

An Overview of State Coastal Zone Management Policies Designed to Promote Coastal Resilience

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An Overview of State Coastal Zone Management Policies Designed to Promote Coastal Resilience

I. Executive Summary

The New Jersey Coastal Management Program (NJCMP), housed at the state Department of Environmental Protection, engaged the Rutgers University Bloustein School of Planning and Public Policy and the Rutgers Climate Institute to review science-informed sea-level rise programs and policies in the following fifteen states:

California	Connecticut	Delaware	Florida	Hawaii
Louisiana	Maine	Maryland	Massachusetts	New York
Oregon	Rhode Island	Texas	Virginia	Washington

While, this report is not intended to provide an exhaustive inventory of all state resilience activities, it does provide a summary of state policy options for incorporating science-informed sea-level rise science into policy, along with illustrative examples of policy implementation.

Overall, the Rutgers Team found that all fifteen of the case study states have significant efforts underway with regard to sea-level rise. The nature of these efforts may vary, including development of sea-level rise science, adoption of public policies, guidance and technical assistance, and development of decision-support tools. Experiences of the states included in this study point to overarching leadership at the senior levels of government as an essential element of advancing comprehensive science-informed climate adaptation efforts, including sea-level rise.

The Rutgers Team identified five categories of state agency efforts underway within the fifteen states included in this study:

- 1. Stakeholder Engagement** - All of the states have some form of stakeholder engagement that may vary in several ways. Some states maintain “standing” committees that may be established by law, as is the case with the Maryland Commission on Climate Change. In other cases, a stakeholder group may be convened for a particular purpose, such as with New York’s statutory establishment of its State Sea-Level Rise Task Force. States’ efforts to systematically engage stakeholders serve several purposes including informing decision-making while also building a supportive community for state action.
- 2. Climate Science and Vulnerability Assessment** - Most of the states are examining the latest climate science and translating it for application in state policies and programs. These efforts include: examining the latest climate science and integration with local conditions, applying science-informed sea-level rise values to assess

statewide vulnerabilities; determining a frequency for conducting updates to a state's sea-level rise values, consulting with the science community and with stakeholders; and determining approaches to integrate science-informed sea-level rise values into state programs and policies.

3. Strategic Planning - Strategic planning efforts among the states may vary. In some cases, such as Louisiana and Texas, coastal resilience plans identify coastal natural resource restoration priorities for expenditures of public monies. In other states, strategic planning serves to provide an overarching direction for the consistent development of science-informed state programs, funding, policies, and other initiatives. Some states' efforts are focused on sea-level rise while other states, such as New York, focus on statewide flood hazards, and still other states, such as Maryland, Rhode Island and Massachusetts, focus on all climate hazards in their strategic planning.

4. Implementation and Policy development - The Rutgers Team identified eight states that systematically incorporated state-recognized science-informed sea-level rise values into directed public policy which may include policies that: direct state agency operations and policies, direct or incentivize local jurisdictions, and/or directly or indirectly affect state programs that relate to the private sector such as planning or permitting.

5. Capacity building - All of the fifteen case study states are involved in some level of capacity building, which may include: development of guidance, including guidance to state agencies and local governments; creation of state level interagency working groups that facilitate consistent use of science-informed sea-level rise values in policies and programs; development of decision-support tools, such as web-based mapping and visualization platforms; training of local officials, community leaders and others. At least one state, Rhode Island, has a statutory requirement for local Planning Board officials to attend a state-offered training; technical assistance and outreach, including direct technical assistance from state agencies to communities undertaking resilience planning which often involves collaboration with academic institutions; and grants such as those offered to Climate Smart Communities in New York and increased eligibility for grants to municipalities that participate in the Massachusetts Municipal Voluntary Preparedness (MVP) program.

In some cases, state sea-level rise efforts are led through a coastal planning program. In many cases, the sea-level rise efforts are integrated into overall state efforts to address all hazards associated with climate change. In other cases, climate change and sea-level rise efforts are integrated into a state's larger climate change program that includes efforts associated with emissions reduction as well as adaptation.

OBSERVATIONS

Based on the review of efforts in the fifteen states, the Rutgers Team offers the following observations:

- ◆ “**Lead up**” time to policy adoption - For the states that have integrated state-recognized, science-informed sea-level rise values into policy, there typically has been a lengthy period of time, often a decade or more, leading up to policy adoption.
- ◆ **Similarities and differences among the states especially with regard to policy approaches** - For states that are engaged in implementation and policy development efforts, approaches vary. No one state applies all possible existing policy mechanisms.
- ◆ **Science-informed sea-level rise values** - States generally take a bottom-up probabilistic or a top-down scenario-based approach to creating planning frameworks to embody sea-level rise science. Most states are considering how to address recent science regarding sea-level rise contributions from Antarctic ice-sheet melt. More states are choosing to incorporate probabilistic approaches for sea-level rise into their guidance, while addressing Antarctic ice-sheet melt is less consistent among states.
- ◆ **Planning for uncertainty** - The rapidly evolving scientific understanding of sea-level rise science, and changing circumstances such as those associated with ice sheets covering Antarctica and Greenland, drive different approaches for incorporating sea-level rise information. Most states build in requirements to update state sea-level rise values as science emerges. Additionally, some states are implementing management approaches to plan for uncertainties.
- ◆ **Support for implementation of policy** - As states’ efforts to integrate sea-level rise science into policy matures, more states are developing specific strategies, such as decision-support tools, detailed guidance, and stepwise instructions to support implementation on the part of state agencies, local government and private sector entities, rather than setting sea-level rise values with the expectation that state and local agencies and private entities can interpret them.
- ◆ **Effectiveness** - Many of the states’ policies are new and, for that reason, it is difficult to measure effectiveness. The Rutgers Team found an extensive amount of new activity within the fifteen states’ programs in 2018 alone including updated science-informed sea-level rise values, adoption of new policies, development of new guidance and decision-support tools, and issuance of new comprehensive strategic plans.
- ◆ **Vulnerability assessments** - Assessing vulnerability is a key step in managing risk. Many states follow a risk management approach whereby linkages are drawn between climate science, vulnerability assessment, policy development, and implementation. These approaches involve applying science to understand vulnerability and risk to inform the necessary response measures to prevent and minimize future impacts to people, natural assets and built infrastructure.
- ◆ **Limitations** - Despite significant efforts on the part of the states to advance the integration of science-informed sea-level rise policies, there are some limitations with regard to the breadth of current state programs for consideration by the NJCMP, such as consideration of socially vulnerable populations, how to effectively address private lands, and strategies to ensure adequate funding for programs.
- ◆ **Interagency coordination and stakeholder engagement** - Interagency collaboration at the state level serves several purposes: it ensures consistent application of sea-level rise science in programs and policies of multiple agencies; it

identifies mechanisms that may not be available to a Coastal Management Program to advance science-informed sea-level rise; and it allows multiple state agencies to offer consistent guidance and direction to local governments.

- ◆ **Community-based Resilience Planning** - In many of the states, there is a strong recognition of the value of engaging communities in sea-level rise and climate change resilience planning. Community-based resilience planning approaches, such as guidance developed in California, recognize that impacts from changing climate conditions, including sea-level rise, have broad multi-sector impacts that will affect the whole fabric of a community. This approach also recognizes that certain populations are especially vulnerable to changing climate conditions given social conditions and that planning processes need to address the needs of those populations.
- ◆ **Partnerships with academic institutions** - Academic collaboration on climate resiliency occurs in most of the states reviewed for this project either through a direct requirement that tasks universities with developing the climate science, guidance or tools, or through participation on various working groups.

IMPLICATIONS FOR NEW JERSEY

Experiences in other states provide New Jersey with valuable opportunities to consider the effective strategies to advance coastal resilience to sea-level rise and other coastal hazards. Based on experiences in other states, there appears to be existing opportunities in New Jersey to advance sound science-informed sea-level rise policy, including:

- ◆ **Availability of science-informed sea-level rise values** - Many of the states focused on in this report spent resources and capacity on the development of state recognized or state adopted science informed sea-level rise values to inform public policy at the state level. Science-informed sea-level rise values, and a planning framework to support the application of those values, have been developed for New Jersey through a Science and Technical Advisory Panel (STAP) effort through a partnership of the New Jersey Climate Change Alliance, the Rutgers Bloustein School and the Rutgers Climate Institute (Kopp et al. 2016). The probabilistic projections of Kopp et al. have formed the basis for sea-level rise values in California, Delaware and Maryland.
- ◆ **Greater recognition of and support for efforts to address sea-level rise** - Previous research undertaken by members of the Rutgers Team finds there is a foundation of support among local decision-makers and professionals to address sea-level rise and coastal flooding. Engagement with municipal decision-makers and professionals in coastal regions of New Jersey affirm that there is a greater recognition regarding sea-level rise impacts to New Jersey coastal areas as a result of increased awareness following Hurricane Sandy and a greater support for state action to protect people and property.
- ◆ **Availability of decision support tools** - Over the past decade, the NJCMP has worked with academic and non-governmental partners to develop a suite of coastal resilience planning tools and guidance that can be modified to support implementation of a state sea-level rise policy.

- ◆ **Existing comprehensive coastal policies** - New Jersey already has a strong network of coastal zone management policies that can serve as the basis for the integration of sea-level rise policy. The Rutgers Team found that, in several states, coastal management policies were deployed to advance science-informed sea-level rise policies such as in the Rhode Island Special Area Management Plan, and California's Use of the Public Trust Doctrine.
- ◆ **Strong academic partnerships** - Academic collaboration on climate resiliency occurs in most of the states reviewed for this project either through a direct requirement that tasks universities with developing the climate science or through participation on various working groups. Similarly, New Jersey does indeed have state-academic collaboration on issues related to climate and resiliency including the New Jersey Fostering Regional Adaptation through Municipal Economic Scenarios (NJFRAMES) project, the 2018 Coastal Summit and NJDEP's Science Advisory Board.

Despite the strong foundation on which the NJCMP can build a comprehensive science-informed sea-level rise initiative, there are several challenges facing New Jersey in advancing science-informed sea-level rise policies and programs.

- ◆ **Statutory Authorization** - Unlike the experience of many other states studied for this report, New Jersey's climate statutes do not include provisions related to climate adaptation. The 2009 first report to the Legislature pursuant to the Global Warming Response Act opted to include a chapter outlining climate change impacts to the state and potential adaptation considerations for New Jersey.
- ◆ **Unfunded Mandate Provision** - A 1995 amendment to the New Jersey state constitution prohibits the state legislative and executive branches from adopting mandatory laws, rules or regulations that impose an "unfunded mandate" on boards of education, counties or municipalities without authorizing resources, other than property taxes, to "offset the additional direct expenditures required for the implementation of the law or rule or regulation." Given these provisions in the state, it would be difficult for the state to impose a resilience planning requirement on local governments without the allocation of resources for purposes of implementation.
- ◆ **High-level Statewide Engagement** - Also unlike the experience of many other states studied for this report, New Jersey does not have a mandated public body, the role of which is to consult on resilience and adaptation efforts. Many of the states included in this report host or hosted executive-level standing or ad-hoc committees that guide or inform the processes to prepare their states for climate change.
- ◆ **Internal Coordination** – Many of the states examined for this report have established formal or informal interagency working groups that vary from the staff to cabinet levels. State government in New Jersey does not currently maintain a structured interagency working group on resilience and adaptation at either the staff or cabinet levels.
- ◆ **All Climate-hazard Planning** – Many of the states examined for this report have addressed sea-level rise and coastal resiliency as part of all-climate hazard assessment and planning. These other hazards would relate to current and anticipated changes in temperature and precipitation, in addition to sea-level rise and coastal storms.

II. Overview

A. PURPOSE OF THIS REPORT

Thirty-four of the eligible 35 states and territories participate in the national Coastal Zone Management Program, the mission of which is to “preserve, protect, develop, enhance, and restore where possible, coastal resources.” Established under the 1972 Coastal Zone Management Act (CZMA), the national program is intended to address challenges associated with population growth and development along the nation’s coast. Stated objectives of policies developed to further Coastal Zone Management (CZM) goals are to:

- ◆ Protect natural resources;
- ◆ Manage development in high hazard areas;
- ◆ Give development priority to coastal-dependent uses;
- ◆ Provide public access for recreation, and
- ◆ Prioritize water-dependent uses.

These objectives interconnect with efforts by participating states to increase and enhance the resilience of coastal zones to changing climate conditions, including sea-level rise, coastal storms and coastal flood hazards. With almost half of the U.S. population living in coastal areas and in light of the projected acceleration of changing environmental conditions, communities, assets and resources in the coastal zone are increasingly vulnerable to long-term environmental changes.

The New Jersey Coastal Management Program (NJCMP) oversees the State of New Jersey’s activities associated with the federal Coastal Zone Management Act. The State’s activities include comprehensive efforts to enhance the resilience of coastal resources and communities to ensure the protection of the assets, resources and communities within New Jersey’s 1,800 miles of tidal coastline that extends 3 nautical miles off the coast and inland as far as 16 miles including tidally influenced waters in parts of the Raritan and Delaware Rivers.¹

The NJCMP engaged the Rutgers University Bloustein School of Planning and Public Policy and Rutgers Climate Institute to conduct an assessment of sea-level rise standards in place and underway in other states participating in the national Coastal Zone Management Program. More specifically, the purpose of this project is to evaluate other state’s sea-level rise standards and policies to provide insights on the formation of coastal resilience policies and programs in New Jersey. The term “standards” herein refers to sea-level rise values that have been formally recognized by a state entity through written policy, guidance or legislation.

B. SCOPE OF PROJECT

As part of this project, the Rutgers Team conducted an assessment of available state sea-level rise policy and official guidance in other participating CZM states. The Rutgers Team

¹ <https://www.state.nj.us/dep/cmp/>

considered sea-level rise policy and official guidance to include statutes, regulations, adopted guidance documents, and other written policies promulgated through state authorities. While recognizing their importance in adaptation strategies, the project team did not consider regional planning projects, local adaptation planning, or other policy outcomes that did not reflect a statewide policy on the establishment and integration of sea-level rise through regulation or agency operations. While, this report is not intended to provide an exhaustive inventory of all state resilience activities, this report provides an analysis of state policy options for incorporating sea-level rise science into policy, along with illustrative examples of policy implementation in 15 other states. The CMP and Rutgers Team jointly chose the 15 states to study based on shared knowledge of the states' active participation in the federal Coastal Zone Management Program and the presence of a coastal resilience program. (Table 1).

TABLE 1. TARGETED STATES

California	Connecticut	Delaware	Florida	Hawaii
Louisiana	Maine	Maryland	Massachusetts	New York
Oregon	Rhode Island	Texas	Virginia	Washington

The Rutgers Team's primary research focus was to assess whether and the degree to which the targeted states had adopted sea-level rise values, and have statutes, regulations, or written policies that require consideration of "official" science-informed sea-level rise into planning, design, or decision-making on the part of state and local agencies and governing bodies. Overall, the Rutgers Team found that there is an extensive amount of activity underway in all fifteen states with regard to sea-level rise science as well as policy development. Eight of the fifteen states appear to have efforts in place that intersect adopted science-informed sea-level rise values with policy and, while the other seven states have significant sea-level rise efforts underway, they do not appear to currently intersect adopted science-informed sea-level rise values with policies. Section IV. of this report provides an overview of efforts in each of the fifteen states and identifies those eight states where science-informed sea-level rise values intersect with policy.

In general, information collected about other states' sea-level rise standards includes:

- ◆ Standards or official written guidance that states participating in the federal CZM program have established;
- ◆ Enabling authority;
- ◆ Science basis and background to support the establishment of sea-level rise standards;
- ◆ Nature of how standards or official guidance are structured and implemented;
- ◆ Any documented or reported outcomes and evaluation of impact, including public opinion.

C. PROJECT APPROACH

This project was conducted collaboratively between the Rutgers Team and the CMP. The general activities of the project are below:

TABLE 2. PROJECT TASKS

Literature Review and Consultation	The Rutgers Team reviewed peer-reviewed and popular literature and conducted informal interviews with experts in state sea-level rise policies to better understand approaches and trends in state sea-level rise policies.
Data Gathering and Identification of State Typologies	<p>The Rutgers team conducted a review of information regarding past and present efforts in the targeted fifteen states. The team prepared written summaries of efforts in each state and identified information gaps for each state to address via teleconference interviews. A member of the Rutgers Team held at least one teleconference interview with the Coastal Management Program in each targeted state. A template for the state interviews was prepared to ensure consistency in the interviews (see Appendix A).</p> <p>In addition to standard questions asked for all interviewed, state-specific questions to address identified data gaps were included in the interviews. A graduate student assistant participated in each call for purposes of note-taking. A representative of the New Jersey CMP joined several of the calls.</p> <p>In consultation with the CMP, the Rutgers Team used the insights gained from the review of state materials and state interviews to develop a typology framework for presenting the findings of activities in the 15 targeted states.</p>
Consult Stakeholders	The Rutgers Team hosted two identical webinars in August and October 2018 with participants of the New Jersey Climate Change Alliance and the New Jersey Coastal Resilience Collaborative, respectively. The webinars provided coastal resilience stakeholders an understanding of the project as well as an opportunity for the Team to receive input regarding project design. Additionally, the Rutgers Team presented an overview of the project and initial impressions at the October 9-10 New Jersey Coastal Resilience Summit held at Monmouth University. This presentation provided an opportunity to brief coastal stakeholders on early project insights as well as to receive input from stakeholders on topics to explore further as part of the project.
Consult with the New Jersey CMP	The Rutgers Team routinely consulted with the NJCMP on all aspects of the project including development of the template for state interviews, early insights after reviewing state materials, development of a PowerPoint slide deck to provide stakeholders with an overview of the project on the August and September 2018 webinars, and development of a PowerPoint slide deck for the October 9-10 Coastal Summit.

Prepare Final Deliverables	The Rutgers Team worked closely with the NJCMP on the development of this report. A second deliverable is a PowerPoint slide deck that provides an overview of the report and its findings.
Advisory Services	The Rutgers Team has and continues to provide input and consultation to the NJCMP upon request regarding sea-level rise policies.

III. State Approaches for Developing Sea-level Rise Programs

While specific approaches for development of sea-level rise and coastal resilience programs varied in each state, in general, these can be organized under three considerations: the nature of how action is directed to be taken, the engagement of task forces and working groups, and the development of partnerships with academic institutions.

A. DIRECTING ACTION: REGULATORY AND EXECUTIVE APPROACHES

Organizational approaches to incorporating sea-level rise into state policy vary for each state. This section describes the policy approach for incorporating sea-level rise into regulation or executive orders, in addition to describing the different types of governance bodies that states use to oversee and coordinate the integration of climate science into their state policies. Table 4 summarizes the laws and executives orders in each state that call for the incorporation of sea-level rise in state agency processes and programs. The table indicates instances where state executives or legislators have explicitly required that a science-based advisory group, or other designated entity, examine ways to incorporate the ‘best available’ climate science that state policies should reference as authoritative. Governors and legislators can call for this action by writing procedures into laws or creating executive orders that require state agencies to operate in a manner that considers sea-level rise as part of their agency responsibilities. For this study, we focused on policies and plans at the state and local level in which laws, regulations, official state guidance, administrative or executive orders directed state or local governments to incorporate science-informed sea-level rise provisions into their operations.

It is critically important to point out the rapid flurry of executive and legislative action in 2018 alone that affect state climate adaptation, resilience and sea-level rise policy. Even during the period of conducting the research to support this report, the Rutgers Team found that at least 14 of the 15 states undertook some sort of significant development regarding sea-level rise initiatives including actions associated with establishment of science-informed sea-level rise values, such as in Connecticut, and/or establishment of new policies, such as in New York, or issuance of statewide plans such as in Massachusetts and Rhode Island. Table 3 highlights the rapid pace of programmatic activity at the state level with regard to sea-level rise:

TABLE 3: SUMMARY OF NEW STATE SEA-LEVEL RISE ACTIONS IN 2017 AND 2018

Science-informed sea-level rise values	Statewide Planning	New Policy
CA	2017	2018
CT	2018	
DE	2017	2017
HI	2017	2017
LA		2017
MA	2017	2018
ME		2018
MD	2018	2018
NY	2017	2018
OR	2017	
RI		2017
TX		2017
VA		2018
WA	2018	

Table 4. summarizes state laws or Executive Orders that specifically call for the incorporation of the most updated climate science into state actions.

TABLE 4. STATE LAWS OR EXECUTIVE ORDERS THAT CALL FOR INCORPORATING CLIMATE SCIENCE (INCLUDING SEA-LEVEL RISE) INTO STATE POLICY

State	Law	Executive Order
California	Assembly Bill 2516 (2016) Senate Bill No. 379 (2015) Senate Bill 246 (2015)	EO S-13-08 (2008) EO B-30-15 (2015)
Connecticut	Public Act 18-82 (2018) Public Act 13-179 (2013) Special Act 13-9 (2013)	EO 46 (2015)
Delaware	None	EO 41 (2013)
Florida	None	None
Hawaii	Act 286 (2012) Act 83 (2014) Act 32 (2017)	None
Louisiana	None	None
Maine	None	None
Maryland	Chapter 628 (2018) Chapter 429 (2015)	EO 01.01.2014.14 (2014) EO 01.01.2012.29 (2012) EO 01.01.2007.07 (2007)
Massachusetts	Chapter 298 (2008)	EO 569 (2016)
New York	6 NYCRR Part 490 (2014) ECL § 3-0319 (2014)	None
Oregon	House Bill 3543 (2007)	None
Rhode Island	RIGL 23-84 (2010) RIGL 45-22-7 (2018)	EO 17-10 (2017)
Texas	None	None
Virginia	None	EO 24 (2018)

Notes: Entries are noted from most recent (top) to oldest (bottom) for each state. The Executive Orders and Laws above indicate those which establish the sea-level rise science for the state and do not necessarily reflect a full inventory of all laws or executive orders that derive authorities from or incorporate the acts herein by reference.

In general, the development of science-informed sea-level rise policies appears to derive from or extend authorities and policies associated with a state's Coastal Management Program and/or from a statewide comprehensive climate change program that may be

SPURRING STATE PROGRAMS THROUGH EXECUTIVE ACTION

CASE EXAMPLE: MASSACHUSETTS

In 2016, Governor Charlie Baker signed Executive Order 569 that directed two cabinet secretaries to develop a statewide Climate Adaptation Plan that includes: observed and projected climate trends based on the best available data, including extreme weather events, drought, coastal and inland flooding, sea-level rise and increased storm surge, wildfire, and extreme temperatures; and strategies for state agencies and authorities, municipalities and regional planning agencies to proactively address climate hazards through adaptation and resiliency measures. In response to Executive Order 569, the state incorporated values for sea level rise into the State Hazard Mitigation and Climate Adaptation Plan in September 2018.

limited to adaption but, in some states, include mitigation of climate emissions. Massachusetts' 2018 adoption of a statewide plan, the State Hazard Mitigation and Climate Adaptation Plan, is structured to address all climate hazards including: rising temperatures, sea-level rise, changes in precipitation, and extreme weather events. New York's 2014 regulations and supporting 2018 guidance to implement the state's Community Risk and Resilience Act includes provisions regarding both coastal flooding, storm surge, sea-level rise as well as inland flooding. While Rhode Island's Special Area Management Plan (BEACH SAMP) provisions are focused on coastal hazards, including sea-level rise, the state's Executive Climate Change Council created in 2014 by Executive Order focused on all climate hazards as does the state's 2018 "Resilient Rhody" comprehensive plan. Connecticut's efforts over more than fifteen years are integrated into the state's overall climate change efforts including adapting to all climate hazards as well as reducing greenhouse gas emissions.

In several states, practitioners must incorporate sea-level rise science into their work because of an executive order or law to address holistic state climate adaptation and mitigation initiatives. For example, Massachusetts sea-level rise projections are included along with projections of temperature, precipitation, and other climatic variables (Northeast Climate Adaptation Science Center, 2018). The Delaware Department of Natural Resources and Environmental Control has integrated its coastal program into The Division of Climate, Coastal and Energy which uses an integrated approach of applied science, education, policy development and incentives to address the state's climate, energy and coastal challenges under the branding of: "Clean Energy, Sustainable Coasts, Livable Climate." (DNREC, 2018). The New York State Department of Environmental Conservation has established a 'Climate Action Team' that includes a representative of all programs and which is intended to facilitate coordination of both climate change mitigation and resilience policies including sea-level rise.

INTERNALLY INITIATED DEVELOPMENT OF SEA LEVEL RISE VALUES

CASE EXAMPLE: DELAWARE

The Delaware Coastal Management Program, housed in its Department of Natural Resources and Environmental Control, created a technical working work that released a 2009 set of future sea level rise planning scenarios. Subsequently, the DNREC Commissioner convened a 3-year Public Advisory Committee that accepted the Technical Working Groups 2009 report and, in 2013, issued recommendations on how Delaware can prepare for sea level rise. In response, Governor Jack Markell signed Executive Order 41 directing state agencies to consider the sea level rise scenarios into long range planning and capital spending.

Other states develop science and manage sea-level adaptation through executive and legislative efforts exclusively focused on sea-level rise and commensurate flood hazards. Louisiana efforts target flood hazard and resilience projects undertaken by the Coastal Protection and Restoration Authority. Rhode Island initiatives are promulgated through both broader climate initiatives from the executive office, coupled with authorities on incorporating sea-level change exercises through the coastal zone management rules in the state. Hawaii and Oregon are the only states where legislative action has occurred absent previous executive action by a Governor. Delaware and Virginia are the only states in our review sample where governors issued executive orders that state legislature have not yet followed with commensurate action to codify the incorporation of sea-level rise into policies and programs. Texas, Maine, Louisiana and Florida do not have an Executive Order or law that determines the acceptable consideration of sea-level rise science at the state level; however, it is important to point out that these states programs do not have a strong policy focus and, instead, have a greater emphasis on creating criteria for coastal resilience restoration projects and local planning.

Another important observation made by the Rutgers Team is the lengthy period of time leading up to all states' actions associated with establishment of a science-informed sea-level rise standard and/or incorporation of that standard into policy. As evidenced by the summary of each of the states' efforts contained in this report, extensive efforts on the part of state agencies, create the conditions that support a state's adoption of science informed sea-level rise values and the integration of those values into policy. These efforts tend to include:

- ◆ *Evaluation of science and research* – Whether in the form of science working groups or other mechanisms, it appears that the states with the approaches that most systematically integrate science-informed sea-level rise values into policy, have spent 10-17 years evaluating sea-level rise science and impacts and presenting those values and impacts in public mechanisms (e.g. reports, meetings, trainings, etc.). In some states, such as Delaware and Connecticut, science initially conducted years earlier is updated to reflect the latest climate science even prior to adoption of policy;
- ◆ *Stakeholder engagement* – Many states undertake stakeholder processes, establishment of advisory or ad-hoc committees to explore impacts of sea-level rise and, in some cases, other climate hazards on the state. Typically, these statewide

vulnerability assessments generate reports and evidence that points to impacts to critical infrastructure, economy, natural resources, public health and populations, and other assets in the state. In doing so, these efforts inform public awareness of climate change and sea-level rise impacts, and even build constituencies to support action, for years leading up to the development of policy; and

- ◆ *Interagency coordination* – Given the complex and multi-sectoral impacts of climate change on a state, many states convene public or private interagency working groups to foster capacity for coordinated efforts to address climate impacts including from agencies with jurisdictions related to coastal management, transportation, public health, community development, emergency management and hazard mitigation, state finances and others. In these ways, the interagency deliberations build an internal capacity to be able to manage the implementation of complex cross-agency policies. In some cases, interagency working groups include local government agencies that are designed to, similarly foster capacity development for inevitable consistent implementation of public policy between the state and local levels.

B. TASK FORCES AND WORKING GROUPS

Table 5 demonstrates the governance structure for developing, examining and determining the scientific assumptions and approaches that will comprise the sea-level rise science in each state. Across states, our project team focused on identifying the presence of three types of groups associated with the development of sea-level rise science; (1) Science and Technical (2) Stakeholder Advisory, and (3) Steering / Agency Coordination.

Science and Technical groups can include universities, agencies, non-governmental organizations or other stakeholders whose purpose is to assess climate science and develop the scientific basis for the sea-level rise in a given state. Many states work through some form of committee or working group in the development of their sea-level rise values although the specific approach may vary (See Table 5). In some cases, committees and working groups are formally established. In other cases, they may be self-organized through staff-level interagency working groups collaborating on the development of sea-level rise guidance, often in consultation with academic scientists.

The information produced by science and technical group efforts is sometimes reviewed by a Stakeholder Advisory Group or Interagency

MAXIMIZING EXTERNAL ENGAGEMENT

CASE EXAMPLE: MARYLAND

In 2007 Governor Martin O’Malley established The Maryland Commission on Climate Change (MCCC) through Executive Order. The Commission, which included cabinet-level representatives, was charged with developing an action plan for climate change mitigation and adaptation which was finalized in 2009. Through a second Executive Order in 2014, O’Malley expanded the scope of the Commission and its membership to include non-state government participants. The Commission was codified into law by the Maryland General Assembly in 2015. Currently, the Commission consists of 26 members representing State agencies and legislature, local government, business, environmental non-profit organizations, organized labor, philanthropic interests, and the State University system. The work of the Commission is supported by a Steering Committee and four Working Groups, including an Adaptation and Response Working Group.

Working Group. In many states, stakeholder advisory groups and interagency working groups are comprised of entities (i.e., state and local agencies) that will ultimately be responsible for incorporating the sea-level rise science into practices and programs. Stakeholder advisory groups are often comprised of public and private entities whose jurisdictions are different from the state (e.g., a municipality) or who may serve a technical assistance role throughout the state (e.g., an environmental NGO). Interagency working groups often comprise executive branch agency representatives to foster coordinate actions resulting from the development of either sea-level specifically or broader incorporation of climate science into state planning and operations.

TABLE 5. STATE COMMITTEES AND WORKING GROUPS TO IMPLEMENT CLIMATE ACTIONS

State	Science and Technical Advisory Group(s)	Standing Stakeholder Advisory Group(s)	Steering / Agency Coordination Working Group(s) (Agency or Executive Level)
California	California Ocean Protection Council Science Advisory Team (OPC-SAT)	Ad-hoc. Sea-level rise science committee subject to public hearing.	California Ocean Protection Council / Coastal and Ocean Working Group of California's Climate Action Team (CO-CAT)
Connecticut	UConn Marine Sciences Division ²	Ad-hoc. Sea-level rise science committee subject to public hearing.	Governor's Council on Climate Change (GC3)
Delaware	DNREC Sea-level Rise Technical Workgroup	Ad-hoc	Delaware Cabinet Committee on Climate and Resilience
Florida	None		
Hawaii	Ad-hoc	Ad-hoc	Hawaii Climate Change Mitigation and Adaptation Commission
Louisiana	CPRA Working Group	Ad-hoc. Planning and Research Division of CPRA	Governor's Coastal Advisory Commission on Coastal Protection, Restoration, and Conservation.
Maine	None		
Maryland ³	MCCC Scientific and Technical Working Group / University of Maryland Center for Environmental Science	MCCC Steering Committee and Working Groups	Maryland Commission on Climate Change
Massachusetts	Northeast Climate Science Center at the University of Massachusetts Amherst	Global Warming Solutions Act Implementation Advisory Committee ⁴	Secretariat level Climate Change Coordinators meet under Executive Office of Energy and Environmental Affairs and the Executive Office of Public Safety and Security ⁵
New York	NYSERDA	Yes	No
Oregon	Oregon Climate Change Research Institute (HB 3543)		
Rhode Island	EC4 Science & Technical Advisory Board URI Environment Data Center	EC4 Advisory Board	Rhode Island Executive Climate Change Coordinating Council

² Per public act 18-82

³ <https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Pages/Commission.aspx>

⁴ <https://www.mass.gov/service-details/implementation-advisory-committee>

⁵ <https://www.mass.gov/executive-orders/no-569-establishing-an-integrated-climate-change-strategy-for-the-commonwealth>

Texas	None	None	None
Virginia*	TBD	TBD	TBD
Washington	Washington Coastal Resilience Project	None	None

*Notes: UConn = University of Connecticut. MCCC = Maryland Commission on Climate Change. CPRA = Louisiana Coastal Protection and Restoration Authority. NYSERDA= New York State Energy Research and Development Authority. Ad-hoc classifications indicate that, while several expert groups may be convened for individual efforts and plan development, no overarching committee exists that serves to provide oversight over all efforts related to sea-level. * Virginia EO-24 establishes the Secretary of Natural Resources as the Chief Resilience Officer, and appoints a Special Assistant to the Governor for Coastal Adaptation and Protection. Virginia SEA-LEVEL RISE standards to be developed in consultation with scientists from the Secretary of Administration, the Secretary of Commerce and Trade, the Secretary of Finance, the Secretary of Transportation, and the Virginia Institute of Marine Science.*

SCIENCE AND TECHNICAL ADVISORY GROUP(S)

Development of the scientific basis and background underlying state sea-level rise policies, programs and guidance is often conducted by the target states through consultation with technical experts in state and federal programs (such as a State Geological Survey, and Sea Grant programs), as well as with technical experts and scientists outside of government, most notably academic institutions. While the scope of scientific assumptions in the advisory groups' charges can vary, the science and technical groups typically focus on reviewing the most recent scientific literature to identify future sea-level rise values that are most relevant given local conditions in the state. The result is most often a 'consensus' report that outlines a set of projected sea-level rise values or ranges, but that does not cross over into offering policy recommendations. In Maryland, the Commission on Climate Change Act of 2015 specifically requires that the University of Maryland Center for Environmental Science (UMCES) establish and update the sea-level science for the state. A similar statutory requirement is in place in Connecticut where the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) at the University of Connecticut is directed to generate science-informed sea-level rise values and update them regularly. In the case of Maryland, UMCES chose to constitute a panel of experts, as was done in Oregon, Texas, and other locations. In the case of Connecticut, CIRCA scientists generated sea-level rise values in 2018 based on an independent review of the science. In some cases, (e.g., Texas, Washington, Delaware) states have chosen to convene expert panels that include scientific experts and representatives of organizations that could be responsible for implementing the outcomes of the panel. For example, in Texas, The University of Texas at Austin hosted a 2012 workshop with 28 scientists from six academic institutions along with representatives of non-governmental organizations, government and the private sector specifically to examine current science regarding sea-level rise values and to assess the risk to assets along the state's gulf coast.

STANDING STAKEHOLDER ADVISORY GROUP(S)

Several states have created standing external stakeholder groups to inform climate change and/or sea-level rise policy at the state level. Formal standing Advisory committees for the implementation of sea-level change exist at the state level. These standing committees offer opportunities for the co-production of science with practitioners at regional and local scales and are considered critical for future updates to sea-level change policy for

implementation (California, 2018 guidance). Maryland, Massachusetts, and Rhode Island have standing stakeholder advisory committees across all climate adaptation initiatives to advise on implementation of climate adaptation initiatives. Other states engage stakeholder groups through specific projects and initiatives, with groups that are constituted specifically for a given project.

STEERING / AGENCY COORDINATION WORKING GROUP(S) (AGENCY OR EXECUTIVE LEVEL)

When established either formally or informally, interagency working groups serve to facilitate coordination, knowledge transfers and consistent application of sea-level rise values as part of guidance, planning, and policy. Interagency working groups for considering sea-level change were more common among the states than other climate hazards and were often formed as a part of an initial executive or administrative order to coordinate and report climate change exposure and vulnerability across agency lines and to share adaptation practices among and between staff at different agencies across state government. Interagency working groups can sit directly within the executive office of the governor (e.g., Rhode Island, Louisiana, Connecticut) or are headed and facilitated by one or more of the executives at an agency level (e.g. Massachusetts, Maryland, Hawaii). In states like New York and Delaware, prior adaptation planning committees have created sustained relationships among agencies when planning for climate adaptation when there is no formally constituted interagency working group.

C. ROLE OF ACADEMIC INSTITUTIONS

Given the broad complexity of climate science fields and the rapid evolution of methods to develop sea-level rise values⁶, sea-level rise efforts in all of the target states involve some involvement of academic scientists. Universities participate in examining, developing and determining applicable sea-level rise science assumptions in each state by directly managing the process, participating in processes run by other institutions, or through their own efforts to deploy research for technical assistance and training resources absent state efforts.

- ◆ In 5 out of 15 states reviewed for this project, law or executive orders explicitly tasked universities with developing the scientific basis for sea-level rise for the state. For example, the Maryland Legislature enacted a law directing UMCES, a state university, to develop sea-level rise values for the state. UMCES followed by convening an expert panel, which included scientific partners from within and outside of academia. In Massachusetts, the scientific basis for sea-level rise was produced by the Northeast Climate Adaptation Science Center, a partnership with the University of Massachusetts, Amherst and other institutions. In Connecticut, the Connecticut Institute for Climate and Climate Adaptation at the University of Connecticut is required by law to produce state sea-level rise values using the latest science. Those values were released in 2018.
- ◆ In most states (such as California, Delaware, Hawaii, Louisiana, Connecticut, New York, and Rhode Island), academic scientists participate in committees and working

⁶ Horton et al. (2018)

groups convened by government scientists to develop consensus methodology for generating sea-level rise values for the state. For example, in Delaware, the University of Delaware participated in the Department of Natural Resources and Environmental Control's 2009 Sea-Level Rise Technical Workgroup, the Sea-Level Rise Advisory Committee, and the state's Climate Change Vulnerability Committee.

- ◆ In Texas, Oregon and Washington, university institutes have led the deliberation and development of sea-level change science absent legislative or executive requirements (See Table 4). The University of Washington Climate Impacts Group, in partnership with the Washington State Department of Ecology and Department of Fish and Wildlife, generated scientific and mapping products to support the Washington Coastal Resilience Project⁷.

ACADEMIC PARTNERSHIPS

CASE EXAMPLES: CONNECTICUT, MARYLAND, RHODE ISLAND

The Connecticut 2013 Act Concerning Climate Change Adaptation and Data Collection established the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) which is tasked with improving the resilience of coastal communities in Connecticut to sea level rise. CIRCA is also required by law to update the state's sea level rise values at least every ten years to reflect the latest science.

The Maryland Commission on Climate Change Act of 2015 requires the University of Maryland Center for Environmental Science (UMCES) to establish science-based sea-level rise projections for the state's coastal areas and update them every 5 years; requiring the sea-level rise projections to include maps made available on the Internet that indicate areas of Maryland that may be most affected by storm surges, flooding, and extreme weather events.

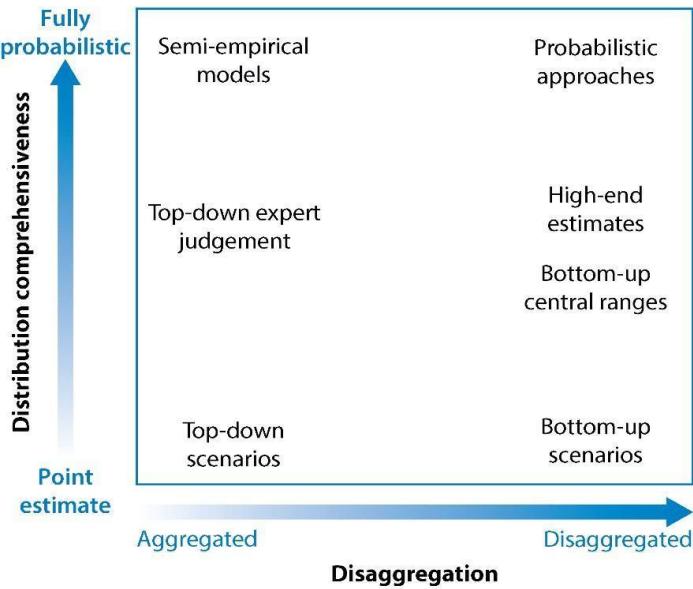
The Rhode Island BEACH Special Area Management Plan (SAMP) requires permit applicants to include consideration of sea level rise impacts using a suite of decision-support tools created and maintained by the University of Rhode Island.

⁷ Miller et al. (2018)

IV. Science Basis and Background

There are many different methods that scientists have used to establish the scientific basis for sea-level change and several decision frameworks that have appeared over the past decade to aid practitioners in applying sea-level rise science (Horton et al., 2018). Among the options, policy choices among our sample states center on choosing top-down scenario or probabilistic approaches for establishing the underlying scientific basis for their policy. Of the 11 states that have state determinations for sea-level rise, seven of the states use a probabilistic framework as the scientific basis of their sea-level rise determination. Frameworks for applying the sea-level rise science to decisions varied widely, with a majority of states presenting sea-level rise choices within a central range accompanied by options for high-end estimates.

Top-down scenario approaches to sea-level rise science start with a specific assumption about the change in global mean sea level (e.g., 1.5 m by 2100) and then work backward to establish the local change that communities would see if sea-level rose by that amount, on average, around the world. Instead of making local adjustments based on global mean sea level change (top-down scenario), **probabilistic approaches** use the different ingredients of sea-level rise (i.e., ice-sheet melt, subsidence, currents, etc.) globally and locally, and simulate thousands of possible future combinations in the future to build up a potential range of sea-level change that local community might experience (e.g., Kopp et al., 2014). Early state efforts relied on the top-down scenario scientific projections promulgated by NOAA (Parris et al., 2012) for the Third National Climate Assessment. The top-down scenarios define reasonable ranges of sea-level rise that the scientists use to construct discrete pathways for future sea-level rise. Scenario-based projections are generally informed by a 2012 National Research Council report, are partially tied to specific emissions scenarios presented in the IPCC's Fourth Assessment Report, and do not include a likelihood of occurrence (IPCC, 2013; NRC, 2012). Probabilistic approaches for establishing the scientific basis of sea-level rise aim to estimate a single, comprehensive estimate of the likelihoods of different levels of sea-level rise (under different emissions scenarios) from a bottom-up accounting of different components (Kopp et al., 2014). Table 6 characterizes the projection framework that each state uses for defining sea-level rise parameters in their state. Of the 11 states in Table 6 that have state determinations for sea-level rise, 7 of the states use a probabilistic framework as the scientific basis of their sea-level rise determination.



Horton BP, et al. 2018.
Annu. Rev. Environ. Resour. 43:481–521

FIGURE 1. SEA-LEVEL PROJECT TYPOLOGY (HORTON ET. AL., 2018)

Maryland, Washington, Oregon, and Delaware all use probabilistic scientific basis based on local data using the Kopp et al., 2014 bottom-up accounting method for sea level to develop **central and high-end range estimates** for application in decisions. Central and high range estimates, similar to those proposed by the NJCAA STAP (Kopp et al., 2016) are intended to allow users to pick from “likely” ranges, while also allowing users to consider low-probability high consequence events. Hawaii uses a probabilistic framework to discuss the range of future options, but uses only the high end of the RCP 8.5 central range estimate for guidance purposes. California uses the central and high-end range estimate framework for users, but adds an additional extreme (H++) estimate to account for long-term ice sheet melt that is plausible, but whose probability cannot be determined. Massachusetts’ most recent estimates consolidate different probability ranges into a set of scenarios that represent different likelihood assumptions for use in state planning activities, and are reconciled with the federal top-down scenario framework.⁸

Bottom-up scenarios frame discrete scenarios of future change for users to apply in their professional capacity, often presented as discrete selection of high, medium, and low future outcomes. New York converts the wide-ranging scientific basis (Horton et al, 2014) for state policy into a set of scenarios for users to apply in incorporating sea-level rise.

⁸ For example, projected sea-level rise in Massachusetts’ is unlikely to exceed the federal intermediate scenario given a high emissions pathway (RCP 8.5). Using a medium emissions pathway (RCP 4.5) when accounting for possible higher ice sheet contributions, sea-level rise in Massachusetts becomes about as likely as not to exceed (50% probability) to exceed the intermediate federal scenario projection.

TABLE 6. SUMMARY OF SCIENTIFIC BASIS AND UPDATE FREQUENCY FOR STATE DETERMINED SEA-LEVEL RISE PROJECTIONS

State	Decision Framework	Update Frequency	Scientific Basis / Sources
California ⁹	Probabilistic Central and High-End Ranges Extreme scenario with unknown probability	Periodically, or at least every 5 years	Kopp et al. (2014) Sweet et al. (2017)
Connecticut ¹⁰	Top-down Scenarios*	Every 10 years	Parris et al. (2012)
Delaware ¹¹	Probabilistic Central and High-End Ranges	N/A	Kopp et al. (2014)
Florida	None	N/A	N/A
Hawaii ¹²	Probabilistic High-End Range	Every 5 years, commensurate with report update	Kopp et al. (2014)
Louisiana ¹³	Top-down Scenarios with Expert Elicitation	Every 6 Years, commensurate with CPRA planning update	Meselhe et al. (2017) Pahl et al. (2017)
Maine	None	N/A	N/A
Maryland ¹⁴	Probabilistic Central and High-End Ranges	Every 5 years	Kopp et al. (2014)
Massachusetts ¹⁵	Probabilistic Central and High-End Ranges****	N/A	Kopp et al. (2017) Deconto and Pollard (2016) Kopp et al. (2014)
New York	Bottom-Up Scenarios	Every 5 Years	Horton et al. (2014)
Oregon ¹⁶	Probabilistic Central Range	Every 2 Years	Kopp et al. (2014)
Rhode Island	High End Top-down Scenario	N/A	Sweet et al. (2017)
Texas	None	N/A	N/A
Virginia**	TBD	Every 5 years, commensurate with Virginia Coastal Resilience Masterplan Update (EO 24)	TBD
Washington ¹⁷	Probabilistic Central and High-End Ranges	N/A	Kopp et al., 2014

*Notes: Florida, Maine, and Texas do not have guidance for state authorized sea level change science, but do work with communities to adapt to sea-level change using available scientific data. *Pursuant to PA 18-82, NOAA CPO-1 (Parris et al., 2012) serves as the baseline information upon which UConn Marine Sciences Division is authorized to make revisions. **Pursuant to Virginia EO 24 (2018), the Virginia Institute of Marine Science at William & Mary is charged with creating state level sea-level rise recommendations ***Delaware's study was conducted as part of an executive order, but no formal authoritative scientific guidance exists at the state level following on from the initial report. ****Massachusetts' guidance create "crosswalked" scenarios of probabilistic projections to the federal top-down scenarios to allow decision makers flexibility in application frameworks.*

Of the remaining 4 states, two (2) use the federal **top-down scenario** scientific basis and decision framework projections promulgated through NOAA (Parris, 2012). The difference

⁹ Griggs et al. (2017)

¹⁰ O'Donnell (2018)

¹¹ Callahan et al. (2017)

¹² Hawai'i Climate Change Mitigation and Adaptation Commission. (2017)

¹³ Meselhe et al. (2017), Pahl, J. (2017)

¹⁴ Boesch, et al. (2018)

¹⁵ Northeast Climate Adaptation Science Center. (2018).

¹⁶ Dalton et al. (2017)

¹⁷ Miller et al. (2018)

between top-down scenarios described here, and the bottom up scenarios described above for New York and Massachusetts, are that New York and Massachusetts scenarios are supported by a probabilistic scientific basis, whereas the scenarios presented in the states that follow are supported by a top-down scientific basis. In other words, while the frameworks for decisions are presented similarly (e.g., choose high, medium or low), the underlying science is different (i.e., probabilistic or top-down scenario). Connecticut uses the 2012 Parris scenarios, localizing to Connecticut specific gauge observations. Rhode Island uses the “high” scenario of the update federal projections by Sweet et al., 2017 to hedge against perceived upward trends in sea-level change projections, as well as to reflect the critical nature of the assets protected under the authorities in Rhode Island. Louisiana’s approach is unique to the states reviewed, and was undertaken through ***top-down expert*** panel in coordination with their coastal modeling efforts to select sea-level information that was both scientifically valid and that they could incorporate into their coastal modeling methodologies.

UPDATING SEA LEVEL RISE GUIDANCE

CASE EXAMPLE: CALIFORNIA

In 2017, at the direction of California Governor Jerry Brown, the state’s Ocean Protection Council’s Science Advisory Team released a report, “Rising Seas in California: An Update on Sea Level Rise.” Among other conclusions, the report pointed to the need to review the state’s sea level rise guidance due to several factors including a recognition that scientific understanding of sea-level rise is advancing at a rapid pace, that the rate of ice loss from the Greenland and Antarctic ice sheets is increasing, and that the scientific community has made significant progress in producing probabilistic projections of future sea level rise. As a result, California updated its sea level rise guidance in 2018 using probabilistic sea level rise projections, along with updated technical guidance and inundation mapping tools.

V. Summary of State Efforts

A. OVERVIEW

The Rutgers Team found that all fifteen of the targeted states have significant efforts underway with regard to sea-level rise. The nature of these efforts may vary including development of sea-level rise science, adoption of public policies, guidance and technical assistance, and development of decision-support tools. The particular focus of this report is on examining those states that intersect science-informed sea-level rise values recognized by the state with policy. Eight states appear to have undertaken comprehensive efforts that meet the criteria of having the state recognize or adopt a science-informed sea-level rise value(s) and directing its integration into policy. Seven of the fifteen states do not satisfy that criteria of intersecting state recognized science-informed sea-level rise values with policy. However, given the extensive nature of work underway in those seven states, some of their efforts are summarized in this report as well.

States with science-informed sea-level rise values integrated into policy:

The Rutgers team identified eight states where science-informed sea-level rise values are recognized by a state and where those values are incorporated into one of three types of policies:

- ◆ *To state agencies:* In many states, some form of authoritative direction (e.g., law, Executive Order, or Administrative Order) directs state agencies to consider or incorporate provisions regarding sea-level rise into agency long-term planning, capital and infrastructure investment spending (including with regard to state facilities and assets), and/or standards;
- ◆ *To local government:* These are cases where some form of authoritative direction is given to local governments (county, municipal, regional) to consider or incorporate provisions regarding sea-level rise into agency long-term planning, capital and infrastructure investment spending, and/or standards such as building codes; and/or
- ◆ *That directly or indirectly affect the private sector:* The Rutgers Team found several examples of where state level policy either directly or indirectly affect activities of private sector entities.

A summary of the eight state efforts is outlined in Table 7, below:

TABLE 7: SUMMARY OF STATE-LEVEL SEA-LEVEL RISE POLICY PROVISIONS

State	Authority	Provision
CALIFORNIA	Executive Order S-13-08	Directs state agencies to plan for sea-level rise and climate impacts through coordination of the state Climate Adaptation Strategy (prepared by the Natural Resources Agency).
	2011 Ocean Protection Council Resolution on Sea-Level Rise	Decrees that state agencies and people building on state land or using state funding should use the Council's sea-level rise guidance to guide development. Directs Council staff to provide technical assistance.
	2013 Passage of the Planning for Sea-Level Rise Act (Assembly Bill 691, Chapter 592)	This law amends the Public Trust Doctrine to require trustees of public lands with gross revenues of more than \$250,000 to annually assess how it proposes to address sea-level rise using currently available science.
	2015 Executive Order B-30-15	Directs the California Natural Resources Agency to update the state's climate adaptation strategy, Safeguarding California, every three years, and to ensure that its provisions are fully implemented, most notably those provisions related to sea-level rise. The Order also directs state agencies to take climate change into account in their planning and investments decisions, and to employ full life-cycle cost accounting to evaluate and compare infrastructure investments and alternatives. The Order requires the Governor's Office of Planning and Research to establish a technical advisory group to assist state agencies in their efforts to incorporate climate change impacts into planning and programmatic decisions.
CONNECTICUT	Public Act 18-82 (2018)	Requires that sea level rise projections be updated by the Connecticut Institute for Resilience and Climate Adaptation every ten years and that the most recent sea level values be used in local planning. The law requires that, beginning in October 2019, revisions to the following state and local plans require the consideration of sea level rise using the most recent sea level rise projections: municipal evacuation or hazard mitigation plans; the state's civil preparedness plan municipal plans of conservation and development; and the state's plan of conservation and development.
DELAWARE	Executive Order 41	Directs state agencies to address both the causes and impacts of climate change, including sea level rise, by developing actionable recommendations to reduce greenhouse gas (GHG) emissions that contribute to climate change, increase resilience to climate impacts, and avoid and minimize flood risks due to sea level rise.
MARYLAND	Chapter 429 of 2015	Directs state agencies to review their planning, regulatory and fiscal programs to identify and recommend actions to integrate Maryland's' emissions reductions goal and impacts of climate change, including consideration of sea-level rise, storm surges and flooding.
	Chapter 415 of 2014 and 628 of 2018	Requires design and construction of state-funded structures and highways address sea-level rise and coastal flooding, as well as require municipal plans to address nuisance flooding.

MASSACHUSETTS	Global Warming Solutions Fund Act of 2008	Directs state agencies to consider climate change impacts in decision-making.
	Executive Order 569 of 2016	Requires the development of a state Climate Adaptation Plan using the latest climate science, the development of guidance for state agencies to incorporate in decision-making and the establishment of a state Climate Adaptation Plan. The resulting plan was adopted in 2018 and serves both as the statewide Climate Adaptation Plan as well as the state Hazard Mitigation Plan pursuant to the federal Stafford Act.
	Act Promoting Climate Change Adaptation, Environmental and Natural Resource Protection and Investment in Recreational Assets and Opportunity	Directs state agencies to provide technical assistance to local governments in conducting vulnerability assessments, developing and implementing plans to reduce hazards and vulnerabilities.
NEW YORK	2014 Community Risk and Resilience Act	<ul style="list-style-type: none"> - The state Department of Environmental Conservation is required to adopt regulations establishing science-based state sea-level rise projections and update them every five years. - The law adds mitigation of climate hazards to the state's list of smart-growth criteria for public infrastructure investment. - The law requires the state to develop guidance on how to incorporate sea-level rise and future flood risk into applications for specified permits, facility-siting, and funding programs.
RHODE ISLAND	2018 Shoreline Change Special Management Area Plan pursuant to coastal policies of the Coastal Zone Management Act	In 2018, Rhode Island adopted a Shoreline Change Special Area Management Plan, known as the Beach SAMP, which sets forth the process through which development permit applicants will use the state's sea level rise projections and coastal hazard exposure assessment tools to address coastal hazards associated with climate change.
VIRGINIA	2018 Executive Order 24	Designates a Chief Resilience Officer and requires that a Review of Vulnerability of Commonwealth Owned Buildings be conducted, that a unified Sea Level Rise Projection for State-Owned Buildings be adopted, and that a freeboard Standard for State-Owned Buildings be established.

STATES WITHOUT SCIENCE-INFORMED SEA-LEVEL RISE VALUES INTEGRATED INTO POLICY:

The Rutgers team found that seven of the fifteen states do not appear to have science-informed sea-level rise values integrated into policy (Table 8): Hawaii, Florida, Louisiana, Maine, Oregon, Texas, and Washington. In these cases, the state may have science-informed sea-level rise values but not have integrated them into policy, or the state may have policy that reflects sea-level rise without a specific state-recognized sea-level rise value.

TABLE 8: CHARACTERISTICS OF STATES WITHOUT A STATE AUTHORIZED ‘BEST AVAILABLE SCIENCE’ FOR SEA-LEVEL RISE POLICY

State	State Sea-Level Rise Values	State and/or local policies	Other voluntary activities
HAWAII	2017 report on sea-level rise vulnerability in Hawaii issued by state agencies in conjunction with Sea Grant and academic institutions. ¹⁸	In 2014, the Hawaii State Legislature passed Act 83, the Hawaii Climate Adaptation Initiative Act that created the Interagency Climate Adaptation Committee, (later named the Hawaii Climate Change Mitigation and Adaptation Commission). ¹⁹	
FLORIDA	No Official Designation	<p>163.3178 - Coastal management rules modifying development and redevelopment principles to include impacts from “high-tide events, storm surge, flash floods, stormwater runoff, and the related impacts of sea-level rise.”</p> <p>The 2015 Florida Peril of Flood Act establishes significant requirements for local governments to consider future flood risk from storm surge and sea-level rise in certain portions of local government comprehensive plans.</p>	The 2011 Florida Community Planning Act allows, but does not require, local governments to designate Adaptation Action Areas (AAA) within their jurisdiction that are vulnerable to current and future coastal flooding.

¹⁸ Hawaii Climate Change Mitigation and Adaptation Commission. 2017. Hawaii Sea Level Rise Vulnerability and Adaptation Report. Prepared by Tetra Tech, Inc. and the State of Hawaii Department of Land and Natural Resources, Office of Conservation and Coastal Lands, under the State of Hawaii Department of Land and Natural Resources Contract No: 64064.

¹⁹ https://www.capitol.hawaii.gov/session2014/bills/HB1714_.HTM

LOUISIANA	No Official Designation		<p>Coastal Protection and Restoration Authority (CPRA) Master Plan incorporates extensive technical analysis of impacts of coastal hazards and identifies restoration priorities in specific locations and regions.²⁰</p> <p>CPRA review of project proposals²¹</p>
MAINE	No Official Designation	<p>Natural Resources Protection Act – Chapter 355 – Coastal Sand Dune Rules and Application. Defines an erosion hazard area as that which “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.”²²</p>	<p>Maine Flood Resilience Checklist²³</p>

²⁰ <https://legis.la.gov/legis/Law.aspx?d=672077>

²¹ <https://legis.la.gov/legis/law.aspx?d=672079>

²² https://www.maine.gov/dep/land/nrpa/sand_dune_application.pdf

²³ <https://www.maine.gov/dacf/mgs/hazards/coastal/index.shtml#floodchecklist> Document download:
https://digitalmaine.com/cgi/viewcontent.cgi?article=1520&context=mgs_publications

OREGON	No official Designation		<p>2017 development of sea-level rise values by Oregon Coastal Management Program NOAA Coastal Fellow: "Sea-level Rise Exposure Inventory for Oregon's Estuaries."</p> <p>January 2009 Oregon Coastal Management publication of "Climate Ready Communities-A Strategy for Adapting to Impacts of Climate Change on the Oregon Coast," which outlines a plan for decision-makers at the local and state level to address the effects of climate change.</p>
TEXAS	No official designation	<p>Texas Open Beaches Act (1959) provides a 'rolling easement' as storms move the line of vegetation landward, the public beach also moves landward. Recent court actions ruled that rolling easements are created only through the gradual process of erosion, not through sudden land erosion following severe weather events. A 2017 statutory amendment gives the Texas General Land Office authority to determine the new line of vegetation after a "meteorological event."</p>	<p>In 2017, the General Land Office issued the Texas Coastal Resilience Master Plan which identifies the following areas of concern: bay shoreline erosion, coastal flood manage, water quality and quantify, abandoned vessels, gulf beach erosion and dune degradation, habitat loss. Sea-level rise is identified as a pressure on the system. The plan identifies restoration priorities for specific geographic regions.²⁴</p>

²⁴ <http://www.glo.texas.gov/coastal-grants/projects/files/Master-Plan.pdf>

WASHINGTON	No official designation	<p>NOAA Regional Coastal Resilience Grant Outcome that outlined statewide sea-level rise projections²⁵</p> <p>A network of public, private and academic coastal hazard professionals developed sea-level rise projections for the state in 2018.²⁶</p> <p>The Washington State Department of Transportation issued guidance for consideration of climate change as part of the National and State Environmental Policy Acts. Sea-level rise is referenced but specific sea-level rise values are not used.²⁷</p>
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²⁵ Miller, I.M., Morgan, H., Mauger, G., Newton, T., Weldon, R., Schmidt, D., Welch, M., Grossman, E. 2018. Projected Sea Level Rise for Washington State – A 2018 Assessment. A collaboration of Washington Sea Grant, University of Washington Climate Impacts Group, Oregon State University, University of Washington, and US Geological Survey. Prepared for the Washington Coastal Resilience Project

²⁶ <http://www.wacoastalnetwork.com/files/theme/wcrp/SLR-Report-Miller-et-al-2018.pdf>

²⁷ <https://www.wsdot.wa.gov/sites/default/files/2017/11/15/ENV-Climate-ClimateGuidance.pdf>

B. SUMMARY OF INDIVIDUAL STATES

B.1. STATES WITH SCIENCE-INFORMED SEA-LEVEL RISE VALUES INTEGRATED INTO POLICY:

California

STATE EFFORTS:

The California Ocean Protection Act (COPA) was signed into law in 2004, creating the Ocean Protection Council within the Governor's Office.²⁸ Under the law, the Council, a non-regulatory body that works in concert with the California Coastal Commission, is tasked with coordinating activities of ocean-related state agencies, establishing policies to coordinate the collection and sharing of scientific data related to coast/ocean between agencies, and identifying and recommending changes in law. The seven-member Council is comprised of state cabinet executives, representatives of the state legislature and members of the general public. The Council is advised by a Science Advisory Team that was established in 2008 and that provides scientific analysis and recommendations to the Council. The Science Advisory Team is mostly comprised of academic scientists along with other scientists from tribal nations and non-governmental science-based organizations. It is funded by the Ocean Protection Council but is independently administered by the California Ocean Trust. The Executive Director of the Trust serves as the lead Science Advisor to the Council. Established in 2000 by the California Ocean Resources Stewardship Act, the Ocean Trust is designed to "advance a constructive role for science in decision-making by promoting collaboration and mutual understanding among scientists, citizens, managers and policymakers working toward sustained, healthy, and protective coastal and ocean ecosystems."²⁹ The Ocean Protection Council provides the planning and science used by other agencies to implement the federal Coastal Zone Management Act of 1972.

COASTAL ZONE MANAGEMENT IN CALIFORNIA

Three agencies administer California's implementation of the federal Coastal Zone Management Act of 1972: The California Coastal Commission, the Bay Conservation and Development Commission and the California Coastal Conservancy. The Coastal Commission manages development along the coast except for San Francisco Bay, which is under the jurisdiction of the Bay Conservation and Development Commission. The mission of the California Coastal Conservancy is to purchase, restore and enhance coastal resources.

²⁸ <http://www.opc.ca.gov/>

²⁹ <http://www.oceansciencetrust.org/about-us/#ourlinktocalifornia>

In 2008, Governor Jerry Brown signed Executive Order S-13-08, directing state agencies to plan for sea-level rise and climate impacts through coordination of the state Climate Adaptation Strategy. This Executive Order specifically directed agencies to consider a range of sea-level rise scenarios for the years 2050 and 2100 to assess project vulnerability, reduced expected risks, and increase resiliency to SLR. In response to Executive Order S-13-08, the California Natural Resources Agency issued the 2009 California Climate Adaptation Strategy³⁰ that outlines a long-term framework of adaptation strategies incorporating input from several working groups focused on the following areas: public health; ocean and coastal resources; water supply and food protection; agriculture; forestry; biodiversity and habitat; and transportation and energy infrastructure.

In 2011, the Ocean Protection Council issued its *Resolution of the California Ocean Protection Council on Sea-Level Rise*³¹. Among other actions, the resolution decrees that:

- ◆ State agencies should consider risks posed by sea-level rise into all decision-making, including investment of public funds;
- ◆ State agencies should follow the science-based recommendations developed by the Ocean Protection Council citing the Council's website for the latest science guidance;
- ◆ The Ocean Protection Council's Science Advisory Team will provide ongoing coordination on use of science and update guidance to reflect "current scientific understanding and projections;"
- ◆ State agencies should "avoid making decisions based on SLR values that would result in high risk;" and
- ◆ OPC will support the development of SLR science and guidance.³²

In 2014, AB 2516, Planning for Sea-Level Rise Database Bill was passed into law, calling for the California Natural Resources Agency, in collaboration with the OPC, to conduct a survey of "sea-level rise planning information." Surveys are conducted biannually and are posted on the OPC web page.³³

SEA-LEVEL RISE SCIENCE STANDARD:

In 2017, the Ocean Protection Council, as advised by its Science Advisory Team and convened by the Ocean Science Trust, issued guidance to update guidance previously adopted in 2010 and 2013, *Rising Seas in California: An Update on Sea-Level Rise Science*³⁴. The 2017 update, issued pursuant to Executive Order B-30-15, is intended to inform efforts

³⁰ 2009 California Climate Adaptation Strategy. A Report to the Governor of the State of California in Response to Executive Order S-13-2008. California Natural Resources Agency. 2009. http://resources.ca.gov/docs/climate/Statewide_Adaptation_Strategy.pdf

³¹ http://www.opc.ca.gov/webmaster/ftp/pdf/docs/OPC_SeaLevelRise_Resolution_Adopted031111.pdf

³² http://www.opc.ca.gov/webmaster/ftp/pdf/docs/OPC_SeaLevelRise_Resolution_Adopted031111.pdf

³³ <http://www.opc.ca.gov/planning-for-sea-level-rise-database/>

³⁴ Griggs, G., Árvai, J., Cayan, D., DeConto, R., Fox, J., Fricker, H.A., Kopp, R.E., Tebaldi, C., Whiteman, E.A. (California Ocean Protection Council Science Advisory Team Working Group). Rising Seas in California: An Update on Sea-Level Rise Science. California Ocean Science Trust, April 2017. <http://www.opc.ca.gov/webmaster/ftp/pdf/docs/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf>

of state agencies to incorporate sea-level rise projections into planning, design, permitting, construction, investment and other decisions. The new sea-level rise projections and rates incorporated into the updated guidance apply a probabilistic approach developed by Kopp et al. 2014 to project sea-level rise for three representative tide gage locations in California: Crescent City, San Francisco, and La Jolla. The Council recommends considering the high and extreme sea-level rise projections when making planning decisions past 2050.

POLICY

In 2015, Governor Jerry Brown signed Executive Order B-30-15. While this EO mostly covers reducing greenhouse gas emissions, it also orders the California Natural Resources Agency to update the state's climate adaptation strategy, *Safeguarding California*, every three years, and to ensure that its provisions are fully implemented, most notably those provisions related to SLR. The Executive Order also directs state agencies to consider climate change in their planning and investments decisions, and to employ full life-cycle cost accounting to evaluate and compare infrastructure investments and alternatives. Moreover, the Executive Order requires the Governor's Office of Planning and Research to establish a technical advisory group to assist state agencies incorporate climate change impacts into planning and programmatic decisions. The most recent update to the Safeguarding California Plan is 2018.³⁵

In 2013, California passed the Planning for Sea-Level Rise Act (Assembly Bill 691, Chapter 592). This law amends the Public Trust Doctrine to require trustees of public lands with gross revenues of more than \$250,000 to annually assess how it proposes to address sea-level rise using currently available science. Implementation of the law is within the jurisdiction of the California State Lands Commission that oversees management of 4 million acres of tidal and submerged lands and the beds of navigable rivers, streams, lakes, bays, estuaries, inlets, and straits.³⁶

Local land use planning and development decisions are delegated to local governments in California. In 2015 the state's law governing local planning in California (Chapter 3, Article 5, Section 65302) was amended to require local governments to review and update the safety elements of their general plans to include climate change adaptation and resiliency strategies. These updates must include a vulnerability assessment, a set of adaptation and resiliency goals, and a set of feasible implementation measures to achieve those objectives. The Governor's Office of Planning and Research updated its planning guidance in 2017³⁷. The guidance includes a dedicated section on climate change planning, including adaptation planning. It recommends that local governments use the state's visualization

³⁵ Safeguarding California Plan: 2018 Update California's Climate Adaptation Strategy. California Natural Resources Agency. 2018. <http://resources.ca.gov/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf>

³⁶ <http://www.slc.ca.gov/About/Overview.html>

³⁷ General Plan Guidelines. State of California, Office of Planning and Research. 2017. <http://opr.ca.gov/planning/general-plan/guidelines.html>

tool, Cal-Adapt,³⁸ along with the state's Adaptation Planning Guide³⁹ to assist with their local planning.

TOOLS AND GUIDANCE:

There is a wide array of tools and guidance available in California to support state and local integration of sea-level rise values into statewide planning, policy, capital investments, local land use and hazard mitigation planning and regulatory decisions. Elements of Executive Order B-30-15 were codified into law with the 2015 adoption of a law establishing the Integrated Climate Adaptation and Resiliency Program within the Governor's Office of Planning and Research's Integrated Climate Adaptation and Resiliency Program to coordinate state and local climate adaptation strategies. In 2017, the Program established a web-based adaptation clearinghouse that includes extensive guidance on adaptation and resilience planning. Examples of the guidance include:

- ◆ Procedures for use by state agencies to fulfill their obligations under Executive Order B-30-15 to integrate current and future climate conditions into all planning and investment decisions;
- ◆ Guidance for local governments to use in fulfilling obligations under the 2015 statutory requirement to incorporate climate change planning into general (master) plans; and
- ◆ Guidance for state and local agencies to use in advancing equitable, community-driven climate preparedness planning.⁴⁰

In 2018, the Ocean Protection Council, in consultation with the California Natural Resources Agency, published the *State of California Sea-Level Rise Guidance*,⁴¹ which integrates the science contained in the 2017 Ocean Protection Council "Rising Seas in California" report. The 2018 guidance was developed with extensive public outreach and provides:

- ◆ "A synthesis of the best available science on sea-level rise projections and rates for California;
- ◆ A step-by-step approach for state agencies and local governments to evaluate those projections and related hazard information in decision making; and
- ◆ Preferred coastal adaptation approaches."

³⁸ <https://cal-adapt.org/>

³⁹ Planning for Adaptive Communities: California Adaptation Planning Guide. California Emergency Management Agency. 2012. http://resources.ca.gov/docs/climate/01APG_Planning_for_Adaptive_Communities.pdf

⁴⁰ <https://resilientca.org/>

⁴¹ State of California Sea-Level Rise Guidance. California Ocean Protection Council. 2018. http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

Key elements of the Guidance includes establishment of:

- ◆ A minimum five-year threshold for updating the state's sea-level rise science;
- ◆ A five-step decision framework (see box) to guide state and local integration of sea-level rise values into policy, planning and other decision-making.
- ◆ A preferred approach to adaptation planning that includes the following considerations:
- ◆ Prioritization of vulnerable communities including consideration of social equity and environmental justice;
- ◆ Projection of coastal habitats;
 - ◆ Consideration of the characteristic of water-dependent uses, impacts of acute sea-level rise due to extreme weather events, and local conditions to inform risk tolerance
 - ◆ Advancement of risk assessment and adaptation planning at the local levels; and
 - ◆ Integration of adaptive capacity into project design and planning; and
 - ◆ Consideration of impacts from acute sea-level rise due to extreme weather events.

In addition to the aforementioned guidance, California has developed a web-based platform, Cal-Adapt, that makes scientific projections and analyses available as a basis for understanding local climate risks and resilience options. The platform offers web-based mapping and visualization tools for all climate hazards and serves to support guidance issued by other state agencies. Developed by the University of California, Berkeley, support for development of Cal-Adapt was from the California Energy Commission. A major enhancement of Cal-Adapt was issued in 2017 and includes the most recent scientific climate change projections, improved functionality, and greater intersection with the guidance issued by the Office of Planning and Research's integrated climate Adaptation and Resiliency Program.⁴²

>> STEP 1: *Identify the nearest tide gauge.*

>> STEP 2: *Evaluate project lifespan.*

>> STEP 3: *For the nearest tide gauge and project lifespans, identify range of sea-level rise projections.*

>> STEP 4: *Evaluate potential impacts and adaptive capacity across a range of sea-level rise projections and emissions scenarios.*

>> STEP 5: *Select sea-level rise projections based on risk tolerance and, if necessary, develop adaptation pathways that increase resiliency to sea-level rise and include contingency plans if projections are exceeded.*

⁴² <https://cal-adapt.org/>

Connecticut

STATE EFFORTS:

In October 2002, Connecticut state agencies gathered for the "Connecticut Climate Change Action Plan Summit." This summit, attended by 22 participants from 13 state agencies, resulted in formation of the Governor's Steering Committee on Climate Change. The Governor's Steering Committee led to the development of a 2005 statewide action plan⁴³ to reduce greenhouse gas emissions in the state. In 2015, Governor Dannel Malloy signed Executive Order 46⁴⁴ that formalized the Steering Committee, establishing the Governor's Council on Climate Change. The Council was charged with developing policies to reduce greenhouse gas emissions. The Council is composed of fifteen members from state agencies, quasi-state agencies, businesses and non-governmental organizations, the Connecticut Institute for Resilience and Climate Adaption (CIRCA) at the University of Connecticut, and the Connecticut Green Bank.⁴⁵

In 2008, amendments to the state's Global Warming Solutions Fund Act created an Adaptation Subcommittee to the Governor's Council on Climate Change. The Subcommittee was charged with assessing the impacts of climate change on state and local infrastructure, public health and natural resources and habitats in the state; (2) developing recommendations and plans that, if adopted, would enable state and local government to adapt to such impacts; and (3) providing technical assistance to implement such recommendations and plans.⁴⁶ In 2010, the Subcommittee issued a report to the Steering Committee detailing the impacts of climate change on infrastructure, natural resources, public health, and agriculture, referencing sea-level rise as a key threat to Connecticut's infrastructure and natural systems.⁴⁷ The report states that: "*Sea level may increase by 12 to 23 inches by the end of the century. Sea level may increase by 41 to 55 inches by the end of the century with the 'Rapid Ice-Melt Sea-Level Rise' scenario. There may be more coastal flooding caused by extreme storm events.*" It offers recommendations regarding minimizing the siting of facilities in coastal areas prone to sea-level rise and erosion.

Following the issuance of the 2010 Adaptation Report, the following legislative actions were taken in Connecticut:

- ◆ 2012: Passage of Public Act 12-101⁴⁸ which combines several provisions to address sea-level rise and to revise the regulatory procedures applicable to shoreline protection, including:

⁴³ Connecticut Climate Change Action Plan. Governor's Steering Committee on Climate Change. 2005. https://www.ct.gov/deep/lib/deep/climatechange/ct_climate_change_action_plan_2005.pdf

⁴⁴ https://www.ct.gov/deep/lib/deep/climatechange/gc3/executive_order_46.pdf

⁴⁵ <https://www.ct.gov/deep/cwp/view.asp?a=4423&q=533786>

⁴⁶ <https://www.cga.ct.gov/2008/ACT/PA/2008PA-00098-R00HB-05600-PA.htm>

⁴⁷ The Impacts of Climate Change on Connecticut Agriculture, Infrastructure, Natural Resources and Public Health – A report by the Adaptation Subcommittee to the Governor's Steering Committee on Climate Change. 2010. https://www.ct.gov/deep/lib/deep/climatechange/_impactsofclimatechange.pdf

⁴⁸ <https://www.cga.ct.gov/2012/ACT/PA/2012PA-00101-R00SB-00376-PA.htm>

- ◆ Authorizing the Commissioner of the Department of Energy and Environmental Protection to establish a pilot program to encourage the usage of low-impact mitigation strategies, such as living shorelines;
- ◆ Integrating consideration of sea-level rise into Connecticut Coastal Management Act (CCMA)'s general goals and policies of coastal planning. More specifically, the law requires the state Coastal Management Program to consider the potential impact of sea-level rise, coastal flooding and erosion in decision-making with regard to coastal development.
- ◆ Adjusting the “high tide line” to reflect sea-level rise consistent with tidal data as developed by the state’s Coastal Management Program.⁴⁹
- ◆ 2013: Public Act 13-15 (An Act Concerning Sea-Level Rise and the Funding of Projects by the Clean Water Fund). This Act adds the consideration of “the necessity and feasibility of implementing measures designed to mitigate the impact of a rise in sea level over the projected life span of such project” as part of the criteria for approving projects funded by the state’s Clean Water Fund⁵⁰
- ◆ 2013: Passage of Special Act 13-9 (An Act Concerning Climate Change Adaptation and Data Collection)⁵¹ establishing the Connecticut Center for Coasts, a joint partnership between the University of Connecticut and Connecticut Department of Energy and Environmental Protection, and is now known as the Connecticut Institute for Resilience and Climate Adaptation (CIRCA). CIRCA is tasked with improving the resilience of coastal communities in Connecticut to sea-level rise. The law also directs CIRCA to update the state’s sea-level rise values at least every ten years to reflect the latest science. In 2017, the University of Connecticut released its initial technical basis and background report regarding sea-level rise values for Connecticut⁵² and in 2018, a draft final report was issued.⁵³ The CIRCA sea-level rise values were adopted as policy by the Commissioner of the Connecticut Department of Energy and Environmental Protection in December 2018, authorizing their use in: municipal evacuation and hazard mitigation planning, the state’s civil preparedness plan and program, municipal plans of conservation and development, and revisions to the state’s plan of conservation and development.⁵⁴
- ◆ 2018: Passage of Public Act 18-82 (An Act Concerning Climate Change Planning and Resiliency)⁵⁵ which updates the state’s prior statutory references to and conditions

⁴⁹ https://www.ct.gov/DEEP/cwp/view.asp?a=2705&Q=511544&deepNAV_GID=1622

⁵⁰ <https://www.cga.ct.gov/2013/ACT/PA/2013PA-00015-R00SB-01010-PA.htm>

<https://www.cga.ct.gov/2013/ACT/PA/2013PA-00015-R00SB-01010-PA.htm>

⁵¹ <https://www.cga.ct.gov/2013/act/sa/2013SA-00009-R00SB-01013-SA.htm>

⁵² <https://circa.uconn.edu/2018/03/27/sea-level-rise-projections-for-the-state-of-connecticut-webinar-recording-available/>

⁵³ O’Donnell, James, “Sea Level Rise in Connecticut – Draft Report.” University of Connecticut Institute for Resilience and Climate Adaptation. 2018. https://circa.uconn.edu/wp-content/uploads/sites/1618/2017/10/SeaLevelRiseConnecticutFinalDraft-Posted-3_27_18.pdf

⁵⁴ https://www.ct.gov/deep/lib/deep/long_island_sound/coastal_hazards/sea_level_change_deep_statement_12_26_2018.pdf

⁵⁵ <https://www.cga.ct.gov/2018/ACT/PA/pdf/2018PA-00082-R00SB-00007-PA.pdf>

associated with sea-level rise (I.e. Public Act 13-179 and Public Act 12-101). PA 18-82 also requires that CIRCA's updated sea-level rise values be used in all local government and state agency planning documents and facility siting regulations. The law specifically requires that, beginning in October 2019, the following state and local plans require the consideration of sea-level rise using the most recent sea-level rise values developed by CIRCA: municipal evacuation or hazard mitigation plans; the state's civil preparedness plan and program; municipal plans of conservation and development; and revisions to the state's plan of conservation and development. The law includes specific reference to integration of the most recent sea-level rise values into the State Civil Preparedness Plan that is developed by the Department of Emergency Services & Public Protection, Division of Emergency Management & Homeland Security. The 2013-2018 revision of the plan includes the establishment of "climate change adaptation strategies to manage the public health and safety risks associated with the potential increased frequency and/or severity of flooding and drought conditions, including impacts to public water supplies, air quality and agriculture/aquaculture production."⁵⁶

SEA-LEVEL RISE SCIENCE STANDARD:

The most recent statement of policy with regard to a sea-level rise standard in Connecticut is the December 2018 adoption of the CIRCA sea-level rise values by the Commissioner of the Department of Energy and Environmental Protection.⁵⁷ The scientific basis for the CIRCA sea-level rise values derives from Parris et al. (2012), using a set of top-down scenario approaches for local relative sea-level rise in the Long Island sound.⁵⁸ As part of this adoption, the state refers to and adopts the 2018 CIRCA sea-level rise values and, more specifically adopts the sea-level rise value of 0.5 (1 foot 8 inches) higher than the national tidal datum for the Long Island Sound for 2050, with a recommendation to revisit the value on a decadal basis. This adoption authorizes use of such sea-level rise values for purposes of municipal evacuation or hazard mitigation planning, the State's Civil Preparedness Plan and program, municipal plans of conservation and development, and revisions to the state's plan of conservation and development.

POLICY

The 2018 CIRCA sea-level rise values have been adopted by the Department of Energy and Environmental Protection as policy.⁵⁹ Pursuant to Public Act 18-82, these sea-level rise

⁵⁶ Conservation and Development Policies for Connecticut. Connecticut Office of Policy and Management. Public Draft 2013-2018.

⁵⁷ https://www.ct.gov/deep/lib/deep/long_island_sound/coastal_hazards/sea_level_change_deep_statement_12_26_2018.pdf

⁵⁸ O'Donnell, J. (2018). Sea Level Rise in Connecticut. UConn Department of Marine Sciences and Connecticut Institute for Resilience and Climate Adaptation. Available at: https://circa.uconn.edu/wp-content/uploads/sites/1618/2017/10/SeaLevelRiseConnecticutFinalDraft-Posted-3_27_18.pdf

⁵⁹ https://www.ct.gov/deep/cwp/view.asp?a=2705&Q=607286&deepNav_GID=2705

values are required to guide municipalities and the state in preparation of the following planning documents:

- ◆ municipal evacuation or hazard mitigation plans;
- ◆ the state's civil preparedness plan and program;
- ◆ municipal plans of conservation and development; and
- ◆ revisions to the state's plan of conservation and development

TOOLS AND GUIDANCE

In terms of resource and tools offered, the Department of Energy and Environmental Protection offers technical, outreach, and education assistance with regard to sea-level rise, flooding, coastal hazards, and adaptation planning to municipalities, and it has worked with municipalities to review planning efforts. The Department also maintains the following tools:

- ◆ *Coastal Hazard Primer* – Background about storms, flooding, erosion, and the effects climate change may have on these;⁶⁰
- ◆ *Coastal Hazards Management* – General guidance on managing costal hazard risks for municipalities and property owners⁶¹;
- ◆ *Coastal Hazards Mapping* – Interactive mapping to that reflects coastal hazards (e.g., changes in sea level, storm surge, erosion, etc.);⁶²

Additionally, CIRCA at the University of Connecticut offers training and technical assistance to communities as well as tools that are consistent with state policy such as:

- ◆ the “Municipal Resilience Planning Assistance Project” that includes tools for municipalities and state agencies to use in assessing vulnerable infrastructure to inundation by river flow, sea-level rise, and storm surge in the next 25-50 years; and
- ◆ An online sea-level rise map viewer that shows various levels of sea-level rise projections consistent with the CIRCA 2018 sea-level rise values.

CIRCA also works in partnership with municipalities, regions and other jurisdictions to incorporate the latest sea-level rise science into planning and vulnerability assessments.

⁶⁰ https://www.ct.gov/deep/cwp/view.asp?a=2705&Q=470886&deepNav_GID=2022

⁶¹ https://www.ct.gov/deep/cwp/view.asp?a=2705&Q=484998&deepNav_GID=2022

⁶² https://www.ct.gov/deep/cwp/view.asp?a=2705&q=480782&deepNav_GID=2022

Delaware

AGENCY EFFORTS:

Delaware sea-level rise initiatives began in 2009 when the Delaware Department of Natural resources and Environmental Control (DNREC) established a Sea -Level Rise Technical Workgroup, tasked with providing the state with sea-level rise scenarios up to the year 2100. The resultant initial projections were then ordered by the DNREC Secretary to be incorporated into Department projects and programming.

Between 2010 and 2013, the DNREC convened a Sea-Level Rise Advisory Committee with representatives from other Cabinet-level state agencies, municipal governments, and business and citizen advocacy groups. The sea-level rise Advisory Committee was tasked with devising a plan to prepare Delaware for sea-level rise. In 2012 the Sea-Level Rise Advisory Committee approved a sea-level rise vulnerability assessment prepared by the DNREC Coastal Program: *Preparing for Tomorrow's High Tide: Sea-Level Rise Vulnerability Assessment for the State of Delaware*.⁶³ The report contains background information about sea-level rise, methods used to determine vulnerability and a comprehensive accounting of the extent and impacts that sea-level rise will have on resources in the state.

In 2013, the Advisory Committee published a report with 55 recommendations for making Delaware more resilient to sea-level rise: "*Preparing for Tomorrow's High Tide*".⁶⁴ In 2014, the Sea-Level Rise Advisory Committee hosted a workshop with stakeholders and issued a report summarizing the outcomes of the workshop: "*Preparing for Tomorrow's High Tide: Implementation the Recommendations of the Sea-Level Rise Advisory Committee*".⁶⁵ The workshop was designed to bring together stakeholders to develop specific implementation actions for each of the sea-level rise adaptation recommendations published by the Sea-Level Rise Advisory Committee in September 2013.

Immediately following the issuance of the September 2013 "Preparing for Tomorrow's High Tide" report, Governor Jack Markell signed Executive Order 41, *Preparing Delaware for Emerging Climate Impacts and Seizing Economic Opportunities from Reducing Emissions*.⁶⁶ The Executive Order established the Cabinet Committee on Climate and Resilience, which was charged with overseeing the development of an implementation plan

⁶³ Preparing for Tomorrow's High Tide Sea Level Rise Vulnerability Assessment for the State of Delaware. Department of Natural Resources and Environmental Control. July 2012.

<http://www.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/AssesmentForWeb.pdf>.

⁶⁴ Preparing for Tomorrow's High Tide Recommendations for Adapting to Sea Level Rise in Delaware. Delaware Department of Natural Resources and Environmental Control. September 2013.

<http://www.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/FinalAdaptationPlanasPublished.pdf>

⁶⁵ Preparing for Tomorrow's High Tide; 2014 Sea Level Rise Workshop Proceedings and Interim Implementation Plan. Delaware Department of Natural Resources and Environmental Control. September 2014. <http://www.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/SLRImplementationWorkshopProceedingsComplete.pdf>

⁶⁶ Delaware Executive Order 41: Preparing Delaware for Emerging Climate Impacts and Seizing Economic Opportunities from Reducing Emissions. 2013. September 12, 2013. <https://governor.delaware.gov/wp-content/uploads/sites/24/2016/12/EO041.pdf>

to reduce greenhouse gas emissions and to develop recommendations from each state agency to prepare Delaware for the impacts of climate change. The work of the Cabinet Committee was supported by staff from the Delaware Department of Natural Resources and Environmental Control. Executive Order 41 resulted in the creation of the *Climate Framework for Delaware* (December 2014)⁶⁷, which included three categories of recommendations:

- ◆ Reducing greenhouse gas emissions
- ◆ Increasing resilience to climate impacts; and
- ◆ Avoiding and minimizing flood risks that increase the state's liability and decrease public safety.

The Cabinet Committee met several times during the course of the agencies' deliberations and were informed by three multiagency workgroups: Mitigation, Adaptation and Flood Avoidance. The final Climate Framework included 155 recommendations from the Cabinet Committee for adaptation actions that would address climate change, including the effects of sea-level rise.

During this time period, there was also an effort to assess the vulnerabilities of the state to all climate impacts. A Steering Committee was brought together that included technical experts from the DNREC and local universities. As a component of this, Dr. Katherine Hayhoe developed downscaled climate models for the state for temperature and precipitation, and Dr. Dan Leathers, the state climatologist, put together a comprehensive record of state weather data, including trends.

<http://www.dnrec.delaware.gov/energy/Pages/The-Delaware-Climate-Impact-Assessment.aspx>

The State of Delaware also undertook a set of public opinion surveys in 2009 and 2014 to better understand the public's perception of climate change and adaptation issues in general to inform development of the state's public policies.⁶⁸

SEA-LEVEL RISE SCIENCE STANDARD:

The state updated its sea-level rise values in November 2017.⁶⁹ The revisions were the result of a collaboration between the Delaware Geological Survey, working closely with DNREC Delaware Coastal Programs, which, together, led the Delaware Sea-Level Rise Technical Committee that was composed of regional scientific and local planning experts.

⁶⁷ The Climate Framework for Delaware, 2014. <http://www.dnrec.delaware.gov/energy/Documents/The%20Climate%20Framework%20for%20Delaware%20PDF.pdf>

⁶⁸ <https://dnrec.alpha.delaware.gov/coastal-programs/planning-training/adapting-to-sea-level-rise/climate-change-perceptions/>

⁶⁹ Callahan, John A., Benjamin P. Horton, Daria L. Nikitina, Christopher K. Sommerfield, Thomas E. McKenna, and Danielle Swallow, 2017. Recommendation of Sea-Level Rise Planning Scenarios for Delaware: Technical Report, prepared for Delaware Department of Natural Resources and Environmental Control (DNREC) Delaware Coastal Programs. 115 pp. https://www.dgs.udel.edu/sites/default/files/projects-docs/DE%202017%20SLR%20Technical%20Report_Mar2018.pdf

The Committee's goal was to determine if the existing 2009 sea-level rise planning scenarios require modification, recognizing that considerable research had taken place in the interim period. The Committee produced a technical report summarizing the impacts of sea-level rise in Delaware, recent research on historic sea-level rise reconstructions, data from tide gauges located within the Delaware region, several recent international and national assessments on projecting future sea-level rise conditions, and recommendations of new sea-level rise scenarios to use in Delaware long-range planning activities. The new sea-level rise planning scenarios recommended in the report correspond to increases of mean sea-level in Delaware by the year 2100 of 1.53 m / 5.02 ft. (High scenarios), 0.99 m / 3.25 ft. (Intermediate scenario), and 0.52 m / 1.71 ft. (Low scenario.) These scenarios were based on a scientific methodology that combines the latest physical climate model results from the IPCC, locally observed tide gauge data, and expert elicitation into a probabilistic approach, described in *Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites*, published in the journal Earth's Future by Robert Kopp et al. 2014.. The methodology also provides a physical basis of the time evolution of sea-level rise, enabling estimates of sea-level rise amounts at times before year 2100. The new sea-level rise curves are referenced to year 2000 mean sea-level.

POLICY

Governor Markell's Executive Order 41 directs state agencies to address both the causes and impacts of climate change, including sea-level rise, by developing actionable recommendations to reduce greenhouse gas (GHG) emissions that contribute to climate change, increase resilience to climate impacts, and avoid and minimize flood risks due to sea-level rise. In 2016, the state issued a progress report on activities underway in Delaware State Agencies to comply with Executive Order 41.

The progress reported in the 2016 report includes:

- ◆ Assessment of the vulnerabilities faced by state assets to changing climate conditions;
- ◆ The creation of the 2016 Strategic Opportunity Fund for Adaptation (SOFA) that used proceeds from Delaware's participation in the Regional Greenhouse Gas Initiative (RGGI) to provide funds to stimulate implementation of state agency climate adaptation activities related to their recommendations in the 2014 Climate Framework for Delaware report. Ten projects from six state agencies were awarded grants for a wide range of adaptation actions;
- ◆ The development of guidance to inform state agency implementation of the provisions of Executive Order 41⁷⁰;

⁷⁰ Avoiding and Minimizing Risk of Flood Damage to State Assets: A Guide for Delaware State Agencies Prepared by the Delaware Flood Avoidance Workgroup Under Executive Order 41. March 2016. <http://www.dnrec.delaware.gov/energy/Documents/DE%20Flood%20Avoidance%20Guide%20For%20State%20Agencies.pdf>

- ◆ Development of guidance and tools for state and local planners and decision-makers including web-based mapping platforms, a green infrastructure primer⁷¹;
- ◆ Assistance to local communities in planning for resilience;
- ◆ Individual initiatives of state agencies such as a vulnerability assessment for the Route 9 corridor by the state Department of Transportation;
- ◆ The development “climate-smart” coastal impoundment guidelines by the Delaware Division of Fish and Wildlife that are designed to enhance critical habitat and allow freshwater species to migrate inland.

Despite this progress, to date, there are few examples of statewide standards and regulations that have been changed to address sea-level rise specifically. Most progress is in the form of voluntary individual agency initiatives and projects.⁷²

Also, the Coastal Zone Conversion Permit Act, passed in 2017, allowed new industrial development in the coastal area for the first time since 1971, but also requires anyone wanting to construct a heavy industrial project to develop a Sea-Level Rise and Coastal Storm Plan. Development of implementation approach for the program is still under development but the initiative reflects the state’s initial attempt to codify sea-level rise into a regulatory program.

TOOLS AND GUIDANCE:

To support implementation of Executive Order 41, the Cabinet Committee on Climate and Resilience’s Flood Avoidance Workgroup developed a set of tools and guidelines to help state agencies comply with the flooding directives of the order. These include:

- ◆ Guidance found in the *Avoiding and Minimizing Risk of Flood Damage to State Assets* guide (March 2016)⁷³. The guide contains information and step-by-step instructions for state agencies undertaking projects to build or repair structures and infrastructure.

⁷¹ <https://dnrec.alpha.delaware.gov/climate-coastal-energy/sustainable-communities/green-infrastructure/>

⁷² Climate Action in Delaware, 2016 Progress Report.

<http://www.dnrec.delaware.gov/energy/Documents/2016%20Climate%20Action%20Progress%20Report/Climate%20Action%20in%20Delaware%202016%20Progress%20Report.pdf>

⁷³ Avoiding and Minimizing Risk of Flood Damage to State Assets: A Guide for Delaware State Agencies

Prepared by the Delaware Flood Avoidance Workgroup Under Executive Order 41, March 2016.

<http://www.dnrec.delaware.gov/energy/Documents/DE%20Flood%20Avoidance%20Guide%20For%20State%20Agencies.pdf>

- ◆ To help state agencies more fully understand existing and future flood risk, a new statewide map depicting the combined impacts of storms and sea-level rise was also developed as a companion to the guide.^{74,75}
- ◆ In 2016, the DNREC created a new grant program, the Strategic Opportunity Fund for Adaptation using proceeds from the Regional Greenhouse Gas Initiative carbon emissions auction that provides resources to state agency efforts to undertake climate change adaptation efforts.

Executive Order 41 only applies to state agencies and not local government efforts, meaning incorporation of sea-level rise into local planning, policies, and regulations is voluntary. The DNREC provides incentives for municipalities to address sea-level rise through grant funding from the Resilient Communities Partnership (DE Coastal Programs effort funded by NOAA) and through the Sustainable Communities Planning Grant Program (offered by the Climate and Sustainability Section using RGGI funds), but municipalities are not required to address sea-level rise in any capacity. In cooperation with the University of Delaware, the Department of Natural Resources and Environmental Control published a guide for incorporating climate change into local comprehensive plans.

Delaware has developed a few mapping tools to assist state agencies and local governments with their sea-level rise planning. These include:

1. Inundation maps, 1ft increments as outlined above
2. The FRAM, which is an overlay depicting the 1% storm with 3' SLR
3. The Flood Tool, which is an easy to use and access tool for the regulatory flood maps.

For instance, the DNREC developed a web application on the DNREC website that allows users to access sea-level rise inundation maps.⁷⁶ The flood mapping tool is designed to aid local practitioners (floodplain managers, developers, local planners, etc.) with resources to make informed decisions about the degree of flood risk for a specific area or property. Map features are connected to geospatial databases that may be queried by users in order to obtain pertinent information that may otherwise be difficult to obtain or relate to specific geographic locations.

End users also have the option to locate an address on the map and see how that particular site is affected by the sea-level rise scenarios. The Delaware Geologic Survey (DGS) developed a series of coastal inundation maps showing water surfaces from the Mean Higher High Water (MHHW) level to 7 ft. above MHHW, in 1-ft. increments. The DGS also provides a comprehensive guide explaining the mapping methodology that was used to

⁷⁴ Flood Risk Adaptation Map (FRAM). Delaware Department of Natural Resources and Environmental Control. http://www.dnrec.delaware.gov/energy/Documents/Flood%20Risk%20Adaptation%20Map_Fact%20Sheet_Updated.pdf

⁷⁵ Delaware Flood Risk Adaptation Map: Methods, Assumptions and Limitations. February 2015. URS, Germantown, MD. http://www.dnrec.delaware.gov/energy/Documents/Flood%20Risk%20Adaptation%20Map_Methods-Assumption-and-Limitations.pdf

⁷⁶ <http://www.dnrec.delaware.gov/Pages/SLRMaps.aspx>

create the coastal inundation maps, ideally so that users can replicate the steps and create larger scale maps for their own locales.

The state is currently developing a single portal to allow end users to access all resources and tools regarding climate change adaption from a single source. The initial site will continue to be curated and expanded over time with immediate plans for enhancements in early 2019.⁷⁷

Maryland

STATE EFFORTS:

In Maryland, incorporation of sea-level rise into state planning, investment, and regulation has followed a 20-year trajectory that has included legislative resolution, a task force report,⁷⁸ scoping strategies⁷⁹, implementation of three Executive Orders (EO)^{80 81 82}, state agency policy, state regulation, and ultimately statutory authority for integrating sea-level rise into the functions of state government. Key was a 2007 EO resulting in a 2008 comprehensive Maryland Climate Change Action Plan that addressed both greenhouse gas emissions reduction and climate adaptation developed under the auspices of the Maryland Commission on Climate Change (MCCC).⁸³ The MCCC, now codified through statute (Chapter 429 of 2015), is composed of leaders from the State executive branch, legislature, and relevant constituencies; its functions are carried out through working groups representing public and private interests in climate change.⁸⁴

SEA-LEVEL RISE SCIENCE STANDARD:

The 2008 comprehensive Maryland Climate Change Action Plan included an initial assessment of sea-level rise data for Maryland by the Commission's Scientific and Technical

⁷⁷ <https://www.declimateinfo.org/>

⁷⁸ State of Maryland. 2000. Shore Erosion Task Force Final Report.
https://dnr.maryland.gov/ccs/Publication/setf_report.pdf

⁷⁹ Johnson, Z. 2000. A Sea Level Response Strategy for the State of Maryland. Maryland Department of Natural Resources, Coastal Zone Management Division.
<http://dnr.maryland.gov/ccs/Publication/asealevelrise.pdf>

⁸⁰ EO 01.01.2007.07 Commission on Climate Change.
<https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Publications/EO2007MCCC.pdf>

⁸¹ EO 01.01.2012.29 Climate Change and Coast Smart Construction.
<https://news.maryland.gov/mda/wp-content/uploads/sites/5/2015/08/01.01.2012.29.pdf>

⁸² EO 01.01.2014.14 Strengthening Climate Action in Maryland.
<https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Publications/EO2014.pdf>

⁸³ EO 01.01.2007.07 Commission on Climate Change.
<https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Publications/EO2007MCCC.pdf>

⁸⁴ Chapter 429 of 2015. Md. House Bill 514. Maryland Commission on Climate Change.

<http://mgaleg.maryland.gov/2015RS/bills/hb/hb0514E.pdf>

Working Group (STWG).⁸⁵ Subsequent updates were published in 2013⁸⁶ and 2016⁸⁷ with a statutory requirement (Chapter 429 of 2015) that the projections be updated every 5 years by the University of Maryland Center for Environmental Sciences (UMCES).⁸⁸ An update overseen by UMCES was completed in 2018.⁸⁹ The Maryland 2018 projections represent the consensus of an expert group from the Mid-Atlantic region and use the same probabilistic framework incorporating regional factors as that applied in New Jersey under the aegis of the New Jersey Climate Change Alliance's Science and Technical Advisory Panel⁹⁰, as well as that applied by for recent projections in Delaware, California, Oregon, and Washington.⁹¹ The 2018 UMCES report states a "likely range (66% probability) of the relative rise of mean sea-level expected in Maryland between 2000 and 2050 is 0.8 to 1.6 feet, with about a one-in-twenty chance it could exceed 2.0 feet and about a one-in-one hundred chance it could exceed 2.3 feet. If emissions continue to grow well into the second half of the 21st century, the Likely range of sea-level rise experienced in Maryland is 2.0 to 4.2 feet over this century, two to four times the sea-level rise experienced during the 20th century. Moreover, there is a one-in-twenty chance that it could exceed 5.2 feet. If, on the other hand, global society were able to bring net greenhouse gas emissions to zero in time to meet the goals of the Paris Climate Agreement and reduce emissions sufficient to limit the increase in global mean temperature to less than 2°Celsius over pre-industrial levels, the Likely range for 2100 is 1.2 to 3.0 feet, with a one-in-twenty chance that it would exceed 3.7 feet."⁹² The UMCES Maryland 2018 report further notes: "These probabilistic sea-level rise projections can and should be used in planning and regulation, infrastructure

⁸⁵ Maryland Commission on Climate Change. 2008. Climate Change Action Plan. Chapter 2. Comprehensive Assessment of Climate Change Impacts in Maryland.

http://www.mde.state.md.us/programs/Air/ClimateChange/Documents/FINAL - Chapt%202%20Impacts_web.pdf

⁸⁶ Boesch, DF, LP Atkinson, WC Boicourt, JD Boon, DR Cahoon, RA Dalrymple, T Ezer, BP Horton, ZP Johnson, RE Kopp, M Li, RH Moss, A Parris, CK Sommerfield. 2013. Updating Maryland's Sea-level Rise Projections. Special Report of the Scientific and Technical Working Group to the Maryland Climate Change Commission, 22 pp. University of Maryland Center for Environmental Science, Cambridge, MD. <http://www.umces.edu/sites/default/files/pdfs/SeaLevelRiseProjections.pdf>

⁸⁷ Maryland Commission on Climate Change, Scientific and Technical Working Group. 2016. Re-examining Projected Climate Changes for Maryland. October 25, 2016.

<https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/STWG/STWGRe-examinCC01252016.pdf>

⁸⁸ Chapter 429 of 2015. Md. House Bill 514. Maryland Commission on Climate Change.

<http://mgaleg.maryland.gov/2015RS/bills/hb/hb0514E.pdf>

⁸⁹ Boesch, D.F., W.C. Boicourt, R.I. Cullather, T. Ezer, G.E. Galloway, Jr., Z.P. Johnson, K. H. Kilbourne, M.L. Kirwan, R.E. Kopp, S. Land, M. Li, W. Nardin, C.K. Sommerfield, W.V. Sweet. 2018. Sea-Level Rise: Projections for Maryland 2018. 27 pp. University of Maryland Center for Environmental Science, Cambridge, MD.

<https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Documents/Sea-LevelRiseProjectionsMaryland2018.pdf>

⁹⁰ Kopp et al. 2014. Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites. *Earth's Future*. 2(8), 383-406.

<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014EF000239>

⁹¹ Boesch, D.F., W.C. Boicourt, R.I. Cullather, T. Ezer, G.E. Galloway, Jr., Z.P. Johnson, K. H. Kilbourne, M.L. Kirwan, R.E. Kopp, S. Land, M. Li, W. Nardin, C.K. Sommerfield, W.V. Sweet. 2018. Sea-Level Rise: Projections for Maryland 2018. 27 pp. University of Maryland Center for Environmental Science, Cambridge, MD.

<https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Documents/Sea-LevelRiseProjectionsMaryland2018.pdf>

⁹² Id.

siting and design, estimation of changes in tidal range and storm surge, developing inundation mapping tools, and adaptation strategies for high-tide flooding and saltwater intrusion.”⁹³

POLICY:

First through Executive Order⁹⁴ and now mandated through legislation,⁹⁵ Maryland state agencies are required to review their planning, regulatory and fiscal programs to identify and recommend actions to integrate Maryland’s emissions reductions goal and impacts of climate change, including consideration of sea-level rise, storm surges and flooding and make specific recommendations to existing programs that do not currently address climate change. Maryland also has two “coast smart construction” statutes that address design and siting criteria to account for sea-level rise and coastal flooding that relate to the Maryland sea-level rise projections: Chapter 415 of 2014⁹⁶ and Chapter 628 of 2018⁹⁷ together require design and construction of state-funded structures and highways address sea-level rise and coastal flooding, as well as require municipal plans to address nuisance flooding.

SPECIFIC INTEGRATION OF SEA LEVEL RISE VALUES INTO POLICY CASE EXAMPLE: MARYLAND’S COASTSMART CONSTRUCTION PROGRAM

Maryland’s CoastSmart Construction Program establishes guidelines and standards for the preliminary planning, design and budgeting phase of capital projects and facilities that are or will be state-owned. The 2014 Coast Smart Council law established the Coast Smart Construction Program and a Council to oversee its implementation. In 2015, the program adopted specific Coast Smart siting and design criteria to address impacts associated with sea-level rise and coastal flooding on future capital projects. Pursuant to Maryland State Finance and Procurement Code, any State capital project that includes the construction of a structure or reconstruction of a structure with substantial damage, must adhere to the siting and design criteria established by the Council. The program requires that the lowest floor elevation of proposed structures located within a Special Flood Hazard Area be built at an elevation of at least 2 feet above the base flood elevation with a 3 foot requirement for “critical and essential” structures. The law was amended in 2018 to include highways, and for certain construction projects to be able to withstand 2 feet of sea-level rise inundation and a Category 2 storm surge. The program is reviewed annually by the Council and revised as necessary.

⁹³ Id.

⁹⁴ EO 01.01.2007.07 Commission on Climate Change.

<https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Publications/EO2007MCCC.pdf>

⁹⁵ Chapter 429 of 2015. Md. House Bill 514. Maryland Commission on Climate Change.

<http://mgaleg.maryland.gov/2015RS/bills/hb/hb0514E.pdf>

⁹⁶ Chapter 415 of 2014. Md. House Bill 615. Coast Smart Council.

http://mgaleg.maryland.gov/2014RS/Chapters_noln/CH_415_sb0615t.pdf

⁹⁷ Chapter 628 of 2018. Md. House Bill 1350. Sea Level Rise Inundation and Coastal Flooding – Construction, Adaptation, and Mitigation.

<http://mgaleg.maryland.gov/2018RS/bills/hb/hb1350E.pdf>

IMPLEMENTATION, TOOLS, AND GUIDANCE:

Depending upon which projections were current at the time, the Maryland projections for sea-level rise have been incorporated into various state programs including: minimum freeboard standards and siting and design criteria for state capital projects;⁹⁸ siting and design criteria be integrated into the Maryland Hazard Mitigation Plan, the State Disaster Recovery Plan, and into projects under review for hazard mitigation funding assistance;⁹⁹ evaluation of State projects in Maryland “Critical Areas” (areas within 1,000 feet of the tidal waters of the Chesapeake and Atlantic Bays);^{100 101 102} guidance for local planners who want to consider climate resilience in their local Critical Area programs;¹⁰³ Maryland’s Model Floodplain Ordinance for local jurisdictions (note, nearly every coastal/tidal community in Maryland now has a 2 foot of freeboard requirement in its floodplain ordinance and one county and portions of another community have a 3 foot freeboard requirement);¹⁰⁴ assessment of state priorities for land acquisition and restoration; state support for community resilience planning and nature-based projects for coastal community protection; anticipated flood planning guidance for Maryland’s historic buildings; and identification of sea-level change and predicted effects on roadways and roadway infrastructure in the Maryland.¹⁰⁵

Tools and mapping products include: a series of indices and mapped GIS data layers that incorporate or are informed by the Maryland sea-level rise values (e.g., its Wetland Adaptation Area data layer and Sea-Level Rise Vulnerability layer) which are used by Maryland DNR in a variety of applications such as to assess land acquisition, restoration, and wildlife vulnerability and are publicly available through the State of Maryland Coastal

⁹⁸ Johnson, Z. 2014. State of Maryland Climate Change and Coast Smart Construction Infrastructure Siting and Design Guidelines. http://climatechange.maryland.gov/wp-content/uploads/sites/16/2014/12/climate_change_and_coast_smart_final_report1.pdf

⁹⁹ Maryland Coast Smart Council. 2015. Coast Smart Construction Siting and Design Guidelines. http://dnr.maryland.gov/climateresilience/Documents/CoastSmart-Construction-Program_Summary_2018.pdf

¹⁰⁰ Code of Maryland Regulations. Title 27. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays. Development in the Critical Area Resulting from State and Local Agency Programs. http://www.dsd.state.md.us/comar/subtitle_chapters/27_Chapters.aspx

¹⁰¹ Code of Maryland Statutes Natural Resources Article Title 8. Subtitle 18.

¹⁰² Critical Area Commission. 2017. State Project Submittal Instruction, Application Checklist, & Supporting Documentation.

¹⁰³ DeWeese, A. et al. 2017. Critical Area Coastal Resilience Planning Guide. 2017. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays. http://dnr.maryland.gov/criticalarea/Documents/Coastal_Resilience_Planning_Guide.pdf

¹⁰⁴ Maryland Department of the Environment. 2014. Maryland Model Floodplain Ordinance. https://mde.maryland.gov/programs/Water/FloodHazardMitigation/Documents/www.mde.state.md.us/assets/document/flood_hazards/MD_Model_FPMO_Ordinance_May2014.pdf

¹⁰⁵ Maryland Department of Transportation. 2018. SHA Climate Change Vulnerability HVI. <https://www.arcgis.com/home/webmap/viewer.html?webmap=4b218c5669354b8b970706c646cfe771>

Atlas;¹⁰⁶ ¹⁰⁷a requirement under Chapter 429 of 2015 that the UMCES sea-level rise projections include Internet-available maps indicating areas of Maryland that may be most affected by storm surges, flooding, and extreme weather events;¹⁰⁸ and the Maryland Department of Transportation's State Highway Administration Climate Change Vulnerability Index mapping tool for coastal counties.¹⁰⁹

Maryland officials provided professional judgment and observations with respect to integrating sea-level rise concerns into state and local planning efforts. The reflections below represent a collective synthesis of interviews with several professionals working for or with the State of Maryland. Insights include an emphasis on state and local coordination as planning is often local and local knowledge is critical when assessing flood risk. Challenges cited include addressing historic properties considering sea-level rise if solutions could imperil properties' historic designation. Employing local hazard mitigation plans to address future climate impacts, which are on a 5-year cycle, may not lend themselves to thinking about longer-term impacts. Education, outreach and incentive programs have helped to facilitate consideration of sea-level rise projections on non-State lands by: understanding increased risk reduction and insurance savings that has motivated local adoption of higher freeboard standards in local floodplain ordinances; providing guidance and incentives for local resilience planning; and in one case, purchase of a coastal resilience easement which included development setbacks in an inundation zone and buffers around high priority wetland adaptation areas. Maryland has recently launched a Climate Academy to educate and certify state and local officials, infrastructure executives and business leaders through certification and professional credential-oriented programs that can help facilitate long-term climate planning; the Maryland values for sea-level rise will be incorporated into the academy's curriculum, scenarios, tool, and exercises.

The Coast Smart Construction Program project checklist (as well as its predecessor checklist), contains a Cost-Benefit Analysis that requires an assessment of the potential future financial and other losses associated with sea-level rise, coastal flooding and storm surge over the project's anticipated design life, including how this cost compares with inaction.¹¹⁰ ¹¹¹ Maryland DNR has an economist on staff who is examining the ecosystem benefits of avoided costs, but this assessment has not been completed.

¹⁰⁶ The Nature Conservancy. 2016. Maryland Coastal Resiliency Assessment. M.R. Canick, N. Carlozo and D. Foster. Bethesda, MD.

http://dnr.maryland.gov/ccs/Documents/MARCH-2016_MDCoastalResiliencyAssessment.pdf

¹⁰⁷ Maryland Department of Natural Resources. 2016. Maryland State Wildlife Action Plan 2015-2025.

Annapolis, Maryland. https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx

¹⁰⁸ Chapter 429 of 2015. Md. House Bill 514. Maryland Commission on Climate Change.

<http://mgaleg.maryland.gov/2015RS/bills/hb/hb0514E.pdf>

¹⁰⁹ Maryland Department of Transportation. 2018. SHA Climate Change Vulnerability HVI.

<https://www.arcgis.com/home/webmap/viewer.html?webmap=4b218c5669354b8b970706c646cf771>

¹¹⁰ Maryland Coast Smart Council. 2015. Coast Smart Construction Siting and Design Guidelines.

http://dnr.maryland.gov/climateresilience/Documents/CoastSmart-Construction-Program_Summary_2018.pdf

¹¹¹ Johnson, Z. 2014. State of Maryland Climate Change and Coast Smart Construction Infrastructure Siting and Design Guidelines. http://climatechange.maryland.gov/wp-content/uploads/sites/16/2014/12/climate_change_and_coast_smart_final_report1.pdf

Massachusetts

STATE EFFORTS:

In 2008, Massachusetts passed the Global Warming Solutions Act,¹¹² in which Section 7 specifically references sea-level rise directing state agencies and departments to consider climate change impacts, such as sea-level rise, when issuing permits, licenses, and other administrative decisions. Section 9 established a committee consisting of multi-sector stakeholders and agencies to analyze strategies to support statewide efforts to adapt to climate impacts. In 2011, the Committee produced the *Climate Change Adaptation Report*,¹¹³ which included the first statewide sea-level rise projections for Massachusetts.

In 2016, Governor Charlie Baker signed Executive Order No. 569 *Establishing an Integrated Climate Change Strategy for the Commonwealth*¹¹⁴. The Order expanded upon the provisions of the 2008 Global Warming Solutions Act and included the following provisions that either directly or indirectly related to sea-level rise:

- ◆ Requires the development of a state Climate Adaptation Plan that would include:
 - ◆ observed and projected climate trends, including sea-level rise, as well as guidance for state agencies, municipalities, and regional planning bodies to address climate change impacts;
 - ◆ guidance and strategies for state agencies and authorities, municipalities and regional planning agencies to proactively address climate change impacts through changes in plans, regulations, and policies, including strategies to ensure that “adaptation and resiliency efforts complement efforts to reduce greenhouse gas emissions and contribute towards the Commonwealth meeting the statewide emission limits established pursuant to the Global Warming Solutions Act, and strategies that conserve and sustainably employ the natural resources of the Commonwealth to enhance climate adaptation, build resilience and mitigate climate change;” and
 - ◆ Recommendations on how state agencies can lead by example in resilience planning.
- ◆ Requires executive branch agencies to implement the recommendations of the state Climate Adaptation Plan;
- ◆ Requires the establishment of a framework that shall be used by each executive agency “to assess its and its agencies’ vulnerability to climate change and extreme weather events, and to identify adaptation options for its and its agencies’ assets;” and

¹¹² <https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298>

¹¹³ Massachusetts Climate Change Adaptation Report. Executive Office of Energy and Environmental Affairs. 2011. <https://www.mass.gov/files/documents/2017/11/29/Full%20report.pdf>

¹¹⁴ <https://www.mass.gov/executive-orders/no-569-establishing-an-integrated-climate-change-strategy-for-the-commonwealth>

- ◆ Requires that executive branch agencies provide resilience technical assistance to communities and it establishes a grant program to assist local governments in resilience efforts.¹¹⁵

In 2017, the Governor hosted a Municipal Climate Change Summit to report on the ongoing implementation of Executive Order 569 and to announce the release of statewide climate change projections developed by the University of Massachusetts including metrics such as coastal sea-level rise, storm surge coverage along the coast, and hydrological data to predict inland flooding in river basins. An outcome of the Summit was the state's formation of its "Resilience MA" website that includes tools, guidance, data, information the community resilience program and navigates to other state agencies' guidance and actions.

In September 2018, Massachusetts published the *State Hazard Mitigation and Climate Adaptation Plan*¹¹⁶ in response to Executive Order 569. The Plan states that it is an "innovative, first-of-its-kind statewide plan that fully integrates a traditional hazard mitigation plan with a climate change adaptation plan." In doing so, the 2018 Plan integrates climate change projections into statewide hazard mitigation planning pursuant to the federal Stafford Act that governs state and local emergency management planning. The 2018 plan integrates the climate change projections announced at the Municipal Climate Change Summit in 2017 into a framework for hazard mitigation and climate adaptation planning. Climate projections are provided for:

- ◆ Rising temperatures
- ◆ Sea-level rise
- ◆ Changes in precipitation
- ◆ Extreme weather events

The *State Hazard Mitigation and Climate Adaptation Plan* serves as the overarching plan for the state with regard to climate change adaptation including offering specific actions to be undertaken at the state and local levels to incorporate climate projections into

HIGHLIGHTS OF THE MASSACHUSETTS STATE HAZARD MITIGATION AND CLIMATE ADAPTATION PLAN

- ◆ States that climate change is worsening natural hazards and extreme weather events;
- ◆ Incorporates the most recent science-informed projections to assess risk and vulnerability focused on five sectors: populations, government, built environment, natural resources, and economy.
- ◆ Evaluates the Commonwealth's existing capabilities to implement agency-specific and statewide hazard mitigation and climate adaptation activities to increase resilience.
- ◆ Establishes a strategy to implement and continue implementation of the plan while incorporating new science and data as well as engage relevant stakeholders.

¹¹⁵ <https://www.mass.gov/executive-orders/no-569-establishing-an-integrated-climate-change-strategy-for-the-commonwealth>

¹¹⁶ Massachusetts State Hazard Mitigation and Climate Adaptation Plan. Commonwealth of Massachusetts. 2018. <https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan>

integrated resilience and hazard mitigation planning including with actions associated with assessment of vulnerable populations, natural resources, capital facilities and infrastructure and impacts to public health.

In 2018, Governor Baker signed an *Act Promoting Climate Change Adaptation, Environmental and Natural Resource Protection and Investment in Recreational Assets and Opportunity* (H. 4835) that directs state agencies to create a resilience planning framework for use by regional and local governments. Additionally, it provides funding for implementation of many of the elements of the State Hazard Mitigation and Climate Adaptation Plan. In addition to developing a framework to support local resilience planning, the law directs state agencies to provide technical assistance to local governments in conducting vulnerability assessments, developing and implementing plans to reduce hazards and vulnerabilities. The law dedicates more than \$500 million to climate change resiliency efforts and stipulates that state investments must be consistent with the Plan, including \$290 million to fund coastal resilience projects, \$75 million to support community grants through the Municipal Vulnerability Preparedness Program, and additional funds to support implementation of the State Hazard mitigation and Climate Adaptation Plan.

SEA-LEVEL RISE SCIENCE STANDARD:

Initial sea-level rise projections for Massachusetts were published in the 2011 Climate Adaptation Report¹¹⁷ published by the state Office of Energy and Environmental Affairs in consultation with an advisory committee convened to “develop a report, analyzing strategies for adapting to the predicted changes in climate change” pursuant to Section 9 of the state’s 2008 Global Warming solutions Act¹¹⁸. Subsequently, sea-level rise values were updated by the state Coastal Zone Management Program in its 2013 report, “*Sea-Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning*,” which applies the scenario-based approach from Parris et al. 2012.¹¹⁹

In 2018, the Northeast Climate Science Center (NECSC) at the University of Massachusetts, Amherst, generated an updated version of the sea-level rise values for Massachusetts.¹²⁰ Massachusetts’ recent sea-level rise values are based on analysis that uses a probabilistic approach assuming both moderate and high emissions (RCP 4.5 and RCP 8.5) to generate tide-gage specific values at 10-year increments through 2100. The recent MA sea-level rise analysis also reconciles the probabilistic approach taken by NECSC with four top-down SLR scenarios in the National Climate Assessment (Intermediate, Intermediate-High, High, and

¹¹⁷ Massachusetts Climate Change Adaptation Report. Executive Office of Energy and Environmental Affairs and the Adaptation Advisory Committee. 2011.

<https://www.mass.gov/files/documents/2017/11/29/Full%20report.pdf>

¹¹⁸ <https://malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter298>

¹¹⁹ <https://www.mass.gov/files/documents/2016/08/vp/slrguidance-2013.pdf>

¹²⁰ Northeast Climate Science Center. (2018). Massachusetts Climate Change Projections - Statewide and for Major Drainage Basins. Massachusetts Executive Office of Energy and Environmental Affairs. Available at: <http://www.resilientma.org/resources/resource::2152>

Extreme).¹²¹ Across the four tide gages analyzed, sea-level rise values for 2050 range between 1.3 and 3.1 feet. Massachusetts state agencies are updating guidance materials developed to assist municipalities with coastal resilience planning to reflect the most recent sea-level rise values.

POLICY

Massachusetts policy associated with sea-level rise reflects coordination of climate change, hazard mitigation, and coastal management programs at both the state and local levels. Facilitation of this coordination comes through the 2016 Executive Order 569 that points to the Secretary of Energy and Environmental Affairs (EEA) as the entity to "coordinate and make consistent new and existing efforts to mitigate and reduce greenhouse gas emissions and to build resilience and adapt to the impacts of climate change," as well as the EEA Secretary and the Secretary of Public Safety to "coordinate efforts across the Commonwealth to strengthen the resilience of our communities, prepare for the impacts of climate change, and to prepare for and mitigate damage from extreme weather events."

This directed coordination results in a statewide integrated climate adaptation and hazard mitigation plan that serves as the overarching policy directive at the state and local level. This plan is supported by executive and legislative authorities directing state executive agency leadership on resilience as well as consistent local government action. This approach ensures that consistent planning and use of climate projections are used across state agencies as well as at the local government level. Coordination with a state academic institution ensures routine updates based on changes in climate science. Local government grants, technical assistance and hazard mitigation plan are coordinated with statewide climate projections and guidance, tools, and guidance developed by state agencies are coordinated as well.

The Massachusetts Environmental Policy Act (MEPA) requires state agencies to assess environmental consequences of their actions, including permitting and financial assistance. It also requires them to take all feasible measures to avoid, minimize, and mitigate damage to the environment. MEPA requires that state agencies "use all practicable means and measures to minimize damage to the environment," by studying alternatives to the proposed project, and developing enforceable mitigation commitments, which will become conditions for the project if and when they become permitted. The MEPA review process is applied to specific types of projects that require a permit, financial assistance or land transfer from state agencies. In 2014, the Massachusetts MEPA Office issued a draft policy on climate change and resilience as part of the MEPA review process¹²². Although the policy has not yet been adopted, it is currently being used by the MEPA Office as interim guidance. The draft policy refers to the following two provisions in the state's Global Warming

¹²¹ Sweet, W.V., R.E. Kopp, C.P. Weaver, J. Obeysekera, R.M. Horton, E.R. Thieler, and C. Zervas, 2017: Global and Regional Sea Level Rise Scenarios for the United States. NOAA Technical Report NOS CO-OPS 083. NOAA/NOS Center for Operational Oceanographic Products and Services.

¹²² <http://www.lawandenvironment.com/wp-content/uploads/sites/5/2014/11/MEPA-Climate-Adaptation-and-Resiliency-Policy-November-2014-DRAFT-.pdf>

Solutions Act as the basis for the draft MEPA policy: In the first provision, the Act states that the MEPA Office is required to:

(1) consider the reasonably foreseeable climate change impacts and GHG emissions of projects subject to MEPA review (and effects such as predicted sea-level rise); and (2) ensure that projects subject to MEPA take all feasible measures to avoid, minimize, or mitigate "Damage to the Environment..." including GHG emissions.

In the second provision, the Act, the Act states that:

In considering and issuing permits, licenses and other administrative approvals and decisions, the respective agency, department, board, commission or authority shall also consider reasonably foreseeable climate change impacts, including additional greenhouse gas emissions, and effects, such as predicted sea-level rise.

The draft MEPA guidance includes references to sea-level rise impacts as a MEPA consideration and also includes references the 2013 Coastal Management Program's report on sea-level rise. Under the draft policy, applicants must prepare a Climate Impact Assessment that is designed to: evaluate potential impacts of changing climate conditions including sea-level rise, and evaluate the effectiveness and feasibility of measures to reduce hazards and increase resilience. The policy refers to state sea-level rise values as well as provides detailed guidance on the required components of the Climate Impact Assessment including:

- ◆ Assessment of risk, taking into account adaptive capacity and uncertainty;
- ◆ Potential impacts to a variety of assets, including critical infrastructure and natural resources;
- ◆ Consideration of water levels as well as potential duration of inundation;
- ◆ Evaluation of mitigation alternatives

TOOLS AND GUIDANCE:

Resilient MA is the “climate change clearinghouse for Massachusetts” maintained by the Massachusetts Office of Energy and Environmental Affairs.¹²³ The site was released in 2018 to support the state’s Municipal Vulnerability Preparedness (MVP) program that was initiated in 2017 at the Governor’s Municipal Climate Change Summit. The intent is for the Resilient MA site to serve as a resource for communities to access science and data on changing climate conditions, community resilience, grant programs and practical tools for resilience planning.¹²⁴ The site is undergoing expansion and currently includes a web-

¹²³ http://resilientma.org/changes/sea-level-rise#sea_level_rise_projected_changes

¹²⁴ <http://resilientma.org/sectors>

based mapping tool that includes sea-level rise projections¹²⁵ and it navigates other climate change resources from other state agency websites.

The Massachusetts Office of Coastal Zone Management's (CZM) "StormSmart Coasts Program"¹²⁶ unifies its tools, guidance and resources associated with sea-level rise, coastal flooding and erosion, including:

- ◆ the Massachusetts Sea-Level Rise and Coastal Flooding Viewer;¹²⁷
- ◆ Guidance designed to help coastal communities plan for sea-level rise impacts on residential and commercial development, infrastructure and critical facilities, natural resources and ecosystems. The guidance includes analysis of sea-level rise trends and projections and use of scenarios in coastal vulnerability assessments and resilience planning;¹²⁸
- ◆ regulatory guidance;¹²⁹
- ◆ guidance on historic shoreline change;¹³⁰ and
- ◆ Guidance for local officials and property owners.¹³¹

The Massachusetts Coastal Management Program manages the state's Coastal Resilience Grant Program¹³² for which 78 municipalities in the state's coastal zone are eligible. In 2018, more than \$3 million in grants were awarded to municipalities to undertake efforts involving vulnerability assessment, adaptation planning and design, redesign of public facilities and infrastructure to incorporate resilience, and implementation of green infrastructure approaches that enhance natural resources and address stormwater.

The Massachusetts Municipal Voluntary Preparedness (MVP) program provides support for cities and towns in resilience planning. It administers the municipal grant program and provides technical assistance to communities. Municipalities that participate in the MVP program receive certification from the state and are eligible to participate in additional resilience grant programs. The MVP program also certifies technical assistance providers through training and workshops and towns are able to choose among certified providers for development and implementation of their MVP programs.

¹²⁵ http://resilientma.org/map/?active-layers=noaa_slr&

¹²⁶ <https://www.mass.gov/stormsmart-coasts-program>

¹²⁷ <https://www.mass.gov/service-details/massachusetts-sea-level-rise-and-coastal-flooding-viewer>

¹²⁸ Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning. Massachusetts Office of Coastal Zone Management. 2013.

<https://www.mass.gov/files/documents/2016/08/vp/slris-guidance-2013.pdf>

¹²⁹ <https://www.mass.gov/service-details/applying-the-massachusetts-coastal-wetlands-regulations>

¹³⁰ <https://www.mass.gov/service-details/massachusetts-shoreline-change-project>

¹³¹ <https://www.mass.gov/service-details/overview-and-index-czm-stormsmart-coasts-program>

¹³² <https://www.mass.gov/service-details/coastal-resilience-grant-program>

The State Office of Technical Assistance and Technology works with businesses and communities to reduce risks by incorporating toxics use reduction strategies into emergency preparedness to reduce the risk of industrial accidents, including potential increased hazards caused by flooding and climate change.¹³³

New York

STATE EFFORTS:

In 2007, the New York Legislature created the New York State Sea-Level Rise Task Force (Chapter 613 of the Laws of New York). The Task Force (which included a Steering Committee) was chaired by the New York State Department of Environmental Conservation (DEC) Commissioner and was comprised of state agency staff and representatives of non-governmental organizations (NGOs). Five workgroups: community resilience, ecosystems and natural resources, infrastructure, legal, and public outreach including participants from academia, businesses, NGOs, environmental justice and community groups, and federal, state and local agencies. In 2010, the Task Force issued its final report¹³⁴ that included projections of sea-level rise provided by Columbia University based on research conducted for the New York City Panel on Climate Change¹³⁵. The final report summarizes the Task Force's charge as evaluating "ways of protecting New York's remaining coastal ecosystems and natural habitats, and increasing coastal community resilience in the face of sea-level rise, applying the best available science as to sea-level rise and its anticipated impacts." The report outlines the current state of climate science as applicable to the State of New York and recommended that the state adopt official sea-level rise projections.

In 2014, New York enacted the Community Risk and Resiliency Act¹³⁶, which includes five major provisions:

- ◆ Requires the Department of Environmental Conservation to adopt science-based sea-level rise projections into regulation and update them every five years;
- ◆ Requires applicants for permits or funding in specified programs to demonstrate that future physical climate risk due to sea-level rise, storm surge and flooding have been considered, and that the Department of Conservation consider incorporating these factors into certain facility-siting regulations;
- ◆ Adds mitigation of risk due to sea-level rise, storm surge and flooding to the list of smart-growth criteria to be considered by state public-infrastructure agencies;

¹³³ <https://www.mass.gov/chemical-safety-and-climate-change-preparedness>

¹³⁴ New York State Sea Level Rise Task Force, Report to the Legislature. New York Department of Environmental Conservation. 2010. https://www.dec.ny.gov/docs/administration_pdf/slrtffinalrep.pdf

¹³⁵ Climate Change Adaptation in New York City: Building a Risk Management Response. New York City Panel on Climate Change. Michael R. Bloomberg, Mayor. 2010. <https://doi.org/10.1111/j.1749-6632.2009.05415.x>

¹³⁶ https://nyassembly.gov/leg/?default_fld=&bn=A06558&term=2013&Summary=Y&Actions=Y&Memo=Y&Text=Y

- ◆ Requires the Department of Environmental Conservation to develop guidance on the use of natural resources and natural processes to enhance community resiliency; and
- ◆ Requires the Department of State to develop model local laws that include consideration of future risk due to sea-level rise, storm surge and/or flooding.

In 2015, the New York Department of Conservation issued an overview of projected and observed climate change in New York.¹³⁷ Under the authority of the 2014 Community Risk and Resiliency Act (Chapter 355 of the laws of 2014), the New York Department of Environmental Conservation adopted regulations in 2017 establishing science-based State sea-level rise projections as a new section 6 of NYCRR Part 490¹³⁸. The regulations were developed by the Department of Environmental Conservation in consultation with other state agencies and with extensive stakeholder engagement.

In 2018 and pursuant to the Community Risk and Resilience Act, New York released two flood-risk management guidance documents for public review. In addition to providing the basis and background to support implementation of the Coastal Risk and Resilience Act, the guidance also outlines strategies to mitigate risk due to sea-level rise, storm surge, and flooding in the approval and funding of public infrastructure, project design, facility-siting and funding programs by state agencies. The two guidance documents issued in 2018 are:

- ◆ State Flood Risk Management Guidance that is intended to inform state agencies as they develop program-specific guidance to require that applicants demonstrate consideration of sea-level rise, storm surge and flooding. The guidance includes possible future conditions including future risks of coastal flooding caused by sea-level rise as well as future risks of inland flooding expected to result from increased extreme precipitation events;¹³⁹ and
- ◆ Guidance for Smart Growth Public Infrastructure Assessment, which informs state agencies efforts to assess strategies to mitigate sea-level rise, storm surge and flooding in design of public-infrastructure projects.¹⁴⁰

The Department of Environmental Conservation is currently developing other guidance pursuant to the Climate Risk and Resilience Act, including use of natural resiliency

¹³⁷ Observed and Projected Climate Change in New York State: An Overview Developed for the Community Risk and Resiliency Act (CRRA). Drafting Teams Final. 2015.

https://www.dec.ny.gov/docs/administration_pdf/climbkgncrra.pdf

¹³⁸ <https://www.dec.ny.gov/regulations/103877.html>

¹³⁹ DRAFT New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act. New York State Department of Environmental Conservation. 2018.

https://www.dec.ny.gov/docs/administration_pdf/nysfrm.pdf

¹⁴⁰ Community Risk and Resiliency Act DRAFT Guidance for Smart Growth Public Infrastructure Assessment. New York State Department of Environmental Conservation. 2018.

https://www.dec.ny.gov/docs/administration_pdf/nysdga.pdf

measures and model laws to enhance resilience¹⁴¹. Drafts are expected to be issued in 2019.

SEA-LEVEL RISE SCIENCE STANDARD:

The New York sea-level rise regulation is limited to establishing the science-based sea-level rise values. Under the state's Community Risk and Resiliency Act, state agencies are directed to develop policies to incorporate the adopted sea-level rise and future flood risk values into regulatory, funding, planning and other programs. Under the authority of the 2014 Community Risk and Resiliency Act (Chapter 355 of the laws of 2014), the New York Department of Environmental Conservation adopted regulations establishing science-based State sea-level rise projections as a new section 6 of NYCRR Part 490¹⁴². The New York sea-level rise regulation establishes projections of sea-level rise in three specified geographic regions through 2100, using a bottom-up component-based approach similar to Kopp et al. (2014). However, the process used in Horton et al. (2014) relies on deterministic outcomes of 24 global climate models (GCM), and is not a fully probabilistic approach. The scientific committee used the combined outcomes for the GCMs under both RCP 4.5 and RCP 8.5 emissions scenarios to set forth 10th, 25th, 75th, and 90th percentile values (corresponding to Low Estimate, Middle Range (25-75), and High Estimate scenarios) for sea-level rise.¹⁴³ The New York sea-level rise regulation is limited to establishing the science-based sea-level rise values. Under the state's Community Risk and Resiliency Act, state agencies are directed to develop policies to incorporate the adopted sea-level rise and future flood risk values into regulatory, funding, planning and other programs.

POLICY

Programs affected by the sea-level rise permitting and funding provisions of the Community Risk and Resilience Act and the 2018 proposed flood-risk management guidance documents include those that oversee:

- ◆ oil and natural gas wells;
- ◆ Major projects including: protection of waters, sewerage service, liquefied natural gas and liquefied propane facilities, mined land reclamation, freshwater wetlands, tidal wetlands, coastal erosion hazard areas;
- ◆ Hazardous waste transportation, storage and distribution facility siting;
- ◆ Petroleum and hazardous substance bulk storage;
- ◆ Funding programs including those under the Water Pollution Control Revolving Fund, the Drinking Water Revolving Fund, open space and farmland acquisition and

¹⁴¹ <https://www.dec.ny.gov/energy/102559.html>

¹⁴² <https://www.dec.ny.gov/regulations/103877.html>

¹⁴³ Horton, R., D. Bader, C. Rosenzweig, A. DeGaetano, and W. Solecki. 2014. Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information. New York State Energy Research and Development Authority (NYSERDA), Albany, New York.

maintenance, recreation and historic Preservation, landfill closures; waterfront revitalization;

- ◆ Department of Transportation State Bridge Manual, which governs design of almost all bridges in the state; and
- ◆ The State Fire Prevention and Building Code.

In addition to adopting science-based sea-level rise projections, the Community Risk and Resilience Act requires action in four specific programmatic areas: permitting, facility siting, and funding; smart growth and public infrastructure; model local laws concerning climate risk; and natural resiliency measures. The provisions require agencies and permitting applicants to consider sea-level rise in specified situations.

- ◆ **Permitting, Facility Siting, and Funding:** Under the Community Risk and Resilience Act, sea-level rise, storm surge, and flooding must be considered in facility siting, permitting, and funding. The Act amends the state's Environmental Conservation, Agriculture and Markets, and Public Health Laws to require permitting applicants in specific programs to demonstrate consideration of future climate risk. Permitting programs identified in CRRA that are managed by the DEC include: oil and natural gas wells, protection of waters, sewerage service, liquefied natural gas and liquefied propane facilities, mined land reclamation, freshwater wetlands, tidal wetlands, and coastal erosion hazard areas. In addition to permitting, the Act identifies funding programs managed by the Departments of Environmental Conservation, Health, State and other agencies as being subject to its provision. The design of the Act involves the Department of Environmental Conservation adopting the science-informed sea-level rise projections with other programs taking appropriate action to incorporate the sea-level rise projections into permitting and funding efforts, considering storm surge and inland flood hazards as well. The state acknowledges the significance of incorporating inland flood hazards:

"While DEC is required to adopt projections of only sea-level rise, the specified facility-siting, permitting and funding programs must consider storm surge and flooding as well. The inclusion of this language therefore clarifies the scope of the statute to extend beyond coastal areas. The linkage to extreme weather events is particularly significant given the number of non-tidal communities in New York State that recently have experienced flooding or storm surge, or are at risk."¹⁴⁴

- ◆ **Smart Growth & Public Infrastructure:** The 2010 New York State Smart Growth Public Infrastructure Policy Act directs state agencies governing infrastructure to not "approve, undertake, support or provide financial assistance to a public infrastructure project unless, to the extent practicable, the project is consistent with smart growth criteria¹⁴⁵. The Community Risk and Resilience Act amends the state

¹⁴⁴ <https://www.dec.ny.gov/energy/104113.html>

¹⁴⁵ <https://www.efc.ny.gov/smартgrowth>

smart growth law to add mitigation of risk due to sea-level rise, storm surge and inland flooding to the list of smart-growth criteria. The Community Risk and Resilience Act requires the Department of Environmental Conservation to develop guidance for implementation of the Act into the state's smart growth public infrastructure programs.

- ◆ **Model Local Laws Concerning Climate Risk:** Under the Community Risk and Resilience Act, the Department of State must develop model local laws that reflect the future risks of sea-level rise, storm surge, and/or flooding.
- ◆ **Guidance on Natural Resiliency Measures:** Under the Community Risk and Resilience Act, the Department of Environmental Conservation must develop guidance on natural resources and natural resiliency measures.

TOOLS AND GUIDANCE:

In addition to the guidance issued by the state to support implementation of the Community Risk and Resilience Act, New York State hosts the statewide Climate Smart Communities program¹⁴⁶ in which municipalities and counties can register to participate and receive recognition for their efforts regarding both climate change mitigation and adaptation. Joining the Climate Smart Communities program requires a local government to take a seven point pledge, which includes one element associated with increasing local resilience.¹⁴⁷ Climate Smart Communities participating local governments gain additional points when application for state grants associated with local climate change programs including grants from the "Climate Smart Community Projects" initiative under Title 15 of the Environmental Protection Fund Funding for a variety of climate adaptation, mitigation and certification actions. Local governments that participate in the Climate Smart Communities Program also receive free technical support from state agency providers that is consistent with state guidance, science, and regulations.¹⁴⁸

Rhode Island

STATE EFFORTS:

Efforts to address sea-level rise in Rhode Island are embodied both in overarching climate change resilience policies and policies pursuant to the federal Coastal Zone Management Act of 1972. Several organizations function to advance climate change adaptation and mitigation policies and programs in the state, including programs specific to sea-level rise:

Rhode Island Climate Change Commission

The Rhode Island Climate Risk Reduction Act of 2010 established the Rhode Island Climate Change Commission. The standing Commission was comprised of twenty-eight

¹⁴⁶ <https://www.dec.ny.gov/energy/76483.html>

¹⁴⁷ <https://www.dec.ny.gov/energy/82168.html>

¹⁴⁸ <https://www.dec.ny.gov/energy/76910.html>

representatives from the Rhode Island General Assembly, executive agencies, business organizations, environmental organizations, and community groups. The Commission was charged with studying impacts of climate change on Rhode Island, identifying strategies to adapt to climate change impacts and approaches to integrate resilience planning into existing state and municipal programs. The Commission issued a 2012 Progress Report¹⁴⁹

Rhode Island Executive Climate Change Coordinating Council (EC4)

In 2014, Rhode Island Governor Lincoln Chafee signed Executive Order 14-01, creating the Rhode Island Executive Climate Change Coordinating Council (EC4).¹⁵⁰ The EC4 includes cabinet level executives from various state agencies and serves to coordinate cross-agency initiatives related to climate change. In June of the same year, the Council issued a report to the Governor outlining climate change impacts in the state.¹⁵¹

Establishment of the Council was codified in statute when the state legislature passed the Resilient Rhode Island Act of 2014¹⁵² which charged the EC4¹⁵³ with coordinating both climate change mitigation and adaptation actions for the State of Rhode Island, evaluating and making recommendations regarding plans, programs, and strategies relating to climate change mitigation and adaptation, improving public access to resources/information about climate change (both mitigation and adaptation) and issuing an annual report to the Governor. The Act stipulated that the EC4 would maintain two advisory bodies that includes public members: the EC4 Advisory Board and the EC4 Science and Technical Advisory Board, both of which are charged with assisting the Council in incorporating consideration of climate change impacts into the powers and duties of all state agencies. The Act also includes provisions that stipulate that "consideration of the impacts of climate change shall be deemed to be within the powers and duties of all state departments, agencies, commissions, councils, and instrumentalities, including quasi-public agencies, and each shall be deemed to have and to exercise among its purposes in the exercise of its existing authority."¹⁵⁴ The EC4 Advisory Board is comprised of thirteen members, appointed by the Governor, House and Senate. Members include municipal representatives as well as those with expertise in economic policy, workforce development, protection of natural/cultural resources, energy planning, education, public health, and housing. The EC4 Science and Technical Advisory Board is charged with keeping the EC4 and EC4 Advisory Board abreast of important developments associated with scientific and technical information regarding climate change and resilience. The EC4 Science and technical Advisory Board advises the EC4 on fulfilling its statutory mandate to routinely update scientific guidance to support state agency actions, including sea-level rise.¹⁵⁵ EC4 The

¹⁴⁹ Adapting to Climate Change in the Ocean State: A Starting Point. Rhode Island Climate Change Commission. 2012 Progress Report. 2012. <http://www.rilin.state.ri.us/Reports/Climate%20Change%20Commission%20Prog%20Report%20Final%2011%2015%2012%20final%202.pdf>

¹⁵⁰ <https://www.ri.gov/press/view/21348>

¹⁵¹ A Resilient Rhode Island: Being Practical about Climate Change, a Report to Governor Lincoln D. Chafee. Rhode Island executive Climate Change Council. June 2014.

<http://climatechange.ri.gov/documents/rcc0614.pdf>

¹⁵² <http://www.energy.ri.gov/policies-programs/ri-energy-laws/resilient-rhode-island-act-2014.php>

¹⁵³ <http://climatechange.ri.gov/state-actions/ec4/>

¹⁵⁴ <http://webserver.rilin.state.ri.us/Statutes/TITLE42/42-6.2/42-6.2-8.HTM>

¹⁵⁵ <http://climatechange.ri.gov/state-actions/ec4/ec4-council/stab.php>

Science and Technical Advisory Board, currently chaired by a University of Rhode Island faculty member, is comprised of four members from institutions of higher education; two from research laboratories located in the state; and three from state agencies with expertise in, and responsibility for, addressing issues pertaining to climate change. An ex-officio member from the RI Department of Health also serves on the Board.

Chief Resiliency Officer

In September 2017, Governor Gina Raimondo issued Executive Order 17-10 that created the position of Rhode Island Chief Resiliency Officer. Through coordination with the Executive Climate Change Coordinating Council and use of “best available science,” the Officer was tasked with leading the development of a comprehensive climate preparedness strategy by July 1, 2018.¹⁵⁶ The Executive Order identified the following components to be included in the comprehensive climate preparedness strategy: community resilience, economic resilience, critical infrastructure and environmental resilience, implementation strategies, and strategies for state agencies to “lead by example.” On July 1, 2018, the state released its comprehensive climate preparedness strategy pursuant to executive Order 17-10. Development of the “Resilient Rhody” strategy¹⁵⁷ was led by the Chief Resiliency Officer in coordination with the Climate Change Coordinating Council, state agencies, and extensive stakeholder engagement including 10 statewide workshops. The strategy provides an overview of climate change impacts in Rhode Island and outlines impacts and more than 60 actions in five categories: critical infrastructure and utilities, natural systems, emergency preparedness, community health and resilience, and financing climate resilience projects.

Sea-level rise is an overarching consideration in the actions contained in the “Resilient Rhody” strategy. Specific provisions associated with the coastal zone include policy directives to:

- ◆ “Continue monitoring and assessment of coastal wetland habitats and management practices to evaluate and prioritize future actions;
- ◆ Identify opportunities for retreat and infrastructure removal on state-owned properties. State agencies and their partners should continue to work with municipalities to identify opportunities for retreat, removal of derelict infrastructure, and enhancement of natural shoreline areas. Where possible, retreat rather than fortification should be emphasized as a coastal adaptation strategy.
- ◆ Preserve the dynamic nature of beaches and barriers in future management of these critical natural systems. Differentiation between developed and undeveloped systems is necessary when considering management approaches. New development should be minimized in undeveloped beach and dune areas and retreat incentivized as a coastal adaptation strategy where possible;

¹⁵⁶ <http://governor.ri.gov/documents/orders/ExecOrder-17-10-09152017.pdf>

¹⁵⁷ Resilient Rhody: An Actionable vision for Addressing the Impacts of Climate Change in Rhode Island. Office of the Governor. July 2, 2018. <http://climatechange.ri.gov/documents/resilientrhody18.pdf>

- ◆ Develop initiatives for coastal resilience activities, such as monitoring existing pilot projects, developing offshore sand sources suitable for beach replenishment, prioritizing beaches to be re-nourished, and creating beach and barrier migration pathways through property acquisition and relocation of structures.”

As part of the activities of the Council, the Rhode Island Division of Statewide Planning has also led the coordination of efforts to integrate climate change impacts into statewide planning. Several specific initiatives include:

- ◆ 2016 Development of a report that incorporates the state’s current sea-level rise science to identify the social, economic and demographic characteristics of the populations located within the 1, 3, 5 and 7-foot sea-level rise inundation zones in the state’s 21 coastal communities. The report also evaluated characteristics of housing within the study area. The project resulted in several deliverables including a technical methodology summary¹⁵⁸, and statewide and individual county fact sheets and data profiles for the state’s coastal communities that outline the characteristics of populations that would be affected by coastal inundation¹⁵⁹. Characteristics include those that pertain to federal Title VI and Environmental Justice populations.
- ◆ 2016 Development of a Vulnerability Assessment of municipal transportation assets to sea-level rise and storm surge which identifies local infrastructure and transportation assets affected by sea-level rise and storm surge at several different scenarios of sea-level rise¹⁶⁰. The analysis resulted in a methodology report, a statewide assessment of municipal transportation infrastructure as well as individual fact sheets for each municipality in the coastal region. The analysis was conducted in coordination with the CRMC and use of STORMTOOLS. The individual fact sheets identify roads and bridges most likely to be affected by Sea-Level Rise, including a scoring of their relative vulnerability based on the severity of the hazard they face and the potential impact of asset damage on the transportation system as a whole.¹⁶¹
- ◆ 2015 Development of a vulnerability assessment of statewide transportation assets to sea-level rise. Similar to the other reports, the assessment of statewide transportation assets evaluated statewide transportation infrastructure vulnerable to a variety sea-level rise scenarios, including 1, 3 and 5 feet of sea-level rise. Assets included: roads, rail, bike paths, ports & harbors, bus routes, intermodal hubs, and

¹⁵⁸ Socioeconomics of sea level rise Technical Paper 168. Rhode Island Department of Administration, Division of Statewide Planning. 2016. <http://www.planning.ri.gov/planning-areas/climate-change/sea-level-rise/socioeconomics-slr.php>

¹⁵⁹ The Socioeconomics of Sea Level Rise Costal Factsheet. Rhode Island Department of Administration, Division of Statewide Planning. 2016. http://www.planning.ri.gov/documents/sea_level/socio/PDF%20-%20RI%202021%20Coastal%20Factsheet%20and%20Data%20Profile.pdf

¹⁶⁰ Vulnerability of Municipal Transportation Assets to Sea Level Rise and Storm Surge Technical Paper 167. September 28, 2016 Rhode Island Department of Administration, Division of Statewide Planning. 2016.

¹⁶¹ Sea Level Rise Technical Fact Sheets. Rhode Island Department of Administration, Division of Statewide Planning. 2016. <http://www.planning.ri.gov/planning-areas/climate-change/sea-level-rise/slrfactsheets.php>

bridges to ocean water. The sea-level rise scenarios are based on current conditions and do not include projections of erosion, storm surge, or precipitation.¹⁶² The outcomes include analysis of vulnerabilities for transportation assets by municipality in the coastal zone.¹⁶³

Rhode Island Coastal Resources Management Council

The Rhode Island Coastal Resources Management Council (CRMC) was established in 1971 through legislative action. The CRMC is structured as an independent management agency with regulatory functions and governed by a Council composed of sixteen members appointed by the Governor representing the public and local and state government. Overall, the CRMC is charged with the primary responsibility for the continued planning and management of the resources of the state's coastal region, including consideration of economic and other impacts within the coastal zone. The CRMC is authorized to formulate ecosystem-based policies and plans, to adopt regulations necessary to implement its various management programs; coordinate its functions with local, state, and federal governments on coastal resources issues and act as binding arbitrator in any dispute involving both the resources of the state's coastal region and the interests of two (2) or more municipalities or state agencies. Using authority from the federal Coastal Zone Management Act of 1972, the CRMC is authorized to develop and implement Special Area Management Plans (SAMPs) to address specific regional issues. The regulatory authority of the CRMC includes the area extending from the territorial sea limit, 3 miles offshore, to two hundred feet inland from any coastal feature. Regulatory procedures of the CRMC are governed by the Rhode Island Administrative Procedures Act. The CRMC is also responsible for the designation of all public rights-of-way to the tidal water areas of the state, and carrying on a continued discovery of appropriate public rights-of-way. The CRMC has a professional staff of engineers, scientists, and marine resource specialists.¹⁶⁴

Rhode Island Division of Statewide Planning

In 2017, Rhode Island passed amendments to the state law governing the powers and duties of planning boards or commissions. The new statutory provision requires that each member of a planning board or commission must participate in training and education classes concerning the effect of development in a flood plain and the effects of sea-level rise once every two years. The state Division of Planning, which is housed in the Department of Administration, oversees implementation of the program.

The new provision (j) requires that each member of a planning board or commission must participate in training and education classes concerning the effect of development in a flood plain and the effects of sea-level rise once every two years.

¹⁶² Vulnerability of Transportation Assets to Sea Level Rise Technical Paper 164. Rhode Island Department of Administration, Division of Statewide Planning, 2015.

http://www.planning.ri.gov/documents/sea_level/2015/TP164.pdf

¹⁶³ <http://www.planning.ri.gov/planning-areas/climate-change/sea-level-rise/statewide-transportation-assets.php>

¹⁶⁴ <http://www.crmc.ri.gov/index.html>

SEA-LEVEL RISE SCIENCE STANDARD:

The EC4 Science and Technical Advisory Board has updated the state's sea-level rise science used in state planning 3 times, each time referencing the most recent federal guidance. The framework for the state uses the NOAA high projection as defined in the USACE SLR calculator tool for the Newport, RI tide gauge. This represents planning for approximately 7 ft. of SLR by the year 2100 throughout Rhode Island. The motivation for choosing this level was to be able to adapt to uncertainty in future changes in sea-level projections under a precautionary, no regrets approach to considerations in construction and planning. Examples of where the projections have been included several studies on transportation and by the department of health. The climate science is also used in support of federal grant funds and other projects in the coastal areas.

The most recent update of climate science by the EC4 Science and Technical Advisory Board was issued in 2016.¹⁶⁵ The 2016 report indicates that sea-level has risen in Rhode Island more than 9 inches since 1930 exceeding the global average mean for the same period. The strategy points to NOAA research that indicates that: sea levels will likely increase 1 inch between every 5 or 6 years in Rhode Island. The July 2018 "Resilient Rhody" strategy incorporates the science of the 2016 Science and Technical Advisory Board report. The Science and Technical Advisory Board 2016 report also provides the following insight:

"Rhode Island is now well positioned to conduct state, municipal and private sector vulnerability analyses with new tools to assess the risk for sea-level rise and coastal storm surge inundation with the development of STORMTOOLS by the University of Rhode Island on behalf of the Coastal Resources Management Council Shoreline Change Special Area Management Plan."

POLICY

In 2018, the Rhode Island CRMC adopted a Shoreline Change Special Area Management Plan (SAMP), known as the Beach SAMP using authorities under the federal Coastal Zone Management Act of 1972¹⁶⁶. The SAMP sets forth the process through which development permit applicants will use the state's sea-level rise projections and coastal hazard exposure assessment tools to address coastal hazards associated with climate change. Special Area Management Plans are authorized under the federal Coastal Zone Management Act and are intended to establish "a comprehensive plan providing for natural resource protection and reasonable coastal-dependent economic growth containing a detailed and comprehensive statement of policies; standards and criteria to guide public and private uses of lands and waters; and mechanisms for timely implementation in specific geographic areas within the coastal zone." Adopted by the state's Coastal Resources Management Council, the Rhode Island Beach SAMP includes eight tailored regional plans that span most of the state, providing customized guidelines and regulations for addressing the specific needs of those

¹⁶⁵ Current State of Climate Science in Rhode Island. A Report From the STAB to the EC4. 2016.

<http://climatechange.ri.gov/documents/ec4-science-and-technical-advisory-board-report.pdf>

¹⁶⁶ <https://www.beachsamp.org/beachsamp-document/>

areas. Pursuant to the Beach SAMP, coastal development permit applicants are required to complete a hazard assessment that considers the impacts of current and future coastal hazards. Applicants are directed to consider coastal hazards, including future sea-level rise, via five components:

- ◆ Choose an appropriate design life for the project along with a projected sea-level rise;
- ◆ Review identified maps and tools to assess exposure and potential risk;
- ◆ Integrate additional risk assessment provisions for large projects and subdivisions;
- ◆ Identify and assess the feasibility of design technical to minimize or avoid risks; and
- ◆ Incorporate the hazard assessment as part of its permit application.

The approach taken to administer the Rhode Island SAMP includes a requirement that permit applicants must use a set of tools developed by state agencies and the University of Rhode Island to Tools that provide permit applicants with the critical information needed to ensure that their applications incorporation consideration of sea-level rise impacts consistent with the state's sea-level rise standard. These tools all rely on the platform STORMTOOLS, which is an online mapping tool that shows storm surge and sea-level rise scenarios for the entire coastline. STORMTOOLS was developed as a partnership of the CRMC, University of Rhode Island, Rhode Island Sea Grant, Roger Williams University School of Law, and the Rhode Island Geological Survey.¹⁶⁷ Related tools include:

- ◆ The Rhode Island Coastal Environmental Risk Index (CERI) developed by the University of Rhode Island that can be used to predict storm surge and wave height in different storm scenarios, combined with shoreline change maps showing erosion, and damage functions to construct a risk index to structures.¹⁶⁸
- ◆ The Rhode Island e911 exposure assessment offers a summary of all exposed structures in each of the 21 coastal communities in Rhode Island under a variety of coastal flooding scenarios.¹⁶⁹
- ◆ The Rhode Island's Coastal Resources Management Council's Sea-Level Affecting Marshes Model (SLAMM) maps show how coastal wetlands will likely transition and migrate onto adjacent upland areas under projected sea-level rise scenarios of 1, 3, and 5 feet.¹⁷⁰
- ◆ The Coastal Resources Management Council's Coastal Property Guide, which outlines actions property owners can take to protect coastal properties from flooding and shoreline erosion.¹⁷¹

¹⁶⁷ <https://www.beachsamp.org/stormtools/>

¹⁶⁸ <https://www.beachsamp.org/stormtools/stormtools-coastal-environmental-risk-index-ceri/>

¹⁶⁹ <https://www.beachsamp.org/stormtools/e911/>

¹⁷⁰ http://www.crmc.ri.gov/maps/maps_slamm.html

¹⁷¹ <http://www.beachsamp.org/relatedprojects/coastalpropertyguide/>

- ◆ MyCoast Rhode Island is an online reporting tool that provides real-time tidal, storm, and shoreline monitoring data and images to coastal managers, developed by the Coastal Resources Management Council, the University of Rhode Island, Rhode Island Sea Grant and others.¹⁷²

The Rhode Island Comprehensive Planning and Land Use Act governs comprehensive (master) planning at the municipal level.¹⁷³ All municipalities are required to prepare and adopt and update a comprehensive plan every ten years. The plans are required to forecast conditions for a minimum 20-year planning horizon. The law requires municipalities to “include an identification of areas that could be vulnerable to the effects of sea-level rise, flooding, storm damage, drought, or other natural hazards.” Amendments to the Act in 2011 requires that municipalities address “natural hazards” in their comprehensive plans, including identification of areas that would be vulnerable to sea-level rise, flooding and storm danger. A 2017 amendment to the act¹⁷⁴ requires that:

“Each member of a planning board or commission shall participate in training and education classes concerning the effects of development in a flood plain and the effects of sea-level rise once every two years.”¹⁷⁵

TOOLS AND GUIDANCE:

Many of the tools to assist state and local agencies, as well as the private sector, were developed as a partnership between state agencies, the Rhode Island CRMC, and academic institutions. The suite of tools developed as part of STORMTOOLS have been used for purposes other than the BEACH SAMP including the state Division of Statewide Planning’s vulnerability assessment of state and municipal transportation. Along with a STORMTOOLS “Beginner’s Guide¹⁷⁶,” STORMTOOLS is featured as part of a package of tools available to municipal and county planners and communities along with several guides such as:

- ◆ The Rhode Island Coastal Property Guide¹⁷⁷
- ◆ A 2017 memo from the State Division of Planning¹⁷⁸ outlined requirements of the state’s municipalities pursuant to the 2017 amendments to the state’s requirements for municipal comprehensive planning.¹⁷⁹
- ◆ The Rhode Island Emergency Management Agency floodplain mapping tool¹⁸⁰

¹⁷² <https://mycoast.org/ri>

¹⁷³ <http://webserver.rilin.state.ri.us/Statutes/TITLE45/45-22.2/INDEX.HTM>

¹⁷⁴ <http://climatechange.ri.gov/cities-towns/toolkits-guidance.php>

¹⁷⁵ <http://webserver.rilin.state.ri.us/PublicLaws/law17/law17403.htm>

¹⁷⁶ <https://uri.maps.arcgis.com/home/webmap/viewer.html?webmap=2d691387bbaa49518be77add554d4b40>

¹⁷⁷ <http://climatechange.ri.gov/documents/rhode-island-coastal-property-guide-2014.pdf>

¹⁷⁸ http://www.planning.ri.gov/documents/about/PGM_Pl-Bd-Education_Final.pdf

¹⁷⁹ <http://webserver.rilin.state.ri.us/PublicLaws/law17/law17403.htm>

¹⁸⁰ <http://www.riema.ri.gov/>

- ◆ The PREP-RI online module series. This platform aims to increase the resilience capacity of municipal decision makers. The modules consider current and future impacts of climate change at the municipal level, and ready-to-use educational tools. The platform was developed by the Rhode Island Sea Grant, the University of Rhode Island and the Narragansett Bay National Estuarine Research Reserve with financial support from the state.¹⁸¹

Extensive training and technical assistance for use of the variety of tools are available by the CRMC, Rhode Island Sea Grant, the Narragansett Bay National Estuarine Research Reserve and the University of Rhode Island.

Virginia

STATE EFFORTS:

In 2007, Governor Tim Kaine established the Governor's Commission on Climate Change via Executive Order 59 chaired by the Secretary of Natural Resources. The Executive Order directs the Commission to prepare a Climate Change Action Plan that, in addition to climate change mitigation provisions, requires the Commission to:

- ◆ Evaluate expected impacts of climate change on Virginia's natural resources, the health of its citizens, and the economy, including the industries of agriculture, forestry, tourism, and insurance,
- ◆ Identify what Virginia needs to do to prepare for the likely consequences of climate change.¹⁸²

In 2008, the Commission issued *A Climate Change Adaptation Plan*¹⁸³. The Plan outlined a framework for reducing greenhouse gas emissions and adapting the changing climate in Virginia. The Commission made a number of non-binding recommendations for state agencies and local governments to consider in order to address climate change, a few of which pertained to sea-level rise. The report includes a dedicated set of recommendations regarding integration of scientific projections of climate change into state policies and operations: "*Virginia state agencies and local governments will prepare for and adapt to the impacts of climate change that cannot be prevented*", such as recommending that:

- ◆ The legislature fund establishment of a network of scientific institutes to regularly update Virginia-specific predictions of climate change;
- ◆ The Virginia Marine Resources Commission should adopt shoreline protection policies that emphasize the use of living shorelines wherever feasible.

¹⁸¹ <http://prep-ri.seagrant.gso.uri.edu/>

¹⁸² <http://wayback.archive-it.org/263/20080102220612/>

http://www.governor.virginia.gov/Initiatives/ExecutiveOrders/2007/EO_59.cfm

¹⁸³ Governor's Commission on Climate Change Final Report: A Climate Change Action Plan. Virginia Department of Natural Resources. 2008.

http://www.sealevelrisevirginia.net/docs/homepage/CCC_Final_Report-Final_12152008.pdf

- ◆ Local governments should revise zoning and permitting ordinances to require projected climate change impacts be addressed in order to minimize threats to life, property, and public infrastructure and to ensure consistency with state and local climate change adaptation plans.
- ◆ The Secretary of Transportation should ensure that climate change impacts, particularly sea-level rise and storm surge vulnerability in coastal areas of Virginia, are taken into account in all transportation planning, project design, and prioritization of projects for funding as well as transportation systems management, operations, and maintenance.
- ◆ State agencies and local governments should develop climate change adaptation plans for critical infrastructures for which they are responsible.
- ◆ The Secretary of Natural Resources should lead an inter-agency and intergovernmental effort to develop a Sea-Level Rise Adaptation Strategy.
- ◆ The Department of Conservation and Recreation should assess the need to expand Virginia's Resources Protection Area buffer designations beyond the current 100-foot requirement to accommodate the impact of sea-level rise.
- ◆ The Virginia Floodplain Management Plan be updated to create model floodplain management ordinances to address sea-level rise and increasing storm surge impacts due to climate change.

In 2012, Senate Joint Resolution 76 requested that the Virginia Institute of Marine Sciences to study adaptation strategies to prevent future flooding local governments on the Eastern Shore and Tidewater regions. In 2016, the Virginia Legislature passed SB 1443, Comprehensive Plan: Strategies to Combat Projected Sea-Level Rise.¹⁸⁴ The law requires all localities in the Hampton Roads Planning District Commission to incorporate strategies to address sea-level rise and recurrent flooding in the next scheduled and all subsequent reviews of its comprehensive plans. The law requires that the localities undertake this planning in coordination and it also requires that the state Departments of Conservation and Recreation, Emergency Management, the Marine Resources Commission, Old Dominion University and the Virginia Institute of Marine Science to provide technical assistance to any locality upon request.

On July 1, 2014 Governor Terry McAuliffe convened the Governor's Climate Change and Resiliency Update Commission via Executive Order 19¹⁸⁵. The Commission was directed to assess progress on climate change adaptation and resiliency using Governor Kaine's Commission on Climate Change and the resulting 2008 Change Adaptation Plan as a starting point for discussion. The Commission issued the following recommendations in its report to the Governor published on December 21, 2015:

- ◆ Establish a Climate Change and Resilience Resource Center and/or Clearinghouse;

¹⁸⁴ <https://lis.virginia.gov/cgi-bin/legp604.exe?151+sum+SB1443>

¹⁸⁵ <https://www.naturalresources.virginia.gov/media/governorrvirginiagov/governor-of-virginia/pdf/eo/eo-19-convening-the-governors-climate-change-and-resiliency-update-commissionada.pdf>

- ◆ Create a New Virginia Bank for Energy and Resilience;
- ◆ Set a Renewable Energy Procurement Target for Commonwealth Agencies;
- ◆ Adopt a Zero Emission Vehicle Program; and
- ◆ Leverage Federal Funding

In 2016, House Bill 903 created the Commonwealth Centre for Recurrent Flooding and Resiliency, which includes Old Dominion University, the Virginia Institute of Marine Sciences and the College of William and Mary.¹⁸⁶ The Center is directed to provide guidance to local governments and regional planning entities on sea-level rise planning.

In 2016, the Virginia Legislature established the Virginia Shoreline Resiliency Fund¹⁸⁷ with the purpose of creating a low-interest loan program to help residents and businesses that are subject to recurrent flooding as approved by a locality-certified floodplain manager. Monies are intended to be used to mitigate future flood damage. Monies to support the fund may be appropriated by the General Assembly. No monies have been appropriated to the Fund as of 2018.

In 2018, House Bill 345/SB 265 established the Executive Branch position of Special Assistant to the Governor for Coastal Adaptation and Protection¹⁸⁸. The Assistant is charged with leading the development and implementation of a statewide coastal flooding adaptation strategy. The bill directs the Assistant to identify economic development opportunities associated with adaptation, to advance academic expertise at the Commonwealth Center for Recurrent Flooding and Resiliency, and to pursue federal, state, and local funding opportunities for adaptation initiatives.

Also, in 2018, Governor Ralph Northam signed Executive Order 24¹⁸⁹, Increasing Virginia's Resilience to sea-level rise and natural hazards. The Executive Order:

- ◆ Designates the Secretary of Natural Resources as the Chief Resilience Officer for the state;
- ◆ Requires a review of the vulnerability of Commonwealth Owned Buildings;
- ◆ Establishes a unified Sea-Level Rise Projection and freeboard standard for State-Owned Buildings; and
- ◆ Requires the development of a Virginia Coastal Resilience Master Plan to reduce the impacts of tidal and storm surge flooding. Requires a review of State Pre-disaster Mitigation Programs which will include an inventory of all state-run programs to encourage and implement pre-disaster mitigation;

¹⁸⁶ <https://www.floodingresiliency.org/>

¹⁸⁷ <https://law.lis.virginia.gov/vacode/title10.1/chapter6/section10.1-603.25/>

¹⁸⁸ <https://lis.virginia.gov/cgi-bin/legp604.exe?181+sum+SB265>

¹⁸⁹ <https://www.governor.virginia.gov/media/governorvirginiagov/executive-actions/ED-24-Increasing-Virginias-Resilience-To-Sea-Level-Rise-And-Natural-Hazards.pdf>

- ◆ Directs the development of Sea-Level Rise projection and freeboard guidance for local governments in which guidance shall be made available to local governments;
- ◆ Requires the implementation of provisions to ensure greater coordination among state agencies and between state agencies and local governments;
- ◆ Directs state agencies to use their planning, grant-making and legal authorities to ensure that natural hazard mitigation projects are conducted on a community-wide, rather than individual property scale and to empower local governments to plan and create more resilient communities through means such as planning grants, model ordinances, technical assistance, and increased participation in the FEMA National Flood Insurance Program.

SEA-LEVEL RISE SCIENCE STANDARD:

The 2012 Virginia Senate Joint Resolution 76¹⁹⁰ requested that the Virginia Institute of Marine Science (VIMS) conduct a study to identify strategies to prevent recurrent flooding in Tidewater and Eastern Shore Virginia localities. The resolution requires VIMS to: review and develop a comprehensive list of adaptation strategies, convene a stakeholder advisory panel to assess the feasibility of applying the strategies in Virginia, and offer specific recommendations for strategies to adopt to sea-level rise. VIMS issued its report pursuant to Senate Joint Resolution 76 in 2013¹⁹¹. The report does not include ranges or fixed sea-level rise values. It includes a graph with curves depicting “historic,” “low,” “high,” and “highest” future SLR projections. The projections were based on the U.S. National Climate Assessment sea-level rise data, which was also depicted four scenarios of sea-level rise. The report combined the U.S. National Climate Assessment data with the best available subsidence data for eastern Virginia to generate projections for sea-level rise in the Tidewater and Eastern Shore localities.

A second round of projections was produced in 2015 in the Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment.¹⁹² The sea-level rise projections included in the VADOT report use the same methodology as the 2013 VIMS report but incorporates the most recent National Climate Assessment Data from 2014. The VADOT report is for the Eastern Shore only, and provides a comprehensive vulnerability assessment of all transportation infrastructure assets in the Eastern Shore localities, but provides no guidance for the Virginia Tidewater region.

¹⁹⁰ <https://lis.virginia.gov/cgi-bin/legp604.exe?121+ful+SJ76ER>

¹⁹¹ Recurrent Flooding Study for Tidewater, Virginia. Virginia Institute of Marine Science. 2013. http://ccrm.vims.edu/recurrent_flooding/Recurrent_Flooding_Study_web.pdf

¹⁹² Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment. Virginia Department of Transportation. 2015.

https://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/Virginia_CZM_Grant_Report_FY13_Task_53_no_appendices.pdf

POLICY

The 2018 Executive Order 24 includes a broad set of policy directives but implementation is not yet underway.

TOOLS AND GUIDANCE:

The Virginia Coastal Management Program offers technical assistance and grants focused on sea-level rise resilience planning. These efforts are generally in partnership with regional planning districts.¹⁹³

With support from the state Coastal Management Program, several regional planning districts in Virginia have undertaken resilience or adaptation planning using. These efforts may vary by region.

- ◆ As required by law, municipalities in the Hampton Roads Planning District Commission region, are required to incorporate strategies to address flooding and SLR in their comprehensive plans. In conjunction with Old Dominion University, the Hampton Roads Planning District Commission conducted the 2014-2016 Hampton Roads Sea-Level Rise and Resiliency Intergovernmental Pilot Project.¹⁹⁴ The project involved stakeholder engagement to outline resilience planning recommendations. Several other studies assessing vulnerability of infrastructure in the Hampton Roads region have been undertaken as well.^{195, 196}
- ◆ The Middle Peninsula Planning District Commission partnered with the Virginia Coastal Management Program to issue a 2017 report outlining resilience planning options, "Local Government Planning Options to Address the Impacts of Flooding and Sea-Level Rise."¹⁹⁷ The report identified and outlined planning strategies, regulatory tools, and financial incentives that local governments can use to address flooding and sea-level rise. Implementation of any of the outlined strategies is voluntary.
- ◆ Accomack-Northampton Planning District Commission undertook a transportation infrastructure vulnerability assessment in 2015.¹⁹⁸

¹⁹³ <https://www.deq.virginia.gov/Programs/CoastalZoneManagement/CZMIssuesInitiatives/ClimateChange.aspx>

¹⁹⁴ https://digitalcommons.odu.edu/hripp_reports/2/

¹⁹⁵ Belfield S.S. 2013. Hampton Roads Military Transportation Needs Study: Roadways Serving the Military and Sea Level Rise/ Storm Surge. Statistics :

<https://www.hrtpo.org/uploads/docs/Roadways%20Serving%20the%20Military%20%26%20Sea%20Level%20Rise-Storm%20Surge%20Report.pdf>

¹⁹⁶ Belfield S.S. 2016. Sea Level Rise and Storm Surge Impacts to Roadways in Hampton Roads. Statistics :

<https://www.hrtpo.org/uploads/docs/Sea%20Level%20Rise-Storm%20Surge%20Impacts%20to%20Roadways%20in%20HR%20Final%20Report.pdf>

¹⁹⁷ <https://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/FundsInitiativesProjects/task54-15a.pdf?ver=2017-01-04-093946-500>

¹⁹⁸ Prepared by Accomack-Northampton Planning District Commission. 2015. Eastern Shore of Virginia Transportation Infrastructure Inundation Vulnerability Assessment. Prepared for Virginia Coastal Zone Management Program. Statistics:

B.2. STATES WITHOUT SCIENCE-INFORMED SEA-LEVEL RISE VALUES INTEGRATED INTO POLICY:

Florida

There are considerable efforts underway in Florida to address sea-level rise but those efforts are not guided by a consistent state level, science-informed policy. The Florida Oceans and Coastal Council was created by the 2005 Legislature through The Oceans and Coastal Resources Act. The Council is charged with developing priorities for ocean and coastal research and establishing a statewide ocean research plan. Much of the focus of the Council is on developing natural resource management plans and research priorities to support those management plans. In 2009 the Council issued a report summarizing impacts that climate change will have on the state's ocean and coastal resources and in, in 2010, it issued a second report focused specifically on impacts of sea-level rise on the state's coastal area. The updated 2010 report was based on scientific literature published by August 2010. The report outlined significant impacts from sea-level rise on the state's coastline, identified areas for future research, but did not offer sea-level rise projections or values for use in planning and decision-making.

Efforts underway in Florida with regard to sea-level rise appear to be more prevalent at the regional and local level and not formally driven by a statewide determination of 'best available science' with regard to sea-level rise. The 2011 Florida Community Planning Act returned control of local land use planning to local jurisdictions. The law allows, but does not require, local governments to designate Adaptation Action Areas (AAA) within their jurisdiction that are vulnerable to current and future coastal flooding based on the following criteria: where land elevations are below, at, or near mean higher high water; where land areas have a hydrologic connection to coastal waters; and/or where land areas are designated as evacuation zones for storm surge. Designation of the Adaptation Action Areas are intended to identify priority areas for infrastructure funding and for adaptation planning priorities.

The 2015 Florida Peril of Flood Act establishes requirements for local governments to consider future flood risk from storm surge and sea-level rise in certain portions of local government comprehensive plans. The Law requires local governments to include a redevelopment component to reduce the risk of flood when drafting comprehensive coastal management plans, and requires surveyors and mappers to submit elevation certificates to the Division of Emergency Management. The coastal management plans developed pursuant to the law must outline strategies that will eliminate inappropriate and unsafe development in the coastal areas when opportunities arise. The plan must consider best practices that:

- ◆ will reduce the flood risk in coastal areas including risks affected by sea-level rise;

https://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/Virginia_CZM_Grant_Report_FY13_Task_53_no_appendices.pdf

- ◆ result in removal of property in FEMA flood zones;
- ◆ may reduce losses due to flooding and claims made under flood insurance;
- ◆ may go beyond construction requirements in the Florida Building Code;
- ◆ encourages local governments to participate in the National Flood Insurance Program Community Rating System.

State agencies, including the Florida Department of Environmental Protection, the Florida Coastal Management Program and the Florida Department of Economic Opportunity work with local and regional jurisdictions to provide training and assistance with regard to coastal resilience and adaptation planning including with regard to local government efforts associated with the Peril of Flood Act and comprehensive planning pursuant to the Community Planning Act. For example, state agencies have provided voluntary technical assistance to local governments in coastal resilience planning and development of adaptation plans including in Broward County, Fort Lauderdale, St. Augustine, Clearwater, and Escambia County. In other parts of Florida, regional partnerships have formed to advise and support regional and local resilience planning. Two examples of local and regional projects include the Tampa Bay Climate Science Advisory Council and a 2009 convening, the Southeast Florida Climate Leadership Summit, which led to the establishment of the Southeast Florida Climate Compact that issued unified scenario-based sea-level rise projections in 2011 and then updated those projections in 2015 recognizing advances in scientific knowledge about sea-level rise.

Hawaii

The Hawaii State Planning Act was amended in 2012 to incorporate the Climate Change Adaptation Priority Guidelines that are designed to encourage collaboration between state agencies to address climate change, both mitigation and adaptation. In 2014, the Hawaii State Legislature passed Act 83, the Hawaii Climate Adaptation Initiative Act, which created the Interagency Climate Adaptation Committee (ICAC), which was later, renamed the Hawaii Climate Change Mitigation and Adaptation Commission by legislation enacted in 2017. The ICAC was charged with developing a statewide Sea-Level Rise Vulnerability Assessment and Adaptation Report by the end of 2017. As a benchmark toward this goal, the State Office of Planning published “A Sea-Level Rise Information Brief,” which was one of a series of documents intended to provide updates on climate science and adaptation. In December 2017, the Commission issued the Hawaii Sea-Level Rise Vulnerability and Adaptation Report that provided the first statewide assessment of Hawaii’s vulnerability to sea-level rise. The report also established a framework that anticipates economic loss based on the present value of the land and structures from the Hawaii State County tax parcel database permanently lost in the sea-level rise exposure areas included in the report. The sea-level rise values in the 2017 report use the upper boundary of the global sea-level rise projections based on IPCC AR5 RCP 8.5 (IPCC 2014).¹⁹⁹

¹⁹⁹ Hawaii Climate Change Mitigation and Adaptation Commission. 2017. Hawaii Sea Level Rise Vulnerability and Adaptation Report. Prepared by Tetra Tech, Inc. and the State of Hawaii Department of Land and Natural

The sea-level rise values developed in the 2017 report are used to support guidance and other efforts within state agencies although no official policy, such as legislation, regulations, administrative or executive policy are adopted. The Hawaii Environmental Policy Control Office encourages state agencies to address sea-level rise in Environmental Assessments and Environmental Impacts Statements. When reviewing Environmental Impact Statements, the state Office of Planning may use a web-based sea-level rise inundation mapping platform developed by the Pacific Islands Ocean Observing System to consider how a project is affected by sea-level rise and recommend that the applicant voluntarily consider sea-level rise impacts.²⁰⁰ Currently, there is no guidance with regard to such reviews.

Louisiana

Louisiana has a long history with establishing authorities to address coastal hazards. Act 8 of a special legislative session following Hurricanes Katrina and Rita in 2005 established the Coastal Protection and Restoration Authority and gave it oversight of coastal hurricane protection activities and coastal restoration activities. The law requires the Authority to produce a Comprehensive Master Plan and to update it every five years to incorporate new data, science and planning tools. The first of these plans was released and approved by the legislature in 2007, with updates in 2012 and 2017. The 2017 Coastal Master Plan identifies flooding and sea-level rise as increasing threats to Louisiana's coastline, and includes a list of projects for consideration to improve resiliency including restoration, structural protection, and nonstructural risk reduction projects. Since 2005, the law has been amended and Coastal Master Plans must now be submitted every 6 years instead of 5, and the next plan update will be in 2023.

In 2009, Act 523 was passed creating the Office of Coastal Protection and Restoration, which serves to implement programs of the Authority and which consolidates the activities and efforts of several state agencies working on coastal issues. In 2011 Louisiana Laws Revised Statutes Title 49 RS 49:214.3.1 established the position of the Governor's Executive Assistant for Coastal Activities that reports directly to the governor and works on issues related to coastal protection, including infrastructure, hurricane protection and coastal wetlands conservation and restoration. In 2012, in an attempt to better reflect the nature of the relationship between different programs, Act 604 was passed renaming the Authority as the Coastal Protection and Restoration Authority Board and formally shifted programmatic efforts from the Office of Coastal Protection and Restoration to the Authority. The Act also transferred additional protection and restoration responsibilities from various state entities to the Board and the Authority. In 2016 Governor John Bel Edwards signed Executive Order JBE 2016-09, which references the 2011 law establishing

Resources, Office of Conservation and Coastal Lands, under the State of Hawaii Department of Land and Natural Resources Contract No: 64064. https://climateadaptation.hawaii.gov/wp-content/uploads/2017/12/SLR-Report_Dec2017.pdf

²⁰⁰ <https://www.pacioos.hawaii.edu/shoreline/sl-hawaii/>

the Governor's Executive Assistant on coastal protection and also authorizes certain actions on the part of the Governor. It also directs all state agencies to: "*administer their regulatory practices, programs, projects, contracts, grants, and all other functions vested in them in a manner consistent with the Coastal Master Plan and public interest to the maximum extent possible.*"

Significant effort and analysis went into developing sea-level rise scenarios for Louisiana. Both the 2012 and 2017 Coastal Master Plans contained eustatic sea-level rise scenarios, which measure the predicted change in sea-level measured from the center of the earth to the sea surface. These scenarios were derived from available data and a review of the current literature. The 2017 Coastal Master Plan placed greater emphasis on new observations and predictive modeling generated since the 2012 Coastal Master Plan. Specifically, input for setting the new range included altimetry data, western Florida tide gauge stations, an updated U.S. Army Corps of Engineers Circular #1165-2-212 (USACE, 2011), National Research Council 2012 sea-level rise estimates, a sea-level rise scenarios and regional modifications included in the 2013 5th Assessment Report of the IPCC. The future SEA-LEVEL RISE range in the 2017 Coastal master Plan is 0.14 to 0.83 meters over 50 years.

Louisiana does not have a state act or executive order requiring state agencies and local governments to address sea-level rise.

Instead, the Authority takes an approach in which it uses scientific analyses to guide funding for "shovel in the ground" projects that promote coastal resiliency. A key component of the scientific analysis that is used to guide funding for projects is predictive modeling of the effects of sea-level rise, storm surge and extreme weather events on Louisiana's coast. The Authority partnered with 19 organizations and more than 75 experts with knowledge of coastal systems and experience working in Louisiana to develop several models, such as the Coastal Louisiana Risk Assessment model which takes the combined outputs from several other models to identify flood depths behind structural protection projects and quantifies the cost of predicted direct economic damage caused by flooding.

IMPLEMENTATION THROUGH COASTAL

RESILIENCE INVESTMENTS

CASE EXAMPLE: LOUISIANA

Louisiana offers a case example where the state relies on the use of in-depth science and analytical work to significantly invest in "shovel in the ground" projects designed to enhance coastal resilience rather than taking a directed planning approach. By law, the state Coastal Protection and Restoration Authority (CPRA) must issue a Comprehensive Master Plan for a Sustainable Coast and update it every five years to reflect changes in data and science. The CPRA is authorized to identify, prioritize and implement coastal resilience projects using general state appropriations, federal grants, and enforcement settlement dollars. Projects totaling \$50 billion were identified for implementation in the 2017 Plan with \$25 billion each going to restoration (barrier island, hydrologic, and ridge restoration, marsh creation, sediment diversion, and shoreline protection and structural (\$19 billion) and non-structural (\$6 billion) risk reduction projects. With almost \$18 billion dedicated to marsh creation, the 2017 Louisiana plan represents the country's largest investment in marsh creation using dredge materials and sediment diversion.

The Authority's charge is limited to implementing the projects set forth in the Coastal Master Plan and has no regulatory authority with relation to permitting or other regulatory actions. However, by law the Authority does have a consultative role in reviewing different types of permits in the coastal zone. Therefore, the Authority works closely with the Office of Coastal Management, Louisiana's federally recognized Coastal Zone Management program coastal regulatory permitting agency, within the Department of Natural Resources to coordinate reviews of coastal permits. The Authority is also authorized with coordinating coastal activities of other state agencies, but, to date, state agencies have not been directed to incorporate a science-informed sea-level rise standard into their planning and operations.

Maine

While Maine does not have a coordinated statewide sea-level rise policy, some state agencies have begun to undertake action to address sea-level rise. In the last decade Maine has tried to develop a more coordinated and comprehensive policy to address climate change. In 2013, at the request of Governor LePage, the Environmental and Energy Resources Work Group (EERWG) was created with representatives from several state agencies to identify and coordinate state agency activities to address climate change. The EERWG issued a report in 2014 entitled, "Monitoring, Mapping, Modeling, Mitigation, and Messaging: Maine Prepares for Climate Change," which recommends that:

- ◆ Sea-level rise modeling of the state's coastline be undertaken;
- ◆ Infrastructure upgrades for evacuation routes that are climate vulnerable should be a priority; and
- ◆ The Department of Environmental Protection develop a statewide clearinghouse of climate adaptation resources.

In 2016, more state agencies were added to the EERWG to create the Maine Interagency Climate Workgroup (MICA), which is tasked with providing status updates for each agency's progress to address climate change, and to continue interagency discussions. In 2018, MICA published an update to "Maine Prepares for Climate Change."²⁰¹

The Maine Geologic Survey issued a report in 2006 that provided an overview of sea-level rise impacts within the coastal plain.²⁰² In 2018, the Maine Geologic Survey released a

²⁰¹ Maine Prepares for Climate Change: 2018 Update. Maine Interagency Climate Adaptation Working Group. 2018. <https://www.documentcloud.org/documents/4597645-MainePreparesforClimateChange-2018.html>

²⁰² Impacts of Future Sea Level Rise on the Coastal Floodplain. Peter A. Slovinsky and Stephen M. Dickson. Maine Geological Survey. Open-File 06-14. 2006. https://digitalmaine.com/cgi/viewcontent.cgi?article=1125&context=mgs_publications

web-based sea-level rise mapping platform.²⁰³ The mapping platform uses scenarios of 1, 2, 3.3, and 6 feet on top of the Highest Annual Tide for geographic regions all over Maine.

While there is no state act or executive order that specifically requires state agencies or local governments to address sea-level rise, several state agencies have developed programmatic initiatives. For example, a brownfield redevelopment program requires sites receiving USEPA funding be evaluated for vulnerability to sea-level rise, permitting requirements for siting of underground oil tanks consider sea-level rise, and the state parks program has identified vulnerable infrastructure and ecosystems in the state parks system. Maine's Department of Transportation (DOT) also considers sea-level rise when assessing the vulnerability of its bridges and roads using 1, 2, 3 and 6-ft. scenarios. While it is voluntary for municipalities, the Maine Coastal Program maintains a number of guidance materials to assist municipalities in addressing sea-level rise, such as the Guidelines for Municipal Shoreland Zoning Ordinances, Municipal Climate Adaptations Series, and Flood Resilience Checklist. The Municipal Climate Adaptation Series, through the Municipal Planning Assistance Program is especially useful as it provides municipal governments guidance on best practices for adaptation practices sea-level rise across several programmatic areas such as transportation, wastewater infrastructure, comprehensive planning, and site plan review ordinances. In addition to these guidance documents, the Maine Coastal Program has also partnered with Regional Planning Commissions to work with municipalities to revise comprehensive plans, floodplain ordinances, and planning for the effects of sea-level rise on salt marshes, as well as encouraging implementation of sea-level rise adaptation measures such as a 3-ft. freeboard requirement in local ordinances.

Addressing sea-level rise is local planning is voluntary with the exception of the Mandatory Shoreland Zoning Act (1971), which requires municipalities to establish land use controls for all land areas within 250 feet of coastal wetlands and other tidal waters, among other bodies of water. The Maine Department of Environmental Protection (MDEP) maintains Guidelines for Municipal Shoreland Zoning Ordinances to assist municipalities in writing their ordinances. In 2015 the guidelines were amended to replace the maximum spring tide with highest annual tide. This change considers sea-level rise as an effect of climate change by setting a standard for the setback of structures based on yearly estimates of the yearly estimates of highest tides by NOAA.

Oregon

Oregon has many efforts underway to address climate change adaptation, including sea-level rise, but those do not appear to have a policy focus. In 2007, the Legislature enacted the Oregon Global Warming Commission, which has eleven voting members appointed by the Governor. Staffed by the state Department of Energy, the mission of the Commission is to "recommend ways to coordinate state and local efforts to reduce Oregon's greenhouse gas emissions, and to help the state, local governments, businesses, and Oregonians prepare for the effects of climate change." The same law that created the Commission also created the Oregon Climate Change Research Institute (OCCRI) within the Department of

²⁰³ <https://www.maine.gov/dacf/mgs/hazards/slrs/index.shtml>

Higher Education and administered by Oregon State University. OCCRI is a network of more than 150 researchers at Oregon State University (OSU), the University of Oregon, Portland State University, and Southern Oregon University. Also housed at OCCRI are the National Oceanic and Atmospheric Administration's (NOAA) Pacific Northwest Climate Impacts Research Consortium (CIRC), one of 11 Regional Integrated Sciences and Assessments (RISA) projects and the Oregon State Climate Office. The OCCRI is required to periodically submit a report to the Legislature outlining anticipated climate change impacts to Oregon. The most recent report was issued in January 2017, entitled "Third Oregon Climate Assessment Report," which references the 2013 IPCC sea-level rise projections.

In 2007, Governor Ted Kulongoski appointed the multi-agency Climate Change Integration Group (CCIG) to prepare an adaptation strategy for Oregon, implement and track ongoing adaptation activities and serve as a clearinghouse for Oregon climate change information, as well as identify research priorities with Oregon's universities. In 2008, the Group issued "Oregon's Climate Adaptation Framework" was published with the help of several state agencies and the OCCRI. The report identifies 11 climate risks, two of which are related to sea-level rise: coastal erosion and flooding and loss of wetlands and ecosystems. For each of these risks, the report provides risk assessment results, consequences of the risks to vital sectors, current state agency efforts to address the risk, gaps in agency capacity, needed actions, and priority implementation actions including coordination, research, and resources needed.

In January 2009 and in response to the 2008 Oregon Climate Adaptation Framework, the Oregon Coastal Management Program published "Climate Ready Communities, A Strategy for Adapting to Impacts of Climate Change on the Oregon Coast," which outlines a comprehensive strategy for decision-makers at the local and state level to address the effect of climate change, of which sea-level rise is a large component.

In 2012, the National Academy of Sciences published a brief on anticipated sea-level rise impacts for the coasts of California, Oregon, and Washington.²⁰⁴ In 2017 an Oregon Coastal Management Program NOAA Coastal Fellow developed an overview of statewide sea-level rise projections for 21 of Oregon's coastal estuaries.²⁰⁵

There appears to be no policy, statute, or Executive Order that specifically directs state agencies or local governments to address sea-level rise. The Office of Coastal Management provides funding and technical assistance to municipalities and counties that want to address sea-level rise and helps them incorporate sea-level rise mitigation strategies into their comprehensive plans and other planning programs/regulations. Most of these efforts are through voluntary participation of local governments to address sea-level rise with coastal erosion and loss of wetlands a priority for local planning. To support these efforts,

²⁰⁴ Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. A Report in Brief. National Academy of Sciences. 2012. <https://www.nap.edu/resource/13389/sea-level-rise-brief-final.pdf>

²⁰⁵ Sea-level Rise Exposure Inventory. Julie Sepanik, NOAA Coastal Management Fellow Department of Land Conservation and Development. 2012. <https://coast.noaa.gov/data/docs/geotools/2017/presentations/Sepanik.pdf>

the State has developed a “Model Coastal Erosional Overlay Ordinance” as a source of guidance for local communities. Some counties have joined together to develop their own regional coastal erosion plans, such as Tillamook and Clatsop Counties. The Coastal Management Program also assists local governments develop hazard mitigation plans that incorporate strategies to address sea-level rise and the Coastal Management Program typically encourages municipalities to also reflect conditions in Hazard Mitigation Plans in local comprehensive plans as well. The Oregon Department of Transportation identifies key infrastructure assets vulnerable to sea-level rise using projections. The Department of Transportation’s Hydraulics Manual includes guidance for consideration sea-level rise as part of the design of coastal structures.

Texas

The state’s Coastal Management Program resides in the General Land Office. In 2017 the General Land Office issued the Texas Coastal Resilience Master Plan which is intended to be a “coordinative vehicle that complements various coastal planning and coastal management initiatives of other entities at the federal, state and local level.” The Plan identifies restoration projects and priorities for specific locations and regions in four areas of the Texas coast. It has a very strong emphasis on nature based solutions to enhance coastal resilience and is intended to inform the General Land Office’s use of its resources and authorities to restore, enhance and protect the Texas coast. In its development of the Plan, the General Land Office formed a Technical Advisory Committee comprised of state and regional coastal experts from state and federal agencies, universities, local governments, non-profits, engineering firms, port representatives, regional trusts, foundations and partnerships. The planning team evaluated more than 900 potential projects within watersheds and beach subregions located in the four regions of the Texas coast. Project screening reduced the list of candidate projects to 177, which were further designated as Tier 1 (high priority), Tier 2 and Tier 3 projects. Tier 1 projects are listed in the master plan document. Additionally, the Plan includes a cost-benefit analysis of specific coastal restoration projects. The cost-benefit analysis conducted for the Plan was conducted by General Land Office staff and is intended to point decision-makers to the economic benefits of restoration activities of coastal natural resources. The General Land Office’s intent is to use the Coastal Resilience Master Plan as a vehicle to secure funding for large scale beach, dune, and wetland habitat restoration projects, as well as other natural infrastructure projects for coastal resilience.

The Harte Research Institute for Gulf of Mexico Studies at Texas A&M University at Corpus Christi is undertaking a sea-level rise assessment with private foundation funds. The project will study sea-level rise and its impact on the Texas Gulf Coast, including the development of inundation mapping based on different sea-level rise scenarios.

Texas has always recognized the public’s common-law right to access its 367 miles of Gulf Coast beaches. To protect and enhance those rights, the state adopted the Texas Open Beaches Act in 1959. The Act codifies the public’s unrestricted right of access to “public beaches” which the statute defines as the area bordering the Gulf between the mean low tide line and the inland vegetation line. The Act recognizes that, due to natural coastal

processes, the physical structure of beaches, including the vegetation lines that delineate them, are constantly moving. But under the Act, the public's right of access moves along with them. Under the Texas approach, public beaches and their attendant public rights move and exist regardless of what structures are in their path, be they fences, bulkheads, private homes or hotels. If such structures interfere with public access, the Act authorizes the State to order their removal.²⁰⁶ Although the Act was adopted for the purposes of ensuring public access to coastal resources, the Coastal Management Program views the provisions as a strategy to advance sea-level rise adaptation by ensuring that as the water level rises, the public beach area continually moves back, allowing for movement and inland migration of vegetation and related habitat. In 2012, the Supreme Court of Texas ruled that rolling easements are created only through the gradual process of erosion, not through sudden land erosion following severe weather events. In response, the Texas Open Beaches Act was amended by House Bill 3459 in 2017 to grant the Commissioner of the General Land Office the authority to suspend the determination of the line of vegetation after it is destroyed by a "meteorological event" and to then determine the location of the new line of vegetation. The new law defines "meteorological event" to include both atmospheric conditions that cause a sudden loss of land (avulsive events) as well as those caused by accretion and erosion. Implications of the recent actions in Texas on coastal resilience policy are unclear.

Washington

The 2009 State Agency Climate Leadership Act directs state agencies to develop a climate change response framework to assist state agencies, local governments, and private entities to prepare for, address, and adapt to climate change. It directs the Washington Department of Ecology to serve as the central clearinghouse for scientific and technical information regarding climate change impacts in Washington and to collaborate with other agencies and departments to develop the integrated climate change response strategy. The integrated climate change response strategy is intended to assist state agencies, local governments, and private entities to prepare for, address, and adapt to climate change. Governor Gregoire's E2009 Executive Order 09-05, *Washington's Leadership on Climate Change*, directed the Washington Department of Ecology (DoE) to work with local governments and state agencies to develop recommendations, guidance, and tools that can be used to assist these jurisdictions to address sea-level rise. In response to both actions, in 2012 the Department of Ecology published *Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy*, which includes recommendations and strategies for state agencies and local governments to address climate change in several focus areas, including health, habitat management, and infrastructure.

The Washington Coastal Hazards Resilience Network is a partnership of public and private sector coastal management professionals from state and federal government agencies, tribes, nonprofit organizations, consulting firms and academic institutions. Membership in

²⁰⁶ Texas Open Beaches Act, Texas Natural Resources Code, Chapter 61, § 61.012; 61.013(c); 61.0183. (TX Nat Res. § 61.)

the network is open and the Network is co-managed by the state Department of Ecology and Washington Sea Grant. Established in 2013 with seed funding from NOAA, the Network serves to provide participants with a structured mechanism to share best available science, strategies and tools regarding coastal hazards. In 2018, the Network partners offered sea-level rise projections for Washington using the probabilistic approach developed by Kopp et al. 2014. The report produced sea-level rise projections for the years 2050, 2100, and 2150 for two greenhouse gas scenarios, "low" and "high." Six scenarios were generated: a high and low greenhouse gas emission scenario for the years 2050, 2100, and 2150. Because vertical land movement is a very pertinent issue in Washington and has a significant impact on sea-level rise locally, the report also includes relative sea-level rise projections that take into account vertical land movement for more than 170 locations on Washington's coastline²⁰⁷.

Washington's relies on several state laws for implementation of its provisions under the federal Coastal Zone Management Act. The Shoreline Management Act is the only state law specifically related to sea-level rise. All coastal local jurisdictions must prepare a Shoreline Master Plan (SMP). Because addressing sea-level rise is voluntary for both state agencies and local governments, sea-level rise is addressed across several programmatic areas. Since most municipalities address sea-level rise through their SMPs, land use planning is a common area for sea-level rise planning strategies. *Washington State's Integrated Climate Change Response Strategy* includes a number of recommendations and strategies for municipalities and state agencies to consider to address sea-level rise spanning several programmatic areas, such as health, ecosystems and habitat management, water resources, infrastructure, and public engagement. While local jurisdictions are not specifically required to address sea-level rise in their Shoreline Master Plans, the Washington Department of Ecology (DoE) maintains a Shoreline Master Program Handbook, in which there is an appendix (Appendix

TRANSPORTATION ASSET APPLICATION OF SEA LEVEL RISE VALUES

CASE EXAMPLE: WASHINGTON

In 2011, the Washington State Department of Transportation (WSDOT) completed a statewide Climate Impacts Vulnerability Assessment for transportation assets. Following on from that assessment, WSDOT began to provide guidance for project teams to consider sea level rise as part of environmental review processes under NEPA and SEPA for other capital and programmatic investments. For example, the Mukilteo Multimodal Terminal project included design accommodations for 2 and 4 feet of sea-level rise in the Final Environment Impact Statement. In addition, the guidance has been used with regard to several projects considering the influence of sea level rise on strategies for wetland and aquatic resource mitigation strategies resulting from transportation improvements to ensure mitigation benefits are sustainable for decades to come.

²⁰⁷ Miller, I.M., Morgan, H., Mauger, G., Newton, T., Weldon, R., Schmidt, D., Welch, M., Grossman, E. 2018. Projected Sea Level Rise for Washington State – A 2018 Assessment. A collaboration of Washington Sea Grant, University of Washington Climate Impacts Group, Oregon State University, University of Washington, and US Geological Survey. Prepared for the Washington Coastal Resilience Project. <http://www.wacoastalnetwork.com/files/theme/wcrp/SLR-Report-Miller-et-al-2018.pdf>

A, *Addressing Sea-Level Rise in Shoreline Masters Programs*) which provides local jurisdictions with guidance on how to address sea-level rise as part of shoreline master planning. The Washington Growth Management Act (Chapter 36.70A of the Revised Code of Washington) requires local governments to identify and gather the most current, accurate, and complete scientific and technical information available with regard to land use planning.

The Washington State Department of Transportation issued guidance for use in reviewing projects under the National and State Environmental Policy Acts (NEPA and SEPA) which includes guidance associated with consideration of climate change. As part of the guidance, the Department's advises that project developers should be considering how their proposed project will be affected by climate change. The guidance points to sustainable transportation planning strategies, including climate change impacts that were developed as part of a pilot program grant from the Federal Highway Administration.²⁰⁸ The NEPA and SEPA guidance directs project managers to document: "whether or not climate change will exacerbate the effects of a proposed project on environmental resources; and whether or not climate change will exacerbate the effects on vulnerable populations." As part of this consideration, project managers are advised to "include consideration of ways to address vulnerability of Environmental Justice populations, transit dependent, or residents with special transportation needs."²⁰⁹

There is a high degree of collaboration among state executive agencies with regard to advancing sea-level rise programs. There is an informally-created staff-level Interagency Climate Adaptation Network, coordinated by the Department of Ecology, that provides agencies with an opportunity to share efforts to integrate climate adaptation strategies into state agency planning practices and policies. Additionally, the Washington DoE has strong working relationships with other state agencies and private institutions including Washington Sea Grant. For example, in 2013 the DoE and Sea Grant undertook the Washington Coastal Resilience Project in a set of coastal communities and DoE participates in the WCHRN which includes more than 100 members of coastal hazards and climate change practitioners from federal and state government agencies, tribes, academic institutions, consulting firms, and nonprofit organizations. Through these networks the DoE has been able to help state agencies and local governments address sea-level rise in their planning and policies without directed authority.

C. IMPLEMENTATION APPROACHES

C.1. INTEGRATION INTO STATE POLICY

There is a diversity of experience among the target states as to the mechanisms by which they may include provisions regarding sea-level rise into state-level policies including state capital investment and management of state assets, long-term planning, standard setting/permits, and environmental impact reviews.

²⁰⁸ <https://www.wsdot.wa.gov/SustainableTransportation/adapting.htm>

²⁰⁹ <https://www.wsdot.wa.gov/sites/default/files/2017/11/15/ENV-Climate-ClimateGuidance.pdf>

State Capital Investment and Management of State Assets – Examples include:

- ◆ **New York** – The 2014 Community Risk and Resiliency Act adds mitigation of climate hazards to the State's list of smart-growth criteria for public infrastructure investment. Additionally, the 2018 technical guidance issued by the New York Department of Environmental Conservation pursuant to the Act New York includes provisions regarding mitigation of risk due to sea-level rise, storm surge, and flooding in the approval and funding of public infrastructure, project design, facility-siting and funding programs by state agencies, including the Water Pollution Control Revolving Fund, the Drinking Water Revolving Fund;
- ◆ **Virginia** – 2018 Executive Order 24 requires the establishment of a unified Sea-Level Rise Projection and a freeboard Standard for State-Owned Buildings;
- ◆ **Maryland** – 2015 Adoption of Coast Smart siting and design criteria that are applied to any state capital project that includes the construction of a structure or reconstruction of a structure with substantial damage and was amended in 2018 to include highways.

Long-term planning – Examples include:

- ◆ **New York** – 2018 Guidance issued pursuant to the 2014 Community Risk and Resiliency Law directs consideration of planning, funding and design of programs related to open space and farmland acquisition, recreation and historic preservation, landfill closures; waterfront revitalization; the Department of Transportation state Bridge Manual that governs design of almost all bridges in the state and the state Department of Health as part of its long-term population health efforts.
- ◆ **Massachusetts** – 2018 issuance of the State Hazard Mitigation and Climate Adaptation Plan in response to Executive 569. The Plan outlines a comprehensive integration of sea-level rise projections, and other natural hazards, into statewide hazard mitigation planning pursuant to the federal Stafford Act, including directing integration of sea-level rise mitigation strategies into capital facilities and infrastructure, public health planning and long term hazard mitigation planning.
- ◆ **Delaware** – 2016 publication of guidance to state agencies for complying with provisions of 2013 Executive Order 41 that directs agencies to develop plans to address impacts of climate change, including sea-level rise.
- ◆ **Maryland** – 2010 Department of Natural Resources policy that directs consideration of climate change impacts, including sea-level rise, storm surge and shoreline erosion, as part of the agency's consideration of all potential land acquisitions using open space funding. Other properties are reviewed for their potential to enhance public benefits of climate change adaptation and mitigation.

Standard setting/permits – Examples include:

- ◆ **Rhode Island** – 2018 Adoption of a Shoreline Change Special Area Management Plan, known as the Beach SAMP, which sets forth the process through which

development permit applicants will use the state's sea-level rise projections and coastal hazard exposure assessment tools to address coastal hazards associated with climate change.

- ◆ **New York** – The 2014 Community Risk and Resiliency Act law requires the State to develop guidance on how to incorporate sea-level rise and future flood risk into applications for specified permits and standards, including programs, standards and codes regulating fire prevention and building codes; oil and natural gas wells; sewerage service, liquefied natural gas and liquefied propane facilities, mined land reclamation, freshwater wetlands, tidal wetlands, coastal erosion hazard areas; hazardous waste transportation, storage and distribution facility siting; petroleum and hazardous substance bulk storage.

Environmental Impact reviews – Examples include:

- ◆ **Massachusetts** – 2014 issuance of draft guidance for use in review applications under the Massachusetts Environmental Policy Act that requires applicants to prepare a Climate Impact Assessment that is designed to: evaluate potential impacts of changing climate conditions including sea-level rise, and evaluate the effectiveness and feasibility of measures to reduce hazards and increase resilience. The policy refers to state sea-level rise values as well as provides detailed guidance on the required components of the Climate Impact Assessment.
- ◆ **Washington** – 2017 Guidance from the Washington State Department of Transportation's Environmental Services Office regarding consideration of climate change impacts into National and State Environmental Policy Acts (NEPA and SEPA). The 2017 Washington guidance is consistent with guidance issued in 2016 by the federal Council on Environmental Quality's for use by federal agencies in considering impacts of climate change as part of National Environmental Policy Act (NEPA) reviews.

C.2. INTEGRATION INTO LOCAL GOVERNMENT POLICY

Several states have statutory authority to address sea-level rise in local comprehensive planning and/or hazard mitigation planning. Several states have specific statutory authority to integrate sea-level rise into local planning (Table 9).

TABLE 9: STATES WITH STATUTORY AUTHORITY TO MANDATE LOCAL SEA-LEVEL RISE ACTIONS:

State	Name	Provisions
CALIFORNIA	CHAPTER 592 An act to add Section 6311.5 to the Public Resources Code, relating to state lands. 2013.	Amends the Public Trust Doctrine to require trustees of public lands with gross revenues of more than \$250,000 to annually assess how it proposes to address sea-level rise using currently available science.
	Amendments to the General Authority for and Scope of General Plan; 2015. Chapter 3, Article 5, Section 65302.. 2015.	Requires local governments to review and update the safety elements of their general plans to include climate change adaptation and resiliency strategies.

CONNECTICUT	An Act Concerning Climate Change Planning and Resiliency; 2018. Public Act 18-82.	Requires that sea-level rise projections be updated every ten years and that the most recent sea-level values be used in municipal evacuation and hazard mitigation plans.
MARYLAND	The Sea-Level Rise Inundation and Coastal Flooding Act. Chapter 628 of 2018.	Includes many provisions including those that require municipal plans to address nuisance flooding.
RHODE ISLAND	Public Law Chapter 403 amends Rhode Island General Laws §45-22-7 Chapter 45-22.2 2017.; Section 45-22.2-6	Amends requirements of planning board or planning commission members to require that each member of a planning board or commission must participate in training and education classes concerning the effects of development in a flood plain and the effects of sea-level rise once every two years. Adds addressing natural hazards to the requirements of comprehensive planning by municipal governments, including identification of areas that may be vulnerable to sea-level rise and to identify strategies to minimize effects of natural hazard in its jurisdiction.
MASSACHUSETTS	An Act Promoting Climate Change Adaptation, Environmental and Natural Resource Protection and Investment in Recreational Assets and Opportunity (H. 4835). 2018.	Directs state agencies to create a resilience planning framework for use by regional and local governments; provides funding for implementation of many state and local resilience projects identified in the State Hazard Mitigation and Climate Adaptation Plan; and directs state agencies to provide local governments with technical assistance.
VIRGINIA	SB 1443, Comprehensive Plan: Strategies to Combat Projected Sea-Level Rise, 2016.	Requires all localities in the Hampton Roads Planning District Commission to incorporate strategies to address sea-level rise and recurrent flooding in the next scheduled and all subsequent reviews of its comprehensive plans.

C.3. INTEGRATION INTO POLICY AFFECTING PRIVATE SECTOR

Many states have identified or adopted science-informed sea-level rise science values and provided guidance for how that science can be used by their state and local agencies to address the impacts of sea-level rise. Additionally, states have gone a step further to engage either directly or indirectly, private property owners in sea-level rise adaptation efforts. The Rutgers Team identified efforts in four states in which the states' efforts engage the private sector in sea-level rise preparedness: Maryland, through Coastal Resilience Conservation Easements; Rhode Island, through its development permitting process; California, through the Public Trust Doctrine; and Texas, through Rolling Easements.

Maryland Coastal Resilience Conservation Easements: Maryland's efforts to address SLR include the preservation of natural areas owned by private entities and individuals through Coastal Resilience Conservation Easements (Easements). Implemented by the

Department of Natural Resources (DNR), the Easements serve several purposes, including incorporating development setbacks in areas subject to SLR inundation, setting impervious surface limits to reduce runoff from increased storm events and flooding, and facilitating appropriate shoreline stabilization projects.²¹⁰ However, one of the most important uses of the Easements is the protection of Wetland Adaptation Areas, which are areas that if left intact, will allow wetlands to migrate inland as sea-level rises. Since its inception, the DNR was granted the statutory authority to protect land through acquisition and easements. The statute that created and sets forth the powers and duties of the DNR states that the agency “shall negotiate the acquisition of real property for open space, recreation and other purposes...”²¹¹

A “Building Resilience to Climate Change” policy adopted by the DNR in 2010 connects its land purchasing authority with climate change and SLR. Under this policy, the DNR must “proactively seek the protection of lands that enhance the resilience of the bay, aquatic and terrestrial ecosystems and/or mitigate the impacts of climate change...” The policy also requires the DNR to “review all proposed land acquisitions and conservation easements to assess the potential impacts of climate change and sea-level rise...” and, where necessary, consider limitations on future use of the property.²¹²

Funding for land conservation, including fee simple purchases and easements, is provided through Maryland’s Program Open Space that is funded through a .05% transfer tax on every real estate transaction in the State. The funds are overseen by the Maryland Board of Public Works (BPW) and, in accordance with the aforementioned DNR Climate Change policy, all parcels being considered for BPW approval must be reviewed for their vulnerability to climate change.²¹³ Because the Easements in question are resilience related and located in the State’s coastal zone, additional funding sources are appropriate, such as resilience funding, disaster recovery funding and, as is the case in the Easement example discussed below, Coastal Zone Management funding. To assist in determining whether a property is eligible for conservation funding, the DNR has developed a checklist that evaluates the attributes of each property, including its potential for inundation by 2050 and 2100. Through a companion data guide, the evaluation directs the assessor to the DNR’s Coastal Atlas to aid in the information gathering. In addition to meeting the Policy objectives, the evaluation ensures that conservation funds won’t be spent on properties that will be lost due to inundation.²¹⁴

²¹⁰ Maryland Department of Natural Resources Website, https://dnr.maryland.gov/ccs/Pages/habitats_slr.aspx, Climate Change and Coastal Conservation, Coastal Resilience Easements

²¹¹ ²¹¹ MD Code Ann., Natural Resources, § 1-109 (2017).

²¹² Building Resilience to Climate Change, Maryland Department of Natural Resources, Policy Number 2010:11.

²¹³ https://taxes.marylandtaxes.gov/Individual_Taxes/Individual_Tax_Types/Income_Tax/Filing_Information/Determine_Tax_Credits_and_Deductions/Preservation_and_Conversation_Easement_Credit.shtml

²¹⁴ See conservation criteria checklist,

https://dnr.maryland.gov/ccs/Documents/MDCPEForm_July2011.pdf; see also data guide, https://dnr.maryland.gov/ccs/Documents/MDCCDataGuide_July2011.pdf

Restrictions placed upon each property will vary and must be tailored to protect its specified Conservation Attributes. The Easement also requires the parties to set forth the uses or activities that will be allowed on the property. Additional analysis or plans for the property may be required depending upon the type and size of property involved, the level of SLR inundation anticipated and the purpose of the Easement. For example, if the property is located within a 0 to 2 foot SLR inundation zone or has 5 acres or more of adaptation areas, consultation with a DNR coastal planner is required. In addition, the landowner will be offered the opportunity to work with the DNR to develop a Voluntary Coastal Resilience Plan at no cost to them, a service that is also offered to any landowner upon request. If the property contains more than 5 acres of contiguous woodland, a Forest Stewardship Plan must be prepared by a licensed, registered forester and approved by the DNR within one year of the date the Easement was executed.

Benefits realized by the Grantors of an Easement vary and are dependent upon each owner's objectives and needs. Landowners may want to protect the property from development after they sell the land or after their death, or they may want to reduce the estate tax burden for those who will inherit the land upon their death. They may want the property maintained in a manner that protects inland property and structures from SLR and increased flooding and storm surge. The transaction may provide them with much needed funds for other endeavors or, if the Easement is donated, provide them with significant federal and state tax deductions.²¹⁵ These benefits can be realized through an Easement while allowing the property owner to retain ownership of the land.

To date, the DNR has obtained one Coastal Conservation Resilience Easement in 2013. The Easement protects 221 acres in Dorchester County along the historic Harriet Tubman Underground Railroad National Historical Park and Scenic Byway, less than a mile from the Blackwater National Wildlife Refuge. The Easement was granted to a private property owner and is co-managed by the DNR and the Eastern Shore Land Conservancy (ESLC).²¹⁵

The DNR employs an indirect approach of allowing third-party experts to serve as expert intermediaries to assist in acquisition, removing the intimidation and opposition that often occurs when a State agency is seen as targeting private property for any reason. The most difficult aspect of the Easement program is finding willing sellers, and the DNR hopes to bolster its efforts by increasing community outreach. Part of the outreach will be to tout the potential benefits to landowner participation and reassure landowners that existing uses can continue.²¹⁶

²¹⁵ "First of its Kind Easement from Sea Level Rise Impacts", Southern Maryland News Net, August 23, 2013; Telephone interview of Kelly Collins, Center for Coastal Planning, Chesapeake and Coastal Service, MD Department of Natural Resources, December 18, 2018 (Collins Interview).

²¹⁶ Collins Interview

California Public Trust Doctrine: California's public trust lands are held in trust by the state for the benefit of its citizens and cannot be sold to private persons or entities. However, the state can grant public trust lands to local municipalities to act as trustees for such lands within their jurisdictions (local trustees). The grants are effectuated by the legislature through statutes and to date, 300 statutes granting public trust lands to more than 80 local municipalities have been enacted.²¹⁷ The specific uses allowed by each local grant vary and are detailed in the granting statutes. Some authorize the construction of structures that facilitate commerce and navigation, such as ports, harbors, airports, wharves, docks and piers. These enterprises are operated by private entities that are tenants of the local trustees and, while the tenants own the structures they build to facilitate operations, they never own the land underneath.²¹⁸ Other granting statutes specify that the lands can be utilized for open space or recreational purposes only. Any revenues generated by the local trustee from the authorized uses are considered to be state trust assets and must be reinvested back in the trust. The funds must be kept separate from the local municipality's general fund and cannot be used for any purpose unrelated to the trust.

Although public trust lands are managed by the local municipal trustees, the legislature granted the responsibility for oversight of all trust lands to the State Lands Commission (the Commission).²¹⁹ It is up to the Commission to ensure that the local trustees utilize their grants in accordance with applicable laws, including the California Constitution, the respective granting statutes and the Public Trust Doctrine. In accordance with its oversight responsibilities and a California statute known as AB-691, the Commission is requiring local trustees to prepare and submit a detailed assessment describing how they intend to protect their trust lands from SLR.

In 2013, California adopted Assembly Bill 691 (AB-691) as an addition to the state lands section of the California Public Resources Code.²²⁰ The statute requires local trustees of public trust lands to submit to the Commission by no later than July 1, 2019, a detailed assessment of how they propose to address SLR. The requirement applies only to trustees with annual trust revenues greater than \$250,000, which comprise 32 of the 80 local trustees, and ensures that public trust lands with significant infrastructure, such as ports and airports, are included. The language of AB-691 connects the SLR assessment to the fiduciary duties of the trustees, the importance of trust lands to the state economy, and the reports, policies and SLR science developed and adopted by the California Ocean Protection Council and other State entities. Because the assessment is directly related to the operation and management of the trust lands, the statute authorizes the use of local trust revenues to finance the assessment.

²¹⁷ California State Lands Commission website, http://www.slc.ca.gov/Programs/Granted_Lands.html, Granted Public Trust Lands.

²¹⁸ Telephone interview of Maren Farnum, Environmental Scientist and SLR Specialist, California State Land Commission, December 19, 2018 (Farnum Interview).

²¹⁹ See CA Public Resources Code, § 6301, which states "all jurisdiction and authority remaining in the state as to tidelands and submerged lands as to which grants have been or may be made is vested in the Commission."

²²⁰ AB 691, Chapter 592, CA Public Resources Code, §6311.5, October 5, 2013.

The crux of AB-691 is the requirement that trustees estimate the financial costs of SLR.²²¹ To do this, the assessment must include the following for each of the years 2030, 2050 and 2100 based upon the most recent state SLR projections in combination with a 100 year storm event:

- ◆ An inventory of vulnerable natural and built resources and facilities and a prioritization of the vulnerabilities to be addressed;
- ◆ Replacement or repair costs of impacts to the resources and facilities inventoried;
- ◆ Calculate the non-market values of impacts to recreation and ecosystem services;
- ◆ A description of proposed mitigation/adaptation measures that can be utilized to address the vulnerabilities; and
- ◆ The estimated costs of the mitigation/adaption measures and their potential benefits.

This information will allow for a direct comparison of the costs of a defensive approach to SLR versus an offensive approach to SLR and a determination of whether mitigation and adaptation measures are cost effective.²²² The detailed information required for the cost estimates is such that local trustees must work closely with the private tenants to prepare the assessment.

Despite the July 1, 2019 deadline, several local trustees have already submitted SLR assessments to the Commission, including the Port of Long Beach. The assessment of this California mega-port demonstrates the complexity of this task and some of the issues that arise in its preparation.²²³ The Port trust lands consist of 3,000 acres of land and 4,600 acres of water and the land underneath. The Port's asset inventory is lengthy, and includes 10 piers, 80 berths, 66 post-Panamax gantry cranes, and 22 shipping piers to facilitate transport of cars, lumber, steel, iron ore, petroleum coke, salt, gypsum, cement and liquid petroleum. Additional "wharf assets" were identified, including mooring and wharf structures, fender systems and lifting and unloading equipment; "backland assets" such as pavement, storage areas and facilities, truck loading and unloading facilities and conveyer systems; and "utilities assets" including sewer conveyance systems and pumps, storm drain and pump systems and electrical, lighting and communication systems.²²⁴

Mitigation/adaptation measures identified by the Port for each scenario are:

16" SLR + 100 (2030): Improve seawalls, install semi-permanent/temporary barriers to protect key transportation links and update all Port plans, policies and design guidelines to address SLR

²²¹ See, <http://www.slc.ca.gov/Info/AB691.html>

²²² If a local trustee determines that, based on the most recent state SLR guidance, its public trust lands are not subject to sea level rise by 2100, the trustee is exempt from the SLR assessment requirement.

²²³ To view the entire assessment, see <http://www.slc.ca.gov/Info/AB691/Assessments/POLB.pdf>

²²⁴ Port of Long Beach Climate Adaptation and Coastal Resiliency Plan, accepted by the Commission as its AB-691 SLR assessment (hereafter Port Assessment), p. 27.

36"SLR + 100 (2050): All of the 16" measures plus improve seawall to protect overtopping at piers A, B, C and D;

55" SLR + 100 (2100): All of the 16" and 36" measures plus install semi-permanent/temporary barriers to protect key transportation routes and links.

The Port prepared a "high level financial analysis" that did not include direct financial impacts or cost estimates due to the purported confidential nature of the value of the cargo, the port functions and facility equipment damage implications. However, it did consider these impacts and costs in a qualitative tiered categorization approach to classify impacts as "low", "medium" or "high" under each SLR scenario.²²⁵ Below is a table demonstrating the results of the Port's cost analysis.²²⁶

Port of Long Beach Cost of Repairs vs Cost of Mitigation Analysis					
SLR Scenario	Repair Costs	Impact of Disrupted Port Functions	Cost of Mitigation/Adaptation Measures	Cost Benefit of Mitigation/Adaptation Measures	Mitigation/Adaptation Cost Effective? (benefits > cost?)
16" + 100	Medium	High	Medium	High	Yes
36' + 100	Medium	High + loss of transportation infrastructure	High	High	Yes
55" + 100	High	High + loss of transportation infrastructure	High	High	Yes

The Port assessment concluded that, in all three SLR scenarios, the benefits of the proposed mitigation and adaptation measures outweighed the costs and that all such measures were cost effective. Because of the limited natural resources on its trust lands, the Port did not address non-market values.

While the Commission is pleased with the valuable information provided by the assessments, there are some notable implementation issues:²²⁷

- ◆ AB-691 provides no approval process or criteria to measure the assessments once they are submitted and no enforcement mechanism if the Commission is not satisfied with the effort. To date, the local trustees have been reasonably cooperative and have incorporated suggestions made by the Commission. However, other than require the submission of a document that contains the statutory elements, the Commission cannot compel local trustees to act.²²⁸

²²⁵ Port Assessment, p. 159-160.

²²⁶ Table created from information in Discussion of Findings Section, Port Assessment, p. 162.

²²⁷ Farnum Interview.

²²⁸ The legislature considered incorporating an approval process into AB-169, but there is such a variation between the local trustees that it could not come up with a set of uniform standards. While some believe that

- ◆ As indicated in the Port of Long Beach Assessment, local trustees are having difficulty assessing, and some are just paying less attention to, the non-market values of public trust resources that could be impacted by SLR, such as public access, recreation and ecosystem services. The Commission has provided guidance on how to calculate non-market values and works closely with local trustees to assist them, but the lack of assessment approval criteria makes this difficult to dwell on.
- ◆ Although the purpose of AB-169 is to assess the impact of SLR on the State's public assets, the process inevitably involves the numerous private entities that lease the public trust lands from the local trustees and that own the structures they have built to run their operations (e.g., shipping companies, terminals, shops, restaurants). This requires the local trustees to work with their tenants and subtenants to obtain the information necessary for the assessments. The ports are very concerned that the assessment process will cause them to lose valuable tenants because. However, because the assessment is a State-wide requirement, there is nowhere within California for the tenants to relocate their water-dependent operations that will relieve them of their assessment obligations.
- ◆ The ports are also concerned with the release of the damages and costs associated with climate change and sea-level rise and the impacts it might have on their investors, investment portfolios and insurers.

The Navy has been very supportive of the Commission's efforts, with significant support coming from naval installations adjacent to the Port of San Diego and Port of Hueneme. The Port of San Diego is a designated "strategic port" for military uses and, in a first of its kind partnership, the Port and the Commander Navy Region Southwest have reached an agreement to work together to address the effects of SLR. Because of the significant threats SLR poses to all naval installations regardless of their location, the Navy has been very proactive in its own SLR assessments.²²⁹

The information the Commission obtains from the assessments is the first step in a larger effort that will entail an evaluation of all the assessments to (i) identify and prioritize the most vulnerable resources; (ii) identify the most commonly-preferred mitigation and adaptation approaches; (ii) determine an estimate of the statewide costs of SLR; and (iv) develop meaningful recommendations, including a state financing mechanism, to support local implementation efforts.²³⁰

Rhode Island Coastal Permitting: In 2008, Rhode Island incorporated a Climate Change and Sea-Level Rise policy into its Coastal Resources Management Program (CRMP) based on the best science available at that time. A special chapter of the June 2018 RI Shoreline Change Special Area Management Plan, known as the Beach SAMP, sets forth the process

the local trustees' cooperation is due in part because they are not under strong regulatory pressure to do so, the consensus is that an approval or authorization process would be helpful.

²²⁹ Farnum Interview; "Port of San Diego and U.S. Navy Make Plans for Sea Level Rise", The Maritime Executive, May 17, 2018.

²³⁰ Farnum Interview

through which development permit applicants will use SLR projections and STORMTOOLS to address coastal hazards associated with climate change.

By adopting its SLR policy as part of its CRMP, Rhode Island is carrying out the intent and mandate of the Coastal Zone Management Act (CZMA), and ensuring the broad application of the policy throughout the State. The CZMA is clear in its mandate that coastal states plan for SLR, including in the statute's Congressional Findings, which state: "*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.*"²³¹ In addition, to gain NOAA approval, the CZMA requires every Coastal Management Program to incorporate certain elements, including "the study and development of plans for addressing the adverse effects of...sea-level rise."²³² The CZMA also encourages coastal states to prepare SAMPs setting forth with specificity how they will protect natural resources, their economies, and life and property in areas likely to be affected by SLR.²³³ Rhode Island's SLR policy carries out these important CZMA objectives.

In June, 2018, the CRMC adopted a Shoreline Change SAMP, also known as the Beach SAMP, to provide guidance and tools for the state and local decision makers to prepare and plan for coastal storms, erosion and sea-level rise.²³⁴ Chapter 5 of the Beach SAMP contains the Rhode Island CRMC Coastal Hazard Application Guidance ("Guidance"), which was developed to ensure that CRMC-approved projects are designed and built with the applicant's acknowledgement of the risks of building in coastal hazard areas exposed to storm surge, erosion and sea-level rise.²³⁵ The Guidance sets forth a five-step process that applies to applications for new and substantial improvements to properties within the planning boundary of the Beach SAMP. The planning boundary is defined as the coastal area projected to be inundated by a 100-year storm plus seven feet of sea-level rise. This includes some portion of all 21 of Rhode Island's coastal communities. Utilizing the various tools and other assistance provided by the CRMC, applicants with projects in the planning boundary must:

- ◆ Choose a projected design life for the project - a 30-year minimum is recommended to correspond to a typical mortgage - and identify a projected SLR for the project site;
- ◆ Using the SLR value from step 1, (a) determine what impact SLR will have on the site and on access roads to the site; (b) determine the STORMTOOLS design elevation (DSE); (c) calculate projected erosion at the project site; and (d) consider other risk factors that might impact development, such as coastal habitats, shoreline features, public access, stormwater, depth to water table/groundwater, and saltwater intrusion.

²³¹ 16 U.S.C. § 1452 (l)

²³² 16 U.S.C. § 1452 (2)

²³³ 16 U.S.C. § 1452 (3)

²³⁴ Beach SAMP, p. 1-3.

²³⁵ Beach SAMP, p. 5-2.

- ◆ If the project is large (6 or more units) or a subdivision, consult the SLAMM maps to assess the potential impacts to coastal wetlands under future conditions. Determine whether the project accommodate or impeded coastal wetland salt marsh migration resulting from SLR? (a 5-foot SLR projection within SLAMM is recommended). Skip this step if the project is not a large project or subdivision.
- ◆ Identify, document and assess the feasibility of design techniques that could serve to avoid or minimize risk of losses. The Guidance notes that this may involve an “iterative process” that leads to one or more alternatives for the project site. Design options and alternatives may include relocation, elevation or fortification to avoid or lessen risks. The applicant is encouraged to select the alternative that will avoid or minimize the risks to the project, abutting structures, infrastructure and coastal resources.
- ◆ Complete and submit the permit application for CRMC staff review. The information and analysis in steps 1-4 should provide the information necessary to assess current and future site conditions and clearly articulate the level of risk the applicant is willing to accept during and after project construction.²³⁶

All projects that meet the planning boundary criteria will be examined through this process for SLR and other coastal hazards to empower the applicant to make an informed decision on the long term use and viability of their project.²³⁷

Although this is a very new program – the Guidance was adopted in June 2018 – it has already proven successful. For example, an applicant for a large commercial project proposed in the City of Newport recently went through the five-step process. The applicant selected a project design life of 30 years and the projected SLR for the site was determined. This demonstrated that, well within the 30-year time frame, the entire parking area, which was proposed at ground level under the buildings occupied floors, would be fully submerged. The CRMC advised that to receive a positive project assessment, the applicant would have to add two feet of freeboard to the parking lot. Due to height restrictions in the area, this required the applicant to obtain and submit a project redesign. The applicant also agreed that if the project life extends beyond 30 years, the parking area will have to be relocated off site to accommodate for increased SLR.²³⁸

Despite the public outreach associated with the Guidance, applicants that have gone through Rhode Island’s process stated that they were “taken by surprise.” Several noted they had already gone through numerous planning and approval processes on a local level, during which SLR was never mentioned. This was true in the example set forth above, even though increased and continuous flooding had already resulted in the installation of storm water system flapper valves in and around the project site. However, once the applicants went through the process with CRMC assistance, they understood the issues involved and adjusted their projects accordingly. The CRMC believes that when the program goes into

²³⁶ Beach SAMP, p. 5-25.

²³⁷ Beach SAMP, p. 5-23,5-24

²³⁸ Telephone interview of Grover Fugate, Director, RI Coastal Resources Management Council, December 19, 2018 (Fugate Interview)

full effect in January 2019, the surprise factor will no longer be an issue, and is hopeful that there will be opportunities to engage local governments in the process.²³⁹

Texas Open Beaches Act: Texas has always recognized the public's common-law right to access its 367 miles of Gulf Coast beaches. To protect and enhance those rights, the state adopted the Texas Open Beaches Act (TOBA) in 1959. TOBA codifies the public's unrestricted right of access to "public beaches" which the statute defines as the area bordering the Gulf between the mean low tide line and the inland vegetation line. TOBA recognizes that, due to natural coastal processes, the physical structure of beaches, including the vegetation lines that delineate them, are constantly moving. But under TOBA, the public's right of access moves along with them. What makes this "rolling easement" approach extraordinary is that the public beaches and their attendant public rights move and exist regardless of what structures are in their path, be they fences, bulkheads, private homes or hotels. If such structures interfere with public access, TOBA authorizes the State to order their removal.²⁴⁰ Although TOBA was adopted long before SLR was a known concern, the rolling easements could be a critical SLR adaptation measure, ensuring that as the water level rises, the public beach area continually moves back, allowing for natural movement and inland migration of vegetation and related habitat.

TOBA does not affect ownership or title of Gulf shore properties, but renders them subject to an easement that allows the public unrestricted access to public beaches.²⁴¹ The statute prohibits the construction of any obstruction, barrier or restraint of any nature that would interfere with access to and use of a public beach, such as bulkheads or seawalls. The Commissioner of the Texas General Lands Office (GLO) is responsible for the enforcement and oversight of TOBA, and has the discretion to order the removal of a structure, improvement, obstruction or hazard from a public beach.²⁴² One of the most significant provisions of TOBA is the requirement that deeds for the sale of coastal properties include a disclosure statement warning the buyer of TOBA's impacts.²⁴³ The statute sets forth the language that must be in the disclosure, including the following:²⁴⁴

- ◆ *"If you own a structure located on coastal real property near a gulf coast beach, it may come to be located on a public beach because of coastal erosion and storm events;*
- ◆ *As the owner of a structure located on the public beach, you could be sued by the state of Texas and ordered to remove the structure;*

²³⁹ Fugate Interview

²⁴⁰ Texas Open Beaches Act, Texas Natural Resources Code, Chapter 61, § 61.012; 61.013(c); 61.0183. (TX Nat Res. § 61.)

²⁴¹ Texas A&M AgriLife Extension, Coastal Resilience, Rolling Easements and the Texas Open Beaches Act, <https://coastalresilience.tamu.edu/home/wetland-protection/policy-framework/bay-and-ocean-side-submerged-lands-some-fundamental-differences-in-law-and-management/the-texas-open-beaches-act-an-exceptional-example-of-a-rolling-easement/>

²⁴² TX Nat Res § 61.013 (a); 61.0183; 61.017(a); 61.016; and 61.019

²⁴³ TX Nat Res § 61.025

²⁴⁴ TX Nat Res § 61.025 (a)

- ◆ *The costs of removing a structure from the public beach and any other economic loss because of a removal order would be solely your responsibility.”*

The strength of this language in combination with other TOBA provisions demonstrates the clear intent of Texas to protect and maintain public beaches in a manner that respects natural coastal processes. TOBA also makes it clear that those natural processes include coastal erosion that occurs gradually over time and more suddenly from storm events.

Many lawsuits and key court decisions involving TOBA originated in the aftermath of major storms, when property owners suddenly found themselves on the public side of the vegetation line. One such decision in the *Severance* case threatened the very heart of the statute and resulted in a legislative amendment to TOBA. In 2006, Carol Severance purchased three properties on Galveston Island’s West Beach. Five months later, Hurricane Rita devastated the area and moved the vegetation line inward such that the entirety of one of her houses was seaward of the vegetation line. The state moved to enforce the removal of the home through TOBA and Ms. Severance sued, asserting that the State action violated her rights under the 5th and 14th amendments of the Constitution.

In assessing the arguments, the Texas Supreme Court for the first time in a TOBA case made a distinction between the gradual and imperceptible changes to the coastline caused by erosion, and the rapid and obvious changes resulting from storm events known as avulsion. The court held that, in the case of erosion, the easement moves with the gradually changing property line, but that this is not the case with avulsion caused by storms. Instead:

“The property owner is not automatically deprived of her right to exclude the public from the new dry beach. In those situations, when changes occur suddenly and perceptibly to materially alter littoral boundaries, the land encumbered by the easement is lost to the public trust, along with the easement attached to that land.”²⁴⁵

With respect to TOBA’s rolling easements, the court was unequivocal:

“We hold that Texas does not recognize a ‘rolling easement.’ Easements for public use of dry beach property change size and shape along with the gradual and imperceptible erosion or accretion in the coastal landscape. But avulsive events such as storms and hurricanes that drastically alter pre-existing littoral boundaries do not have the effect of allowing a public use easement to migrate onto previously unencumbered property.”²⁴⁶

The *Severance* decision found that the history of land ownership in West Beach did not support a finding that there were preexisting limitations on West Beach private property owners “since time immemorial”, as was asserted by the GLO. Instead, when the property transferred from Mexico to Texas, the 1840 deeds granting private title to West Galveston Island granted the land to private property owners without reservation. Although the

²⁴⁵ *Severance v. Patterson*, 370 S.W. 2d at 724.

²⁴⁶ At 724.

court noted that “in some states, the common law governing oceanfront property provide a basis for public ownership or use of the beachfront property” i.e., the Public Trust Doctrine, it held that such principles *do not exist in the origins of Texas.*²⁴⁷

Some legal analysts argue that the court’s decision was limited to the West Beach area of Galveston Island, and does not apply elsewhere along the Gulf Coast. However, the GLO believes that if the *Severance* analysis described above was applied elsewhere along the Gulf Shore, there would be no evidence of a reservation of rights in those historic deeds either, and the outcome would be the same.²⁴⁸

In 2013, in response to and approximately one year after the *Severance* decision, Texas adopted House Bill 3459 amending TOBA. The amendment grants new authority to the GLO Commissioner to suspend the determination of the line of vegetation after it is destroyed by a “meteorological event” and to then determine the location of the new line of vegetation.²⁴⁹ The suspension can remain in place up to a period of up to three years to allow ample time for the natural recovery of the coast before the vegetation line is definitively delineated.²⁵⁰ The new law defines “meteorological event” broadly to mean “atmospheric conditions or phenomena resulting in avulsion, erosion, accretion or other impacts to the shoreline that alter the location of the line of vegetation.”²⁵¹ The determination of a new vegetation line in the event of a storm is discretionary, and how the Commissioner chooses to exercise this authority, and whether it will be challenged, remains to be seen.²⁵² To date, no additional litigation has been filed as a test case for the amendment. Although recent storms such as Hurricane Harvey caused significant damage throughout Texas, damage along the Gulf Coast was focused mostly on undeveloped land and did not lead to any TOBA conflicts.²⁵³

²⁴⁷ At. 710.

²⁴⁸ Telephone interview of David Green, Director, Coastal Management, Texas General Lands Office, December 19, 2018 (Green Interview).

²⁴⁹ TX Nat Res. § 61.0171

²⁵⁰ Green Interview.

²⁵¹ TX Nat Res. § 61.001

²⁵² Howe, Angela, “New Texas Open Beaches Act Amendment Explained”, Surfrider Foundation, July 25, 2013, <https://www.surfrider.org/coastal-blog>

²⁵³ Green interview

VI. State Guidance, Tools and Incentives

A. MAPPING AND DATA VISUALIZATIONS

Most of the coastal states have invested in development of localized mapping platforms to help disseminate sea-level rise science and inundation mapping to state practitioners, local governments and citizens. In several states, making data available for public use is part of the Executive Order or rulemaking requirement (e.g., Rhode Island, New York, Virginia, Maryland, Connecticut). Rhode Island, New York, Hawaii and California provide sea-level rise information through web mapping platforms that help users explicitly plan for different climate adaptation scenarios and alternatives. Massachusetts, Delaware, and Maryland publish data through other broader tools (e.g., Coastal Atlases) and include specific resilience data in addition to other data sets available within the purview of the Coastal Zone Management program. Delaware and Washington currently provide the data for use by the user community, but do not provide it in a manner that would allow for web-based exposure assessments or other planning tasks. Louisiana publishes the data from each coastal resilience project included in its Coastal Resilience Plan but does not provide an online mapping platform. In some cases, the mapping platforms are developed in partnership with academic institutions such as in Delaware and Maryland and, in some cases, such as Texas and Louisiana, a non-governmental organization, (i.e., The Nature Conservancy) has created and maintains a public web-based mapping platform. A summary of state mapping platforms follows:

- ◆ Rhode Island - Rhode Island StormTools²⁵⁴ mapping program has different user levels available depending on the audience for the tool. The beginner level seeks to answer "Will X feet of SEA-LEVEL RISE affect my property?" while the advanced level has several additional steps for generating information. Applicants for permits under the state's Special Area Management Plan are directed to use the mapping platform to consider sea-level rise impacts of a proposed project as part of the permit application. Housed at the University of Rhode Island.
- ◆ Hawaii SEA-LEVEL RISE Viewer²⁵⁵ - Hawaii developed its SEA-LEVEL RISE mapping tool as an outcome of the resilience project and as a requirement of the legislative action to make those data available. Housed at the Pacific Islands Integrated Ocean Observing Station.
- ◆ Washington State - New University of Washington report provided guidance for SEA-LEVEL RISE mapping, and includes an embedded google map that allows for data downloading.²⁵⁶ The Washington Department of Transportation hosts a community planning portal which included mapping and vulnerability assessments for transportation assets²⁵⁷

²⁵⁴ <http://www.beachsamp.org/stormtools/>

²⁵⁵ http://www.pacioos.hawaii.edu/shoreline/sea-level_rise-hawaii/

²⁵⁶ <http://www.wacoastalnetwork.com/wcrp-documents.html>

²⁵⁷ <http://wsdot.maps.arcgis.com/home/webmap/viewer.html?webmap=927b5daaa7f4434db4b312364489544d>

- ◆ New York – Hosted by the New York State Energy Research and Development Authority, the Coastal New York Future Floodplain Mapper hosts data for a range of future coastal flooding conditions including established sea-level rise projections by decade under low, median, and high scenarios (http://services.nyserda.ny.gov/SEA-LEVEL RISE_Viewer/About). New York City has developed its own web-based mapping platform: <https://www1.nyc.gov/site/planning/data-maps/flood-hazard-mapper.page>)
- ◆ Virginia does not currently have a web-based mapping platform but pursuant to the 2018 Executive Order 24, the state is required to disseminate information through an online mapping tool. It is not yet clear where the platform will be hosted.
- ◆ California maintains several web-based mapping platforms but no single one is considered the state authoritative platform. The 2018 guidance issued by California includes establishment of a climate clearing house, including mapping resources.²⁵⁸
- ◆ Connecticut is currently developing a sea-level rise viewer pursuant to its 2018 law, the development of which is being led by the Connecticut Institute for Resilience and Climate Adaptation at the University of Connecticut.
- ◆ Delaware has developed a state sea-level rise mapping platform that is available as a web-based tool for downloadable through the Department of Natural Resources and Environmental Control.
- ◆ Florida does not have a state level web-based mapping tool.
- ◆ Louisiana Coastal Protection and Restoration Authority publishes their master plan data through a plan specific mapping tool.²⁵⁹
- ◆ Maine does not have a state level web-based mapping tool. The state uses NOAA mapping tools to inform its public outreach and education.
- ◆ Maryland disseminates sea-level rise SEA-LEVEL RISE mapping and other resilience assessments at the state level through the Maryland Coastal Atlas hosted by the Department of Natural Resources.²⁶⁰ Maryland also has a web-based mapping tool showing roadway flooding where highway infrastructure would be impacted under different water levels integrating sea-level rise.²⁶¹
- ◆ Massachusetts²⁶² Office of Coastal Zone Management developed its Sea-Level Rise and Coastal Flooding Viewer to support the assessment of coastal flooding vulnerability and risk for community facilities and infrastructure, consistent with Executive Order 569. The state's Division of Fish and Wildlife has created a planning mapping tool: <http://climateactiontool.org/content/sea-level-rise>

²⁵⁸ <https://resilientca.org/search/?topics=4&impacts=13&types=11#resources>

²⁵⁹ <https://cims.coastal.louisiana.gov/masterplan/>

²⁶⁰ <https://gisapps.dnr.state.md.us/coastalatlas/WAB2/>

²⁶¹ <https://www.arcgis.com/home/item.html?id=4b218c5669354b8b970706c646cf771>

²⁶² <https://mass-eoeea.maps.arcgis.com/apps/MapSeries/index.html?appid=6f2797652f8f48eaa09759ea6b2c4a95>

- ◆ Oregon does not reference any web-based mapping platform as a state authoritative tool but Oregon State University hosts a sea-level rise viewer:
[https://www.coastalatlas.net/index.php/tools/planners/68-sea-level rise/](https://www.coastalatlas.net/index.php/tools/planners/68-sea-level%20rise/).
- ◆ Texas does not host an authoritative state mapping platform. The Gulf of Mexico Coastal Resilience Mapping Platform is available for public use:
<http://maps.coastalresilience.org/gulfmex/>

B. OTHER STATE ASSISTANCE

All of the targeted states provide some form of assistance to regional and local entities. This assistance may vary and can include training programs for local elected and appointed officials as well as members of the public, technical assistance to support local resilience planning, development and deployment of local planning guidance such as guidance on how to assess vulnerability of local assets to sea-level rise and other coastal hazards, support for adoption of state-developed model ordinances, use of state-developed decision-support tools such as web-mapped mapping platforms, and grants to support resilience planning. In some states, this type of local assistance is delivered in collaboration with academic partners.

Of interest to the Rutgers Team is the increased extent to which states have begun to target the design and purpose of their assistance to local entities. During the early implementation of state sea-level rise programs, local assistance was often highly generalized. In the more mature programs, state agencies are increasingly tying the use of decision support tools such as web-based mapping platforms and vulnerability assessment protocols to local grantmaking, to state adopted or recognized science-informed sea-level rise values, and to state policies. For example, Maryland's Coast Smart Communities Grant Program requires use of the state's science informed sea-level rise values to provide grants to local communities for coastal hazard and sea-level rise planning. As another example in Maryland, the Department of Natural Resources provided a grant to Cecil County that provided support for the county to use state coastal resilience tools, such as the sea-level rise mapping tool, to develop an overall resilience plan for the county. In Rhode Island, the state directs the use of decision-support tools, such as the mapping platform STORMTOOLS, as part of permit applications under its Special Area Management Plan. Also, in Rhode Island, statutorily-mandated training of Planning Board members is tied to the state's coastal resilience decision-support tools. Another example is in Massachusetts where state agencies are directed, by law, to create a resilience planning framework that can be used by local entities and to provide local governments with assistance in deploying use of the planning framework. Maryland has developed a model floodplain ordinance which provides allowance for sea-level rise based on projections from its science and technical working group; outreach and communication with municipalities regarding reduced risk and insurance savings factors into local decisions to voluntarily increase freeboard.

VII. Funding Mechanisms

The targeted states combine use of funds from various mechanisms to advance coastal resilience. In all states federal dollars provided to the state Coastal Zone Management Program are a critical element of program funding that can be complemented through other sources of funding. Federal Coastal Zone Management Funds are used to support a host of state efforts including state administrative costs, development of decision-support tool and science-informed sea-level rise values, and planning grants such as in Maryland where Coastal Zone Management funds were used to fund the state's first Coastal Resiliency Easement whereby sea-level rise values were used to identify high priority wetland adaptation areas and the grant funds were used to compensate a property owner a portion of the value of the property to restrict use and provide development setbacks.

Some states, such as Massachusetts, link science informed sea-level rise policies and planning to hazard mitigation programs pursuant to the federal Stafford Act allowing use of hazard mitigation grant funds from the Federal Emergency Management Agency. Other sources of funds include:

- ◆ **State appropriations** – For example, in the years 2007, 2008 and 2009, the Louisiana Legislature allocated \$790 million in State surplus funds for use in coastal protection and restoration activities. This includes both cost-sharing in other federal programs as well as the implementation of projects without a federal partner. Broadly speaking, these projects generally fit into one of the following categories:
 - ◆ Expedited construction of components of federal protection projects
 - ◆ Coordination on federal-only projects
 - ◆ Feasibility studies for flood protection in areas not currently covered by the existing federal protection network
 - ◆ Protection and restoration projects not included in one of the other coastal programs to be implemented in conjunction with local parishes
 - ◆ Augmented design or construction of projects in other coastal programs
- ◆ **Enforcement settlement dollars** – For example, in 2016 a Federal District Judge approved the largest environmental damage settlement in U.S. history, \$20.8 billion from multiple responsible parties associated with the Deep Water Horizon Oil Spill. The 2012 federal RESTORE Act dedicated 80 percent of all administrative and civil penalties from the responsible parties to ecological and economic recovery efforts in the Gulf.²⁶³
- ◆ **Oil and gas leasing revenue** - The 2006 Gulf of Mexico Energy Security Act created a revenue-sharing model for oil- and gas-producing gulf states. Under the act, Alabama, Louisiana, Mississippi, and Texas receive a portion of the revenue generated from oil and gas production offshore in the Gulf of Mexico. The act also directs a portion of revenue to the Land and Water Conservation Fund. Funds are

²⁶³ <https://www.noaa.gov/explainers/deepwater-horizon-oil-spill-settlements-where-money-went>

required to be used for coastal conservation, restoration, and hurricane protection. Phase 1 of the Act's funding starting in 2007 was divide with 37.5% of all revenues shared among the four states and 12.5 percent of the funds disbursed to the Land and Water Conservation Fund. Phase 2 of the Act's funding commenced in 2017.²⁶⁴

- ◆ **Other federal funds** – Some of the targeted states use federal monies from other agencies to undertake resilience efforts. For example, the Maryland Highway Administration received grant funds from the Federal Highway Administration to establish its mapping method to evaluate risks posed to the state's roadways and bridges from sea-level rise and coastal hazards.
- ◆ **Greenhouse Gas Auctions** – Delaware is the only targeted state that has directed use of revenues from its participation in the Regional Greenhouse Gas Initiative to dedicated resilience initiatives. In 2016, the Delaware Department of Natural Resources and Environmental Control established the Strategic Opportunity Fund for Adaptation using RGGI auction proceeds to fund resilience efforts of state agencies that were consistent with recommendations in the Climate Framework for Delaware. In the first year of the program, ten projects from six state agencies were awarded grants for a wide range of adaptation actions.
- ◆ **Bond funds** – At least one state, Maryland, identified the use of state bond monies as one source among many to support various aspects of resilience.

²⁶⁴ <https://revenuedata.doi.gov/how-it-works/gomesa/>

VIII. Observations

A. SUMMARY OF INSIGHTS FROM EXPERIENCES OF OTHER STATES

Experiences of the states included in this study point to overarching leadership at the senior levels of government as an essential element of advancing comprehensive science-informed climate adaptation efforts, including sea-level rise. In some cases, this leadership is focused on sea-level rise alone but, more often than not, the leadership is broader and includes all climate hazards and may even include addressing the causes of climate change meaning greenhouse gas emissions. For those states that are intersecting the latest climate and/or sea-level rise science with innovative implementation of policies, there is generally express direction at the Governor's level which may manifest in authorizing legislation, establishment of Governors' Advisory Groups, establishment of systems for interagency communication, and/or Executive Orders with directives to state agencies. This leadership serves to foster interagency cooperation on development of multi-agency policy solutions, create participatory processes to support development of policy, and build public support for state action.

The Rutgers Team identified five categories of state agency efforts underway within the fifteen states included in this study:

1. Stakeholder Engagement

All of the states have some form of stakeholder engagement which may vary in several ways. Some states maintain “standing” committees that may be established by law, as is the case with the Maryland Commission on Climate Change. In other cases, a stakeholder group may be convened for a particular purpose such as with New York’s statutory establishment of its State Sea-Level Rise Task Force that was charged with evaluating “ways of protecting New York’s remaining coastal ecosystems and natural habitats, and increasing coastal community resilience in the face of sea-level rise, applying the best available science as to sea-level rise and its anticipated impacts.” The states’ efforts to systematically engage stakeholders serve several purposes including informing decision-making while also building a supportive community for state action.

2. Climate Science and Vulnerability Assessment – These efforts include:

- a. Examination of the latest climate science and integration with local conditions,
- b. Application of science-informed sea-level rise values to assess statewide vulnerabilities based on the latest science-informed projections of sea-level rise such as impacts to critical infrastructure, natural resources and/or vulnerable populations,
- c. Determination of a frequency for conducting updates to a state’s sea-level rise values,

- d. Consultation with the science community which may include state agency scientists such as Geologic Surveys, expert scientists from outside the state, scientists in non-governmental organizations and consulting firms, Sea Grants, and scientists from in-state academic institutions. In some cases, scientific working groups are formally established such as with California's Ocean Protection Council Science Advisory Team.
- e. In some cases, consultation with stakeholders is undertaken such as the effort in Delaware as part of its Sea-level Rise Advisory Committee.
- f. State recognition of a particular sea-level rise value or range of values. The type of recognition may vary among the states such as New York's adoption of sea-level rise values through regulation, Connecticut's policy statement adopting sea-level rise values developed by the University of Connecticut, or Massachusetts' reference to sea-level rise values in its State Hazard Mitigation and Climate Adaptation Plan.

3. Strategic Planning:

Strategic planning efforts among the states may vary. In some cases, such as Louisiana and Texas, coastal resilience plans are focused on identifying coastal natural resource restoration priorities for expenditures of public monies. In other states, strategic planning serves to provide an overarching direction for the consistent development of science-informed state programs, funding, policies, and other initiatives. In 2018, the states of Massachusetts and Rhode Island adopted statewide strategic plans that not only present science-informed climate change projections but that also outline specific state actions and priorities to inform policies, programs and funding. Of note is that the Massachusetts 2018 plan, the Massachusetts State Hazard Mitigation and Climate Adaptation Plan, which was developed in response to Executive Order 569 appears to be the first statewide plan that integrates a statewide climate change adaptation plan with a state hazard mitigation plan pursuant to the federal Stafford Act. Both the Rhode Island and Massachusetts plans address all climate hazards and include science-informed projections and strategies associated with: rising temperatures, sea-level rise, changes in precipitation, extreme weather events, and riverine flooding.

4. Implementation and Policy development:

The Rutgers Team identified eight states that systematically incorporated state-recognized science-informed sea-level rise values into directed public policy which may include policies that-

- a. Direct state agencies' long-term planning, capital and infrastructure investment, asset management, program work procedures and decision-making actions to integrate the state-recognized sea-level rise science;
- b. Direct or incentivize local jurisdictions to integrate state-recognized, science-informed sea-level rise values into local action; and

- c. Directly or indirectly affect state programs that affect the private sector whether through requirements or incentives for planning or permitting.

5. Capacity building – Capacity building efforts include:

- a. Development of guidance, including guidance to local governments to voluntarily undertaken resilience planning efforts and/or to meet requirements for local resilience planning. Other guidance includes information for state agencies to use in implementing requirements for integration of sea-level rise considerations into state programs such as New York Flood Risk Management Guidance that guides state agencies in development of permit programs requiring applicants to demonstrate consideration of sea-level rise, storm surge and flooding. Other guidance is provided to applicants for state review or permits such as the guidance issued to support integration of climate change considerations into implementation of the Massachusetts Environmental Protection Act. Still other guidance has been developed for property owners and permittees such as guidance developed for coastal permit applicants under the Rhode Island BEACH Special Area Management Plan. In some cases, guidance is developed and delivered through state collaborations with academic institutions such the Connecticut “Municipal Resilience Planning Assistance Project” developed by the University of Connecticut.
- b. Creation of state level interagency working groups which are designed to facilitate coordination among different state agencies as well as consistent use of science in policies and programs intended to integrate climate change and/or sea-level rise considerations. These may be at a staff working group level or, in some states, they are formed as a “climate cabinet” with senior officials from state agencies such as the Executive Order establishment of Rhode Island’s Executive Climate Change Council. In some cases, the working groups are formally designated and, in others, such as Washington, the working groups are informally, self-developed by staff within state agencies. In some states, a legislature or Governor may appoint a coordinating position within state government such as in Virginia where an Executive Order created the position of Special Assistant to the Governor for Coastal Adaptation and Protection.
- c. Development of decision-support tools, such as web-based mapping platforms which are in place in several states, and/or the Rhode Island Coastal Environmental Risk Index (CERI) developed by the University of Rhode Island and the Rhode Island e911 exposure assessment tool that determines a risk index to structures.
- d. Training of local officials, community leaders and others. At least one state, Rhode Island, has a statutory requirement for local Planning Board officials to attend a state offered training. Another state, Massachusetts, trains and certifies consulting planners who are then eligible to be used by municipalities participating in the state’s Municipal Voluntary

Preparedness (MVP) Program. Maryland has created a Climate Leadership Academy to build capacity among state and local officials as well as infrastructure executives and business leaders.

- e. Technical assistance and outreach, including direct technical assistance from state agencies to communities undertaking resilience planning which often involve collaboration with academic institutions. Trainings may focus on conducting vulnerability assessments, meeting legal requirements, understanding adaptation best practices, understanding the benefits of stricter regulatory standards. For example, Maryland's model floodplain ordinance, coupled with extensive outreach by the state NFIP office, has helped local government officials understand the benefits of increased freeboard standards in local ordinances including insurance savings and enhanced resiliency.
- f. Grants such as grants offered to Climate Smart Communities in New York and increased eligibility for grants to municipalities that participate in the Massachusetts Municipal Voluntary Preparedness (MVP) program.

Of the fifteen states reviewed for this project, the Rutgers Team found that all of the states have extensive activities underway with regard to three of the five categories outlined above: Stakeholder engagement, strategic planning, and capacity building. Most of the states, with the exception of a few such as Florida, are engaged in statewide analysis of climate science and/or statewide vulnerability assessment. Eight of the fifteen states are involved in all five categories of efforts, including implementation and policy development: California, Connecticut, Delaware, Maryland, Massachusetts, New York, Rhode Island, Virginia.

In some cases, state sea-level rise efforts are led through a coastal planning program. In many cases, the sea-level rise efforts are integrated into overall state efforts to address all hazards associated with climate change. For example, New York's regulations pursuant to its Community Risk and Resiliency Act establishes science-informed projections both for coastal and inland flood hazards. The statewide plans in Massachusetts and Rhode Island address all climate change hazards, not just sea-level rise. In other cases, climate change and sea-level rise efforts are integrated into a state's larger climate change program that includes efforts associated with emissions reduction as well as adaptation such as in Maryland where its Commission on Climate Change is charged with "developing an action plan and firm timetable for mitigation of and adaptation to the likely consequences and impacts of climate change in Maryland, including strategies to reduce Maryland's greenhouse gas emissions."

The Rutgers Team offers the following observations based on the review of the targeted fifteen states, with a particular focus on the eight states that have integrated state-recognized, science informed sea-level rise values into state policy:

“LEAD UP” TIME TO POLICY ADOPTION

For the states that have integrated state-recognized, science-informed sea-level rise values into policy, there typically has been a lengthy period of time, often a decade or more, leading up to policy adoption during which:

- ◆ A base of science is developed, including an assessment and articulation of vulnerabilities;
- ◆ Strategies are developed and tested through voluntary and pilot programs and education and training (often of local governments) is undertaken;
- ◆ Stakeholders are engaged to inform action on the part of the state;
- ◆ Capacity is developed to foster interagency collaboration to ensure consistent integration of climate science into cross-sectoral agency jurisdictions (e.g. transportation, natural resource management, hazard mitigation, etc.); and
- ◆ Outreach and education takes place to build to build support for state action.

SIMILARITIES AND DIFFERENCES AMONG THE STATES ESPECIALLY WITH REGARD TO POLICY APPROACHES

For states that are engaged in implementation and policy development efforts, approaches among the states vary. No one state applies all possible existing policy mechanisms. For example:

- ◆ Massachusetts is the only state that has integrated its statewide climate adaptation planning with statewide hazard mitigation planning;
- ◆ Maryland is the only state to offer coastal resilience conservation easements;
- ◆ Rhode Island is the only state that requires local Planning Board members to attend training;
- ◆ Delaware is the only state to apply auction proceeds from its participation in the Regional Greenhouse Gas Initiative program to offer financial assistance to state agencies to implement sea-level rise policies;
- ◆ New York is the only state to adopt regulations that establish sea-level rise values for which executive branch agencies are expected to integrate into agency specific policies, standards and regulations;
- ◆ Rhode Island’s “Resilient Rhody” Plan is the only state plan that expressly notes identifying opportunities for retreat and infrastructure removal on state owned-properties, working with municipalities to do the same, and “where possible, retreat rather than fortification should be emphasized as a coastal adaptation strategy.”
- ◆ Massachusetts is the only state with formal guidance for integration of climate change into review under the state’s Environmental Policy Act;

- ◆ California is the only state that relies on its Public Trust Doctrine to advance systematic sea-level rise resilience;
- ◆ Virginia and Maryland are the only states that have established requirements for construction standards for state-owned buildings;
- ◆ Rhode Island is the only state to require sea-level consideration in its coastal policies which, among other provisions, includes the adoption of a Special Area Management Plan under which coastal permit applicants must consider sea-level rise impacts using tools developed by the University of Rhode Island;
- ◆ California is one of the states that has a statutory requirement directing local governments to review and update the safety elements of their general plans to include climate change adaptation and resiliency strategies.
- ◆ Maryland is the only state that requires local comprehensive (master) plans to address nuisance flooding;
- ◆ Massachusetts is the only state that takes the approach in which a law directs state agencies to develop a planning framework, using the latest sea-level rise science, that can be used by local governments to plan for climate adaptation;
- ◆ Washington appears to be the only state to have adopted specific guidelines for review of capital spending on transportation infrastructure projects;
- ◆ Connecticut is the only state that has a statutory requirement to consider “the necessity and feasibility of implementing measures designed to mitigate the impact of a rise in sea level over the projected life span of such project” as part of the criteria for approving projects funded by the state’s Clean Water Fund.

SCIENCE-INFORMED SEA-LEVEL RISE VALUES

States faced two primary questions during recent updates to sea-level science regarding (1) their choice of framework (bottom-up probabilistic or top-down scenario-based) and (2) how to incorporate recent science defining more extreme sea-level rise contributions from Antarctic ice-sheet melt (DeConto and Pollard, 2016). More states are choosing to incorporate probabilistic approaches for sea-level rise into their guidance, while the incorporation of Antarctic ice-sheet melt is less consistent among states. The Rutgers team observed that several states incorporated probabilistic approaches into their sea-level policies most recent updates (i.e., Washington State, California, Maryland and Massachusetts), whereas Connecticut and Rhode Island used top-down federal scenario approaches in recent updates. In Maryland, updated state guidance does not include Antarctic ice-sheet melt, but acknowledges that the next update will likely incorporate this dynamic because of anticipated scientific investigation (MD 2018 Guidance). In California, updated state guidance includes an extreme scenario with unknown probability for considering Antarctic ice-sheet melt in highly consequential long-term decisions (CA 2018 Guidance).

PLANNING FOR UNCERTAINTY

The rapidly evolving scientific understanding of sea-level rise science, and changing circumstances such as those associated with giant ice sheets covering Antarctica and Greenland, drive different management approaches for incorporating sea-level rise information. Most states recognize these scientific uncertainties and, for that reason, build in ‘up front’ requirements to update the science associated with state sea-level rise values to reflect the latest science. In addition to routine updates to sea-level rise science, some states are implementing management approaches to plan for uncertainties. For example, Rhode Island instructs practitioners to use the “High” scenario (7.0 ft. of sea-level rise by 2100) based on precautionary principle and the knowledge that the “likely range” of sea-level rise is uncertain. Other states, such as California, reference “flexible adaptation pathways,” a management approach that accommodates uncertainty by using risk-based decision frameworks that involve trigger points for making adjustments to climate change adaptation strategies in response to new information. California and New York state both suggest practitioners working on strategies for long-lived (after 2050) decisions recommend planning and designing to allow for iterative changes that can help manage for the uncertainty of sea-level rise projections late in the century.

SUPPORT FOR IMPLEMENTATION OF POLICY

As states’ efforts to integrate sea-level rise science into policy matures, more states are developing specific strategies, such as decision-support tools, detailed guidance, and stepwise instructions to support implementation on the part of state agencies, local government and private sector entities. Rather than setting sea-level rise values and projections with the expectation that state and local agencies and private entities can interpret them to adhere to policies, the more recent state level policies create strategies that translate complex science into actions that meet the objectives of the policy. For example, Rhode Island has established a 5-step permitting process that automates actions to ensure sea-level rise is incorporated into a coastal permit and requires use of the University of Rhode Island’s suite of STORMTOOLS as part of permit application development. The guidance issued by New York in 2018 pursuant to its Community Risk and Resilience Act outlines specific strategies to mitigate risk due to state adopted sea-level rise values as well as storm surge, and flooding in the approval and funding of public infrastructure, project design, facility-siting and funding. Maryland’s Coast Smart process is also explicit about actions that adequately address sea-level rise as part of preliminary planning and construction of proposed capital projects to address sea-level rise and coastal flood impacts. Massachusetts’ policy on incorporation of climate adaption into its state Environmental Policy Act reviews includes detailed guidance on issues to incorporate into the review process. In other words, the most recent state policies translate science-informed sea-level rise values into specific guidelines, actions and standards for use by state and local agencies and private sector entities.

EFFECTIVENESS

Many of the states' policies are new and, for that reason, it is difficult to measure effectiveness. The Rutgers Team identified new policies mechanisms or major actions in 7 states proposed or adopted in 2018 alone:

- ◆ Connecticut – 2018. An Act Concerning Climate Change Planning and Resiliency; Public Act 18-82.
- ◆ Maryland – 2018. The Sea-Level Rise Inundation and Coastal Flooding Act. Chapter 628. Passage of the Coast Smart Construction Act.
- ◆ Rhode Island. 2018. Adoption of a Shoreline Change Special Area Management Plan, known as the Beach SAMP.
- ◆ Massachusetts – 2018. An Act Promoting Climate Change Adaptation, Environmental and Natural Resource Protection and Investment in Recreational Assets and Opportunity (H. 4835). Issuance of the State Hazard Mitigation and Climate Adaptation Plan in response to Executive 569.
- ◆ Virginia – 2018. Executive Order 24
- ◆ Washington. 2018. Projected Sea-Level Rise for Washington State.
- ◆ New York – 2018. Proposed guidelines to implement the Community Risk and Resilience Act.

VULNERABILITY ASSESSMENTS

Many states follow a comprehensive approach whereby linkages are drawn between climate science, vulnerability assessment, policy development, and implementation. Assessing vulnerability is a key step in managing risk. Thus, many states follow the logic of applying science to understand vulnerability and assessing risk to inform the necessary response measures to prevent and minimize future impacts to people, natural assets and built infrastructure. For example, in California, state agencies were initially directed to plan for sea-level rise and climate impacts considering sea-level rise scenarios, assess vulnerability, reduce expected risks, and increase resiliency. In Connecticut, a law that created the Adaptation Subcommittee to the Governor's Council on Climate Change issued a report outlining the impacts of climate change on infrastructure, natural resources, public health, and agriculture, which referenced sea-level rise projections. A subsequent statute in 2012 required the state Coastal Management Program to consider the impact of sea-level rise, coastal flooding and erosion in decision-making with regard to coastal development. In Massachusetts, a 2016 Executive Order required the development of a state Climate Adaptation Plan that would include observed and projected climate trends, including sea-level rise, guidance and strategies for state agencies and authorities, municipalities and regional planning agencies to proactively address climate change impacts and establishment of a framework that shall be used by each executive agency "to assess its and its agencies' vulnerability to climate change and extreme weather events, and to identify adaptation options for its and its agencies' assets." The Maryland Commission on Climate Change issued a comprehensive Climate Action Plan in 2008 which included projections of

relative sea-level rise as well as a comprehensive strategy for reducing Maryland's Vulnerability to Climate Change.

LIMITATIONS

Despite significant efforts on the part of the fifteen states to advance the integration of science-informed sea-level rise policies, there are some limitations with regard to the breadth of current state programs for consideration by the NJCMP. These include but are not limited to:

- ◆ Consideration of socially vulnerable populations - States' recognition of vulnerable populations typically have a health and/or health equity focus. For example, the Rhode Island Department of Health,²⁶⁵ the Massachusetts Department of Health,²⁶⁶ and the Oregon Health Authority²⁶⁷ each produced studies that reflect the needs and challenges of socially vulnerable populations as part of state resilience programs. Other efforts across states included reflecting socially vulnerable populations on mapping platforms, and rely on existing metrics for social vulnerability such as the U.S Centers for Disease Control and Prevention's Social Vulnerability Index.²⁶⁸ However, other than California's adoption of AB2616 in 2016, the Rutgers Team did not find additional examples of where social vulnerability became a criteria in affecting state level sea-level rise policy. AB2616 requires that at least one member of the California Coastal Commission to reside in and work directly with low-income communities of color that are disproportionately impacted by pollution and other environmental justice issues. The law also requires the Commission to consider "the equitable distribution of environmental benefits in communities throughout the state when acting on a coastal development permit."²⁶⁹
- ◆ Private Lands – The most recent evolution of state sea-level rise policy is beginning to consider impact to privately held land, such as with evolving policies in Rhode Island, Massachusetts and New York. However, the lengthier experience at the state and local levels has been with public lands and with policy directed at state agency and local government action.
- ◆ Funding – In general, states have relied on federal funds, such as funding from the federal Coastal Zone Management Act, to support implementation of state sea-level rise policy as well as incentives for coastal resilience efforts at the local level.

²⁶⁵ <http://health.ri.gov/publications/reports/ClimateChangeAndHealthResiliency.pdf>

²⁶⁶ <https://matracking.ehs.state.ma.us/Climate-Change/vulnerable-populations.html>

²⁶⁷ <https://www.oregon.gov/oha/ph/HealthyEnvironments/climatechange/Documents/Social-Vulnerability-Assessment.pdf>

²⁶⁸ <https://svi.cdc.gov/>

²⁶⁹ http://leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=201520160AB2616

INTERAGENCY COORDINATION AND STAKEHOLDER ENGAGEMENT

Interagency collaboration at the state level generally serves several purposes: it ensures the consistent application of sea-level rise science in programs and policies of multiple agencies; it identifies mechanisms that may not be available to a Coastal Management Program but that offers value in advancing science-informed sea-level rise policy such as Washington State's Department of Transportation guidance; and it allows multiple state agencies to offer consistent guidance and direction to local governments. Some states deploy varying degrees of formality with regard to coordination of interagency sea-level rise programs. States also deploy varying approaches with regard to engagement with stakeholders and the degree of transparency of program operations. A statutorily-established Maryland Commission on Climate Change offers one approach that is highly visible. Facilitation of consistent approaches across state agencies benefit from mechanisms such as working groups. In some states, interagency collaboration is fostered through formal mechanisms such as Virginia's establishment of a Resilience Officer or Maryland's establishment of a Climate Change Commission.

COMMUNITY-BASED RESILIENCE PLANNING

In many of the states, there is a strong recognition about the value of engaging communities in sea-level rise and climate change resilience planning. "Effective resilience planning involves inclusive, thoughtful, multi-step processes that respond to the identity of a community based on location, history, leadership, population, and available resources. Each community is subject to various natural and man-made hazards, and has its own level of risk tolerance."²⁷⁰ The most effective community resilience plans are customized to take all of these factors into account. As a result, state level policies that seek to advance sea-level rise and climate adaptation planning are increasingly being structured in ways that integrate science-informed climate change projections and vulnerability assessments with community visioning and overall community planning. This approach is observed in efforts in the fifteen states that strive to intersect the latest science-informed climate projections and evidence-based assessments of vulnerability and impact with flexible guidance that can be used by communities based on their own priorities, needs and community vision. In recent years, there is an increasing trend towards fostering community-based resilience planning with a focus on advancing equity. This trend, along with supporting guidance, recognizes that impacts from changing climate conditions, including sea-level rise, have broad multi-sector impacts that will affect the whole fabric of a community. This approach also recognizes that, certain populations are especially vulnerable to changing climate conditions given social conditions and that planning processes need to be undertaken that are designed to engage and address the needs of those populations. This approach to community-based resilience planning seeks to deliver more equitable outcomes by using a different approach to planning in which social equity

²⁷⁰ U.S. Climate Resilience Toolkit. Last accessed February 1, 2019. <https://toolkit.climate.gov/topics/built-environment/community-resilience>.

is inherently integrated into efforts to address specific adaptation solutions, tactics for inclusive community engagement, and/or the root causes of inequities in climate risk.²⁷¹

Community-based resilience planning incorporates three essential elements of building capacity:

- ◆ To integrate climate resilience into a community's overall vision for its future and advancement of priorities that flow from the community vision;
- ◆ To assess community vulnerabilities and develop solutions that emerge from community members' own experiences, perceptions and needs; and
- ◆ To build processes that ensure that community voices drive the integration of resilience planning into attainment of an overall vision for a community.²⁷²

Recognizing the inherent goals of community-based resilience planning necessitates innovative approaches and policies at the state level. The Rutgers Team found that many of the fifteen states, such as California, are working to more systematically integrate community-resilience planning into the design of their state policies and that this is an emerging area of practice for attention from the NJCMP as it advances sea-level rise programs and policies.

PARTNERSHIPS WITH ACADEMIC INSTITUTIONS

Academic collaboration on climate resiliency occurs in most of the states reviewed for this project either through a direct requirement that tasks universities with developing the climate science, guidance or tools, or through participation on various working groups. In some cases, the partnerships are formally established through state policy such as in Maryland where the 2016 Maryland Climate Commission Act established a requirement that the University of Maryland Center for Environmental Sciences update sea-level rise projections for the state every five years, in Rhode Island where the University of Rhode Island's Rhode Island Coastal Environmental Risk Index (CERI) is a tool used as part of permit applications under the state's Special Area Management Plan, and in Connecticut where the 2013 Special Act 13-9 established the Connecticut Institute for Resilience and Climate Adaptation which is charged with partnering with the Connecticut Department of Energy and Environmental Protection to "translate sound scientific research to actions that can ensure the resilience and sustainability of both the built and natural environments of the coast and watersheds of Connecticut." Representatives of academic institutions serve on state sea-level rise Advisory Boards and Commissions, such as in Delaware where several University of Delaware representatives serve on the Climate Change Vulnerability Steering Committee convened by the Delaware Department of Natural Resources and

²⁷¹ Guide to Equitable, Community-Driven Climate Preparedness Planning. Urban Sustainability Directors' Network. 2017. https://www.usdn.org/uploads/cms/documents/usdn_guide_to_equitable_community-driven_climate_preparedness_high_res.pdf

²⁷² Community Driven Climate Resilience Planning: A Framework. National Association of Climate Resilience Planners. 2017.

https://kresge.org/sites/default/files/library/community_drive_resilience_planning_from_movement_strategy_center.pdf

Environmental Control (DNREC) as well as on a technical working committee that has assessed Delaware's vulnerability to sea-level rise. Academic institutions are involved in developing decision-support tools to support state sea-level rise programs and policies, offering scientific input to state efforts, and hosting training and other programs that, overall, support state sea-level rise objectives. Similarly, New Jersey does indeed have extant state-academic collaboration on issues related to climate and resiliency including the aforementioned NJFRAMES project, the 2018 NJCMP's Coastal Summit and a review of Rutgers-generated science-informed sea-level rise values by NJDEP's Science Advisory Board, as some examples.

B. IMPLICATIONS FOR NEW JERSEY

Experiences in other states provide New Jersey with valuable opportunities to consider the most effective and New Jersey-relevant strategies to advance coastal resilience to sea-level rise and other coastal hazards. Based on insights from experiences in other states, there appears to be a strong foundation in New Jersey to advance sound science-informed sea-level rise policy, including:

- ◆ **Availability of science-informed sea-level rise values** – Many of the fifteen states focused on in this report spent considerable resources and capacity on the development of state recognized or state adopted science informed sea-level rise values to inform public policy at the state level. Science-informed sea-level rise values, and a planning framework to support the application of those values, have been developed for New Jersey through a Science and Technical Advisory Panel (STAP) effort through a partnership of the New Jersey Climate Change Alliance, the Rutgers Bloustein School and the Rutgers Climate Institute (Kopp et al. 2016). These sea-level rise values offer peer reviewed, nationally prominent science that have been adopted by many of the states as part of probabilistic planning frameworks for which periodic updates are conducted to ensure policies continue to be informed by the latest science. The probabilistic projections of Kopp et al. (2014) that formed the basis for the STAP are the same projections and similar approach as taken by California, Delaware and Maryland. The “Total Water Values” framework from the NJ STAP is already informing resilience planning in the NJ Coastal Management Program-led multiple-municipal coastal resilience planning effort, New Jersey Fostering Regional Adaptation Through Municipal Economic Scenarios (NJFRAMES)²⁷³, as well as development of a joint Land Use Plan for Monmouth County and Naval Weapons Station Earle, the state Hazard Mitigation Plan and planning efforts for the Coastal Management Program Resilient NJ.²⁷⁴ Further, the NJFRAMES project is grounded in a community-engagement approach similar to that developed by the Equity and Vulnerable Communities subcommittee of the Climate Change and Health Equity Program of the California Department of Public Health.²⁷⁵

²⁷³ <https://www.nj.gov/dep/oclup/njframes.html>

²⁷⁴ <https://www.nj.gov/dep/oclup/resilientnj/>

²⁷⁵ http://www opr.ca.gov/docs/20180828-Community_Engagement_Best_Practices.pdf

- ◆ **Greater Recognition of and support for efforts to address sea-level rise -** Previous research undertaken by members of the Rutgers Team finds there is a foundation of support among local decision-makers and professionals to address sea-level rise and coastal flooding. Engagement with municipal decision-makers and professionals in coastal regions of New Jersey affirm that there is a greater recognition regarding sea-level rise impacts to New Jersey coastal areas as a result of increased awareness following Hurricane Sandy and a greater support for regulatory measures, such as additional freeboard height above the minimum New Jersey state standard to protect people and property. Municipal decision-makers and professionals desire a more holistic approach to resilience guided by a statewide vision for planning and implementation. When asked about sea-level rise data in municipal decision making, these decision-makers and professionals noted that sea-level rise planning numbers need to be consistent within and between state agencies. There are indeed some municipalities in New Jersey that have higher freeboard standards than those mandated by the state because of incentives for insurance savings, flooding conditions they are experiencing, or because sea-level rise is identified as a concern.²⁷⁶
- ◆ **Availability of decision support tools -** Over the past decade, the Coastal Management Program, Rutgers University, other academic institutions and non-governmental organizations have developed a suite of coastal resilience planning tools that can be modified to support implementation of a state sea-level rise policy. Additionally, with support from NOAA, Rutgers University is currently involved in enhancing two coastal hazard mapping platforms, New Jersey Flood mapper and the Coastal Hazard Profiler on www.njadapt.org including merging the two platforms, adding in an automated "Total Water Levels" framework based on sea-level rise values developed on behalf of the New Jersey Climate Change Alliance, improving functionality, and automating data-driven reports at the municipal, multi-municipal and state levels.
- ◆ **Existing comprehensive coastal policies -** New Jersey already has a strong network of coastal zone management policies that can serve as the basis for the integration of sea-level rise policy. The Rutgers Team found that, in several of the targeted states, coastal management policies were deployed to advance science-informed sea-level rise policies such as in the Rhode Island Special Area Management Plan, and California's Use of the Public Trust Doctrine. In some states, this use of existing authorities was complemented by new authorities provided via new state laws and/or Executive Orders. Current enforceable policies of the New Jersey Coastal Management Program²⁷⁷ offer important opportunities to ensure consistent development and guidance associated with science-informed sea-level rise values, such as the Federal Coastal Zone Management Act, the Coastal Area

²⁷⁶ Kaplan et al. 2016. Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: A Companion Report to the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel Report. Prepared for the New Jersey Climate Adaptation Alliance. New Brunswick, NJ: Rutgers University.

<https://njadapt.rutgers.edu/docman-lister/conference-materials/168-crfinal-october-2016/file>

²⁷⁷ See: https://www.state.nj.us/dep/cmp/czm_enforcepolicies.html

Facility Review Act, the Waterfront Development Act, and the Wetlands Protection Act. With respect to reliance on the state's existing Coastal Management Policies, experiences in several of the fifteen states studied by the Rutgers Team may offer areas of potential interest with to the NJCMP to explore the feasibility of considering in New Jersey, including:

- *Coastal Resilience Conservation Easements* - Conservation easements that facilitate the landward migration of wetlands impacted by SLR may be an option in New Jersey. There are numerous State authorities that promote such easements, including the Green Acres and Blue Acres programs, established by statute in 1961 and 2007; the New Jersey Natural Lands Trust, established by statute in 1968; and the New Jersey Conservation Restriction and Historic Preservation Restriction Act, adopted in 1979. Work is underway in New Jersey by a variety of organizations to identify wetlands that are threatened by SLR and to find solutions, including the identification of migratory corridors. Work is underway in New Jersey by a variety of organizations to identify wetlands that are threatened by SLR and to find solutions, including the identification of migratory corridors. For example, scientists from the Rutgers University Center for Remote Spatial Analysis (CRSSA), Rutgers University Department of Marine and Coastal Sciences, the Partnership for the Delaware Estuary and the Barnegat Bay Partnership teamed up for a study entitled "Decision Making for Coastal Adaptation: Sustaining Coastal Salt Marshes for Ecosystem Services along the Jersey Shore." The scientists evaluated the elevation, erosion rate and landward migration potential of seven marsh areas in the Delaware Bay, Great Bay and Barnegat Bay/Little Egg Harbor areas and developed "Marsh Futures Maps" that highlight the marshes most susceptible to SLR over the next several decades.²⁷⁸ Similar efforts are underway in the northern part of the State. The Regional Plan Association, working with numerous partners including the Rutgers Climate Institute, CRSSA, The Nature Conservancy and the New York-New Jersey Harbor Estuary Program released "The New Shoreline: Integrating Community and Ecological Resilience Around Tidal Wetlands." The 2018 report drew from existing studies and models to assess the impacts SLR will have on wetlands in the New York-New Jersey-Connecticut region, identify areas where wetlands have the potential to migrate upland in response to SLR and areas where existing development impedes wetland migration.²⁷⁹ The data generated by these and other studies and tools may offer value in identifying upland areas where conservation easements would facilitate wetland migration. The State could accomplish this under the authorities identified above, or the NJDEP could adopt a new Coastal Resilience Conservation Easement rule in its Coastal Management Program to serve several objectives: (I) clearly state the purpose of the Easements; (ii) establish the criteria for eligible properties; (iii) sanction the studies and

²⁷⁸ July 2017, Investigators: Richard G. Lathrop, Josh Moody, Martha Maxwell-Doyle, Danielle Kreeger, Mike Kennish, Rachael Sacatelli and LeeAnn Haaf. See, <https://doi.org/doi:10.7282/T3542RCT>

²⁷⁹ A Report of the Fourth Regional Plan, Regional Plan Association, September 2018.

tools that are most appropriate to identify potential Easement locations; and (iv) detail the benefits to private property owners that participate in the effort. With or without a rule adoption, the State could strongly encourage coastal municipalities to participate in identifying potentially eligible properties through their Master Plan Conservation Elements required by the Municipal Land Use Law, or through local coastal resilience plans.²⁸⁰

- ♦ *Special Area Management Planning* – The Rhode Island BEACH Special Area Management Plan is new with its guidance only being released in 2018. There are likely to be important insights to be gained for the NJCMP in following the initial outcomes of the experiences in Rhode Island. In particular, NJCMP may benefit in understanding the ease of implementation of the program, positive outcomes with regard to integration of strategies to mitigate sea-level rise impacts as part of coastal permitting, and benefits to the regulated community of establishing a consistent and transparent sea-level rise conditions within the state's Coastal Zone Management policies.
- ♦ *Public Trust Sea-level rise assessment* - Conveyances of public trust lands, or "tidelands", in New Jersey are governed by the NJ Tidelands Act. Tidelands management is overseen by the Tidelands Resources Council, a board of 12 governor-appointed volunteers, along with the DEP Bureau of Tidelands Management. The Council has the authority to review and issue tidelands conveyances under the Act.²⁸¹ Currently, the Tidelands Act does not require the recipients of New Jersey tidelands conveyances to conduct an assessment relating to their use of these public trust resources. A California AB-691 approach is probably not applicable in New Jersey because, in New Jersey, conveyances are authorized by a riparian grant, which is a deed from the State for the sale of formerly flowed tidelands. Once the property is deeded – meaning sold – to these entities, the land is considered to be privately held and the Council has no further claim to those lands. Also, in California, all income generated from the public trust grants are state trust assets and must be reinvested and used for trust purposes, including preparation of the sea-level rise assessments. In New Jersey, funds earned from tidelands conveyances are not considered to be State trust assets and are not restricted to trust-related uses; currently, all funds generated by the purchase of the tidelands grants go into a dedicated fund to support New Jersey public schools.²⁸² Despite these differences between New Jersey and California, there may be other avenues for New Jersey to provide incentives to integrate sea-level rise considerations into tidelands programs. The State Waterfront Development Act includes the following provision that could be explored as an approach to promote assessment of sea-level rise impacts:

²⁸⁰ N.J.S.A. 40:55D -28(b)(8)

²⁸¹ NJ DEP Division of Land Use, Tidelands webpage, https://www.nj.gov/dep/landuse/tl_main.html

²⁸² NJDEP Bureau of Tidelands Management presentation prepared by William Kresnosky, Supervising Environmental Specialist. <https://www.nj.gov/dep/enforcement/JCNERRWebinartidelands.pdf>

"The board of commerce and navigation²⁸³ shall investigate and report annually to the legislature the condition of water-front and harbor facilities and any other matter incident to the movement of commerce upon all navigable rivers and waters within this state or bounding thereon." ²⁸⁴ Another consideration is that the New Jersey Tidelands Council also issues tidelands leases and licenses. The leases are long term rental agreements for the use of currently flowed tidelands for projects that involve long term financing, such as homes that have been constructed over water or large-scale development projects and the licenses are short term rental agreements for the use of currently flowed tidelands for structures such as docks and piers, marina slips (5 or more), bulkhead extensions and bridge construction and maintenance. NJCMP might consider exploring whether it may be possible for the Council to incorporate a sea-level rise consideration as part of these processes.

- ◆ **Strong academic partnerships** - Academic collaboration on climate resiliency occurs in most of the states reviewed for this project either through a direct requirement that tasks universities with developing the climate science or through participation on various working groups. Similarly, New Jersey does indeed have extant state-academic collaboration on issues related to climate and resiliency including the aforementioned NJFRAMES project, the 2018 Coastal Summit and NJDEP's Science Advisory Board, as some examples.

Despite the strong foundation on which the NJCMP can build a comprehensive science-informed sea-level rise initiative, there are several challenges that can become opportunities to inform the development of impactful sea-level rise programs and policies in New Jersey:

1. Statutory Support

Unlike the experience of many other states studied for this report, New Jersey's climate statutes do not include provisions related to climate adaptation. The 2009 first report to the Legislature pursuant to the Global Warming Response Act opted to include a chapter outlining climate change impacts to the state and potential adaptation considerations for New Jersey. The report also indicated that the state would begin to:

"engage experts from academia, government, non-governmental organizations, and the business community in developing policy recommendations on the most pressing adaptation policies New Jersey should adopt to significantly reduce the State's risks from climate change impacts. There will be issues unique to all ecosystems and regions throughout the State. These actions will need to be customized to specific regions, and eventually tailored to municipalities throughout New Jersey. By bringing together various constituencies to develop a statewide climate change adaptation plan, New Jersey can be proactive in

²⁸³ Currently recognized as the Economic Development Authority in New Jersey

²⁸⁴ N.J.S.A. 12:5-1.

fostering adaptive capacity of the built, natural and human systems statewide to respond to climate change.”²⁸⁵

In response to those recommendations, NJDEP management began the development of a statewide assessment and plan, which did not proceed.

2. High-level Statewide Engagement

Also unlike the experience of many other states studied for this report, New Jersey does not have a mandated public body, the role of which is to consult on resilience and adaptation efforts. Many of the states included in this report host or hosted executive-level standing or ad-hoc committees that guide or inform the processes to prepare their states for climate change at the executive level. Key to these processes are an examination of the science and assessment of the state’s vulnerability; identification of impacts to multiple sectors including the economy, public health and infrastructure; and identification of appropriate, science-informed action.

3. Internal Coordination

Many of the states examined for this report have established formal or informal interagency working groups that vary from the state to cabinet levels. State government in New Jersey does not currently maintain a structured interagency working group on resilience and adaptation at either the staff or cabinet levels. Experiences in some of the other states indicate that such working groups facilitated the consistent integration of sea-level rise and climate science into multiple agencies’ efforts. By fostering interagency collaboration, the working groups also promoted the identification of mechanisms by which other agencies could act to promote the shared outcome of resilience or adaptation, such as strategies associated with infrastructure planning, capital investment, environmental reviews and engagement with local governments.

4. All Climate-hazard Planning

Many of the states examined for this report have addressed sea-level rise and coastal resiliency as part of all-climate hazard assessment and planning. These other hazards would relate to current and anticipated changes in temperature and precipitation, in addition to sea-level rise and coastal storms. Although all climate hazards were not the focus of this study, New Jersey does evaluate to some degree all climate hazards in the State Hazard Mitigation Plan and some counties are as well (e.g., Ocean County).

5. Unfunded mandate provisions

A 1995 amendment to the state constitution (Article VIII, Section II, paragraph 5) prohibits the state legislative and executive branches from adopting mandatory laws, rules or regulations that impose an “unfunded mandate” on boards of education, counties or municipalities without authorizing resources, other than

²⁸⁵ Meeting New Jersey’s 2020 Greenhouse Gas Limit: New Jersey’s Global Warming Response Act Recommendations Report. New Jersey Department of Environmental Protection. 2009. https://www.nj.gov/dep/sage/docs/njgrwa_final_report_and_appendices_dec2009.pdf

property taxes, to "offset the additional direct expenditures required for the implementation of the law or rule or regulation." As a result, the state legislature or executive branch is disallowed from promulgating a mandatory requirement on local governments (counties and/or municipalities) that requires resilience planning. Several specific exceptions are allowed (N.J.S.A. 52:13H-3) such as where requirements are equally extended to the private sector (such as a minimum wage increase), compliance with other constitutional requirements (such as providing a thorough and efficient education), imposition of federal requirements, and costs to remedy failure to comply with existing laws or rules. The law also establishes a procedure whereby the legislature can make an exception for a law that would impose a new mandate through a process that involves approval of $\frac{3}{4}$ of the legislature and preparation of a fiscal analysis. Where questions exist regarding implementation of the law, a State Mandates Council was established which has the authority to rule on cases as to compliance.²⁸⁶

Given these provisions in the state, it would be difficult for the state to impose a resilience planning requirement on municipal and county governments without the allocation of resources for purposes of implementation. As seen in the experiences in other states, other voluntary options may include development of detailed guidance for local governments along with technical assistance, decision-support tools and grant funding. Another alternative may be the approach taken by Massachusetts in which a state law directs the state to develop a planning framework for voluntary use by local governments, which the state complements with a targeted grant program to incent local governments to apply the state-developed planning framework. Still another option for New Jersey could be an approach in which incentives (e.g. grant funds) are provided to local governments that have undertaken resilience planning according to some minimum elements set by the state.

In the experiences in other states, challenges such as these were overcome through the intersection of leadership with public engagement, interagency cooperation and close coordination with the science community.

²⁸⁶ <https://www.state.nj.us/localmandates/>

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