 2007). p12. www.coastalstates.org/documents/CSO%20Climate%20Change%20Final%20Report.pdf.

- c. Public infrastructure in flood hazard zones;
- d. Dredging and re-nourishment; and
- e. Design and construction of stormwater management.

As an example, Minimum Performance Standard 2.2.2.2 states:

“In order to accommodate possible relative sea-level rise and possible increased storm intensity, ensure human health and safety, and protect the integrity of coastal landforms and natural resources, all new buildings, including replacements, or substantial improvements to existing structures within FEMA A-zones shall be designed to accommodate the documented relative sea-level rise rate in Massachusetts of at least one foot per 100 years, except as provided in Minimum Performance Standard 2.2.2.13, and in V-zones shall be designed to accommodate a relative sea-level rise rate of two feet per 100 years.”

For more information on the *Regional Policy Plan: County of Barnstable*, go to: www.capecodcommission.org/RPP/home.htm.

2. The Coastal Hazards Commission (CHC) was chaired and staffed by the Massachusetts Office of Coastal Zone Management (CZM) at the request of the governor and the state Legislature. The CHC (launched in February 2006) was charged with reviewing existing coastal hazards practices and policies, identifying data and information gaps, and drafting recommendations for administrative, regulatory, and statutory changes, if deemed necessary. The CHC identified several specific information gaps that affect the ability of CZM, other state agencies, and local officials to discourage or prevent development or redevelopment in high hazard areas. These include flood maps that reflect the 1990 FEMA regulations changes in velocity zone mapping and sea-level-rise policy. Final recommendations were released in May 2007 and recognize that

“The coastal zone is being severely impacted by erosion and flooding due in part to climate change and sea-level rise. It is likely that this impact will increase in the future as sea level continues to rise at the current rate or rises at an accelerated rate. Additional shoreline change and inundation data are needed to plan for and manage current and potential future impacts of sea level rise. The Commonwealth should support efforts by the United States Geological Survey (USGS) and others to map the current and future vulnerability of coastal areas to erosion, inundation, and storm flooding. Light Detection and Ranging (LIDAR) and other subaerial and submarine data, as well as dynamic coastal geomorphic modeling, should be utilized. These data and information will be useful to a wide range of organizations for both short-term and long-term planning.”

For more information on the CHC’s *Preparing for the Storm: Recommendations for Management of Risk from Coastal Hazards in Massachusetts*, go to: www.mass.gov/czm/chc/recommendations/final_recommendations.htm.

Michigan

1. At this time the Michigan Coastal Program does not have lake-level-change policies or

initiatives specific to climate change. However, in 2007, a group of nearly 50 organizations and over 75 scientists published a long term study of the Detroit River and western Lake Erie entitled *State of the Strait: Status and Trends of Key Indicators Report*. Looking to past and future trends, it reports that Lake Erie water levels are projected to decline one to two meters over the next 70 years. The study, partially funded by the Michigan Sea Grant Program, is an overall assessment of ecosystem health in the region, aimed at educating both policy makers and the public, and includes sections specifically addressing climate change and water-level change in Lake Erie.

For more information on the related Detroit River-Western Lake Erie Basin Indicator Project, go to: www.epa.gov/med/grosseile_site/indicators/index.html.

For more information on the *State of the Strait*, go to: www.stateofthestrat.org.

Minnesota

1. Minnesota is addressing some aspects of climate change and its anticipated impacts through the Next Generation Energy Initiative, administered by the Pollution Control Agency. The website refers to the potential impacts on lake levels:
“Shorter ice-cover seasons and increased lake evaporation could have major effects on Lake Superior. Fresh water flowing into Lake Superior could decrease with global warming, potentially reducing lake levels and degrading water quality.”

For more information, go to: proteus.pca.state.mn.us/hot/globalwarming.html.

2. Minnesota Sea Grant has included climate change information in outreach and educational programs since 2006, addressing such topics as the effects of lake-level decline of coastal wetlands and fisheries as well as the impact of increased storm frequency on stormwater runoff. This program has been partially funded by Minnesota’s Lake Superior Coastal Program.

Mississippi

1. At this time the Mississippi Coastal Program does not have sea-level-rise policies or initiatives specific to climate change.

New Hampshire

1. The Office of State Planning in 1987 published the *Technical Report: Rise in Sea Level and Coastal Zone Planning*. This report recommends a three-step process factoring sea level rise into coastal planning. Briefly, these recommendations are:
 - a. Delineate impacted areas;
 - b. Inventory potentially affected populations, assets, resources; and
 - c. Develop regulatory and legislative responses.
2. In 1991 the Rockingham Planning Commission released a *Preliminary Study of Coastal*

Submergence and Sea Level Rise in Selected Areas of New Hampshire. This document describes the phenomenon of sea-level fluctuation, examines various projections, and identifies potentially threatened areas. Included are general suggestions for managing coastal areas under a regime of rising sea levels.

For more information and to access the *Preliminary Study of Coastal Submergence and Sea Level Rise in Selected Areas of New Hampshire*, go to: www.csc.noaa.gov/CZIC/.

New Jersey

1. *Greenhouse Effect, Sea Level Rise, and Barrier Islands: Case Study of Long Beach Island, New Jersey* is a frequently cited paper written by James Titus in 1991. The paper provides an overview of the problem of sea level rise as it pertains to barrier island morphology. The author uses Long Beach Island, New Jersey, as a case study for a series of policy approaches for dealing with rising seas in a developed coastal community. Essentially, barrier islands can respond to sea level rise naturally by washing over and remaining intact (accretion) or by drowning in place. Titus presents four policy options (and cost analyses) for dealing with rising sea levels along developed barrier communities:
 - a. Do nothing, but use setbacks to mitigate affected development, and post-disaster plans to prohibit reconstruction of severely damaged properties;
 - b. Engineer a retreat (create new land on lagoon side);
 - c. Raise an island in place (sand replenishment); and
 - d. Encircle the island with levees (dikes).

For more information on *Greenhouse Effect, Sea Level Rise, and Barrier Islands: Case Study of Long Beach Island, New Jersey*, go to: users.erols.com/jtitus/NJ/CM.html.

2. In November 2005, the Woodrow Wilson School of Public and International Affairs at Princeton University published *Future Sea Level Rise and the New Jersey Coast: Assessing Potential Impacts and Opportunities*. The study projects future sea level rise based on historical measurements and global scenarios, and applies the projected levels to digital elevation models in order to illustrate the extent to which the New Jersey coast is vulnerable. The IPCC (2001) assessment predicts a global mean sea level rise of 0.09 to 0.88 m (0.29 – 2.89 ft) between 1990 and 2100. Accounting for the local component of two mm/year, the model projection for relative sea level rise for the New Jersey coast is estimated to be between 0.31 and 1.10 meters (1.02 – 3.6 ft). Accordingly, this study focuses its analyses on two specific elevation contours: 0.61 m and 1.22 m (two feet and four feet).

“The 0.61 m (2 ft) contour approximates the median-projected sea level rise (50% probability) for 2050 and 2100, while the 1.22 m (4 ft) contour estimates a high-end projected rise (1% probability) over the next century.”

The authors estimate that 1 to 3 percent of New Jersey’s land area will be affected by inundation and 6.5 to over 9 percent by episodic coastal flooding over the next century. The study also suggests a range of adaptation and mitigation strategies for managing coastal areas in response to sea level rise. The findings suggest that where possible, a gradual withdrawal of development from some areas of the New Jersey coast may be the optimum management

strategy for protecting natural ecosystems.

For more information on *Future Sea Level Rise and the New Jersey Coast: Assessing Potential Impacts and Opportunities*, go to: www.environmentnewjersey.org/reports/global-warming/global-warming-reports/future-sea-level-rise-and-the-new-jersey-coast-assessing-potential-impacts-and-opportunities.

3. In September 2006, New Jersey's governor convened the "Summit Confronting Climate Change in New Jersey." The purpose of the summit was to examine the economic ramifications of global climate change on New Jersey and the impacts of sea level rise, related changes in coastal and other hazards, and to generate strategic policy options that the state should consider. The summit was a closed roundtable discussion chaired by the governor and involved the participation of select members of the governor's cabinet, financial services and insurance industry leaders, and recognized experts from both the scientific community and industry. One of the recommendations stemming from the summit is the need to develop more accurate information to determine degrees of vulnerability to coastal hazards in New Jersey's coastal communities. Additionally, projections of future changes in vulnerability are considered essential for planning that addresses accelerating sea level rise and increasing storm frequency and intensity.
4. The New Jersey Coastal Program's *Assessment and Enhancement Strategy, FY 2006 - 2010*, submitted to NOAA in accordance with Section 309 of the Coastal Zone Management Act, addresses certain consequences of climate change including accelerated sea level rise.
"While the precise rate of sea level rise is uncertain, current models indicate that global warming will cause the rate to increase. Recent projections forecast that relative sea level rise at the New Jersey coast will be between 0.31 m and 1.10 m by 2100. The approximate central value of this range, 0.71 m, is more than twice the rise that occurred during the last century."

The relevant tasks are presented in the Coastal Hazards section of the document and include:

- a. Adoption of refined New Jersey Coastal Program goals;
- b. Development of consistent, comprehensive municipal coastal hazards mitigation plans;
- c. Coastal hazards education and outreach initiatives;
- d. Measures to address recommendations from the summit "Confronting Climate Change in New Jersey";
- e. Review of the Coastal Zone Management barrier island corridor rule; and
- f. Development of methodology, protocol, and regulations and/or guidance documents designed to accommodate the adaptation of coastal wetlands to sea level rise.

For more information on the assessment and enhancement strategy, go to: www.nj.gov/dep/cmp/czm_309.html.

5. Rutgers University, in partnership with the American Littoral Society, studied aspects of long-term sustainability of habitats with regards to vulnerability and adaptation to sea level rise. The mapping project identified vulnerable development in New Jersey's coastal zone

and where this development constricts the natural dynamics of coastline migration in response to sea level rise. These maps provide a visual representation of areas vulnerable to sea level rise and coastal storms, areas where habitats are constricted by development and will not be able to retreat, and areas where habitat is free to retreat inland, given current conditions.

For more information and to access the 2007 report, go to:
deathstar.rutgers.edu/projects/coastal/sealevel/index.html.

6. New Jersey's Coastal Program was a member and sponsor of a project conducted by the Urban and Regional Planning and Science, Technology and Environmental Policy Graduate Student Workshop at Princeton University's Woodrow Wilson School of Public and International Affairs. The research project culminated in a report, *The Garden State in the Greenhouse, Climate Change Mitigation and Coastal Adaptation Strategies for New Jersey* (January 2007).

For more information on this report, go to:
www.princeton.edu/~mauzeral/teaching/wws591a_report.pdf.

7. The New Jersey Department of Environmental Protection's Coastal Program includes two broad plans of action to mitigate sea-level-rise impacts: to direct development and residency away from coastal high-hazard areas through regulation and improved public education, and to address the impacts to the marsh system through more research prior to developing additional regulations/plans.

New York

1. A new initiative proposed in the governor's 2007-08 state budget initiative creates a climate change office within the Department of Environmental Conservation that will be responsible for implementing the Regional Greenhouse Gas Initiative in New York as well as developing other initiatives to combat the ecological and economic threats caused by climate change. Sea level rise is a concern of the Division of Coastal Resources and is expected to be a priority concern of the climate change office.
2. New York Sea Grant has organized meetings and conducted interviews with key state and local officials to identify regulations and policies governing coastal protection and sea level rise, and to identify opportunities for national policy refinements that will help address potential local problems associated with sea level rise. This initiative is described in a program brief, "Mapping a National Plan Re: Sea Level Rise." For several communities, New York Sea Grant has also developed case studies of sea-level-rise scenarios, which combined findings of the IPCC with GIS-based elevation data. As a general rule, the role of past and predicted sea level rise is regularly incorporated into New York Sea Grant coastal hazards material.

For more information on "Mapping a National Plan Re: Sea Level Rise," go to:
www.seagrantsunysb.edu/Communications/printables/NYSGImpacts05/2005TanskiSeaISF.

[pdf](#).

For access to a primer documenting coastal hazards on New York's ocean coast, go to: www.seagrant.sunysb.edu.

3. The New York Coastal Program has issued a set of 44 policy statements to promote the beneficial use of coastal resources, prevent their impairment, or deal with major activities that substantially affect numerous resources. Policies and standards do not exist for the singular purpose of addressing sea level rise, but rather they are integrated and intended to reinforce one another. They attempt to maximize benefits for appropriate uses in evaluating decisions on proposed activities (e.g. conservation and preservation of ecosystem habitats in appropriate locations are considered beneficial to the coast and a preferred use). As a result of this emphasis on performance, the Coastal Program has not found it necessary to create new policies or standards. Instead, the Coastal Program uses existing policies while applying new knowledge as it becomes available. Several of the policies that have a particular bearing on sea level rise are outlined in Part II of this report.
4. Policy 4.6 of the Long Island Sound Coastal Management Program (1999) mandates that projects in New York's coastal area must "consider sea level rise when siting and designing projects involving substantial public expenditures." The program also recognizes sea level rise relative to the shore as a significant factor in the incidence of erosion and flooding over time. For Long Island Sound, tidal gauge data collected within the last 100 years shows a relative sea level rise varying from about 0.1 inches to less than 0.04 inches per year. At this rate, a horizontal movement of mean sea level of one to three inches per year (assuming a 1 on 30 beach/nearshore slope) is anticipated in the region.

For more information on the Long Island Sound Coastal Management Program, go to: www.nyswaterfronts.com/downloads/pdfs/lis_cmp/index.htm.

North Carolina

1. In North Carolina, NOAA's Center for Sponsored Coastal Ocean Research has partnered with local research institutions with the goal of enhancing managers' ability to analyze and use climate-relevant information in their decision making through sustained science. The Sea Level Rise - North Carolina Pilot Project aims to inform state and local decision makers as well as the general public in North Carolina about the local and regional effects of current and future sea level rise. The following studies (partners indicated in parentheses) are examples of this effort:
 - a. *Climate Change and Intertidal Risk Analysis: Forecasting the Effects of Climate Change on the Biogeography of Foundation Species in Estuarine and Rocky Intertidal Ecosystems* (University of South Carolina Research Foundation);
 - b. *Ecological Effects of Sea-Level Rise on Coastal North Carolina Marshes* (University of South Carolina, Vanderbilt University, East Carolina University, and the U.S. Geological Survey);
 - c. *Modeling Estuarine Habitat Response to Rising Water Level* (University of North Carolina at Chapel Hill, UNC Institute of Marine Sciences); and

- d. *Shore-Zone Modification in Response to Sea Level Rise in North Carolina Estuaries* (East Carolina University and University of Pennsylvania).

For more information about the Sea Level Rise – North Carolina Pilot Project, go to:
www.cop.noaa.gov/stressors/climatechange/current/slr/welcome.html.

2. The “Planning for the Impacts of Sea Level Rise and Climate Change Workshop” (January 31 – February 1, 2007) brought together over 50 coastal managers and stakeholders to discuss and identify potential modeling and mapping tools to help plan for and mitigate future sea level rise. As stated in the workshop summary, the attendees identified five key concerns and needs:
 - a. Tools should incorporate information ascertained through scientific research and modeling that can be easily applied by state and local governments and large land owners when planning future land use and deciding on policy and regulations that affect coastal resources;
 - b. Tools should forecast expected habitat changes, especially potential loss of habitats important for ecological services;
 - c. Tools easy to translate to decision makers;
 - d. Tools to enable easy understanding of potential risks to people and development due to future flooding and related hazards; and
 - e. Continued engagement of NOAA and their research partners with workshop attendees via email and the web.

For more information on the workshop, go to:
www.cop.noaa.gov/stressors/climatechange/current/slr/SLR_mgr_mtg_summary.pdf.

3. Published by the North Carolina Department of Environmental and Natural Resources/North Carolina Sea Grant, *Drowning the North Carolina Coast: Sea-Level Rise and Estuarine Dynamics* provides in-depth information about erosion processes and rates along North Carolina’s northeastern estuarine shoreline. The authors also examine sea level rise and its role in changing the shoreline, as well as the evolution of the estuarine system. The book was funded with grants from the National Oceanic and Atmospheric Administration (NOAA), the North Carolina Division of Coastal Management, and the Albemarle-Pamlico National Estuary Program.

For more information on *Drowning the North Carolina Coast: Sea-Level Rise and Estuarine Dynamics*, go to: nsgl.gso.uri.edu/ncu/ncub03002.pdf.

4. Currently, the North Carolina Coastal Program serves on the state Legislative Commission on Global Climate Change, which will issue its final report no later than April 15, 2008. The North Carolina Coastal Program, in collaboration with the Division of Water Resources, will address sea level rise and other issues in the state’s first comprehensive beach and inlet management plan (to be completed by March 2009).

For more information on the Legislative Commission on Global Climate Change, go to:
www.ncga.state.nc.us/gascripts/Committees/Committees.asp?sAction=ViewCommittee&sAc

[tionDetails=Non-Standing_6268.](#)

5. A report entitled *Measuring the Impacts of Climate Change on North Carolina Coastal Resources* was released in March 2007 to the National Commission on Energy Policy. The report was prepared by a team of representatives from East Carolina University, the University of North Carolina at Wilmington, Duke University, and Appalachian State University.

For more information on the report, go to: econ.appstate.edu/climate/.

6. The North Carolina Beach, Inlet & Waterway Association's 2007 Annual Conference theme was "Everything You Always Wanted to Know about Sea Level Rise, But Were Afraid to Ask (and Other Timely Topics)." Conference presenters and attendees included local government officials, scientists, engineers, contractors, policy makers, managers, and other interested parties.

For more information on the conference presentations, go to:
www.coastalplanning.net/projects/NCBIWA/NCBIWA07.html.

7. The North Carolina Division of Coastal Management (DCM) is working on a project that will map the estuarine shoreline, shoreline types, and coastal structures. It is hoped that this project will succeed in mapping the entire North Carolina estuarine system. The maps will be utilized as a tool to monitor and manage sea level rise, wetland retreat and loss, erosion, and development impacts.
8. As a result of the Coastal Habitat Protection Plan, meetings held with marine contractors in 2007 and a report submitted by the North Carolina Estuarine Biological and Physical Processes Workshop in 2006, the Division of Coastal Management (DCM) is working towards updating shoreline stabilization rules in order to encourage alternatives to vertical shoreline protective structures, such as living shorelines, as well as shoreline stabilization measures that will allow more of the natural shoreline to remain. Further, the DCM has produced a set of proposed rule changes as well as other recommendations for shoreline stabilization structures for various shoreline types, and presented these recommendations to the Implementation and Standards Committee in September 2007.

For more information on the report, go to:
www.nccoastalmanagement.net/Hazards/EWG%20Final%20Report%20082106.pdf.

For more information on the estuarine shoreline programs, go to:
www.nccoastalmanagement.net/Hazards/estuarine.htm.

Northern Mariana Islands

1. At this time the Northern Mariana Islands Coastal Program does not have sea-level-rise policies or initiatives specific to climate change.

Ohio

1. At this time the Ohio Coastal Program does not have lake-level-change policies or initiatives specific to climate change.

Oregon

1. The Oregon Coastal Program is working with Oregon Sea Grant, South Slough National Estuarine Research Reserve, and the Governor's Office of Climate Change to convene an interagency forum to develop a climate change report for the 2009 Oregon Legislature⁴ (CSO, 2007). The interagency forum will also provide a framework for coordinating state-level programs designed to address the effects of climate change in the Oregon coastal zone.
2. Oregon Sea Grant, in collaboration with Maine Sea Grant, has recently initiated a new two-year project to help coastal communities prepare for climate change. Supported by NOAA's Sectoral Application Research Program, the project aims to develop and test a model of public outreach about climate change. One premise of the project is that decision makers and residents need to better understand the challenges of adapting to climate variability locally in order to lessen its effects and make their communities more resilient. With this in mind, outreach will be directed toward and involve public and private decision makers such as city managers, county planners, private developers, bankers, and realtors. Surveys, focus groups, and interviews will be used to determine information needs and strategies. Collaboration between the two states is expected to yield insights about critical information needs and effective outreach strategies that may be applicable to other states.

Pennsylvania

1. At this time the Pennsylvania Coastal Program does not have sea-level-rise policies or initiatives specific to climate change.

Puerto Rico

1. Puerto Rico's Coastal Management Program and Puerto Rico Sea Grant cosponsored a climate-change roundtable with the University of Puerto Rico in May 2007.⁵ As a result, a Commission on Climate Change was appointed, in which Puerto Rico Sea Grant is a key actor. Furthermore, the governor has initiated regular meetings of a Climate Change Advisory Committee to discuss possible mitigation activities.

Rhode Island

1. In December, 2006, the Rhode Island Legislature passed a law to amend the state building

⁴ Coastal States Organization, *The Role of Coastal Zone Management Programs in Adaptation to Climate Change: Synthesis Report from the CSO Climate Change Work Group* (September, 2007). p 8. www.coastalstates.org/documents/CSO%20Climate%20Change%20Final%20Report.pdf.

⁵ CSO. p13.

code (R.I.G.L. § 23-27.3-100.1.5.5), explicitly addressing sea level rise and climate change, and authorized the Rhode Island Coastal Program's Coastal Resources Management Council (CRMC) to collaborate with the state building commissioner and adopt freeboard calculations, stating in its section on hurricane, storm, and flood standards:

“The state building code standards committee has the authority in consultation with the building code commissioner, to adopt, maintain, amend, and repeal code provisions, which shall be reasonably consistent with recognized and accepted standards and codes, including for existing buildings, for storm and flood resistance. Such code provisions shall, to the extent reasonable and feasible, take into account climatic changes and potential climatic changes and sea level rise. Flood velocity zones may incorporate freeboard calculations adopted by the Coastal Resources Management Council pursuant to its power to formulate standards under the provisions of section 46-23-6.” (*Referring to the Coastal Resources Management Council Act of 1971*)

2. The CRMC is currently developing regulations related to climate change and sea level rise. Initial efforts address impacts to development, habitat, and beaches. In collaboration with the Coastal Resources Center/Rhode Island Sea Grant program at the University of Rhode Island, the CRMC held a workshop and subsequent meeting to develop a series of findings and policy statements related to sea level rise. In January 2008, the CRMC adopted a new policy that states:
 - a. “The Council’s sea-level-rise policies are based upon the CRMC’s legislative mandate to preserve, protect, and where possible, restore the coastal resources of the state through comprehensive and coordinated long-range planning.”
 - b. “The Council recognizes that sea level rise is ongoing and its foremost concern is the accelerated rate of rise and the associated risks to Rhode Island coastal areas today and in the future. Accordingly, for planning and management purposes, it is the Council’s policy to accommodate a base rate of expected 3- to 5- foot rise in sea level by 2100 in the siting, design, and implementation of public and private coastal activities and to insure proactive stewardship of coastal ecosystems under these changing conditions. It should be noted that the 3- to 5-foot rate of sea level rise assumption embedded in this policy is relatively narrow and low. The Council recognizes that the lower the sea level rise estimate used, the greater the risk that policies and efforts to adapt sea level rise and climate change will prove to be inadequate. Therefore, the policies of the council may take into account different risk tolerances for differing types of public and private coastal activities. In addition, this long term sea level change base rate will be revisited by the Council periodically to address new scientific evidence.”

The CRMC is in the process of developing standards and criteria for implementing the policy. Tools being considered include identifying a project “design life” as a factor multiplied by sea-level-rise rate for use in freeboard and/or setbacks and living shorelines (i.e. perched wetlands) in areas of fringing wetlands.

South Carolina

1. Sea level rise is theoretically taken into account in the South Carolina Coastal Program’s

erosion-based retreat policy. As part of the Beachfront Management Act (1988), the state has adopted a policy of retreat from eroding beaches. Using historic shoreline and present-day beach profiling data, the South Carolina Office of Ocean and Coastal Resource Management (OCRM) has established two lines of jurisdiction for oceanfront property: a “baseline” and the more landward 40-year “setback line.” These lines establish the boundaries for the state’s jurisdiction, and are used to regulate the size and location of new or replacement structures located near the beach. The baseline is typically placed at the crest of the primary sand dune (the dune immediately adjacent to the ocean) while the setback line is demarcated landward of the baseline. The setback line’s distance from the baseline varies along the coast. It is determined by the annual erosion rate in that particular area. Stable or accreting beaches have a minimum 20-foot (for consistency) setback line, while areas that are eroding have setbacks of as much as 400 feet. Seaward of the setback line, new erosion-control structures such as seawalls and rock revetments are banned, and new habitable structures are limited in size to 5,000 square feet of heated space. These same lines are used to regulate the repair or reconstruction of existing erosion-control structures and habitable structures following a storm. These lines are revised every 10 years as required by the South Carolina Coastal Zone Management Act. The last revisions were made in 1999 and 2000.

For more information on the South Carolina Code of Regulations 30.13 - 30.14, go to: www.scstatehouse.net/coderegs/c030.htm.

For more information on the South Carolina Code of Laws 48-39-10, go to: www.scstatehouse.net/code/t48c039.htm.

2. Section 30.1 of the state Code of Regulations (above) discusses sea level rise within the context of the value of beach and dune systems, although it does not include specific policies or information on the documented increase in the rate of sea level rise:

“It has been clearly demonstrated that the erosion problems of this State are caused by a persistent rise in sea level, a lack of comprehensive beach management planning, and poorly planned oceanfront development, including construction of hard erosion control structures, which encroach upon the beach/dune system. Sea level rise in this century is a scientifically documented fact. Our shoreline is suffering from its effects today. It must be accepted that regardless of attempts to forestall the process, the Atlantic Ocean, as a result of sea level rise and periodic storms, is ultimately going to force those who have built too near the beachfront to retreat.”
3. In 2007, the National Sea Grant Office and the NOAA Climate Office funded the establishment of a regional coastal climate extension position for the North Carolina and South Carolina coasts. In addition, the South Carolina Coastal Program serves on a “Crosscutting” Technical Work Group⁶ for the Governor’s Climate, Energy, and Commerce Committee (Executive Order 2007-04), which is highlighting coastal impacts and potential adaptation strategies.
4. The South Carolina Coastal Program is also increasing its focus on coastal communities’

⁶ CSO. p.8.

resilience to erosion, hurricanes, and sea level rise through a new *Shoreline Change Initiative*. The Coastal Program established a Shoreline Change Advisory Committee in 2007 to bring together researchers, partner agencies, and stakeholders to gather accurate information, conduct analyses of the risks to South Carolina's coastal communities and habitats, reexamine policies, and develop new approaches for coastal regulators, planners, local governments, and the public to prepare for and adapt to shoreline changes in the state.

Texas

1. At this time the Texas Coastal Program does not have sea-level-rise policies or initiatives specific to climate change; however, the issues are very relevant to different programs as seen below.
2. Texas Sea Grant, along with the Mississippi-Alabama Sea Grant Legal Program and the National Sea Grant Law Center, has recently published *The Resilient Coast: Policy Frameworks for Adapting the Built Environment to Climate Change and Growth in Coastal Areas of the U.S. Gulf of Mexico*. This document reviews the existing legal and institutional frameworks for adapting to growth and climate change and develops a set of recommendations related to insurance, planning, and implementation of different adaptation strategies.

For more information on *The Resilient Coast*, go to: www.urban-nature.org/publications/publications.htm

3. Sea level rise is included in the Texas Coastal Program's definition of "adverse effects" (31 TAC 501.3(a)(1)(J)). This section defines adverse effects as "effects that result in physical destruction or detrimental alteration of a CNRA (Coastal Natural Resource Area)," and includes as an example of such detrimental alteration as "alterations that increase losses of shore areas or other CNRAs from a rise in sea level with respect to the surface of the land, whether caused by actual sea level rise or land surface subsidence." As any activities proposed to the Texas Coastal Program are evaluated for possible effects on CNRAs, the rate of relative sea level rise is considered, but not necessarily within the context of climate change.
4. The Texas Coastal Program also references sea level rise in its discussion of coastal erosion. Coastal erosion is defined in Sec. 33.601, Natural Resources Code:
"Coastal erosion means the loss of land, marshes, wetlands, beaches, or other coastal features within the coastal zone because of the actions of wind, waves, tides, storm surges, subsidence, or other forces."

In 1996, the Texas General Land Office submitted the *Texas Coastwide Erosion Response Plan* to the Texas Legislature describing the problems caused by erosion of gulf beaches and bay shorelines, and the need for funding projects to mitigate the damages. The Legislature, in response, enacted the Coastal Erosion Planning and Response Act in 1999, supplying the initial \$15 million in funding for 23 erosion response projects. A 2004 update to the response plan includes a discussion of the geologic framework of the Texas Gulf coast and the coastal

processes that affect the Texas coast currently, including relative sea level rise. The report concludes that sections of the Texas coast do experience significant erosion because there is not enough sediment in the depositional system to balance the effects of rising relative sea level and the impacts from coastal storms. It also notes issues associated with human activities—such as hydrocarbon production and the withdrawal of groundwater—that have impacted the rates of subsidence. The report uses data presented by Warrick et al. (1996) in its discussion of long-term sea level rise. The curve shows that sea levels will rise over the next century between 20 cm (best-case scenario) to 90 cm (worst-case scenario). The findings also indicate that the greatest cause of episodic erosion of the gulf shoreline is from storms, but the long-term erosion suffered by 64 percent of the gulf shoreline is caused by the rate of relative sea level rise and the lack of sediment input into the coastal system to keep it in balance.

For more information on *Texas Coastwide Erosion Response Plan*, go to:
www.glo.state.tx.us/coastal/cerp/index.html.

Virgin Islands

1. At this time the Virgin Islands Coastal Program does not have sea-level-rise policies or initiatives specific to climate change.

Virginia

1. Climate change and its impacts on Virginia's coastal resources was one of two topics discussed at the December 2007 Coastal Partners Workshop in Portsmouth, Virginia. The workshop was attended by representatives from state agencies, local governments, private concerns and others involved in coastal management. In addition to a range of presentations on various climate change issues, including sea level rise, the workshop included a facilitated discussion of how Virginia should respond to these issues. An identified priority was to provide better information for developing proper local and state responses to anticipated sea level rise, including regional vulnerability analyses and identification of potential policy response strategies.
2. The Virginia Coastal Management Program will be working to support the efforts of the Virginia Commission on Climate Change. The commission, created through Executive Order 59, fulfills one of the recommendations of the Virginia Energy Plan. It is charged with developing a climate change action plan that will include, among other things, an evaluation of expected impacts of climate change on Virginia's citizens, natural resources, and economy. The plan will also identify what Virginia needs to do to prepare for the likely consequences of climate change.
3. Recognizing the need for better elevation data and maps to understand the predicted locations of sea level rise impacts, the Virginia Coastal Management Program is participating in state efforts to obtain LIDAR data for coastal hazards planning and other coastal management purposes, such as an analysis of wetlands migration.
4. The Virginia Coastal Program's *Assessment and Enhancement Strategy, FY 2006 - 2010*,

submitted to NOAA in accordance with Section 309 of the Coastal Zone Management Act, includes a strategy that focuses on promoting the use of “living shorelines” for shoreline erosion control. Living shorelines are shorelines that have been altered to protect them from erosion and to create new habitat using nature-based techniques such as marsh plantings, beach nourishment, low-profile oyster reefs, breakwaters, and sills. This initiative recognizes both immediate and long-term threats to eroding shorelines from coastal development, hardening structures, and sea level rise. Living shorelines provide an alternative to more structural approaches and can preserve, and in some cases expand, wetlands and natural shoreline features in the face of rising sea levels. This effort aims to decrease shoreline hardening so that wetlands will be able to migrate inland as sea levels rise. This strategy is slated to provide \$750,000 over a five-year period for various initiatives and products including:

- a. A “Living Shoreline Summit,” held in December 2006, with peer-reviewed proceedings, to advance the use of this management technique;
- b. Revised wetlands guidelines to be used by the Virginia Marine Resources Commission, the Virginia Institute of Marine Science, local wetlands boards and others to guide decisions about shoreline and tidal wetlands management;
- c. Improved data on shoreline conditions to support more informed shoreline management decisions;
- d. Research to document the habitat value of living shorelines and to improve their design;
- e. A guidance document for local governments to use in shoreline management planning;
- f. Outreach materials for land use decision-makers, landowners, and contractors on living shoreline advantages and design principles;
- g. A training program for contractors and local government staff on living shoreline practices;
- h. A report on improving management of Virginia’s dune and beach resources, including proposed revisions to the Coastal Primary Sand Dunes and Beaches Act;
- i. Anticipated changes to the Coastal Primary Sand Dunes and Beaches Act by the Virginia General Assembly; and
- j. Revisions to the Coastal Primary Sand Dunes and Beaches Guidelines.

Washington

1. Though the state has not formally incorporated requirements related to sea level rise into its Coastal Program or the local Shoreline Master Programs (the primary method of implementing the Washington Coastal Program), the governor did sign Executive Order No. 07-02 in February of 2007, establishing goals for reductions in climate pollution, increases in jobs, and reductions in expenditures on imported fuel. As part of this directive, the departments of Ecology and Community have launched a Climate Change Challenge initiative focused on addressing climate change impacts to coasts and infrastructure and sea-level-rise issues, and other key themes, such as water resources, agriculture, and human health. Coastal and Infrastructure Preparation/Adaptation Working Groups (PAWGs) have been formed to assist in developing recommendations for the governor on how Washington can prepare and adapt to the impacts of climate change. The Coastal and Infrastructure

PAWG has been meeting regularly and will be making recommendations to the governor on a variety of adaptation strategies, including those which address sea level rise. Key issues under consideration include:

- a. Improvement of data and monitoring to support planning for sea-level-rise changes on the coast;
- b. Implications of shoreline hardening;
- c. Vulnerability of community infrastructure; and
- d. Evaluation of existing land-use planning tools for adapting to coastal changes.

At the time of writing, the Coastal and Infrastructure PAWG had just published the recommendations for public comment. The report suggested recommendations that identify opportunity areas, additional preparation/adaptation strategies, and critical research needs and approaches for filling information gaps. This initial step may lead to changes in the state's Shoreline Management Act and State Environmental Policy Act, or other policies and statutes, which are enforceable policies of the Coastal Program.

For more information on the report in which the recommendations are outlined, go to: www.ecy.wa.gov/climatechange/CATdocs/122107_2_preparation.pdf.

For more information on PAWGs, go to: www.ecy.wa.gov/climatechange/cat_pawg_ci.htm and ces.washington.edu/cig/fpt/guidebook.shtml.

3. The Climate Impacts Group (CIG) is an interdisciplinary research group studying the impacts of natural climate variability and global climate change in the Pacific Northwest. CIG is part of a group of NOAA-funded Regional and Integrated Science and Assessment groups (www.climate.noaa.gov/cpo_pa/risa/) and is part of the Center for Science in the Earth System at the University of Washington's Joint Institute for the Study of the Atmosphere and Ocean (JISAO). Coastal research at the CIG has been directed at identifying how the economically and ecologically diverse coasts and estuaries of the Pacific Northwest are sensitive to climate variations and change. A recent publication by Canning et al. examines how projected sea level rise could cause or exacerbate a number of problems, including coastal erosion, flooding, and inundation. The authors conclude that shoreline erosion due to sea-level changes would vary from place to place depending on a number of factors, including local geology and topography. Due to tectonic subsidence in south Puget Sound, Olympia is likely to be among the most vulnerable urban areas to sea level rise.

For more information on the CIG, go to: www.cses.washington.edu/cig/.

For more information on the Joint Institute for the Study of the Atmosphere and Ocean, go to: jisao.washington.edu/.

4. King County, Washington, in partnership with the International Council for Local Environmental Initiatives and CIG, developed *Setting the Course: A Guidebook on Planning for Global Warming* for local governments preparing for climate change. The guidebook is designed to help local, regional, and state governments prepare for climate change by recommending a detailed, easy-to-understand process for climate change preparedness based

on familiar resources and tools.

To view the guidebook or obtain a copy, go to: ces.washington.edu/cig/fpt/guidebook.shtml.

5. In January 2008, the Washington Department of Ecology, along with the University of Washington CIG, published a report on sea level rise in Washington entitled *Sea Level Rise in the Coastal Waters of Washington State*. The findings of the report include observed rates of sea level rise as well as projections considering thermal expansion, the cryospheric contribution, local atmospheric circulation, and local tectonic movement.

To view the report, go to: www.ces.washington.edu/db/pdf/moteetalslr579.pdf.

Wisconsin

1. The document *Wisconsin Coastal Management Program: A Strategic Vision for the Great Lake*, incorporates a number of issues and policies that address changing lake levels. Under a section concerning coastal water and air quality:

“The flows and levels of the Great Lakes and their tributaries are an important determinant of the usefulness and attractiveness of these waters for many coastal functions....Permanent declines in Great Lakes water levels or tributary flows could seriously harm water-dependent businesses, coastal ecosystems, and quality of life of both residents of and visitors to Wisconsin’s coastal zone.

“The state’s policy on coastal waters is to manage these waters for the purpose of improving their quality and protecting their levels and flows in order to restore their chemical, physical and biological integrity; to protect public health, safeguard aquatic life and scenic and ecological values; and to enhance the domestic, municipal, recreational, industrial, agricultural and other uses of water.”

Regarding coastal erosion and flood hazard areas, it has been recognized that:

“Shore erosion has been a primary concern of many shoreline residents and governmental bodies owning property on the immediate shoreline, particularly during periods of high lake levels. There are also localized areas subject to serious flooding. Fluctuating lake levels remains a key concern of many Wisconsin coastal residents. While control of lake levels is beyond the reach of any state program, increased erosion during the period of high water is one of Wisconsin’s most visible coastal problems.”

The Wisconsin Coastal Program has recently updated its policies to ensure that they reflect existing state regulations.

For more information on the updated policies, go to: coastal.wisconsin.gov.

For more information on the *Wisconsin Coastal Management Program (WCMP): A Strategic Vision for the Great Lakes document*, go to:

www.doa.state.wi.us/dir/documents/programdocument.pdf.

2. The Wisconsin Coastal Program promotes activities that address lake-level changes. For

instance, the Coastal Program grant program that funds low-cost construction projects gives preference to projects “that are part of an adopted waterfront or public access development plan that incorporates planning for lake-level changes.”

3. The Wisconsin Coastal Program has funded multiple planning projects for coastal communities. Some of the resulting plans address lake levels within natural hazards or natural resources elements.
 - a. *A Guide to Hazard Mitigation Planning for Coastal Communities in Wisconsin, Bay-Lake Regional Planning Commission* - This project created a hazards mitigation planning guide for coastal communities throughout Wisconsin which will discuss coastal hazards as they relate to local hazard mitigation plans formed under the Disaster Mitigation Act. Fluctuating lake levels are discussed as a planning element that communities should consider.
 - b. Great Lakes Climate Change Issues Seminar Series – This series is currently underway through the University of Wisconsin-Superior. With a regional focus on climate change issues, the 16 seminars cover the causes of climate change and its potential effects on Wisconsin coastal communities, including Great Lakes water levels, coastal habitats and biodiversity, fisheries, invasive species, temperature/precipitation and their impacts on agriculture, public health, and coastal tourism and economic effects.

Part II – Coastal Hazards Initiatives That May Contribute to Climate Change Adaptation Strategies

While this study focused on sea-level-rise and climate change initiatives in the states and territories, many respondents provided information on their states' associated hazards initiatives. We included this information here for managers, policy makers and researchers in order to better inform their efforts to develop future coastal adaptation strategies. *However, this does not constitute a comprehensive summary of state coastal hazards initiatives, since that is beyond the scope of this particular study.*

Alabama

1. The Alabama Coastal Area Management Program (ACAMP) addresses coastal hazards through policies, regulations, and technical assistance/funding opportunities that indirectly address these concerns. Specifically, the ACAMP program document contains policies on natural hazards mitigation, including policies addressing floods, hurricanes and erosion.

Additionally, the Alabama Department of Environmental Management Division 8 Coastal Program Rules require that persons seeking permits for large development along the gulf-front submit an Environmental Impact and Natural Hazard Study. These studies must include a wave height study that addresses flood hazards and erosion potential at the site, as well as a Beach and Dune Enhancement Plan. Two gulf-front communities have also adopted more stringent requirements for these types of projects.

Finally, the ACAMP provides funding to local communities to support their hazard mitigation initiatives. This includes providing funding for the development of hazard mitigation plans, flood ordinance development, floodplain management plans, zoning ordinances, building code development, and wetlands protection ordinances.

Alaska

1. The Alaska Coastal Program's Natural Hazard Standard 11 AAC 112.210, 11 AAC 112.990 and 11 AAC 114.250, contains provisions concerning natural hazard areas. The regulation enables the Department of Natural Resources (as well as districts) to designate specific natural processes and adverse conditions as well as locations likely to be effected as "natural hazard areas." These designations prevent development in such natural hazard areas:
"Unless the applicant has taken appropriate measures in the siting, design, construction, and operation of the proposed activity to protect public safety, services, and the environment from potential damage caused by known natural hazards."

Here, appropriate measures are those that satisfy relevant safety codes and standards; in the absence of such standards, the project plans must be approved by a state-registered natural hazards expert.

Connecticut

1. Connecticut has no state-mandated coastal erosion setback provisions, although individual coastal municipalities have varying development setback requirements for tidal wetlands. In Connecticut, coastal structures (shoreline armoring) are permissible with a permit. The Connecticut General Statutes, Section 22a-92(b)(2)(F) and Section 22a-92(b)(2)(J) state:
“Structural solutions are permissible when necessary and unavoidable for the protection of infrastructural facilities, water-dependent uses, or existing inhabited structures, and where there is no feasible, less environmentally damaging alternative and where all reasonable mitigation measures and techniques have been provided to minimize adverse environmental impacts.”

For more information on the Connecticut General Statutes, go to:
www.cga.ct.gov/2007/pub/Chap444.htm.

Delaware

1. Recognizing the need to enhance, preserve, and protect public and private beaches and to ensure their use as protective and recreational lands, the Delaware Legislature passed the Beach Preservation Act (Chapter 68, Title 7 of the Delaware Code) in 1972. The act defines the extent of the beach and establishes a building line along the coast as part of the Regulations Governing Beach Protection and the Use of Beaches. Stated in *The Geological Structure of the Shorelines of Delaware, Delaware Sea Grant Technical Report*, associated regulations (updated in 1983) recognize:
“The present sea level rise rate, relative to land features, is approximately 1/2 foot per century” (no source) and recognizes that “beach stabilization projects must be undertaken with the knowledge that their implementation will only serve to slow the natural processes for a relatively short period of time.”

For more information on the Beach Preservation Act, go to:
delcode.delaware.gov/title7/c068/index.shtml.

2. The Delaware Department of Natural Resources and Environmental Control, Division of Parks and Recreation has a policy of strategic retreat.

Florida

1. In 2006, the U.S. Geologic Survey Coastal and Marine Geology Program generated a database of digital vector shorelines and shoreline change rates for the southeast Atlantic coast (Florida, Georgia, South Carolina, and North Carolina), utilizing extensive digital information compiled by the states. Short-term and long-term shoreline change evaluations were based on merging three historical shorelines with a modern shoreline derived from LIDAR surveys. Historical shorelines generally represent the following time periods: 1800s; 1920s and 1930s; and 1970s.

For more information on the report entitled *The National Assessment of Shoreline Change: A GIS Compilation of Vector Shorelines and Associated Shoreline Change Data for the U.S.*

Southeast Atlantic Coast, go to: pubs.usgs.gov/of/2005/1326/.

2. The Florida Department of Environmental Protection (DEP) is responsible for identifying beaches that are critically eroding, as well as developing and maintaining a comprehensive long-term management plan for their restoration.

For more information on the *Critical Erosion Areas Report and the Strategic Beach Management Plan*, go to: www.dep.state.fl.us/beaches/.

3. The Coastal Construction Control Line Program (CCCL), an essential element of Florida's Coastal Program, is administered by the DEP. Construction activities seaward of the control line must meet special siting and design criteria. Within the CCCL, there is 30-year erosion setback, prohibiting major development seaward of that zone. The CCCL takes into consideration historical weather data (including past hurricanes that have impacted the area under study), tidal cycles, offshore bathymetry, and erosion trends. According to a CCCL fact sheet, the data are evaluated using "appropriate engineering predictive models and scientific principles to determine the upland limits of the effect of a one-hundred year coastal storm."

A summary of jurisdictions specific to the CCCL, contained in Chapter 161 of the Florida Statutes, is listed below:

- a. A 50-foot setback or "setback line" as a line of jurisdiction where construction is prohibited within 50 feet of the line of mean high water at any riparian coastal location fronting the Gulf of Mexico or the Atlantic coast shoreline. The setback requirements do not apply to any riparian coastal locations that have predominately vegetation-type non-sandy shores. (Section 161.052, F.S.)
- b. The CCCL defines the area of the beach/dune system subject to severe fluctuations from the influence of a 100-year storm. The CCCL has been adopted, county-by-county. (Section 161.053, F.S.)
- c. The "30-year erosion projection" is the projected location of the shoreline, defined as the seasonal high water line (SHWL), on the subject property 30 years following submittal of an application for a permit.
- d. The coastal building zone (section 161.54, F.S) is the land area from the SHWL to a line 1,500 feet landward from the CCCL. For coastal barrier islands, the coastal building zone is the land area from the SHWL to a line 5,000 feet landward from the CCCL. If there is no CCCL in a particular area, (i.e., no sandy beach), the area is designated from the seaward edge of the "velocity zone" established by the Federal Emergency Management Agency and shown on the Flood Insurance Rate Maps.
- e. Coastal construction or excavation activities seaward of the CCCL require a permit from the state DEP. Chapter 62B-33, Florida Administrative Code, provides the design and siting requirements that must be met to obtain a CCCL permit and includes the following discussion of sea level changes:

"Major structures shall be located a sufficient distance landward of the beach and frontal dune to permit natural shoreline fluctuations, to preserve and protect beach and dune system stability, and to allow natural recovery to occur following storm-induced erosion."

Approval or denial of a permit application is based on a review of the facts and circumstances on the potential impacts on the beach/dune system, adjacent properties, native salt-resistant vegetation and marine turtles, and interference with public beach access.

For more information on jurisdiction specified in the CCCL Program, go to:
www.dep.state.fl.us/beaches/publications/gen-pub.htm#Rules.

For Chapter 161 of the Florida Statutes, go to:
www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&URL=Ch0161/tit10161.htm&StatuteYear=2003&Title=%2D%3E2003%2D%3EChapter%20161.

For further details on the CCCL Program, go to:
www.dep.state.fl.us/beaches/programs/ccclprog.htm.

For the CCCL FAQ fact sheet, go to: www.dep.state.fl.us/beaches/data/pdf/cccl-faq.pdf.

4. On September 7, 2005, Florida's governor issued Executive Order 05-178 creating a Coastal High Hazard Study Committee. The 19-member committee was charged with studying and formulating recommendations for managing growth in coastal high hazard areas, which are defined as the Category 1 hurricane evacuation zone. The committee met with experts throughout Florida from November 2005 through January 2006. By conducting meetings around the state, the committee served as a forum for identifying and recommending land-use policies that safeguard the public from natural hazards, protect property rights, preserve coastal ecosystems, and enhance economic development and tourism opportunities. While the report focuses on the susceptibility of the state to tropical cyclone hazards, the committee's recommendations also included significant discussion of the role of the CCCL. The committee recommended that the state DEP develop a scope of work to reevaluate setbacks and other dune protection criteria within the CCCL regulatory program. A restudy of the CCCL was suggested in portions of the state where consideration of hydrographic and topographic data indicate that shoreline changes (e.g. sea level rise) have rendered established control lines to be ineffective.

For more information on the final report of findings and recommendations, go to:
www.dca.state.fl.us/fdcp/dcp/chhsc/index.cfm.

Georgia

1. The Georgia Department of Community Affairs has a process for reviewing developments of regional impact. In its review, the Coastal Program recommends minimizing development in the flood zone; however, the recommendation is only advisory and the department has no authority to ensure that recommendations are enacted.
2. The Georgia Sea Grant Program has funded a proposal ("Assessing Shoreline Change and Coastal Hazards for the Georgia Coast") whose objectives are to assess shoreline change rates for the perimeter of each Georgia barrier island complex (upland and attached marsh platform) and to assess and map coastal hazards for each island.

Hawaii

1. *The Hawaii Coastal Hazard Mitigation Guidebook* (Hwang, 2005) was prepared for the state's Department of Land and Natural Resources as a guidance manual to reduce risks from natural hazards when planning and siting coastal projects. Although the measures presented are not regulatory, this guidebook is intended to inform policy makers (e.g. the Kauai shoreline bill currently under consideration cites Section 4.1 of the guidebook to determine the shoreline erosion rate). The guidebook addresses sea level rise within its discussion of coastal erosion. The setback formula combines features from the Federal Emergency Management Agency (FEMA) Coastal Construction Manual (long-term erosion rates determined from aerial photos) with additional adjustments for episodic storm erosion (and recovery) of the dune, errors associated with erosion rates, accelerated sea level rise, and a safety design buffer. The erosion zone is defined as the sum: [Life expectancy of the structure (70 to 100 years)] · [erosion rate (adjusted for errors and for sea level rise)] + [storm erosion event (20 ft)] + [Safety design buffers (20 ft)]. The guidebook follows the FEMA recommendation that the erosion rate increase by factor of 1.2 (20 percent) to account for errors inherent in the methodology of determining erosion rates when comparing aerial photos (relief displacement, uncorrected tilt, measurement errors, and lens distortion).

While past sea level rise is factored into long-term erosion measurements, predicted accelerated rise is not. To account for additional adjustments to the erosion rates, the guidebook discusses the variability of different shoreline types in the archipelago. It is recommended that for coastlines with a sea level ranking risk of three or four (as determined in the *Atlas of Natural Hazards in the Hawaii Coastal Zone* (Fletcher et al., 2002)), the historical erosion rate be increased by a value of 10 percent. This generalized default value is used to increase the setback where there is risk of accelerated sea level rise due to local topography and bathymetry. The guidebook references an estimate in the Intergovernmental Panel on Climate Change's 2001 report of 49 cm over the next 100 years. The projection of sea level rise in the next century is of great interest locally and continues to be the focus of many discussions related to coastal hazard mitigation.

For more information on *The Hawaii Coastal Hazard Mitigation Guidebook*, go to: www.soest.hawaii.edu/seagrant/communication/HCHMG/hchmg.htm.

For more information on the *Atlas of Natural Hazards in the Hawaiian Coastal Zone*, go to: pubs.usgs.gov/imap/i2761/.

For more information on the 2001 report by the Intergovernmental Panel on Climate Change, go to: www.ipcc.ch/ipccreports/index.htm.

For more information on evacuation maps, go to: www5.hawaii.gov/tsunami/.

For more information on the *Hawaii Hazard Mitigation Plan*, go to: www.mothernature-hawaii.com/hazmit_planning.htm.

2. The Hawaii Coastal Program has provided funding for research on erosion rate-based setbacks in Maui and Kauai counties, toward coastal hazard guidance manuals such as *The Hawaii Coastal Hazard Mitigation Guidebook* (Hwang, 2005), and towards state and county multi-hazard mitigation plans required by the Federal Emergency Management Agency. The Hawaii Coastal Program regularly collaborates with agencies and organizations at the community, county, state, federal, and international levels on its coastal hazard and community resilience projects.

Louisiana

1. The Louisiana Coastal Program has recognized the shrinking of the Louisiana coastline as a major problem since the beginning of the program in the 1970s. The shrinking of the coast is due to a variety of synergistic forces, such as geologic and localized subsidence, erosion, sediment starvation, direct and indirect losses due to anthropogenic causes, as well as eustatic sea level rise. As such, this issue is addressed in an integral way in the Louisiana Coastal Program; it is not possible to parse out the elements which relate solely to sea level rise. A review of the state administrative code, Title 43 (which includes the Coastal Use Guidelines) makes no mention of sea level rise.
3. On May 30, 2007, the Louisiana Legislature approved a master plan for coastal restoration and hurricane protection created by the Coastal Protection and Restoration Authority of Louisiana (CPRA). The report *Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast* recommends improving the collection and management of basic coastal data in the state as well as including a greater understanding of the net effect of sea level rise coupled with subsidence.

For more information on *Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast*, go to: www.lacpra.org/.

Maine

1. In February 2006, at the direction of the Maine Legislature, the State Planning Office's Maine Coastal Program published *Protecting Maine's Beaches for the Future: A Proposal to Create an Integrated Beach Management Program*. The document describes existing problems with current beach management while proposing a series of recommendations, including the creation of a new Integrated Maine Beach Management Program. This program proposes an integrated system of regulations, incentives, public investment and hazard mitigation aimed at improving the physical, economic, and environmental quality of Maine's beaches. While the authors acknowledge the challenge of sea level rise throughout the report, policy recommendations and planning tools do not address the topic specifically.

For more information on *Protecting Maine's Beaches for the Future: A Proposal to Create an Integrated Beach Management Program*, go to: www.maine.gov/spo/mcp/downloads/beaches%20future/Protecting%20Maines%20Beaches_Feb06.pdf.

2. The Maine Coastal Program, in partnership with MGS, the Southern Maine Regional Planning Commission, and several coastal municipalities, is currently working on a project entitled “Developing Hazard Resiliency Tools for Municipalities.” This project focuses on developing partnerships that would help share and further the decision-making and support tools that the state has developed to address coastal hazards, including shoreline erosion and potential impacts of sea level rise. The first phase of the project should be completed in December 2008.

Massachusetts

1. In 1980, Executive Order No. 181 was enacted to mitigate future storm damage to barrier beaches in Massachusetts. Among other things, this order recognized that human-induced changes to barrier beaches can decrease storm damage prevention and flood control capacities, that inappropriate development on barrier beaches results in the loss of lives and property, and that future storm damage to development on barrier beaches is inevitable due to sea level rise. In recognition of these factors, the executive order discourages further development on barrier beaches by limiting state and federal funding for new infrastructure (e.g. sewer and water lines), directs state agencies to prepare management plans for all state-owned barrier beaches, gives priority status for relocation assistance to storm-damaged barrier beach areas and encourages public acquisition of barrier beaches for recreational purposes.
2. The Massachusetts Wetlands Protection Act Regulations establish primary frontal dunes as significant and establish the no-adverse-effect standard (Section 310 CMR 10.28). The preface to the regulations was revised in 2005 (Massachusetts Department of Environmental Protection) and significant passages are provided below:

“When a coastal dune is determined to be significant to storm damage prevention, flood control, or the protection of wildlife habitat, 310 10.28(3) through (6) shall apply:

 - (3) Any alteration of, or structure on, a coastal dune or within 100 feet of a coastal dune shall not have an adverse effect on the coastal dune by:
 - a. Affecting the ability of waves to remove sand from the dune;
 - b. Disturbing the vegetative cover so as to destabilize the dune;
 - c. Causing any modification of the dune form that would increase the potential for storm or flood damage;
 - d. Interfering with the landward or lateral movement of the dune;
 - e. Causing removal of sand from the dune artificially; or
 - f. Interfering with mapped or otherwise identified bird nesting habitat.
 - (4) Notwithstanding the provisions of 310 CMR 10.28(3), when a building already exists upon a coastal dune, a project accessory to the existing building may be permitted, provided that such work, using the best commercially available measures, minimizes the adverse effect on the coastal dune caused by the impacts listed in 310 CMR 10.28 (3)(b) through 10.28(3)(e).”

For more information on the complete regulations, go to:

www.mass.gov/dep/water/laws/regulati.htm.

For more information specifically on 310 CMR, go to:
www.mass.gov/dep/service/regulations/310cmr10a.pdf.

3. The *South Shore Coastal Hazards Characterization Atlas* (2005) was developed to provide local coastal managers with information to help with the review of projects in areas that are vulnerable to coastal hazards. The atlas provides maps that illustrate shoreline variables at a scale of 1:40,000 and depict such features as littoral cell boundaries, short-term shoreline change, shoreline type, distribution of properties with multiple federal flood insurance claims between 1978 and 2002, and beach width fronting coastal banks. Tide range, wave climate and storm susceptibility are also characterized for the entire coast of Massachusetts, while the rate of relative sea level rise is provided for stations along the northeastern coast of the United States.

For more information on *South Shore Coastal Hazards Characterization Atlas*, go to:
www.mass.gov/czm/hazards/ss_atlas/atlas.htm.

4. The Woods Hole Oceanographic Institution Sea Grant program is leading an effort, funded by the National Sea Grant Law Center, to develop a national model coastal floodplain by-law, in partnership with an experienced attorney in floodplain management and the Cape Cod Commission. The project team is currently researching national precedent-setting coastal floodplain case law to document the reasoning of these legal decisions, researching and documenting current scientific understanding of the beneficial functions of coastal floodplains, and will ultimately prepare a national model coastal floodplain bylaw/ordinance. This legal and scientific information will be used to analyze the underpinnings of an existing model floodplain bylaw that was generated by the Cape Cod Commission in their 1996 regional policy plan update (discussed above). Workshops, bulletins, one-on-one meetings with local community planners, officials, and state and federal floodplain specialists are proposed to ensure the results of this research are applied in local, state and federal coastal floodplain management.
5. The Massachusetts Office of Coastal Zone Management (CZM), over the past year and a half, has been developing a suite of ideas, strategies, and case studies to help communities improve their efforts to manage coastal floodplains. With continued private and public development and redevelopment of flood-prone areas, as well as a projected increase in the frequency and intensity of coastal storms, the potential harmful impacts to people and property continue to grow.

With this in mind, CZM will launch its new StormSmart Coasts program with a series of regional workshops in the spring of 2008. This program includes technical assistance and legal guidance, regulatory tools, case studies, planning strategies, and an extensive website created to support local efforts to improve the management of coastal floodplains in Massachusetts. The program and the workshops will target municipal officials, including staff and members of planning boards, conservation commissions, zoning boards of appeals, departments of public works, building/engineering departments, boards of health, and

emergency management planners. Each half-day workshop will feature specific information and examples of ways that communities can better protect property and people from coastal storms. A nationally recognized legal expert has been invited to explain how communities can effectively develop plans and/or regulate while minimizing the chances of legal challenges. The workshops will include a discussion of hypothetical proposed developments and ways for communities to plan, site, design, condition, and permit public infrastructure and private development to assure that it is safe and fiscally responsible.

Michigan

1. Michigan provides protection from coastal erosion and flooding through the provisions set forth in Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act (1994 Public Act 451). Setbacks for construction are established for areas of the Great Lakes shoreline and connecting waters where recession rates are equal to long-term average of one foot or more per year. Recession rates and required setbacks are updated every 10 years to account for fluctuations in water levels. A permit from the Department of Environmental Quality is required prior to construction in a high risk erosion area.

Approximately 300 miles of Michigan's Great Lakes mainland is subject to coastal flooding. The flood risk area program requires new construction in the 100-year floodplain of the Great Lakes to be elevated to prevent property damage. Communities in flood risk areas have approved zoning ordinances and regulate construction in flood risk shore lands locally.

2. The Michigan Department of Environmental Quality, Office of the Great Lakes published a report in 2000 entitled *Great Lakes Trends: Into the New Millennium*. The report provides a discussion of Great Lakes water-level records, examining both recent and historical trends. For example, the report explains that the years from 1918 to 1999 encompassed several periods of both extremely high and extremely low water levels and flows. Studies of water level fluctuations have shown that the Great Lakes naturally fluctuate in response to periods of above-average, below-average, or extreme precipitation, water supply, and temperature conditions. The report states that the primary driving factors that determine water levels are "climatic conditions, precipitation (and thus groundwater recharge), runoff, direct supply to the lakes, and the rate of evaporation."

Most regional Great Lakes models predict an increase in storm intensity and frequency with global warming, but it is unknown if the total precipitation levels will increase. A warming trend of the earth's climate would be expected to result in an increased evaporation rate of the Great Lakes, and thus a reduction in the Great Lakes water levels. Thus, shoreline erosion, which has been a significant problem over time in this region, may become less of an issue.

For more information on *Great Lakes Trends: Into the New Millennium*, go to:
www.deq.state.mi.us/documents/deq-ogl-gltrends.pdf.

Minnesota

1. Lake-level management is addressed in Minnesota statutes, specifically *Water Level Establishment and Control* (MS 103G.401). Lake-level change on inland lakes is managed in a similar fashion. MN Rules Part 6115.0220 contains information on water-level controls.

New Jersey

1. New Jersey's Coastal Zone Management rules define "erosion hazard areas" (N.J.A.C. 7:7E-3.19) as shoreline areas that are eroding and/or have a history of erosion, causing them to be highly susceptible to further erosion and damage from storms. Erosion hazard areas extend inland from the edge of a stabilized upland area to the limit of the area likely to be eroded in 30 years for one- to four-unit dwelling structures, and in 60 years for all other structures, including developed and undeveloped areas. The erosion hazard area is measured from the crest of a bluff for coastal bluff areas, the most seaward established dune crest for unvegetated dune areas, the first vegetation line from the water for established vegetated dune areas, and the landward edge of a beach or the eight-foot contour line of 1983 North American Datum, whichever is farther inland, for non-dune areas. Except for limited specific types of development, development is prohibited in erosion hazard areas.

For more information on New Jersey's erosion hazard areas rule, go to:

www.state.nj.us/dep/landuse/7-7e.pdf.

2. In response to the need for vulnerability mapping, the New Jersey Coastal Program is working with the Department of Environmental Protection and the state's Office of Geographic Information Systems to procure LIDAR mapping of coastal counties. The high resolution (two-foot contour intervals) will provide essential data on the coastal vulnerability, as well as contribute to planning efforts and development of coastal multi-hazard mitigation plans. The mapping will contribute to the Coastal Program's efforts to implement policies that accommodate the landward migration of coastal wetlands, the establishment of coastal wetlands along open water areas, and transformation of freshwater wetlands to tidal wetlands.
3. In 2004, the New Jersey Department of Environmental Protection revised and adopted stormwater management regulations. These regulations contain general principles for the development of stormwater management plans and stormwater control ordinances designed to reduce flood damage, including damage to life and property. They also provide:
 - a. Minimum design and performance standards to address post-construction stormwater runoff quality;
 - b. Impacts of major development;
 - c. Establish minimum design and performance standards to control erosion; and
 - d. Encourage and control stormwater infiltration and groundwater recharge.

Furthermore, the revised regulations provide special protection for Category One waters. Category One waters are waters requiring particular protection from measurable changes in water quality because of their exceptional ecological, recreational, water supply, and fisheries significance, as well as other distinguishing characteristics. The regulations require a 300-

foot special water resource protection area adjacent to these waters. In addition to the benefits attendant to the reduction of flood damage, the 300-foot special water resource protection area will serve to preserve areas suitable for the horizontal landward migration of certain coastal wetlands in response to sea level rise.

4. New Jersey Coastal Zone Management rules were amended to encourage the dedication of developed and undeveloped flood hazard areas as public open space. Additionally, the rules were changed to clarify the types of development that can occur in undeveloped flood hazard areas. Allowable exceptions to the preservation of flood hazard corridors are water-dependent uses, infill development, and uses for which there is no feasible alternative location.

New York

1. The New York Coastal Program has issued a set of 44 policy statements to promote the beneficial use of coastal resources, prevent their impairment, or deal with major activities that substantially affect numerous resources. Policies and standards do not exist for the singular purpose of addressing sea level rise, but rather they are integrated and intended to reinforce one another. They attempt to maximize benefits for appropriate uses in evaluating decisions on proposed activities (e.g. natural resources, conservation and preservation of ecosystem habitats that are considered beneficial to the coast, and in appropriate locations are the preferred uses.) As a result of this emphasis on performance, the Coastal Program has not found it necessary to create new policies or standards. Instead, the Coastal Program uses existing policies while applying new knowledge as it becomes available. The following policies have particular bearing on sea level rise:

Policy 11: “Buildings and other structures will be sited in the coastal area so as to minimize damage to property and the endangering of human lives caused by flooding and erosion.”

On coastal lands identified as coastal erosion hazard areas, buildings and similar structures are required to be set back from the shoreline at a distance sufficient to minimize damage from erosion. The setback is calculated by taking into account the current erosion rate (as influenced by sea level rise), the protection provided by existing erosion protection structures, and natural protective features such as beaches, sandbars, spits, shoals, barrier islands, bay barriers, near shore areas, bluffs, and wetlands.

Policy 12: “Activities or development in the coastal area will be undertaken so as to minimize damage to natural resources and property from flooding and erosion by protecting natural protective features including beaches, dunes, barrier islands and bluffs.”

This policy allows the Coastal Program to incorporate updated projections of sea level rise over time. Both development and natural coastal features are to be considered in decisions concerning whether activities are consistent under this policy. As sea level rise accelerates, consistency requires demonstrating that activities will not impair natural protective features

in the future under the changing environmental conditions.

Policy 14: “Activities and development, including the construction or reconstruction of erosion protection structures, shall be undertaken so that there will be no measurable increase in erosion or flooding at the site of such activities or development, or at other locations.”

While erosion and flooding are processes that occur naturally, humans can increase the severity and adverse effects of those processes, causing damage to or loss of property, and endangering human lives. Those actions include:

- a. The use of erosion protection structures such as groins, or the use of impermeable docks, which block the littoral transport of sediment to adjacent shore lands, thus increasing their rate of recession;
- b. The failure to observe proper drainage or land-restoration practices, thereby causing runoff and the erosion and weakening of shore lands; and
- c. The placing of structures in identified floodways so that the base flood level is increased causing damage to otherwise hazard-free areas.

Policy 17: “Non-structural measures to minimize damage to natural resources and property from flooding and erosion shall be used whenever possible.”

The use of nonstructural measures is coordinated with preservation of natural protective features under Policy 12. The combination of policies incorporates an understanding that near-shore features are transitional, natural changes must be accommodated, and that measures protecting natural resources are preferred solutions when managing near-shore areas. These provisions are intended to address a variety of coastal environmental conditions and hazards, including sea level rise.

Other policies are designed to coordinate with and reinforce these examples. For example, Policy 15 protects sediment supplies and natural processes, allowing the shoreline to respond to changing conditions, including sea level rise. As a variety of uses must be accommodated in the coastal area, other policies help identify locations for appropriate uses, including areas where commercial, industrial, and maritime industry uses are preferred and conditions under which natural resources must be protected. Within each use area, activities must be consistent with all other applicable policies, including those with provisions that help address sea level rise.

For more information on the New York Coastal Program policies, go to:

www.nyswaterfronts.com/consistency_coastalpolicies.asp.

North Carolina

1. Passed by the North Carolina General Assembly in 1974, the Coastal Area Management Act (CAMA) establishes policies, guidelines, and standards to manage the natural ecological conditions of the coastal environment as well as to regulate development and preservation of the land and water resources of the coastal area. Rules that govern coastal development are

public record under chapter 132 of the North Carolina General Statutes. Although neither CAMA nor the Administrative Code address sea level rise directly, both emphasize an understanding that the state's shorelines are in a constant state of flux. Examples of this emphasis include:

- a. The ban on hardened oceanfront structures (CAMA).
- b. The significance and primary causes of coastal hazards in North Carolina, and acknowledgement that landforms (in particular beaches, dunes, and inlets) are in a permanent state of flux (section 07H .0302).
- c. Oceanfront setbacks are tied to erosion rates (section 07H.0306). By their very nature, setbacks tied to long-term erosion rates take sea level rise into account, as it is one of the drivers of shoreline change from which erosion rates are determined.
- d. New development along estuarine and public trust shorelines shall be located a distance of 30 feet landward of the normal water level or normal high water level, with the exception of water-dependent uses (section 07H .0209 D10).
- e. The reference to normal high water or normal water level (e.g. section 07H .0106) as opposed to mean high water. Normal high water is the ordinary extent of high tide based on site conditions such as presence and location of vegetation, which has its distribution influenced by tidal action, and the location of the apparent high tide line.
- f. The state's Coastal Resource Commission requirement that all local communities prepare and adopt a land use plan conforming to CAMA. As part of this condition, section 07B.0702 includes an objective that local land-use plans are to address natural hazards towards minimizing risks. An example of one such natural hazard is sea level rise.

For more information on the North Carolina Administrative Code (Title 15A, Chapter 7, Coastal Management), go to: www.nccoastalmanagement.net/Rules/current.htm.

For more information on the Coastal Area Management Act, go to: www.nccoastalmanagement.net/Rules/cama.htm.

2. In 2007, the North Carolina Administrative Code (Title 15A, Chapter 7, Coastal Management) was expanded to address changes in shoreline configuration. Specifically, the passage states that permits for development in Subchapter 7H Section .0300 - Ocean Hazard Area, "shall include the condition that any structure shall be relocated or dismantled when it becomes imminently threatened by changes in shoreline configuration."

For more information on rule 15A NCAC 07H .0306 - General Use Standards for Ocean Hazard Areas under chapter 132 of the North Carolina General Statutes, go to: www.dcm2.enr.state.nc.us/Rules/Text/t15a-07h.0300.pdf and [dcm2.enr.state.nc.us/Rules/current.htm](http://www.dcm2.enr.state.nc.us/Rules/current.htm).

Ohio

1. The Ohio Coastal Program is now in the process of developing a Lake Erie Shore Erosion Management Plan (LESEMP). Ohio Sea Grant is providing local community needs

assessments for the LESEMP via focus groups and random mail surveys.

Oregon

1. A considerable number of research projects, policy initiatives, technical assistance materials, and data and information system elements on coastal hazards have been produced by Oregon Coastal Management Program member agencies and their partners, including Oregon Sea Grant, over the past two decades. Most of this material is directly applicable to, and already available for use within, climate change adaptation initiatives on the Oregon coast.
2. The Oregon Department of Geology and Mineral Industries (DOGAMI) is conducting an ocean shore monitoring project that establishes a series of benchmarks for selected ocean beaches, and will allow for monitoring changes in beach morphology. This project will allow monitoring of erosion and inundation patterns that may be exacerbated by sea level rise.

Puerto Rico

1. Several hazard mapping projects have advanced in Puerto Rico. Maps have been developed for the island's coast that incorporate limits of inundation for various events including tsunamis, the 1962 wave swash limit, hurricane storm surge, and 100-year flood zones. These maps do not include sea level rise. New GIS maps were prepared by incorporating current coastal flood maps with satellite images and census data. In addition, the University of Puerto Rico Sea Grant Program has conducted a coastal vulnerability study using flood maps prepared by NOAA's SLOSH storm-surge model.

For more information on the GIS maps, go to: coastalhazards.uprm.edu/mainmap.html.

Rhode Island

1. The Rhode Island Coastal Program and its implementing body, the CRMC, have implemented regulations over the last three decades designed to minimize the impact of coastal hazards. These include policies regulating the location of structures on vulnerable properties, construction of shoreline protection facilities (various sections), and beneficial reuse of dredged materials to help mitigate some of the hazards associated with coastal living. Rhode Island General Law § 46-23-6, (1971, as amended) authorizes the CRMC to develop and adopt policies and regulations necessary to manage the coastal resources of the state and protect life and property from coastal hazards. The state plan also provides for implementation of Special Area Management Plans, in which policies, strategies, and tools can be tailored to a specific ecosystem and localized concerns, which have included coastal hazards.
2. The Rhode Island Coastal Program also implements a Coastal Buffer Zone Program for lands adjacent to a shoreline (coastal) feature that is, or will be, vegetated with native shoreline species and that acts as a natural transition zone between the coast and adjacent upland

development. The coastal buffer zone has multiple benefits, including protecting water quality and habitat as well as enhancing erosion control and flood control. It also provides a buffer allowing wetlands to migrate landward in the future.

3. The Rhode Island Coastal Program actively classifies barrier beaches and spits as undeveloped, moderately developed, and developed. The council recognizes the highly dynamic nature of barriers, and that storms may cause sudden and significant changes to the geomorphic form of these coastal features. Accordingly, large-scale public infrastructure improvements and dense development are deemed inappropriate, thereby prohibiting construction or expansion of new infrastructure or utilities (including water, gas, and sewer) on all barriers. It is not the intention of these policies to apply to individual gas lines, on-site water supplies, or wastewater treatment systems.
4. Regarding potential impacts of sea level rise and the adaptation measures, the council favors non-structural methods for controlling erosion such as stabilization with vegetation and beach nourishment. When structural shoreline protection is proposed, the council requires the owner exhaust all reasonable and practical alternatives including, but not limited to, the relocation of the structure and nonstructural shoreline protection methods (see Section 300.7.E.1). The council prohibits new structural shoreline protection methods on barriers classified as undeveloped, moderately developed, and developed, and in Type 1 conservation waters. Additionally, structural shoreline protection facilities are prohibited when proposed to be used to regain property lost through historical erosion or storm events. CRMC advocates the beneficial reuse of dredged material; several projects have created wider beaches, with the secondary benefit of providing protection for some coastal properties.
4. The Rhode Island Coastal Program's policies and tools related to shoreline management may be considered "rolling easements" (i.e., as the sea rises, the public's easement "rolls" inland), since there are regulated coastal setbacks from shoreline features (i.e., prohibitions against development of certain areas at a set distance from the shoreward property line). The Coastal Program establishes an erosion setback policy designed to protect both the homeowner and the public resources. Setbacks are based on long-term erosion rates as established by maps that are periodically updated. Erosion rates are calculated by comparing the shoreline location as depicted in historic aerial photographs to the most recent shoreline position. In critical erosion areas on barrier islands and barrier spits, all residential construction with less than six units must be set back 30 times, and commercial property 60 times, the average annual erosion rate. In light of sea level rise and increased erosion on some beaches, the Coastal Program is considering a revision of the setback policy as well as a policy related to removal of structures that are now on active beaches due to erosion.

For more information on shoreline change maps, go to:
www.crmc.state.ri.us/maps/shoreline.html.

South Carolina

1. A research and outreach program, Coastal and Inland Flood Observation and Warning (CI-FLOW), has been established to improve the ability of forecasters to pinpoint areas of

potential flood and flash flood events, track pollutant transport by flood waters, and model the interaction between inland flood waters and coastal storm surge. Partners include the NOAA National Severe Storms Laboratory, the South Carolina and North Carolina Sea Grant programs, NOAA National Weather Service, and North Carolina State University. Other community-level outreach programs and partnerships, such as the Charleston Area Project Impact and the residential hazards display house at 113 Calhoun Street, have also been established and are proving successful.

Texas

1. The Texas General Land Office (GLO) addresses issues related to coastal processes and shoreline impacts within the Coastal Texas 2020 initiative. This effort aims to evaluate coastal erosion and obtain feedback from local residents on the problems they face along the coast. The publication *Coastal Texas 2020: A Clear Vision for the Future of the Texas Coast* breaks the state into five geographic regions and provides an analysis of each region's erosion problems. It summarizes the Coastal Erosion Planning and Response Act Program efforts to reduce the harmful effects of coastal erosion along the Texas shoreline. This effort has encouraged state and local stakeholders to address these critical coastal issues.

For more information on *Coastal Texas 2020*, go to:

www.glo.state.tx.us/coastal/ct2020/index.tml.

2. Chapter 61, Natural Resources Code of the Texas Open Beaches Act provides that beaches may be privately owned but are subject to a rolling public beach easement, guaranteeing the public free and unrestricted access to and use of the beach. An important element of this act is a "rolling easement," which may be a tool that can assist other states in adapting to sea level rise. According to Titus' *Rising Seas, Coastal Erosion, and the Takings Clause: How to Save Wetlands and Beaches Without Hurting Property Owners*, a "rolling easement" is "A policy that allows development, but explicitly prevents property owners from holding back the sea. Rolling easements can be implemented with (a) eminent domain purchases of options, easements, covenants, or defeasible estates that transfer title if a bulkhead is built or the sea rises by a certain degree, or (b) statutes that accomplish the same result [referring to Maine, South Carolina, Texas and Rhode Island]."

The Texas Open Beaches Act and the Texas Open Beaches Enforcement Policy primarily address structures such as houses and bulkheads that remain on the open beach from erosion or storm events. The General Land Office is actively working to balance public access and private property interests, as the implementation of this policy has been challenged by events such as those experienced during the 2005 hurricane season.

For more information on the implementation of this policy, go to:

www.csc.noaa.gov/cz/2007/Coastal_Zone_07_Proceedings/PDFs/Tuesday_Abstracts/2658.Fisher.pdf.

For more information on *Rising Seas, Coastal Erosion, and the Takings Clause: How to Save Wetlands and Beaches Without Hurting Property Owners*, go to:

yosemite.epa.gov/OAR/globalwarming.nsf/content/ResourceCenterPublicationsSLRTakings.html.

3. The Texas Coastal Program is supporting the development of local geohazard maps that include sea level rise, erosion rates, wetlands, and other information, such as one developed as a planning tool for the city of Galveston by the University of Texas.

For more information on the development of these maps, go to:
www.beg.utexas.edu/coastal/GalvHazIdx.htm.

4. The Texas Coastal Program is supporting work by the University of Texas to map and assess the status and trends of wetlands on coastal barriers and peninsulas. These studies have attributed the loss of coastal wetlands and other CNRAs to relative sea level rise (eustatic rise and subsidence) and erosion.

For information on the coastal wetland status and trends reports, go to:
www.glo.state.tx.us/coastal/pubs.html.

Washington

1. The Washington State Department of Ecology's Coastal Monitoring and Analysis Program has participated in a number of studies that have contributed to hazards management analysis on Washington's outer coast. One such study is the Southwest Washington Coastal Erosion Study, which was initiated to examine coastal geology, coastal processes, and natural hazards in order to predict and avoid emergencies along the southwest Washington coast. While this study was not initiated in response to the threat of sea level rise, it provides an example of the type of information being collected by Washington's Coastal Program that could inform future studies.

For more information, go to: www.ecy.wa.gov/programs/sea/swces/index.htm.

Wisconsin

1. Collaborative efforts associated with shoreline hazards that address lake levels include:
 - a. Coastal Natural Hazards Work Group – The Wisconsin Coastal Management Program (WCMP) chairs this group, which meets several times a year and focuses on natural processes that can affect coastal resources (including flooding, erosion, and storms). Climate change and lake levels are of concern to the group due to potential effects on erosion, flooding, etc.
 - b. The *State of Wisconsin Hazard Mitigation Plan* – WCMP participated in developing and updating the original plan, and continues to provide biannual reports to Wisconsin Emergency Management (WEM) on implementation of the plan. Another update is scheduled to begin this year, and the Wisconsin Coastal Program will again participate in the workgroup that will be chaired by WEM. The plan addresses, among many other topics, flooding, storm surges, and erosion. The effects of lake-

levels changes are discussed in the current draft of the plan as well.

For more information on the *State of Wisconsin Hazard Mitigation Plan*, go to:
ftp://doafp04.doa.state.wi.us/wem/Hazard_Mitigation_Plan/Index.htm.

Table 1: Summary of State/Territory Sea-Level-Rise Policies and Initiatives

Sea-Level-Rise Policies and Initiatives by State/Territory					
State/ Territory	Working Groups, Commission, Committees	Outreach	Information for Decision Makers	Implementable Policy or Regulation	Plans, Strategies, Recommendations for Action
Alabama					
Alaska					
American Samoa					
California			X	X	X
Connecticut			X		X
Delaware	X	X	X		X
Florida			X		
Georgia					
Guam					
Hawaii			X		
Indiana					
Louisiana		X			
Maine		X	X	X	X
Maryland	X	X	X		X
Massachusetts			X	X	X
Mariana Islands					
Michigan			X		
Minnesota		X			X
Mississippi					
New Hampshire			X		X
New Jersey	X		X		X
New York	X		X	X	X
North Carolina	X		X		X
Northern Mariana Is.					
Ohio					
Oregon	X	X			X
Pennsylvania					
Puerto Rico	X				
Rhode Island	X	X		X	
South Carolina	X	X			
Texas			X	X	
Virginia	X		X		X
US Virgin Islands					
Washington	X		X		X
Wisconsin		X	X	X	X

Table 2: Contributors to this Study

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