Coastal Zone Management Act
Section 309 Enhancement Grants Program
Assessment and Strategy
July 2016 – June 2021

May 2015
Amended January 2017

New Hampshire Department of Environmental Services
Water Division
Watershed Management Bureau
New Hampshire Coastal Program

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Section 309 Enhancement Grants Program
Assessment and Strategy
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List of Abbreviations

CAW – New Hampshire Coastal Adaptation Workgroup
CMP – Coastal Management Program
CZM – Coastal Zone Management
CZMA – Coastal Zone Management Act
GBNERR – Great Bay National Estuarine Research Reserve
FEMA – Federal Emergency Management Agency
NHCP – New Hampshire Coastal Program
NHDES – New Hampshire Department of Environmental Services
NOAA – National Oceanic and Atmospheric Administration
NPS – Nonpoint Source
NROC – Northeast Regional Ocean Council
PREP – Piscataqua Region Estuaries Partnership
SAMP – Special Area Management Plan
UNH – University of New Hampshire

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INTRODUCTION

The Coastal Zone Enhancement Program was established under Section 309 of the Coastal Zone Management Act (CZMA), as amended. The program encourages state coastal management programs (CMPs) to strengthen and improve their federally approved coastal management programs in one or more of nine enhancement areas: wetlands, coastal hazards, public access, marine debris, cumulative and secondary impacts, special area management plans (SAMPs), ocean/Great Lakes resources, energy and government facility siting, and aquaculture.

Every five years, states and territories are encouraged to conduct self-assessments of their CMPs to determine the extent to which problems and opportunities exist to enhance their programs within each of the nine enhancement areas and assess the effectiveness of existing management efforts to address identified problems.

Past Section 309 Assessments

In 1991, as part of instituting an Enhancement Grants Program in New Hampshire, the state conducted a detailed assessment of the New Hampshire Coastal Program (NHCP) using public input and other resources. This assessment prioritized needed NHCP improvements by identifying Wetlands Protection and Restoration as well as Cumulative and Secondary Impacts of Development as New Hampshire's two priority coastal issues. A five-year Strategy document to serve the state through Federal Fiscal Year 1995 was then developed that identified specific projects for addressing these priority issues. Each project was designed to lead a program change that New Hampshire would seek to implement. For example, the 309 Plan was used to support the establishment of the salt marsh restoration program.

The Strategy was revised in 1994, 1996, 2001, 2006 and 2011. The table below summarizes the high priority areas identified in each NHCP assessment, which have included Cumulative and Secondary Impacts of Development as well as Wetland Protection and Restoration throughout the history of the New Hampshire coastal program.

High Priority Coastal Issues in New Hampshire							
Enhancement Areas	**1991**	**1994**	**1996**	**2001**	**2006**	**2011**	**2016**
Wetlands	✓	✓	✓	✓	✓	✓	✓
Coastal Hazards						✓	✓
Public Access							
Marine Debris							
Cumulative & Secondary Impacts	✓	✓	✓	✓	✓	✓	✓
Special Area Management Planning							
Ocean & Great Lakes Resources					✓	✓	
Energy & Government Facility Siting							
Aquaculture							

2016 Section 309 Assessment

The priority issues and strategies for this Assessment were determined through a comprehensive planning process undertaken by NHCP staff during the summer and fall of 2014. Stakeholders and partners were involved in this process through personal interviews and facilitated input sessions. The facilitated sessions included confirmation of enhancement area prioritization developed by NHCP staff as well as targeted discussions on coastal hazards, wetlands, and cumulative and secondary impacts. The sessions provided NHCP staff with additional management needs, gaps, and emerging issues at the community, state and regional level. The enhancement area prioritization was supported by members of the New Hampshire Coastal Adaptation Workgroup (CAW), the Management Committee of the Piscataqua Region Estuaries Partnership (PREP), the New Hampshire Department of Environmental Services (NHDES) Watershed Assistance Section, and the NHDES Wetlands Bureau. Additional support for priorities and strategies for this Assessment came through the PREP 2010 Comprehensive Conservation and Management Plan (PREP, 2010) as well as the 2014 NHDES New Hampshire Nonpoint Source Management Program Plan (NHDES, 2014). Because both of these management plans also contain prioritized goals and objectives based on input from stakeholders, they, too, provide public guidance on Section 309 activities.

Upon completion of the draft 2016 Section 309 Assessment and Strategy in February 2015, the report was subjected to a 30-day public comment period. Partners and stakeholders, including numerous agencies and organizations, were invited to comment. No comments were received during the public comment period.

SUMMARY OF RECENT SECTION 309 ACHIEVEMENTS

Wetlands

Program change: Changes to pesticides regulations regarding invasive species
The NHCP staff-supported Coastal Watershed Invasive Plant Partnership Steering Committee (CWIPP) was formally organized in 2008. With the signing of an official agreement, 11 state and federal agencies and nonprofit conservation groups formed a strong alliance to stop the spread of invasive plants in New Hampshire's coastal watershed. The creation of CWIPP was first proposed in the 309 Enhancement Grants Program Assessment and Strategy in 2006 and was further expanded upon in the 2011 309 Assessment and Strategy. NHCP served as CWIPP chairperson for 8 years until the partnership dissolved in 2013 due to lack of chairperson successor.

CWIP partnership significantly increased the capacity for invasive control in the coastal watershed, which resulted in several program changes in the form of regulatory changes and process improvements. CWIPP partners provided critical support and comments to a variety of rule changes at the Division of Pesticide Control that resulted in major benefits to regional invasive plant control. NHCP's Restoration Coordinator attended hearings and provided testimony to the Division of Pesticide Control about the benefit of the proposed rule changes. These changes are summarized below.

<u>"Label is the Law" rule modified</u>
The rule change allows practitioners to apply herbicide at rates less than specified on the label (unless expressly prohibited by the label). The change also means that an herbicide can be used against a target pest that is not specified on the label as long as the use conforms with the site specified on the label, unless otherwise prohibited.

Previous to this rule change, there were specific invasive species, such as Oriental bittersweet, that were not listed on any label; thereby preventing the effective control of these invasive plants. This rule change allows practitioners to use an herbicide based on the approved habitat rather than the specific plant. This rule change allowed the NHCP and its partners to finally begin control on the significant populations of bittersweet at Odiorne Point State Park. Oriental bittersweet had come to dominate the vegetation communities throughout the 320 acre park since it was first planted by the Department of Army to camouflage bunkers during the 1940s.

<u>Brown-Out rule lifted for invasive plants</u>
The previous rule regarding 'brown out' along rights-of-way stated, in part, that no herbicide shall be applied to brush along New Hampshire public road rights-of-way of more than one year's growth or during the period of green foliage for deciduous trees with the exception of where the brush was cut down and removed. The largest consequence of this outdated rule was to essentially prohibit the effective control of invasive Japanese knotweed along state highways, which, in some instances, had created dense monocultures on roadsides and highway medians. In some circumstances, such as along Route 1A in Rye, the uncontrolled knotweed encroached into the roadway and obscured lines of sight. In all instances, these uncontrolled roadside knotweed sites served as sources of seed and plant material to establish other knotweed sites, eventually getting into river corridors, which are much more difficult to control due to the sensitivity of aquatic resources.

Waiting time for permits eliminated

To aid early detection rapid response work on invasive species, a rule change enacted by the Division of Pesticide Control in 2011 eliminates the lead time requirements for special permits for invasive plant projects. Invasive plant projects have also been exempted from notification requirements for spraying in the right-of-way. The Seacoast has benefited from this rule change through the NHCP's efforts to prevent perennial pepperweed from becoming established in coastal New Hampshire. There have been two instances where new populations of pepperweed were controlled with herbicide in the same year that they were identified, which would have been impossible prior to the rule change.

Statewide contract for services for control of invasive species

In 2011, the New Hampshire Department of Transportation and the New Hampshire Department of Administrative Services created a statewide contract for services for the control of invasive species on state lands and rights-of-way. This contractual mechanism allows state agencies to more effectively contract invasive plant control to a pre-qualified contractor at a pre-determined cost per acre. State agency partners of CWIPP, including the NHCP, provided valuable input on the statewide contract during its initial drafting. As a result of this change and the brown-out rule change described above, New Hampshire state agencies have made significant progress in controlling roadside populations of Japanese knotweed and common reed, which is evident on Interstate 95, Highway 101, and many other smaller state highways throughout the coastal zone.

Statewide limit on nutrient levels in fertilizers

Effective January 2014, the New Hampshire legislature placed limits on the level of nitrogen and phosphorus in lawn fertilizers that can be sold in retail stores. The purpose of these limits is to reduce nutrient pollution from nonpoint sources to Great Bay and New Hampshire's lakes and ponds. These changes to RSA 431 were supported by NHDES and NHCP and are expected to lower nitrogen levels in Great Bay by reducing nutrient runoff.

Coastal Hazards

Coastal Adaptation Workgroup (CAW)

CAW was established in 2010, and NHCP's ongoing participation supports the Adaptation Program Creation and Support strategy identified in the *2011 Section 309 Assessment and Strategy Report*.[1] NHCP joins the NHDES Air Resources Divisions Permitting and Environmental Health Bureau, the Coastal Training Program at the Great Bay National Estuarine Research Reserve (GBNERR), New Hampshire Sea Grant, the Natural Resources Outreach Coalition, two regional planning commissions, and a multitude of other organizations and expertise in participating in CAW.

CAW helps communities in New Hampshire's Seacoast area prepare for the effects of extreme weather events and other effects of long term climate change by providing education, facilitation, technical assistance and guidance. CAW members coordinate on projects that move forward climate adaptation planning.

NHCP staff have been active members of CAW throughout the last five years. In recent years, NHCP staff have participated in approximately two meeting per month to support CAW's ongoing activities including: planning and publicizing the "Water, Weather, Climate, and Community" workshop series; helping plan the annual New Hampshire Coastal Climate Summit and other conferences, including New Hampshire's first

[1] http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-10-25.pdf.

Shoreline Management Conference in late 2014. In addition, NHCP staff coordinated the development of the CAW website, leveraging existing web resources provided by the national StormSmart Coasts network. Numerous activities and projects have resulted from NHCP's work with CAW. Highlights of specific projects include:

- The "Water, Weather, Climate, and Community" ongoing workshop series, hosted by CAW, aids communities in becoming more comfortable with discussing, developing, and implementing adaptation and hazard mitigation strategies. There have been eight workshops to date. NHCP staff assists with planning and publicity, including designing the workshop flyers, as well as workshop facilitation. All workshop materials and PowerPoint presentations are available on the New Hampshire StormSmart Coasts website at http://nhblog.stormsmart.org/past-workshops/.
- The New Hampshire Coastal Climate Summit is an annual event hosted by CAW member GBNERR and coordinated through CAW that brings together the community to learn about projects and research related to climate change and adaptation. The third annual summit in spring 2014, at which NHCP staff presented, brought together approximately 100 people sharing stories and lessons learned from coastal communities outside of New Hampshire. NHCP staff also helped publicize the 2014 Summit, assisting with flyer design and dissemination.
- NHCP led the development of and wrote the proposal for the Taking Action for Resilient Natural and Built Communities in New Hampshire through Applied Modeling and Development of a User-Driven Toolbox Project of Special Merit. This project was developed and coordinated through CAW. This was one of the only projects to receive full funding under the Coast Zone Management Act Projects of Special Merit Competition - FY2013. NHCP is the project lead and the chair of the project's steering committee. As part of this Project of Special Merit, NHCP staff assisted with facilitation during the "Preparing for Climate Change" community workshops as well as providing input on design and data acquisition for the Coastal Hazards Data Viewer.
- NHCP staff connected the National Weather Service with CAW to conduct a storm surge focus group that helped inform a National Weather Service product on storm surge.
- A subgroup of the CAW, coordinated by NHCP staff and including a NHCP staff person, reviewed the structure and organization of the New Hampshire StormSmart Coasts website and helped transition it to a new format. The group developed a plan of short-, mid- and long-term improvements that will be implemented on the website. In addition to regular postings about events and other news items, the CAW subgroup contributed several in-depth articles to the CAW blog highlighting community and state agency progress toward adapting to effects of climate change. The CAW subgroup staff also created the CAW Twitter feed, regularly used to promote events and important science and news articles.
- CAW partner organizations, with NHCP funding and staff assistance, facilitated a project with the town of Rye to help community members begin planning for climate change impacts.
- The New Hampshire Shoreline Management Conference, hosted by the GBNERR and CAW, was an initiative that started a collaborative dialogue about shoreline management issues, including sea level rise, in New Hampshire and identify best practices in other parts of the country. NHCP provided funding support and one NHCP staff served on the conference planning team, assisting with agenda development, interactive exercise design including maps, and publicity. NHCP staff presented and facilitated during the conference in addition to participating in a follow-up planning meeting to draft a work plan for future research and outreach needs on the topic.
- The New Hampshire King Tide Photo Competition took place during the October 2014 King Tide. In partnership with the Gulf of Maine Council, CAW designed a photo competition for communities to document coastal hazards and vulnerabilities that will be exacerbated with sea level rise. NHCP

staff helped plan and publicize the event, obtained prizes from local businesses, and managed the photo judging process.

Program change: New state legislation
NHCP staff helped develop two new pieces of legislation that have been passed since the last 309 Assessment was done: 1) the Coastal Risks and Hazards Commission and 2) coastal management provisions in master plans.

1) In 2013, the New Hampshire legislature enacted RSA 483-E establishing the New Hampshire Coastal Risks and Hazards Commission. "The commission shall recommend legislation, rules, and other actions to prepare for projected sea level rise and other coastal and coastal watershed hazards such as storms, increased river flooding, and storm water runoff, and the risks such hazards pose to municipalities and state assets in New Hampshire." (RSA 483-E:3 I) The commission reports to the legislature annually. This change was driven by CAW and supported by NHCP as one outcome of the Adaptation Program Creation and Support strategy identified in the *2011 Section 309 Assessment and Strategy Report*.[1] NHCP expects that this legislation will result in better planning for projected sea level rise and other coastal hazards.
2) Also in 2013, the New Hampshire legislature approved an addition to local planning and zoning regulations that authorizes coastal management provisions in master plans in order to address planning needs and property loss resulting from projected coastal risks due to increased frequency of storm surge, flooding, and inundation. This CAW-driven, NHCP-supported change promotes climate change planning in coastal communities and was the result of a 309 strategy identified in the 2011 Section 309 Assessment and Strategy Report.[1] The town of Rye recently added climate change considerations to its master plan, based on this enabling legislation.

Project of Special Merit Grant: Taking Action for Resilient Natural and Built Communities in New Hampshire through Applied Modeling and Development of a User-Driven Toolbox
The Taking Action for Resilient Natural and Built Communities in New Hampshire is a NHCP-driven NOAA Project of Special Merit that received full funding in the CZMA Projects of Special Merit Competition - FY2013. This ongoing project includes both modeling and mapping products. The project's coordinated approach enables project partners to learn how communities want to use and access coastal data and GIS tools in hazards and climate adaptation planning as well as to identify the steps that can be taken to ensure that climate related science is relevant to local needs.

Through this Project of Special Merit, NHCP and project partners are connecting Seacoast municipal leaders, community members and business owners with information and tools to help plan for coastal hazards. This work advances resiliency and adaptation planning for climate change related hazards in coastal habitats in New Hampshire's 17 coastal zone communities and 42 coastal watershed communities by integrating tools, research, outreach and technical assistance.

Some highlights of the project include: The Sea Level Affecting Marsh Migration (SLAMM) model which uses new, more precise data to provide updated information on how salt marshes will be able to adapt to future sea level rise conditions; the incorporation of data such as the 13 newly verified Sediment Elevation Tables for tidal marsh elevation into the SLAMM; the New Hampshire Coastal Hazards Viewer (available in the spring of 2015) where data and maps can be used by coastal watershed communities for hazard mitigation planning; the efforts of three New Hampshire communities to reduce vulnerability to coastal hazards and raise awareness about coastal vulnerability; and outreach to area businesses.

Coastal Resilience Specialist Position
In 2015, the NHCP hired a full-time Coastal Resilience Specialist to develop and implement a coastal resilience program. The Coastal Resilience Specialist provides technical assistance, outreach materials and training to communities and state agencies, serves as the point person for coastal resilience grant projects administered by NHCP, participates in CAW, supports the New Hampshire Coastal Risks and Hazards Commission, and will be assisting with coastal hazard vulnerability assessments for 10 communities.

Cumulative and Secondary Impacts

Program change: Model stormwater standards for coastal watershed communities
The *Model Stormwater Standards for Coastal Watershed Communities*, published in December 2012 (UNH and RPC, 2012), was compiled by the Southeast Watershed Alliance, funded by NHCP, and developed with assistance of the University of New Hampshire (UNH) Stormwater Center and the Rockingham Planning Commission (RPC). This model offers minimum, consistent, and enforceable stormwater management standards for coastal watershed communities.

The standards encourage the use of Low Impact Development strategies, build upon innovative stormwater standards recently adopted by several coastal watershed communities, and are consistent with EPA Region 1 and NHDES guidelines. Adoption of the model stormwater standards can provide consistent water quality protection throughout New Hampshire's coastal watershed. These model standards are under consideration by several New Hampshire communities and have been adopted by the Town of Newfields.

Project of Special Merit: Soak Up the Rain Great Bay
NHCP has recently been awarded funding in the CZMA Projects of Special Merit Competition - FY2014 for the Soak Up the Rain Great Bay project. Soak up the Rain (SOAK) Great Bay is a stormwater outreach and assistance program designed to increase awareness of stormwater runoff, the problems it can cause, and the simple ways it can be better managed to reduce water pollution and adapt to our changing climate. Through work with the Great Bay Stewards, the UNH Cooperative Extension, and coastal volunteer groups, SOAK Great Bay empowers individuals and provides them with the resources to contribute to protecting and restoring clean water.

SOAK Great Bay and partners will encourage residential and lot-scale stormwater management, coordinate messaging about stormwater, and provide a way for communities, residents, and environmental professionals to communicate about stormwater, nonpoint source pollution, and other coastal water quality issues. Implementation of SOAK Great Bay will help to raise the awareness and the acceptance of the shared responsibility for clean water and the ease and abundance of voluntary opportunities to reduce nonpoint source (NPS) pollution at the lot scale.

Over an 18 month period beginning in November 2014, partners will develop a local program sustainability plan to identify program successes, barriers, and strategies for managing the program over the long term. The completed sustainability plan will provide a road map for the SOAK Great Bay program as well as for other coastal zone communities interested in pursuing similar programs. The project will also develop a landscaper training program for professional landscapers to install stormwater management practices suitable for small sites and to consider site drainage when designing and performing landscaping services.

This project will help build community resilience to climate change related impacts, such as storm frequency, intensity, and flooding by promoting infiltration of stormwater on residential properties to

reduce risk. This project also works toward building political will to support land use ordinances related to water quality protection and instilling the concept that stormwater management is simply a component of everyday property management.

Ocean Resources

Program Change: Committee to Study Offshore Wind Energy and the Development of Other Ocean Power Technology

In 2014, the Committee to Study Offshore Wind Energy and the Development of Other Ocean Power Technology determined that while wave and tidal energy generation would not produce significant energy, offshore wind energy generation is feasible. The Committee recommended that the turbines be placed three or more miles off the shore of the Isle of Shoals, be built on floating platforms attached to the sea floor, and that New Hampshire work cooperatively with Maine and Massachusetts in the development of offshore wind energy.

Project of Special Merit: Marine Habitat Characterization and Classification in the Northeast

In 2012, NHCP submitted a proposal and secured funding for a regional Project of Special Merit titled *Marine Habitat Characterization and Classification in the Northeast*. Through this project, the five Coastal Programs of New England – Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut – collaborated through the Northeast Regional Ocean Council (NROC), which NHCP chaired at the time, on a project to improve regional marine habitat characterization and classification. The project built directly off existing regional- and state-level activities that focused on foundational components of marine habitat protection such as identification of habitats through mapping and classification efforts.

Over the course of a year and half, the Habitat Classification Working Group (Working Group) – comprised of practitioners and managers from each of the five Coastal Programs, other state and federal agencies, and academics – discussed the multitude of methodologies and activities transpiring in the Northeast regarding habitat classification. This allowed participants a unique opportunity to develop new partnerships and raise awareness of not just the importance of their work, but of similar projects where collaboration between two or more parties would greatly benefit northeast habitat classification efforts in general.

The Working Group's efforts culminated in a 2013 workshop in which a set of regional goals were agreed upon by Working Group members and other experts in the fields of Habitat Classification and Ocean Mapping. NROC has subsequently established a Habitat Classification and Ocean Mapping Subcommittee under its Ocean and Ecosystem Health Committee to advance the goals identified at the workshop. This will enable NROC to continue the exceptional work accomplished under the regional Project of Special Merit and shape the way the New England States discuss and practice habitat classification and ocean mapping far into the future. The NROC Ocean and Ecosystem Health Committee's 2014-2015 work plan, which discusses the habitat classification efforts, is expected be available on their website http://northeastoceancouncil.org in the near future.

New Hampshire estuary spatial planning project: Coordinating data to assess our ecosystem services (In progress, due September 2015)

The New Hampshire Estuary Spatial Planning Project (NHESP) is a two-year, NOAA Coastal Management Fellowship project to coordinate the collection, integration, and accessibility of existing spatial data for New Hampshire's Hampton-Seabrook and Great Bay estuaries and to assess ecosystem services within the Great Bay estuary. The overall goal is to help improve management decisions. Cash match in the amount of $7,500 each by The Nature Conservancy and PREP is helping make this project possible.

The first phase (September 2013 to August 2014) of NHESP coordinated existing spatial datasets to address well-defined management questions and improve public access to this important information. The primary venue for this data is the Coastal Viewer, which is being created with funding from the ongoing Project of Special Merit *Taking Action for Resilient Natural and Built Communities in New Hampshire.* By integrating these datasets in a single public location, New Hampshire's coastal managers and other interested stakeholders are able to make better informed decisions. Phase I resulted in an extensive inventory of spatial datasets as well as a New Hampshire Spatial Data Management Plan that identifies local data stewards and data gaps and makes recommendations to improve spatial data coordination in the future.

During the second phase (March 2014 to September 2015), the project team is working on a tradeoff analysis of key ecosystem services provided by eelgrass, oyster beds, and salt marshes to understand the value of restoration and other activities in the Great Bay estuary. This analysis is using existing New Hampshire spatial datasets as well as models from InVEST (Integrated Valuation of Environmental Services and Tradeoffs - a suite of software models used to map and value the goods and services from nature that sustain and fulfill human life).[2] An advisory committee of more than 20 partner organizations is providing technical assistance and expertise for this ecosystem services assessment, and experts and other stakeholders are helping to develop scenarios that depict future management options. In addition to an assessment of current ecosystem services, the future scenarios will be assessed to compare the levels of ecosystem services expected for the future. The analysis will be shared through maps and other final outreach materials.

Northeast Regional Planning Body

The goal of ocean planning is to protect coastal and ocean resources, reduce potential user conflicts, and facilitate compatible uses. NHDES is involved with an ongoing regional ocean planning initiative to work with stakeholder groups, including federal and state agencies, tribes, environmental organizations, industry representatives and the public to identify opportunities to improve coordination and use of New England's regional ocean information.

New Hampshire's participation in regional ocean planning occurs through two federal and multi-state partnerships: the NROC, formed in 2005 by the Governors of the New England states, and the Northeast Regional Planning Body (NRPB), which is one of nine planning bodies established by a Presidential Executive Order in 2010 under the National Ocean Policy. New Hampshire is represented on NROC by the NHDES Coastal Program and on the NRPB by NHDES Commissioner Tom Burack and New Hampshire Fish and Game Department Executive Director Glenn Normandeau. Neither the NRPB nor NROC have regulatory authority.

The NRPB is charged with leading a cooperative effort to develop a regional ocean plan, which is expected to be released in final form in early 2016. With input from NROC and many ocean stakeholders, the NRPB has developed two documents which set forth the fundamental elements of its ocean planning activities: *RBP's Goals and Objectives* (NRPB, n.d.) and *The Framework for Ocean Planning in the Northeastern United States* (NRPB, 2014).

The November 2014 NRPB meeting took place in New Castle, marking the first time the NRPB met in New Hampshire.

[2] http://www.naturalcapitalproject.org/InVEST.html.

PHASE I (High-level) ASSESSMENTS

Wetlands

Section 309 Enhancement Objective: Protection, restoration, or enhancement of the existing coastal wetlands base, or creation of new coastal wetlands. §309(a)(1)

Note: For the purposes of the Wetlands Assessment, wetlands are "those areas that are inundated or saturated at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." [33 CFR 328.3(b)]. See also pg. 17 of the CZMA Performance Measurement Guidance[3] for a more in-depth discussion of what should be considered a wetland.

PHASE I (HIGH-LEVEL) ASSESSMENT: *(Must be completed by all states.)*

Purpose: To quickly determine whether the enhancement area is a high priority enhancement objective for the CMP that warrants a more in-depth assessment. The more in-depth assessments of Phase II will help the CMP understand key problems and opportunities that exist for program enhancement and determine the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. Using provided reports from NOAA's Land Cover Atlas[4] or high-resolution C-CAP data (Pacific and Caribbean Islands only), please indicate the extent, status, and trends of wetlands in the state's coastal counties. You can provide additional or alternative information or use graphs or other visuals to help illustrate or replace the table entirely if better data are available. Note that the data available for the islands may be for a different time frame than the time periods reflected below. In that case, please specify the time period the data represents. Also note that Puerto Rico and the Commonwealth of the Northern Mariana Islands (CNMI) currently only have data for one time point so will not be able to report trend data. Instead, Puerto Rico and CNMI should just report current land use cover for all wetlands and each wetlands type.

Coastal Wetlands Status and Trends		
Current state of wetlands in 2011 (acres)		
Percent net change in total wetlands (% gained or lost)	from 1996-2011	from 2006-2011
	-0.9% (-923.2 acres)	-0.2% (-220.0 acres)
Percent net change in freshwater (palustrine wetlands) (% gained or lost)	from 1996-2011	from 2006-2011
	-0.8% (-785.1 acres)	-0.2% (-206.6 acres)
Percent net change in saltwater (estuarine) wetlands (% gained or lost)	from 1996-2011	from 2006-2011
	-0.1% (-98.1 acres)	-0.02% (-20.5 acres)

[3] http://coastalmanagement.noaa.gov/backmatter/media/czmapmsguide11.pdf.
[4] http://www.csc.noaa.gov/ccapatlas/. Summary reports compiling each state's coastal county data are provided on the ftp site.

How Wetlands Are Changing		
Land Cover Type	**Area of Wetlands Transformed to Another Type of Land Cover between 1996-2011 (Sq. Miles)**	**Area of Wetlands Transformed to Another Type of Land Cover between 2006-2011 (Sq. Miles)**
Development	1.14	0.36
Agriculture	0.041	0.04
Barren Land	0.14	0.006
Water	0.20	0.012

2. If available, briefly list and summarize the results of any additional state- or territory-specific data or reports on the status and trends of coastal wetlands since the last assessment to augment the national data sets.

   - *PREP's State of Our Estuaries Report* (PREP, 2013) – This report, published by PREP, "examines environmental indicators of estuarine health, such as bacteria levels, nutrient concentrations, toxic contaminant levels, abundance of shellfish, and land use in the coastal watershed. By examining long-term data sets compiled from a variety of organizations, the report describes the current status of Southeastern New Hampshire and Southern Maine's estuaries and suggests trends for the future. The report is designed to provide readers with an accurate understanding of environmental trends for the Great Bay and Hampton-Seabrook estuaries so that they may make informed land use and resource management decisions." The report indicates that 280.5 acres of salt marsh in the Piscataqua coastal zone have been restored since 2000, and 30.6 acres of salt marsh have been enhanced since 2009, which is moderate progress toward the PREP's goals of 300 acres each of restored and enhanced salt marsh.
   - *Piscataqua Region Environmental Planning Assessment 2015* (PREPA, PREP 2015) – The 2015 PREPA, described more fully in "Phase I – Cumulative and Secondary Impacts, Resource Characterization Question 5,"notes that region-wide action is needed to increase and manage buffers and setbacks along waterbodies. The 2015 report is consistent with the original report published in 2010 (Sowers, 2010) which indicated a lack of consistency in shoreland and wetland buffers as well as structure setback requirements from shoreland within the 42 coastal communities.
   - In fall of 2014, the US Fish and Wildlife Service (USFWS) published a revised set of National Wetland Inventory (NWI) maps for New Hampshire's Seacoast Region.[5] This data set had not been updated since 1985. The previous NWI data had become out-of-date and was not often relied upon. The 2014 NWI map update includes the 17 New Hampshire coastal communities.

Management Characterization:

1. Indicate if there have been any significant changes at the state or territory level (positive or negative) that could impact the future protection, restoration, enhancement, or creation of coastal wetlands since the last assessment.

[5] http://www.fws.gov/wetlands/Data/Data-Download.html

Management Category	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these	Y
Wetlands programs (e.g., regulatory, mitigation, restoration, acquisition)	N

2. For any management categories with significant changes, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:
    a. Describe the significance of the changes;
    b. Specify if they were 309 or other CZM-driven changes; and
    c. Characterize the outcomes or likely future outcomes of the changes.

    The NHDES adopted new rules regarding culvert certification effective December 21, 2013. The new rules allow certified New Hampshire state and municipal public works employees to complete culvert maintenance and replacement work on culverts up to 48 inches diameter without applying for a routine roadway maintenance permit. Certified culvert maintainers must attend a training course, follow New Hampshire Department of Transportation's *Best Management Practices for Routine Roadway Maintenance Activities in New Hampshire* (New Hampshire Department of Transportation, 2001) guidelines, and are limited to working in areas that do not include sensitive areas such as prime wetlands, tidal wetlands and undisturbed tidal buffer zones. Allowed work is limited to sites not requiring major culvert extensions or realignments and where culverts have not been overtopped in the past. These changes allow for faster, more efficient culvert maintenance, which is expected to improve passage of stormwater and reduce infrastructure destruction during storm events. While this change was not 309- or CZM-driven, it was supported by NHCP.

    Although not deemed a significant change, New Hampshire wetlands statute RSA 482-A was amended by the legislature in 2012, resulting in reduced protections for some prime wetlands in New Hampshire. The statute change also required modifications to wetlands rule Env-Wt 700, which outlines the requirements for municipalities that wish to designate wetlands of significant value that are worthy of extra protection because of their uniqueness, fragility, or unspoiled character. The changes to RSA 482-A and Env-Wt 700 eliminate the 100 foot buffer surrounding prime wetlands for municipalities that designated prime wetlands prior to 2006, though protections to the 100 foot buffer adjacent to prime wetlands within communities that designated prime wetlands after 2006 remain unchanged. Coastal Zone communities with designated Prime Wetlands include: Exeter, Hampton, Hampton Falls, Newington, Newmarket and Portsmouth. This change was not driven by 309 or CZM and may result in negative direct impacts to upland buffers and negative indirect impacts to the prime wetlands themselves. Protection against direct impacts on prime wetlands remains unchanged.

Enhancement Area Prioritization:

1. What level of priority is the enhancement area for the coastal management program?

    High __X__
    Medium _____
    Low _____

2. Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.

   Given the importance of wetlands to help mitigate flooding and erosion risks, their susceptibility to degradation resulting from development, their role as critical habitat for fish and wildlife, and the need for policies and programs to foster future wetland protection improvements, this enhancement area is rated as a High priority. This prioritization was confirmed at presentations to CAW and the management committee of PREP. PREP and CAW include representatives from the UNH Institute for Earth, Oceans and Space; New Hampshire Fish and Game Department (NHF&G)-Great Bay National Estuarine Research Reserve; New Hampshire Sea Grant; UNH-Jackson Estuarine Laboratory; Rockingham Planning Commission; Strafford Planning Commission; UNH-NH GRANIT; City of Portsmouth; USEPA; Lamprey River Advisory Committee; NHF&G-Marine Fisheries Division; Conservation Law Foundation; The Nature Conservancy; and Great Bay Trout Unlimited.

Coastal Hazards

Section 309 Enhancement Objective: Prevent or significantly reduce threats to life and property by eliminating development and redevelopment in high-hazard areas, managing development in other hazard areas, and anticipating and managing the effects of potential sea level rise and Great Lakes level change. §309(a)(2)

Note: For purposes of the Hazards Assessment, coastal hazards include the following traditional hazards and those identified in the CZMA: flooding; coastal storms (including associated storm surge); geological hazards (e.g., tsunamis, earthquakes); shoreline erosion (including bluff and dune erosion); sea level rise; Great Lake level change; land subsidence; and saltwater intrusion.

PHASE I (HIGH-LEVEL) ASSESSMENT: *(Must be completed by all states.)*

Purpose: To quickly determine whether the enhancement area is a high priority enhancement objective for the CMP that warrants a more in-depth assessment. The more in-depth assessments of Phase II will help the CMP understand key problems and opportunities that exist for program enhancement and determine the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. **Flooding:** Using data from *NOAA's State of the Coast* "Population in the Floodplain" viewer[6] and summarized by coastal county through NOAA's Coastal County Snapshots for Flood Exposure,[7] indicate how many people were located within the state's coastal floodplain as of 2010 and how that has changed since 2000. You may to use other information or graphs or other visuals to help illustrate.

[6] http://stateofthecoast.noaa.gov/pop100yr/welcome.html. Note FEMA is in the process of updating the floodplain data. This viewer reflects floodplains as of 2010. Summary population data for each coastal state is available on the ftp site.
[7] www.csc.noaa.gov/digitalcoast/tools/snapshots.

Population in the Coastal Floodplain			
	2000	2010	Percent Change from 2000-2010
No. of people in coastal floodplain[6]	42,325	44,647	5.5%
No. of people in coastal counties[8]	389,592	418,021	7.3%
Percentage of people in coastal counties in coastal floodplain	10.8%	10.7%	----------

2. **Shoreline Erosion** (for all states other than Great Lakes and islands; for Great Lakes and islands, see Question 5): Using data from *NOAA's State of the Coast* "Coastal Vulnerability Index,"[9] indicate the vulnerability of the state's shoreline to erosion. You may use other information or graphs or other visuals to help illustrate or replace the table entirely if better data is available. *Note: For New York and Pennsylvania that have both Atlantic and Great Lakes shorelines, fill out the table below for the Atlantic shoreline only.*

Vulnerability to Shoreline Erosion		
Vulnerability Ranking	Miles of Shoreline Vulnerable[9]	Percent of Coastline
Very low (>2.0m/yr) accretion	0	0
Low (1.0-2.0 m/yr) accretion)	0	0
Moderate (-1.0 to 1.0 m/yr) stable	49	100
High (-1.1 to -2.0 m/yr) erosion	0	0
Very high (<-2.0 m/yr) erosion	0	0

3. **Sea Level Rise** (for all states other than Great Lakes and islands; for Great Lakes and islands, see Question 5): Using data from *NOAA's State of the Coast* "Coastal Vulnerability Index,"[10] indicate the vulnerability of the state's shoreline to sea level rise. You may provide other information or use graphs or other visuals to help illustrate or replace table entirely if better data is available. *Note: For New York and Pennsylvania that have both Atlantic and Great Lakes shorelines, fill out the table below for your Atlantic shoreline only.*

Coastal Vulnerability to Historic Sea Level Rise		
Vulnerability Ranking	Miles of Shoreline Vulnerable[10]	Percent of Coastline
Very low	49	100
Low	0	0
Moderate	0	0
High	0	0
Very high	0	0

4. **Other Coastal Hazards:** In the table below, indicate the general level of risk in the coastal zone for each of the coastal hazards. The state's multi-hazard mitigation plan is a good additional resource to support these responses.

[8] http://www.csc.noaa.gov/digitalcoast/data/stics.
[9] "Erosion rate" http://stateofthecoast.noaa.gov/vulnerability/welcome.html.
[10] "Historic sea-level rise" http://stateofthecoast.noaa.gov/vulnerability/welcome.html.

Type of Hazard	General Level of Risk[11] (H, M, L)
Flooding (riverine, stormwater)	High
Coastal storms (including storm surge)[12]	High
Geological hazards (e.g., tsunamis, earthquakes)	Moderate
Shoreline erosion[9]	Moderate
Sea level rise[10]	Moderate
Great Lake level change	N/A
Land subsidence	Low
Saltwater intrusion	Not assessed
Other (please specify): Fluvial erosion	High

5. If available, briefly list and summarize the results of any additional data or reports on the level of risk and vulnerability to coastal hazards within your state since the last assessment. The state's multi-hazard mitigation plan or climate change risk assessment or plan may be a good resource to help respond to this question.

Scientific Reports

- *Climate Change in the Piscataqua/Great Bay Region: Past, Present, and Future* (Wake et al., 2011) - This report outlines historical climate trends and future climate change projections for the Piscataqua/Great Bay Region in coastal New Hampshire. Historical and future sea level rise, temperature, and precipitation information helped the state, and in particular the coastal zone, better understand risk and vulnerability. The report was released with a series of maps that show flood risk with future sea level rise and storm surge conditions, giving an improved understanding of the spatial vulnerability to these hazards along the New Hampshire coast.
- *Climate Change in Southern New Hampshire: Past, Present, and Future* (Wake et al., 2014) - This report presented similar information to the Piscataqua/Great Bay report described above, but used more current climate change science and local data.
- *Sea-level Rise, Storm Surges, and Extreme Precipitation in Coastal New Hampshire: Analysis of Past and Projected Future Trends* (Kirshen, 2014) - The Science and Technical Advisory Panel for the New Hampshire Coastal Risk and Hazard Commission recommended that the state plan for a range of 1.3 to 2.0 feet of sea level rise by 2050 and 3.9 to 6.6 feet of sea level rise by 2100. The panel's report also predicts more intense coastal storms and resulting flooding. At the time of this 309 Assessment, this report is the most current information focused on these hazards in New Hampshire.

Vulnerability Assessments and Plans

- *State of New Hampshire Multi-Hazard Mitigation Plan* (New Hampshire Department of Safety, 2013) – This report, released by the New Hampshire Department of Safety, Homeland Security, and Emergency Management, identifies updated risk scores for several hazards that are pertinent to coastal management including coastal and riverine flooding, hurricanes, dam failure, earthquakes, and severe weather. The 2013 plan defines riverine flooding and coastal flooding as *high risk* hazards and dam failure, earthquakes, hurricanes/tropical cyclones, and

[11] Risk is defined as "the estimated impact that a hazard would have on people, services, facilities and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage." *Understanding Your Risks: Identifying Hazards and Estimating Losses. FEMA 386-2. August 2001.*
[12] http://nca2014.globalchange.gov/.

tornado/downbursts as *moderate risk* hazards. The plan also highlights the need to investigate New Hampshire's risk of saltwater intrusion in the next iteration of the plan.

- *Coastal New Hampshire Floodplain Mapping Project* (New Hampshire Office of Energy and Planning, 2014) - The New Hampshire Office of Energy and Planning, together with Federal Emergency Management Agency (FEMA) and other project partners, carried out a coastal mapping project to update the FEMA flood insurance rate maps for coastal New Hampshire. The maps will be preliminary until mid-2015. They identify new coastal areas of high flood risk as well as areas that are at lower risk than previous maps show. Higher resolution topographic data was used as well as new methods to better calculate flood risk from wave action. Some non-regulatory mapping products were released, including maps that show the changes between the preliminary updated Flood Insurance Rate Maps (FIRMs) and the current effective FIRMs. Sea level rise scenario maps will be released in 2015 as part of this project.
- *PREP's State of Our Estuaries Report* (PREP, 2013) – See "Phase I - Wetlands, Resource Characterization Question 2" response above for a summary of this report. The report summarizes indicators, status and trends associated with estuarine ecosystem risk, and highlights deteriorating negative trends that relate to coastal hazards including increases in impervious surfaces, declining coastal habitats that provide shoreline stabilization and other benefits, and reduced eelgrass and shellfish populations.
- *Piscataqua Region Environmental Planning Assessment 2015* (PREP, 2015) – See "Phase I – Cumulative and Secondary Impacts, Resource Characterization Question 5" response below for a summary of this report. In addition, the 2015 PREPA identifies impervious cover, climate change and nitrogen loading as the greatest threats to the Piscataqua watershed and the Great Bay and Hampton-Seabrook estuaries, prioritizing stormwater management as a method to address some of these threats.
- *City of Portsmouth, New Hampshire Coastal Resilience Initiative* (City of Portsmouth, 2013) - The Coastal Resilience Initiative resulted in a final Climate Change Vulnerability Assessment and Adaptation Plan for the city of Portsmouth, New Hampshire. The project produced sea level rise and coastal storm scenario maps as well as estimates of the financial losses to the city given specific storm and flooding scenarios as well as the predicted costs of various adaptation options, including flood gates and tide barriers.
- *COastal Adaptation to Sea-level rise Tool (COAST) for Hampton, Hampton Falls, and Seabrook, New Hampshire* (New England Environmental Finance Center, 2011) - This project assessed the potential financial costs and benefits to different adaptation actions in towns in the Hampton-Seabrook estuary given different sea level rise and storm scenarios. The benefits of preparing critical infrastructure in the communities for coastal storms and sea level rise outweighed the costs at ratios between 12:1 and 25:1, depending on the town and sea level rise scenario selected.
- *Durham, New Hampshire Climate Adaptation Chapter of the Hazard Mitigation Plan: Developing Strategies to Protect Areas at Risk from Flooding Due to Climate Change and Sea Level Rise* (Strafford RPC, 2013) - The town of Durham, NH developed a new Climate Adaptation Chapter for the town Hazard Mitigation Plan which identifies flooding from sea level rise and storms as a major hazard.
- *New England Adaptation Project: Summary Climate Change Risk Assessment: Dover, New Hampshire* (Wake, Kirshen & Russo, 2014) - The Climate Change Risk Assessment for Dover, NH identified stormwater flooding and heat as the two major climate impacts of concern for the city.

- *Ecosystems and Wildlife: Climate Change Adaptation Plan* (NHF&G, 2013) - The NHF&G developed an amendment to its *Wildlife Action Plan* to consider the hazards and risks associated with climate change. With a focus on sea level rise and freshwater precipitation increases, the plan highlights likely risks to habitats like sea grasses and salt marshes. Changes in salinity and water depth will likely have significant effects on these habitats.

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if significant state- or territory-level changes (positive or negative) have occurred that could impact the CMP's ability to prevent or significantly reduce coastal hazards risk since the last assessment.

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these that address:			
elimination of development/redevelopment in high-hazard areas	N	Y	Y
management of development/redevelopment in other hazard areas	Y*	Y	Y
climate change impacts, including sea level rise or Great Lake level change	Y	Y	Y
Hazards planning programs or initiatives that address:			
hazard mitigation	Y	Y	Y
climate change impacts, including sea level rise or Great Lake level change	Y	Y	Y
Hazards mapping or modeling programs or initiatives for:			
sea level rise or Great Lake level change	Y	Y	Y
other hazards: fluvial erosion and coastal flooding from storms	Y	Y	Y

*Existing regulations include the Shoreland Water Quality Protection Act (RSA 483-B) and the Tidal Buffer Zone setbacks in wetlands law (RSA 482-A). New regulations are described in Question 3 below.

2. Briefly state how "high-hazard areas" are defined in your coastal zone.

In New Hampshire, coastal "high-hazard areas" are defined as FEMA FIRM zones V, V1-30, and VE. The preliminary flood insurance rate maps that incorporate new coastal data have consolidated the zones by eliminating V and V1-30; therefore, when the preliminary maps are adopted in 2015, "high-hazard areas" will be defined as FEMA flood insurance rate map zone VE.

In addition to this definition, the state of New Hampshire recognizes Fluvial Erosion Hazard Area Zones, designated along river corridors that present high risks of erosion. Several river segments within the coastal zone have been designated as Fluvial Erosion Hazard Areas, including parts of the

Cocheco River, the Exeter River, and the Lamprey River. Development is limited in designated Fluvial Erosion Zones in order to reduce risk and vulnerability.

3. For any management categories with significant changes, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:
    a. Describe the significance of the changes;
    b. Specify if they were 309 or other CZM-driven changes; and
    c. Characterize the outcomes or likely future outcomes of the changes.

i. Statutes, regulations, policies, or case law interpreting these that address: *Elimination of development/redevelopment in high-hazard areas*

New preliminary FEMA FIRMs were released for New Hampshire coastal communities in 2014. These maps identify updated 100-year (1 percent annual chance storm event) floodplains based on improved data. The floodplains determine flood insurance rates for homeowners. These maps identify new high-hazard areas in the V, V1-30 and VE zones along the coast which has implications for community floodplain management policies. This change was not driven by CZM or 309. Expected outcomes include official adoption of the FEMA FIRMs by communities in 2015 as well as more community participation in the FEMA Community Rating System which requires specific floodplain management policies at local levels.

ii. Statutes, regulations, policies, or case law interpreting these that address: *Management of development/redevelopment in other hazard areas*

In 2013, the New Hampshire legislature approved an addition to local planning and zoning regulations that authorizes coastal management provisions in master plans in order to address planning needs and property loss resulting from projected coastal risks due to increased frequency of storm surge, flooding, and inundation. This CAW-driven, NHCP-supported change promotes climate change planning in coastal communities, and was the result of a 309 strategy identified in the *2011 Section 309 Assessment and Strategy Report*.[1] The town of Rye, New Hampshire recently added climate change considerations to its master plan, based on this enabling legislation.

iii. Statutes, regulations, policies, or case law interpreting these that address: *Climate change impacts, including sea level rise or Great Lake level change*

In addition to the local planning regulations described in section ii above, the state legislature also enacted RSA 483-E in 2013, establishing the New Hampshire Coastal Risks and Hazards Commission. "The commission shall recommend legislation, rules, and other actions to prepare for projected sea level rise and other coastal and coastal watershed hazards such as storms, increased river flooding, and storm water runoff, and the risks such hazards pose to municipalities and state assets in New Hampshire." (RSA 483-E:3 I) The commission reports to the legislature annually. This change was driven by CAW and supported by NHCP as one outcome of the Adaptation Program Creation and Support strategy identified in the *2011 Section 309 Assessment and Strategy Report*.[1] NHCP expects that this legislation will result in better planning for projected sea level rise and other coastal hazards.

iv. Hazards planning programs or initiatives that address: *Hazard mitigation*

CAW, which was established in 2010 in response to a 309 strategy, has held several community workshops addressing best practices for floodplain management, including minimizing development in high hazard areas. Section 309 funding also supports CAW members Rockingham and Strafford Regional Planning Commissions in their efforts to support hazard mitigation planning. For instance, between 2010 and 2014 Strafford RPC assisted 16 of its communities with updates to their Multi-hazard Mitigation Plans.

The response to Coastal Hazards Resource Characterization Question 5, above, also describes several new studies and projects that have been conducted related to climate change impacts in coastal New Hampshire. While many of these were driven and funded by efforts outside of CZM and 309, NHCP has been involved with aspects of most of these projects.

v. Hazards planning programs or initiatives that address: *Climate change impacts, including sea level rise or Great Lake level change*

Refer to section iv above, as climate change impacts and sea level rise are among the most significant coastal hazards addressed during hazard mitigation planning.

vi. Hazards mapping or modeling programs or initiatives for: *Sea level rise or Great Lake level change*

The Resilient New Hampshire Coasts Project is a CZM-driven NOAA Project of Special Merit which includes both modeling and mapping products. The Sea Level Affecting Marsh Migration (SLAMM) model will use new, more precise data to provide updated information on how salt marshes will be able to adapt to future sea level rise conditions. Data such as the 13 newly verified Sediment Elevation Tables for tidal marsh elevation will be incorporated into the SLAMM model to show if New Hampshire's salt marshes are keeping up with sea level rise. Model results will be mapped in the New Hampshire Coastal Hazards Viewer, available in the spring of 2015, and the resulting data and maps can be used by coastal watershed communities for hazard mitigation planning.

vii. Hazards mapping or modeling programs or initiatives for: *Other hazards- fluvial erosion and coastal flooding from storms*

In 2008, New Hampshire Geologic Survey staff began a Fluvial Geomorphology Assessment program to assist with planning for flood hazard mitigation and river restoration. While this on-going data collection effort is not 309 or CZM-driven, four of the first five rivers assessed as of 2012 were coastal region rivers including the Cocheco, Exeter, Isinglass and Lamprey Rivers. These geomorphic assessments include evaluations of erosion sensitivity, culvert condition, aquatic habitat and other data that municipalities can use for planning, management and restoration efforts that will reduce flood damage in future years. Data will available in a map format on the New Hampshire Coastal Hazards Viewer, which is 309-driven and funded.

Predictions of coastal flooding as a result of storms will be modeled and mapped as part of the Resilient New Hampshire Coasts Project described in section vi above.

Enhancement Area Prioritization:

1. What level of priority is the enhancement area for the coastal management program?

High __X__
Medium _____
Low _____

2. Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.

Given the increasing magnitude of storms and accelerating rates of sea level rise that are contributing to intensifying erosion along with more frequent and damaging flooding, habitat destruction, and resource damage, the Coastal Hazards enhancement area is rated as a High priority. This prioritization was supported by members of CAW and the management committee of PREP.

Public Access

Section 309 Enhancement Objective: Attain increased opportunities for public access, taking into account current and future public access needs, to coastal areas of recreational, historical, aesthetic, ecological, or cultural value. §309(a)(3)

PHASE I (HIGH-LEVEL) ASSESSMENT: *(Must be completed by all states.)*
Purpose: To quickly determine whether the enhancement area is a high priority enhancement objective for the CMP that warrants a more in-depth assessment. The more in-depth assessments of Phase II will help the CMP understand key problems and opportunities that exist for program enhancement and determine the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. Use the table below to provide data on public access availability within the coastal zone.

Public Access Status and Trends			
Type of Access	**Current number**	**Changes or Trends Since Last Assessment** (↑, ↓, –, Unknown)	**Cite data source**
Beach access sites	**16**	**–** (Note: Reported 15 sites in 2010, increase due to use of new, more precise database.)	NH Coastal Atlas. 2014
Shoreline (other than beach) access sites	**15**	**–** (Note: Does not include beach or boat access sites.)	NH Coastal Atlas. 2014
Recreational boat (power or non-motorized) access sites	**31**	**–** (Note: Reported 30 sites in 2010, increase due to improved precision listing 2 individual ramps at 1 park separately.)	NH Coastal Atlas. 2014

Public Access Status and Trends			
Type of Access	**Current number**	**Changes or Trends Since Last Assessment** (↑, ↓, –, Unknown)	**Cite data source**
Number of designated scenic vistas or overlook points	**31**	–	NHCP Section 309 Enhancement Grants Program Assessment and Strategy. 2001, 2006 and 2011.
Number of fishing access points (i.e. piers, jetties)	**14**	↑ (Does not include beach access for fishing.)	NH Office of Energy and Planning, "Access Sites to Public Waters" GIS coverage. 2012 Revision.
Coastal trails/ boardwalks	No. of Trails/ boardwalks **27** Miles of Trails/boardwalks **64.7 mi.**	– (Distance reported is 26.6 miles less than in 2010, but difference is due to elimination of trail duplication in the report, such as a single trail listed twice for hiking and cross country skiing.)	www.trails.com
Number of acres parkland/open space	Total sites **449** **19,118 ac** Sites per miles of shoreline **24.9**	Unknown (Note: This is the number and area of conservation parcels, primarily fee ownership, in the coastal zone.)	Society for the Protection of New Hampshire Forests. "Conservation/Public Lands" GIS coverage. 2013 Revision.
Other (please specify)	N/A	N/A	N/A

2. Briefly characterize the demand for coastal public access and the process for periodically assessing demand. Include a statement on the projected population increase for your coastal counties. There are several additional sources of statewide information that may help inform this response, such as the Statewide Comprehensive Outdoor Recreation Plan, the National Survey on Fishing, Hunting, and Wildlife Associated Recreation, and your state's tourism office.

   The population within the state's coastal shoreline counties is projected to increase (or decrease) by _+13_ percent between 2010 and 2020.[13]

Nearly 78 percent of New Hampshire's beaches along the coast are publicly owned either by the State or local communities. The public has access to these beaches through numerous State Parks, which include parking, restrooms and in some instances RV accommodations. Additionally, the Great Bay Estuary has numerous public access points, although a greater proportion of the shoreline is privately owned. Public access points within Great Bay include motorized and non-motorized boat launches as well as trails and wildlife viewing areas. Based on stakeholder feedback, the only type of access lacking within the Great Bay Estuary is a year-round all-tide small craft boat launch. A launch of this type has been proposed at Hilton Park in Dover.

Travel spending throughout New Hampshire declined between 2008 and 2010 due to the recent economic recession, but began increasing between 2010 and 2012 as the economy improved. Travel

[13] NOAA Coastal Population Report: 1970-2020 (Table 5, pg. 9): http://stateofthecoast.noaa.gov/coastal-population-report.pdf.

spending in the New Hampshire coastal region increased 8.6 percent between 2010 and 2012, compared to 11.0 percent across the state.[14]

Demand for coastal access is also assessed by the New Hampshire Office of Energy and Planning (OEP) periodically through the use of outdoor recreation surveys and community needs assessments. The OEP compiles their surveys as well as other stakeholder input in its Statewide Comprehensive Outdoor Recreation Plan (SCORP). The most recent plan was developed for 2013-2018. The surveys do not poll stakeholders on coastal access specifically; however they do poll New Hampshire residents on their outdoor recreation priorities and interests. For example, surveys conducted for the most recent report revealed that the greatest demand for recreation were for youth activities and for sites close to major population centers. In addition, the 2013-2018 SCORP reports that Rockingham County, one of New Hampshire's two coastal counties, has the highest number, 65, of water sports areas and fishing access sites in the state (NHOEP, 2012).

Data published by the U.S. Fish and Wildlife Service in their *2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* report indicates that 228,000 anglers fished in New Hampshire in 2011, a slight decrease in the number of anglers of compared to 2006. However, of these anglers, an estimated 22 percent fished in saltwater in 2011,[15] compared to only 20 percent in 2006,[16] indicating that saltwater fishing has increased by about 2000 anglers despite the slight decrease in fishing of all types across the entire state.

3. If available, briefly list and summarize the results of any additional data or reports on the status or trends for coastal public access since the last assessment.

   Surveys and Reports on New Hampshire Outdoor Recreation

   - *New Hampshire Public Waters Access Advisory Board 2012 Annual Report* (NH PWAAB, 2014) - The 2012 annual report outlined an NHCP funded project carried out by the New Hampshire Department of Resources and Economic Development to rebuild the bathhouse at the North Hampton Beach. NHCP grant funds were used to connect the new bathhouse to the municipal sewer system. NHCP funds also helped the City of Portsmouth acquire a one-acre island in Sagamore Creek in September 2012. A conservation easement, including public access opportunities, will be placed on the property.
   - *UNH Carsey Institute, NH Listens: Statewide Community Conversations on Outdoor Recreation in New Hampshire* (UNH Carsey Institute, 2011) - During listening sessions, New Hampshire residents expressed an increased acknowledgement of the benefits of outdoor recreation, particularly for youth; a need for recreation sites near population centers; and recognition of the important economic impact of outdoor recreation in New Hampshire.
   - *UNH Cooperative Extension's New Hampshire Recreation and Conservation Leaders Survey 2011* (UNH Cooperative Extension, 2011) - Key stakeholders and conservation leaders focused on the need for additional public access to outdoor recreation, more connectivity between existing recreational areas, increased outdoor and environmental education opportunities for children,

[14] New Hampshire Fiscal Year 2012 Tourism Satellite Account: https://www.plymouth.edu/institute-for-new-hampshire-studies/files/2011/04/Tourism-Satellite-Account-2012.docx.

[15] U.S. Fish and Wildlife Service and U.S. Census Bureau. *2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation—New Hampshire*. http://www.census.gov/prod/2013pubs/fhw11-nh.pdf.

[16] U.S. Fish and Wildlife Service and U.S. Census Bureau. *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation—New Hampshire*. http://www.census.gov/prod/2008pubs/fhw06-nh.pdf.

the need for strong stewardship partnerships, and a concern for environmental impacts resulting from multiple user groups.

Surveys and Reports focused on the New Hampshire Coastal Region

- *Final Report of the Commission to Study the Causes, Effects, and Remediation of Siltation in the Great Bay Estuary* (State of New Hampshire, 2010) - Recreational Use Survey results indicated a need for more public access, especially all-tide, small boat access.
- *Northeast Regional Ocean Council 2012 Northeast Recreational Boater Survey* (Sea Plan, 2012) - This survey showed that most boating occurs close to shore and along major transit routes, such as those around Portsmouth and the Isles of Shoals. The survey also showed the location and types of activities recreational boaters conducted while boating in New Hampshire. The most popular activity was fishing (42 percent).

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if there have been any significant state- or territory-level management changes (positive or negative) that could impact the future provision of public access to coastal areas of recreational, historical, aesthetic, ecological, or cultural value.

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these	Y	N	N
Operation/maintenance of existing facilities	Y	Y	N
Acquisition/enhancement programs	Y	Y	N

2. For any management categories with significant changes, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:
    a. Describe the significance of the changes;
    b. Specify if they were 309 or other CZM-driven changes; and
    c. Characterize the outcomes or likely future outcomes of the changes.

There have been no significant changes in the Public Access management categories since the last assessment. However, note the description of the North Hampton Beach bathhouse project and the Sagamore Creek island acquisition in the Resource Characterization section, question #3, above.

3. Indicate if your state or territory has a publically available public access guide. How current is the publication and how frequently it is updated?

Public Access Guide	Printed	Online	Mobile App
State or territory has? (Y or N)	Y	Y	Y
Web address (if applicable)	http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/coastal_access_map.pdf	http://xml2.des.state.nh.us/CoastalAtlas/Atlas.html	http://xml2.des.state.nh.us/CoastalAtlas/Atlas.html
Date of last update	April 2007	Daily as necessary	Daily as necessary
Frequency of update	As necessary	As necessary for Beach and Shellfish advisory updates	As necessary for Beach and Shellfish advisory updates

The online New Hampshire Coastal Atlas was released in 2014. This internet-based product provides the public with quick access to information on shellfish harvest opportunities and closures, beach swimming advisories, and coastal public access sites. The shellfish and beach advisories are updated as the information becomes available. The public access information will be revisited as capacity and resources permit. The mobile version of this product includes a geo-location feature to help users get directions to where they want to go while using their mobile devices.

Enhancement Area Prioritization:

1. What level of priority is the enhancement area for the coastal management program?

High _____
Medium __X__
Low _____

2. Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.

Given the prevalence of direct public access to coastal resources in the New Hampshire coastal zone, but because stakeholders and the public have expressed a need for additional access and educational outreach, this enhancement area is rated as a Medium priority. This prioritization was confirmed at presentations to CAW and the management committee of PREP.

Marine Debris

Section 309 Enhancement Objective: Reducing marine debris entering the Nation's coastal and ocean environment by managing uses and activities that contribute to the entry of such debris. §309(a)(4)

PHASE I (HIGH-LEVEL) ASSESSMENT: *(Must be completed by all states.)*
Purpose: To quickly determine whether the enhancement area is a high priority enhancement objective for the CMP that warrants a more in-depth assessment. The more in-depth assessments of Phase II will help the CMP understand key problems and opportunities that exist for program enhancement and determine the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. In the table below, characterize the existing status and trends of marine debris in the state's coastal zone based on the best available data.

Source of Marine Debris	Existing Status and Trends of Marine Debris in Coastal Zone		
	Significance of Source (H, M, L, unknwn)	**Type of Impact** (aesthetic, resource damage, user conflicts, other)	**Change Since Last Assessment** (↑, ↓, –, unkwn)
Land-based			
Beach/shore litter	High	Aesthetic & Resource Damage	–
Dumping	Medium	Aesthetic & Resource Damage	–
Storm drains and runoff	Medium	Aesthetic & Resource Damage	–
Fishing (e.g., fishing line, gear)	Low	Aesthetic, Resource Damage & User Conflicts	–
Other (please specify): Wastewater treatment disks*	Low	Aesthetic	↑
Ocean or Great Lake-based			
Fishing (e.g., derelict fishing gear)	High	Aesthetic, Resource Damage & User Conflicts	–
Derelict vessels	Low	Aesthetic & Resource Damage	–
Vessel-based (e.g., cruise ship, cargo ship, general vessel)	Low	Aesthetic & Resource Damage	–
Hurricane/Storm	Medium	Aesthetic & Resource Damage	–
Tsunami	N/A	N/A	N/A
Other (please specify)	N/A	N/A	N/A

*In March 2011, the Hooksett, NH Wastewater Treatment Facility accidentally released between 4 million and 8 million plastic disks used to enhance the wastewater treatment capacity of the plant. The disks were released into the Merrimack River during a storm. They have subsequently been found along the banks of the Merrimack River downstream over 65 miles to its mouth, as well as on beaches and in estuaries in New Hampshire, Massachusetts and Maine. The white plastic disks, approximately 2 inches in diameter, continue to be collected along the New Hampshire coast more than three years later.

2. If available, briefly list and summarize the results of any additional state or territory-specific data or reports on the status and trends or potential impacts from marine debris in the coastal zone since the last assessment.

- New Hampshire Marine Debris to Energy Project[17] – This project reports on the amount and type of debris collected on New Hampshire beaches, and reported to the project's website, from 2006 to present. Between 2006 and 2013, the amount of debris collected has ranged from a high of 12,386 lbs. in 2009 to a low of 5,288 lbs. in 2011. In 2013, 2,191 volunteers collected 7,876 lbs. of debris at 40 locations during 231 clean-up events. This project is supported by the NOAA Marine Debris Program and other partners.
- New Hampshire Coastal Cleanup – The Blue Ocean Society for Marine Conservation (BOS) coordinates the New Hampshire Coastal Cleanup in conjunction with the Ocean Conservancy's International Coastal Cleanup, utilizing funding from the NHCP. BOS has been coordinating this effort since 2005. Since that time, a range of 907 (2012) to 1,557 (2008) volunteers have been involved per year. The pounds per trash removed has ranged from 8,037 (2011) to 2,125 (2013) and appears to be on the decline, but this decline has happened amid the presence of regular monthly cleanups/maintenance on the beaches.[18]
- *New Hampshire Public Waters Access Advisory Board Annual Reports* (NH PWAAB, 2014) – The 2012 report described the NHCP support of the BOS's beach cleanup programs, including the Adopt-a-Beach Program, International Coastal Cleanup Day, and the monthly marine debris monitoring program at Jenness Beach. The NHCP funded 155 beach cleanups that removed an estimated total 12,711 pounds of marine debris, helping to keep public access sites along the coast clean and more enjoyable for visitors. BOS uses data from the cleanups, along with informative educational materials developed in past projects, to better inform the public of the prevalence and impacts of marine pollution.

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if there have been any significant state- or territory-level management changes (positive or negative) for how marine debris is managed in the coastal zone.

Management Category	Employed by State/Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Marine debris statutes, regulations, policies, or case law interpreting these	Y	N	N
Marine debris removal programs	Y	Y	N

The New Hampshire Fish and Game Department currently has regulations concerning the molestation of lobster traps. RSA 211:31 states that "lobster pots, traps, warps (ropes), cars or buoys are private property, regardless of the location. This includes on the beach and in the rocks. No person except the owner or a conservation officer can possess, lift, molest or disturb them. To do so can result in a fine of $2,000 and up to one year in jail." While these regulations can impede coastal clean-up efforts, BOS, along with their project partners New Hampshire Sea Grant and UNH Cooperative Extension, have

[17] http://cecf1.unh.edu/debris/index.cfm. See Beach Debris Data page for statistics.
[18] Jen Kennedy, Executive Director, Blue Ocean Society for Marine Conservation. Personal communication. August 2014. Note that statistics reported for the New Hampshire Coastal Cleanup have not been included in the statistics reported for the New Hampshire Marine Debris to Energy Project.

developed a working relationship with New Hampshire Fish and Game that has allowed for the approved removal of derelict gear on a case-by-case basis. For example, in 2012, over 70 lobster traps were removed from White Island at the Isles of Shoals under the presence of a conservation officer. Based on conversations with New Hampshire Fish and Game, it is unlikely that there will be a push to change regulations regarding trap cleanup, but New Hampshire Fish and Game will continue to make officers available to supervise derelict gear removal as time and funding allows.[19]

2. For any management categories with significant changes, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:
    a. Describe the significance of the changes;
    b. Specify if they were 309 or other CZM-driven changes; and
    c. Characterize the outcomes and likely future outcomes of the changes.

There have been no significant changes in the Marine Debris management categories since the last assessment. However, note the data collected by the Marine Debris to Energy Project in the Resource Characterization section, question #2, above, which was a very successful significant management change described in the prior assessment report.

Enhancement Area Prioritization:

1. What level of priority is the enhancement area for the coastal management program?

High	_____
Medium	__X__
Low	_____

2. Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.

Given that analysis of the Marine Debris Enhancement Area did not identify any high priority needs relative to debris that are not already being addressed, but because several sources of marine debris are still considered highly or moderately significant, this enhancement area is rated as a Medium priority. This prioritization was confirmed at presentations to CAW and the management committee of PREP.

Cumulative and Secondary Impacts

Section 309 Enhancement Objective: Development and adoption of procedures to assess, consider, and control cumulative and secondary impacts of coastal growth and development, including the collective effect on various individual uses or activities on coastal resources, such as coastal wetlands and fishery resources.§309(a)(5)

[19] Jen Kennedy, Executive Director, Blue Ocean Society for Marine Conservation. Personal communication. August 2014.

PHASE I (HIGH-LEVEL) ASSESSMENT: *(Must be completed by all states.)*
Purpose: To quickly determine whether or not cumulative and secondary impacts is a priority enhancement objective for the CMP that warrants a more in-depth assessment to understand key problems and opportunities that exist for program enhancement as well as the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. Using National Ocean Economics Program Data on population and housing,[20] please indicate the change in population and housing units in the state's coastal counties between 2012 and 2007. You may wish to add additional trend comparisons to look at longer time horizons as well (data available back to 1970) but, at a minimum, please show change over the most recent five year period (2012-2007) to approximate current assessment period.

Trends in Coastal Population and Housing Units (Rockingham and Strafford counties)				
Year	**Population**		**Housing**	
	Total (# of people)	% Change (compared to 2002)	Total (# of housing units)	% Change (compared to 2002)
2007	418,124	0.91%	173,748	3.22%
2012	421,939		179,335	

2. Using provided reports from NOAA's Land Cover Atlas[21] or high-resolution C-CAP data (Pacific and Caribbean Islands only), please indicate the status and trends for various land uses in the state's coastal counties between 2006 and 2011. You may use other information and include graphs and figures, as appropriate, to help illustrate the information. Note that the data available for the islands may be for a different timeframe than the time periods reflected below. In that case, please specify the time period the data represents. Also note that Puerto Rico and CNMI currently only have data for one time point so will not be able to report trend data. Instead, Puerto Rico and CNMI should just report current land use cover for developed areas and impervious surfaces.

Distribution of Land Cover Types in Rockingham and Strafford Counties		
Land Cover Type	**Land Area Coverage in 2010 (Square Miles)**	**Gain/Loss Since 2006 (Square Miles)**
Developed, High Intensity	47.77	2.59
Developed, Low Intensity	78.59	4.88
Developed, Open Space	35.36	0.48
Grassland	10.33	0.62
Scrub/Shrub	49.06	6.36
Barren Land	10.13	0.62
Open Water	105.12	0.01
Agriculture	85.32	-3.30
Forested	589.15	-11.92
Woody Wetland	130.13	-0.19
Emergent Wetland	31.43	-0.16

[20] http://www.oceaneconomics.org/. Enter "Population and Housing" section. From dropdown boxes, select your state, and "all counties". Select the year (2012) and the year to compare it to (2007). Then select "coastal zone counties". Finally, be sure to check the "include density" box under the "Other Options" section.
[21] http://coast.noaa.gov/ccapatlas/.

3. Using provided reports from NOAA's Land Cover Atlas[21] or high-resolution C-CAP data (Pacific and Caribbean Islands only), please indicate the status and trends for developed areas in the state's coastal counties between 2006 and 2011 in the two tables below. You may use other information and include graphs and figures, as appropriate, to help illustrate the information. Note that the data available for the islands may be for a different timeframe than the time periods reflected below. In that case, please specify the time period the data represents. Also note that Puerto Rico and CNMI currently only have data for one time point so will not be able to report trend data. Unless, Puerto Rico and CNMI have similar trend data to report on changes in land use type, they should just report current land use cover for developed areas and impervious surfaces.

Development Status and Trends for Rockingham and Strafford Counties			
	2006	**2010**	**Percent Net Change**
Percent land area developed	13.12%	13.79%	5.01%
Percent impervious surface area	4.59%	4.87%	5.73%

How Land Use is Changing in Rockingham and Strafford Counties	
Land Cover Type	**Areas Lost to Development Between 2006-2010** (Square Miles)
Barren Land	0.44
Emergent Wetland	0.14
Woody Wetland	0.22
Open Water	0.04
Agriculture	2.92
Scrub/Shrub	0.91
Grassland	0.46
Forested	3.48

4. Using data from NOAA's State of the Coast "Shoreline Type" viewer,[22] indicate the percent of shoreline that falls into each shoreline type.[23] You may provide other information and/or use graphs or other visuals to help illustrate.

Shoreline Types		
Surveyed Shoreline Type	**Miles of shoreline***	**Percent of Shoreline**
Mixed Sand and Gravel Beaches	1.38	0.6%
Exposed Tidal Flats	11.11	5.0%
Salt- and Brackish-water Marsh	163.42	73.6%
Scrub-Shrub Wetlands	0.24	0.1%
Exposed rocky shores	0.51	0.2%
Exposed, Wave-cut Platforms in Bedrock	2.76	1.2%
Fine- to Medium-grained Sand Beaches	0.86	0.4%
Gravel Beaches	7.97	3.6%

[22] http://stateofthecoast.noaa.gov/shoreline/welcome.html.

[23] Note: Data is from NOAA's Environmental Sensitivity Index (ESI) Maps. Use a footnote to convey data's age and source (if other than ESI maps). http://response.restoration.noaa.gov/maps-and-spatial-data/environmental-sensitivity-index-esi-maps.html.

Shoreline Types (cont.)		
Surveyed Shoreline Type	**Surveyed Shoreline Type**	**Surveyed Shoreline Type**
Riprap	5.25	2.4%
Sheltered Rocky Shores	4.63	2.1%
Sheltered, Solid Man-made Structures	3.47	1.6%
Sheltered Riprap	7.41	3.3%
Sheltered Tidal Flats	13.13	5.9%

*Based on 2014 NOAA ESI data. Not all coastal miles were mapped.

5. If available, briefly list and summarize the results of any additional state or territory-specific data or reports on the cumulative and secondary impacts of coastal growth and development, such as water quality and habitat fragmentation, since the last assessment to augment the national datasets.

- *Great Bay Nitrogen Non-Point Source Study* (Trowbridge et al., 2014) – This report summarizes research conducted by NHDES on the relative contribution of non-point sources of nitrogen to the estuary. Overall, 68 percent of the nitrogen that ends up in the Great Bay Estuary originates from non-point sources (approximately 800 tons/yr); the remainder derives from direct discharges of municipal wastewater treatment facilities. The model predicts that 42 percent of non-point source nitrogen comes from atmospheric deposition, 29 percent from human waste from septic systems, 15 percent from chemical fertilizer and 14 percent from animal waste. The model also concludes that 34 percent of the nonpoint source loads were delivered through stormwater.
- *Piscataqua Region Environmental Planning Assessment 2015* (PREP 2015) – The 2015 PREPA provides a comprehensive review of the current state of municipal environmental regulations in place in the 52 New Hampshire and Maine communities in the Piscataqua Region watershed. The results of the review show that although communities value their natural resources and have taken steps to manage those resources, there are critical protections still needed in most communities throughout the watershed. Recommended actions include consistent, region-wide buffer and setback regulations, land conservation, and incorporating stormwater management similar to the model developed by the Southeast Watershed Alliance.
- *PREP's State of Our Estuaries Report* (PREP, 2013) – See "Phase I - Wetlands, Resource Characterization Question 2" response above for a summary of this report.
- *Lamprey River Water Management Plan* (NHDES, 2013) – This water management plan, described more fully in Question 2 below, was developed as part of the New Hampshire Instream Flow Program Pilot Study. The goal of the study was to determine the amount of water needed to support the human and natural uses that depend on the river. The management plan details the actions to be implemented to maintain the protected instream flows on the Lamprey River, guide water use, and minimize negative consequences to any particular user or natural use.
- *New Hampshire Nonpoint Source Management Program Plan* (NHDES, 2014) – The goal of New Hampshire's Nonpoint Source Program is to protect and restore clean water in the state's rivers, lakes, estuaries, and other waters from the negative impacts of nonpoint source pollution. Specifically, the NPS Program works toward improving land management practices such that water quality in impaired watersheds is restored and water quality in healthy watersheds is not degraded as a result of land use activities. The NPS Program partners with many organizations, including coastal watershed partners, to develop and implement the Plan. This update of the

1999 NPS Plan establishes specific, short-term objectives and measurable milestones to be accomplished over the next five years to work toward attaining long-term NPS Program goals.

- *Model Stormwater Standards for Coastal Watershed Communities* (UNH Stormwater Center and RPC, 2012) – This model, compiled by the Southeast Watershed Alliance and funded by the NHCP, offers minimum, consistent, and enforceable stormwater management standards for coastal watershed communities. The standards encourage the use of Low Impact Development strategies, build upon innovative stormwater standards recently adopted by several coastal watershed communities, and are consistent with EPA Region 1 and NHDES guidelines. Adoption of the model stormwater standards can provide consistent water quality protection throughout New Hampshire's coastal watershed.
  On January 9, 2015, this model was also used as the basis for a presentation titled "The Effect of Local Stormwater Regulations on Future Nitrogen Loads in the Oyster River Watershed," given by Jaime Houle of the UNH Stormwater Center and Bill Arcieri of VHB, Inc. at the 2015 Lamprey River Symposium. The talk summarized research that combined the use of the Model Stormwater Standards with a 2040 build-out analysis for the Oyster River watershed communities to examine the potential effect of the standards on Total Suspended Solids, Total Nitrogen, and Total Phosphorus. Model results suggested significant reductions of all of these pollutants could be achieved.[24]
- *Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-Point Sources in the Great Bay Estuary Watershed - DRAFT* (Trowbridge, 2010) - This report describes models developed by NHDES to estimate the existing nitrogen loads to each of the impaired sub-estuaries and predict the watershed nitrogen load thresholds needed to meet the 0.3 mg nitrogen/liter criteria that will protect eelgrass beds in the estuary. Due to the need to address significant feedback on the draft version of this report, a final report has not yet been published.

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if there have been any significant state-level changes (positive or negative) in the development and adoption of procedures to assess, consider, and control cumulative and secondary impacts of coastal growth and development, including the collective effect on various individual uses or activities on coastal resources, such as coastal wetlands and fishery resources, since the last assessment?

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these	Y	Y	Y
Guidance Documents	Y	Y	N
Management Plans (including SAMPs)	Y	Y	Y

2. For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:

[24] Presentation slides posted at http://www.wrrc.unh.edu/2015-lamprey-river-symposium.

a. Describe the significance of the change;
b. Specify if it was a 309 or other CZM-driven change; and
c. Characterize the outcomes and/or likely future outcomes of the changes(s).

On August 28, 2013, NHDES Commissioner Thomas S. Burack adopted the *Lamprey River Water Management Plan* (NHDES, 2013). This plan not only establishes seasonal minimum flows designed to ensure that both human and natural uses of the river can be met and that fresh water continues to flow to the estuary, but it also outlines specific actions required by water users and dam owners during periods of chronic low flows. Water users are required to conserve water during low flow periods and may need to cease withdrawing all but a very minimal amount of water during extreme low flow events. Dam owners on the Lamprey River may be required to release water from impoundments to alleviate extreme low flows and have also been required to impound more water during some seasons in order to allow for these relief flows. This management change was not driven by NHCP, but will have future impact on the Cocheco, Exeter-Squamscott, Isinglass, and Oyster Rivers if the pilot program is deemed successful and the Instream Flow Program is expanded.

In November 2013, New Hampshire adopted interim rules to improve efficiency in the use of road salt across the state. Commercial salt applicators who have completed the UNH Technology Transfer Center's Green SnowPro training program can apply to NHDES for a voluntary certificate. Under the new rules, these certified salt applicators that follow best management practices and keep basic records, and the property owners who hire them, are provided with limited liability for damages arising from hazards caused by snow or ice.[25] These new rules were not CZM-driven, but are expected to reduce salt levels in freshwater streams, ponds and wetlands throughout the more densely developed portions of the coastal region.

Effective January 2014, the New Hampshire legislature has placed limits on the levels of nitrogen and phosphorus in lawn fertilizers that can be sold in retail stores. The purpose of these limits is to reduce nutrient pollution from nonpoint sources to Great Bay and New Hampshire's lakes and ponds. These changes to RSA 431 were supported by NHDES and CZM and are expected to lower nitrogen levels in Great Bay by reducing nutrient runoff.

Enhancement Area Prioritization:

1. What level of priority is the enhancement area for the coastal management program?

High	__X__
Medium	_____
Low	_____

2. Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.

Given the heightened concern with the degradation of Great Bay combined with the development pressures for New Hampshire's coastal communities, the Cumulative and Secondary Impacts enhancement area rated as a High priority. This prioritization was confirmed at presentations to CAW and the management committee of PREP.

[25] See *new law and interim rules* document at http://des.nh.gov/organization/divisions/water/wmb/was/salt-reduction-initiative/salt-applicator-certification.htm.

Special Area Management Planning

Section 309 Enhancement Objective: Preparing and implementing special area management plans for important coastal areas. §309(a)(6)

The Coastal Zone Management Act defines a Special Area Management Plan (SAMP) as "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. In addition, SAMPs provide for increased specificity in protecting natural resources, reasonable coastal-dependent economic growth, improved protection of life and property in hazardous areas, including those areas likely to be affected by land subsidence, sea level rise, or fluctuating water levels of the Great Lakes, and improved predictability in governmental decision making."

PHASE I (HIGH-LEVEL) ASSESSMENT: *(Must be completed by all states and territories.)*
Purpose: To quickly determine whether the enhancement area is a high priority enhancement objective for the CMP that warrants a more in-depth assessment. The more in-depth assessments of Phase II will help the CMP understand key problems and opportunities that exist for program enhancement and determine the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. In the table below, identify geographic areas in the coastal zone subject to use conflicts that may be able to be addressed through a SAMP. This can include areas that are already covered by a SAMP but where new issues or conflicts have emerged that are not addressed through the current SAMP.

Geographic Area	Opportunities for New or Updated Special Area Management Plans
	Major conflicts/issues
Offshore waters	Offshore structures competition for area used for commercial fishing and the loss of marine habitat.
Great Bay Estuary watershed, Hampton-Seabrook Estuary watershed and the Atlantic Coast	Resources management, living resources and habitat restoration, and land use and habitat protection.
Estuarine waters	Competing use of the waters for shellfish harvest versus recreational boating.
Great Bay Estuary	Habitat loss due to degradation of water quality.
Beaches, state- and town-owned	Differences in sand deposition and erosion leading to costs in nourishing or removing sand from beaches.
Great Bay Estuary watershed	Pollutant reductions required by point and non-point sources.
Coastal Zone	Conflict between development for economic stability versus need to prepare for coastal hazards, especially long-term planning needed due to future sea level rise, including primary and secondary impacts.

2. If available, briefly list and summarize the results of any additional state- or territory-specific data or reports on the status and trends of SAMPs since the last assessment.

The State and its federal and local partners have a number of processes in place to proactively manage resources. So far these have been adequate to address potential conflicts without the need for a formal SAMP. These management processes include the following:

- *New Hampshire Estuary Spatial Planning Project: Coordinating Data to Assess Our Ecosystem Services* (In Progress, due September 2015)[26] – This project, described more fully in the Summary of Recent Section 309 Achievements section, will coordinate the collection, integration, and accessibility of existing spatial data for New Hampshire's Hampton-Seabrook and Great Bay estuaries. The overall goal is to help improve management decisions. For example, re-organized, centralized and publically available spatial datasets will be used to assess the economic tradeoffs among different possible future activities in Great Bay, informing how coastal managers consider the many new and existing uses vying for space in the bay.
- *Oyster River Management Plan* (ORLAC, 2014) – The Strafford Regional Planning Commission has coordinated with local, regional, and state partners to develop, on behalf of the Oyster River Local Advisory Committee, a management plan for the Oyster River to improve river protection and complete ongoing local efforts to address the use and conservation of the river corridor and its watershed. The Plan identifies short-term, intermediate, and long-term goals, along with objectives and actions to address them. The river is a secondary drinking water source for the Town of Durham and UNH.
- *PREP's State of Our Estuaries Report* (PREP, 2013) – See "Phase I - Wetlands, Resource Characterization Question 2" response above for a summary of this SAMP.
- *Oyster River Integrated Watershed Plan for Nitrogen Load Reductions - Final Technical Report* (VHB, 2014) – This document describes an Integrated Watershed Planning and Permit approach to allow the Town of Durham and UNH to combine planning and implementation efforts to develop effective and sustainable solutions to reduce nitrogen loading within the same watershed. Since both the Town and UNH share the same Wastewater Treatment Facility and have adjacent regulated municipal stormwater systems that discharge to the Oyster River Estuary, the use of this Integrated Planning and Permit approach is a means to address water quality objectives in an effective, economical and socially responsible manner.
- *Lamprey River Water Management Plan* (NHDES, 2013) – See "Phase I - Cumulative and Secondary Impacts, Resource Characterization Question 5" response above for a summary of this SAMP.
- *2013 Lamprey Rivers Management Plan* (LRAC, 2013) – This update of the original 1995 Lamprey River Corridor Management Plan and its 2007 revision addresses not only previously identified concerns such as the need for public outreach, the benefits of good land stewardship, and the impacts to water quality and habitat in the coastal region resulting from development, but also newer concerns including increased demand for drinking water and the challenges of more frequent extreme weather events, both wet and dry.
- *New Hampshire Nonpoint Source Management Program Plan* (NHDES, 2014) – See "Phase I - Cumulative and Secondary Impacts, Resource Characterization Question 5" response above for a summary of this SAMP.

[26] http://des.nh.gov/organization/divisions/water/wmb/coastal/restoration/nh-esp.htm.

- *Great Bay National Wildlife Refuge Comprehensive Conservation Plan* (USF&WS, 2012) – This plan presents the management goals, objectives, and strategies that will guide management decisions and actions on the Great Bay Refuge for the following 15 years. It also helps New Hampshire natural resource agencies, conservation partners, local communities, and the public understand Great Bay Refuge priorities in order to better work with the Refuge to achieve common goals.
- *Model Stormwater Standards for Coastal Watershed Communities* (UNH Stormwater Center and RPC, 2012) - See "Phase I - Cumulative and Secondary Impacts, Resource Characterization Question 5" response above for a summary of this New Hampshire NHCP-funded SAMP.
- *Exeter-Squamscott River Watershed Management Plan Update* (ESRLAC, 2012) – This plan provides "the Exeter-Squamscott River Local Advisory Committee, landowners, municipal officials, municipal boards and committees, and regional and state agencies and organizations with an action plan for working together to protect water quality, water quantity, wildlife habitat and recreational opportunities in the watershed."
- *2010 Piscataqua Region Comprehensive Conservation and Management Plan* (PREP, 2010) – This plan is an update of the 2000 plan and "addresses current and emerging issues impacting the water quality and environmental health of estuaries in the Piscataqua Region. The 10-year plan includes seven goals, 35 objectives, and 82 action plans that were developed through an extensive 18-month process involving 159 stakeholders representing federal and state resource management agencies, nongovernment organizations, industry, legislators, and the 52 communities of the Piscataqua Region. Action plans are categorized by critical theme areas, including water resources, land use and habitat protection, living resources and habitat restoration, and watershed stewardship."

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if there have been any significant state- or territory-level management changes (positive or negative) that could help prepare and implement SAMPs in the coastal zone.

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
SAMP policies, or case law interpreting these	Y	Y	N
SAMP plans*	Y	Y	N

* NHCP does not develop formal SAMPs but instead develops or provides input on management plans and planning documents that contain the same elements as a formal SAMP.

2. For any management categories with significant changes, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:
    a. Describe the significance of the changes;
    b. Specify if they were 309 or other CZM-driven changes; and
    c. Characterize the outcomes or likely future outcomes of the changes.

There have been no significant changes in SAMP policies or the types of management plans written since the last assessment. Most of the plans described above are updates to pre-existing plans. Even the *New Hampshire Estuary Spatial Planning Project* currently in progress and described in the Summary of Recent Section 309 Achievements section is part of an ongoing effort to make spatial data for the Coastal Zone more accessible to the public and to local policy decision-makers.

Enhancement Area Prioritization:

1. What level of priority is the enhancement area for the coastal management program?

High	_____
Medium	__X__
Low	_____

2. Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.

Review of Special Area Management Planning needs did not identify any high priority gaps or requirements that are not already being addressed by existing management resources and tools. However, given the importance of ensuring that any new planning needs are met and that existing planning tools are updated, this enhancement is rated as a Medium priority. This prioritization was confirmed at presentations to CAW and the management committee of PREP.

Ocean and Great Lakes Resources

Section 309 Enhancement Objective: Planning for the use of ocean [and Great Lakes] resources. §309(a)(7)

PHASE I (HIGH-LEVEL) ASSESSMENT: *(Must be completed by all states and territories.)*
Purpose: To quickly determine whether or not ocean and Great Lakes resources is a priority enhancement objective for the CMP that warrants a more in-depth assessment to understand key problems and opportunities that exist for program enhancement as well as the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. Understanding the ocean and Great Lakes economy can help improve management of the resources it depends on. Using the Economic: National Ocean Watch,[27] indicate the status of the ocean and Great Lakes economy as of 2010* as well as the change since 2005 in the tables below. Include graphs and figures, as appropriate, to help illustrate the information. Note ENOW data is not available for the territories. The territories can provide alternative data, if available, or a general narrative, to capture the value of their ocean economy.

[27] http://www.coast.noaa.gov/enowexplorer/.

Status of Ocean and Great Lakes Economy for Coastal Counties (2012)				
	Establishments (# of Establishments)	**Employment** (# of Jobs)	**Wages** (Millions of Dollars)	**GDP** (Millions of Dollars)
Living Resources	26	575	$14.0	$42.9
Marine Construction	8	77	$3.0	$5.8
Marine Transportation	40	6,225	$589.2	$1,000
Offshore Mineral Extraction	16	45	$1.8	$13.9
Tourism & Recreation	452	6,996	$127.4	$279.7
All Ocean Sectors	549	13,919	$735.4	$1,400

Change in Ocean and Great Lakes Economy for Coastal Counties (2005-2012)				
	Establishments (% change)	**Employment** (% change)	**Wages** (% change)	**GDP** (% change)
Living Resources	NA	NA	NA	NA
Marine Construction	-20.0	-13.5	+222.9	+205.3
Marine Transportation†	NA	NA	NA	NA
Offshore Mineral Extraction	-11.1	-11.8	+38.5	NA
Tourism & Recreation	+9.7	+6.1	+18.4	+16.3
All Ocean Sectors	+6.4	+69.8	+391.6	+249.3

* 2012 data is available at ENOW and was used to complete the tables above.

† 2012 Marine Transportation data includes industry sector data that was not available for 2005. Therefore, the data is not comparable across these years.

2. In the table below, characterize how the threats to and use conflicts over ocean and Great Lakes resources in the state or territory's coastal zone have changed since the last assessment.

Significant Changes to Ocean and Great Lakes Resources and Uses	
Resource/Use	**Change in the Threat to the Resource or Use Conflict Since Last Assessment** (↑, ↓, –, unkwn)
Resource	
Benthic Habitat (including coral reefs)	↑ [dredging & dredge material disposal, aquaculture, water quality (eelgrass), ocean acidification]
Living marine resources (fish, shellfish, marine mammals, birds, etc)	↑ (dredging, ocean acidification)
Sand/gravel	– ‡
Cultural/historic	–
Other (please specify)	–
Use	
Transportation/navigation	–
Offshore development	–
Energy Production	– §

Significant Changes to Ocean and Great Lakes Resources and Uses	
Resource/Use	**Change in the Threat to the Resource or Use Conflict Since Last Assessment** (↑, ↓, –, unkwn)
Fishing (Commercial and Recreational)	–
Recreation/Tourism	–
Sand/gravel extraction	–
Dredge disposal	–
Aquaculture	↑ (several new commercial aquaculture facilities since last assessment – see Aquaculture Phase I Assessment for details)
Other (please specify)	N/A

‡ While there are currently no direct threats to sand/gravel resources in New Hampshire's coastal zone, there is heightened interested in offshore sand/gravel resources as a result of Hurricane Sandy. For example, the Bureau of Ocean Energy Management (BOEM) is proposing to conduct Geological and Geophysical activities in the Atlantic Outer Continental Shelf (3-8 nautical miles offshore) to identify sand and gravel resources. BOEM has also funded a University of New Hampshire/New Hampshire Geological Survey study to assess New Hampshire's offshore sand resources. Finally, the NROC has established a Regional Sand Management Work Group.

§ Proposed UNH tidal, wave and wind technology testing areas are still awaiting necessary state and federal approvals (see *Energy & Government Facility Siting Phase I Assessment* following).

3. For the ocean and Great Lakes resources and uses in Table 2 (above) that had an increase in threat to the resource or increased use conflict **in the state or territory's coastal zone since the last assessment,** characterize the major contributors to that increase.

Major Contributors an Increase in Threat or Use Conflict to Ocean and Great Lakes Resources												
Resource	**Major Reasons Contributing to Increased Resource Threat or Use Conflict** (Note All that Apply with "X")											
	Land-based development	Offshore development	Polluted runoff	Invasive species	Fishing (Comm & Rec)	Aquaculture	Recreation	Marine Transportation	Dredging	Sand/Mineral Extraction	Ocean Acidification	Habitat Restoration
Benthic Habitat	X		X			X			X		X	
Living Marine Resources	X		X						X		X	
Aquaculture							X					X

4. If available, briefly list and summarize the results of any additional state or territory-specific data or reports on the status and trends of ocean and Great Lakes resources and/or threats to those resources since the last assessment to augment the national datasets.

No reports on the status or trends of Ocean Resources or threats to ocean resources since the last assessment are available.

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if any significant state or territory-level changes (positive or negative) in the management of ocean and Great Lakes resources have occurred since the last assessment?

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these	Y	Y	N
Regional Comprehensive Ocean/Great Lakes Management Plans	N (Regional Ocean Plan under development)	N	Y (Nat'l Ocean Policy – 2010)
State Comprehensive Ocean/Great Lakes Management Plans	N	N	N
Single-sector Management Plans	Y	N	Y

2. For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:

    a. Describe the significance of the change;
    b. Specify if it was a 309 or other CZM-driven change;
    c. Characterize the outcomes and/or likely future outcomes of the changes(s).

Regional Comprehensive Ocean Management Plans -
In June 2010 the President signed an Executive Order establishing a comprehensive, integrated National Policy (National Ocean Policy) for the stewardship of the ocean, coasts, and Great Lakes. The Executive Order provided for the development of coastal and marine spatial plans that build upon and improve existing federal, state, tribal, local, and regional decision-making and planning processes. Consistent with the National Ocean Policy, the Northeast Regional Planning Body (RPB) was established in 2012 to develop the Northeast's ocean plan and oversee its implementation. NHDES Commissioner Tom Burack is one of two individuals selected by the Governor to represent New Hampshire on the Northeast RPB. NHCP staff provides support to the Commissioner as the Northeast RPB works to develop a regional ocean plan by the fall of 2015. While not driven by a 309 or CZM change, the NHCP is a member of NROC and has been supporting regional ocean planning efforts in the region prior to 2010.

The anticipated outcome of the change will be the development of a Northeast Regional Ocean Plan that identifies areas most suitable for various types or classes of activities in order to reduce conflicts among uses, reduce environmental impacts, and facilitate compatible uses.

Single-sector Management Plans -
NHF&G has developed management and monitoring plan for rainbow smelt. Due to a declining rainbow smelt population, NHF&G is proposing changing the management plan by reducing harvest levels of rainbow smelt by 60 percent beginning in 2014. The proposed harvest reductions are not driven by a 309 or CZM change, but rather represent a management response by NHF&G to improve the population of rainbow smelt.

3. Indicate if your state or territory has a comprehensive ocean/Great Lakes Management Plan.

Comprehensive Ocean/Great Lakes Management Plan	State Plan	Regional Plan
Completed plan (Y/N) (If yes, specify year completed)	N	N
Under development (Y/N)	N	Y
Web address (if available)	N/A	http://neoceanplanning.org/
Area covered by plan	N/A	Gulf of Maine to Long Island Sound

Enhancement Area Prioritization:

1. What level of priority is the enhancement area for the coastal management program?

   High _____
   Medium __X__
   Low _____

2. Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.

   Given the importance of developing a Northeast ocean management plan to support ecosystem-based management of the region's ocean resources and its human uses, but because NROC's Ocean Planning Committee is well-established and its workgroups are already making progress on the ocean plan in the priority areas of communications, maritime commerce, natural resources, recreation, recreational fishing, and sand management, this enhancement area is rated as a Medium priority. This prioritization was confirmed at presentations to CAW and the management committee of PREP.

Energy and Government Facility Siting

Section 309 Enhancement Objective: Adoption of procedures and enforceable policies to help facilitate the siting of energy facilities and Government facilities and energy-related activities and Government activities which may be of greater than local significance. §309(a)(8)

PHASE I (HIGH-LEVEL) ASSESSMENT: *(Must be completed by all states and territories.)*
Purpose: To quickly determine whether or not energy and Government facilities is a priority enhancement objective for the CMP that warrants a more in-depth assessment. The in-depth assessment would enable CMPs to understand key problems and opportunities that exist for program enhancement as well as the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. In the table below, characterize the status and trends of different types of energy facilities and activities in the state or territory's coastal zone based on best available data. If available, identify the approximate number of facilities by type. The MarineCadastre.gov may be helpful in locating many types of energy facilities in the coastal zone.

Status and Trends in Energy Facilities and Activities in the Coastal Zone				
Type of Energy Facility/Activity	**Exists in CZ**		**Proposed in CZ**	
	(# or Y/N)	Change Since Last Assessment (↑, ↓, –, unknown)	(# or Y/N)	Change Since Last Assessment (↑, ↓, –, unknown)
Energy Transport				
Pipelines	Y	–	N	–
Electrical grid (transmission cables)	Y	–	1	↑ (SeaLink undersea HVDC transmission cable)[28]
Ports	Y	–	N	–
LNG	N	–	N	–
Other (please specify)	N/A		N/A	N/A
Energy Facilities				
Oil and gas	Y	–	1	↑ (Proposed expansion of Sea3 terminal)[29]
Coal	N	–	N	–
Nuclear	1	–	N	–
Wind	N	–	1	↑ (UNH Offshore Wind Energy Test Facility at former Open Ocean Aquaculture Site)
Wave	N	–	1	↑ (UNH Offshore Wave Energy Extraction and Storage Test Facility at former Open Ocean Aquaculture Site)
Tidal	N	–	1	↑ (UNH Tidal Energy Testing Facility beneath General Sullivan Bridge)

[28] SeaLink is an electric transmission project intended to bring reliable electric service from the Seabrook nuclear power plant to northeastern Massachusetts. The project, as currently proposed, consists of a substation on the property of NextEra Seabrook nuclear power plant as well as a 520-megawatt high voltage direct current cable running underground through the towns of Seabrook, NH and Salisbury, MA and then offshore beneath the seafloor for approximately 55 miles to the Mystic substation in Everett, MA.
[29] Sea3 Inc. currently operates a propane terminal facility in the town of Newington, NH. Sea3 is proposing to expand its facility allowing it to receive additional propane shipments by rail. The additional rail cars will travel on PanAm's privately owned Portsmouth and Newington Railroad Branches, several miles of which are adjacent to the Great Bay Estuary.

Status and Trends in Energy Facilities and Activities in the Coastal Zone				
Type of Energy Facility/Activity	**Exists in CZ**		**Proposed in CZ**	
	(# or Y/N)	Change Since Last Assessment (↑, ↓, –, unknown)	(# or Y/N)	Change Since Last Assessment (↑, ↓, –, unknown)
Current (ocean, lake, river)	N	–	N	–
Hydropower	Y	–	N	–
OTEC	N	–	N	–
Solar	N	–	N	–
Biomass	1	–	N	–
Other (please specify)	N/A	N/A	N/A	N/A

2. If available, briefly list and summarize the results of any additional state or territory-specific information, data, or reports on the status and trends for energy facilities and activities of greater that local significance in the coastal zone since the last assessment.

   In 2012 the study entitled *The Economic Impact of the Piscataqua River and the Ports of Portsmouth and Newington* (Magnusson et al., 2012), was released. The study was sponsored by the Piscataqua River Economic Development Committee to better understand the economic impact of maritime commerce on the region. It describes the significant contribution to the regional economy in the states of New Hampshire and Maine by the Port of Portsmouth-Newington and the marine terminal operators along the Piscataqua River. Much of this economic contribution is in the form of energy products and services. The following are excerpts from the study:

   - In 2011, the principal commodity moved on the existing waterway was fossil-fuel based products (oil, propane, and coal) which comprise approximately 50 percent of the marine commerce shipped through the harbor by weight and 55 percent of its value.
   - A significant portion of the region's energy comes through the Port with fossil-fuel based cargo accounting for $0.9 billion in cargo value.
   - The amount of energy brought in through the Port is an estimated 60 trillion BTU – the equivalent to 20 percent of New Hampshire's total energy use and accounted for almost all of New Hampshire's distillate oil use.
   - In the summer of 2011, 33 wind turbines bound for the Granite Reliable Power Project in Coos County, NH were shipped and received at the Market Street terminal. [This] highlights that there is the opportunity for the Port to be involved in new technologies and that it can be involved in other aspects of the regional energy economy in addition to imports of fossil fuel energy sources.

   Five energy-related activities have been proposed in New Hampshire's coastal zone. Three of these are small scale energy testing projects (tidal, wave and wind) where prototypes utilizing emerging technologies will be temporarily deployed and evaluated. Both the wave and wind energy prototypes are proposed to be tested at the same site near the Isles of Shoals. None of the three proposed projects will involve permanent structures, nor will there be any commercial energy production. To date, neither the tidal energy project nor the wave/wind energy project has received all necessary state and federal approvals.

In 2014, the legislative Committee to Study Offshore Wind Energy and the Development of Other Ocean Power Technology, established by House Bill 1312 (Chapter 180, Laws of 2014), published its report on the feasibility of offshore energy production in New Hampshire. The key findings of the Committee indicated that while wave and tidal energy generation would not produce significant energy, offshore wind energy generation is feasible. The Committee recommends that the turbines be placed three or more miles off the shore of the Isle of Shoals, and be built on floating platforms attached to the sea floor due to the depth of the water in that area. Because this area is in federal waters managed by the Bureau of Ocean Energy Management and New Hampshire's coastline is relatively small, the Committee further recommends that New Hampshire work cooperatively with Maine and Massachusetts in the development of offshore wind energy.[30]

3. Briefly characterize the existing status and trends for Government facilities and activities of greater than local significance in the state's coastal zone since the last assessment.

   There have been no changes in the types or numbers of government facilities and activities of greater than local significance in the state's coastal zone since the last assessment.

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if significant state or territory-level changes (positive or negative) that could facilitate or impede energy and Government facility siting and activities have occurred since the last assessment.

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these	Y	N	N
State Comprehensive Siting Plans/Procedures	N	N	N

Note the report published by the Committee to Study Offshore Wind Energy and the Development of Other Ocean Power Technology described above.

2. For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:
   a. Describe the significance of the change; N/A
   b. Specify if it was a 309 or other CZM-driven change; and N/A
   c. Characterize the outcomes and/or likely future outcomes of the changes(s). N/A

   There have been no significant changes in the Energy and Government Facility Siting management categories since the last assessment.

[30] http://www.gencourt.state.nh.us/StatStudComm/committees/2151/documents/Offshore%20wind%20report.pdf.

Enhancement Area Prioritization:

1. What level of priority is the enhancement area for the coastal management program?

High	_____
Medium	__X__
Low	_____

2. Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.

   Given that there are no new energy production or transport facilities in New Hampshire's coastal zone since the last assessment, but that five new projects have been proposed, the Energy and Government Facility Siting enhancement area is rated as a Medium priority. This prioritization was confirmed at presentations to CAW and the management committee of PREP.

Aquaculture

Section 309 Enhancement Objective: Adoption of procedures and policies to evaluate and facilitate the siting of public and private aquaculture facilities in the coastal zone, which will enable states to formulate, administer, and implement strategic plans for marine aquaculture. §309(a)(9)

PHASE I (HIGH-LEVEL) ASSESSMENT: *(Must be completed by all states and territories.)*
Purpose: To quickly determine whether or not aquaculture is a priority enhancement objective for the CMP that warrants a more in-depth assessment to understand key problems and opportunities that exist for program enhancement and the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. In the table below, characterize the existing status and trends of aquaculture facilities in the state's coastal zone based on the best available data. Your state Sea Grant Program may have information to help with this assessment.

Type of Facility/Activity	Status and Trends of Aquaculture Facilities and Activities[31]		
	# of Facilities	Approximate Economic Value	Change Since Last Assessment (↑, ↓, –, unkwn)
American Oyster – Bottom Culture	12	~$861,000 wholesale; $1.54-$3.69 million retail*	↑ (+10)
American Oyster – Upweller	2	Economic value is reflected in bottom culture estimate above	↑ (+2)
Blue Mussel – Open Ocean (long-line)	4	N/A	↑ (+1, licensed in 2014)
Sea Urchins – Bottom Culture	1	N/A	– (Facility licensed in 1998)
Steelhead Trout – Open Ocean/Riverine	1	N/A	↑ (+1, licensed in 2012)

* Range in retail values is due to variability in retail value to supermarkets ($1.25 - $1.50/oyster) versus restaurants ($2-$3/oyster)

2. If available, briefly list and summarize the results of any additional state or territory-specific data or reports on the status and trends or potential impacts from aquaculture activities in the coastal zone since the last assessment.

- *Overview of the Aquaculture Sector in New England* (Lapointe, 2013) - This NROC White Paper written by George Lapointe states, "The value of shellfish aquaculture in New England is between $45 and $50 million of dockside value at point of first sale…, with oysters being the most valuable product being raised." It also states, "The future growth potential for shellfish aquaculture in New England is significant. Current demand for high quality shellfish has resulted in a strong market for aquaculture shellfish." With regard to finfish aquaculture the White Paper states, "The finfish aquaculture sector in New England produces over 25 million pounds of fish, almost entirely Atlantic salmon, with a market value of over $73.5 million."
- *Aquaculture Situation and Outlook Report 2010: New Hampshire* (La Valley, 2010) - This Northeastern Regional Aquaculture Center publication (Publication No. 106-2010) written by Kenneth La Valley states, "New Hampshire has continued to increase aquaculture capacity through research, continued commercial activity and applied technology transfer activities. Most notably the Atlantic Marine Aquaculture Center, formally the UNH Open Ocean Aquaculture Program, has continued to build interest regionally in offshore long-line mussel culture through collaborations with New Hampshire Sea Grant and continued extramural funding acquired to transfer the technology to prospective producers along the New England coast." The publication also states that the most significant issue facing aquaculture in New Hampshire is the permitting process. Specifically, the publication states, "The most pressing need for marine aquaculture is a permitting process for conducting aquaculture in federal waters and a revamping of the process in state waters."

[31] Information in this table above was provided by the New Hampshire Fish and Game Department, the NHDES Shellfish Program, and Fat Dog Shellfish Co., LLC.

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if there have been any state or territory-level changes (positive or negative) that could facilitate or impede the siting of public or private aquaculture facilities in the coastal zone.

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Aquaculture comprehensive siting plans or procedures	Y*	N	N
Other aquaculture statutes, regulations, policies, or case law interpreting these	Y**	N	Y

* NHF&G's *New Hampshire Marine Aquaculture Strategic Plan* (Dec. 1996; Revised Feb. 2012)
** Aquaculture statute (RSA 211.62-e) and Aquaculture Administrative Rules (Fis 807) administered by the New Hampshire Fish & Game Department; Fill and Dredge in Wetlands statue (RSA 482-A) administered by the NHDES Wetlands Bureau; and Shellfish Sanitation Statute (RSA 143:20-28) and Shellfish Sanitation Administrative Rules (He-P 2150.01 – 2150.37) administered by the Department of Health and Human Services.

2. For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:

    a. Describe the significance of the change;
    b. Specify if it was a 309 or other CZM-drive change; and
    c. Characterize the outcomes and/or likely future outcomes of the changes(s).

    Two significant additions were made to the NHF&G's Aquaculture Administrative Rules (Fis 807) since the last assessment, both effective January 29, 2013. The first is a requirement that the locations of licensed marine bottom aquaculture operations inland of the General Sullivan Bridge be at least 150 feet apart. The second limits the size of any licensed bottom aquaculture site inland of the General Sullivan Bridge to no greater than 4.5 acres. These changes were necessitated by the significant increase in licensed commercial bottom culture oyster operations in the Great Bay Estuary in 2011 and 2012. The changes are an attempt by the NHF&G to spatially manage bottom culture aquaculture operations in the Great Bay Estuary in order to protect natural resources, minimize conflicts among existing licensed aquaculture operations, and minimize conflicts between existing licensed aquaculture operations and other users of the Great Bay Estuary. The changes to the Aquaculture Administrative Rules (Fis 807) were not the result of a 309 or other CZM-driven change.

    Of importance for significant future changes is an effort currently underway by the NHDES Wetlands Bureau to rewrite its administrative rules, Env-Wt 100-900. These rules also regulate marine aquaculture operations, and, as part of this effort, the Wetlands Bureau is coordinating with NHF&G to reduce duplication in NHF&G's aquaculture licensing and NHDES' aquaculture permitting processes. The goal is to ensure that future regulatory decisions regarding marine aquaculture

operations are scientifically-based and protect New Hampshire's sensitive and important natural resources while simplifying the licensing process.

Enhancement Area Prioritization:

1. What level of priority is the enhancement area for the coastal management program?

High	_____
Medium	__X__
Low	_____

2. Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.

   Given the significant growth in the commercial marine aquaculture industry since the last assessment, particularly in the American Oyster bottom culture sector, but because the industry is managed effectively via existing state regulations for commercial aquaculture by the combined work of NHF&G, NHDES Wetlands, and the New Hampshire Department of Health and Human Services, this enhancement area is rated as a Medium priority. This prioritization was confirmed at presentations to CAW and the management committee of PREP.

PHASE II (In-Depth) ASSESSMENTS

Wetlands

In-Depth Resource Characterization:
Purpose: To determine key problems and opportunities to improve the CMP's ability to protect, restore, and enhance wetlands.

1. What are the three most significant existing or emerging physical stressors or threats to wetlands within the coastal zone? Indicate the geographic scope of the stressor, i.e., is it prevalent throughout the coastal zone or specific areas that are most threatened? Stressors can be development/fill; hydrological alteration/channelization; erosion; pollution; invasive species; freshwater input; sea level rise/Great Lake level change; or other (please specify). When selecting significant stressors, also consider how climate change may exacerbate each stressor.

	Stressor/Threat	**Geographic Scope** (throughout coastal zone or specific areas most threatened)
Stressor 1	Development/Fill	Throughout
Stressor 2	Hydrological alteration	Throughout
Stressor 3	Sea Level Rise	Tidal (and adjacent) Wetlands

2. Briefly explain why these are currently the most significant stressors or threats to wetlands within the coastal zone. Cite stakeholder input and/or existing reports or studies to support this assessment.

   The effects of development on wetland extent and integrity have been a concern for New Hampshire's Coastal Zone for many years. Both Rockingham and Strafford counties are the fastest growing counties in the State. With development come not only the direct effects to wetlands such as dredge or fill but also the indirect effects such as runoff from impervious surfaces that can alter the hydrological regime of wetlands. All three of these stressors were brought up at the CAW special meeting on Coastal Climate Resilience & the New Hampshire Coastal Program: the Next Five Years. In addition, the triennial PREP *State of Our Estuaries* reports, described more fully in the Phase I Wetlands section under Resource Characterization question #2, track changes to relative to both quantity and health of New Hampshire's coastal wetlands.

3. Are there emerging issues of concern but which lack sufficient information to evaluate the level of the potential threat? If so, please list. Include additional lines if needed.

Emerging Issue	**Information Needed**
Nutrient Enrichment of salt marsh	Need to better understand how to evaluate this phenomenon to determine whether it is happening in New Hampshire.
Green Crabs effect on salt marsh	Need additional research on European Green Crab population and habitat utilization in New Hampshire as well as the effect that they may have on salt marsh integrity.
Restoration/Management Techniques that increase resiliency tidal marsh from increased sea level rise	Regional information on successful marsh management techniques.

In-Depth Management Characterization:
Purpose: To determine the effectiveness of management efforts to address identified problems related to the wetlands enhancement objective.

1. For each additional wetland management category below that was not already discussed as part of the Phase I assessment, indicate if the approach is employed by the state or territory and if significant state- or territory-level changes (positive or negative) have occurred since the last assessment.

Management Category	Employed By State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Wetland assessment methodologies	Y	Y	N
Wetland mapping and GIS	Y	Y	Y
Watershed or special area management plans addressing wetlands	N	N	N
Wetland technical assistance, education, and outreach	Y	Y	N
Other (please specify)	N/A	N/A	N/A

2. For management categories with significant changes since the last assessment, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information.
    a. Describe significant changes since the last assessment;
    b. Specify if they were 309 or other CZM-driven changes; and
    c. Characterize the outcomes or likely future outcomes of the changes.

    The completion of revised a revised set of National Wetland Inventory (NWI) maps[5] was the most significant change to wetlands management in coastal New Hampshire since the last assessment. The updated NWI maps for the coastal zone provide excellent coverage for comparison of changing conditions. In addition, the new maps are instrumental to the Sea Level Affecting Marsh Model (SLAMM), the outputs of which will be critical to land acquisition and restoration planning. The development of the updated maps was not 309- or CZM-driven, but, as noted above, they will provide essential inputs to NHCP programs and projects.

3. Identify and describe the conclusions of any studies that have been done that illustrate the effectiveness of the state's or territory's management efforts in protecting, restoring, and enhancing coastal wetlands since the last assessment. If none, is there any information that you are lacking to assess the effectiveness of the state's or territory's management efforts?

    PREP's *State of Our Estuaries* reports are one mechanism for illustrating the effectiveness of New Hampshire salt marsh restoration efforts. These triennial reports, described more fully in the Phase I Wetlands section under Resource Characterization question #2, describe progress toward achieving PREP's goals. Another mechanism that evaluates effectiveness of the state's management efforts in

protecting and enhancing coastal wetlands are the PREPA reports (PREP 2015 and Sowers 2010), which are also described in the Phase I Wetlands and Cumulative and Secondary Impacts sections.

Identification of Priorities:

1. Considering changes in wetlands and wetland management since the last assessment and stakeholder input, identify and briefly describe the top one to three management priorities where there is the greatest opportunity for the CMP to improve its ability to more effectively respond to significant wetlands stressors. *(Approximately 1-3 sentences per management priority.)*

   Management Priority 1: Improve Buffer Management within the Coastal Zone

   Description: Buffers are undervalued for the services they provide for wildlife corridors, marsh transgression, water quality and flood attenuation. Emphasis will be given to assessing the existing condition of buffers and the protections they are provided at the State and municipal level. Possible outcomes of this management priority include improving buffer protections through regulation, enforcement, and voluntary adherence to recommended setbacks.

   Management Priority 2: Identify Opportunities for Restoration and Protection of Wetland Resources

   Description: There is recent interest from stakeholders (NHDES Aquatic Resource Mitigation Program, NROC) in identifying restoration/conservation opportunities to ensure technical and financial resources are allocated to high value projects. Evaluation criteria (e.g. wildlife habitat including eelgrass beds, water quality, hazard mitigation, response to sea level rise) will need to be developed through further stakeholder engagement to categorize restoration and protection opportunities.

   Management Priority 3: Provide technical assistance to the NHDES Wetlands Bureau with regard to revising regulatory framework for jurisdictional coastal resources

   Description: The NHDES Wetlands Bureau is currently implementing a multi-year process to revise wetland regulation to achieve environmental based outcomes and to improve regulatory processes. NHCP has already provided technical assistance in the form of recommendations for regulation of tidal culverts. Technical assistance to the Wetland Bureau will be ongoing.

   Management Priority 4: Assess tidal crossings to determine their impact to adjacent tidal wetlands under existing and future conditions

   Description: NHCP was instrumental in implementing a suite of tidal culvert replacements that resulted from a hydraulic assessment of New Hampshire's tidal culverts in 1992. Collective hydraulic assessment of all tidal culverts at a gross level will allow natural resource managers to be proactive when determining tidal volume necessary at a site level to sustain tidal marsh extent in the face of increasing sea level.

2. Identify and briefly explain priority needs and information gaps the CMP has to help it address the management priorities identified above. The needs and gaps identified here do not need to be limited to those items that will be addressed through a Section 309 strategy but should include any items that will be part of a strategy.

Priority Needs	Need? (Y or N)	Brief Explanation of Need/Gap
Research	Y	Research on tidal marsh: nutrient enrichment, green crab effects, sea level rise effects, and sentinel monitoring[32] Research on eelgrass: Understanding causal effects of eelgrass decline and restoration potential
Mapping/GIS	Y	Buffers
Data and information management	Y	Continued support is needed for the Coastal Viewer
Training/capacity building	Y	Training for municipalities for importance of buffers and of tidal marsh.
Decision-support tools	N	N/A
Communication and outreach	Y	Communications plan for importance of buffers.
Other (Specify)	N/A	N/A

Enhancement Area Strategy Development:

1. Will the CMP develop one or more strategies for this enhancement area?

   Yes ___X__

   No _____

2. Briefly explain why a strategy will or will not be developed for this enhancement area.

   Management, restoration, regulation, protection, and monitoring of wetlands are central to the mission of the NHDES Wetlands Bureau, as described in their "2011-2017 Wetland Program Plan." With the exception of direct regulation, NHCP shares similar priorities. In addition, both CAW and the PREP *Comprehensive Conservation and Management Plan* (2010) have similar 'highest' ranking priorities for wetlands. For these reasons, a strategy will be developed that provides tools to improve flushing through tidal culverts. A second strategy will provide technical assistance and outreach to coastal zone communities and state agencies through a coastal resilience program, with an emphasis on the impact to wetlands due to flooding and sea level rise.

Coastal Hazards

In-Depth Resource Characterization:

Purpose: To determine key problems and opportunities to improve the CMP's ability to prevent or significantly reduce coastal hazard risks by eliminating development and redevelopment in high-hazard areas and managing the effects of potential sea level rise and Great Lakes level change.

1a. **Flooding In-depth** (for all states besides territories): Using data from *NOAA's State of the Coast* "Population in the Floodplain" viewer[33] and summarized by coastal county through NOAA's Coastal

[32] http://oceanservice.noaa.gov/sentinelsites/pdf/Sentinel-Site-Program.pdf and http://www.neracoos.org/sites/neracoos.org/files/documents/Sentinel/Northeast_Sentinel_Monitoring_IOOC_CommunityWhitePaper_Rung_etal_2012.pdf.

County Snapshots for Flood Exposure,[34] indicate how many people at potentially elevated risk were located within the state's coastal floodplain as of 2010. These data only reflect two types of vulnerable populations. You can provide additional or alternative information or use graphs or other visuals to help illustrate or replace the table entirely if better data are available. *Note: National data are not available for territories. Territories can omit this question unless they have similar alternative data or include a brief qualitative narrative description as a substitute.*

2010 Populations in Coastal Counties at Potentially Elevated Risk to Coastal Flooding				
	Under 5 and Over 65 years old		In Poverty	
	# of people	% Under 5/Over 65	# of people	% in Poverty
Inside Floodplain	8,144	18%	3,166	6%
Outside Floodplain	65,179	17%	23,548	7%

1b. **Flooding In-depth** (for all states besides territories): Using summary data provided for critical facilities, derived from FEMA's HAZUS[35] and displayed by coastal county through NOAA's Coastal County Snapshots for Flood Exposure,[34] indicate how many different establishments (businesses or employers) and critical facilities are located in the FEMA floodplain. You can provide more information or use graphs or other visuals to help illustrate or replace the table entirely if better information is available.

Critical Facilities in the FEMA Floodplain[34]						
	Schools	Police Stations	Fire Stations	Emergency Centers	Medical Facilities	Communication Towers
Inside Floodplain	6	3	2	0	0	1
Outside Floodplain in Coastal Counties	226	51	50	7	7	15

2. Based on the characterization of coastal hazard risk, what are the three most significant coastal hazards[36] within the coastal zone? Also indicate the geographic scope of the hazard, i.e., is it prevalent throughout the coastal zone or are specific areas most at risk?

	Type of Hazard	Geographic Scope (throughout coastal zone or specific areas most threatened)
Hazard 1	Flooding	Primarily within the FEMA 1% and 0.2% annual chance floodplains
Hazard 2	Coastal storms*	Throughout coastal zone
Hazard 3	Sea level rise*	Shorelines within the coastal zone

* Riverine and coastal erosion are impacts that the New Hampshire Coastal Zone is experiencing associated with coastal storm surge and sea level rise. Efforts to prepare for coastal storms and sea level rise hazards will address multiple impacts, including erosion.

[33] http://stateofthecoast.noaa.gov/pop100yr/welcome.html.
[34] http://coast.noaa.gov/digitalcoast/tools/snapshots.
[35] http://www.fema.gov/hazus. Data can also be downloaded at NOAA STICS, http://www.csc.noaa.gov/digitalcoast/data/stics. Summary data on critical facilities for each coastal state is available on the ftp site.
[36] See list of coastal hazards at the beginning of the Phase I assessment.

3. Briefly explain why these are currently the most significant coastal hazards within the coastal zone. Cite stakeholder input and/or existing reports or studies to support this assessment.

   - See the table of Other Coastal Hazards as well as the report descriptions (especially the *State Multi-Hazard Mitigation Plan)* in the *Coastal Hazards Phase I Assessment*.
   - See the description of the stakeholder meeting conducted with CAW in the *Coastal Hazards Phase I Assessment*.

4. Are there emerging issues of concern, but that lack sufficient information to evaluate the level of the potential threat? If so, please list. Include additional lines if needed.

Emerging Issue	Information Needed
Understanding risks from sea level rise combined with freshwater flooding	A methodology to assess the cumulative risk to coastal communities from freshwater riverine flooding and storm surge with sea level rise that would likely result from a major storm event
Planning for risk to culverts and tidal connectivity from sea level rise	A standard to evaluate and prioritize tidal culverts based on existing criteria and the compounded risks from sea level rise and tidal flooding
Evaluating saltwater intrusion risks	An evaluation of risk to public infrastructure from saltwater intrusion under different sea level rise scenarios
Understanding and planning for cumulative impacts of a population increase and coastal hazards, specifically climate-related risk	A build-out analysis for the Coastal Zone for 2025 and 2050 that can be integrated with sea level rise scenarios and combined with ecosystem services information

In-Depth Management Characterization:
Purpose: To determine the effectiveness of management efforts to address identified problems related to the coastal hazards enhancement objective.

1. For each coastal hazard management category below, indicate if the approach is employed by the state or territory and if there has been a significant change since the last assessment.

Management Category	Employed by State/Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Change Since the Last Assessment (Y or N)
Statutes, Regulations, and Policies:			
Shorefront setbacks/no build areas	Y	Y	Y
Rolling easements	N	N	N
Repair/rebuilding restrictions	Y	N	N
Hard shoreline protection structure restrictions	Y	N	N
Promotion of alternative shoreline stabilization methodologies (i.e., living shorelines/green infrastructure)	Y	Y	Y
Repair/replacement of shore protection structure restrictions	Y	N	N

Management Category	Employed by State/Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Change Since the Last Assessment (Y or N)
Inlet management	N	N	N
Protection of important natural resources for hazard mitigation benefits (e.g., dunes, wetlands, barrier islands, coral reefs) (other than setbacks/no build areas)	Y	Y	N
Repetitive flood loss policies (e.g., relocation, buyouts)	N	N	N
Freeboard requirements	N	N	N
Real estate sales disclosure requirements	Y	N	N
Restrictions on publicly funded infrastructure	N	N	N
Infrastructure protection (e.g., considering hazards in siting and design)	Y	Y	N
Other (please specify)			
Management Planning Programs or Initiatives:			
Hazard mitigation plans	Y	Y	Y
Sea level rise/Great Lake level change or climate change adaptation plans	Y	Y	Y
Statewide requirement for local post-disaster recovery planning	N	N	N
Sediment management plans	N	N	N
Beach nourishment plans	N	Y	N
Special Area Management Plans (that address hazards issues)	N	N	N
Managed retreat plans	N	N	N
Other (please specify): New Hampshire Coastal Risks & Hazards Commission establishment	Y	Y	Y
Other (please specify): Master Plan Climate Adaptation Chapters enabled	Y	Y	Y
Other (please specify): Fluvial erosion hazard zones	Y	Y	Y
Research, Mapping, and Education Programs or Initiatives:			
General hazards mapping or modeling	Y	Y	Y
Sea level rise mapping or modeling	Y	Y	Y
Hazards monitoring (e.g., erosion rate, shoreline change, high-water marks)	Y	Y	Y
Hazards education and outreach	Y	Y	Y
Other (please specify)			

2. Identify and describe the conclusions of any studies that have been done that illustrate the effectiveness of the state's management efforts in addressing coastal hazards since the last assessment. If none, is there any information that you are lacking to assess the effectiveness of the state's management efforts?

   No studies have been done assessing the state's effectiveness in addressing coastal hazards. A study on this topic would be useful—information to conduct an assessment is likely available, however the resources to conduct the study are lacking.

Identification of Priorities:

1. Considering changes in coastal hazard risk and coastal hazard management since the last assessment and stakeholder input, identify and briefly describe the top one to three management priorities where there is the greatest opportunity for the CMP to improve its ability to more effectively address the most significant hazard risks. *(Approximately 1-3 sentences per management priority.)*

   Management Priority 1: Assist the New Hampshire Coastal Risk and Hazards Commission to finalize recommendations for reducing coastal risks and hazards and support implementation of the recommendations

   Description: The Commission is required to provide recommendations to the New Hampshire legislature by the end of 2016 about how to enhance resiliency of coastal communities and statewide assets to coastal risks and hazards exacerbated by climate change. Given that the Commission has limited staffing and no funding, NHCP plans to help staff their efforts and provide technical assistance as the Commission develops recommendations. NHCP will also assist with outreach associated with Commission meetings and reports and promote implementation of the final recommendations at state and local levels after the Commission completes its work.

   Management Priority 2: Assist all coastal zone communities and state agencies to complete vulnerability assessment processes that account for climate change impacts and identify next steps to prepare for coastal hazards

   Description: In order to achieve this priority action, NHCP plans to:
   - Expand the methodology used by the Rockingham Planning Commission Tides to Storms project and the NROC to engage and develop vulnerability assessments with the ten coastal communities within the coastal zone that have yet to participate in the process.
   - Take advantage of opportunities to assist the seven Atlantic Coast communities to implement actions they have identified as priorities within their coastal resiliency planning processes.
   - Provide technical assistance to the NHDES and other state agencies such as the Department of Transportation, the Department of Resources and Economic Development, the Office of Energy and Planning, the Division of Historical Resources, and the Department of Health and Human Services to conduct vulnerability assessments of state assets and implement identified measures to reduce coastal hazards.
   - Work with regional and local partners to leverage existing funding and establish new funding mechanisms that will support long-term technical assistance and implementation of projects to reduce coastal hazards (examples might include: municipal stormwater utilities that fund coastal hazard protection projects from revenues, state revolving fund, public-private partnerships).

   Management Priority 3: Develop and promote guidance to encourage best management practices for coastal infrastructure and land use, such as shoreline management techniques and culvert design, with the goals of protecting communities and natural resources and allowing for adaptation over time.

   Description: In order to achieve this priority action, NHCP plans to:
   - Promote the adoption of bridge and culvert design guidelines that accommodate increased

storm flows and tidal impacts due to climate change and sea level rise in addition to hydrologic connectivity and aquatic organism passage.

- Promote the adoption of shoreline protection guidelines that protect natural resources and implement priority actions identified at the 2014 Shoreline Management Conference.
- Encourage the adoption of Fluvial Erosion Hazard Ordinances and enhanced floodplain protection in coastal communities.

2. Identify and briefly explain priority needs and information gaps the CMP has for addressing the management priorities identified above. The needs and gaps identified here should not be limited to those items that will be addressed through a Section 309 strategy but should include any items that will be part of a strategy.

Priority Needs	**Need?** (Y or N)	**Brief Explanation of Need/Gap**
Research	Y	Research is needed related to the interaction between freshwater flooding, sea-level rise, and storm surge. More research is needed to understand saltwater intrusion risks. Ongoing research is needed to refine sea-level rise projections. Legal research is needed to understand the issues associated with living shorelines with regards to existing statutes and regulations.
Mapping/GIS/modeling	Y	A mapped shoreline habitat and structure inventory is needed in addition to a mapped assessment of shoreline vulnerability to identify options for shoreline treatment and management in specific areas. New mapping is needed to understand risks to infrastructure from sea-level rise as well as culvert connectivity under different sea-level rise scenarios. Modeling to demonstrate flood risks from the combination of freshwater and coastal flooding is also needed.
Data and information management	Y	Continued support is needed to maintain the Coastal Data Viewer and incorporate new data as it is developed. A centralized website is needed to serve as a Coastal Resilience Hub for all information related to CAW's work, the Coastal Viewer landing page and training tools, and other important information about coastal resilience and shoreline management in New Hampshire.
Training/Capacity-building	Y	Support is needed for NHCP, CAW, and regional planning commissions to expand training and capacity-building to municipalities for coastal resiliency and shoreline management planning and implementation. NHCP needs to develop training tools and opportunities for Coastal Viewer user audiences.
Decision-support tools	Y	Development of decision-support tools to assist communities and state agencies in determining appropriate culvert design guidelines and shoreline management strategies for specific areas under sea-level rise scenarios. Additional decision-support tools should be developed to encourage use of data on the Coastal Viewer.
Communication and outreach	Y	Communication and outreach support is needed for the Coastal Risk and Hazards Commission as it develops recommendations and communicates the associated products. Support is needed to NHCP, CAW, and regional planning commissions to expand outreach and education to municipalities about approaches to enhance coastal resiliency and improve shoreline management. NHCP needs to continue education and outreach related to the Coastal Viewer.
Other (Specify)	N/A	N/A

Enhancement Area Strategy Development:

1. Will the CMP develop one or more strategies for this enhancement area?

   Yes ___X__

   No _____

2. Briefly explain why a strategy will or will not be developed for this enhancement area.

Given the increasing magnitude of storms and accelerating rates of sea level rise that are contributing to intensifying erosion along with more frequent and damaging flooding, habitat destruction, and resource damage, the Coastal Hazards enhancement area is rated as a High priority and NHCP intends to focus significant efforts to address these hazards in the next five years. Together with the development of accessible research and mapping tools, efforts have been made in the past five years to conduct education and outreach to coastal communities and state agencies about climate change effects on coastal hazards and possible actions to prepare for those hazards. In addition to sustained education and outreach and research and mapping efforts, the program would like to enhance training and technical assistance to empower others to develop plans and implement solutions over the course of the next five years. The New Hampshire Coastal Risk and Hazards Commission, a legislative study commission, will identify recommendations by the end of 2016 for communities and state agencies to address coastal hazards, suggesting that this topic is also a priority for the state legislature and other state agencies. The Commission's deadline provides NHCP with an ideal opportunity to influence statewide coastal policy and planning within the five-year timeframe. The development of a strategy for Coastal Hazards was supported by members of CAW and the management committee of PREP.

Cumulative and Secondary Impacts

In-Depth Resource Characterization:
Purpose: To determine key problems and opportunities to improve the CMP's ability to address cumulative and secondary impacts of coastal growth and development.

1. What are the three most significant existing or emerging cumulative and secondary stressors or threats within the coastal zone? Indicate the geographic scope of the stressor, i.e., is it prevalent throughout the coastal zone or are there specific areas that are most threatened? Stressors can be coastal development and impervious surfaces; polluted runoff; agriculture activities; forestry activities; shoreline modification; or other (please specify). Coastal resources and uses can be habitat (wetland or shoreline, etc.); water quality; public access; or other (please specify). When selecting significant stressors, also consider how climate change may exacerbate each stressor.

	Stressor/Threat	**Coastal Resource(s)/Use(s) Most Threatened**	**Geographic Scope** (throughout coastal zone or specific areas most threatened)
Stressor 1	Coastal development & impervious surfaces	Habitat (freshwater wetland & estuarine); Water quality	Throughout CZ
Stressor 2	Polluted runoff	Water quality; Habitat (estuarine)	Throughout CZ
Stressor 3	Flooding/sea level rise	Habitat (esp. shoreline); Water quality	Throughout CZ

2. Briefly explain why these are currently the most significant cumulative and secondary stressors or threats from coastal growth and development within the coastal zone. Cite stakeholder input and/or existing reports or studies to support this assessment.

   Development continues to increase in the coastal zone (3.48 percent from 2006 to 2010) with a concurrent greater increase in impervious area (4.54 percent).[21] This increase is combined with housing growth of 0.96 percent from 2007 to 2012[37] during a period encompassing an economic recession. With the economy now improving, development pressure is already increasing, and will likely again outstrip population growth (population growth was slightly higher than housing growth from 2007 to 2012 at 1.01 percent, resulting in a slight decrease in land consumption per person). In addition, stressors 1 and 2 above, coastal development & impervious surfaces plus polluted runoff, have been identified as primary concerns in the PREP *Comprehensive Conservation and Management Plan* (2010). Growth and its secondary impacts have resulted in increased nutrient loading from both point and nonpoint sources, decreased water clarity, and reduced eelgrass habitat, among other effects. For example, despite some recent, localized increases in eelgrass, long-term statistics show a 38 percent decline in Great Bay eelgrass coverage between 1990 and 2011 along with an absence of eelgrass in the tidal rivers and a lack of connectivity between Great Bay and Portsmouth Harbor (PREP, 2013).

3. Are there emerging issues of concern, but which lack sufficient information to evaluate the level of the potential threat? If so, please list. Include additional lines if needed.

Emerging Issue	Information Needed
Change in stream hydrology due to climate change, including resulting need for changes in floodplain management	Downscale climate change modeling to small stream level
How to better focus land conservation efforts to account for climate change impacts	Maps
Comprehensive water quality information for Great Bay, including new contaminants of concern	Coordinated water quality data and concentrations, especially for new concerns such as macro algae
Lack of integrated watershed management and permitting	Policy and regulatory support

In-Depth Management Characterization:
Purpose: To determine the effectiveness of management efforts to address identified problems related to the cumulative and secondary impacts enhancement objective.

1. For each additional cumulative and secondary impact management category below that is not already discussed as part of the Phase I assessment, indicate if the approach is employed by the state or territory and if significant state- or territory-level changes (positive or negative) have occurred since the last assessment.

[37] http://www.oceaneconomics.org/.

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Methodologies for determining cumulative and secondary impacts (CSI) impacts	Y	Y	Y
CSI research, assessment, monitoring	Y	Y	N
CSI GIS mapping/database	Y	Y	N
CSI technical assistance, education and outreach	Y	Y	N
Other (please specify)	N/A	N/A	N/A

2. For management categories with significant changes since the last assessment, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information.
    a. Describe significant changes since the last assessment;
    b. Specify if they were 309 or other CZM-driven changes; and
    c. Characterize the outcomes or likely future outcomes of the changes.

    The *Great Bay Nitrogen Non-Point Source Study* (Trowbridge et al., 2014) utilized a customized version of the Nitrogen Loading Model originally published in Valiela et al. (1997) to determine the amount and sources of nitrogen pollution to the Great Bay, which had not previously been done at this level of detail. The model tracked nitrogen inputs from atmospheric deposition, chemical fertilizers, human waste through septic systems, and animal waste. Nitrogen from these sources was traced through surface waters, stormwater and groundwater, and model output matched field measurements of non-point source loads within the model uncertainty of +/-13 percent. Unique aspects of the New Hampshire model were the identification of animal wastes as a significant source of nitrogen, and the addition of a stormwater/surface water nitrogen transport pathway for the significant portion of nitrogen that would not enter groundwater. A summary of model results can be found in the Cumulative and Secondary Impacts Phase I section of this report, under Resource Characterization question number 5.

    This report was neither CZM-driven nor 309-funded, but CZM staff provided a significant amount of support. The expected outcome of this report was to identify the most significant sources of nitrogen pollution to the Great Bay by both source type and sub-watershed location in order to guide efficient pollution abatement projects.

3. Identify and describe the conclusions of any studies that have been done that illustrate the effectiveness of the state's or territory's management efforts in addressing cumulative and secondary impacts of development since the last assessment. If none, is there any information that you are lacking to assess the effectiveness of the state and territory's management efforts?

    PREP's *State of Our Estuaries* reports, described in Phase I - Wetlands, Resource Characterization Question 2, are the primary vehicle for illustrating the effectiveness of New Hampshire's management efforts in addressing the cumulative and secondary impacts of development in the

Piscataqua watershed. The triennial reports describe progress toward achieving PREP's goals in areas such as limiting impervious surface, reducing nutrient loads to the estuary, restoring salt marshes, and conserving land and critical habitats in the watershed. Significant results from the most recent report, published in 2013, are described in the Wetlands Phase I section of this report. In addition to describing overall trends, the reports highlight projects successful at improving conditions as well as emerging issues and research priorities.

Identification of Priorities:

1. Considering changes in cumulative and secondary impact threats and management since the last assessment and stakeholder input, identify and briefly describe the top one to three management priorities where there is the greatest opportunity for the CMP to improve the effectiveness of its management effort to better assess, consider, and control the most significant threats from cumulative and secondary impacts of coastal growth and development. *(Approximately 1-3 sentences per management priority.)*

   Management Priority 1: Comprehensive Watershed-based Planning for Great Bay

   Description: Coordinate with NHDES Watershed Assistance Program to develop new, or update existing, sub-watershed plans for addressing NPS pollution to Great Bay which would also comply with EPA's Nine Minimum Elements of Watershed-Based Plans. With EPA elements "a," "b" and "i" already complete through the use of two existing reports and on-going monitoring done by PREP and GBNERR, NHCP will work with Watershed Assistance grantees to fill the c-h gaps. Plans will include evaluations of NPS hot spots and site specific identification of structural and non-structural approaches for reducing nitrogen loads, with expected products to incorporate pollutant hot spot analysis mapping, sub-watershed level identification of locations for site specific fixes and estimated load reductions, implementation strategies/schedule, and a description of costs and authorities for implementation.

   Management Priority 2: Reduce Non-point Source Nutrient Pollution from Sewer and Septic Systems

   Description: Cooperate with the NHDES Watershed Assistance Program to ensure that coastal region sewer and septic systems, especially those that are highly vulnerable to sea level rise and stormwater, are regulated, designed, installed and maintained in a way that allows them to function without degrading water quality. Objectives will include reduction of nitrogen and phosphorus pollution through maintenance and replacement of existing systems as well as development of alternative technologies and establishment of community systems. This effort will build on recent work conducted by the Strafford Regional Planning Commission to identify septic systems most at risk for NPS pollution due to the effects of climate change and on the research conducted by the Rockingham County Conservation District to determine the effectiveness of permeable reactive barriers for septic systems.

   Management Priority 3: Promote Municipal Planning that Reduces Cumulative and Secondary Impacts

   Description: Work with communities to identify and fill local needs with respect to achieving municipal goals for protecting water quality and coastal resources. NHCP staff will partner with

regional planning commissions, the NHDES Watershed Assistance Section, CAW and others to help communities adopt ordinances such as those to establish or expand buffer areas, to improve stormwater management, whether on a town-by-town basis or via a regional or multi-town stormwater utility, and to install and maintain green infrastructure and best management practices (BMPs).

2. Identify and briefly explain priority needs and information gaps the CMP has to help it address the management priorities identified above. The needs and gaps identified here do not need to be limited to those items that will be addressed through a Section 309 strategy but should include any items that will be part of a strategy.

Priority Needs	**Need?** (Y or N)	**Brief Explanation of Need/Gap**
Research	Y	Better information about changes in stormwater impacts from climate change/precipitation changes. Studies to understand cost benefit analysis/economics.
Mapping/GIS	Y	Location and extent of buffers. Complete datasets to conduct detailed geospatial water resources analyses.
Data and information management	Y	Complete and update Coastal Viewer.
Training/Capacity building	Y	Technical support
Decision-support tools	Y	Conduct an economics and efficiency analysis to determine the effectiveness of various green infrastructure techniques and BMPs in NPS pollution control.
Communication and outreach	Y	Communities need additional resources and training in order to choose, install and maintain appropriate Low Impact Development techniques and BMPs that will effectively reduce NPS pollution.
Other (Specify): Local Regulations	Y	Determine existing municipal regulations affecting cumulative and secondary impacts such as buffer requirements, impervious surface limits and stormwater regulations, and then help towns develop and adopt effective, consistent regulations.

Enhancement Area Strategy Development:

1. Will the CMP develop one or more strategies for this enhancement area?

   Yes __X___
   No _____

2. Briefly explain why a strategy will or will not be developed for this enhancement area.

   The New Hampshire Coastal Region has been experiencing population and development growth greater than the average growth for the state as whole for the past several decades, and this trend is expected to continue for the foreseeable future. As a result, it is critical that coastal communities both reduce the cumulative and secondary impacts on coastal water quality and resources of past growth as well as plan ahead to minimize the secondary effects of future development. Thus the three management priorities above focus on determining how and where past development has affected New Hampshire's coastal region, reducing these effects, and developing ordinances and

partnerships to reduce or eliminate future effects. The critical nature of these impacts have already been recognized by NHCP's partner organizations in the coastal region and in the state: these management priorities have been identified as highest priority actions in the PREP *Comprehensive Conservation and Management Plan* (2010), as critical goals in the PREP *State of Our Estuaries Report* (2013), as important objectives for the next five years in the *New Hampshire Nonpoint Source Management Program Plan* (NHDES, 2014), and as top emerging priorities by CAW.

STRATEGIES

1. Tidal Culverts

I. Issue Area(s)

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☐ Cumulative and Secondary Impacts
- ☒ Wetlands
- ☐ Marine Debris
- ☐ Public Access

II. Strategy Description

A. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

- ☐ A change to coastal zone boundaries;
- ☐ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;
- ☐ New or revised local coastal programs and implementing ordinances;
- ☐ New or revised coastal land acquisition, management, and restoration programs;
- ☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,
- ☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. ***Strategy Goal:*** The goal of this strategy is to improve design and permitting outcomes of the replacement and/or construction of new road crossings in tidal environments in New Hampshire's Coastal Zone through non-regulatory approaches.

C. ***Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above.***

NHCP plans to achieve this strategy by conducting in-depth field assessments of tidal crossings in New Hampshire's Coastal Zone followed by evaluating field data to determine whether road crossings are restrictive of existing and predicted tide elevations. This approach will achieve program change by providing guidelines in the form of environmental targets and hydrological needs for selected tidal areas. This will allow engineers and permitting agencies to have a standard upon which to measure suitability of a proposed action for the site in question.

III. Needs and Gaps Addressed

In May 2010, NHDES promulgated administrative rules (Env-Wt 900) which established standards for all crossings of perennial and intermittent streams. These rules revised the manner in which culverts and bridges are designed in New Hampshire. The purpose of this rule change was to ensure that stream crossing structures in New Hampshire are designed to accommodate flood flows, geomorphic processes and aquatic organism passage. Env-Wt 900 does not specifically address stream crossings affected by tidal hydrology because their complexity prevented development of standards at the time that Env-Wt 900 was promulgated. To date, permitting of tidal stream crossings by NHDES has been on a case-by-case basis, which is consistent with approaches by other New England states. While there are general targets that NHDES regulatory personnel utilize to inform regulatory decisions for tidal crossings, there remains no formal guidance or requirements for design considerations, data inputs, or design outcomes of proposed tidal stream crossing projects.

In the absence of any guiding doctrine or policy, individual tidal stream crossing projects may achieve varying outcomes. Incorporating tidal criteria into New Hampshire's Stream Crossing Rules was a component of New Hampshire's *2011 Section 309 Assessment and Strategy*.[Error! Bookmark not efined.] While a program change for tidal culverts wasn't achieved, the concept was evaluated and a rule change was considered; however, the issue was deemed a lower priority as compared to other needs of the NHDES Wetlands Bureau.

Our 2016 strategy approaches the same issue from a different direction by providing non-regulatory guidance for tidal culvert replacement projects in the form of establishing environmental targets for tidal systems and, potentially, guidance for designers, permitters, and local decision makers.

IV. Benefits to Coastal Management

Although few in number, tidal stream crossings have a considerable impact on the ecological integrity of existing salt marsh as well as on the processes that will, under climate change scenarios, maintain and accommodate salt marshes in the future. Improved design and permitting will ensure that tidal processes are sustained to the greatest extent.

V. Likelihood of Success

The strategy will begin in June 2015 through a contract between NHCP and The Nature Conservancy (TNC). TNC is contracted to implement a process to convene regional experts to provide guidance on what should be included in the tidal culvert assessment protocol. Their work will also evaluate any assessment protocol examples from around the country. The outcome of the work will be a draft assessment protocol that will be piloted at several locations. This work will be complete by July 1, 2016. Completion of subsequent activities for this strategy is dependent upon outside funding. However, NHCP is confident that we will be able to successfully recruit outside funding to achieve this goal. In addition, this strategy is designed incrementally such that goals can still be partially achieved with reduced project funding by assessing high priority sites.

VI. Strategy Work Plan

Strategy Goal: Improve design and permitting outcomes of tidal culvert replacement projects through non-regulatory approaches

Total Years: **5**

Total Budget: **$60,000**

Year(s): 1-2
Description of activities: Convene regional experts in hydrology, ecology, and transportation to develop a tidal culvert assessment protocol to characterize the culvert and surrounding area.
Major Milestone(s):
- 1workshop.
- Draft Tidal Culvert Assessment Protocol.

Budget: **$15,000**

Year(s): 2-3
Description of activities:
- Utilize Sea Level Affecting Marshes Model (SLAMM) to prioritize which stream crossings should to be evaluated in the field.
- Assess selected tidal culverts using the approved assessment protocol.

Major Milestone(s):
- Field work completion.
- Database of field data.

Budget: **$10,000**

Year(s): 3-4
Description of activities:
- Hire a contractor or join with technical partner to conduct Hydrological and Hydraulic analysis of selected tidal systems affected by road crossings.
- Develop a report indicating how well each crossing is able to pass a representative tide under existing and future conditions.
- Establish environmental targets for selected tidal systems.

Major Milestone(s):
- Draft report.
- Final report.

Budget: **$30,000**

Year(s): 5
Description of activities:
- Share the results of the study with NHDES Wetlands Bureau, Department of Transportation, municipalities and other project partners.
- Integrate findings into the coastal viewer.

Major Milestone(s): Workshop to share findings**.**
Budget: **$5,000**

VII. Fiscal and Technical Needs

A. Fiscal Needs:

Appropriate management of tidal resources adjacent to road crossings is critical for the maintenance of tidal marsh under sea level rise scenarios. The science behind this issue is

extremely complex; therefore, outside funding is required to implement this program to its capacity.

B. Technical Needs:

NHCP possesses the technical skills and knowledge lead this strategy, however, additional capacity from local partners and technical resources are necessary.

VIII. Projects of Special Merit (Optional)

Another approach for creating significant program change with regard to management of tidal wetlands is to create best management practices for replacement or construction of tidal stream crossings. A guidance document for tidal culverts would be timely given the predicted impacts of sea level rise on the extent of tidal wetlands throughout the Northeast. SLAMM model outputs indicate that future high marsh will be constrained to locations landward of road crossings. With this in mind, it is critical to provide municipalities, natural resource managers, engineers, and transportation agencies better guidance on this issue.

2. New Hampshire Coastal Risks & Hazards Commission

I. Issue Area(s)

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☐ Cumulative and Secondary Impacts
- ☐ Wetlands
- ☐ Marine Debris
- ☐ Public Access

II. Strategy Description

A. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

- ☐ A change to coastal zone boundaries;
- ☐ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;
- ☐ New or revised local coastal programs and implementing ordinances;
- ☐ New or revised coastal land acquisition, management, and restoration programs;
- ☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,
- ☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. ***Strategy Goal:*** To support development of the recommendations of the legislative New Hampshire Coastal Risks and Hazards Commission and assist with communication and outreach about the effort and draft recommendations.

C. ***Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above.***

The New Hampshire Coastal Risks and Hazards Commission (Commission) was established by state legislation July 2, 2013. By December 1, 2016, the Commission is required to summarize the best available science about climate change impacts to coastal New Hampshire and "recommend legislation, rules, and other actions to prepare for projected sea-level rise and other coastal and coastal watershed hazards such as storms, increased river flooding, and storm water runoff, and the risks such hazards pose to municipalities and state assets in New Hampshire." NHCP staff members have been assisting with the Commission process as schedules have permitted, however the new Coastal Resilience Specialist's work plan will include a specific task to support the Commission as it completes its work. The Coastal Program Manager will also continue to serve an advisory role on the Commission Steering Committee and in the State Working Group. The Coastal Resilience Specialist will:

- Attend meetings of the full Commission as well as the Coastal, Inland, and State working groups.
- Give presentations as needed.
- Provide research and writing capacity.
- Provide technical assistance.
- Manage the Commission website.
- Work with CAW to develop a communication strategy for the Commission as well as a series of workshops that will relay the latest science, draft recommendations, and seek input from community members.

The Commission recommendations are specifically intended to inform and create new legislation, policies, guidance and practices associated with coastal hazards. The Commission's work represents the best opportunity for achieving large-scale program change in the form of better management of coastal hazards in New Hampshire at both state and local levels. In order to ensure that the Commission completes its work in an effective, well-informed and timely manner, staff assistance from NHCP is critical. Following the release of the Commission recommendations at the end of 2016, NHCP will amend the 309 Strategy to better reflect the specific program changes to be targeted for 2017 through 2020.

III. Needs and Gaps Addressed

NHCP expects that the Commission recommendations, once finalized, will address many of the needs identified by the 309 Assessment. In the meantime, this strategy will assist with the critical need for communication and outreach support for the New Hampshire Coastal Risk and Hazards Commission as it develops recommendations and communicates the associated products. This strategy will also help achieve identified research needs by incorporating those needs into recommendation language for the Commission. Some of these research needs include: 1) a better understanding of the interaction between freshwater flooding, sea-level rise, and storm surge; 2) saltwater intrusion risks; and, 3) refined sea-level rise projections.

IV. Benefits to Coastal Management

This strategy will benefit coastal management by ensuring that good coastal management strategies are incorporated into the recommendations of a state-level legislative committee. The likelihood of achieving these strategies will be significantly higher if sanctioned by the Commission. This strategy will be amended to provide more specific examples when the recommendations are published at the end of 2016.

V. Likelihood of Success

The likelihood of success of this strategy is high. NHCP staff members have already been engaged in the Commission process. New staff resources provided by the Coastal Resilience Specialist will ensure that NHCP can provide the level of technical assistance and outreach support needed to make the Commission's recommendations useful and aligned with best practices for coastal management. CAW and the Commission itself have both expressed the need for more staff and communications support to the Commission, and the Commission has accepted that NHCP is the appropriate program to provide that support.

VI. Strategy Work Plan

Strategy Goal: To support development of the recommendations of the legislative New Hampshire Coastal Risks and Hazards Commission, assist with communication and outreach about the effort, and draft recommendations.

Total Years: **3**

Total Budget: **$40,000**

Year(s): 1-2
Description of activities: Support the work of the New Hampshire Coastal Risks and Hazards Commission and participate in the development of recommendations.
Major Milestone(s):

- Attend monthly Commission, steering committee and working group meetings.
- Give presentations, as needed.
- Provide research, writing and other technical assistance as recommendations are developed.
- Update Commission website, as needed.

Budget: **$15,000**

Year(s): 1-3
Description of activities: Work with CAW to develop a communication strategy for the Commission as well as communication tools and a series of workshops that will relay the latest science, draft recommendations, and seek input from community members.
Major Milestone(s):

- Draft Commission communications strategy, in partnership with CAW, and approved by Commission.
- Develop communication tools, including at least one two-page fact sheet and a canned Power Point presentation.
- Public workshop organized and executed, in partnership with CAW, to inform about the Commission Science Report.
- Organize and execute at least three public workshops (coastal, inland and state), in partnership with CAW, to communicate CRHC recommendations and obtain community input.

Budget: **$25,000**

VII. Fiscal and Technical Needs

A. Fiscal Needs:

Additional funds are needed to design communication tools for the Commission's science report and other products. CAW has secured funding to fill some of these needs.

B. Technical Needs:

NHCP possesses the technical skills and knowledge to carry out this strategy, however, additional capacity from CAW will be needed and has been arranged.

VIII. Projects of Special Merit (Optional)

None

3. Coastal Resilience Technical Assistance Program

I. Issue Area(s)

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☒ Cumulative and Secondary Impacts
- ☒ Wetlands
- ☐ Marine Debris
- ☐ Public Access

II. Strategy Description

A. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

- ☐ A change to coastal zone boundaries;
- ☒ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;
- ☒ New or revised local coastal programs and implementing ordinances;
- ☐ New or revised coastal land acquisition, management, and restoration programs;
- ☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,
- ☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. ***Strategy Goal:*** To develop a coastal resilience program with a dedicated NHCP staff person that provides technical assistance and outreach to coastal zone communities and state agencies, resulting in plans and policies that better address the coastal risks and hazards that are exacerbated by climate change in New Hampshire.

C. ***Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above.***

The Coastal Resilience Technical Assistance Program will provide a central source for assessments and information, technical assistance, community outreach, and coordination for reducing coastal risks and hazards in New Hampshire. The new Coastal Resilience Specialist within NHCP will coordinate the program, bringing together the combined resources and knowledge of CAW members, NHCP staff, and other local, state and federal sources to provide assistance and training to communities and state agencies, support the New Hampshire Coastal Risks and Hazards Commission as it develops recommendations, and administer coastal resilience grant projects.

The work plan tasks described below are designed to provide tools and resources that will achieve key programmatic changes at a variety of levels. Through community-based vulnerability assessments and wetland buffer outreach, municipal plans and ordinances will be created or

updated to improve local floodplain management and buffer protection. A state-level assessment of vulnerable coastal assets will result in better-protected state resources through the implementation of guidance and new administrative decisions (for example: improvements to how state-owned roads are built, managed and repaired in areas of high flood risk). A new coastal resilience hub will more effectively disseminate tools and guidance that help communities and state-level decision-makers reduce coastal hazards through a variety of mechanisms, including new policies and planning. Finally, successful implementation of the New Hampshire Coastal Risks and Hazards Commission recommendations will result in guidance as well as new statutes, regulations, enforceable policies, administrative decisions, executive orders, and/or memoranda of agreement/understanding that enhance state and local resilience to coastal hazards. NHCP plans to amend the 309 Strategy to include more detailed implementation strategies for the New Hampshire Coastal Risks and Hazards Commission recommendations when they are published in 2016. Ultimately, all of these implementation strategies will form components of the new NHCP coastal resilience program led by the Coastal Resilience Specialist, which represents a key programmatic change for NHCP and NHDES.

III. Needs and Gaps Addressed

This Assessment has identified several priority needs that will be addressed by this strategy including GIS mapping, data and information management, training and capacity-building, and communication and outreach. By developing new vulnerability assessments for 10 coastal communities and state assets, this strategy seeks to fill the need for new mapping to understand risks to infrastructure from sea level rise and storms. By developing a web-based coastal resilience hub, this strategy seeks to fill the need for a centralized platform that organizes, consolidates, and disseminates information about resilience efforts and tools focused in the Coastal Zone. By expanding the application of the 'Preparing for Climate Change' workshop series and enhancing education about wetland buffer protection, this strategy seeks to fill the identified need for additional capacity-building, communication, and outreach. The recommendations of the New Hampshire Coastal Risks and Hazards Commission will identify some needs and gaps that overlap with those identified by this Assessment as well as additional needs and gaps. An amended 309 Strategy will be submitted when those recommendations are published.

IV. Benefits to Coastal Management

The strategy will benefit coastal management in New Hampshire in several tangible ways. This strategy ensures that coastal resilience program work is *institutionalized* within NHCP and NHDES in the form of a full-time staff person and their work plan. As a result, projects and resources will continue to be directed at reducing coastal risks and hazards for the long-term. The strategy will allow NHCP to fill several information gaps that communities and state agencies have identified as impediments to progress on reducing coastal hazards. Ultimately, this strategy will result in communities, state agencies and resources that are better prepared for and more resilient to the impacts of climate change along the New Hampshire Coastal Zone.

V. Likelihood of Success

The strategy has a high likelihood of success, given the availability of new NHCP resources through the full-time Coastal Resilience Specialist and existing support from CAW. CAW participated in a focus group session to help develop this strategy. Additionally CAW will play an important role in carrying out some of the activities identified in this strategy, such as the 'Preparing for Climate Change' workshops and the wetland buffer education. In addition, the New Hampshire Coastal Risks and Hazards Commission is a State Legislative Committee with strong support from the Governor's

Office and state legislators. Through the outreach and communication efforts outlined in this strategy (e.g. workshops and website), NHCP will expand support for work on coastal resiliency issues and for the implementation of the New Hampshire Coastal Risks and Hazards Commission recommendations.

VI. Strategy Work Plan

Strategy Goal: To develop a coastal resilience program with a dedicated NHCP staff person that provides technical assistance and outreach to coastal zone communities and state agencies, resulting in plans and policies that better address the coastal risks and hazards that are exacerbated by climate change in New Hampshire.

Total Years: **5**

Total Budget: **$180,000**

Year(s): 1-5
Description of activities: Engage additional Coastal Zone communities in the 'Preparing for Climate Change' workshop series to build capacity among local leaders and encourage the development of community resilience action plans.
Major Milestone(s):

- Contract with the Natural Resources Outreach Coalition to complete at least three additional 'Preparing for Climate Change' workshop series.
- Assist with facilitation and outreach for the workshop series.
- Complete draft action plans or set of action steps as identified by municipal participants.
- Complete workshop series.

Budget **$20,000**

Year(s): 1-3
Description of activities: Improve education and outreach about wetland buffer protection, including developing outreach materials and organizing a 'Water, Weather, Climate and Community' workshop.
Major Milestone(s):

- Develop and disseminate outreach materials related to municipal wetland buffer protection, in partnership with PREP.
- Hold workshop, in partnership with CAW, focused on buffer protection as a tool to prepare for climate change impacts.

Budget **$10,000**

Year(s): 1-4
Description of activities: Improve community education and engage in projects focused on using green stormwater infrastructure as a tool to enhance flood protection and water quality as climate change exacerbates both issues, and explore opportunities to implement municipal stormwater utilities as a method for raising local revenue for floodplain management.

Major Milestone(s):

- Conduct education in at least two municipalities related to green infrastructure and climate change.
- Complete at least two projects that result in the design of green infrastructure to accommodate increased precipitation levels related to climate change.
- Following the issuance of the MS4 EPA permits, participate in discussions with NHDES 319 program and at least one municipality related to stormwater utility development.

Budget **$10,000**

Year(s): 1-5

Description of activities: Complete vulnerability assessments for the remaining 10 coastal zone communities using an approach similar to the Tides to Storms project which has focused on the seven Atlantic coastal communities. Information from these assessments will ultimately be incorporated into local Master Plans and/or Hazard Mitigation Plans.

Major Milestone(s):

- Develop work plan and contracts for vulnerability assessments with Regional Planning Commissions.
- Complete vulnerability assessments.
- Complete model Hazard Mitigation Plan chapter based on assessments for incorporation by municipalities.

Budget **$60,000**

Year(s): 1-5

Description of activities: Complete a vulnerability assessment of state-owned assets in the Coastal Zone and develop recommendations to better prepare the state's assets for climate change impacts.

Major Milestone(s):

- Collaborate with relevant state agencies.
- Develop a work plan for the assessment.
- Complete the assessment.
- Develop recommendations.
- Publish and conduct outreach.

Budget: **$30,000**

Year(s): 1-3

Description of activities: Lead the development of a new CAW website to serve as a 'coastal resiliency hub' where community members can engage with each other, access the Coastal Data Viewer and associated training tools along with additional assessment tools and guidance, explore shoreline management options, and find information about the New Hampshire Coastal Risks and Hazards Commission.

Major Milestone(s):

- Contract CAW 'resiliency hub' website.
- Approve design.
- Launch website.

Budget: **$30,000**

Year(s): 2-5

Description of activities: Implement the New Hampshire Coastal Risks and Hazards Commission recommendations, to be published by December 2016.

Major Milestone(s): Priority recommendations from the New Hampshire Coastal Risks and Hazards Commission are implemented. More specific milestones will be determined upon publication of the final recommendations.

Budget: $20,000

VII. Fiscal and Technical Needs

A. Fiscal Needs:

309 funds are not sufficient to complete several elements of this strategy. First, NHCP will rely on partnerships with CAW, PREP, NROC, the Strafford Regional Planning Commission, the Rockingham Regional Planning Commission, other NHDES programs, and other state agencies to complete many of the identified activities. Additional funding will be needed to complete the 'Preparing for Climate Change' workshop series, the vulnerability assessments for 10 coastal communities, the green infrastructure projects, and the CAW 'coastal resiliency hub' website.

In FY2014, NHCP, in partnership with the Regional Planning Commissions, applied for a NOAA Project of Special Merit (PSM) in support of goals expressed in the 2011 Section 309 Assessment and Strategy to obtain funding for the 10 coastal-inland community vulnerability assessments. NHCP expects to be able to fund other components of the strategy through additional grant opportunities and partnership agreements. If received, this PSM will serve to bridge the implementation of the 2011 Section 309 Assessment with the 2016 Section 309 Assessment.

B. Technical Needs:

NHCP does not have the expertise to carry out several components of the strategy, including 'coastal resiliency hub' website design, the state and local vulnerability assessments, and the 'Preparing for Climate Change' workshops. However, existing partnerships will be leveraged to achieve these activities, as identified in the Major Milestones above. The Regional Planning Commissions have partnered with NHCP on a NOAA Project of Special Merit application to complete the community vulnerability assessments.

VIII. Projects of Special Merit (Optional)

- Contract the development of a new CAW website to serve as a 'coastal resiliency hub' where community members can engage with each other, access the Coastal Data Viewer along with additional survey tools and guidance, and find information about the New Hampshire Coastal Risks and Hazards Commission.
- Contract new 'Preparing for Climate Change' workshop series with NROC.

4. Advancing Shoreline Management

I. Issue Area(s)

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☐ Cumulative and Secondary Impacts
- ☒ Wetlands
- ☐ Marine Debris
- ☐ Public Access

II. Strategy Description

A. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

- ☐ A change to coastal zone boundaries;
- ☐ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;
- ☐ New or revised local coastal programs and implementing ordinances;
- ☐ New or revised coastal land acquisition, management, and restoration programs;
- ☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,
- ☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. ***Strategy Goal:*** To develop and provide guidance for shoreline protection strategies that consider climate change impacts and protect ecosystem services, including natural flood protection and habitat, and identify potential demonstration sites for living or soft shorelines.

C. ***Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above.***

In December 2014, over 100 members of the New Hampshire coastal management community began a dialogue about the future of shoreline management in the state at the New Hampshire Shoreline Management Conference. With assistance from experts in other states, members of the NHCP and partner organizations began to develop a work plan to advance resilient shoreline management strategies in New Hampshire. That dialogue informed this strategy, which is composed of the following strategy activities:

- Publish a white paper that assesses existing regulatory issues related to living shorelines in New Hampshire, including permitting and public trust issues as well as the potential for regulatory changes.
- Complete spatial inventory of existing shoreline structures and natural shorelines in the Coastal Zone.

- Conduct an assessment of shoreline vulnerability to erosion and sea level rise, and a suitability analysis for living shoreline management approaches, using the shoreline inventory and other available data.
- Publish guidance for shoreline management strategies directed at municipal officials, permitters and developers, and conduct education workshops about the guidelines.

Interest in natural and hybrid shoreline management strategies is expanding nationwide, and NHCP recognizes the multitude of benefits to be gained from using approaches that protect built infrastructure, safety and natural resources. No comprehensive inventory of current shoreline structures exists and no targeted approach to evaluate potential for living shorelines has been conducted at the state level. This strategy will create a new body of knowledge in New Hampshire and will ultimately lead to new guidelines sanctioned by the state. This strategy may also lead to new legislation, depending on the findings of the white paper.

III. Needs and Gaps Addressed

This strategy addresses several needs identified in this Assessment, including: 1) the need for research on the legal issues associated with living shoreline projects;2) mapping of existing shoreline structures and shoreline vulnerability; 3) the development of a tool to identify appropriate shoreline management strategies; and, 4) the need for education and outreach focused on improved shoreline management strategies.

IV. Benefits to Coastal Management

This strategy will benefit coastal management by clarifying existing regulations about shoreline management and identifying what is allowable for living shoreline projects. This strategy will also ultimately identify opportunities for shoreline management strategies that benefit both communities and natural resources, and allow for better understanding and protection against the impacts of sea level rise.

V. Likelihood of Success

Given the interest in this issue shown at the Shoreline Management Conference, this strategy has a high likelihood of success. CAW and its partner organizations have shown support for this strategy, as has the New Hampshire Coastal Risks and Hazards Commission.

VI. Strategy Work Plan

Strategy Goal: To provide guidance for shoreline protection strategies that consider climate change impacts and protect ecosystem services, including natural flood protection and habitat, and identify potential demonstration sites for living or soft shorelines.

Total Years: **5**

Total Budget: **$65,000**

Year(s): 1

Description of activities: Publish a white paper that assesses existing regulatory issues related to living shorelines in New Hampshire, including permitting and public trust issues as well as the potential for regulatory change.

Major Milestone(s):

- Draft white paper and submit for comments.
- NHDES-approved white paper.

Budget: **$7,500**

Year(s): 1

Description of activities: Complete spatial inventory of existing shoreline structures and natural shorelines in the Coastal Zone.

Major Milestone(s):

- Publish the shoreline inventory on the New Hampshire Coastal Viewer.

Budget: **$12,500**

Year(s): 2-4

Description of activities: Conduct an assessment of shoreline vulnerability to erosion and sea level rise as well as a suitability analysis for living shoreline management approaches using the shoreline inventory and other available data.

Major Milestone(s):

- Completed review of shoreline vulnerability assessment methods and living shoreline suitability analyses employed by other states.
- Establish advisory team to complete shoreline vulnerability assessment and suitability analysis.
- Establish methodology for shoreline vulnerability assessment and suitability analysis.
- Complete and publish shoreline vulnerability assessment and suitability analysis on the New Hampshire Coastal Viewer.

Budget **$20,000**

Year(s): 3-5

Description of activities: Publish guidance for shoreline management strategies directed at municipal officials, permitters and developers, and conduct education workshops about the guidelines.

Major Milestone(s):

- Assemble advisory team to develop guidance.
- Draft and review guidance for shoreline management strategies.
- Publish guidance.
- Hold at least three workshops/outreach events to disseminate and train target audiences on the guidance.

Budget **$25,000**

VII. Fiscal and Technical Needs

A. Fiscal Needs:

Funding is needed for a NHCP intern to conduct the shoreline inventory – this funding will be budgeted for Year 2 of the strategy. Additional funding may be needed to complete the vulnerability assessment and suitability analysis.

B. Technical Needs:

NHCP will establish an advisory team at NHDES and external partner organizations to provide the technical and regulatory expertise needed to achieve this strategy.

VIII. Projects of Special Merit (Optional)

- Design, construction and monitoring of a living shoreline project to serve as a demonstration site.
- Develop a tool that identifies suitability of specific locations in the Coastal Zone for different shoreline management strategies and identifies potential pilot locations for living shoreline projects.

5. Development of 309 Assessment and Strategy

I. Issue Area(s)

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☒ Cumulative and Secondary Impacts
- ☒ Wetlands
- ☐ Marine Debris
- ☐ Public Access

II. Strategy Description

A. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

- ☐ A change to coastal zone boundaries;
- ☐ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;
- ☐ New or revised local coastal programs and implementing ordinances;
- ☐ New or revised coastal land acquisition, management, and restoration programs;
- ☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,
- ☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. ***Strategy Goal:*** To develop the next 309 Assessment and Strategy, including identification of new emerging issues for coastal management.

C. ***Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above.***

Development of the next 309 Assessment and Strategy in 2020 will assess progress on the known issues identified in this report, develop more information and interest in those issues, and identify additional issues for future strategy updates. New coastal management concerns will be identified and prioritized in cooperation with NHCP partners including CAW, PREP, NHDES, the Gulf of Maine Council, and NROC, as well as through attendance at regional meetings and conferences. Once top management priorities have been agreed on, NHCP will work with its coastal partners to address these issues and create program change. NHCP staff will review the Assessment annually to ensure that progress is being made toward achieving program goals.

III. Needs and Gaps Addressed

New coastal management needs are constantly coming to light as science, policy and environmental threats change, and known management priorities change frequently as some problems are solved and others take on increased importance. The five year assessment provides an opportunity to

reflect on NHCP's progress and determine where future efforts will have the greatest impact on New Hampshire's most significant coastal concerns.

IV. Benefits to Coastal Management

The process of gathering information to complete the 309 Assessment and Strategy report will allow NHCP staff to remain abreast of numerous state and regional coastal efforts on wetland restoration, river restoration, stormwater management, habitat restoration, invasive species and water quality. Partnerships and relationships built through this task will also make implementation of other tasks run more smoothly. The result will be a revised 309 Assessment and Strategy.

V. Likelihood of Success

This task has a high likelihood of success based on prior experience. The 309 Assessment and Strategy process has helped build many of the partnerships that assist NHCP staff not only identify issues but also build the support necessary to achieve program changes. Other state agencies and communities have come to depend on the NHCP to participate in planning efforts and to provide coordination.

VI. Strategy Work Plan

Strategy Goal: An updated Section 309 Strategy and Assessment report along with the benefits of coordination and information transfer among NHCP partners that result from the identification of coastal management priorities.

Total Years: **5**

Total Budget: **$30,000**

Year(s): 1-4
Description of activities:

- Track progress on tasks and strategies, develop annual work plan and revise strategies as necessary.
- Participate in conferences, workshops, CAW meetings, Gulf of Maine Council events, etc. to identify issues and needed partners for 309 program changes.

Major Milestone(s): Annual work plans submitted.
Budget: **$10,000**

Year(s): 4-5
Description of activities:

- Identify emerging issues and coastal management priorities during one or more workshops or meetings with NHCP partners, as well as through informal interviews with NHCP partners and stakeholders.
- Reassess the *2016 Section 309 Assessment and Strategy* document.
- Develop new 309 strategies.
- Develop a *2021 Section 309 Assessment and Strategy* draft document.
- Post the *2021 Section 309 Assessment and Strategy* draft document for public review.
- Finalize the *2021 Section 309 Assessment and Strategy* report and submit to OCRM for review.

Major Milestone(s):

- Management priority setting meetings held with NHCP partners and stakeholders.
- *2021 Section 309 Assessment and Strategy* document submitted.

Budget: **$20,000**

VII. Fiscal and Technical Needs

A. Fiscal Needs:

NHCP utilized a portion of an employee's time from another section within the NHDES Watershed Management Bureau to create this current assessment. This methodology works well as it brings in an environmental professional familiar with general water issues in New Hampshire, but who is not part of the NHCP, for an objective assessment.

B. Technical Needs:

NHCP has most of the technical skills necessary to complete most of this strategy, and can draw on the knowledge of its partners and other NHDES staff to answer any other technical questions.

VIII. Projects of Special Merit (Optional)

None

5-Year Budget Summary by Strategy

At the end of the strategy section, please include the following budget table summarizing your anticipated Section 309 expenses by strategy for each year.

Strategy Title	**Year 1 Funding**	**Year 2 Funding**	**Year 3 Funding**	**Year 4 Funding**	**Year 5 Funding**	**Total Funding**
Tidal Culverts	$5,000	$15,000	$17,500	$17,500	$5,000	$60,000
New Hampshire Coastal Risks and Hazards Commission	$10,000	$10,000	$20,000	$0	$0	$40,000
Coastal Resilience Technical Assistance Program	$47,500	$37,500	$17,500	$40,000	$37,500	$180,000
Advancing Shoreline Management	$10,000	$10,000	$15,000	$15,000	$15,000	$65,000
Development of 309 Strategy	$2,500	$2,500	$5,000	$2,500	$17,500	$30,000
Total Funding	$75,000	$75,000	$75,000	$75,000	$75,000	$375,000

SUMMARY OF STAKEHOLDER/PUBLIC COMMENT

Identification of emerging and critical issues, management priorities and strategies for this report were developed through a comprehensive planning process by NHCP staff during the summer and fall of 2014 in cooperation with NHCP partners and stakeholders. NHCP staff conducted multiple informal interviews with NHDES colleagues to determine the priorities of other programs, major gaps in knowledge or resources, and where NHCP could most effectively work in cooperation with these programs to accomplish mutual goals. For example, discussions with the NHDES Watershed Assistance Section resulted in the development of Cumulative and Secondary Impact Management Priorities #1 and #2. Similarly, Wetlands Management Priorities #1, #2 and #3 were developed in consultation with the NHDES Wetlands Bureau. Partners also provided valuable input to many other sections of this report, such as the marine debris data and significance of various debris types supplied by Jen Kennedy, Executive Director of the Blue Ocean Society for Marine Conservation.

More formally, stakeholders and partners were also involved in the 309 assessment process through facilitated input sessions. The enhancement area prioritization was guided and supported by members of CAW and the management committee of PREP. PREP and CAW include representatives from the UNH Institute for Earth, Oceans and Space; NHF&G-Great Bay National Estuarine Research Reserve; N.H. Sea Grant; UNH Jackson Estuarine Laboratory; Rockingham Regional Planning Commission; Strafford Regional Planning Commission; UNH-NH GRANIT; City of Portsmouth; USEPA; Lamprey River Advisory Committee; NHF&G-Marine Fisheries Division; Conservation Law Foundation; The Nature Conservancy; and Great Bay Trout Unlimited. At the CAW meeting on June 26, 2014, meeting attendees confirmed the Wetlands, Coastal Hazards, and Cumulative and Secondary Impact enhancement areas as high priority focus areas for the next five years. In addition, they identified emerging issues, management priorities and resource gaps for each of these enhancement areas. For example, the discussion identified a recent trend where municipalities were decreasing the minimum size of wetlands buffers and noted that determining the size of adequate, protective buffers through the lens of climate change was a priority over the course of the next few years. The group also determined that while more information was needed on the effects of climate change with respect to coastal hazards, it was critical that both new and existing information on coastal hazards be disseminated such that the information can be easily used by coastal communities.

Additional support for priorities and strategies for this Assessment came through the PREP *Comprehensive Conservation and Management Plan* (2010) as well as the *New Hampshire Nonpoint Source Management Program Plan* (NHDES, 2014). Because both management plans are based on input from stakeholders and prioritize issues and strategies, they, too, serve as stakeholder and public guidance on Section 309 activities.

Upon completion of the draft *2016 Section 309 Assessment and Strategy* in February 2015, the report was subjected to a 30-day public comment period. Partners and stakeholders, including numerous agencies and organizations, were invited to comment. No comments were received during the public comment period.

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Amendment to the New Hampshire Coastal Risks & Hazards Commission Strategy

Submitted December 2016

The New Hampshire Coastal Risk and Hazards Commission completed its work on December 1, 2016 with the publication of its final report and recommendations (Commission report), entitled "Preparing New Hampshire for Projected Storm Surge, Sea-Level Rise, and Extreme Precipitation." NHCP now submits the Commission report as an amendment to the Coastal Risks and Hazards 309 Enhancement Grants Program Strategy. NHCP staff will continue work through June 2021 to implement the Commission recommendations most relevant to coastal zone communities and state agencies. Some of the recommendations that NHCP plans to make progress on by June 2021 include but are not limited to: S1., S2., S3., S4., CC1., CC2., CC3., CC6., CC7., E1., E3., E4., BL1., BL2., BL3., BL4., BL5., BL6., NR1., NR2., NR4., NR5., NR6., NR7., H1., H2., H3., H4.

VII. Fiscal and Technical Needs

A. Fiscal Needs:

Additional funds are needed to complete S1. as required by N.H. Chaptered Law 121. The Coastal Program expects to take on the responsibility of coordinating a coastal flooding trends update for the New Hampshire Department of Environmental Services every five years. Additional recommendations will require additional funding for implementation.

B. Technical Needs:

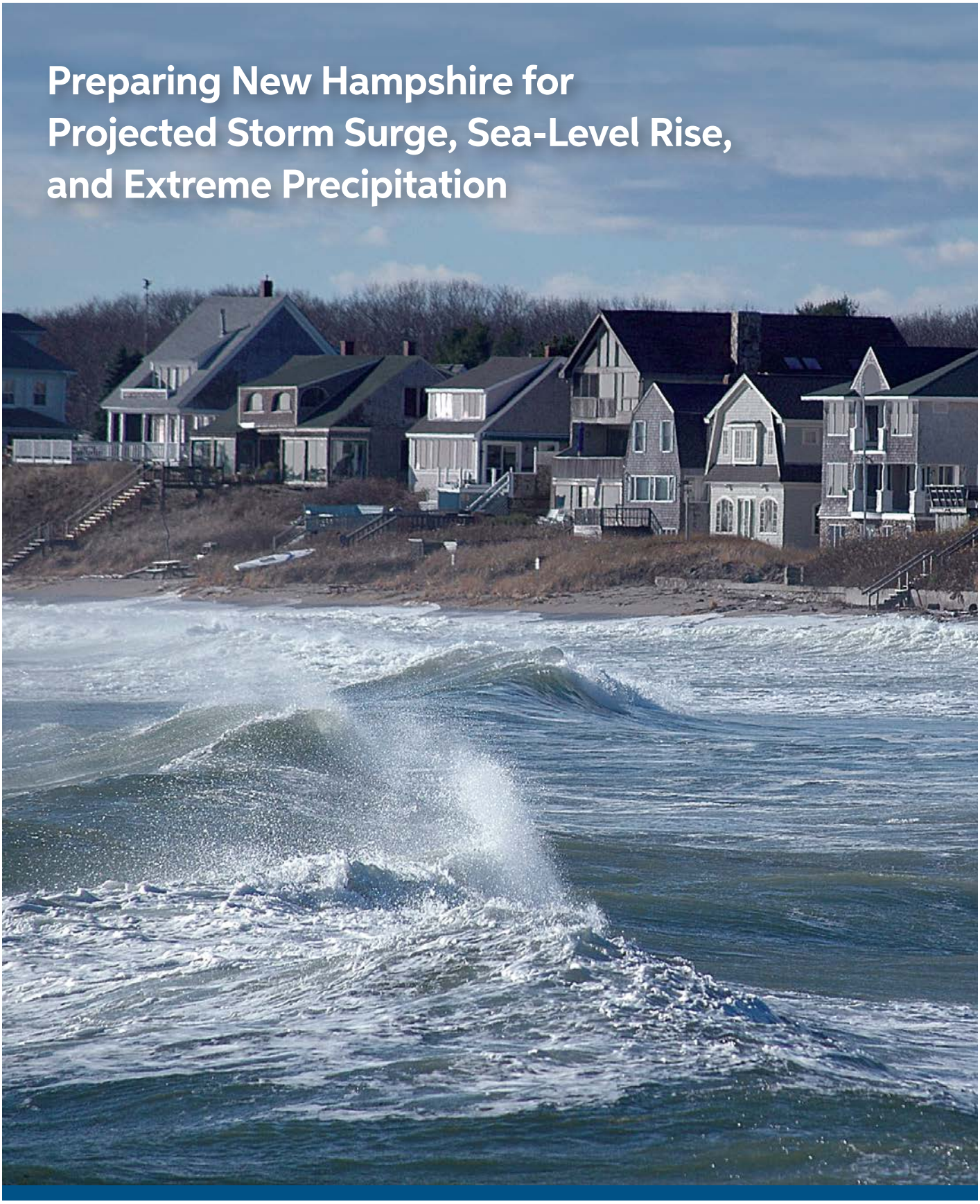
Additional technical needs include engineering assessment and design knowledge for site-specific vulnerability assessments and strategy design as well as coastal geology knowledge for shoreline assessment and strategy design.

VIII. Projects of Special Merit (Optional)

The NHCP expects to apply for a project of special merit in 2017 to support the coordination of the science and technical advisory panel report update which is required by 2019.

NEW HAMPSHIRE COASTAL RISK AND HAZARDS COMMISSION

Preparing New Hampshire for Projected Storm Surge, Sea-Level Rise, and Extreme Precipitation



Final Report and Recommendations

November 2016

The final report of the New Hampshire
Coastal Risk and Hazards Commission,
Preparing New Hampshire for Projected Storm Surge,
Sea-Level Rise and Extreme Precipitation,
is available for download on the Commission's website:
http://www.nhcrhc.org

Please cite this report as follows:

New Hampshire Coastal Risk and Hazards Commission (2016). Preparing New Hampshire for Projected Storm Surge, Sea-Level Rise and Extreme Precipitation.
http://www.nhcrhc.org/wp-content/uploads/2016-CRHC-final-report.pdf

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NEW HAMPSHIRE COASTAL RISK AND HAZARDS COMMISSION

Chair	Representation
Cliff Sinnott	Rockingham Planning Commission

Members[i]	
William Arcieri	Town of Newmarket
Jason Bachand	Town of Hampton
Steve Bird	City of Dover
Rep. David Borden	Town of New Castle
David Caron	New Hampshire Municipal Association
Patrick Carroll	Town of Rollinsford
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Dr. Cameron Wake	University of New Hampshire
Sen. David Watters	New Hampshire Senate
Phil Winslow	Town of Rye
Gail Wolek	New Hampshire Division of Parks and Recreation
Michael Woodward	Town of Newfields
Vacant	Town of Newington

[i] Commission Alternates and former members are listed in Appendix B.

ACKNOWLEDGEMENTS

The New Hampshire Coastal Risk and Hazards Commission (Commission) would like to acknowledge the following individuals and organizations who contributed to the development and completion of this publication, *Preparing New Hampshire for Projected Storm Surge, Sea-Level Rise, and Extreme Precipitation: Final Report and Recommendations.* The Commission's Steering Committee members dedicated significant time to overseeing the Commission's process and activities. Steering Committee members include Senator David Watters (District 4), Senator Nancy Stiles (District 24), Representative Fred Rice (District 21), Representative Renny Cushing (District 21), Cliff Sinnott, Chair (RPC), Cory Riley (NHFG), Sherry Godlewski (NHDES), Jennifer Gilbert (NHOEP), Roger Stephenson (Town of Stratham), Dr. Cameron Wake (UNH), Steve Couture (NHDES), and Ann Scholz (NHDOT). Additionally, Commission member Peter Kinner (Town of Greenland) committed significant time to chair a recommendation working group. Julie LaBranche (RPC), Kirsten Howard (NHDES), Cathy Coletti (NHDES), and Nathalie Morison (NHDES) provided staff support, including coordinating the writing and production of this publication. The NHDES Coastal Program also provided financial support for materials associated with this publication.

The Commission would like to recognize and extend gratitude to the members of the Science and Technical Advisory Panel (STAP) who compiled the 2014 STAP report for the Commission, entitled *Sea-level Rise, Storm Surges, and Extreme Precipitation in Coastal New Hampshire: Analysis of Past and Projected Future Trends.* Members of the STAP included Frederick Chormann (NHGS), Rob Flynn (USGS), Dr. Matt Huber (UNH), Dr. Paul Kirshen (Chair, UNH), Dr. Kevin Knuuti (USACE), Steve Miller (NHFG), Ann Scholz (NHDOT), Dr. Mary Stampone (UNH and NH State Climate Office), Dr. Cameron Wake (UNH), Thomas Wysmuller (Colderside.com), and Sherry Godlewski (NHDES). The New Hampshire Fish & Game Department Great Bay National Estuarine Research Reserve (NHFG-GBNERR) provided funds through a New Hampshire Charitable Foundation grant for outreach materials associated with the STAP report.

The New Hampshire Coastal Adaptation Workgroup (NHCAW), co-chaired by Commission members Sherry Godlewski and Steve Miller, dedicated resources and valuable expertise to organize the Community Discussion Groups. As part of these efforts, Amanda Stone of the University of New Hampshire Cooperative Extension Natural Resources Outreach Coalition provided significant support to plan and execute the Discussion Groups which produced valuable local feedback on the recommendations. The Commission would like to thank the municipal staff, volunteers, and residents who participated in the Discussion Groups.

The Commission would also like to extend its gratitude to the many scientific experts, state agency representatives, municipal officials, industry representatives, and other stakeholders who presented valuable information to the Commission at meetings and in the form of background resources.

Finally, the Commission would also like to give special thanks to the NHFG-GBNERR and Seacoast Science Center for hosting the Public Information & Comment Meetings and to all members of the public who provided thoughtful comments on the public draft of this report.

The development of this final report was funded in part by NOAA's Office for Coastal Management under the Coastal Zone Management Act and in conjunction with the New Hampshire Department of Environmental Services Coastal Program.

EXECUTIVE SUMMARY

Coastal hazards associated with storm surge, sea-level rise, and extreme precipitation events can be devastating to human health and safety, public and private structures and facilities, and the economies of coastal communities. Coastal New Hampshire was fortunate to experience minimal damage from Tropical Storm Irene in 2011 and Superstorm Sandy in 2012. Nevertheless, the impacts of these storms on neighboring states and the more extreme local impacts from storms such as the Mother's Day storm of 2006, the Patriots' Day storm of 2007, and Winter Storm Nemo in 2013 have reinforced our knowledge that strong storm systems are capable of causing immense damage in areas on or near the coast. New Hampshire's coastal exposure to current and future flood risks is significant. As of 2016, the state's 17 coastal zone municipalities are home to approximately 11 percent of the state population, host over 100,000 jobs, and generated a 2014 Gross Regional Product of approximately $11 billion.[1, 2]

Where and how we build and rebuild as the coastal population and economy continue to grow have critical implications for how coastal New Hampshire will withstand projected coastal hazards. Should we choose to build using the same strategies and techniques as we have in the past, we will exacerbate our exposure to these hazards by placing structures, facilities, and people directly at risk. Alternatively, if we incorporate projected flood risks into our planning, design, construction, and conservation practices today, we will greatly reduce exposure to flood hazards, resulting in saved lives and property and lower response and recovery costs.

Recognizing the need to prepare for existing and projected coastal flood hazards, in July 2013 the State Legislature enacted Senate Bill 163, introduced by Senator David Watters (District 4), which established the New Hampshire Coastal Risk and Hazards Commission to "recommend legislation, rules, and other actions to prepare for projected sea-level rise and other coastal and coastal watershed hazards such as storms, increased river flooding, and stormwater runoff, and the risks such hazards pose to municipalities and the state assets in New Hampshire." In response to this legislative mandate, the Commission puts forward a final report and set of recommendations for state legislators, state agencies, and coastal municipalities to help these audiences better prepare for and minimize coastal risks and hazards. The report presents a summary of the best available science and vulnerability information followed by recommendations for action.

Understanding What We Are Facing

To lay the foundation for our understanding of coastal hazards and flood risks, the Commission established a Science and Technical Advisory Panel (STAP) to review existing science and analyze historic trends and projections for the years 2050 and 2100 for storm surge, sea-level rise, and extreme precipitation in coastal New Hampshire.[3] Some of the key scientific findings summarized in the STAP report include:

- Global and regional sea levels have been rising for decades, though not uniformly.
- Using mean sea level in 1992 as a starting point, New Hampshire sea levels are expected to rise between 0.6 and 2.0 feet by 2050 and between 1.6 and 6.6 feet by 2100.
- Today's extreme storm surge events will have a significantly greater inundation extent and destructive impact due to higher sea levels.
- It is likely that coastal storms will be more severe as a result of warmer oceans and other changes in climate systems, but at the time of the STAP report publication, the research continues to be uncertain about whether storm frequency will change in the future.
- Annual precipitation is expected to increase by as much as 20 percent by the end of the 21st century compared to the late 20th century, and extreme precipitation events are projected to increase in frequency and in the amount of precipitation produced.

Understanding Our Risks and Vulnerabilities

The Commission's report summarizes vulnerabilities to projected coastal flood hazards and how these hazards could impact different sectors of our life in the coastal region. Recent and ongoing assessments of the Atlantic Coast and Great Bay communities identify valuable assets at risk of different coastal hazards, evaluate the exposure and sensitivity of those assets to coastal hazards, and assess existing capacity for managing and reducing vulnerabilities. While additional assessments are needed to more fully understand New Hampshire's coastal vulnerabilities, especially in the Great Bay communities and at the site-specific scale, significant progress is underway. Some key findings from regional assessments are presented in this report, focusing on vulnerabilities specific to our economy, our built landscape, our natural resources, and our heritage.

Our Economy

A review of key indicators reinforces the growing importance of the coastal region to the economic vitality of the State. The coastal region hosts 11 percent of the state's population, accounts for 15 percent of total state employment, and generates a disproportionate share of statewide tourism revenue as measured in Meals and Rooms tax revenue.[4, 5, 6] The Tides to Storms vulnerability assessment conducted for the seven Atlantic Coast municipalities reported that just over 7,000 parcels will be partially or wholly affected under the 6.3 feet sea-level rise[ii] plus storm surge scenario, putting approximately $4.4 billion, or 35 percent, of total assessed property value at risk of flooding.[7] Similarly, the Climate Risk in the Seacoast (C-RiSe) vulnerability assessment conducted for the ten Great Bay municipalities suggests that nearly 1,600 parcels will be partially or wholly affected under the 6.3 feet sea-level rise plus storm surge scenario, putting over $805 million, or 8.5 percent, of total assessed property value at risk of flooding.[8]

Our Built Landscape

State and local roadways throughout the coastal region are vulnerable to flooding and damage due to storm surge, sea-level rise and extreme precipitation. In many municipalities, flooding is magnified by the combination of tidal or storm-related flooding and freshwater flooding. The Tides to Storms vulnerability assessment conducted for the seven Atlantic Coast communities reported that, under an intermediate sea-level rise scenario of 4.0 feet, 90 public infrastructure sites, 33 critical facilities, and nearly 24 miles of state and local roads could be subject to daily tidal flooding by 2100.[9] Under the same 4.0 feet sea-level rise scenario, the C-RiSe vulnerability assessment conducted for the ten Great Bay municipalities reported that 23 public infrastructure sites, zero critical facilities, and only one mile of state and local roads could be subject to daily tidal flooding by 2100.[10]

Our Natural Resources

As reported in the 2015 Wildlife Action Plan, sea-level rise will alter the function of coastal habitats such as salt marshes and estuaries, habitat availability, and the timing of nesting and migration for seabirds.[11] Total habitat and species losses will likely be greater in developed areas where there is no space for natural habitats to retreat or migrate inland. Modeling results suggest that salt marshes will likely reach a tipping-point under the highest sea-level rise scenario, with 95 percent of salt marshes potentially disappearing by 2100.[12] In addition to long-term sea-level rise, extreme storm events can pose significant risks to coastal systems by altering hydrology, sedimentation, and land forming processes. Coastal dune sediments will be driven inland by storm surges, and dune degradation will further exacerbate the impacts of storms. As dune systems migrate landward they will compete with developed landscapes and, as a result, the remaining dunes could eventually be lost completely.

ii The 6.3 feet sea-level rise map was developed prior to the STAP report summary and therefore used slightly different estimates for sea-level rise. The maps do not show significant difference in inundated area due to the resolution of the elevation data.

Our Heritage

Cultural, historic, and recreational resources and amenities are vital assets in the coastal region, in part because they support the tourism industry, as well as a sense of place for New Hampshire residents and visitors alike. Regional-scale vulnerability analyses have identified some vulnerable recreational destinations, however less than 11 percent of the coastal region has been inventoried for historic architectural resources.[13] Much less of the coastal region has been evaluated for archaeological resources, though we know that at least 102 archaeological sites, most of which are historic Native American sites, are already situated below mean sea level.

Understanding What We Need To Do

This report is the start of a critical and ongoing effort in the state to embrace a proactive approach that is responsive to changing conditions and societal and ecological needs. Planning for coastal hazards will evolve with research and as creative adaptation strategies are implemented here and around the country. State, municipal, and private sector responses will likely combine *defending* certain key assets and resources from loss, *accommodating* new flood extent and risk, and *retreating* from areas where the frequency or severity of impacts are too great to defend against or accommodate. The appropriateness of responses will vary by location and will change over time as flood risk and exposure changes, requiring the State and municipalities to periodically reassess their responses.

Given this uncertainty and need for flexibility, we present six guiding principles that should be applied at both state and municipal levels to plan for coastal risks and hazards, followed by our goals to achieve a resilient New Hampshire and a summary of the recommendations for action.

Our Guiding Principles

Act Early
By starting now, the normal cycles of reconstruction, replacement and redevelopment can gradually replace vulnerable facilities and construction not designed for future conditions, often at minimal added cost and resulting in long-term cost savings.

Respond Incrementally
Given uncertainties about future flood risk, strategies can be implemented in increments, allowing multiple opportunities to refine and correct actions as understanding of future coastal hazards improves.

Revisit and Revise
Actions must keep pace with observed changes and improved scientific understanding, therefore it is important that state and municipal officials periodically revisit projections and assumptions as the science becomes more certain and adjust their course of action accordingly.

Collaborate and Coordinate
The state and municipalities share assets and infrastructure on the coast that are systematically and functionally linked and as such, they need to work together to align policies, assumptions, and responses about future coastal flood hazards.

Incorporate Risk Tolerance in Design
The acceptable loss or damage to an asset should be considered in determining the most appropriate design standards for protection, with more critical, expensive, and long-lasting structures and facilities having low risk tolerance and lower value, easily replaced structures and facilities having higher risk tolerance.

Make No Regrets Decisions

By preparing for future impacts from uncertain coastal hazards, often the results will be beneficial even if those future hazards turn out to be less extreme than anticipated.

Our Goals

We present four goals intended to help achieve our vision for a resilient coastal New Hampshire. These goals form the SAIL framework: Science, Assessment, Implementation, and Legislation.

1. **Science:** To research, understand, establish, and use best available science about current and future coastal hazards.
2. **Assessment:** To identify our assets that are vulnerable to current and future coastal hazards and evaluate existing policies to identify ways to reduce vulnerabilities.
3. **Implementation**: To implement strategies to enable the state and coastal communities to protect, adapt, and sustain our assets.
4. **Legislation**: To recommend legislation that leads to actions to reduce vulnerability and adapt to current and future coastal hazards.

Recommendation Highlights

We propose extensive and detailed recommendations and associated actions that should be implemented to prepare for projected sea-level rise and other coastal watershed hazards. Highlights from the recommendations are summarized below and form a high-level to do list for New Hampshire's state legislature, state agencies, and coastal municipalities.

- Review and evaluate the current state of climate change science in order to periodically update storm surge, sea-level rise, extreme precipitation, and other relevant climate projections; and provide planning guidance.
- Identify vulnerable state and municipal economic assets; structures and facilities; natural resources; and recreational and cultural resources at regional, municipal, and site-specific scales.
- Amend statutes, ordinances, rules and regulations, policies, programs, and plans to incorporate and consider the best available science and vulnerability information.
- Secure funding sources and develop funding mechanisms, including incentives and market-based tools, to pay for vulnerability assessments and implement climate adaptation strategies.
- Encourage businesses to create preparedness plans in order to minimize economic disruptions and ensure continuity of services to essential facilities, people, businesses, and employment centers.
- Make existing structures and facilities more resilient to flooding, acquire properties in high risk areas, and avoid exposing new structures and facilities to current and future flood risks.
- Protect and restore vulnerable natural resources, and consider how natural resources reduce the impacts of flooding in state and municipal planning efforts.
- Develop plans and implement strategies to prepare and adapt recreational and cultural resources vulnerable to climate impacts.

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1. Introduction

Coastal hazards such as coastal storms and extreme precipitation events can be devastating to human health and safety, public and private structures and facilities, and the economies of coastal communities, and these hazards will only get worse as they are exacerbated by sea-level rise. Tropical Storm Irene in 2011 and Superstorm Sandy in 2012 demonstrated the immense destruction that strong storm systems can cause in both rural and urban settings in the Northeast. As of 2016, New Hampshire's 17 coastal zone municipalities are home to approximately 11 percent of the state population, support more than 100,000 jobs, and account for a 2014 Gross Regional Product of approximately $11 billion.[14, 15] As the coastal population and economy expand, where and how we build will have critical implications for how coastal New Hampshire will withstand projected coastal hazards associated with storm surge, sea-level rise, and extreme precipitation events. The crowding of our coastlines and waterfront has become a hazard unto itself, as we continue to put people and the built landscape directly in harm's way.

Preparing for coastal hazards will save lives, money, and natural resources that are critical to maintaining the quality of life on the seacoast. According to the U.S. Chamber Foundation's Business Civic Leadership Center preliminary estimates, Superstorm Sandy negatively affected between 60,000 and 100,000 small businesses, and as many as 30 percent of those companies were projected to fail as a direct result of the storm.[16] A study completed in 2005 by the Multi-Hazard Mitigation Council of the National Institute of Building Sciences concluded that when it comes to infrastructure, every dollar spent on mitigation saves society an average of four dollars.[17] Climate impacts could drown the majority of New Hampshire's salt marshes by 2100[18] but recent studies conducted locally indicate that proactive planning for the eventual landward migration of salt marshes (i.e., protecting undeveloped uplands) will help ensure their persistence in the face of rising sea levels.

In recognition of the need to prepare for existing hazards and the increased risks associated with climate change, the State Legislature established the New Hampshire Coastal Risk and Hazards Commission in 2013 to "recommend legislation, rules and other actions to prepare for projected sea-level rise and other coastal watershed hazards such as storms, increased river flooding and stormwater runoff, and the risks such hazards pose to municipalities and state assets in New Hampshire" (see Appendix A). For nearly two years, the Commission gathered data and summarized the best available peer-reviewed science to understand current and projected risks posed by coastal hazards to New Hampshire's coastal region and to establish planning assumptions such as the range of likely sea-level rise, and changes in storm surge and intensity. The Commission then evaluated potential impacts of these risks and discussed ongoing efforts to understand and plan for impacts. Finally, the Commission discussed existing knowledge and policy gaps and needs and developed recommendations for municipalities, legislators, and state agencies.

This report summarizes the activities carried out by the Commission as well as the key scientific findings and impact analyses that the Commission used to inform the recommendations and actions laid out in Section 6. The report is divided into several key sections: Section 2 describes the background on the Commission's establishment, membership, scope, and process; Section 3 summarizes the best available climate science as presented by the Science and Technical Advisory Panel report (STAP report); Section 4 presents an overview of known coastal vulnerabilities in the areas of Our Economy, Our Built Landscape, Our Natural Resources, and Our Heritage; Sections 5 and 6 present the Commission's recommendations and suggested actions for state agencies, municipalities, and the New Hampshire legislature; and Section 7 outlines existing mechanisms and suggests next steps to ensure continuity and implementation beyond the Commission's sunset on December 1, 2016.

2. Coastal Risk and Hazards Commission

2.1 Establishment

The New Hampshire Coastal Risk and Hazards Commission was proposed in Senate Bill 163, introduced by Senator David Watters (District 4), and established by the State Legislature through RSA 483-E on July 2, 2013 (see Appendix A). The legislation arose from concerns that neither the state nor coastal municipalities are adequately prepared for projected coastal flooding risks associated with a changing climate. The purpose of the Commission, as stated in the law, is to "recommend legislation, rules and other actions to prepare for projected sea-level rise and other coastal watershed hazards such as storms, increased river flooding and storm water runoff, and the risks such hazards pose to municipalities and the state assets in New Hampshire." Further, in carrying out this charge, the Commission is specifically directed to "review National Oceanic and Atmospheric Administration and other scientific agency projections of coastal storm inundation and flood risk to determine the appropriate information, data, and property risks" to incorporate into its recommendations. By law, the Commission was scheduled to sunset on December 1, 2016.

2.2 Membership

RSA 483-E established a broad-based membership for the Commission representing both state and local government, as well as other stakeholders in the coastal watersheds. The 37 members include representatives from the New Hampshire Senate and House of Representatives; key New Hampshire state agencies, including the Department of Environmental Services (NHDES), Department of Transportation (NHDOT), Department of Resources and Economic Development (DRED), Fish and Game Department (NHFG), Department of Cultural Resources (NHDCR), and Office of Energy and Planning (NHOEP); the University of New Hampshire; all 17 Coastal Zone municipalities; and the two regional planning commissions covering the tidal communities. Other stakeholder groups represented on the Commission include the NH Public Risk Management Exchange, Seacoast Board of Realtors and the NH Home Builders Association. Membership participation and engagement has been consistently strong throughout the Commission's activities, which were led by a Steering Committee made up of a subset of the membership.

2.3 Scope

One of the Commission's first activities was to define its scope and establish a strategy to accomplish its charge within the limits of its voluntary and unfunded status. The Commission determined that its charge was to help the state and its municipalities interpret the best available peer-reviewed science, including empirical data and modeled information. This information would enhance the Commission's understanding of expected future conditions and form the basis for the recommendations.

Based on the language of RSA 483-E and the focus on coastal geography, the Commission interpreted its mandate to focus on the risks and hazards that uniquely or particularly affect coastal watersheds, and less on other climate related impacts such as drought, heat stress, agricultural shifts, and snow cover changes. While these impacts are important to plan for, they are not specific to the coast. Thus, increased coastal flooding hazards associated with storm surge, sea-level rise, and extreme precipitation events were the Commission's primary focus.

Finally, the Commission agreed that its work would be synthesized in one or more reports directed at three audiences: the State Legislature, key state agencies, and municipalities.

2.4 Activities

The Commission, led by a volunteer Steering Committee, conducted work in four phases: fact finding, assessing vulnerability, obtaining stakeholder input, and developing recommendations. Key steps in fact finding included reviewing relevant documents and reports, presentations from agencies, communities and other stakeholders, and the commissioning of a Science and Technical Advisory Panel (STAP) to review available scientific information about coastal hazards and flood risks in New Hampshire.

With limited resources, the Commission relied heavily on existing data and reports, as well as studies that were underway. Peer-reviewed scientific sources are referenced in the Commission's STAP report.[19] The Commission also reviewed existing guidance and actions to prepare for climate change impacts at federal agencies and in New Hampshire state agencies, summarized in Appendix C. A few of the most relevant sources referenced by the Commission are:

- High resolution coastal LIDAR, a remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light, enabling detailed topographic mapping of low lying coastal areas[20]
- Sea-level rise scenario mapping for 2050 and 2100[21] and FEMA Flood Insurance Rate Maps for coastal New Hampshire
- New Hampshire Wildlife Action Plan[22]
- From Tides to Storms[23] and C-RiSe[24] sea-level rise and coastal storm surge vulnerability assessments conducted for the Atlantic Coast and Great Bay municipalities
- Economic flood vulnerability assessment for Hampton-Seabrook estuary using the COAST model[25]
- Community vulnerability assessments and plans from Portsmouth[26], Durham[27], and Dover[28]
- Region-specific research and modeling on changes in precipitation[29]
- Sea level affecting marshes models showing how NH salt marshes could retreat with sea-level rise[30]
- Municipal hazard mitigation plans and assessor databases
- NH Climate Action Plan: A Plan for New Hampshire's Energy, Environmental and Economic Development Future[31]

Town of Newmarket Envisions a Future with Fewer Floods

In 2015, after more than ten years, the Town of Newmarket evaluated its community vision and future direction as part of the Town's master planning process (this chapter was last updated in 2001). With support from the Strafford Regional Planning Commission, the Town developed and implemented a process to engage residents in envisioning the Town's future. This process enabled Newmarket to gain a better understanding of residents' near- and long-term views of the community and provided ideas for addressing current and future challenges. Through a combination of interactive forums, small group discussions, live polling, and an online survey, input from over 455 residents was used to develop a robust set of visionary statements and strategies.

Overturned Jeep on Prescott St. in Newmarket during May 2006 flooding event. (Photo credit: Town of Newmarket)

As a result of this effort, Newmarket's overall vision statement guides the Town in becoming more resilient against coastal and riverine flooding through local land use policies and regulations that reduce risk and vulnerability. The Town also supports the integration of climate adaptation measures into municipal programs, policies, and operations, as well as promotes smart development and greater resilience against adverse impacts and infrastructure vulnerability associated with climate changes, such as sea-level rise and increased flooding.

2.4.1 Presentations

In addition to written sources, the Commission was fortunate to observe various presentations by Commission members and outside experts and stakeholders. Through these presentations, Commission members engaged in discussions about the issues facing various stakeholder groups. Presentations to the Commission included:

Data Resources for Assessing Coastal Risk and Hazards

- *Coastal Change Analysis Using Airborne LIDAR Data and Historic Aerial Photographs* by Neil Olson, NHDES/ NH Geological Survey (July 2015)
- *Tides to Storms Community Vulnerability Assessments*, by Julie LaBranche, RPC (July 2015)
- *The New Hampshire Coastal Viewer* by Kirsten Howard, NHDES Coastal Program (July 2015)
- *NOAA Flood Exposure Risk Mapper* by Jamie Carter, NOAA (February 2015)
- *Climate Trends in New Hampshire and Its Impact on Storm and Riverine Flood Behavior* by David R. Vallee, NOAA/NWS Northeast River Forecast Center (February 2015)
- *FEMA Preliminary Maps for Coastal NH* by Jennifer Gilbert, NH Program Manager for National Flood Insurance Program (April 2014)

Stakeholder Perspectives on Coastal Risk and Hazards

- *Homebuilder Industry Perspective on Future Coastal Risks and Hazards* by Robert Cormier, Homebuilders and Remodelers Association of NH (May 2014)
- *Role of Insurance in Managing Risk from Natural Hazards* by Jonathan Kipp, Primex (April 2014)

Coastal Risk and Hazard Planning in Other States

- *New York Climate Risk and Resilience Act* by Steve Couture, NHDES Coastal Program (December 2014)
- *State of Maryland Climate Change and Infrastructure Siting and Design Guidelines* by Cliff Sinnott, RPC (December 2014)
- *Other State Sea-Level Rise Planning Efforts* by Kirsten Howard, NHDES Coastal Program (July 2014)

State Agency Reports on Coastal Risk and Hazards

- *Division of Parks and Recreation, DRED* by Gail Wolek, DRED (January 2014)
- *Division of Forests and Lands, DRED* by Sabrina Stanwood, Natural Heritage Bureau (January 2014)
- *Cultural Resources and Climate Change, NH Department of Cultural Resources* by Edna Feighner, Division of Historical Resources (January 2014)
- *NH Office of Energy and Planning*, by Jennifer Gilbert, NH Program Manager for the National Flood Insurance Program (January 2014)
- *NH Department of Environmental Services,* by Ted Diers, NHDES Watershed Management Bureau (November 2013)
- *NH Department of Transportation*, by Kevin Nyhan, NHDOT Bureau of the Environment & Ann Scholz, NHDOT Bureau of Materials and Research (November 2013)
- *NH Fish and Game Dept.*, by Cory Riley, Great Bay National Estuarine Research Reserve (November 2013)

Regional Efforts to Address Coastal Hazards

- *New Hampshire Coastal Adaptation Workgroup Initiatives*, by Sherry Godlewski, NHDES (October 2013)
- *Tides to Storms – Coastal Vulnerability Assessment and Response Planning*, by Julie LaBranche, RPC (October 2013)

Municipal Efforts to Address Coastal Hazards

- *New England Climate Adaptation Project – Climate Change Risk Assessment for Dover, NH*, by Steve Bird, Dover; Danya Rumore, New England Climate Adaptation Project; and Carri Hulet, Consensus Building Institute (April 2014)
- *Portsmouth Coastal Resilience Initiative*, by Peter Britz, City of Portsmouth (October 2013)

Coastal Risk and Flooding Related Programs

- *National Flood Insurance Program*, by Jennifer Gilbert, NH Program Manager, National Flood Insurance Program (March 2014)
- *Summary of the New Hampshire Flood Management Study Commission (HB648) Report*, by Steve Couture, NHDES Coastal Program (March 2014)

As needs and possible strategies became evident from information sources and stakeholder presentations, the Commission began developing draft recommendations. Commission members divided into three recommendation working groups: Great Bay communities, Coastal communities, and State and Legislative issues. Initial recommendations from the groups were refined and revised to reduce duplication and to incorporate new information as it became available.

2.4.2 Public Input

A thorough public process was conducted to gather input on the Commission's draft report and recommendations. In December 2015, the Commission partnered with NHCAW to hold three discussion groups for coastal municipal officials to provide input on initial draft recommendations, which was later considered by the Commission and incorporated where appropriate into its draft report.

Following unanimous approval, the Commission released its draft report for public review and comment on March 18, 2016. In addition to soliciting written comments, the Commission held two Public Information and Comment meetings in order to provide information, answer questions, and receive comments on its draft report. The Public Information and Comment meetings were held at the Hugh Gregg Coastal Conservation Center, Great Bay National Estuarine Research Reserve in Greenland, NH on May 26, 2016 and at the Seacoast Science Center at Odiorne State Park in Rye, NH on June 1, 2016. The Public Information and Comment meetings attracted 70 attendees and yielded 25 verbal comments. A detailed summary of the Commission's responses to these and the 20 written comments received is available as a supplement to this report.[32]

3. Understanding What We Are Facing

While New Hampshire has been very fortunate to have avoided the most extreme impacts of recent events like Tropical Storm Irene in 2011 and Superstorm Sandy in 2012, the state has experienced other significant weather events in the coastal region. We have seen intense Nor'easters like Winter Storms Juno in 2015 and Nemo in 2013, the October 2011 Snowstorm, and others that have had large and lasting impacts on our communities. These types of storms will have even greater impacts with projected sea level rise and an increase in the frequency and severity of extreme rain events will lead to more floods. While some additional climate change related impacts are now unavoidable due to past emissions of heat-trapping greenhouse gases (and the long lifetime of these gases in the atmosphere), the amount of future climate change and the extent of damaging impacts will depend on the amount of greenhouse gases that continue to accumulate in the atmosphere. As a result, efforts to reduce emissions or remove carbon dioxide from the atmosphere will not only reduce the amount and speed of climate change, but will also reduce the amount of adaptation needed. Although the Commission's mission and report are focused on adaptation, we recognize that efforts to reduce greenhouse gas emissions and adaptation are intrinsically linked, and therefore support continued action to reduce the drivers of climate change in New Hampshire, including implementation of the New Hampshire Climate Action Plan.[33] The Commission also recognizes that we must continue to track the evolving science regarding atmospheric concentrations of greenhouse gases and associated projected impacts. Understanding the best science behind projected risks and hazards is essential to enabling our coastal communities to be as prepared as possible to avoid costly impacts and the potential loss of life.

3.1 Science and Technical Advisory Panel

The Commission created a Science and Technical Advisory Panel (STAP) to review available scientific information about coastal hazards and flood risks in New Hampshire. Comprised of scientists and experts in the fields of meteorology, engineering, climate, hydrology, and other related sciences, the Panel's charge was to:

1. Ensure the Commission is aware of and is using the best available and relevant scientific and technical information to inform its recommendations; and
2. Assist the Commission in interpreting and reconciling conflicting projections, scenarios and probabilities about future conditions.

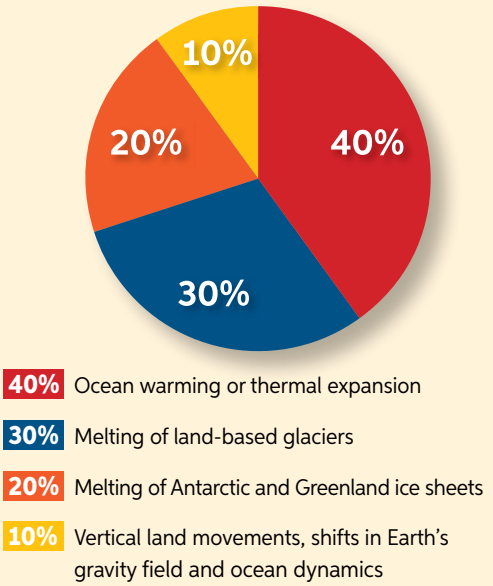
The Panel analyzed the latest published data on historic trends and projections for the years 2050 and 2100 for sea-level rise, coastal storms, and extreme precipitation. These findings were summarized in an externally-reviewed STAP report entitled, *Sea-level Rise, Storm Surges, and Extreme Precipitation in Coastal New Hampshire: Analysis of Past and Projected Future Trends,*[34] which the Commission unanimously adopted after careful and deliberate discussion in July 2014 and used to develop its recommendations to assist in planning and preparation for the changing climatic conditions in coastal areas of the state. The Panel recommends the STAP report be updated regularly as new research and data become available.

While a changing climate, melting ice sheets, and warmer ocean temperatures are enhancing coastal storms and extreme precipitation hazards, and are contributing to sea-level rise, it is important to note that our current and historical development patterns also contribute to the coastal risks and hazards we are facing. We have historically developed along rivers and shorelands. We continue to encroach on natural buffers with development that is, as a result, at risk from flooding. The increases in pavement and other impervious surfaces associated with development cause an increase in runoff and flooding due to the inability of these surfaces to absorb rain and snow melt. These development patterns exacerbate the climatic impacts and contribute to changing floodplains.

3.2 Science and Technical Advisory Panel Report

The following section is a summary of the information presented in the STAP report. A condensed two-page summary of the STAP report is provided in Appendix D. It is important to note that while projections for storm surge, sea-level rise, and extreme precipitation are described independently below, they are not mutually exclusive. In fact, the combined occurrence of heavy rainfall and storm surge, together with sea-level rise, will likely increase flooding in coastal regions. Additionally, present-day storm surge already poses an immediate threat to our coastal region during Nor'easters and tropical storms. Both episodic and unpredictable in nature, storm surge presents a hazard we must remain vigilant about and must continue to plan for carefully. Finally, mapping efforts conducted by the Rockingham Planning Commission and the New Hampshire Geographically Referenced Analysis and Information Transfer System (NH GRANIT) show that projected sea-level rise is largely contained within the current 100-year floodplain.[35] As a result, communities that adopt and enforce floodplain management activities within the current 100-year floodplain will also be preparing for and building resilience against projected sea-level rise related impacts in the long term.

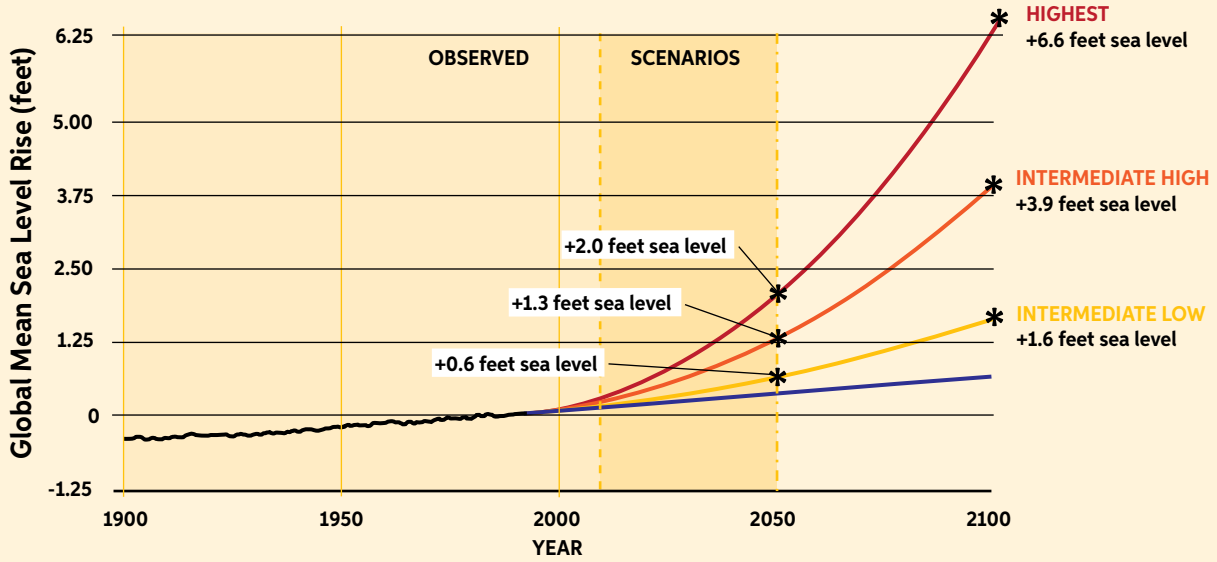
FIGURE 1. Processes causing sea levels to rise from 1990-2012. *Source: NHCRHC STAP (2014).*



Sea-Level Rise

Forecasting rates of global greenhouse gas emissions is challenging, but research shows that current greenhouse gas concentrations and current or accelerated emissions rates will continue to influence sea levels in the future. Planning for a 100-year flood now can also prepare us for mid-century sea-level rise. Figure 1 illustrates the processes contributing to sea-level rise and their proportions over the period from 1990-2012. Figure 2 shows the projected sea-level rise for the years 2050 and 2100 under different greenhouse gas emissions scenarios as reported in the National Climate Assessment published in 2014. These scenarios assume intermediate-low greenhouse gas emissions, intermediate-high emissions, and the highest emissions conceivable.

FIGURE 2. Sea-level rise scenarios under different emission levels in 2050 and 2100. *Source: Adapted from NHCRHC STAP (2014).*



Based on local tide gauge data, sea levels in New Hampshire have been rising by an average of 0.7 inches per decade since 1900. The rate of sea-level rise has increased to approximately 1.3 inches per decade since 1993. Using 1992 sea levels as a baseline, New Hampshire sea levels are expected to rise between 0.6 and 2.0 feet by 2050 and between 1.6 and 6.6 feet by 2100.

Photo credit: Ron Sher

Storm Surge

Considering changes in water levels due to sea-level rise alone, today's extreme storm surge events (i.e. 1-percent-annual-chance flood /100-year flood) will have a greater inundation extent and occur more frequently over time. Due to increased coastal development, there has been a significant increase in impacts from hurricanes nationwide over the 20th Century. However, there is some uncertainty in the projection of trends in hurricane frequency and intensity in any given region, and no research consistently finds a trend in the frequency and intensity of Nor'easters.

Annual and Extreme Precipitation

Annual precipitation is expected to increase by as much as 20 percent by the end of the 21st century compared to the late 20th century. Most of the precipitation increases are expected to be in winter and spring in the form of rain or snow. Fall and summer are expected to experience less of an increase.

Extreme precipitation[iii] events are projected to increase in frequency and in the amount of precipitation produced. In particular, the rainfall amount produced by hurricanes is projected to increase. However, current climate models and analyses are not as good at projecting future changes in the frequency or magnitude of extreme precipitation events.

Other Hazards and Risks

The Commission recognizes that New Hampshire's coastal communities face additional coastal risks and hazards that were not explicitly summarized by the Science and Technical Advisory Panel or by the Commission's recommendations. The Commission limited its focus based on the legislative mandate, available information, and resources, however additional coastal hazards pose serious risks and should be studied further and acted upon, where deemed necessary. Some of these hazards include increases in average temperatures; drought; snowfall; seasonal shifts; potential air quality issues; saltwater intrusion and rising groundwater tables from sea-level rise; ocean acidification and the impacts on habitats and fisheries; and other impacts to well-being and quality of life, including the health of New Hampshire coastal residents. Appendix E highlights some of the additional hazards that should be studied in future iterations of the STAP report and discussed in future Commission efforts. These hazards have significant and increasing health implications as they are exacerbated by climate change, and though efforts have begun in the State to better understand health impacts, this needs to be a continuing focus of study.

Based on this summary of the science, the STAP offered planning guidance for adapting to storm surge, sea-level rise, and changes in annual and extreme precipitation. This guidance is summarized in Section 5.2.

iii For the purposes of this report, "extreme precipitation" is defined as the largest one percent of daily events in a year. This definition comes from the 2014 National Climate Assessment, however many other valid definitions of the term "extreme precipitation" exist.

4. Understanding Our Risks and Vulnerabilities

To prepare wisely for and reduce our risks to coastal hazards, the scope of vulnerability needs to be assessed and understood. Vulnerability is the likelihood that an asset will experience harm due to exposure to coastal hazards, as well as historical, social, economic, political, cultural, institutional, natural resource, and environmental conditions and processes. To determine vulnerability, the following questions are asked:

1. What assets are we interested in understanding and protecting?

In this report, we have identified four types of assets that are important to protect: our economy, our built landscape, our natural resources, and our heritage.

2. How exposed are our assets to coastal hazards?

To understand exposure, we look at the presence of people, livelihoods, environmental services and resources, structures and facilities, or economic, social, or cultural assets in places that could be adversely affected by storm surge, sea-level rise, and extreme precipitation and which, thereby, are subject to potential future harm, loss or damage.[36] For example, the more homes and people located in the floodplain, the greater the potential for harm from flooding. Additionally, understanding which critical structures and facilities are exposed, and the degree of that exposure, can help reduce or eliminate service interruptions and costly reconstruction. Finally, communities with more natural areas and less development within floodplains typically have lower exposure to flooding. Communities that monitor land cover changes within the floodplain can detect important trends that indicate whether flood exposure is increasing or decreasing. Armed with this information, local leaders can take steps to improve their safety and resilience.[37]

3. How sensitive are our assets to coastal hazards?

Sensitivity is a measure of how severe of an impact a hazard will have on an asset. Sensitivity, combined with adaptive capacity, determines how vulnerable assets are. For example, while structures and facilities located in the floodplain may be similarly exposed to coastal flooding, the quality and condition of some structures and facilities may make them more sensitive to coastal flood damage than others (e.g. manufactured homes or homes with basements). Similarly, certain groups of people are particularly sensitive to coastal hazards, such as the elderly, the infirm, children, native and tribal groups, non-English speaking individuals, and low-income populations, who may be less likely to cope with and recover from the impacts of coastal hazards without increased or targeted assistance. It is therefore especially important to consider the differential social and infrastructure impacts of storm surge, sea-level rise, and extreme precipitation in order to identify the needs of sensitive populations and infrastructure and develop effective adaptation strategies.

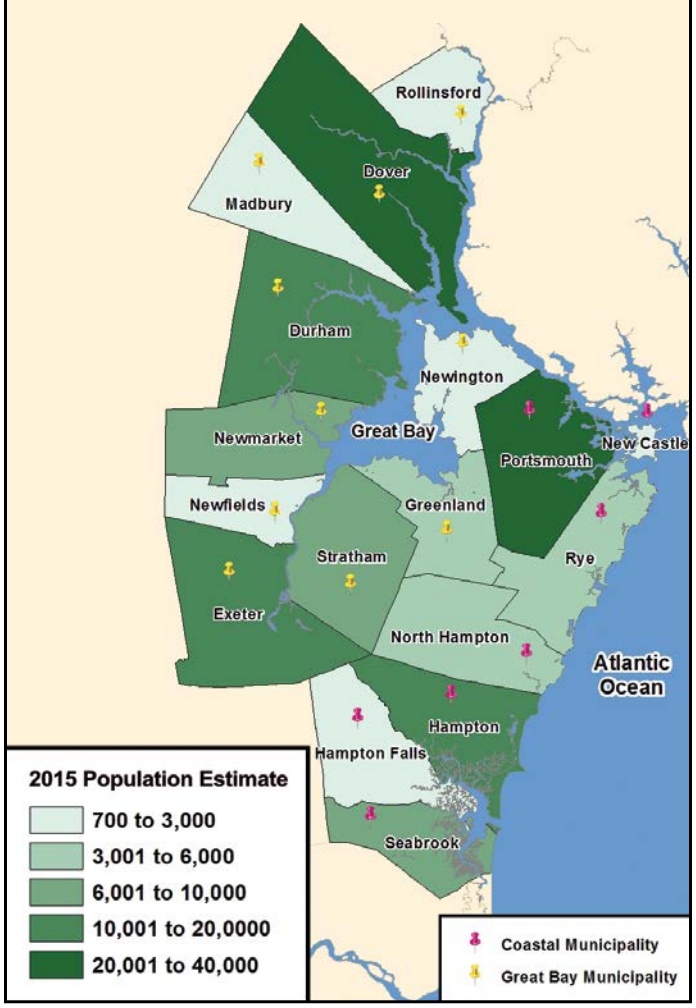
4. Can our assets adapt or be adapted to coastal hazards?

Lastly, vulnerability is influenced by how easily an asset can adapt or be adapted to a change. For example, salt marshes are expected to respond to sea level rise by migrating towards higher elevations; however, the presence of coastal development may limit the amount of space available and obstruct wetland migration inland, resulting in the total loss of wetlands in some areas. Similarly, structures and facilities in the built landscape may be elevated or designed to accommodate increased flooding (e.g., add freeboard to elevate structures above base flood elevation; increase culvert size). Existing building standards (e.g., height restrictions), replacement costs, and secondary impacts to other assets (e.g., increased downstream flooding) may reduce an asset's adaptive capacity and require modification to allow for flexibility in design.

Once the important assets are identified and exposure, sensitivity, and adaptive capacity are ascertained, strategies can be identified to prepare for coastal hazards based on the vulnerability assessment. For example, in the case of a salt marsh, the selected strategy might be to ensure conditions are appropriate to allow for marsh migration as sea levels rise. These adaptation strategies will vary depending on the asset and hazards in question.

While additional research is needed to establish a more complete picture of the vulnerability of specific assets along New Hampshire's coast, particularly as it relates to asset sensitivity and adaptability, significant progress has been made to identify and map important assets and assess their exposure to specific hazards like storm surge and sea-level rise. This section summarizes some of the existing information about our coastal vulnerabilities to some hazards. Section 4.1 presents a summary of the Coastal Region followed by four sections representing the key asset areas[iv] identified by the Commission: Our Economy (4.2), Our Built Landscape (4.3), Our Natural Resources (4.4), and Our Heritage (4.5). Each section summarizes and provides references about our known vulnerabilities and explains critical gaps in our understanding about the vulnerabilities for each topic area. The vulnerabilities outlined in these sections are not a comprehensive assessment of vulnerable assets in coastal New Hampshire, but rather they illustrate some of the known vulnerabilities that exist in the region.

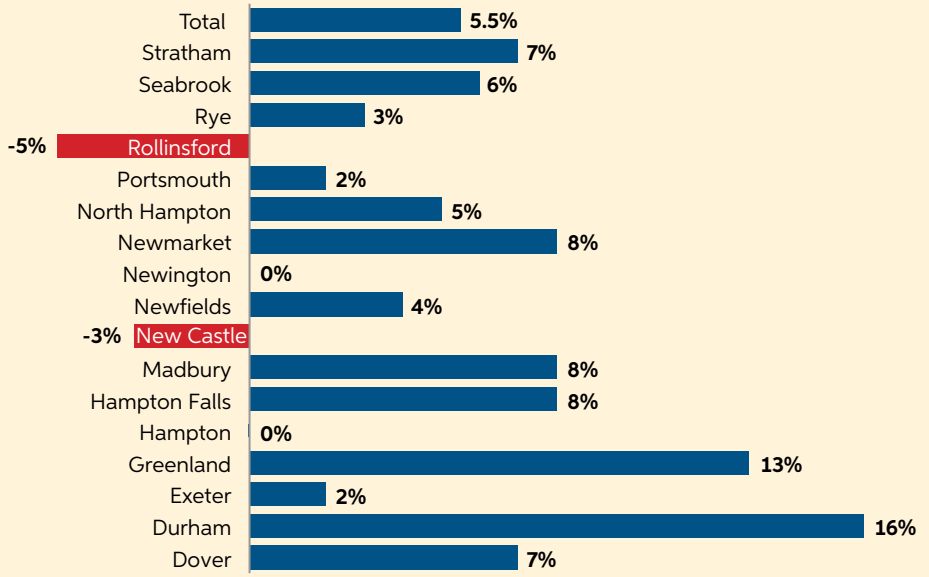
FIGURE 3. 2015 population estimates for New Hampshire coastal region, by municipality. *Source: NHOEP (2016a).*



4.1 Summary of the Coastal Region

According to the NH Office of Energy and Planning (NHOEP) 2015 population estimates, 146,721 people live in New Hampshire's 17 coastal zone municipalities, comprising approximately 11 percent of the state's population.[38] Population in the coastal region has increased 2.5 percent from 2010 to 2015, compared to statewide population growth of 1.1 percent.[39] NHOEP estimates that coastal population will increase an additional 5.5 percent over the next ten years.[40] Figure 3 shows the current distribution of population across coastal municipalities, while Figure 4 illustrates how coastal population is expected to change over the next decade.

FIGURE 4. Population projections by coastal zone municipality for period 2015 through 2025. *Source: NHOEP (2016b).*



[iv] The four asset areas are also used to organize the recommendations presented in Section 6.

As population increases in New Hampshire's coastal communities, more people live, work, and own property in areas prone to coastal risks and hazards. Additionally, scientists have posited that future climate changes may result in an additional population increase as people migrate away from water-starved western United States as well as other countries.[41] These historical population trends and possible future migration, and the development trends that inevitably follow, give added importance to ongoing efforts to identify coastal vulnerabilities and take action to reduce those vulnerabilities.

As we think about vulnerability, it is important to recognize the diversity of New Hampshire's coast. There are two distinct geographic areas that are impacted by coastal hazards and risks: the municipalities that directly border the Atlantic Ocean and those that surround Great Bay and its tidal tributaries.

4.1.1 Atlantic Coast Municipalities

New Hampshire's seven Atlantic Coast communities include Hampton, Hampton Falls, North Hampton, New Castle, Portsmouth, Rye, and Seabrook. These communities are located in the southeastern corner of the state directly exposed to the Atlantic Ocean. The Atlantic Coast is characterized by tidal and riverine systems and landforms. The southern Atlantic Coast consists of a barrier beach system including the extensive salt marshes of the Hampton-Seabrook Estuary, a broad sand beach at Hampton, and dune systems in Hampton and Seabrook. The northern Atlantic Coast is marked by prominent bedrock headlands, small cove beaches and tidal waterways that extend far inland. The primary inland riverine systems include the Taylor River and Winnicut River.

The Atlantic Coast municipalities have a distinct and pressing need to address existing and future impacts relating to climate change, particularly relating to coastal flooding from storm surge and sea-level rise. Without proactive solutions to address the expected impacts of climate change, these communities face a multitude of challenges to ensure the security, health and welfare of their citizens and provide for a stable and viable economic future. In September 2015 the Rockingham Planning Commission (RPC) completed the Tides to Storms project[42] to assess the vulnerability of roadways and supporting transportation assets, critical facilities, and natural resources to flooding from expected increases in storm surge and rates of sea-level rise in the seven Atlantic Coast communities. This study is the first statistical and spatial analysis of its kind conducted for New Hampshire communities. It used a uniform methodology to identify specific state and municipal assets that are vulnerable to flooding under different storm surge and sea-level rise scenarios. The study did not include an assessment of the specific degree of damage nor estimate monetary losses to specific sites or properties. Further depth-damage analyses of affected assets using the flood depth maps may yield some of this information in follow-up work.

Portsmouth Coastal Resilience Initiative

In 2012, Portsmouth was one of five communities selected for a pilot program with $30,000 in funding from the Gulf of Maine Council, through a grant from the National Oceanic and Atmospheric Administration (NOAA). This grant funded a research study the "Coastal Resilience Initiative (CRI)" prepared for the City by a team of researchers from the University of New Hampshire and the Rockingham Planning Commission. This detailed report provides the starting point for understanding the impacts of climate change and offers a number of possible adaptation measures that the City can take over time to protect private property and public facilities. The report evaluated potential impacts from sea-level rise and storm related flooding on critical facilities, buildings and salt marshes. The City is actively implementing measures to adapt its stormwater drainage facilities to increases in extreme precipitation and rising sea levels.

PREPARE. PROTECT. PORTSMOUTH.

The City's current climate initiative "Prepare. Protect. Portsmouth." showcases the CRI report and information about what residents and businesses can do to prepare for climate change. Find more information on the Prepare. Protect. Portsmouth. website at **http://www.planportsmouth.com/cri/.**

Flooding scenario maps were based on the 2014 National Climate Assessment, 2014 (Preliminary) Flood Insurance Rates Maps released by the Federal Emergency Management Agency (FEMA),[43] and high resolution digital elevation data. Data sources and assumptions that underlie the flood scenarios used in this assessment are explained more fully in the Tides to Storms final report.[44]

Key findings of this assessment are based on evaluation of the extent of inundation that would result under three scenarios of sea-level rise: 1.7 feet, 4.0 feet, and 6.3[v] feet for the year 2100 and three additional scenarios that pair the sea-level rise combined with the 100-year storm surge. For example, Figure 5 shows the extent of projected tidal flooding from 1.7 feet, 4.0 feet, and 6.3 feet of sea-level rise scenarios for the Hampton-Seabrook Estuary and surrounding areas. The green color scheme is arranged from lightest to darkest with increasing flood extent.

Figure 6 shows the extent of projected tidal flooding from 1.7 feet, 4.0 feet, and 6.3 feet of sea-level rise plus storm surge scenarios for the Hampton-Seabrook Estuary and surrounding areas. The pink color scheme is arranged from lightest to darkest with increasing flood extent.

Table 1 provides a statistical overview of the flood impacts to specific assets and resources from the sea-level rise and storm surge scenarios evaluated for the seven Atlantic Coast municipalities. The seven Atlantic Coast municipalities combined have 49,266 acres of upland (land currently above mean higher-high water). At the 1.7-foot sea-level rise scenario, about 3 percent (1,485 acres) of this upland will be inundated by tides on a regular basis; at the 4.0-foot scenario, 5.3 percent (2,602 acres) of upland would be regularly flooded by tides; and at the 6.3-foot sea-level rise scenario, 7.3 percent or 3,615 acres would be affected. Upland impacts are greater in Rye than in other communities because of the extensive low-lying areas around the marshes west of Odiorne Point. Additional findings from the Tides to Storms project are summarized throughout Section 4 of this report. A summary of flood impacts from sea-level rise and storm surge scenarios for the ten Great Bay communities is provided in Table 2.

TABLE 1. Summary of flood impacts from sea-level rise and storm surge scenarios* for the seven Atlantic Coast municipalities**
Source: RPC (2015).

Sea-Level Rise (SLR) Scenarios	1.7 feet SLR	4.0 feet SLR	6.3 feet SLR	1.7 feet SLR + Storm Surge	4.0 feet SLR + Storm Surge	6.3 feet SLR + Storm Surge
Upland* (acres)**	1,485	2,602	3,615	3,474	4,439	5,298
BUILT LANDSCAPE						
Infrastructure (# of sites)	37	90	135	137	162	190
Critical Facilities (# of sites)	13	33	48	44	64	98
Roadways – Local (miles)	4	17	29	33	39	51
Roadways – State (miles)	2	7	14	19	22	26
Transportation Assets (# of sites)	35	50	68	65	78	90
100-year floodplain (acres)	8,180	9,361	9,593	9,639	9,766	9,818
NATURAL RESOURCES						
Freshwater Wetlands (acres)	184	396	519	489	593	661
Tidal Wetlands (acres)	235	257	264	267	268	269
Conserved Lands (acres)	493	717	873	883	1,007	1,131
Land Protection Priorities (acres)	4,022	4,851	5,469	5,385	5,948	6,458
Critical Wildlife Habitat (acres)	1,081	1,600	1,915	1,865	2,112	2,310

* Storm surge = 100-year (one-percent-annual-chance) flood event.

** The seven Atlantic Coast communities include Hampton, Hampton Falls, New Castle, North Hampton, Portsmouth, Rye, and Seabrook.

*** Upland refers to land above mean higher high water (highest tidal extent). The seven coastal region municipalities have approximately 49,266 acres of upland.

[v] These sea-level rise maps were developed prior to the STAP report summary and therefore used slightly different estimates for sea-level rise. The maps do not show a significant difference in inundated area due to the resolution of the elevation data.

FIGURE 5. Illustration of the extent of flooding from three sea-level rise scenarios in the Hampton-Seabrook estuary. *Source: RPC (2015).*

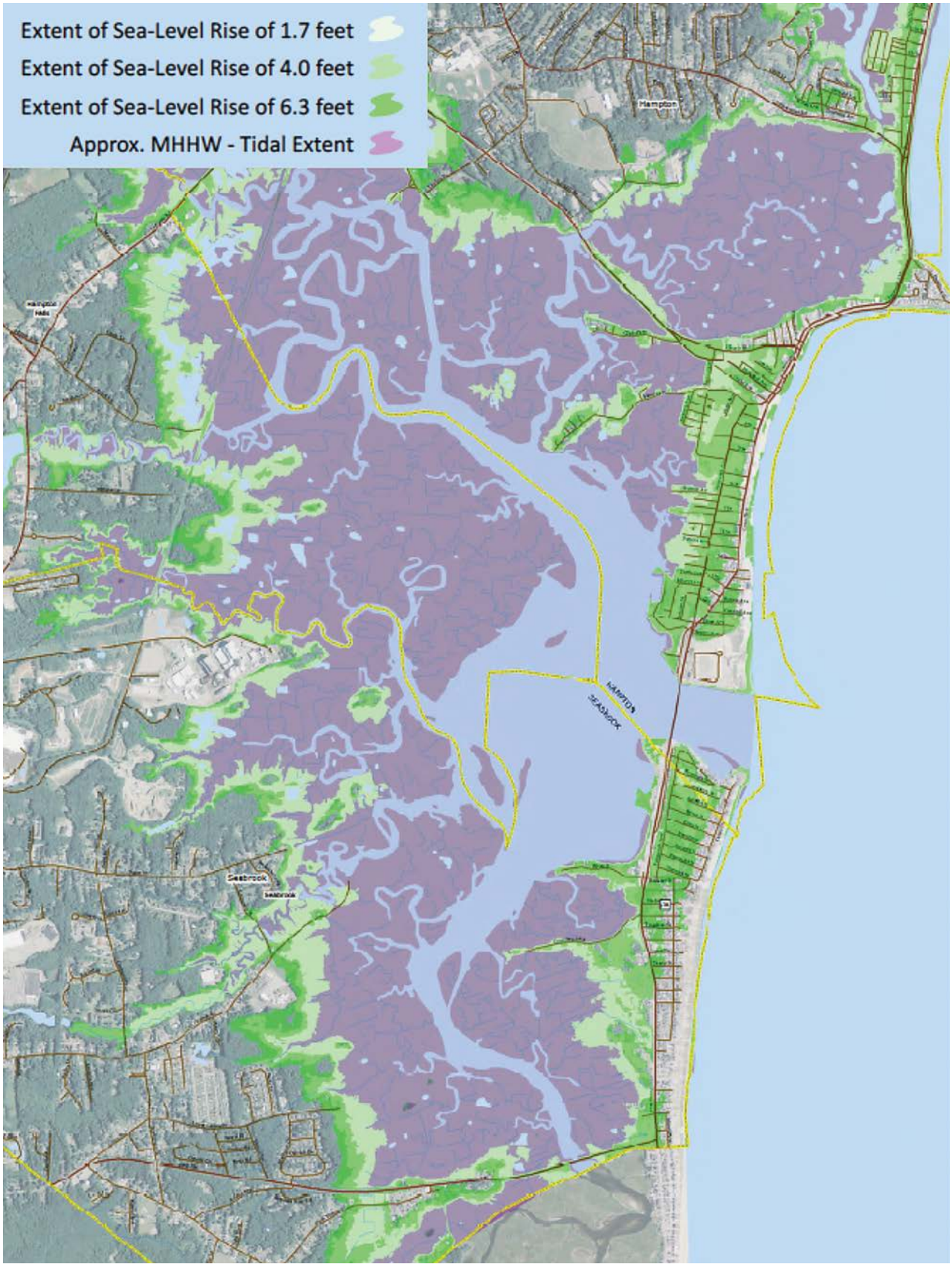
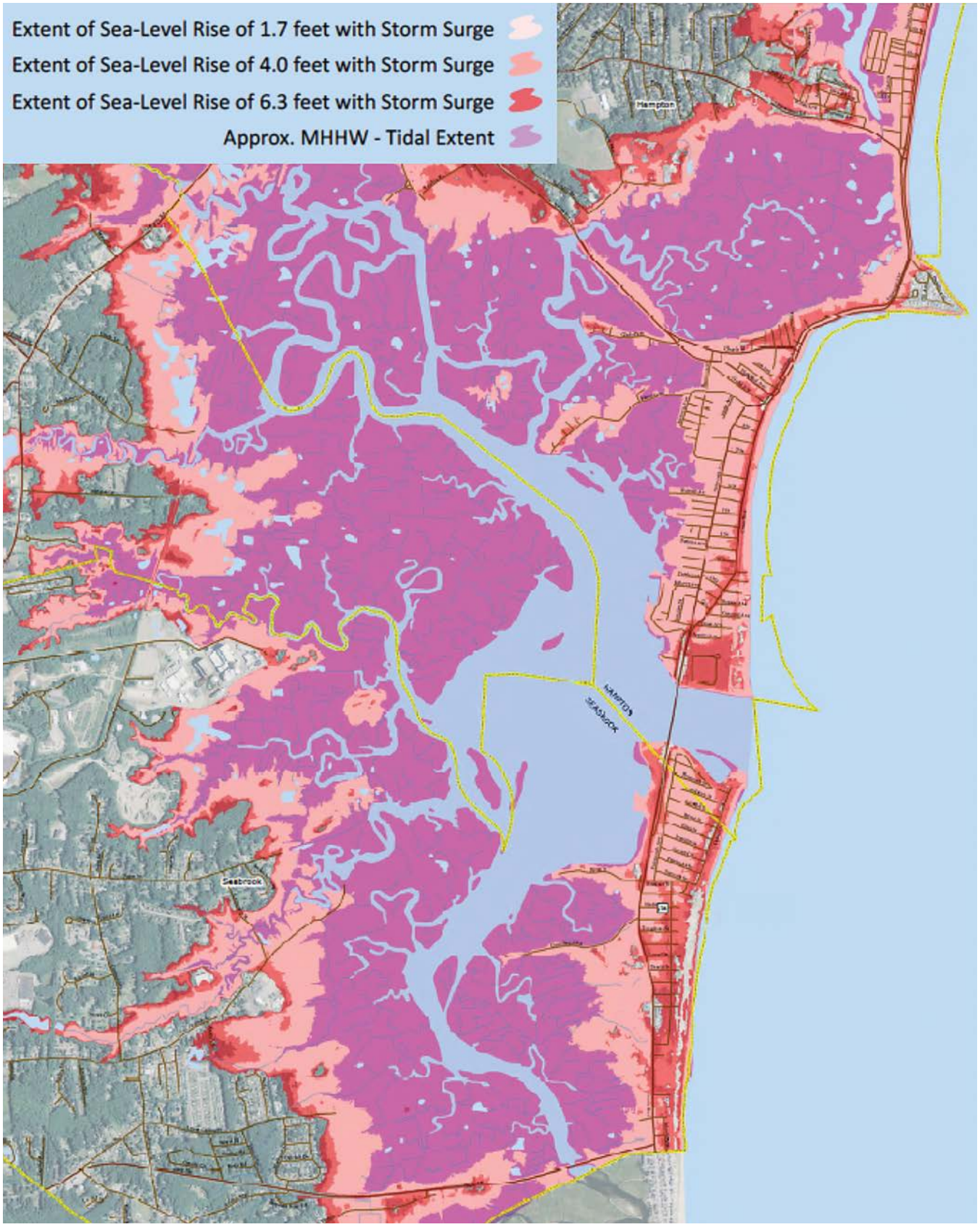


FIGURE 6. Illustration of the extent of flooding from three sea-level rise scenarios with a 100-year (one-percent-annual-chance) storm surge in the Hampton-Seabrook estuary. *Source: RPC (2015).*



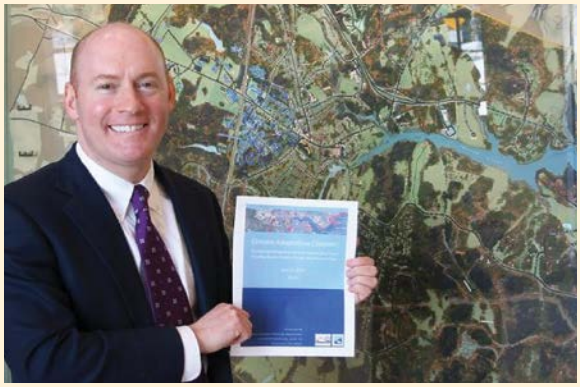
4.1.2 Great Bay Municipalities

New Hampshire's Great Bay municipalities include Dover, Durham, Exeter, Greenland, Madbury, Newfields, Newington, Newmarket, Rollinsford, and Stratham. These communities are located in the southeastern corner of the state surrounding Great Bay, which is a nationally recognized Estuarine Research Reserve. This area is set apart by its beautiful natural resources, diverse urban and rural communities, and rich cultural heritage. Established during the Industrial Revolution as a hub of textile production within the northeast, these communities continue to be defined by traditional mill-town development, built upon the veins of the many coastal rivers leading south to the port of Portsmouth. However, with the increased frequency of severe storm events combined with an increase in impervious surfaces resulting from extensive development over the past four decades, communities have experienced substantial economic losses and damages to critical facilities from major flooding events. The Mother's Day (2006) and Patriots' Day (2007) floods are two examples of catastrophic flooding that wreaked havoc on municipalities in the coastal watershed.

Most of the Great Bay communities lie within the Piscataqua River Basin through which flow a number of coastal rivers, including the Cocheco, Lamprey, Oyster, Exeter, Winnicut, and Salmon Falls. The Salmon Falls flows south into the Piscataqua River and acts as the boundary between New Hampshire and Maine before draining into the Gulf of Maine through Portsmouth Harbor. Influenced by historic development patterns and significant changes in land use, as well as extreme precipitation and coastal surge, these complex freshwater river systems have experienced much more flooding during storm events in recent years. These contributing factors translate into the Great Bay communities being vulnerable to both salt water and freshwater flooding.

A Master Plan for Climate Change in Durham

In 2013, the Town of Durham, in partnership with the Strafford Regional Planning Commission, underwent a process in which the community evaluated their risks to climate change and its associated impacts. Durham specifically focused on future changes in extreme temperature and precipitation, sea-level rise, and coastal flooding. This process resulted in the development of the Town's **Climate Adaptation Chapter** and provides a list of recommendations as to the kinds of steps Durham should be taking over the next several decades.



Durham Town Administrator Todd Selig holds up the town's climate adaptation chapter. (photo credit: Fosters.com)

In 2014, Durham was awarded the NOAA Walter B. Jones Memorial Award for Excellence in Local Government, which is awarded to five towns across the country every two years. The award is given to local governments that have created positive change in coastal management.

The NHDES Coastal Program, New Hampshire Geographically Referenced Analysis and Information Transfer System (NH GRANIT), Rockingham Planning Commission, Strafford Regional Planning Commission, and the University of New Hampshire Stormwater Center are in the process of conducting a detailed statistical and spatial analysis for the ten Great Bay municipalities based on the Tides to Storms methodology. Funded by the National Oceanic and Atmospheric Adminstration, the Climate Risk in the Seacoast (C-RiSe): Assessing Vulnerability of Municipal Resources to Climate Change project will provide Great Bay municipalities with maps and assessments of flood impacts to key state and municipal assets and natural resources under various sea-level rise and storm surge scenarios.[45]

Similar to the Tides to Storms project, the C-RiSe map set is comprised of two components: maps depicting the extent of projected flooding from the three sea-level rise scenarios in shades of green, and maps depicting the three sea-level rise plus storm surge scenarios in shades of pink. Examples of the sea-level rise and storm surge maps produced for the City of Dover are provided in Figure 7 and Figure 8, respectively.

FIGURE 7. Illustration of the extent of flooding from three sea-level rise scenarios in the City of Dover, NH. *Source: NHDES et al. (In-Progress).*

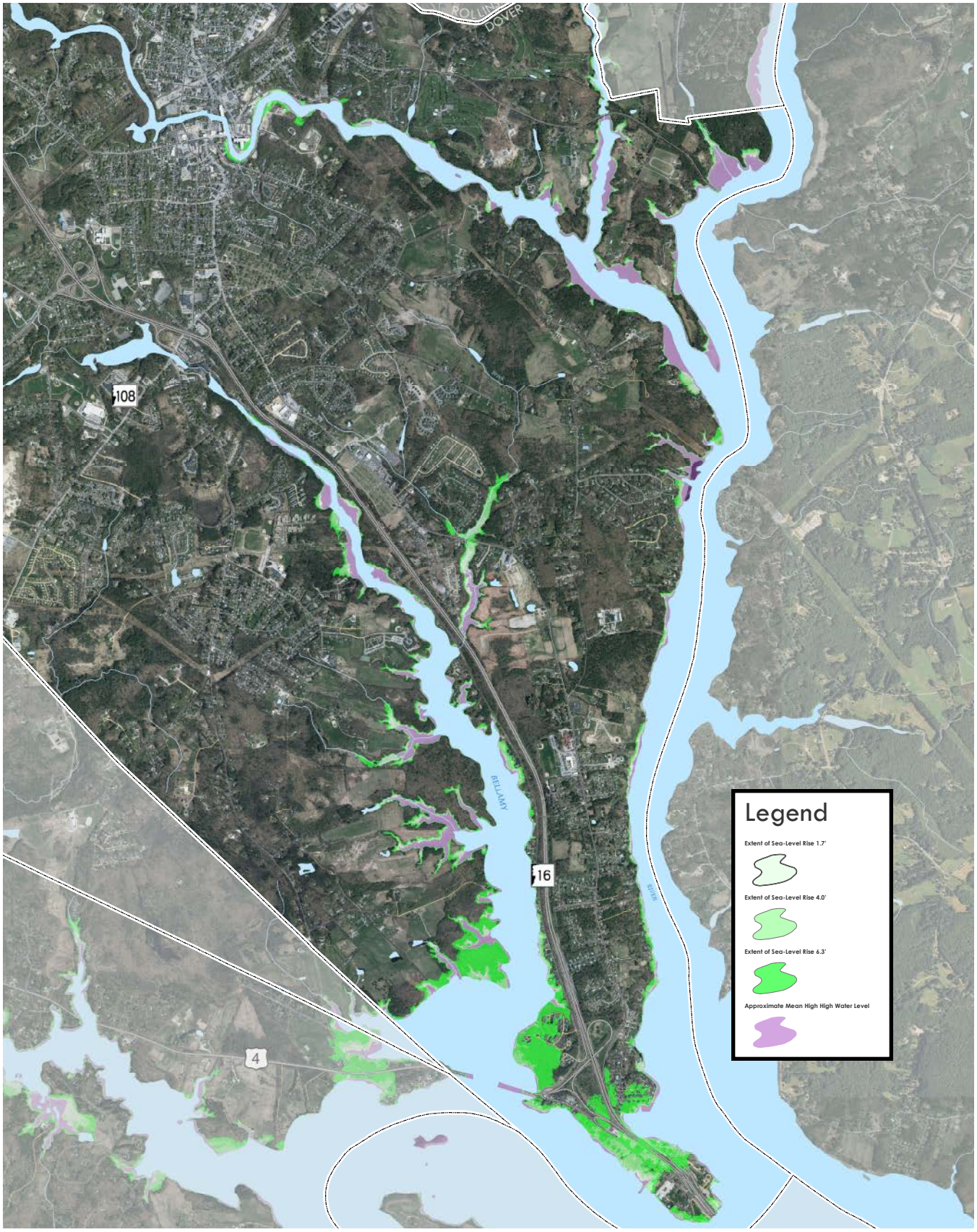


FIGURE 8. Illustration of the extent of flooding from three sea-level rise scenarios with a 100-year (one-percent-annual-chance) storm surge in the City of Dover, NH. *Source: NHDES et al. (In-Progress).*

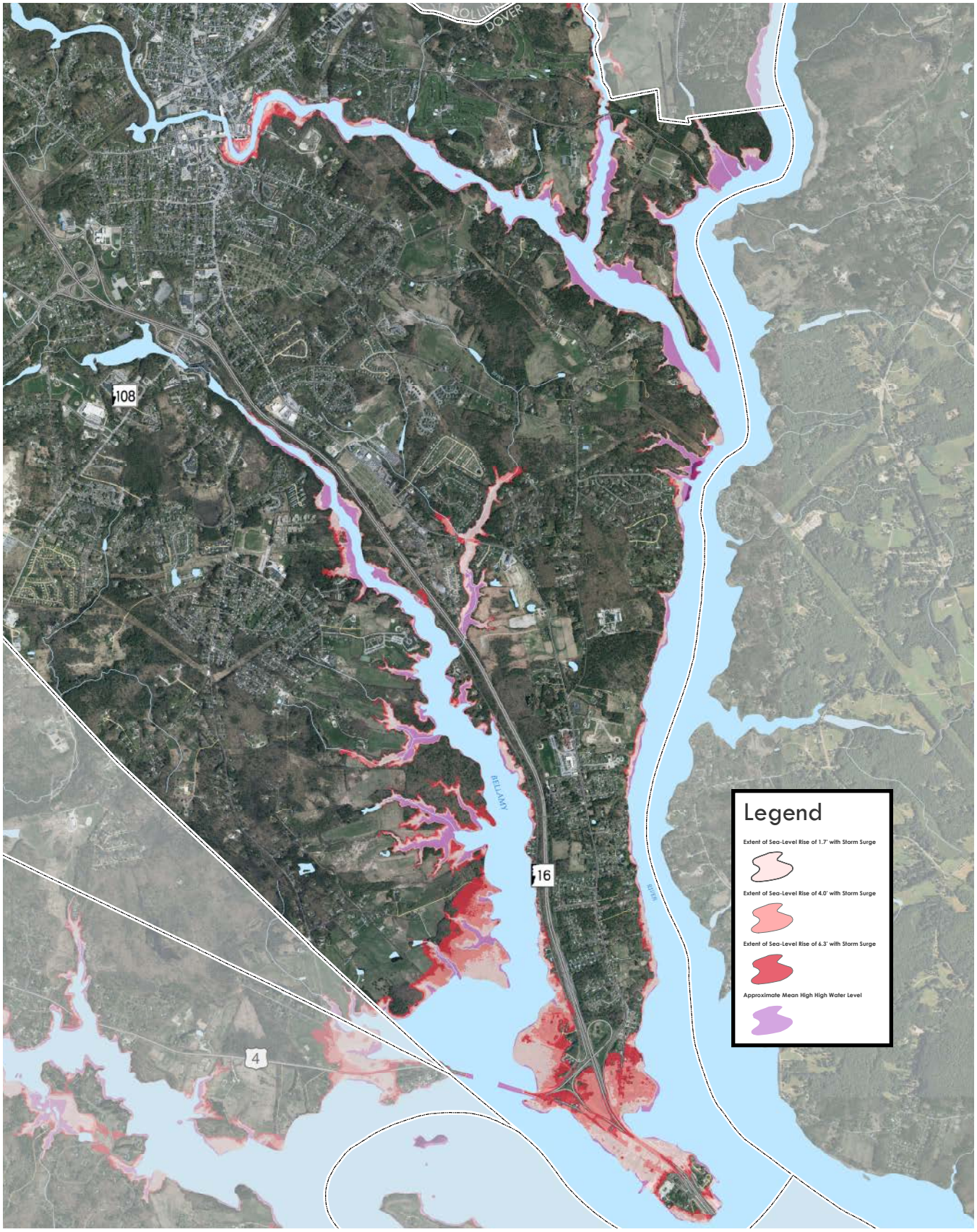


Table 2 provides a statistical overview of the flood impacts to specific assets and resources under the various sea-level rise and storm surge scenarios evaluated for the ten Great Bay municipalities as part of the C-RiSe project. The ten Great Bay municipalities combined have 86,210 acres of upland (land currently above mean higher-high water). Between 914 acres (1.1 percent) and 2,309 acres (2.7 percent) of upland will be regularly flooded by tides under the 1.7 feet and 6.3 feet sea-level rise scenarios; and up to 3,343 acres (3.9 percent) of uplands will be affected under the 6.3 feet sea-level rise plus storm surge scenario. Additional findings from the C-RiSe project are summarized throughout Section 4 of this report.

Photo credit: UNH Stormwater Center

While this report is focused on coastal hazards associated with storm surge, sea-level rise, and extreme precipitation, many of the Great Bay municipalities are also at risk of flooding "above the dams" in purely freshwater (i.e., riverine) systems. For example, a UNH-led research project investigated how flooding in the Lamprey River may change in the future based on scenarios of land cover change and climate change. The research relied upon rainfall-runoff models used by FEMA to define one-percent-annual-chance floods (100-year floods).[46]

TABLE 2. Summary of flood impacts from sea-level rise and storm surge* scenarios for the ten Great Bay municipalities**
Source: NHDES et al. (In-Progress).

Sea-Level Rise (SLR) Scenarios	1.7 feet SLR	4.0 feet SLR	6.3 feet SLR	1.7 feet SLR + Storm Surge	4.0 feet SLR + Storm Surge	6.3 feet SLR + Storm Surge
Upland* (acres)**	914	83	2,309	1,894	2,604	3,343
BUILT LANDSCAPE						
Infrastructure (# of sites)	4	23	115	69	167	304
Critical Facilities (# of sites)	0	0	1	0	1	4
Roadways – Local (miles)	0	1	3	2	4	5
Roadways – State (miles)	0	0	1	1	2	4
Transportation Assets (# of sites)	46	46	49	47	52	57
100-year floodplain (acres)	739	1,234	1,355	1,316	1,397	1,461
NATURAL RESOURCES						
Freshwater Wetlands (acres)	59	182	259	222	306	413
Tidal Wetlands (acres)	754	834	851	845	855	860
Conserved Lands (acres)	304	610	928	758	1,026	1,277
Land Protection Priorities (acres)	625	1,040	1,474	1,244	1,610	1,978
Critical Wildlife Habitat (acres)	721	1,204	1,723	1,447	1,895	2,357

* Storm surge = 100-year (one-percent-annual-chance) flood event.
** The ten Great Bay municipalities include Dover, Durham, Exeter, Greenland, Madbury, Newfields, Newington, Newmarket, Rollinsford, and Stratham.
*** Upland refers to land above mean higher high water (highest tidal extent). The ten Great Bay municipalities have approximately 86,210 acres of upland.

Results clearly show that the one-percent-annual-chance floodplain, peak flood water discharge, and flood water surface elevations have increased significantly over the past four decades and will continue to increase in the future under the build-out and climate scenarios developed for the research project (Table 3). Low impact development zoning was shown to have its greatest mitigation value in terms of resiliency in high impervious cover areas.[47] This increase in the one-percent-annual-chance floodplain and one-percent-annual-chance flood discharge has important ramifications for natural resources, the built landscape, public health and safety, emergency management, and planning. In addition, the risk of municipal legal liability associated with using the new one-percent-annual-chance floodplain maps is low, so long as municipalities follow sound planning principles.[48]

TABLE 3. Potential change in the area of one-percent-annual-chance* floodplains on the main stem of the Lamprey Rivers based on climate and land use change scenarios. *Source: Wake, C. et al. (2013).*

Town	Total acreage in watershed	One-Percent-Annual-Chance Floodplains (acres)		Percent increase in one-percent-annual-chance floodplain area 2100 vs. 2005
		2005 Flood Insurance Rate Map (FIRM)	2100 'Conventional' Buildout**	
Durham	4,984	499	625	20%
Epping	16,752	899	1,026	12%
Lee	7,927	551	916	40%
Newmarket	6,559	450	741	39%
Raymond	12,277	874	1,113	21%
Total	**48,499**	**3,273**	**4,421**	**26%**

*The one-percent-annual-chance floodplain or storm is the more accurate term preferred by FEMA for what is more commonly known of as the 100-year floodplain or storm.

**Projected residential and nonresidential development scenario for 2100 based on historical 1962-2005 residential and nonresidential developed land data.

4.2 Our Economy

OUR ECONOMY is the systematic and productive exchange and flow of goods, services, and transactions that must be intact, functioning, and resilient to coastal risks and hazards in order to create and sustain a high quality of life in coastal New Hampshire.

4.2.1 How We Assess Vulnerability

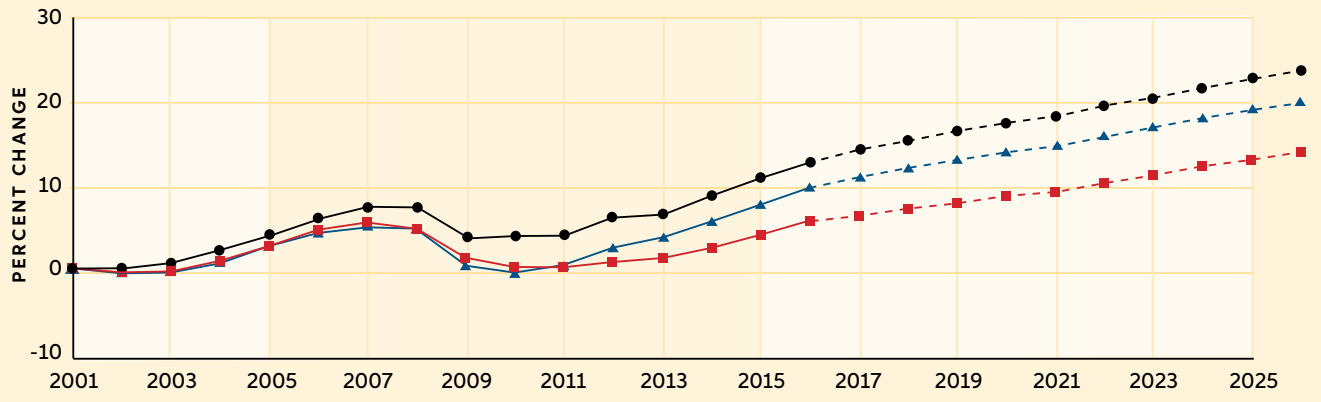
When it comes to assessing the vulnerability of the coastal region to coastal risks and hazards, the regional economy must be considered in two ways. First, research shows that communities with diversified economies and established institutions have a greater capacity to protect and prepare their assets, including the built environment, natural resources, and heritage against coastal risks and hazards. As a result, vulnerability is likely higher in municipalities with fewer financial resources, less stable economic activity, and lower average incomes.[49]

The second consideration is that key components of the economy may be vulnerable to climate change impacts like storms and sea-level rise. A significant portion of the economy in New Hampshire's coastal region is related to coastal industries that may inherently be vulnerable to storms and sea-level rise. For example, the Port of Portsmouth and Piscataqua River terminal operators make important contributions to the economies of New Hampshire and Maine, contributing $275 million in value added and generating 2,350 jobs in 2011. Of the total 2011 employment, income, and value added benefits, approximately 90 percent were experienced in New Hampshire and 10 percent were experienced in Maine.[50]

According to New Hampshire Sea Grant, in 2010 New Hampshire's commercial fisheries industry had a catch value of approximately $17 million.[51] Additionally, businesses that may not deal directly with coastal goods and services may have supply chains, customers, and other resources that are vulnerable to hazards like coastal storms.[52]

New Hampshire's coastal region is an important economic driver for the state and consistently ranks above the national average for job growth. The Gross Regional Product of the coastal region totaled approximately $11 billion in 2014, with 16 percent derived from the finance and insurance industry and 13 percent coming from the manufacturing industry. Between 2002 and 2016 job growth for the coastal region was 12.8 percent, outpacing both the state and national job growth rates of 5.9 and 10.4 percent, respectively. As of the third Quarter of 2016, the coastal municipalities supported 109,070 jobs[vi]. Figure 9 shows the percent change in jobs from 2002 to the third Quarter of 2016 and projected percent change out to 2025 for New Hampshire's coastal municipalities compared to the state and nation.[53]

FIGURE 9. Regional, state, and national percent change in jobs for period 2002-2016 and projected out to 2025. *Source: NHDED (2016).*



	Region	2002 Jobs	2016 Jobs	Change	% Change
●—	Coastal Region	96,734	109,070	12,336	12.8%
■—	New Hampshire	682,775	722,777	40,002	5.9%
▲—	United States	143,960,385	158,866,954	14,906,569	10.4%

In 2014, the coastal region exported $15.5 billion worth of goods and services, imported $14.1 billion worth of goods and services, and produced and consumed $5.9 billion worth of goods and services locally, making the region a net exporter of goods and services.[54] Commuting patterns based on 2010 Census data show that the coastal region has a net inflow of jobs with 86 percent of all jobs in the area filled by people who live outside of the coastal region. These data suggest that both the economic importance and vulnerability of the coastal region extend beyond the borders of its municipalities to the significant number of people who live elsewhere but depend on the area for employment as well as goods and services.[55]

4.2.2 Highlights of Vulnerabilities

One of New Hampshire's key economic vulnerabilities resulting from increased coastal flooding is the potential loss in overall property valuation – both from actual flood related property losses and from the perception that coastal properties are at risk. Since New Hampshire's coastal municipalities derive a large majority of their revenue

vi Economic data as reported by the NH Division of Economic Development includes all 17 coastal municipalities as well as the towns of Brentwood and Kensington. Economic Modeling Specialists Inc. (EMSI) reports include regional information based on Zip Codes. These towns share the same Zip Code (03833) as the Town of Exeter. The Town of Newington also shares a Zip Code with the City of Portsmouth (03801).

from property taxes (based on assessed valuation), potential losses to their tax base resulting from increased coastal flooding could have a significant impact on municipal budgets throughout the coastal region.

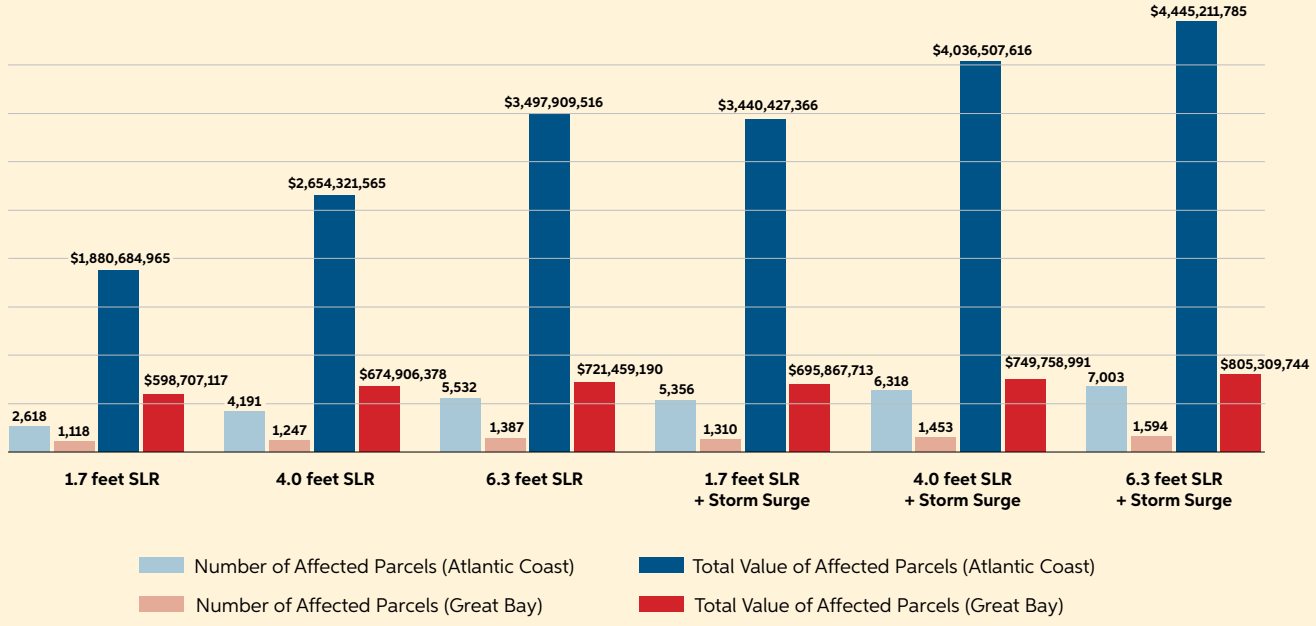
After reviewing the available research as well as the Tides to Storms and C-RiSe vulnerability assessments prepared for the Atlantic Coast and Great Bay municipalities, respectively, we are unable to make a definitive estimate of property valuation impacts. There are several factors that contribute to this uncertainty. First, the uncertainty of the timing and extent of future flooding makes actual damage difficult to assess. Second, the complexity and dynamics of coastal real estate markets are such that we are not able know with any certainty how housing, insurance, and lending markets will respond to projected coastal increases in coastal flood risk. Third, without better understanding, it is impossible to predict the extent to which properties will be rebuilt or replaced after an extensive flooding event, or series of extensive flooding events.

The Commission was able to quantify the general magnitude of property valuation that is at potential risk by estimating how many properties are physically affected under various sea-level rise and storm surge scenarios. As shown in Figure 10, the Tides to Storms and C-RiSe projects analyzed the number and aggregated assessed value of tax parcels in the seven Atlantic Coast and ten Great Bay municipalities affected by each of the six sea-level rise and storm surge scenarios.

In the seven Atlantic Coast municipalities, between 2,618 and 5,532 parcels will be partially or wholly affected under the 1.7 feet and 6.3 feet sea-level rise scenarios, respectively; up to 7,003 parcels will be affected when storm surge is added, putting over $4.4 billion, or 35 percent, of total assessed property value at risk of flooding under the 6.3 feet of sea-level rise plus storm surge scenario.[56]

In the ten Great Bay municipalities, between 1,118 and 1,387 parcels will be partially or wholly affected under the 1.7 feet and 6.3 feet sea-level rise scenarios, respectively; up to 1,594 parcels will be affected when storm surge is added, putting over $805 million, or 8.5 percent, of total assessed property value at risk of flooding under the 6.3 feet of sea-level rise plus storm surge scenario.[57]

FIGURE 10. Number and aggregated assessed value of parcels affected by sea-level rise (SLR) and storm surge* scenarios for the Atlantic Coast** and Great Bay*** municipalities. *Source: RPC (2015); NHDES et al. (In-Progress).*



* Storm surge = 100-year (one-percent-annual-chance) flood event.
** The seven Atlantic Coast municipalities include Hampton, Hampton Falls, New Castle, North Hampton, Portsmouth, Rye, and Seabrook.
***The ten Great Bay municipalities include Dover, Durham, Exeter, Greenland, Madbury, Newfields, Newington, Newmarket, Rollinsford, and Stratham.

It is important to stress that parcels were identified as affected if they were found to be partially or fully located within the flooding extent of the scenarios evaluated. The extent to which the parcel or any structure or development on the parcel would be damaged by sea-level rise or storm related flooding was not analyzed. For example, if the flood impact to a property was a flooded parking lot and no permanent damage to its principle structure, it would still be considered affected even though the property valuation may not change. It is also important to note that the data include a number of high value parcels under state and municipal ownership in addition to private property. As a result, the aggregated assessed values of affected parcels provided in Figure 10 are likely overestimates of the impact to actual property value, at least over the time period of the next several decades. More accurately, the assessed values represent the value of the properties that may be exposed to some flooding in the different scenarios and do not necessarily represent a cost estimate of potential flood damages or losses.

Photo credit: Amy Hansen

While we cannot precisely quantify the amount of assessed property value that is at risk given the information available today, the Commission acknowledges the potential devastating loss of revenue for municipalities should a significant portion of vulnerable coastal properties suffer permanent and irreparable damages, or total losses.

Further progress can be made in quantifying property valuation risk by undertaking depth-damage analyses for flooding scenarios through which damage to structures can be estimated and degree of loss can be determined based on the depth of flooding. This process can be integrated into hazard mitigation planning at the local level and will help communities become better informed as to their specific risk to losses in property valuation.

Even with better vulnerability information, however, several questions will remain, including:

- Will New Hampshire's highly-sought-after waterfront properties continue to attract investment and appreciate in value even in the face of significant risk of repetitive losses in the coming decades?
- Will repetitive losses in New Hampshire and elsewhere influence demand for New Hampshire coastal real-estate and availability of National Flood Insurance Program (NFIP) funds to insure those New Hampshire properties at risk of flooding?
- At what point will the risk from coastal flooding become high enough to cause coastal property values to decline from falling demand and discouraged investment?
- Will properties destroyed by coastal flooding continue to be rebuilt, and if so will the reconstructed buildings be of greater or lesser value than those that preceded them?
- When and to what extent will bank lending practices change to become less supportive of coastal real estate investment?
- What is the role of insurance in enabling reinvestment? Will the phasing out of the most highly subsidized insurance categories in the NFIP result in disinvestment in high risk areas or will property owners simply self-insure?

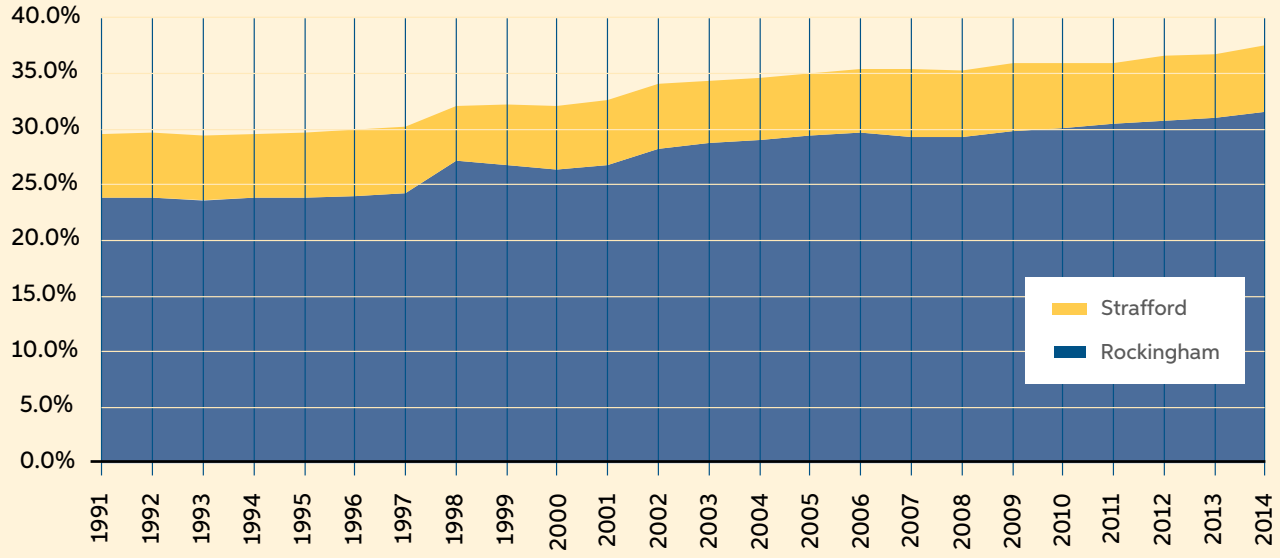
Answers to these questions are speculative at this point and require better understanding of both science and behavior. Without more extensive study of the seacoast real estate market, together with more precise estimates of the damage that various flooding scenarios might produce, we cannot make definitive assessments of the change in property valuation, or of the overall economic impact. Nevertheless, two important generalizations can be made:

- First, the number of properties affected by flooding dramatically increases between the lowest sea level rise scenario and the higher ones. For example, data from the Tides to Storms project show a 60 percent increase in the number of affected parcels and a $773 million increase in assessed value of affected parcels when comparing the 1.7 feet to the 4.0 feet sea-level rise scenario, and an additional 32 percent increase in the number of affected parcels and $843 million increase in the assessed value of affected parcels when comparing the 4.0 feet to the 6.3 feet sea-level rise scenario.[58] This suggests that if changes in sea level reach the higher scenarios, the consequence for property loss will be proportionately much greater.
- Second, sound planning to adapt to increased flood risk can help minimize future property valuation losses. Communities that have improved their resiliency by adjusting building standards, improving infrastructure, communicating flood risk, and preventing further development and redevelopment in the most vulnerable places, will help maintain property values both because flood damage will be less, and because owners and investors will have greater confidence in the continued viability of the community.

Coastal Tourism

County meals and rooms tax revenue data are considered some of the most important indicators for the tourism sector, as they provide the basis for estimating other tourism indicators such as traveler counts and spending. Counties that are visited by large numbers of tourists generate much of the revenue under New Hampshire's meals and rooms tax, which is collected from the patrons of hotels, restaurants, and car rental agencies. In particular, Rockingham and Strafford Counties, which include 13 and four coastal zone municipalities respectively, continue to generate significant revenue for the state under the meals and rooms tax. As shown in Figure 11, Rockingham and Strafford counties contributed 37.5 percent of the total state meals and room tax revenue in fiscal year 2014, accounting for $104.7 million.[59] These data suggest that the coastal tourism economy in Rockingham County continues to be a valuable state asset.

FIGURE 11. Percentage of state total meals and rooms tax generated by Rockingham and Strafford counties from 1991-2014.
Source: NHOEP (2015).



The tourism and recreation sectors would likely be severely impacted by a major coastal storm and may be impacted more gradually over the long-term by sea-level rise. Key tourism destinations like Hampton Beach and Strawbery Banke Museum are known to be vulnerable to storm surge and sea-level rise.[60] Additional research is needed, however, to determine specific vulnerabilities within the tourism sector and to identify specific strategies to deal with those vulnerabilities.

Photo credit: Christopher Harmon

4.2.3 Relevant Recommendations

KEY COMMISSION RECOMMENDATIONS: Our Economy	
E1.	Identify vulnerability of sector-based economic assets, including but not limited to tax base, workforce and jobs, property values, insurance costs, trade facilities, and public recreational facilities based on best available climate science. [*Lead: State Agencies; Municipalities].*
E2.	Incorporate best available climate science and vulnerability assessment information in state, regional, and municipal economic development plans. *[Lead: State Agencies; Municipalities].*
E3.	Use appropriate and available mechanisms, including but not limited to incentives and market-based tools to fund climate adaptation strategies. *[Lead: State Agencies; Municipalities].*
E4.	Improve information available to property owners and prospective buyers about coastal hazards and vulnerabilities. *[Lead: State Agencies; Municipalities].*

4.3 Our Built Landscape

OUR BUILT LANDSCAPE is the network of structures and facilities owned by state and local governments and private entities in coastal New Hampshire. Our built environment must be prepared, adaptive, and responsive to coastal risks and hazards.

4.3.1 How We Assess Vulnerability

A number of methodologies can be used to assess the vulnerabilities in the built landscape, and these methods vary based on the type of built asset and the level of detail desired. In coastal New Hampshire, we benefit from high quality spatial data for roads, critical facilities, and other important built assets. To date, preliminary assessments have overlaid sea-level rise and storm surge inundation maps with mapped roadways and buildings to determine which areas are likely to flood under different scenarios. Many of these mapping resources are publicly available on the New Hampshire Coastal Viewer. These preliminary vulnerability assessments are useful for highlighting patterns, summary statistics, and planning implications for municipalities, however, in most cases more detailed assessments are needed to identify site-specific vulnerabilities and possible adaptation strategies or solutions.

4.3.2 Highlights of Vulnerabilities

Roadways and Transportation Assets

State and local roadways throughout the coastal region are vulnerable to flooding and damage from storm surge, sea-level rise, and extreme precipitation. In many municipalities, flooding is magnified by the combination of tidal or storm related flooding and freshwater flooding. Additionally, ongoing analysis of pavement profiles with changing groundwater levels demonstrates that the service life of pavement systems is reduced as groundwater rises with sea-level rise.

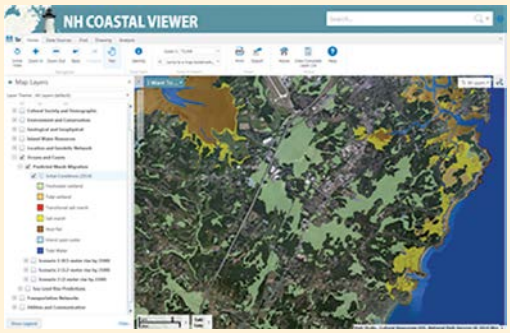
Throughout the Atlantic Coast municipalities, Route 1-A provides the vital transportation link on the coast and is essential to coastal communities for access, safety, livability, recreation and for the continued viability of the coastal tourist economy. With its direct shoreline exposure, it comes as no surprise that Route 1-A is the transportation asset most vulnerable to coastal flooding and disruption from sea-level rise. Route 1-A and any connecting streets and roads are significantly affected by sea-level rise in the 4.0 feet and 6.3 feet sea-level rise scenarios. In addition to Route 1-A, local roads are highly vulnerable to sea-level rise and storms. In all of the seven Atlantic Coast municipalities, the miles of local roadways impacted by flooding are at least double the miles of state roadways affected under all six scenarios. To a great extent, local responses on municipal roads will depend on State plans for improving the resilience of Route 1-A and Route 1, and will require extensive regional coordination.

The Great Bay communities are closely tied together by a dense network of state highway and local road systems. The primary state highways serving these communities are Interstate 95 and Routes 1, 1A, 4, 16, 33, 101, 108, and 125, all of which have sections that traverse tidal waters and freshwater bodies.

Table 4 reports the miles of state and local roadways affected by each of the sea-level rise and storm surge scenarios for the seven Atlantic Coast municipalities as identified in the Tides to Storms vulnerability assessment. Similarly, Table 5 reports the miles of state and municipal roadways affected by each of the sea-level rise and storm surge scenarios for the ten Great Bay municipalities as identified in the C-RiSe vulnerability assessment. By a wide margin, state and local roadways in Great Bay municipalities are at much lower risk from sea-level rise and storm surge flooding than in the Atlantic Coast municipalities. This is in part because there is enough topographic relief along the interior coastline to prevent widespread flooding and historic settlement patterns were focused upriver from coastal areas.

In addition to road surfaces, road crossing facilities such as culverts and bridges are vulnerable to flooding from coastal storms, sea-level rise, and extreme precipitation and damage to crossings can cause significant impacts

The New Hampshire Coastal Viewer: You Can Map Vulnerabilities Too!



The NH Coastal Viewer is an online mapping tool that brings coastal resources spatial data, hazards-related spatial data, and other spatial data sets within NH's 42 coastal watershed communities together in one place. Users can search for available data sets; display the data sets in multiple ways; and create, print, and share customized maps. The Coastal Viewer endeavors to serve as a one-stop shop for all coastal resources and hazards-related spatial data in NH's coastal watershed; to improve access to new and existing spatial data sets; and to provide information about coastal resources, hazards, and opportunities to reduce risk from these hazards and increase coastal resiliency. The Coastal Viewer was developed by NH GRANIT and the NHDES Coastal Program and funded by the National Oceanic and Atmospheric Administration's Office for Coastal Management. You can access the Coastal Viewer to explore data and make maps focused on understanding local vulnerability to coastal hazards at **http://granit.unh.edu/nhcoastalviewer/**.

TABLE 4. Miles of state and local roadways affected by sea-level rise and storm surge* scenarios for the seven Atlantic Coast municipalities.**
Source: RPC (2015).

Sea-Level Rise (SLR) Scenarios	1.7 feet SLR	4.0 feet SLR	6.3 feet SLR	1.7 feet SLR + storm surge	4.0 feet SLR + storm surge	6.3 feet SLR + storm surge
ROAD TYPE						
State	1.6	6.6	14.1	18.7	21.8	25.6
Local	3.5	17.0	29.4	32.8	38.8	50.5
TOTAL MILES	5.1	23.6	43.6	51.5	60.6	76.1
Portsmouth	1.1	2.2	4.9	4.2	7.5	11.0
New Castle	0.1	0.5	1.4	1.5	1.8	2.8
Rye	0.2	4.5	9.5	10.6	14.1	17.1
North Hampton	0.0	0.7	1.3	1.4	2.6	3.0
Hampton	3.4	13.2	20.6	25.8	26.7	31.3
Hampton Falls	0.0	0.1	0.3	0.2	0.4	0.7
Seabrook	0.4	2.4	5.7	7.8	7.5	10.3

* Storm surge = 100-year (one-percent-annual-chance) flood event.

**The seven Atlantic Coast municipalities include Hampton, Hampton Falls, New Castle, North Hampton, Portsmouth, Rye, and Seabrook.

TABLE 5. Miles of state and municipal roadways affected by sea-level rise and storm surge* scenarios for the ten Great Bay municipalities.**
Source: NHDES et al. (In-Progress).

Sea-Level Rise (SLR) Scenarios	1.7 feet SLR	4.0 feet SLR	6.3 feet SLR	1.7 feet SLR + storm surge	4.0 feet SLR + storm surge	6.3 feet SLR + storm surge
ROAD TYPE						
State	0.2	0.4	1.2	0.7	1.8	3.5
Local	0.0	0.8	2.6	1.5	3.6	5.3
Private	0.0	0.4	1.8	1.1	2.3	3.4
Not Maintained	0.0	0.1	0.1	0.1	0.1	0.2
TOTAL MILES	0.2	1.7	5.7	3.4	7.8	12.4
Dover	0.0	0.3	1.8	0.9	3.1	5.5
Durham	0.0	0.3	0.7	0.4	0.9	1.6
Exeter	0.0	0.6	1.1	0.8	1.2	1.4
Greenland	0.0	0.0	0.2	0.0	0.5	0.7
Madbury	0.0	0.0	0.0	0.0	0.0	0.0
Newfields	0.0	0.0	0.0	0.0	0.0	0.0
Newington	0.0	0.1	0.7	0.5	1.0	1.3
Newmarket	0.0	0.1	0.4	0.2	0.4	0.7
Rollinsford	0.0	0.1	0.2	0.1	0.2	0.3
Stratham	0.2	0.3	0.6	0.5	0.6	0.9

* Storm surge = 100-year (one-percent-annual-chance) flood event.

**The ten Great Bay municipalities include Dover, Durham, Exeter, Greenland, Madbury, Newfields, Newington, Newmarket, Rollinsford, and Stratham.

downstream of roadways. Efforts are ongoing to identify and assess the tidally-influenced culverts at risk of sea-level rise and additional flooding from extreme precipitation. Some red-listed bridges in the Coastal Region may also be at risk of sea-level rise and storm surge, including bridges in Hampton, New Castle, Dover, and the Portsmouth US1 Bypass over the Piscataqua River, however more analysis is needed to understand the scope of that vulnerability.[61]

Madbury and Dover: Leaders in Floodplain Management

Two coastal municipalities currently enforce regulations that exceed the National Flood Insurance Program minimum standards. In 2009, Madbury adopted freeboard regulations, which require the lowest floor of new residential structures and manufactured homes to be elevated one foot above the base flood elevation. Madbury also adopted regulations that prohibit new buildings and certain other development in special flood hazard areas.

In 2015, Dover adopted freeboard regulations, which require the lowest floor of residential and non-residential structures that are new construction or substantial improvements to be elevated two feet above base flood elevation.

(Left: Floodplain management brochure distributed by the City of Dover to residents).

Critical Structures and Facilities

Communities recognize the importance of ensuring that emergency facilities and shelters be located in places that are secure and accessible. A preliminary assessment of some critical facilities shows a few examples at risk of sea-level rise and storm surge. If a one-percent-annual-chance-storm occurred on top of 6.3 feet of sea-level rise, facilities that may be vulnerable include the Hampton Police Station and Fire Station; the Hampton and Seabrook wastewater treatment facilities; the Durham primary sewer lift station; and the Riverwalk/Schanda Park and the Creighton Street Pump Station, both in Newmarket.

By a wide margin, critical structures and facilities in the Great Bay municipalities are at much lower risk from sea-level rise and storm surge flooding than those in the Atlantic Coast municipalities according to the findings of the Tides to Storms[62] and C-RiSe[63] vulnerability assessments. Again, this is in part because there is enough topographic relief along the interior coastline to prevent widespread flooding and historic settlement patterns were focused upriver from coastal areas.

Energy facilities fuel our economy and are uniquely important as they power most other critical structures and facilities, including those emergency facilities and shelters that we rely upon during coastal storms and floods. The electrical grid is especially vulnerable to extreme weather events.[64] On average, over 300,000 people were affected by electricity outages between 2008 and 2013 across New Hampshire; the leading causes of electricity outages were weather and falling trees.[65] Following the massive power outages that occurred in 2011 after a large snowfall event in October, utility companies across the region have worked to improve the resilience of the electrical grid. However, additional assessment is needed to better understand the vulnerability of the electrical grid in New Hampshire, and in particular, the vulnerability of large power transformers and substations.

Similar to energy systems, communication systems are an integral component of our economy and provide critical services required to support daily operations in business, government, education, and public safety organizations.[66] Over the last 25 years, the communications sector has evolved into a highly interconnected sector that relies upon terrestrial, satellite and wireless transmission systems; we now rely heavily on cellular networks and the internet. Private sector entities are the primary owners and operators of the majority of our communications infrastructure, and are responsible for protecting communication assets and maintaining overall function of the system. Additional information is required to determine system vulnerabilities to projected flood risks in coastal New Hampshire. As with the electrical grid and energy systems, this vulnerability assessment will require collaboration with the private sector.

Private Property and the National Flood Insurance Program

Floodplain management is one of the most useful existing regulatory frameworks intended to identify existing flood vulnerabilities in the built environment and reduce negative impacts from flooding. The National Flood Insurance Program (NFIP) is a voluntary program administered by the Federal Emergency Management Agency (FEMA) in which communities agree to adopt and enforce at least the minimum requirements established under the NFIP for all development in mapped special flood hazard areas which encompass the one-percent-annual-chance flood area (or 100-year flood). All residents in NFIP communities are then eligible to purchase flood insurance whether the structure is located in or outside a special flood hazard area as shown on FEMA's Flood Insurance Rate Maps (FIRMs). Anyone who owns property with a structure in a special flood hazard area and has a federally-backed mortgage is required to purchase NFIP flood insurance.

All 17 coastal zone municipalities participate in the NFIP and all but two communities have only adopted the NFIP minimum standards, which offer structures some protection from flood damage. It is important for municipalities to consider adopting additional floodplain regulations, which will not only make their municipalities more flood resilient, but can also reduce flood insurance costs for property owners. One of the most common higher standards adopted by communities is known as freeboard, which is an additional height requirement for the lowest floor of a structure to be above the base flood elevation (i.e., the elevation to which floodwaters are expected to rise during a one-percent-annual-chance-flood). The additional height provides a margin of safety against extraordinary or unknown risks and can reduce the property owner's flood insurance premium.

The rising cost of NFIP flood insurance is a concern for most owners of structures located in a special flood hazard area especially since 2013 when FEMA began implementing two flood insurance reform acts, passed by Congress. The new laws aim to gradually eliminate a variety of existing flood insurance subsidies and establish new flood insurance premium rates that reflect the true flood risk to a property and full actuarial rate. As a result, flood insurance premium rates on many properties in special flood hazard areas will likely increase. Certain categories of structures are seeing a faster rise in their flood insurance costs. These structures include business properties, non-primary residences, and properties that have experienced severe repetitive flood losses. Property owners can take action to reduce these costs by making modifications to their structures that will reduce their flood risk.

Communities that conduct floodplain management activities that exceed the NFIP minimum requirements can also assist some of their residents and businesses with rising flood insurance costs by participating in the Community Rating System (CRS). CRS is a voluntary incentive program administered by FEMA. NFIP communities in good standing can apply to join and actively participate in CRS. A community that conducts floodplain management activities can earn points for each activity. The number of points a community accumulates determines the percent discount some of their residents and businesses will receive on their annual flood insurance premiums.

Examples of CRS activities that a community can receive credit for, specifically related to coastal areas, future conditions, and climate change impacts include:

- Provide information about non-mapped areas that are predicted to be susceptible to flooding in the future,
- Advise prospective buyers of a property of the potential for flooding due to climate changes and/or sea level rise,
- Base community regulatory map on future-conditions hydrology, including sea-level rise, by adopting an overlay,
- Adopt community stormwater program that regulates runoff from future development,
- Preserve open space in the floodplain, and
- Pass community regulation to protect shorelines in their natural state.

Currently in New Hampshire, four communities outside of the coastal region (Keene, Marlborough, Peterborough, and Winchester) participate in CRS. Two of these communities receive a 10-percent discount and the other two communities receive a five-percent discount. The coastal towns of Rye and Hampton are currently working on their applications to join CRS. Communities that are not interested in joining CRS but want to improve their floodplain management programs can use the CRS information as guidance.

As of August 2016, there were a total of 3,039 NFIP flood insurance policies in effect in New Hampshire's coastal zone with a total insured value of over $645 million, both of which are approximately 35 percent of the state totals. Figure 12 shows that Hampton holds 59 percent of those policies followed by Rye with 10 percent and Seabrook Beach Village District with 6 percent. Since 1978, there have been a total of over $10 million in NFIP paid losses in the 17 coastal zone municipalities—approximately 20 percent of the state's total. As shown in Figure 13, Hampton has 43 percent of those losses followed by Rye with 16 percent and Exeter with 11 percent.[67]

While FEMA-mapped FIRMs only consider historical flood extent, the 1.7 feet sea-level rise scenario map is mostly contained within the current 100-year floodplain, with minor incursions into the 500-year floodplain and other low lying areas. Flooding expands beyond the 100-year floodplain under higher sea-level rise scenarios. This means that if sea-level rise reaches higher projections, today's one-percent-annual-chance floods could occur twice every day and the new one-percent-annual-chance floods will likely reach further upland. Table 1 reports the acreage within the current 100-year floodplain impacted by projected sea-level rise and coastal storm surge in the seven Atlantic Coast municipalities, increasing from 8,180 acres under the 1.7 feet sea-level rise scenario to 9,818 acres under the 6.3 feet sea-level rise plus storm surge scenario. Similarly, Table 2 reports the acreage within the current 100-year floodplain impacted by projected sea-level rise and coastal storm surge in the ten Great Bay municipalities, increasing from 739 acres under the 1.7 feet sea-level rise scenario to 1,461 acres under the 6.3 feet sea-level rise plus storm surge scenario.

FIGURE 12. Percent of total NFIP policies in Coastal New Hampshire in September 2015. *Source: NHOEP (2016c).*

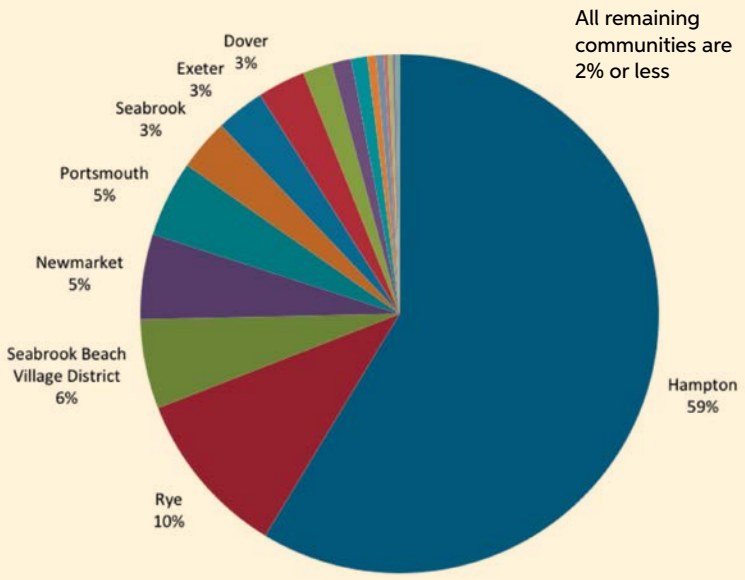
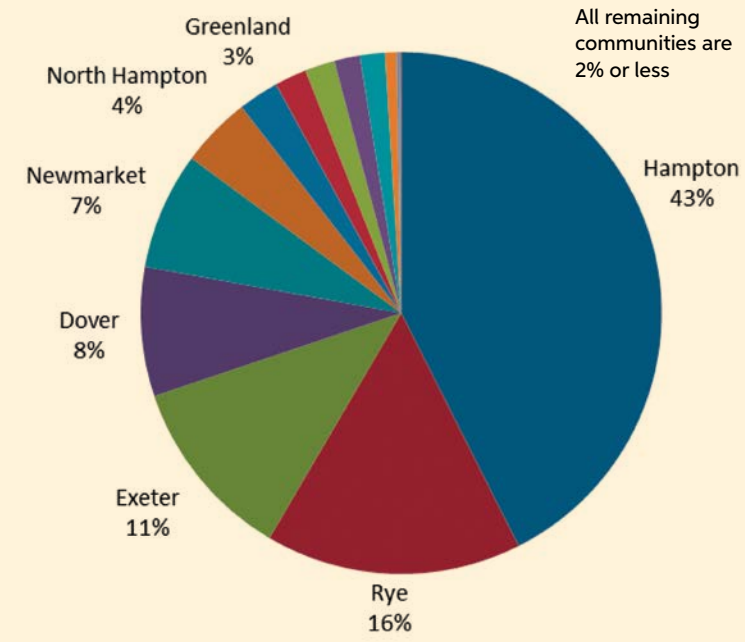


FIGURE 13. Percent of total NFIP paid loss amounts in Coastal New Hampshire since 1978. *Source: NHOEP (2016c).*



4.3.3 Relevant Recommendations

KEY COMMISSION RECOMMENDATIONS: Our Built Landscape	
BL1.	Encourage state agencies and municipalities to complete vulnerability assessments for state, municipal, and regulated private structures and facilities. *[Lead: State Legislature; State Agencies; Municipalities].*
BL2.	Implement regulatory standards and/or enact enabling legislation to ensure that the best available climate science and flood risk information are used for the siting and design of new, reconstructed, and rehabilitated state-funded structures and facilities, municipal structures and facilities, and private structures. *[Lead: State Legislature; State Agencies; Municipalities].*
BL3.	Map the plausible future changes in freshwater and coastal floodplain extent and depth based on best available information about future precipitation and land use for all municipalities. *[Lead: State Agencies].*
BL4.	Integrate comprehensive land use and environmental planning with floodplain management approaches that prevent and minimize impacts from coastal hazards. *[Lead: State Agencies; Municipalities].*
BL5.	Document coastal and riverine shoreline conditions and assess vulnerability of natural features and engineered structures that protect people, structures, and facilities under current and future conditions. *[Lead: State Agencies].*
BL6.	Develop a comprehensive, integrated New Hampshire Tidal Shoreline Management Plan (TSMP) that presents general priorities for coastal shoreline management, as well as site-specific and place-based strategies including, where appropriate, protection, adaptation, and abandonment. *[Lead: State Agencies].*

4.4 Our Natural Resources

OUR NATURAL RESOURCES are the natural systems that support important species and biodiversity in coastal New Hampshire and provide critical and important services to coastal New Hampshire like food, flood protection, fresh water, raw materials, and recreation opportunities.

4.4.1 How We Assess Vulnerability

The natural resources that draw residents, visitors, and businesses to southeastern New Hampshire are a cornerstone of our quality of life. Residents, visitors, and businesses depend on clean water for drinking, swimming, and boating; floodplains and wetlands provide water storage in extreme weather events and as water levels rise; oyster reefs and dune systems provide physical barriers to coastal storms; salt marshes and eelgrass beds are critical habitat for our commercial and recreational fisheries; our beaches draw hundreds of thousands of visitors that boost our state economy and tax income; and our forests and lands provide materials for heating, building and construction, and farm and food products like maple syrup. Together, our coastal natural resources provide important benefits to the people who live here.

Maintaining these benefits is critical to our economy, health, and safety. Yet, as our rivers, estuaries and ocean waters are impacted by storm surge, sea-level rise, extreme precipitation, and other climate impacts, the physical and biological character of our coast is expected to change. Persistent coastal flooding and large storms events

already pose risks to the built landscape. Coastal natural resources like salt marshes and near shore ecosystems may be particularly affected due to their close proximity to various components of the built landscape such as roads, drainage facilities, buildings and utilities. Future decisions about how best to manage the built landscape may require trade-offs between public benefits and natural resource protection as both compete for space to adapt to changing conditions.

Sea-Level Rise Impacts on Species and Habitats

Higher water levels will drown salt marshes, deepen estuarine waters, and convert salt marsh to mudflats and mudflats to subtidal zones. Salt marshes are among the most productive ecosystems in the world, and in addition to wildlife habitat, they provide multiple benefits to humans including flood storage, healthy fisheries, storm protection, and long term carbon storage. Salt marshes may be able to migrate where the shore has a gentle, undeveloped slope, but otherwise will not be able to keep up with sea-level rise and will disappear.[68] Modeling can indicate where ecosystems like salt marshes and eelgrass are most likely to be successful under future sea-level rise scenarios. To invest in restoration wisely, we will want to make sure the habitats we restore will survive future conditions.

Running Out of Room: Saltmarsh Sparrows and Sea-level Rise

New Hampshire has three species of sparrows that depend on salt marsh habitat to survive: the saltmarsh sparrow, the seaside sparrow and Nelson's sparrow. All three species build their nests in the salt marsh, right on the high tide line. When there are unusually high tides, the birds' nests flood and their breeding success is compromised. As sea level rises, the critical breeding habitat for these birds is threatened if salt marshes cannot migrate inward. And if more extreme events cause higher water levels from precipitation or storm surge, the nests' position at the high tide line makes them extremely vulnerable.

Photo credit: Magnus Manske / Creative Commons License

Deeper estuarine waters will deplete eelgrass beds because the light necessary for eelgrass growth and survival will no longer penetrate to the estuarine floor. Rocky intertidal zones will migrate landward where conditions are favorable and disappear where conditions are unfavorable. Changing water levels may impact where fish and waterfowl feed and breed, and saltwater intrusion may change freshwater wetlands to brackish wetlands – altering the types of flora and fauna those systems can support. Rising groundwater levels and saltwater intrusion due to changes in sea level may also impact water resources including local aquifers and drinking water sources (municipal, private and commercial supplies), agricultural lands, and, later, the hydrology of forest ecosystems, and riparian ecosystems.

Storm Surge Impacts to Dunes, Salt Marshes, and Estuaries

Storm surges disrupt dunes, salt marshes, and estuaries. These habitat types are critical to rare species like the saltmarsh sparrow and the piping plover. The sudden changes in salinity, water level, and sedimentation that storm surge causes can be devastating to coastal plants and animals and the habitat types that they depend on. Dunes protect structures and facilities as well as the habitat that lies behind them, and major storm surges would naturally push dunes "back." When dunes do not have a natural path to retreat, they disappear and/or erode. High tides and storm surges will move dunes and may lead to barrier beaches being breached by large storm events. A major breach would change the salt marsh habitat behind the dunes, as well as the beach itself, and sedimentation from large storm events could also smother eelgrass and shellfish beds.

Extreme Precipitation Impacts on Natural Systems

Photo credit: Tricia Miller

Extreme precipitation will change the temporal distribution of fresh water to river and estuarine systems. In the marine environment, freshwater pulses may impact the timing and abundance of algal blooms and influence which species can enter the estuary to breed or feed. This could lead to changes in freshwater wetland systems, an important habitat for many southern New Hampshire birds and amphibians. Increases in episodic water flow in floodplains may change the types of plants and animals that can live in and along our rivers. For example, many fish are sensitive to water temperature which is related both to storm events and to the types of shrubs and trees that live along the bank. With increased flooding both the shoreline species and the in-water species will need to be able to adapt to a wider range of salinity and temperature conditions. Increased precipitation will also lead to an increase in untreated stormwater and, potentially, wastewater when combined sewer outflows are overwhelmed. Increased precipitation, coupled with rising groundwater levels, could compromise the function of individual septic systems and both private and municipal stormwater management facilities. These system failures may result in increased transfer of pollutants to groundwater, surface waters, wetlands, and estuarine systems. Pollutants adversely affect all natural systems and can lead to fish kills, oyster die offs, smothered eelgrass beds, and noxious algal blooms. Freshwater pulses and decaying algal blooms also contribute to ocean acidification. As the ocean becomes more acidic, shellfish and other marine organisms face mortality and reduced fertility.

Human Response to At-Risk Coastal Habitats

Natural systems are inherently adaptive. Most species and habitats can move, accommodate change and adapt to new surroundings if they have intact natural systems around them. Therefore the way that people react to rising seas, coastal storms, and riverine flooding can lead to the most serious threats to coastal ecology. Hardening shorelines to defend structures and facilities against flood and storm surge hazards alters the natural system and prevents habitats and species from migrating landward as sea levels rise and coastal flooding occurs. Hardened structures also alter the hydrology of natural systems, diverting water and increasing runoff. Polluted runoff will increase as precipitation events increase, compounding the damage to natural systems. Human response to extreme coastal flooding or storm surge also compromises living resources, often deploying heavy equipment and structures intended to protect human lives and property.

The cumulative impact of these threats, in combination with climate-driven threats, will result in different conditions along the coast. In some cases, the species that have thrived in southeastern New Hampshire will have a difficult time adapting to changes in water level, salinity, sedimentation, and temperature. At the same time, opportunistic invasive species are likely to gain advantage over native species. This loss of biodiversity has a cascading effect on the natural system's ability to recover from disruption and maintain the functions (flood attenuation, recreational benefits, fisheries habitat, etc.) that people value.

4.4.2 Highlights of Vulnerabilities

Photo credit: JoAnn Theriault

Much work is being done to determine which natural coastal resources are vulnerable to climate change impacts in New Hampshire and to identify strategies to minimize risk to those natural resources. The 2015 NHFG Wildlife Action Plan presents substantial information about the vulnerabilities faced by New Hampshire species and ecosystems.[69]

In one specific example, NHFG ran a Sea Level Affecting Marshes Model (SLAMM) in 2014 to determine how coastal habitats, and specifically salt marshes, might respond to different sea-level rise scenarios. The model demonstrates where marshes have the ability to migrate landward, and if they will have the chance to do so before being drowned by rising water levels. Model results indicate that if sea level rises 6.6 feet by 2100, 240 acres of existing salt marsh will likely be lost by 2025 and only 300 acres will likely remain by 2100, amounting to a 95 percent loss of salt marsh.[70]

Figure 14 demonstrates current habitat distribution in the Hampton-Seabrook Estuary: the yellow color represents salt marsh and the brown color represents mudflat.[71] Modeling indicates that under a scenario of 6.6 feet of sea-level rise by 2100, the habitat distribution changes dramatically, as seen in Figure 15 where there is almost no salt marsh present and the majority of the estuary is either open water or mudflat.[72]

FIGURE 14. Current Hampton-Seabrook Estuary tidal wetlands. *Source: NHFG (2014).*

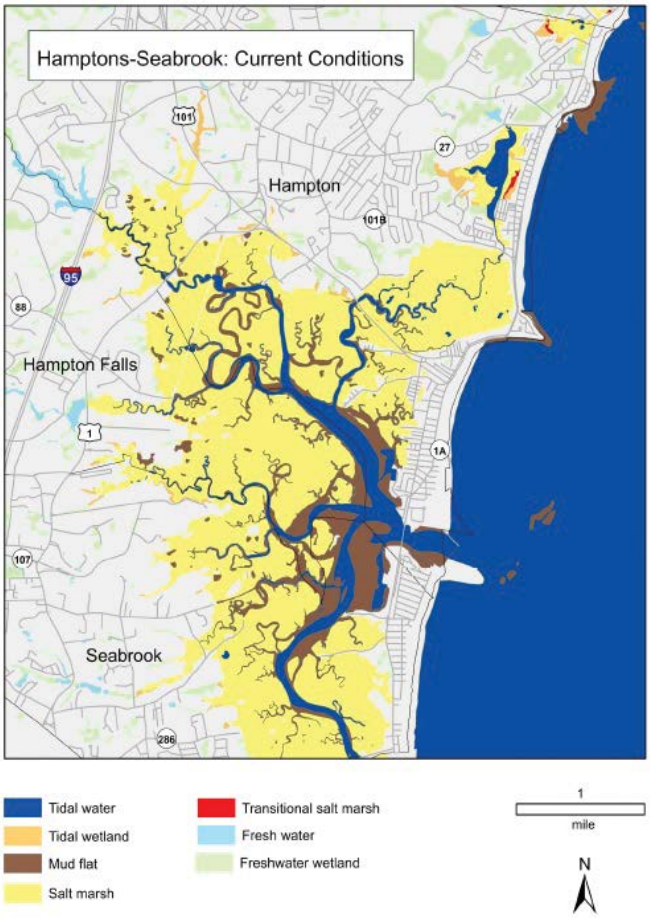
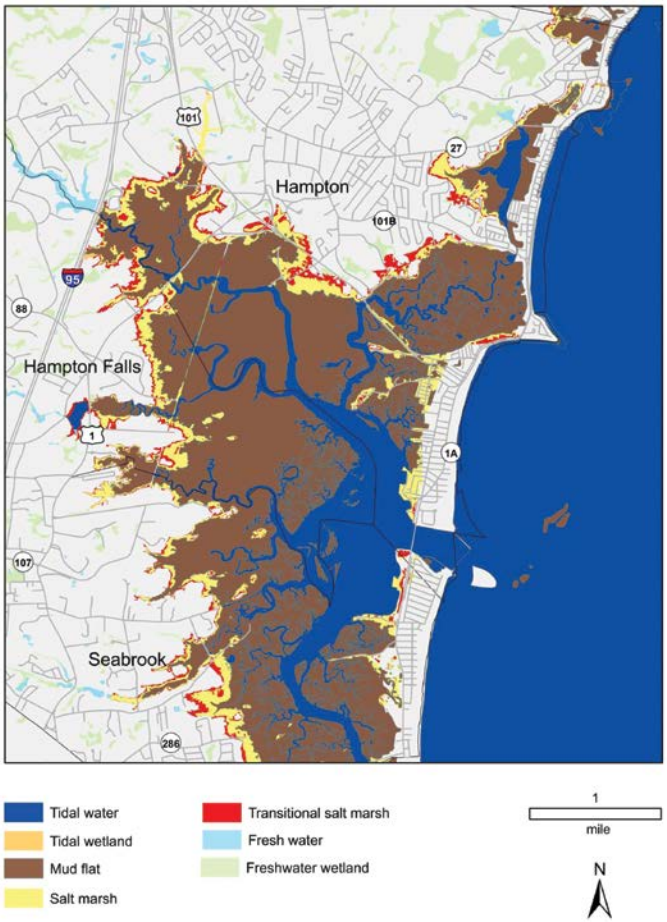


FIGURE 15. Modeled Hampton-Seabrook Estuary tidal wetlands in 2100 with 6.6 feet of sea-level rise. *Source: NHFG (2014).*



Impacts to the following natural resources were evaluated as part of the Tides to Storms vulnerability assessment for the Atlantic Coast municipalities: surface water; aquifers; freshwater and tidal wetlands; critical wildlife habitat; land protection priorities; conserved land; and agricultural soils. Table 6 reports the number of acres of each natural resource affected by each sea-level rise and coastal storm surge scenario for the seven Atlantic Coast municipalities as identified in the Tides to Storms vulnerability assessment. Impacts to the same categories of natural resources, with the exception of agricultural soils, were also evaluated as part of the C-RiSe vulnerability assessment for the Great Bay municipalities. Table 7 reports the acreage of each of the natural resources affected by each of the sea-level rise and storm surge scenarios for the ten Great Bay municipalities.

TABLE 6. Natural resources (acres) affected by sea-level rise and coastal storm surge* scenarios for the seven Atlantic Coast municipalities.**
Source: RPC (2015).

Sea-Level Rise (SLR) Scenarios	1.7 feet SLR	4.0 feet SLR	6.3 feet SLR	1.7 feet SLR + storm surge	4.0 feet SLR + storm surge	6.3 feet SLR + storm surge
Surface Water	49	134	144	144	152	156
Aquifers	8	24	56	48	87	122
Freshwater Wetlands	184	396	519	489	593	661
Tidal Water Wetlands	235	257	264	266	268	269
Critical Wildlife Habitat	4,022	4,851	5,469	5,385	5,948	6,458
Land Protection Priorities	1,081	1,600	1,915	1,865	2,112	2,310
Conserved Land	493	717	873	883	1,007	1,131
Agricultural Soils	123	378	678	620	937	1,238

* Storm surge = 100-year (one-percent-annual-chance) flood event.
** The seven Atlantic Coast municipalities include Hampton, Hampton Falls, New Castle, North Hampton, Portsmouth, Rye, and Seabrook.

TABLE 7. Natural resources (acres) affected by sea-level rise and storm surge* scenarios for the ten Great Bay municipalities.**
Source: NHDES et al. (In-Progress).

Sea-Level Rise (SLR) Scenarios	1.7 feet SLR	4.0 feet SLR	6.3 feet SLR	1.7 feet SLR + storm surge	4.0 feet SLR + storm surge	6.3 feet SLR + storm surge
Surface Water	572	709	772	742	805	861
Aquifers	47	142	340	245	430	596
Freshwater Wetlands	59	182	259	222	306	413
Tidal Water Wetlands	754	834	851	845	855	860
Critical Wildlife Habitat	721	1204	1723	1447	1895	2357
Land Protection Priorities	625	1040	1474	1244	1610	1978
Conserved Land	304	610	928	758	1026	1277
Agricultural Soils	N/A***					

* Storm surge = 100-year (one-percent-annual-chance) flood event.
** The ten Great Bay municipalities include Dover, Durham, Exeter, Greenland, Madbury, Newfields, Newington, Newmarket, Rollinsford, and Stratham.
***This analysis was not completed for the ten Great Bay municipalities as part of the C-RiSe project.

The Tides to Storms vulnerability assessment of natural resources indicates that habitat types are likely to shift as a result of sea-level rise and coastal storm surge. Some tidal wetlands will be submerged, some will migrate inland, and some freshwater wetlands and rivers are likely to see brackish or saltwater flooding. Impacted

freshwater river systems include Cains Brook in Seabrook, Taylor River in Hampton, Little River in North Hampton, and Eel Pond in Rye. The Tides to Storms project also recognizes conserved and public land as natural resources, regardless of the habitat types they contain. Portsmouth, Rye, Hampton, and Seabrook have the greatest amount of conserved and public land within the coastal floodplain. Although these lands will be impacted by sea-level rise and coastal storm surge flooding, they serve as important flood storage areas and provide space for future habitat conservation and salt marsh migration.[73]

By a wide margin, surface waters and tidal wetlands are at higher risk of flood impacts in Great Bay municipalities than in Atlantic Coast municipalities according to preliminary C-RiSe findings. This is largely due to the expansive tidal wetlands along Great Bay and its tidal tributaries and the denser network of freshwater rivers and streams in the upper reaches of the coastal region. Freshwater wetlands located in riverine floodplains are also at high risk of inundation by saltwater from rising seas and storm surge. Conservation lands located in projected flood areas will serve important flood storage functions and will help buffer impacts from sea-level rise and storm surge. Critical wildlife habitat located in flood sensitive areas, such as wetlands and floodplains, may be highly impacted by projected changes in hydrology and environmental conditions resulting from inundation by rising seas and periodic flooding from storm surge. If stratified drift aquifers (shallow deposits of sand gravel glacial materials) are impacted by salt water intrusion as sea level rises, this would compromise municipal and residential drinking water sources.[74]

To protect the plants, animals, and natural systems that New Hampshire values, we need to understand how coastal hazards and risks might impact natural resources and prioritize management actions. Some actions, like land protection, suggested in this report can protect multiple species from both known and unknown impacts of climate change. It is important to recognize that some of the most significant threats to our natural resources may be associated with climate-related threats that are not investigated by this Commission; such as changes in air and water temperatures and water chemistry.

4.4.3 Relevant Recommendations

KEY COMMISSION RECOMMENDATIONS: Our Natural Resources	
NR1.	Identify and map natural resources that are vulnerable to current and future coastal risk and hazards. *[Lead: State Agencies].*
NR2.	Develop natural resource restoration plans that explicitly consider future coastal risk and hazards, and the ecological services that they provide. *[Lead: State Agencies; Municipalities].*
NR3.	Protect land that allows coastal habitats and populations to adapt to changing conditions and also provides ecosystem services that protect people, structures, and facilities. *[Lead: State Legislature; State Agencies; Municipalities].*
NR4.	Encourage State agencies and municipalities to consider ecosystem services provided by natural resources in land use planning, master plans, and asset decisions. *[Lead: State Agencies; Municipalities].*
NR5.	Assess the impact of freshwater and tidal crossings on adjacent tidal wetlands, aquatic organism passage, and public safety under existing and future climate conditions. *[Lead: State Agencies].*
NR6.	Assess current conditions of groundwater resources and impacts from best available climate science. *[Lead: State Agencies].*
NR7.	Restore or maintain natural flow regimes (groundwater, surface water and wetlands) to increase ecosystem resilience to extreme weather events and other coastal hazards, including floods, drought, and sea-level rise. *[Lead: State Agencies].*

4.5 Our Heritage

OUR HERITAGE encompasses the abundance of recreational, cultural, and historic resources, including economic assets and elements of the built landscape, in coastal New Hampshire that our state and communities wish to protect in the face of coastal risk and hazards.

4.5.1 How We Assess Vulnerability

Recreational Resources

Recreational destinations can be directly vulnerable to coastal storm surges, sea-level rise, and extreme precipitation. Because the resources vary significantly, vulnerabilities can and should be assessed in a variety of ways. Depending on their geology, public coastal beaches may be at risk of long-term erosion from sea-level rise and extreme short-term erosion in coastal storms. Our public parks located near tidal waters may be vulnerable to sea-level rise and storm surge; however they may also serve as intentional flood storage areas during extreme events, particularly ones in low lying areas with extensive open space.

Impacts to recreational resources will also affect their use by residents and tourists. If coastal habitats disappear with sea-level rise or more intense storms, then recreational fishing and birding that are supported by those habitats may also diminish.

In order to fully understand how recreational resources are vulnerable to coastal risks and hazards, an assessment should evaluate the physical exposure of recreational destinations to direct impacts, their sensitivity or capacity to bounce back after a shock, and finally, whether those resources can adapt to changes. For example, in the event that a beach destination is eroding, we must understand whether that beach should be renourished and if so, for how long. We could also evaluate whether alternative beach locations exist that could accommodate the recreational demand if that particular beach were to disappear.

The Wentworth-Coolidge Mansion: A Vulnerable Historic Landmark

Photo credit: Andy Willey

The 18th-century Wentworth-Coolidge Mansion was home to New Hampshire's first Royal Governor Benning Wentworth from 1753 to 1767. It is the only surviving residence of a Royal Governor in the United States. The mansion, listed in the National Register of Historic Places, sits on the banks of Little Harbor. Sea-level rise and storm mapping show that the grounds and part of the mansion are exposed to sea-level rise and storm surge. The site is managed by the New Hampshire Department of Resources and Economic Development (DRED) as a State Park. It is a popular tourist destination within the City of Portsmouth. DRED has identified the site as a priority for a detailed vulnerability analysis and preparedness planning.

Cultural and Historic Resources

Cultural and historic resources are not a stand-alone or separate resource type and include historic buildings and districts, archaeological sites, and institutions such as museums and libraries. These are all places that physically represent our histories and cultures. Cultural resources often survive because of the value in their ongoing uses (e.g., how Main Street areas of towns and cities have adapted over time). Many of these resources have economic value as well as historic value (e.g. Main Street stores), recreational value (e.g. museums, parks), or functional value (e.g. bridges, dams, culverts).

New Hampshire towns typically center on a few key public or semi-public buildings. The Meetinghouse represents the need for communal gathering places for both decision-making and socializing. Granges and libraries represent movements for education and social and political outlets. Domestic buildings, including factory worker housing, elaborate estates, and every variation in between are represented in the housing stock of each town. Factory and mill buildings remain from the industries that drove the economies of many towns, and Main Street commercial districts continue to offer business opportunities. The transportation and communication networks that tied these communities together have evolved over time, leaving physical remnants of their evolution. All of these features and more represent the tangible, irreplaceable heritage of our state and serve to make each community a unique representation of its own history and that history's reuse today.

Harry Hu/Shutterstock.com

Coastal New Hampshire contains a rich assortment of such resources, including some of the oldest indigenous settlements in the state dating back 12,500-13,000 years before present (B.P.). During the earliest years of settlement the environment consisted of open tundra and lower sea levels than present day. It is suspected that many of the earliest sites dating to 10,000 B.P. along the Seaboard Lowland lie just offshore and are inundated. The remaining periods of Native American occupation and settlement from 8,000 years B.P. to European contact are well-represented in the archaeological record within the New Hampshire coastal region. With exploration by the English beginning around 1603 in the region, and settlement beginning in the 1620s and 1630s, the cultural and historical resources of the Atlantic Coast and Great Bay regions of New Hampshire are rich traditions that are key to the identity of New Hampshire.

While the value of archaeological sites is partly scientific, revealing new information about the past, it is also social, providing opportunities for education, recreation, and reflection. Archaeological properties range from larger native village sites, historic forts, and tidal mills to smaller sites such as temporary encampments of native populations. Archaeological research carried out to date has identified 102 sites along New Hampshire's coastal margins and surrounding the Great Bay. The majority of sites relate to Native American occupation, but sites relating to European settlement are also represented. The identification of sites and systematic archaeological excavations and research have occurred only sporadically in this region through the years. Reliable reconstruction of the past depends on the recovery and examination of a range of archaeological sites from different periods across varying landscapes along coastal margins. Archaeological sites have revealed evidence of fishing practices and storage methods. Natural resources were also attractive and plentiful, including: fish, shellfish, crustaceans, birds, fish eggs, and marine mammals. Europeans rapidly adapted Native American knowledge of fishing and seafood collection for subsistence. All of this information can be verified and expanded through the archaeological record.

This multi-layered resource type makes historic resources even more valuable when looking at disaster recovery. Research shows that communities that retain a strong sense of place have a leg up on recovery efforts, as people will return to and invest in places where they have strong emotional and interpersonal ties.[75] A strong sense of place comes, in part, from a connection to the history of this place, demonstrated by the use of community landmarks. Historic buildings and neighborhoods and archaeological sites are irreplaceable history, creating

a sense of place in New Hampshire communities. Replacing them with modern buildings will not recreate the heritage; when they are lost, they are lost forever. Therefore, protecting these resources protects the sense of place within communities and can accelerate recovery after a disaster.

4.5.2 Highlights of Vulnerabilities

Recreational Resources

While no comprehensive analysis has been done to understand the vulnerability of coastal recreational resources to climate change impacts, it is clear that some important recreation destinations are at risk of sea-level rise and coastal storms, including State and Town-owned beaches and public access points, outdoor destinations like Strawbery Banke Museum in Portsmouth, and exposed downtown areas such as Hampton's Ocean Boulevard strip.[76] In addition, the Tides to Storms vulnerability assessment reported between 493 and 873 acres of existing conserved and public lands in the seven Atlantic Coast municipalities could be impacted under the 1.7 feet and 6.3 feet sea-level rise scenarios by the year 2100. In a future one-percent-annual-chance storm event, the number of acres impacted could reach up to 1,131.[77] Similarly, preliminary C-RiSe findings indicate that between 304 and 928 acres of existing conserved and public lands in the ten Great Bay municipalities could be impacted under the 1.7 feet and 6.3 feet sea-level rise scenarios, and up to 1,277 acres could be affected when storm surge is added.[78] These estimates indicate potentially serious implications for publicly accessible recreation amenities. Adverse storm and sea-level rise impacts to natural resources like fisheries and bird habitat could also have detrimental effects on recreational activities in coastal New Hampshire.

A more detailed assessment of recreational resources is needed to better understand specific exposure, sensitivity, and adaptive capacity of these resources; and to prioritize areas for preparedness and improve their resilience to coastal flooding.

Cultural and Historic Resources

In order to determine the vulnerability of cultural and historic resources to coastal area risks, data on surveyed resources and risk assessments will need to be compared. These assessments would yield hazards to known resources, as well as potentially at-risk areas about which little or nothing is known. Above-ground (architectural) and below-ground (archaeological) resources are different data sets and are therefore addressed separately.

Above-ground Resources (Architectural)

In general, above-ground resources are vulnerable to anything that may cause moisture damage, particularly extreme storms and flooding. Historic buildings may be more vulnerable than newer buildings in several respects. While they have stood the test of time, many older buildings may have deferred maintenance issues which can be worsened by storm-driven moisture. The high winds that come with extreme storms are also potentially damaging to structures and facilities. Additionally, historic neighborhoods in New Hampshire, especially the oldest developments along the coast, are along water ways, as these were primary transportation corridors. These areas pre-date zoning, flood mapping, and other safety-minded planning concerns, which may mean they were built in areas that did not flood frequently, but also may mean that they are more vulnerable having been "grandfathered" into current rules. With expected sea-level rise due to climate change, the historic floodplains are changing, and more buildings may be at risk of flood damage.

Assessing the vulnerability of historic and cultural resources poses a unique challenge compared to most other asset types. That is, there are many cultural and historic sites that have not been identified, surveyed or mapped, although many properties have been identified through compliance driven surveys and are considered "eligible" for the National or State Registers of Historic Places. Any assessment therefore is partial and incomplete at best. Recognizing this, the Commission did review the vulnerability information included in both the Tides to

Storms and C-RiSe assessments, which included data from the National Register of Historic Places and the New Hampshire State Register of Historic Places to assess which of these known historic resources are affected by coastal flooding under the established sea-level rise and storm surge scenarios. The Tides to Storms vulnerability assessment identified a total of 51 National Register properties and 16 State Register of Historic Place properties in the seven Atlantic Coast municipalities. As shown in Table 8, 17 of those are shown in the mapping analysis to be potentially affected under the 6.3 feet sea-level rise plus storm surge scenario.[79]

TABLE 8. National and New Hampshire State Register of Historic Places properties affected by sea-level rise and storm surge* scenarios for the seven Atlantic Coast municipalities.** *Source: RPC (2015).*

Sea-Level Rise (SLR) Scenarios	1.7 feet SLR	4.0 feet SLR	6.3 feet SLR	1.7 feet SLR + storm surge	4.0 feet SLR + storm surge	6.3 feet SLR + storm surge
National Register of Historic Places	2	3	4	4	6	12
NH State Register of Historic Places	0	4	4	4	5	5
Town of Hampton						
Hampton Beach Fire Station	0	1	1	1	1	1
City of Portsmouth* **						
Strawbery Banke Historic District****	0	1	1	1	1	1
Richard Jackson House	1	1	1	1	1	1
Old North Cemetery	0	0	0	0	0	1
George Rogers House	0	0	0	0	0	1
General Porter House	0	0	0	0	0	1
Haven-White House	0	0	0	0	0	1
Wentworth-Coolidge Mansion	0	0	0	0	0	1
Gov. John Wentworth House	0	0	0	0	1	1
Wentworth-Gardner and Tobias Lear Houses	**0**	**0**	**0**	**0**	**1**	**1**
Portsmouth Marine Railway	0	1	1	1	1	1
Shaw Warehouse	**0**	**1**	**1**	**1**	**1**	**1**
Sheafe Warehouse	0	1	1	1	1	1
Town of New Castle						
Portsmouth Harbor Light	0	0	1	1	1	1
New Castle Cong. Church*****	0	0	0	0	0	0
New Castle Town Hall*****	0	0	0	0	0	0
Town of North Hampton						
Little Boar's Head Historic District****	1	1	1	1	1	1
Town of Rye						
St. Andrew's By-The-Sea	0	0	0	0	0	1
Pulpit Rock Base-End Station*****	0	0	0	0	0	0
Goss Farm	0	0	0	0	1	1
Odiorne Farm	0	0	0	0	0	0

* Storm surge = 100-year (one-percent-annual-chance) flood event.
** The seven Atlantic Coast municipalities include Hampton, Hampton Falls, New Castle, North Hampton, Portsmouth, Rye, and Seabrook.
*** It is expected that a new National Register listing, the "Portsmouth Downtown Historic District" consisting of more than 1200 properties will be added to the National Register in 2016 or 2017.
**** Historic District listings are counted by the National Park Service as one property but include multiple properties and structures.
***** The registered structure is not affected, but access to it will be limited by flooding of the surrounding landing.

As shown in Table 9, the C-RiSe vulnerability assessment has identified a total of 40 National Register properties and four State Register properties in the ten Great Bay municipalities, of which five are shown as potentially affected under the highest flooding scenario.[80]

Photo credit: Todd Selig

It is important to note that the designation of these properties does not come from a systematic review of the resources at hand but rather from the limited sample of properties that appear on either the National Register and New Hampshire State Register of Historic Places, which are based on voluntary property nominations. While this limited assessment serves to highlight a few of the recognized assets that may be at risk, it in no way provides a true assessment of the overall risk to historic properties. A vulnerability assessment based on a more systematic and comprehensive survey of historical resources is needed to understand the full scope of the vulnerability of historic and cultural resources and to prioritize areas for preparedness actions.

Reinforcing this point, research into the New Hampshire Division of Historical Resources' (DHR) town file databases (above-ground survey of buildings, structures, and districts) shows that, for above-ground resources (buildings, districts, structures), 15,034 acres of land have been surveyed in the 17 coastal zone municipalities,

TABLE 9. National and New Hampshire State Register of Historic Places properties affected by sea-level rise and storm surge* scenarios for the ten Great Bay municipalities. ** *Source: NHDES et al. (In-Progress).*

Sea-Level Rise (SLR) Scenarios	1.7 feet SLR	4.0 feet SLR	6.3 feet SLR	1.7 feet SLR + storm surge	4.0 feet SLR + storm surge	6.3 feet SLR + storm surge
National Register of Historic Places	4	4	4	4	5	5
NH State Register of Historic Places	0	0	0	0	0	0
Town of Dover						
Back River Farm	1	1	1	1	1	1
Town of Durham						
Durham Historic District***	0	0	0	0	1	1
Town of Newington						
Margeson, Richman, Estate	1	1	1	1	1	1
Town of Exeter						
Exeter Waterfront Commercial Historic District***	1	1	1	1	1	1
Front Street Historic District	1	1	1	1	1	1

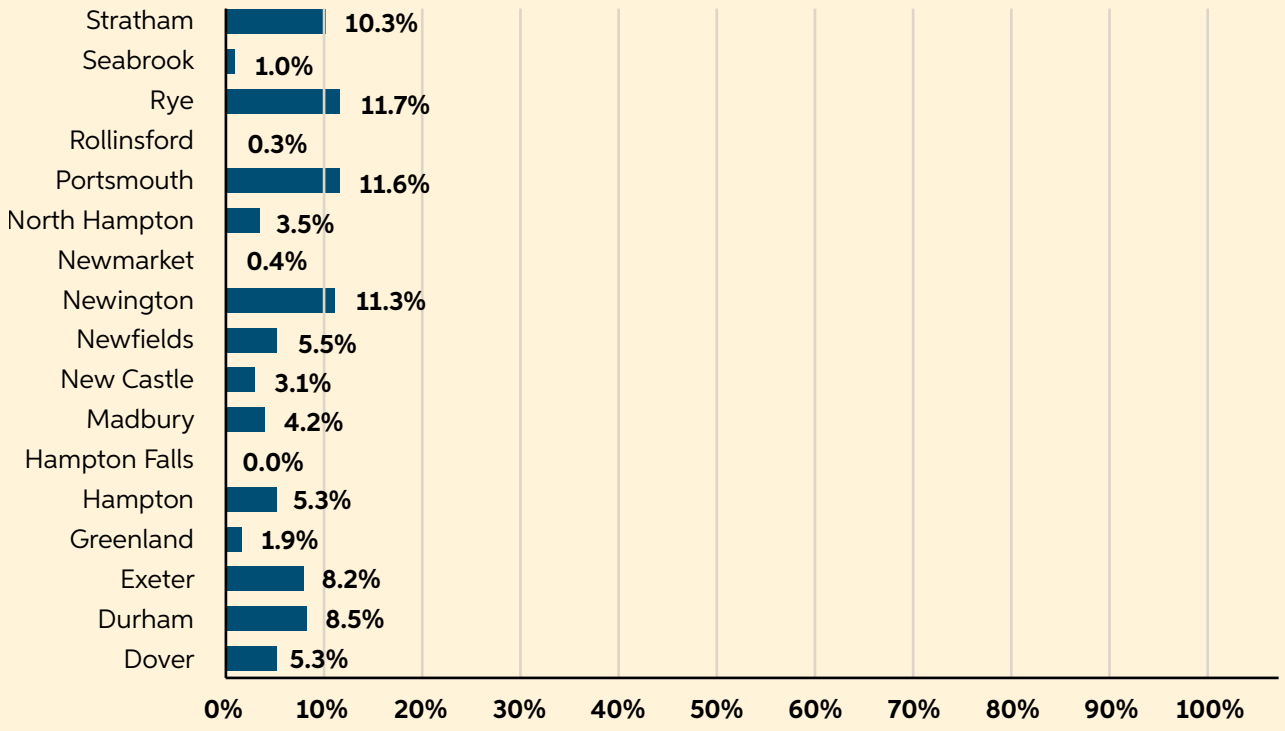
* Storm surge = 100-year (one-percent-annual-chance) flood event.

** The ten Great Bay municipalities include Dover, Durham, Exeter, Greenland, Madbury, Newfields, Newington, Newmarket, Rollinsford, and Stratham.

***Historic District listings are counted by the National Park Service as one property but include multiple properties and structures.

representing only 10.8 percent of the total area that could be surveyed.[81] Figure 16 shows the proportion of area surveyed for above-ground historical resources. This does not mean that all of the unsurveyed areas contain historical resources. It means that at this time, we lack information to determine the presence of historic resources, and that basic baseline data is needed to fully assess the vulnerability of above-ground historical resources in the coastal region.

FIGURE 16. Proportion of area surveyed for above-ground historical resources.* *Source: DHR (2016).*



* Data does not include all National Register-listed properties, and includes only information in the databases as of this report publication. Dataset should not be considered complete and is included for informational purposes only.

Below-ground Resources (Archaeological)

Archaeological sites also are vulnerable to coastal hazards. For most sites, gradual change in sea-level rise is of less concern than some of the other consequences of climate change. Currently underwater sites may survive intact. Most negative effects will come from higher storm surges, changes in storm tide levels, changing wave dynamics, extreme precipitation events, and flooding. These all have the potential to cause erosion, which exposes and damages or even destroys archaeological sites.

There are 581 archaeological properties recorded in Rockingham and Strafford Counties; of these properties, 102 sites are located below the 20 foot mean sea level and are threatened by climate change and its effects. The coast has always been an attractive settlement location and these resources represent the only record of the rich Native American cultures that once lived there.

Ultimately, the biggest vulnerability of cultural and historic resources is our limited knowledge of what cultural and historic resources exist and where they are located throughout the coastal region. Many towns rely on the memories of local long-time citizens, volunteers in their historical societies, and heritage commissions. These are valuable sources of information, but not easily accessible to emergency planners, creators of hazard mitigation plans, or emergency responders, and the data aren't available in digital or mapped formats. The DHR has been

collecting information on historic resources for over 40 years, but as budgets have not kept up with the pace of technology, most information is not available in digital or mapped format. The DHR is currently working on GIS maps and digitization of records for six of the ten New Hampshire counties with funding from a National Park Service grant. Strafford County, which includes four of the coastal zone municipalities, is among the counties not covered by this project.

Additionally, more survey is needed to understand where areas that have high potential for archaeological sites and/or historic buildings and structures may also be at high risk from natural disasters. Community hazard mitigation plans and master plans that include chapters on cultural resources may be helpful in allowing communities to target high risk/high potential areas for future survey. Funding is needed to allow communities to both gather and analyze this material so that mitigation and adaptation plans can be discussed for at-risk resources. Human response to climate change through adaptation and defense may also affect cultural resources if communities are unaware of their resources and their resource location. Including cultural resources in planning will be the best way to mitigate unintended damage during clean up or adaptation projects.

4.5.3 Relevant Recommendations

KEY COMMISSION RECOMMENDATIONS: Our Heritage	
H1.	Identify and survey recreational resources and assess their vulnerability to coastal risk and hazards based on best available climate science. *[Lead: State Agencies; Municipalities].*
H2.	Develop plans and implement strategies to prepare and adapt recreational resources based on best available climate science. *[Lead: State Agencies; Municipalities].*
H3.	Identify and survey cultural and historic resources and assess their vulnerability to coastal risk and hazards based on best available climate science. *[Lead: State Agencies; Municipalities].*
H4.	Require State agencies and encourage municipalities to develop long-term plans for protecting, adapting, or reducing risk to cultural resources affected by climate change. *[Lead: State Agencies; Municipalities].*
H5.	Allocate FY2018-2019 Biennial Budget funding and authority to expend funds for recreational and cultural resource vulnerability surveys, planning efforts, and implementation of the resulting plans. [*Lead: State Legislature].*

5. Understanding What We Need To Do

5.1 General Guidance for Responding to Coastal Flood Risk

In formulating its recommendations, the Commission considered existing approaches to establishing general design and construction standards for structures and facilities that have been considered and enacted in New Hampshire, other states, and at the Federal level. These guidance resources have been summarized in Appendix C. Based on that research, the Commission lays out general guidance and planning principles for responding to coastal flood risk in New Hampshire.

Options for Responses

The increased risk of exposure to coastal flooding from storm surge, sea-level rise, and extreme precipitation raises a number of important issues that should be considered at the state, regional, and local levels. There are considerations that apply to our collective approach and response to this challenge as a state and as communities, as well as responses that apply to the specific asset classes affected (e.g. our economy, our built landscape, our natural resources, and our heritage). The options for responses can be divided into three categories.

1. Defend

This response employs primarily engineered solutions whereby specific sections or features of coastline are protected to prevent coastal erosion and the loss of structures and facilities from flooding—to "keep the water out." Defense techniques can include natural and built systems. Examples of natural systems include creating, protecting, or refurbishing existing sand dunes, vegetated and appropriately sized buffers along rivers and streams and intact wetland systems that can serve to absorb flood waters and wave energy. Built structures include seawalls, dikes, revetments, and ablative defenses such as beach nourishment. There are also hybrids of built and natural defense strategies. Other states have utilized sea walls that incorporate vegetated sections in certain areas. This approach enhances the look of the structure and offers additional benefits from natural defenses and other ecosystem services that vegetation can provide (habitat, food, shading, etc.). Defensive strategies may be appropriate where total cost is not excessive relative to the value of the assets being protected or where safety of populations is at stake. In the case if continuing sea-level rise, the cost effectiveness of this strategy can be expected to decline over time as the cost to defend fixed assets and populations becomes progressively greater. At some point, safety may no longer be reasonably assured regardless of the built and natural defenses.

Adapting Our Coastal Communities Together

The New Hampshire Coastal Adaptation Workgroup (NHCAW) is a collaboration of 22 partners and organizations working to help communities in southeastern New Hampshire prepare for the effects of extreme weather events and other effects of long term climate change.

Photo credit: Cathy Coletti

Since inception in 2010, NHCAW has led numerous projects and events that have elevated discussions about climate preparedness at municipal, state, and regional levels. NHCAW partners incorporate peer-reviewed science and research in the development of tools and technical guidance, and outreach in the coastal watershed to help communities better prepare for the effects of a changing climate in order to protect their social, economic, human and environmental health. For more information, refer to NHCAW's website at **www.nhcaw.org**.

2. Accommodate

Accommodation combines engineered, natural, behavioral, and land use solutions to minimize flooding and, where possible, "live with water." Common accommodate examples include elevating structures on pilings in flood prone areas and designing buildings to allow flood waters to enter the lowest floor while relocating vulnerable systems (heating/cooling units, electricity, and plumbing) to upper floors to avoid damage. Another accommodate strategy is the use of cleared natural drainage corridors for storm driven waves between the ocean and back channel sides of barrier islands. Accommodation usually happens incrementally in response to changing conditions; however, this incremental approach presents significant challenges in the case of linear facilities such as roads, sewer lines, and other utilities. They must be modified in logical segments requiring a coordinated approach. The mix of accommodate strategies can be expected to change incrementally as some strategies decline in effectiveness as the severity of the flooding impact progresses.

Photo credit: Daniel Gobbi

3. Retreat

This response involves abandoning or converting areas where the frequency and severity of flooding impacts are such that permanent settlement is no longer viable or desirable. This response could be undertaken quickly as the consequence of a government buyout or resettlement program (e.g., immediately after a severe flood), or it could occur slowly – the result of a growing inability to provide essential services and of many independent decisions made over time by individual property owners to leave a vulnerable area because of rising costs, repeated loss, or unacceptable risk. Innovative regulatory methods such as rolling easements can facilitate incremental retreat by allowing the existing use of properties for as long as use remains viable, but prohibiting any shoreline armoring or other engineered protections.

In New Hampshire, and likely in other coastal states, the approach taken will be a combination of all three options. Appropriate strategies will likely change over time as the degree of flood risk and exposure rises, requiring the State and municipalities to periodically reassess their responses.

Guiding Principles

Based on the science reviewed and documented in the STAP report, flood risk in the coast is rising, but the rate of that rise is uncertain. A response to defend a segment of coast that is sensible and cost effective in 2050 may become untenable in 2100. Making sensible long-term recommendations with this uncertainty is challenging, and requires flexible approaches. Nevertheless, there are some general guidelines and principles that are useful in making the best possible decisions along the way.

Act Early

Responding now to the future threat of coastal flooding will maximize long-term cost savings that result from building more resilient communities. Resilience is achieved in part by ensuring all current and future investments in facilities and structures can accommodate increases in flood levels expected over their design life without

sustaining large losses. If all future new construction and major renovations in vulnerable areas incorporate resilient designs appropriate to the risk expected within the facility's design life, communities can become incrementally more resilient over time. By starting now, the normal cycles of construction, replacement, and redevelopment can be harnessed to gradually replace substandard designs, often at minimal additional costs.

Photo credit: Laura Fallis

Communities that implement climate adaptation actions early may see many benefits, including but not limited to:

- Enhanced preparedness and community awareness of future flood risks,
- Early identification of cost-effective measures to protect and adapt to changing conditions,
- Improved resiliency of facilities, structures, and other community investments, and
- Protected life, property, and local economies,
- Protected coastal natural resources and the critical services they provide,
- Preserved historical assets and unique community character, and
- Additional credit points awarded through the NFIP Community Rating System (CRS), which provides flood insurance premium discounts for residents in participating communities.

Respond Incrementally

The most difficult circumstance under which to take action in response to a future threat is when there is uncertainty about the degree of risk from that threat. This is especially true when the threat is distant in time and the cost of responding is high – such as with the coastal flooding threat from climate change. In coastal flooding there is risk both in over- and under-estimating the threat. If overestimated, actions may be taken that are unnecessarily expensive and disruptive. If underestimated significant losses in property, resources, and even lives could result.

In these circumstances, an incremental and iterative approach is best, allowing multiple opportunities to refine and correct actions as understanding improves. An incremental approach can adjust to either gradual or catastrophic sea-level rise. At this juncture wholesale investment in hardened shoreline protection structures and major efforts to retreat are not necessary, though these strategies may be appropriate in select, isolated locations. Instead, improving resiliency and the ability to adapt to a wide range of scenarios is the best course of collective action.

Revisit and Revise

Over time, we expect projections of sea-level rise and other contributors to coastal flooding to become more certain, and as they do, we will be better able to predict both the rate at which and by how much sea level is expected to rise. This refinement will allow estimates of vulnerability to become more precise. Likewise, our responses must keep pace with changes in understanding. It is vitally important that state and municipal officials periodically revisit these projections and assumptions and adjust the report's recommendations accordingly.

Collaborate and Coordinate

The State and municipalities share built and natural assets on the coast, and as a result, they need to align policies, assumptions, and responses about future coastal flood hazards to the greatest extent possible. Failure to coordinate such policies and actions will increase the cost and decrease the effectiveness of planning and preparation. Long-term planning and actions to prepare for future flood risk should be developed collaboratively between state, regional, and local governments.

Photo credit: Nathalie Morison

Incorporate Risk Tolerance in Design

With respect to future coastal flood risk, structures, facilities, and other resources should be designed with high safety margins, however, in preparing for future hazards, not all situations warrant the same precautions. Risk tolerance is an important concept in creating sensible and flexible building and design standards. Buildings and facilities that are critical to public functions or safety, that are intended to last a very long time, or that are very expensive to replace should be considered to have low risk tolerance. Facilities and assets with low risk tolerance include (but are not limited to) hospitals, water treatment facilities, bridges, and utilities, as well as irreplaceable or unique historic sites, essential ecosystems, and high value economic assets. In other words, these are assets we can't afford to lose. Design standards should be high for facilities that have low risk tolerance, even if cost is higher to build or maintain them – because as a society we can't afford to do otherwise. Conversely, facilities and structures that are low value, short-lived, easily replaced, or that don't serve a critical function have a high risk tolerance. They do not necessarily require as much concern and can be designed to lower standards.

Make No Regrets Decisions

Generally a no regrets policy or approach refers to actions that yield multiple benefits even under the lowest sea-level rise scenario.[vii] More often than not, acting in ways that improve a community's resilience to present-day risk and hazards will enhance its adaptive capacity to address longer term climate change impacts. Additionally, no regrets decisions should incur relatively low costs or save money over the medium to long term. For example, elevating a pump station three feet above current base flood elevation will increase its ability to function during current coastal storm and flood events, regardless of how much sea level rises in the future. Not only will a functioning pump reduce flooding impacts, it may also remove the need and associated risk and costs for repairs or replacement during or immediately following an emergency or disaster.

5.2 Science and Technical Advisory Panel Guidance

As described in Section 3, The Science and Technical Advisory Panel (STAP) report synthesized the best available science regarding future estimates of storm surge, sea-level rise, and extreme precipitation. The STAP report includes several suggested planning guidelines for the three hazards: storm surge, sea-level rise, and extreme precipitation.

[vii] The National Climate Assessment (2014) *lowest scenario* (0.7 feet by 2100), summarized by the STAP, assumes the historical rate of sea-level rise over the past century continues into the future and does not account for projected rapid changes in atmospheric and ocean temperatures over the 21st century, nor the projected rapid loss of ice from the Greenland and West Antarctic ice sheets.

5.2.1 Storm Surge

The STAP recommends using probabilities of storm frequency and magnitude embodied in updated FEMA Federal Insurance Rate Maps for coastal New Hampshire.

5.2.2 Sea-level Rise

The STAP recommends that for coastal locations where there is little tolerance for risk to a built or natural asset; the range of sea-level rise to consider in planning and design includes the 'Intermediate High' and 'Highest' scenarios (see Figure 2). The STAP suggests the following planning guidance to determine the appropriate range based on design life:

1. Determine the time period over which the system, structure, or facility is designed or desired to serve (either in the range 2014–2050, or 2051–2100).
2. If the design time period is 2014–2050, commit to manage to 1.3 feet of sea-level rise, but be prepared to manage and adapt to 2 feet if necessary.
3. If the design or desired time period is 2051–2100, commit to manage to 3.9 feet of sea-level rise, but be prepared to manage and adapt to 6.6 feet if necessary.
4. Be aware that the projected sea-level rise ranges may change and prepare to adjust design considerations if necessary. The choice of management strategies can include strategies to protect, accommodate, or retreat from the flood risk.

For example, in the case of a new tide gate intended to last until 2075, the gate could be constructed for the Highest scenario (6.6 feet) now, which would be the most robust approach, or constructed for 2 feet of future sea-level rise now but in a manner that would facilitate expanding and raising the gate to protect against 3.9 or 6.6 feet of sea-level rise, if future assessments indicate that is necessary. This could be accomplished by designing and constructing the gate foundation for the 6.6 feet sea-level rise scenario while only constructing the gate for a 2-feet sea-level rise scenario. The choice of management strategies can include strategies to protect, accommodate, or retreat from the threat.

5.2.3 Extreme Precipitation

For extreme precipitation the STAP recommends:

- If the design time period is 2014–2050, buildings and infrastructure should be designed to withstand extreme precipitation intensities based on the most current precipitation data[viii], with the assumption that a gradual increase in frequency of extreme precipitation events will occur over time.
- If the design period is 2051–2100, buildings and infrastructure should be designed to manage a 15 percent increase in the amount of precipitation produced during extreme precipitation events after 2050.

Over time, improved data collection, analysis, and modeling will provide better scientific understanding and higher confidence in projected future changes in storm surge, sea level, and extreme precipitation. Given the current limitations in providing narrow estimates of future conditions with high confidence, applying the concept of risk tolerance becomes important in determining how best to plan and design for the future. The STAP guidance strongly suggests that adaptive and flexible designs that anticipate future flood scenarios become standard procedures for construction within vulnerable areas.

[viii] Current precipitation data can be taken from the NOAA Atlas 14 (**http://hdsc.nws.noaa.gov/hdsc/pfds/**), the Northeast Regional Climate Center (**http://www.nrcc.cornell.edu/**), or more up to date or better resolution sources.

6. Our Goals, Recommendations, and Actions

Four Goals for a Resilient Coastal New Hampshire – SAIL

The Commission has defined four goals for coastal New Hampshire that are paramount to managing our coastal risk and hazards so that municipalities along the Atlantic Ocean and surrounding the Great Bay estuary can be resilient in the face of climate changes, including changes in storm surge, sea level, and extreme precipitation. The four goals focus on science, assessment, implementation, and legislation – "SAIL," in honor of the New Hampshire state seal which features the frigate Raleigh, a warship built in Portsmouth in 1776, and a granite boulder in the foreground that, according to seal law, is "symbolic of the Granite State's rugged terrain and the character of its citizenry."[v]

Goal 1: SCIENCE

Research, understand, establish, and use the best available science about current and future coastal hazards in New Hampshire relating to storm surge, sea-level rise, and extreme precipitation.

Goal 2: ASSESSMENT

Identify assets and resources within our economy, our built landscape, our natural resources, and our heritage that are vulnerable to storm surge, sea-level rise, and extreme precipitation; understand the scope of that vulnerability; and evaluate existing statutes, ordinances, rules and regulations, policies, programs, and plans to determine whether changes should be made to reduce vulnerabilities.

Goal 3: IMPLEMENTATION

Identify and implement strategies that will enable the State and coastal municipalities to effectively protect, adapt, and sustain our current and future economy, built landscape, natural resources, and heritage.

Goal 4: LEGISLATION

Recommend timely considerations for legislation that leads to actions, both immediate and long-term, that reduce and/or eliminate vulnerability and result in adaptation to existing and future coastal hazards.

Who are these recommendations for and how will we achieve them?

Under each SAIL goal, the Commission identified key recommendations and actions that will help coastal New Hampshire prepare for and respond to coastal risk and hazards. In order to carry out the recommendations, and ultimately, achieve the SAIL goals, many different groups will need to work together. The recommendations are primarily directed to the State Legislature, State agencies, and municipal governments. Lead responsible parties – the entity or entities most likely to lead and coordinate efforts to achieve the recommendation – are identified under each recommendation in parentheses; however it is important to note that every recommendation will require collaboration and coordination between the three primary audiences and public and private stakeholders.

[v] The State Seal history can be accessed at https://www.nh.gov/nhinfo/seal.html.

The Commission recognizes that many of the recommendations will take time to achieve and require new funding and expertise. In particular, municipalities will likely require targeted technical assistance in order to carry out the Commission's recommendations. Additionally, the Commission recognizes that state agencies, municipalities, and other stakeholders have already started to act on some of the recommendations listed. The recommendations and the associated actions should be prioritized by the lead responsible parties based on the risk associated with the hazard addressed, cost, and ease of implementation. Additional details concerning the target timeframe and estimated budget to complete each recommendation and the associated actions should also be developed by responsible parties as they prioritize recommendations for implementation.

How are these recommendations organized?

The Commissions makes **five Science** recommendations and **30 Assessment** and **Implementation** recommendations. Of these 35 recommendations, **14** have **Legislative** implications. Assessment and Implementation recommendations are paired by subject and organized into four topic areas: **Our Economy, Our Built Landscape, Our Natural Resources,** and **Our Heritage**. **Cross-cutting** recommendations include recommendations that apply to all four of the topic areas. It is important to note that the topic areas overlap—some of the structures and facilities that comprise our built landscape may also be part of our heritage—so many recommendations could fit into multiple topic areas. These four topic areas help to organize the recommendations, but should not be seen as mutually exclusive categories.

OUR ECONOMY is the systematic and productive exchange and flow of goods, services and transactions that must be intact, functioning, and resilient to coastal risk and hazards in order to create and sustain jobs and a high quality of life in coastal New Hampshire.

OUR BUILT LANDSCAPE is the network of structures and facilities owned by state and municipal governments and private entities in coastal New Hampshire. Our built landscape must be prepared to adapt and respond to coastal risk and hazards.

OUR NATURAL RESOURCES are the natural systems that support important species and biodiversity in coastal New Hampshire and provide critical and important services to coastal New Hampshire like food, flood protection, fresh water, raw materials, and recreation opportunities.

OUR HERITAGE encompasses the abundance of recreational, cultural, and historic resources, including economic assets and elements of the built landscape, in coastal New Hampshire that our state and municipalities wish to protect from coastal risk and hazards.

6.1 Science Recommendations

GOAL 1 is to research, understand, establish, and use the best available science about current and future coastal hazards in New Hampshire relating to storm surge, sea-level rise, and extreme precipitation.

S1. Legislatively authorize a state agency to convene a Science and Technical Advisory Panel to review and evaluate the current state of climate change science in order to periodically update storm surge, sea-level rise, extreme precipitation and other relevant climate projections and provide planning guidance at least once every five years. *[Lead: State Legislature].*

ACTIONS:

a. Establish a collaborative Science and Technical Advisory Panel and a lead state agency to coordinate updated information and recommendations.
b. The Panel, lead agency, and other participating agencies develop a mechanism that ensures communication of the updated climate science and planning guidance to a wide range of stakeholders.

S2. Identify gaps in scientific information, work to fill existing scientific information gaps, and conduct quantitative analyses detailing coastal risk and hazards. *[Lead: State Agencies].*

ACTIONS:

a. Improve coastal storm surge analysis by including wave effects and upland flooding impacts.
b. Gather baseline data to improve analysis of coastal and riverine flood risks resulting from a combination of storm surge, sea-level rise, and extreme precipitation events in coastal areas directly exposed to the Atlantic Ocean and inland areas with tidal rivers, bays and marshes.
c. Conduct additional applied research to better understand the following:
    i. Flooding extent resulting from combined impacts of future climate and land use changes for upland and riverine communities and ecosystems.
    ii. Capacity of natural resources like salt marshes and eelgrass beds to respond to projected changes in storm surge, sea level, and extreme precipitation.
    iii. Changes in physical parameters, species composition, and ecological communities resulting from projected changes in storm surge, sea level, and extreme precipitation.
    iv. Changes in the species food web that may endanger New Hampshire ecosystems resulting from projected changes in storm surge, sea level, and extreme precipitation.
    v. Ecosystem services related to flood attenuation, physical protection from storms, and pollutant attenuation.
    vi. Changes in frequency and severity of winter storm events resulting in large amounts of snow and ice pack and related impacts.
    vii. Saltwater intrusion into coastal surface and ground water sources.
    viii. Impacts of future drought conditions on groundwater and drinking water sources, natural resources, and other assets.
    ix. Differential social impacts of storm surge, sea-level rise, and extreme precipitation, and appropriate adaptation strategies needed to better prepare socially vulnerable populations (i.e., social vulnerability analyses).

d. Collaborate with science, planning and management professionals to determine current and future research gaps. The Panel established under Science Recommendation S.1 (a) could help coordinate this collaboration.

S3. Establish a central repository for spatial coastal hazards-related information, and assign and fund an entity to maintain and adapt this tool over time. [Lead: State Agencies].

ACTIONS:

a. Identify the appropriate data repository for critical coastal information and a strategy for its funding and maintenance. Consider existing spatial databases, including the NH Coastal Viewer managed by NH GRANIT.
b. Identify funding for on-going support of the coastal hazards data repository or database.
c. Establish a mechanism to ensure adequate data sharing exists among state agencies and GRANIT for spatial coastal hazards-related information.

S4. Provide clear, concise, science-based information to inform and raise awareness of relevant audiences about the risks and vulnerabilities associated with coastal risk and hazards. *[Lead: State Agencies].*

ACTIONS:

a. Create and compile informational materials about coastal hazards, risks and vulnerability.
b. Strengthen state, regional, and municipal capacities to better understand the best available science related to potential future impacts of climate change in order to improve decisions.
c. Improve understanding of the concepts of uncertainty and risk and how they can be applied to decision-making and action planning.
d. Partner with federal and state agencies as well as regional and local organizations to expand resources for education, outreach, and coordination.
e. Identify and provide education and outreach to new groups (e.g., socially vulnerable populations, local businesses) by partnering with new entities, holding events at their established venues and meetings, and tailoring materials to meet their needs.
f. Encourage the incorporation of climate science and information about the risks and hazards associated with changing climatic conditions in public school curriculum.
g. Dedicate funding and technical support to implement science-based education and outreach efforts related to coastal risk and hazards.

S5. Augment state funding in support of applied research that improves understanding, modeling, and projections of current and future coastal risk and hazards in New Hampshire's coastal zone. *[Lead: State Legislature].*

6.2 Assessment & Implementation Recommendations: Cross-Cutting

GOAL 2 is to identify assets and resources within our economy, our built landscape, our natural resources, and our heritage that are vulnerable to storm surge, sea-level rise, and extreme precipitation; understand the scope of that vulnerability; and evaluate existing statutes, ordinances, rules and regulations, policies, programs, and plans to determine whether changes should be made to reduce vulnerabilities.

GOAL 3 is to Identify and implement strategies that will enable the State and coastal municipalities to effectively protect, adapt, and sustain our current and future economy, built landscape, natural resources, and heritage.

The Crosscutting recommendations below include assessment and implementation recommendations that apply to all four of the topic areas: **Our Economy, Our Built Landscape, Our Natural Resources,** and **Our Heritage.**

CC1. Secure new and allocate existing funding sources for state agencies and municipalities to conduct vulnerability assessments of assets at appropriate scales and to implement adaptation strategies. *[Lead: State Legislature; State Agencies; Municipalities].*
Note: This recommendation summarizes the funding-related actions found throughout the assessment and implementation recommendations.

ACTIONS:

a. Fund coastal vulnerability assessments and dissemination of results (see CC2 and BL1 (b)).
b. Fund state agency audits of existing statutes and administrative rules (see CC3).
c. Dedicate funding and technical assistance for state agencies and municipalities to incorporate the Science and Technical Advisory Panel report, as amended, in development standards, land use policies, and plans (see CC5 (b)).
d. Establish a funding mechanism to assist state agencies in covering the costs of emergency and disaster response and recovery (see CC 5 (e)).
e. Apply for and utilize FEMA mitigation grants and other sources of funding to implement climate adaptation and planning strategies that reduce or eliminate flooding impacts (see CC6 (a)).
f. Create and utilize a dedicated fund to acquire repetitive loss properties when structures and facilities are abandoned or destroyed (see CC6 (d)).
g. Identify mechanisms to raise matching funds for FEMA and other grant programs, such as creating a dedicated state flood mitigation fund (see CC6 (e)).
h. Establish stormwater utilities to fund retrofits to existing development and future improvements (see E3 (b)).
i. Utilize existing funding sources for natural resource restoration (e.g. offset measures, state Aquatic Resource Mitigation fund) (see NR2 (d)).
j. Establish dedicated funds and sources to support land preservation, restoration, acquisition of easements, and development rights to transfer vulnerable property to conservation lands (see NR3 (b)).
k. Allocate FY2018-2019 Biennial Budget funding and authority to expend funds for recreational and cultural resource vulnerability surveys, planning efforts, and implementation of the resulting plans (see H5).

CC2. Identify vulnerable state and municipal assets at regional, municipal, and site-specific scales as appropriate. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Assess existing regional emergency services and evacuation routes and identify additional service needs, points, and routes where necessary.
b. Collaborate with private sector representatives to evaluate and identify necessary improvements to emergency communications systems preparedness to ensure 911 and other critical communications services remain operational during emergencies and disasters.
c. Develop site-specific vulnerability assessments for public assets at risk from increased coastal flooding based on the flooding scenarios presented in the Science and Technical Advisory Panel report, as amended.
d. Provide local technical assistance to perform vulnerability assessments through collaborative partnerships and local and regional networks, such as the NH Coastal Adaptation Workgroup.
e. Disseminate and share results from coastal vulnerability assessments with relevant audiences.
f. Dedicate existing funding for coastal vulnerability assessments and dissemination of results.

CC3. Review whether existing state statutes and rules adequately permit state agencies and municipalities to prepare and adapt to best available climate science and impacts, and make recommendations for amendments or new regulations where necessary. [Lead: State Agencies].

ACTIONS:

a. Require and provide funding for state agencies to evaluate and recommend necessary amendments to relevant statutes and administrative rules with respect to best available climate science, involving relevant stakeholders as appropriate. Relevant statutes and administrative rules include, but are not limited to, the following: RSA 483-B Shoreland Water Quality Protection Act, RSA 482-A Fill and Dredge in Wetlands, 485-A:29-39 Subsurface Systems, 485-A:17 Terrain Alteration, RSA 230:78 State Highways, RSA 230:79 Liability of NHDOT, and RSA 79-A Current Use.
b. Review current practices to determine the most appropriate buffer and setback distances, freeboard, shoreline treatment, and other design standards and approaches needed to provide adequate levels of risk reduction and protection for at risk structures and facilities.
c. Develop an approach to consolidate RSA 483-B Shoreland Water Quality Protection Act and RSA 482-A Fill and Dredge in Wetlands to create permitting efficiencies and allow for comprehensive management of tidal resources.
d. Assess the status of existing state agency, municipal, and other disaster response and recovery plans, and determine whether new procedures or regulations are necessary to enable response and recovery planning at state and municipal levels.
e. Identify and recommend modifications to state and local building codes necessary to protect against likely changes in flooding and other coastal hazards.

CC4. Amend state laws and rules to incorporate consideration of best available climate science and weather-related data. *[Lead: State Legislature].*

ACTIONS:

a. Adopt amendments to state statutes and administrative rules identified under Cross-cutting Recommendation CC3, including, but not limited to: RSA 483-B Shoreland Water Quality Protection Act, RSA 482-A Fill and Dredge in Wetlands, 485-A:29-39 Subsurface Systems, 485-A:17 Terrain Alteration, RSA 230:78 State Highways, RSA 230:79 Liability of NHDOT, and RSA 79-A Current Use Taxation.

CC5. By 2019[vi], state agencies will consider and use best available climate science in their activities and plans. *[Lead: State Legislature].*

ACTIONS:

a. Establish the Science and Technical Advisory Panel report (see Science Recommendation S1), as amended, as state agency and municipal guidance about anticipated future climate and coastal flooding conditions.
b. Dedicate funding and technical assistance for state agencies and municipalities to incorporate the Science and Technical Advisory Panel report, as amended, in development standards, land use policies, and plans.
c. Establish a mechanism to monitor state agency and municipal use of Science and Technical Advisory Panel findings and recommended approaches to risk management.
d. Require state agencies to address current and future coastal risk and hazards in preparation, response, and recovery plans.
e. Establish a funding mechanism to assist state agencies in covering the costs of emergency and disaster response and recovery.
f. Integrate social vulnerability information in adaptation planning, emergency preparedness strategies, and public health interventions.

CC6. Make existing structures and facilities more resilient and acquire properties in high risk areas in order to reduce or eliminate flooding impacts. *[Lead: State Legislature; State Agencies; Municipalities].*

ACTIONS:

a. Apply for and utilize FEMA mitigation grants and other sources of funding to implement climate adaptation and planning strategies that reduce or eliminate flooding impacts.
b. Elevate existing at-risk structures and implement higher freeboard standards above the Base Flood Elevation on new and substantially reconstructed structures and facilities to protect from future flood risks (see BL2 for more detail).
c. Acquire at-risk and repetitive loss properties to create buffers and open space that facilitate restoration of floodplain functions.
d. Create and utilize a dedicated fund to acquire repetitive loss properties when structures and facilities are abandoned or destroyed.
e. Identify mechanisms to raise matching funds for FEMA and other grant programs, such as creating a dedicated state flood mitigation fund.

[vi] This timeframe was determined to be acceptable by the state agencies on the NH Coastal Risk and Hazards Commission.

CC7. Encourage municipalities to incorporate coastal hazards, risks and vulnerability in policies, plans and investments. *[Lead: Municipalities].*

ACTIONS:

a. Evaluate deficiencies and barriers in municipal regulations, plans and policies, and their implications for regional vulnerability.
b. Incorporate coastal hazards and risks assessments, including social vulnerability information, in municipal hazard mitigation plans, natural hazards and climate change adaptation Master Plan chapters, and emergency management plans.
c. Encourage municipalities to develop detailed preparation, response and recovery plans that build on existing plans and initiatives.
d. Encourage municipalities to adopt buffers and setbacks that better account for risk and vulnerability of structures, facilities, and natural resources and maintain ecosystem services (e.g. flood storage, storm surge attenuation, reduced impacts to public structures and facilities, and private property).
e. Incorporate vulnerability assessment information and adaptation strategies for structures and facilities planning and investment for long term capital projects in municipal Capital Improvement Programs (CIPs).
f. Improve connections between municipal hazard mitigation plans, master plans and capital improvement plans.
g. Identify and reduce existing inconsistencies between municipal plans and state plans, such as hazard mitigation plans, building codes, design standards, and evacuation plans.
h. Consider the concepts of uncertainty and risk in decision-making and action planning.
i. Encourage communities that conduct floodplain management activities that exceed the minimum requirements of the National Flood Insurance Program (NFIP) to consider joining and participating in the Community Rating System (CRS), which provides discounts to annual flood insurance premiums for some residents and businesses as a reward for their community's activities.

CC8. Establish an adaptation coordinator to monitor and coordinate implementation of the NH Coastal Risk and Hazards Commission recommendations. *[Lead: State Legislature].*

6.3 Assessment & Implementation Recommendations: Our Economy

Identify economic assets that are vulnerable to storm surge, sea-level rise, and extreme precipitation; understand the scope of that vulnerability; and evaluate existing statutes, ordinances, rules and regulations, policies, programs, and plans to determine whether changes should be made to reduce vulnerabilities.

Identify and implement adaptation strategies that will enable the State and coastal municipalities to protect, adapt, and sustain our current and future economy.

Our Economy is the systematic and productive exchange and flow of goods, services and transactions that must be intact, functioning, and resilient to coastal risk and hazards in order to create and sustain jobs and a high quality of life in coastal New Hampshire.

E1. Identify vulnerability of sector-based economic assets, including but not limited to tax base, workforce and jobs, property values, insurance costs, trade facilities, and public recreational facilities based on best available climate science. *[Lead: State Agencies; Municipalities].*

E2. Incorporate best available climate science and vulnerability assessment information in state, regional, and municipal economic development plans. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Encourage private property owners and businesses to incorporate best available climate science and vulnerability assessments in their decision making and preparedness plans.
b. Consider vulnerabilities of local tax base, state economic development plan, retention or replacement of economic resources, at risk populations and population migration.
c. Improve management, coordination and delivery mechanisms to ensure continuity of services to essential facilities, people, businesses and employment centers.

E3. Use appropriate and available mechanisms, including but not limited to incentives and market-based tools to fund climate adaptation strategies. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Align land acquisition and easement programs to transfer vulnerable properties into conservation.
b. Establish stormwater utilities to fund retrofits to existing development and future improvements.
c. Develop and utilize tools to identify cost effective strategies and public investments for adapting to increased flood risk in vulnerable areas.
d. Develop special overlay districts, tax credits and revolving loan funds as mechanisms to discourage development in vulnerable areas.

e. Implement voluntary transfer of development rights programs and other economic incentives to acquire or conserve property in high risk areas.
f. Create statewide and municipal funding programs for climate adaptation strategies.
g. Adapt economic development planning approaches to respond to changing environmental conditions and leverage shifting opportunities.
h. Promote resilience and sustainability planning as economic development strategies.

E4. Improve information available to property owners and prospective buyers about coastal hazards and vulnerabilities. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Improve consumer protection disclosure of properties vulnerable to coastal flooding.
b. Distribute flood protection safety information to property owners in high-risk areas.
c. Encourage homeowners in moderate- to low-risk areas to purchase Preferred Risk NFIP Policies.

6.4 Assessment & Implementation Recommendations: Our Built Landscape

Identify assets (i.e., structures and facilities) in our built landscape that are vulnerable to storm surge, sea-level rise, and extreme precipitation; understand the scope of that vulnerability; and evaluate existing statutes, ordinances, rules and regulations, policies, programs, and plans to determine whether changes should be made to reduce vulnerabilities.

Identify and implement strategies that will enable the State and coastal municipalities to effectively protect, adapt, and sustain our current and future built landscape.

Our Built Landscape is the network of structures and facilities owned by state and municipal governments and private entities in coastal New Hampshire. Our built landscape must be prepared to adapt and respond to coastal risk and hazards.

BL1. Encourage state agencies and municipalities to complete vulnerability assessments for state, municipal, and regulated private structures and facilities. *[Lead: State Legislature; State Agencies; Municipalities].*

ACTIONS:

a. Use initial assessments to identify need for more detailed assessments.
b. Require and secure funding for state agencies to conduct vulnerability assessments of state-owned structures and facilities located in the coastal zone at regional, municipal, and/or site-specific scales as appropriate.

BL2. Implement regulatory standards and/or enact enabling legislation to ensure that the best available climate science and flood risk information are used for the siting and design of new, reconstructed, and rehabilitated state-funded structures and facilities, municipal structures and facilities, and private structures. *[Lead: State Legislature; State Agencies; Municipalities].*

ACTIONS:

a. Adopt amendments to state and local building codes recommended under Cross-cutting Recommendation CC3.
b. Require state agencies, through legislation or amendment to NH Executive Order 96-4[vii], to use one of the following approaches [viii, ix, x] for determining a higher vertical flood elevation and expanded corresponding horizontal floodplain than the current base flood elevation and floodplain to address current and future flood risk for state-funded new construction, substantial improvement, or repairs to substantially-damaged structures and facilities:

[vii] NH Executive Order 96-4 directs State agencies to comply with the floodplain management requirements of all local communities participating in the NFIP in which State-owned properties are located.

[viii] See Federal Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Input.

[ix] See Guidelines for Implementing Executive Order 13690.

[x] See Appendix F for State of New Hampshire comments on Draft Guidelines for Implementing Executive Order 13690.

i. *Climate-informed Science Approach* – use the best available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science.[xi]

ii. *Freeboard Value Approach* – use the freeboard value, reached by adding an additional two (2) feet to the base flood elevation for non-critical structures and facilities and from adding an additional three (3) feet to the base flood elevation for critical[xii] structures and facilities.

iii. *The 0.2-percent-annual-chance Flood Approach* – use the 0.2-percent-annual-chance flood elevation (also known as the 500-year flood elevation).

c. Encourage municipalities to use one of the following three approaches[xiii,xiv,xv] for determining a higher vertical flood elevation and expanded corresponding horizontal floodplain than the current base flood elevation and floodplain to address current and future flood risk for new construction, substantial improvement, or repairs to substantially-damaged municipal and private structures and facilities:

i. *Climate-informed Science Approach* – use the best available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science.[xvi]

ii. *Freeboard Value Approach* – use the freeboard value, reached by adding an additional two (2) feet to the base flood elevation for non-critical structures and facilities and from adding an additional three (3) feet to the base flood elevation for critical[xvii] structures and facilities.

iii. *The 0.2-percent-annual-chance Flood Appro*ach – use the 0.2-percent-annual-chance flood elevation (also known as the 500-year flood elevation).

d. Develop model regulations for municipalities to consider adopting into their existing floodplain management regulations, which can assist municipalities in becoming more flood resilient by addressing current and future flood conditions using the best available flood risk and climate science information.

e. Amend the New Hampshire Stream Crossing Guidelines to incorporate anticipated future stormwater flows based on best available climate science.

f. Incorporate the Science and Technical Advisory Panel report information, as amended, into benefit-cost analyses for applications submitted under FEMA Hazard Mitigation Assistance and Public Assistance grant programs. In relevant cases, consider timeframes for potential future relocation or retreat by acquiring at-risk properties.

g. Require, through legislation or other means, that the New Hampshire Site Evaluation Committee and Public Utilities Commission take future sea-level rise and coastal flooding into account in project siting decisions and other planning.

[xi] An acceptable source of climate science for New Hampshire includes the Coastal Risk and Hazards Commission Science and Technical Advisory Panel report, Sea-level Rise, Storm Surges, and Extreme Precipitation in Coastal New Hampshire: Analysis of Past and Projected Trends, as amended.

[xii] Any activity for which even a slight chance of flooding would be too great. For expanded description of "critical action" see Part I, Section 6 of Guidelines for Implementing Executive Order 13690.

[xiii] See Federal Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Input.

[xiv] See Guidelines for Implementing Executive Order 13690.

[xv] See Appendix F for State of New Hampshire comments on Draft Guidelines for Implementing Executive Order 13690.

[xvi] An acceptable source of climate science for New Hampshire includes the Coastal Risk and Hazards Commission Science and Technical Advisory Panel report, Sea-level Rise, Storm Surges, and Extreme Precipitation in Coastal New Hampshire: Analysis of Past and Projected Trends, as amended.

[xvii] Any activity for which even a slight chance of flooding would be too great. For expanded description of "critical action" see Part I, Section 6 of Guidelines for Implementing Executive Order 13690.

BL3. Map the plausible future changes in freshwater and coastal floodplain extent and depth based on best available information about future precipitation and land use for all municipalities. *[Lead: State Agencies].*

ACTIONS:

a. Use the Lamprey River Watershed study or other similar methods for projecting future riverine floodplain extents and vulnerabilities for rivers within the coastal watershed and apply results as appropriate in municipal policy and planning (see BL4 (b) for more detail).

BL4. Integrate comprehensive land use and environmental planning with floodplain management approaches that prevent and minimize impacts from coastal hazards. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Establish minimum regulations at state and municipal levels that consider vulnerability assessment information to support appropriate amendments to building codes, floodplain management, fluvial erosion hazard zones, and stormwater management.
b. Create and encourage adoption of local flood hazard overlay districts that include higher development standards that minimize impacts from natural hazards and climate change.
c. Promote land development regulations that reduce vulnerability and protect ecosystem services (e.g. open space/cluster development).
d. Prepare watershed-based plans that address comprehensive water resource management principles focused on changes in hydrologic systems resulting from climate change.
e. Consider prohibiting development in areas destroyed by storms, experiencing repetitive loss of structures, and subject to chronic flooding and erosion. Consider adaptive reuse and/or acquisition of at-risk private properties.

BL5. Document coastal and riverine shoreline conditions and assess vulnerability of natural features and engineered structures that protect people, structures, and facilities under current and future conditions. *[Lead: State Agencies].*

ACTIONS:

a. Establish a beach monitoring program to collect long-term data regarding beach erosion, sea-level rise, landform changes, and sediment characteristics and processes.
b. Identify areas where erosion and shoreline instability exist.
c. Identify potential sites for nature-based approaches to shoreline stabilization.
d. Prioritize areas for beach nourishment and other shoreline stabilization techniques.

BL6. Develop a comprehensive, integrated New Hampshire Tidal Shoreline Management Plan (TSMP) that presents general priorities for tidal shoreline management, as well as site-specific and place-based strategies including, where appropriate, protection, adaptation, and abandonment. *[Lead: State Agencies].*

ACTIONS:

a. Convene a tidal shoreline management planning team comprised of the NH Department of Environmental Services and other agencies and organizations as appropriate to develop a tidal shoreline management plan for New Hampshire based on, but not limited to, the information developed under Recommendation BL5.

6.5 Assessment & Implementation Recommendations: Our Natural Resources

Identify our natural resources that are vulnerable to storm surge, sea-level rise, and extreme precipitation; understand the scope of that vulnerability; and evaluate existing statutes, ordinances, rules and regulations, policies, programs, and plans to determine whether changes should be made to reduce vulnerabilities.

Identify and implement strategies that will enable the State and coastal municipalities to effectively protect, adapt, and sustain our current and future natural resources.

Our Natural Resources are the natural systems that support important species and biodiversity in coastal New Hampshire and provide critical and important services to coastal New Hampshire like food, flood protection, fresh water, and recreation opportunities.

NR1. Identify and map natural resources that are vulnerable to current and future coastal risk and hazards. *[Lead: State Agencies].*

ACTIONS:

a. Identify where habitats and biological populations would naturally shift in response to best available climate science to prioritize areas and species for protection or restoration.
b. Map natural resources that also protect critical built landscapes.
c. Utilize marsh migration modeling to identify and prioritize marsh migration areas for conservation and restoration.
d. Identify potential changes, and in particular losses, to ecosystem services as a result of sea-level rise and storm surges and compare to current conditions.

NR2. Develop natural resource restoration plans that explicitly consider future coastal risk and hazards, and the ecological services that they provide. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Include protection of natural systems and services, human well-being and protection of built environments in natural resource restoration plans (i.e. water quality, habitat, flood storage).
b. Provide recommendations and incentives for removal or modification of structures and facilities, such as freshwater and tidal crossings, that create barriers to tidal flow and habitat migration, particularly those that will be impaired or severely impacted by sea-level rise, storm surge, or extreme precipitation.
c. Engage in best practices for invasive species planning and removal and incorporate climate considerations in invasive species removal plans.
d. Utilize existing funding sources for natural resource restoration (e.g. offset measures, state Aquatic Resource Mitigation fund).
e. Invest in coastal dune restoration projects.
f. Evaluate and apply sediment application techniques, where feasible, to maintain tidal marsh systems.

NR3. Protect land that allows coastal habitats and populations to adapt to changing conditions and also provides ecosystem services that protect people, structures, and facilities. *[Lead: State Legislature; State Agencies; Municipalities].*

ACTIONS:

a. Use emerging habitat science to prioritize land and resource conservation projects.
b. Establish dedicated funds and sources to support land preservation, acquisition of easements, and development rights to transfer vulnerable property to conservation lands.
c. Prioritize land conservation efforts to adequately account for future sea-level rise and coastal flooding.
d. Establish buffer requirements for setbacks to rivers, shorelines, and wetlands that include consideration of climate change and create a dedicated fund to support local enforcement.
e. Encourage landowners to preserve the beneficial functions of natural features like wetlands and to restore and protect coastal dune habitat.
f. Align land acquisition and conservation easement programs to protect important natural resources and ecosystem services.
g. Protect future marsh migration areas identified by marsh migration modeling.
h. Establish and share municipal inventories of land available for mitigation and conservation in areas that reduce flooding and promote the migration of species and habitat.

NR4. Encourage state agencies and municipalities to consider ecosystem services provided by natural resources in land use planning, master plans, and asset decisions. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Modify NHDES permit requirements and municipal standards to require implementation of stormwater best management practices (BMPs) and low impact development (LID) management systems to minimize impacts and maintain aquatic habitats.
b. Implement strategies and tools (such as land regulations, incentives, building regulations) designed to maintain or restore pervious surfaces, provide nutrient barriers, protect vegetated buffers and maintain wildlife passage.
c. Recommend standards for state-issued permits and municipal zoning regulations that protect natural floodplain functions.
d. Develop watershed-based comprehensive water resource management plans that consider impacts of climate change.
e. Develop best management practices for shoreline buffers, including information on appropriate use of shoreline hardening, bank stabilization, vegetation restoration and agricultural practices.
f. Explore options to minimize shoreline hardening and promote natural or hybrid shoreline protection strategies.
g. Create shoreline management standards that help stabilize banks for more frequent storm events, wave impacts, or higher volume flows (e.g. by using natural vegetation and proper building setbacks.
h. Develop guidelines and provide incentives for communities to incorporate climate adaptation actions for wildlife protection in master plans, hazard mitigation plans, and zoning ordinances.

NR5. Assess the impact of freshwater and tidal crossings on adjacent tidal wetlands, aquatic organism passage, and public safety under existing and future climate conditions. *[Lead: State Agencies].*

ACTIONS:

a. Continue the NHDES freshwater culvert inventory program (SADES).
b. Develop methodology for assessing tidal crossings and implement assessment protocol throughout coastal NH.
c. Prioritize tidal crossing replacement projects and restoration opportunities based on environmental and resiliency criteria.
d. Conduct feasibility analysis and due diligence inquiries on prioritized tidal crossing projects.
e. Assess the impacts of future increased precipitation and stormwater on surface water resources.

NR6. Assess current conditions of groundwater resources and impacts from best available climate science. *[Lead: State Agencies].*

ACTIONS:

a. Assess location, quality and quantity of groundwater under current and future climate conditions.

NR7. Restore or maintain natural flow regimes (groundwater, surface water and wetlands) to increase ecosystem resilience to extreme weather events and other coastal hazards, including floods, drought, and sea-level rise. *[Lead: State Agencies].*

ACTIONS:

a. Improve designs for dams, culverts and bridges to maintain existing function and reconnect fragmented surface waters (wetlands, lakes, ponds, rivers and streams) to provide higher quality habitat for aquatic organisms and the ability to improve resilience of these systems.
b. Work with Federal Energy Regulatory Commission, NHDES Wetlands, Dam and Watershed Management Bureaus to ensure habitat connectivity and resilience to help sustain intact coastal ecosystems.
c. Adopt ecosystem-friendly approaches in the placement and design of freshwater and tidal stream crossing facilities. For example, appropriate sizing for new culverts, identify undersized culverts, and identify dams that need improvements to protect aquatic habitats.
d. Comprehensively manage groundwater resources to consider infiltration and recharge, water quality, and changes to groundwater levels and salinity from sea-level rise.

6.6 Assessment & Implementation Recommendations: Our Heritage

Identify our recreational, cultural, and historic resources, including economic resources and elements of the built landscape, that are vulnerable to storm surge, sea-level rise, and extreme precipitation; understand the scope of that vulnerability; and evaluate existing statutes, ordinances, rules and regulations, policies, programs, and plans to determine whether changes should be made to reduce vulnerabilities.

Identify and implement adaptation strategies that will enable the State and coastal municipalities to effectively protect, adapt, and sustain current and future recreational and cultural resources.

Our Heritage encompasses the abundance of recreational, cultural, and historic resources, including economic assets and elements of the built landscape, in coastal New Hampshire that our state and municipalities wish to protect from coastal risk and hazards.

H1. Identify and survey recreational resources and assess their vulnerability to coastal risk and hazards based on best available climate science. *[Lead: State Agencies; Municipalities].*

H2. Develop plans and implement strategies to prepare and adapt recreational resources based on best available climate science. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Conduct public information hearings to understand the impacts of proposed climate adaptation strategies.
b. Assess existing and future recreational areas for their potential to provide storage for flood waters and stormwater runoff.
c. Preserve open space and recreational areas that serve to minimize climate change impacts.
d. Integrate recreational and open space planning into climate adaptation planning and the Tidal Shoreline Management Plan.
e. Integrate protection of recreational resources into land use and management, engineering, regulatory components of state and municipal plans including the Tidal Shoreline Management Plan, hazard mitigation plans, Master Plans, and design standards.

H3. Identify and survey cultural and historic resources and assess their vulnerability to coastal risk and hazards based on best available climate science. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Map all currently surveyed cultural and historical resources.
b. Identify asset types that may also be cultural and historic resources.
c. Use reconnaissance level survey and vulnerability assessments to identify high priority areas for intensive survey.

H4. Require state agencies and encourage municipalities to develop long-term plans for protecting, adapting, or reducing risk to cultural resources affected by climate change. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Create or modify adaptation strategies for cultural and historic buildings affected by climate change, including plans for protecting or relocating resources.
b. Integrate protection of cultural and historical resources into land use and management, engineering, regulatory components of state and municipal plans including the Tidal Shoreline Management Plan, hazard mitigation plans, Master Plans, and design guidelines.
c. Establish expert group to create a decision-making process for property owners and municipalities to determine when and how to mitigate sites that will be lost.
d. Establish guidelines for adaptation or risk reduction of cultural resources in state ownership.
e. Create programmatic strategies to compensate for the loss of historic asset types that will be replaced in order to adapt to climate change impacts.
f. Modify the Land and Cultural Heritage Investment Program (LCHIP) to include selection criteria that incentivize funding for climate adaptation actions.

H5. Allocate FY2018-2019 Biennial Budget funding and authority to expend funds for recreational and cultural resource vulnerability surveys, planning efforts, and implementation of the resulting plans. *[Lead: State Legislature].*

6.7 Legislation Recommendations

Goal 4 is to recommend timely considerations for legislation that leads to actions, both immediate and long-term, that reduce and/or eliminate vulnerability and result in adaptation to existing and future coastal hazards.

S1. Legislatively authorize a state agency to convene a Science and Technical Advisory Panel to review and evaluate the current state of climate change science in order to periodically update storm surge, sea-level rise, extreme precipitation and other relevant climate projections and provide planning guidance at least once every five years. *[Lead: State Legislature].*

ACTIONS:

a. Establish a collaborative Science and Technical Advisory Panel and a lead state agency to coordinate updated information and recommendations.
b. The Panel, lead agency, and other participating agencies develop a mechanism that ensures communication of the updated climate science and planning guidance to a wide range of stakeholders.

S5. Augment state funding in support of applied research that improves understanding, modeling, and projections of current and future coastal risk and hazards in New Hampshire's coastal zone. *[Lead: State Legislature].*

CC1. Secure new and allocate existing funding sources for state agencies and municipalities to conduct vulnerability assessments of assets at appropriate scales and to implement adaptation strategies. *[Lead: State Legislature; State Agencies; Municipalities].*
Note: This recommendation summarizes the funding-related actions found throughout the assessment and implementation recommendations.

ACTIONS:

a. Fund coastal vulnerability assessments and dissemination of results (see CC2 and BL1 (b)).
b. Fund state agency audits of existing statutes and administrative rules (see CC3).
c. Dedicate funding and technical assistance for state agencies and municipalities to incorporate the Science and Technical Advisory Panel report, as amended, in development standards, land use policies, and plans (see CC5 (b)).
d. Establish a funding mechanism to assist state agencies in covering the costs of emergency and disaster response and recovery (see CC5 (e)).
e. Apply for and utilize FEMA mitigation grants and other sources of funding to implement climate adaptation and planning strategies that reduce or eliminate flooding impacts (see CC6 (a)).
f. Create and utilize a dedicated fund to acquire repetitive loss properties when structures and facilities are abandoned or destroyed (see CC6 (d)).
g. Identify mechanisms to raise matching funds for FEMA and other grant programs, such as creating a dedicated state flood mitigation fund (see CC6 (e)).

h. Establish stormwater utilities to fund retrofits to existing development and future improvements (see E3 (b)).
i. Utilize existing funding sources for natural resource restoration (e.g. offset measures, state Aquatic Resource Mitigation fund) (see NR2 (d)).
j. Establish dedicated funds and sources to support land preservation, restoration, acquisition of easements, and development rights to transfer vulnerable property to conservation lands (see NR3 (b)).
k. Allocate FY2018-2019 Biennial Budget funding and authority to expend funds for recreational and cultural resource vulnerability surveys, planning efforts, and implementation of the resulting plans (see H5).

CC3. Review whether existing state statutes and rules adequately permit state agencies and municipalities to prepare and adapt to best available climate science and impacts, and make recommendations for amendments or new regulations where necessary. *[Lead: State agencies].*

ACTIONS:

a. Require and provide funding for state agencies to evaluate and recommend necessary amendments to relevant statutes and administrative rules with respect to best available climate science, involving relevant stakeholders as appropriate. Relevant statutes and administrative rules include, but are not limited to, the following: RSA 483-B Shoreland Water Quality Protection Act, RSA 482-A Fill and Dredge in Wetlands, 485-A:29-39 Subsurface Systems, 485-A:17 Terrain Alteration, RSA 230:78 State Highways, RSA 230:79 Liability of NHDOT, and RSA 79-A Current Use.
b. Review current practices to determine the most appropriate buffer and setback distances, freeboard, shoreline treatment, and other design standards and approaches needed to provide adequate levels of risk reduction and protection for at risk structures and facilities.
c. Develop an approach to consolidate RSA 483-B Shoreland Water Quality Protection Act and RSA 482-A Fill and Dredge in Wetlands to create permitting efficiencies and allow for comprehensive management of tidal resources.
d. Assess the status of existing state agency, municipal, and other disaster response and recovery plans, and determine whether new procedures or regulations are necessary to enable response and recovery planning at state and municipal levels.
e. Identify and recommend modifications to state and local building codes necessary to protect against likely changes in flooding and other coastal hazards.

CC4. Amend state laws and rules to incorporate consideration of best available climate science and weather-related data. *[Lead: State Legislature].*

ACTIONS:

a. Adopt amendments to state statutes and administrative rules identified under Cross-cutting Recommendation CC3, including, but not limited to: RSA 483-B Shoreland Water Quality Protection Act, RSA 482-A Fill and Dredge in Wetlands, 485-A:29-39 Subsurface Systems, 485-A:17 Terrain Alteration, RSA 230:78 State Highways, RSA 230:79 Liability of NHDOT, and RSA 79-A Current Use Taxation.

CC5. By2019[xviii], state agencies will consider and use best available climate science in their activities and plans. *[Lead: State Legislature].*

ACTIONS:

a. Establish the Science and Technical Advisory Panel report (see Science Recommendation S1), as amended, as state agency and municipal guidance about anticipated future climate and coastal flooding conditions.
b. Dedicate funding and technical assistance for state agencies and municipalities to incorporate the Science and Technical Advisory Panel report, as amended, in development standards, land use policies, and plans.
c. Establish a mechanism to monitor state agency and municipal use of Science and Technical Advisory Panel findings and recommended approaches to risk management.
d. Require state agencies to address current and future coastal risk and hazards in preparation, response, and recovery plans.
e. Establish a funding mechanism to assist state agencies in covering the costs of emergency and disaster response and recovery.
f. Integrate social vulnerability information in adaptation planning, emergency preparedness strategies, and public health interventions.

CC6. Make existing structures and facilities more resilient and acquire properties in high risk areas in order to reduce or eliminate flooding impacts. *[Lead: State Legislature; State Agencies; Municipalities].*

ACTIONS:

a. Apply for and utilize FEMA mitigation grants and other sources of funding to implement climate adaptation and planning strategies that reduce or eliminate flooding impacts.
b. Elevate existing at-risk structures and implement higher freeboard standards above the Base Flood Elevation on new and substantially reconstructed structures and facilities to protect from future flood risks (see BL2 for more detail).
c. Acquire at-risk and repetitive loss properties to create buffers and open space that facilitate restoration of floodplain functions.
d. Create and utilize a dedicated fund to acquire repetitive loss properties when structures and facilities are abandoned or destroyed.
e. Identify mechanisms to raise matching funds for FEMA and other grant programs, such as creating a dedicated state flood mitigation fund.

CC8. Establish an adaptation coordinator to monitor and coordinate implementation of the NH Coastal Risk and Hazards Commission recommendations. *[Lead: State Legislature].*

BL1. Encourage state agencies and municipalities to complete vulnerability assessments for state, municipal, and regulated private structures and facilities. *[Lead: State Legislature; State Agencies; Municipalities].*

ACTIONS:

a. Use initial assessments to identify need for more detailed assessments.
b. Require and secure funding for state agencies to conduct vulnerability assessments of state-owned structures and facilities located in the coastal zone at regional, municipal, and/or site-specific scales as appropriate.

[xviii] This timeframe was determined to be acceptable by the state agencies on the NH Coastal Risk and Hazards Commission.

BL2. Implement regulatory standards and/or enact enabling legislation to ensure that the best available climate science and flood risk information are used for the siting and design of new, reconstructed, and rehabilitated state-funded structures and facilities, municipal structures and facilities, and private structures. *[Lead: State Legislature; State Agencies; Municipalities].*

ACTIONS:

a. Adopt amendments to state and local building codes recommended under Cross-cutting Recommendation CC3.

b. Require state agencies, through legislation or amendment to NH Executive Order 96-4,[xix] to use one of the following approaches[xx,xxi,xxii] for determining a higher vertical flood elevation and expanded corresponding horizontal floodplain than the current base flood elevation and floodplain to address current and future flood risk for state-funded new construction, substantial improvement, or repairs to substantially damaged structures and facilities:

   i. *Climate-informed Science Approach* – use the best available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science.[xxiii]

   ii. *Freeboard Value Approach* – use the freeboard value, reached by adding an additional two (2) feet to the base flood elevation for non-critical structures and facilities and from adding an additional three (3) feet to the base flood elevation for critical[xxiv] structures and facilities.

   iii. *The 0.2-percent-annual-chance Flood Approach* – use the 0.2-percent-annual-chance flood elevation (also known as the 500-year flood elevation).

c. Encourage municipalities to use one of the following three approaches[xxv,xxvi,xxvii] for determining a higher vertical flood elevation and expanded corresponding horizontal floodplain than the current base flood elevation and floodplain to address current and future flood risk for new construction, substantial improvement, or repairs to both municipal and private structures and facilities:

   i. *Climate-informed Science Approach* – use the best available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science.[xxviii]

   ii. *Freeboard Value Approach* – use the freeboard value, reached by adding an additional two (2) feet to the base flood elevation for non-critical structures and facilities and from adding an additional three (3) feet to the base flood elevation for critical[xxix] structures and facilities.

[xix] NH Executive Order 96-4 directs State agencies to comply with the floodplain management requirements of all local communities participating in the NFIP in which State-owned properties are located.

[xx] See Federal Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Input.

[xxi] See Guidelines for Implementing Executive Order 13690.

[xxii] See Appendix F for State of New Hampshire comments on Draft Guidelines for Implementing Executive Order 13690.

[xxiii] An acceptable source of climate science for New Hampshire includes the Coastal Risk and Hazards Commission Science and Technical Advisory Panel report, Sea-level Rise, Storm Surges, and Extreme Precipitation in Coastal New Hampshire: Analysis of Past and Projected Trends, as amended.

[xxiv] Any activity for which even a slight chance of flooding would be too great. For expanded description of "critical action" see Part I, Section 6 of Guidelines for Implementing Executive Order 13690.

[xxv] See Federal Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Input.

[xxvi] See Guidelines for Implementing Executive Order 13690.

[xxvii] See Appendix F for State of New Hampshire comments on Draft Guidelines for Implementing Executive Order 13690.

[xxviii] An acceptable source of climate science for New Hampshire includes the Coastal Risk and Hazards Commission Science and Technical Advisory Panel report, Sea-level Rise, Storm Surges, and Extreme Precipitation in Coastal New Hampshire: Analysis of Past and Projected Trends, as amended.

[xxix] Any activity for which even a slight chance of flooding would be too great. For expanded description of "critical action" see Part I, Section 6 of Guidelines for Implementing Executive Order 13690.

iii. *The 0.2-percent-annual-chance Flood* Approach – use the 0.2-percent-annual-chance flood elevation (also known as the 500-year flood elevation).

d. Develop model regulations for municipalities to consider adopting into their existing floodplain management regulations, which can assist municipalities in becoming more flood resilient by addressing current and future flood conditions using the best available flood risk and climate science information.
e. Amend the New Hampshire Stream Crossing Guidelines to incorporate anticipated future stormwater flows based on best available climate science.
f. Incorporate the Science and Technical Advisory Panel report information, as amended, into benefit-cost analyses for applications submitted under FEMA Hazard Mitigation Assistance and Public Assistance grant programs. In relevant cases, consider timeframes for potential future relocation or retreat by acquiring at-risk properties.
g. Require, through legislation or other means, that the New Hampshire Site Evaluation Committee and Public Utilities Commission take future sea-level rise and coastal flooding impacts into account in project siting decisions and other planning.

NR3. Protect land that allows coastal habitats and populations to adapt to changing conditions and also provides ecosystem services that protect people, structures, and facilities. *[Lead: State Legislature; State Agencies; Municipalities].*

ACTIONS:

a. Use emerging habitat science to prioritize land and resource conservation projects.
b. Establish dedicated funds and sources to support land preservation, acquisition of easements, and development rights to transfer vulnerable property to conservation lands.
c. Prioritize land conservation efforts to adequately account for future sea-level rise and coastal flooding.
d. Establish buffer requirements for setbacks to rivers, shorelines, and wetlands that include consideration of climate change and create a dedicated fund to support local enforcement.
e. Encourage landowners to preserve the beneficial functions of natural features like wetlands and to restore and protect coastal dune habitat.
f. Align land acquisition and conservation easement programs to protect important natural resources and ecosystem services.
g. Protect future marsh migration areas identified by marsh migration modeling.
h. Establish and share municipal inventories of land available for mitigation and conservation in areas that reduce flooding and promote the migration of species and habitat.

H2. Develop plans and implement strategies to prepare and adapt recreational resources based on best available climate science. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Conduct public information hearings to understand the impacts of proposed climate adaptation strategies.
b. Assess existing and future recreational areas for their potential to provide storage for flood waters and stormwater runoff.

c. Preserve open space and recreational areas that serve to minimize climate change impacts.
d. Integrate recreational and open space planning into climate adaptation planning and the Tidal Shoreline Management Plan.
e. Integrate protection of recreational resources into land use and management, engineering, regulatory components of state and municipal plans including the Tidal Shoreline Management Plan, hazard mitigation plans, Master Plans, and design standards.

H4. Require state agencies and encourage municipalities to develop long-term plans for protecting, adapting, or reducing risk to cultural resources affected by climate change. *[Lead: State Agencies; Municipalities].*

ACTIONS:

a. Create or modify adaptation strategies for cultural and historic buildings affected by climate change, including plans for protecting or relocating resources.
b. Integrate protection of cultural and historical resources into land use and management, engineering, regulatory components of state and municipal plans including the Tidal Shoreline Management Plan, hazard mitigation plans, Master Plans, and design guidelines.
c. Establish expert group to create a decision-making process for property owners and municipalities to determine when and how to mitigate sites that will be lost.
d. Establish guidelines for adaptation or risk reduction of cultural resources in state ownership.
e. Create programmatic strategies to compensate for the loss of historic asset types that will be replaced in order to adapt to climate change impacts.
f. Modify the Land and Cultural Heritage Investment Program (LCHIP) to include selection criteria that incentivize funding for climate adaptation actions.

H5. Allocate FY2018-2019 Biennial Budget funding and authority to expend funds for recreational and cultural resource vulnerability surveys, planning efforts, and implementation of the resulting plans. *[Lead: State Legislature].*

7. Where We Go From Here

The Commission was established to develop guidance and recommendations for New Hampshire that will set our state on a responsible path toward enhancing coastal community and watershed resilience to the effects of storm surge, sea-level rise, and extreme precipitation. Because the timing and magnitude of these changes are uncertain, so are the assumptions on which we base our recommendations. While it is true that our level of understanding and degree of certainty about the impacts of climate change will improve over time, we know more than enough now to recognize that we cannot afford to wait for certainty to act. The key to managing economic and social costs and risks of climate-related impacts in the coastal region is to begin early and adapt incrementally.

Photo credit: Ralph Morang

Our central message is this: **begin now**. Even though we expect most of the impacts from climate change to be gradual, instances of severe flooding from extreme precipitation and storm events will occur, as they always have, and are likely to worsen with changes in storm surge and sea level.. Actions taken now, even costly ones, will more than likely pay for themselves in the form of reduced losses and greater resilience. In addition, the normal cycles of reconstruction, replacement and redevelopment can be utilized to introduce more resilient design into structures and facilities.

7.1 Actions Already Underway

The Commission's report and recommendations are the culmination of a collaborative process that recognized a diversity of views and came to a strong consensus about common sense actions to be taken to move New Hampshire forward on a path to coastal resilience. Consensus was achievable in large part because of the work on this issue done by various parties in various coastal communities that preceeded the Commission. The Commission is also aware that the difficult and vital work of **implementation** is yet to come and its members are committed to supporting implementation efforts beyond the Commission's sunset on December 1, 2016. As of this publication, the Commission has already taken several actions and identified existing mechanisms to ensure continuity and implementation of the recommendations.

1. As a first step towards implementation of the Commission's recommendations, Senator Watters (District 4), Senator Stiles (District 24), Senator Fuller Clark (District 21), Representative Rice (Rockingham 21), Representative Cushing (Rockingham 21), and Representative Borden (Rockingham 24) introduced two pieces of legislation in the fall of 2015 that have since both passed into law: Chaptered Law 121 / SB 374 and Chaptered Law 195 / SB 452.

   - **Chaptered Law 121 / SB 374** implements Recommendation S1 and requires the NH Department of Environmental Services to regularly update the storm surge, sea-level rise, precipitation and other relevant projections recommended in the Commission's 2014 Science and Technical Advisory Panel (STAP) Report at least every five years, commencing July 1, 2019. SB 374 was signed by the Governor on May 20, 2016, effective July 19, 2016.

- **Chaptered Law 195 / SB 452** implements Recommendation CC3 and requires certain state agencies to conduct an audit of existing state statutes, rules, and agency policies governing state properties, projects, and actions in coastal and Great Bay regions to determine if any changes are necessary to enable appropriate state and local actions to prepare for projected coastal flood risks. Additionally, Chaptered Law 195 / SB452 also requires state agencies involved in planning, siting, and design of state-funded structures and facilities, public works projects, and transportation projects, as well as land acquisition and management, and other environmental activities in the coastal and Great Bay regions to reference the 2014 STAP Report, as updated, for guidance on all potentially affected activities. SB 452 was signed by the Governor on June 6, 2016, effective immediately.

2. A State Agency Climate Change Work Group has been formed to coordinate agency actions, enhance New Hampshire's capability to reduce the causes of and prepare for the impacts of climate change, and better serve our agencies and the citizens of NH. This group will be instrumental in carrying out Recommendation CC3 and Chaptered Law 195 / SB 452, which requires certain state agencies to conduct an audit of laws governing coastal regions to enable the state and municipalities to take appropriate actions.

3. The NH Department of Environmental Services Coastal Program and partners have secured funding from the National Oceanic and Atmospheric Administration Office for Coastal Management to support outreach and begin implementation of the Commission's recommendations. Broadly, this project, entitled NH Setting SAIL, seeks to achieve the following goals:

   - Ensure through education and outreach that the CRHC recommendations are understood and championed by state, municipal, and regional stakeholders;
   - Assist Great Bay coastal municipalities to prioritize and implement actions that meet their unique needs, including the development of a climate adaptation chapter for the City of Dover Master Plan (similar to what has been done for the Atlantic Coast municipalities under the Tides to Storms 2 project funded by the Northeast Regional Ocean Council); and
   - Provide capacity for the State Agency Climate Change Work Group to coordinate audits of existing state statutes, rules, and agency policies as required by Chaptered Law 195 / SB 452; complete inventories of vulnerable state assets; and conduct other implementation activities.

4. Commission members have begun exploring opportunities to establish a climate adaptation coordinator (see Recommendation CC8) within a state agency/office to coordinate implementation of the Commission's recommendations and other recommendations that follow.

5. The ongoing work of New Hampshire Coastal Adaptation Workgroup (NHCAW) and its member communities and agencies will be instrumental in ensuring continued coordination and implementation of the Commission's recommendations. NHCAW assists communities in New Hampshire's coastal watershed prepare for the effects of extreme weather and long term climate change by providing resources, facilitation, and guidance that enhance readiness and resilience. A list of NHCAW-related projects is included in Appendix G: Related Projects.

6. Finally, it is important to acknowledge that many coastal municipalities have begun taking initial steps toward implementing climate adaptation actions. These steps include, but are not limited to, coastal hazards and climate adaptation master plan chapters, enhanced standards for floodplain development and shoreline buffers, and outreach to raise awareness of the importance of coastal buffers in protecting life and property. These "first responders" have repeatedly sought technical assistance and committed dollars and staff time to their efforts with the goal of creating more resilient and sustainable communities and local economies. We hope their actions will serve as encouraging examples for other municipalities to act.

7.2 Suggested Next Steps

Drawing on the recommendations and actions presented in this report, the Commission suggests the following next steps for state legislators, state agencies, and municipalities to get started.

1. State legislators, state agencies, and municipalities should familiarize themselves with all of the Commission recommendations and actions and identify, prioritize, and implement those recommendations and actions most relevant to their needs.
2. State agencies should implement all laws enacted to carry out the Commission's recommendations, including Chaptered Laws 121 and 195.
3. State legislators, state agencies, and municipalities should identify financial resources and mechanisms needed at state and municipal levels to address storm surge, sea-level rise, and extreme precipitation events.
4. State agencies and municipalities should conduct broad-based public education and outreach to raise awareness of flood hazards and risk, and strategies to protect property and investments.
5. State agencies and municipalities should undertake detailed analyses to determine site-specific vulnerabilities and appropriate management actions for state and municipal structures and facilities, including historical resources, and other key assets.
6. State agencies and municipalities should work cooperatively to develop integrated response, recovery, and continuity plans to reduce and recover from impacts of severe coastal flooding.
7. State agencies and municipalities should conduct planning, siting, design and construction of publicly funded or supported structures, facilities, public works projects and transportation projects in a manner that is consistent with the findings and guidance of the 2014 Science and Technical Advisory Panel Report, as updated.
8. Municipalities should strengthen land use and development standards (e.g., flood hazard overlay districts, building codes, and floodplain management) to reduce vulnerability of existing and future development in areas with highest flood risk.
9. State agencies and municipalities should take immediate action to protect and restore natural resource assets that provide flood storage, erosion protection, hydrologic connectivity, migration opportunities for fish and wildlife and maintain other critical and important services.
10. State agencies and municipalities should accelerate and broaden existing efforts to develop a tidal shoreline management plan that will identify appropriate strategies and conceptual plans to increase resiliency in New Hampshire's most vulnerable sections of shoreline.
11. Finally, state legislators, state agencies, and municipalities should regularly review the recommendations and actions in this report to ensure implementation progresses where needed and the recommendations themselves are refined or replaced as new information and better understanding comes to light. Given the dynamic nature of climate change and the threats it poses to New Hampshire's coastal region, this guidance needs to be treated as a living, evolving document.

8. Definitions and Acronyms

Definitions

Atlantic Coast Municipalities	The seven New Hampshire municipalities in the coastal zone that are directly exposed to the Atlantic Ocean. Includes Hampton, Hampton Falls, North Hampton, New Castle, Portsmouth, Rye, and Seabrook.
Adaptation	Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.
Adaptive Capacity[82]	The combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities.
Built Landscape	The network of structures and facilities owned by state and municipal governments and private entities in coastal New Hampshire.
Climate Adaptation	A response or action that seeks to reduce the vulnerability of social and biological systems to the impacts of climate change.
Climate Effect	A direct result of climate change (e.g., an effect of climate change is that the average annual temperature is rising).
Climate Impact	A consequence of one or more climate change effects (e.g., rising average annual temperature (climate effect) may lengthen the agricultural growing season (climate impact) in some regions).
Climate-Ready	The state of being able to prepare for, adapt to, and respond after expected impacts of climate change. This can refer to a variety of entities, including a program, regulation, or entity like a municipality or State agency.
Coastal Hazard	Natural or human-induced physical events (e.g., hurricanes, nor'easters, storm surge, sea-level rise, extreme precipitation) that may cause loss of life, injury or other health impacts, as well as damage and loss to property, facilities, livelihoods, and natural resources.
Coastal Risk[83]	The probability that coastal hazards will adversely affect a coastal area as determined by the combination of physical hazards and vulnerabilities of exposed elements.
Coastal Zone	New Hampshire's coastal zone includes the 17 coastal municipalities bordering tidal waters in New Hampshire. Represents the geographical scope of the Coastal Risk and Hazards Commission.
Critical Action[84]	Any action for which even a slight chance of flooding is too great. Critical actions include, but are not limited to, those which create or extend the useful life of structures or facilities: a. Such as those which produce, use or store highly volatile, flammable, explosive, toxic or water reactive materials; b. Such as hospitals and nursing homes, and housing for the elderly, which are likely to contain occupants who may not be sufficiently mobile to avoid the loss of life or injury during flood and storm events; c. Such as emergency operation centers, or data storage centers which contain records or services that may become lost or inoperative during flood and storm events; and such as generating plants, and other principal points of utility lines.

Cultural and Historic Resources	A district, site, building, structure or object that is significant in the history, architecture, engineering, archaeology or culture of this state, its communities, or the nation.
Ecosystem Services	The benefits humans derive from nature such as food and water, erosion and flood control, nutrient cycling, and recreation.
Exposure[85]	The presence of people, livelihoods, environmental services and resources, structures, facilities, or economic, social, or cultural assets in places that could be adversely affected by physical events and which, thereby, are subject to potential future harm, loss, or damage.
Extreme Precipitation	Precipitation falling as extreme events, defined by the 2014 National Climate Assessment and in this report as the largest one percent of daily events in a year. There are many other definitions of "extreme precipitation."
Facility	Any man-made or man-placed item other than a structure.[86] Examples include, but are not limited to, bridges and roads. The term "structure" is defined later in the glossary.
Great Bay Municipalities	The ten New Hampshire municipalities in the coastal zone that are not directly exposed to the Atlantic Ocean, but whose boundaries are exposed to tidal waters along Great Bay and its tributaries. Includes Dover, Durham, Exeter, Greenland, Madbury, Newfields, Newington, Newmarket, Rollinsford, and Stratham.
Infrastructure	A subset of the term "facilities," as defined in this glossary. Often refers to roads and other transportation assets, wastewater and stormwater management facilities, and other facilities. Can also refer to natural resources that provide services similar to manmade infrastructure. For example, a salt marsh that cleans and provides flood storage for stormwater is a type of natural infrastructure.
Mean Higher-High Water	The average of all the higher of the two daily high water heights recorded at a particular point or station over a considerable period of time, usually 19 years.
Mean High Water	The average of all the high water heights recorded at a particular point or station over a considerable period of time, usually 19 years.
Mitigation	Any action taken to reduce or eliminate long term risk to people and property from natural hazards. For the purposes of this report, the term mitigation should not to be confused with climate change mitigation, which refers to efforts to reduce or prevent greenhouse gas emissions.
Natural Resources	The natural systems that support important species and biodiversity in coastal New Hampshire and provide critical and important services to coastal New Hampshire like food, flood protection, fresh water, raw materials, and recreation opportunities.
Nature-based Approaches	Features (sometimes referred to as green infrastructure or natural infrastructure) designed to mimic natural processes and provide specific services such as reducing flood risks and/or improving water quality. Nature-based approaches are created by human design (in concert with and to accommodate natural processes) and generally, but not always, must be maintained in order to reliably provide the intended level of service.
New Construction	The construction of a new structure (including the placement of a mobile home) or facility, or the replacement of a structure or facility which has been totally destroyed or is being upgraded. This definition does not override existing or future municipal definitions of this term.

Piscataqua Region (Coastal) Watershed	The land area from which water drains through the Hampton-Seabrook and Great Bay estuaries out to the Atlantic Ocean. Includes 42 municipalities in New Hampshire and portions of Maine and Massachusetts.
Resilience	The ability to avoid, minimize, withstand, and recover from the effects of adversity, whether natural or manmade, under all circumstances of use.
Sea-level Rise	The increase in sea level primarily caused by two factors related to climate change: the added water from melting land ice and the expansion of sea water as it warms. The acronym SLR stands for sea-level rise.
Science	The NH Coastal Risk and Hazards Commission defines science as the knowledge about or study of the natural world based on facts learned through experiments and observation and published in peer-reviewed academic journals. Peer review is the evaluation of research methods and results by one or more people of similar competence (peers) to the producers of the research. Reviews are often completed anonymously. Peer review constitutes a form of self-regulation by qualified members of a profession within the relevant field. Peer review is used to maintain standards of quality, improve performance, provide credibility, and reduce the dissemination of unsubstantiated results and unacceptable interpretations. Publications that have not undergone peer review are regarded with a higher degree of skepticism by academics and scientists. Sources and additional resources can be found at: Merriam-Webster Dictionary, Science Magazine, Proceedings of the National Academy of Sciences
Storm Surge[87]	The sea height during storms such as hurricanes that is above the normal expected at that time and place based on the tides alone.
Structures	Walled or roofed buildings, including mobile homes and gas or liquid storage tanks.[88] The related term "facility" is defined earlier in the glossary.
Upland	Land currently above mean high-high water line (i.e., shoreline).
Vulnerability	The propensity or predisposition to be adversely affected, which results from diverse historical, social, economic, political, cultural, institutional, natural resource, and environmental conditions and processes.

Acronyms

CRHC	New Hampshire Coastal Risk and Hazards Commission
DHR	New Hampshire Division of Historical Resources (within NHDCR)
DRED	New Hampshire Department of Resources and Economic Development
FEMA	Federal Emergency Management Agency
FFRMS	Federal Flood Risk Management Standard
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
GBNERR	Great Bay National Estuarine Research Reserve (within NHFG)
HSEM	New Hampshire Department of Homeland Security and Emergency Management
LIDAR	Light Detection and Ranging
NHCAW	New Hampshire Coastal Adaptation Workgroup
NHDCR	New Hampshire Department of Cultural Resources
NHDES	New Hampshire Department of Environmental Services
NHDOT	New Hampshire Department of Transportation
NHFG	New Hampshire Fish and Game Department
NFIP	National Flood Insurance Program
NHOEP	New Hampshire Office of Energy and Planning
NOAA	National Oceanic and Atmospheric Administration
PREP	Piscataqua Region Estuaries Partnership
RPC	Rockingham Planning Commission
SLR	Sea-level rise
SRPC	Strafford Regional Planning Commission
STAP	Science and Technical Advisory Panel
UNH	University of New Hampshire
USACE	United States Army Corps of Engineers
USDOT	United States Department of Transportation
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey

9. Appendices

APPENDIX A: RSA 483-E

TITLE L
WATER MANAGEMENT AND PROTECTION

CHAPTER 483-E
COASTAL RISK AND HAZARDS COMMISSION

Section 483-E:1

[RSA 483-E:1 repealed by 2013, 188:2, effective December 1, 2016.]

483-E:1 Commission Established. –

There is established a coastal risk and hazards commission.

Source. 2013, 188:1, eff. July 2, 2013.

Section 483-E:2

[RSA 483-E:2 repealed by 2013, 188:2, effective December 1, 2016.]

483-E:2 Membership and Compensation. –

I. The members of the commission shall be as follows:

(a) Two members of the house of representatives, appointed by the speaker of the house of representatives.

(b) Two members of the senate, appointed by the president of the senate.

(c) The commissioner of the department of environmental services, or designee.

(d) The executive director of the fish and game department, or designee.

(e) The administrator of the division of public works design and construction in the department of administrative services, or designee.

(f) The commissioner of the department of transportation, or designee.

(g) The director of the division of parks and recreation, or designee.

(h) The director of the division of historical resources, or designee.

(i) The president of the Seacoast Board of Realtors, or designee.

(j) The director of the New Hampshire Sea Grant, or designee.

(k) A representative of the New Hampshire Public Risk Management Exchange, appointed by the exchange.

(l) The director of the office of energy and planning, or designee.

(m) The president of the Homebuilders and Remodelers Association of New Hampshire, or designee.

(n) The commissioner of the department of resources and economic development, or designee.

(o) The president of the university of New Hampshire, or designee.

(p) A representative of the New Hampshire Municipal Association, appointed by that organization.

(q) A representative of the Strafford regional planning board, appointed by that body.

(r) A representative of the Rockingham regional planning board, appointed by that body.

(s) One representative of each of the following towns, appointed by his or her town's governing body: Rollinsford, Greenland, Stratham, Exeter, Newfields, Newmarket, Portsmouth, Rye, North Hampton, Hampton, Dover, Hampton Falls, Seabrook, Newington, New Castle, Madbury, and Durham.

II. Legislative members of the commission shall receive mileage at the legislative rate when attending

To access the online version of this document, go to http://www.gencourt.state.nh.us/rsa/html/l/483-E/483-E-mrg.htm

to the duties of the commission.

III. The members of the commission shall elect a chairperson from among the members. The first meeting of the commission shall be called by the first-named house member. The first meeting of the commission shall be held within 45 days of the effective date of this section. Eighteen members of the commission shall constitute a quorum.

Source. 2013, 188:1, eff. July 2, 2013. 2014, 327:68, eff. Aug. 2, 2014.

Section 483-E:3

[RSA 483-E:3 repealed by 2013, 188:2, effective December 1, 2016.]

483-E:3 Duties. –

I. The commission shall recommend legislation, rules, and other actions to prepare for projected sea level rise and other coastal and coastal watershed hazards such as storms, increased river flooding, and storm water runoff, and the risks such hazards pose to municipalities and state assets in New Hampshire.

II. The commission shall review National Oceanic and Atmospheric Administration and other scientific agency projections of coastal storm inundation, and flood risk to determine the appropriate information, data, and property risks.

III. The commission shall meet 4 times per year.

IV. The commission shall annually report its findings and any recommendations for proposed legislation to the speaker of the house of representatives, the president of the senate, the house clerk, the senate clerk, the governor, and the state library on or before November 1.

Source. 2013, 188:1, eff. July 2, 2013.

To access the online version of this document, go to **http://www.gencourt.state.nh.us/rsa/html/l/483-E/483-E-mrg.htm**

APPENDIX B: Commission Alternates and Former Members

Alternates

Members	Representation
Peter Bowman	New Hampshire Department of Resources and Economic Development
Steve Couture	New Hampshire Department of Environmental Services
Liz Durfee	Strafford Regional Planning Commission
Brian Fitzgerald	Town of Rye
Mary Kate Ryan	New Hampshire Division of Historical Resources
Ann Scholz	New Hampshire Department of Transportation

Former Members

Members	Representation
Dr. Mimi Becker	Town of Exeter
Robert Cormier	New Hampshire Home Builders Association
Dr. Paul Kirshen	University of New Hampshire
Thomas Morgan	Town of Newington
Former Rep. Christopher Muns	New Hampshire House of Representatives
Dr. Jonathan Pennock	New Hampshire Sea Grant
Vicki Quiram	New Hampshire Department of Environmental Services
Raymond Smith	Town of Seabrook
Former Rep. David Wood	Town of Hampton

APPENDIX C: Federal, New Hampshire, and Other State Guidance on Climate Change

As scientific findings have continued to emerge and modeling has improved, federal, New Hampshire, and other state government agencies have developed guidance and taken action to both reduce greenhouse gas emissions and prepare for the inevitable impacts expected as a result of climate change. This section summarizes some of the guidance and initiatives underway in federal agencies and in our state.

National Guidance and Actions on Climate Change

U.S. Global Change Research Program (USGCRP) and the National Climate Assessment

The U.S. Global Change Research Program (USGCRP) was established by Presidential Initiative in 1989 and mandated by Congress in the Global Change Research Act (GCRA) of 1990 to "assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change." The GCRA requires that the USGCRP produce a National Climate Assessment every four years. The 2014 National Climate Assessment[89] synthesizes the current science and understanding about what climate changes are occurring, what future conditions are expected and how they may affect the United States. The 2014 Assessment is a coordinated, interagency resource that can be used to compare and estimate impacts and assess vulnerability.

Federal Flood Risk Management Standard (FFRMS)

The FFRMS was established by Executive Order 13690 in 2015 establishing new management guidelines for federal investments and programs that involve exposure to future flood risk. It serves as a set of general design standards for federally-funded projects ("Federal actions") subject to coastal flooding and sea-level rise. The FFRMS establishes new criteria for determining future flood risk and requires federally funded projects and other actions to be designed to anticipate future expected flood conditions in addition to existing flood hazards; it anticipates these hazards to increase over time due to the effects of climate change and other threats. The key provision of the new policy is a change in the way federal agencies will determine whether or not a proposed federal "action" (e.g. federally funded and/or permitted projects) would be located within a flood hazard area. This determination is to be made using one of three methods:

1. climate informed science (state or regional-specific estimate of future flood exposure);
2. the minimum freeboard value, adding from 2 to 3 feet of additional elevation from existing base flood levels (depending on risk tolerance of the facility)
3. use the 0.2-percent-annual-chance (500-year) flood elevation as an interim planning value for future flood levels

The FFRMS, also incorporates a process by which and exception to these standards can be made under certain circumstances, relating to emergency, national security and in circumstances where there implementation would be counterproductive.

FEMA Climate Change Adaptation Policy

In January 2012, the Federal Emergency Management Agency (FEMA) issued a policy statement that established an agency-wide directive to integrate climate change considerations, adaptation planning and actions into FEMA's programs and policies. The policy explicitly recognizes that the potential impacts from climate change may affect FEMA's ability to effectively manage emergencies. The policy statement contains several key elements that the agency will employ to improve its capacity to manage in the face of climate change.

The key policy elements are to:

1. Enhance climate research, monitoring and adaptation capabilities.
2. Study the specific impacts of climate change on the National Flood Insurance Program (NFIP) and incorporate climate change considerations in future NFIP reform.
3. Evaluate how climate change considerations can be incorporated into grant programs and strategies, and especially on infrastructure.
4. Engage local communities in addressing and supporting climate change efforts.
5. Promote updated building standards and practices that consider the future impacts of climate change.

In March 2015, FEMA issued new guidance for the minimum required content of State Hazard Mitigation Plans. State plans must now consider the projected effects of climate change on natural hazards such as more intense storms, frequent heavy precipitation, heat waves, drought, extreme flooding, and higher sea levels because of their potential to significantly alter the types and magnitudes of hazards impacting states in the future. Specifically, the new guidance requires state plans to include climate projections and data, and to consider climate change effects in evaluating the probability of future hazard events.

Federal Highway Administration (FHWA) Guidance

As of the publication of this report, the Federal Highway Administration (FHWA) had not established design standards or guidelines that require projected acceleration of sea-level rise to be taken into account in highway and bridge design. FHWA has developed planning tools to facilitate consideration of climate change impacts in transportation systems design, including consideration of heat, precipitation, sea-level rise and storm surge.

In 2012 FHWA developed the **Climate Change and Extreme Weather Vulnerability Assessment Framework**, a voluntary process to help transportation agencies assess transportation asset vulnerability to climate change and extreme weather events. It recommends key steps to be followed in conducting vulnerability assessments and incorporating results into decision-making and provides modules and tools to aid in the assessment process. The framework encourages incorporating the results of the vulnerability assessment into the agency's decision-making process to ensure that the information is used in practice.

In 2008, FHWA published the ***Highways in the Coastal Environment, Second Edition***[90] which reviews special factors to consider when designing transportation facilities in coastal areas, including areas prone to flooding and extreme events. The historical eustatic sea-level rise rate is reviewed as well as the possibility that these rates will accelerate as a consequence of ocean warming, however no recommended eustatic sea-level rise levels or scenarios for design purposes are provided.

FHWA's Climate Change Adaptation website provides resources, tools, and guidance to help local and regional transportation agencies implement the FHWA **Climate Change and Extreme Weather Vulnerability Assessment Framework,** a guide to assessing the vulnerability of transportation assets to climate change and extreme weather events. The FHWA also provides a Virtual Framework for Vulnerability Assessment – **Modules.**

U.S. Department of Transportation (USDOT)

In 2013 the U.S. Department of Transportation Volpe National Transportation Systems Center and the Office of Research, Development and Technology published a report entitled, "Climate Change Adaptation Support for Transportation Practitioners." The report lays the groundwork to support state and local practitioners as they proactively (or reactively) adapt to climate change impacts by:

- Developing a comprehensive database of relevant resources
- Categorizing and tagging those resources to make them more searchable
- Developing an "Expert System" concept to help practitioners quickly identify the resources most relevant to them, through a step-by-step guided approach
- Gathering feedback from USDOT agencies and practitioners to help refine the concept
- Presenting the concept to USDOT agencies and assisting with implementation

U.S. Army Corps of Engineers (USACE)

The U.S. Army Corps of Engineers was one of the first Federal agencies to develop guidance requiring project planning and design to anticipate sea-level rise. The 2011 Circular (revised slightly in 2013) was developed with the aid of other agency experts from the National Oceanic and Atmospheric Administration and U.S. Geological Survey and incorporates sea-level change scenarios into its design requirements.[91] The policy explicitly anticipates the continued acceleration of global mean sea-level rise. Key requirements are:

- Relative sea level change must be considered in all USACE coastal activities within the extent of tidal influence.
- Base level sea-level rise is to be considered from the history of recorded changes for a specific site.
- Project planning and design must consider how sensitive and adaptable natural and managed ecosystem, and human engineered systems are to predicted seal level change and what design or operations and maintenance measures should be implemented to adapt.
- Project development must include consideration of a multiple scenario approach to deal with future condition uncertainty.
- Project alternatives are to be formulated and evaluated for the entire range of future rates of sea level change scenarios using low, medium and high scenario ranges, based on National Research Council's sea-level rise scenarios (SLR values for the NH coast in 2100 are 0.4, 1.5 and 4.8 feet).

New Hampshire Guidance and Activities on Climate Change

New Hampshire Climate Action Plan

In 2009, the Governor's Climate Change Policy Task Force released the New Hampshire Climate Action Plan[92] containing 10 overarching strategies necessary to meet the State's greenhouse gas reduction and climate change related goals. The Plan describes in detail the benefits of planning for and adapting to climate change and how this may be achieved to minimize impacts to the economy, human health, natural systems, and infrastructure. The New Hampshire Climate Action Plan has helped guide many research and planning initiatives, policy decisions, and audits of the existing regulatory standards and procedures by State agencies to address climate change. The plan envisions that all stakeholders throughout the state would contribute to implementation of its recommendations.

New Hampshire Department of Environmental Services

In September 2015, NHDES published a report summarizing the Department Climate Initiative.[93] NHDES recognizes that climate change is real, serious, and substantially man-made and that New Hampshire's residents, environment and economy are already experiencing its effects. NHDES has a responsibility to respond by taking steps to reduce the causes of climate change locally and regionally, as well as to prepare for the current and projected impacts that a changing climates poses to New Hampshire's residents, visitors, communities, and natural resources.

In response, the NHDES incorporated the need to address climate change in its 2010-2015 Strategic Plan goals. The NHDES Climate, Land-Use, Energy And Natural Resources (CLEANR) Team convened in 2010 as an ad-hoc cross-media staff working group, representing all three divisions and the commissioner's office, to support the implementation of the interrelated land-use and climate goals contained in the strategic plan. The team played an invaluable role in guiding the early implementation of the strategic plan through a phased-in approach that built on the success of small pilots to pave the way for more extensive projects and activities.

In 2013, under the guidance of the CLEANR Team and with the full support of its senior leadership, NHDES launched the "Department Climate Initiative" (DCI) to engage agency leadership, middle management and key staff in a strategic review of NHDES's programs and activities. The goal of the DCI is to make coordinate changes to department outreach activities, grants, and regulatory programs that: account for changing climate and environmental conditions; and promote the reduction of greenhouse gases (e.g., carbon dioxide, methane, ozone, black carbon) from all sources. To do so, each bureau in the department has been assessing their programs and activities in order to identify actions they can take to reduce emissions of greenhouse gases within New Hampshire and prepare for the impacts of a changing climate.

Even as the department-wide planning effort has been underway, considerable progress has been made across the agency. The document is the first periodic review of NHDES's efforts to incorporate considerations of climate change into all of its programs and activities. The purpose of the review is to reflect on the work done during 2014 and previously related to the goals NHDES has set for climate change, land use and energy in the 2010-2015 Strategic Plan.

New Hampshire Department of Homeland Security and Emergency Management

The New Hampshire Department of Homeland Security and Emergency Management (HSEM) is responsible for preparing the state's hazard mitigation plan, coordinating the state's response to natural disasters, and administering Hazard Mitigation Assistance programs that fund development of comprehensive hazard mitigation plans and projects to protect citizens, and their property from exposure to all hazards including: natural, human caused, and technological. The New Hampshire Multi-Hazard Mitigation Plan[94], (last updated in 2013) lays out goals and recommendations to protect the state, municipalities and residents from impacts from natural and human caused hazards. In 2009 the Plan incorporated for the first time goals to address climate change impacts including technical support, planning, assessment of risk and vulnerability, and adaptation statewide. For more information about programs and assistance refer to the Homeland Security and Emergency Management HSEM website at **http://www.nh.gov/safety/divisions/hsem/**. Key goals and objectives from the NH Multi-Hazard Mitigation Plan relating to climate change are:

- Reduce the potential impact of natural and human caused disasters on New Hampshire's Critical Support Services, Critical Facilities and Infrastructure.
- Sustain the NHDES Coastal Program's participation and support of the Coastal Adaptation Workgroup to address hazard and mitigation needs relative to state and community infrastructure.
- Address the challenges posed by climate change as they pertain to increasing risk to the state's infrastructure and natural environment.
- Support efforts to characterize and identify risks posed by climate change especially as it relates to changing precipitation patterns, storm event frequency, and sea-level rise.
- Encourage coastal communities to incorporate mitigation planning in master plans, zoning, land use and resource regulations and other planning studies and initiatives that address the existing and potential future threats related to climate change and sea-level rise.

New Hampshire Department of Transportation

Transportation excellence in New Hampshire is fundamental to the state's sustainable economic development and land use, enhancing the environment, and preserving the unique character and quality of life. The New Hampshire Department of Transportation (NHDOT) will provide safe and secure mobility and travel options for all of the state's residents, visitors, and goods movement, through a transportation system and services that are well maintained, efficient, reliable, and provide seamless interstate and intrastate connectivity. NHDOT uses guidance from the FHWA (see above). The NHDOT also puts forward several manuals for designing structures, including:

- Bridge Design Manual – **Design Guide**
- Manual on Drainage Design for Highways

The NH Department of Transportation (NHDOT) has conducted an assessment of its assets, programs, policies, and activities to determine what is at risk due to changing climate stressors. The NHDOT issued a plan that identifies short-, mid-, and long-term steps to develop adaptive strategies to counter the effects. An internal climate change committee meets quarterly to discuss state and federal activities dealing with resiliency and adaptation plans.[95] For additional NHDOT resources, visit: **www.nh.gov/dot/climate-change**.

New Hampshire Department of Administrative Services

The Department of Administrative Services (DAS) oversees energy efficiency and renewable energy efforts in all of the state facilities, coordinating the development of the agency energy conservation plans and the state energy conservation plan. They also oversee energy-use data management by tracking energy consumption and cost for all state agencies, and analyze and report on the State's progress in achieving its goal of reducing fossil-fuel energy-use intensity by 25 percent by 2025 as laid out in Executive Order 2011-131 and Senate Bill 73 (2010).[96]

New Hampshire Office of Energy & Planning

The NH Office of Energy & Planning (NHOEP) is collaborating on a variety of energy efficiency and renewable energy efforts, and is working with local communities and property owners to implement changes to the Federal Emergency Management Agency (FEMA) flood maps, and to educate the public about the associated risks and insurance implications. The NHOEP Energy Division is tasked with: promoting energy efficiency to reduce energy usage and costs; administering federally-funded fuel assistance and weatherization assistance programs; working to make state government buildings more efficient; exploring opportunities to expand the use of renewable, domestic energy resources such as biomass, wind and solar energy; and administering state and federal programs related to energy.

The Floodplain Management Program offers technical assistance to all stakeholders regarding floodplain management regulations, flood insurance, and floodplain mapping. NHOEP is also charged with assisting municipalities with planning issues, supporting implementation of state smart growth policies, and supporting land conservation, all valuable tools in minimizing the causes of climate change and providing protection from its impacts.[97]

New Hampshire Department of Health and Human Services

In 2013, the Division of Public Health Services (DPHS) in the NH Department of Health and Human Services (DHHS) received a Center for Disease Control and Prevention (CDC) grant to further prepare New Hampshire for the health impacts due to climate change. The grant is part of a CDC-funded national collaboration called the Climate Ready States and Cities Initiative (CRSCI). The goal is to help local communities prepare for climate-related public health impacts such as pollen and asthma, extreme heat, or changing habitat and Lyme disease by assessing the connections between climate change and health impacts and helping public health networks develop plans to keep our citizens prepared and healthy. The DPHS is collaborating with the NHDES Coastal Program and the USGS to assess the impact of climate change on watersheds in the state, and estimate the state's changing vulnerability to flood or drought over the next century.[98]

New Hampshire Department of Cultural Resources

The NH DCR Division of Historical Resources (DHR) is offering a new grant program to repair historical properties that were damaged by Superstorm Sandy in October 2012. Grants will support projects that repair damage caused by the storm. Properties receiving funds must be listed on or eligible for listing on the National Register of Historic Places. Another important component of the disaster planning program will be the creation of a statewide online Geographic Information System of historical properties throughout the state. An important component of the program in the upcoming grant round will be a focus on pre-disaster planning for historic and cultural resources. DHR will be looking for proposals that increase community awareness of historic and cultural resources through initiatives that identify vulnerable historic properties and that develop strategies to protect a community's historic assets.[99]

New Hampshire Fish & Game Department

The NH Fish and Game Department is engaged in an update to its Wildlife Action Plan with assistance from other natural-resource-based organizations in New Hampshire. The update includes the impacts from climate change on ecosystems and various species that are more vulnerable. The update is based on the Commission's amendment to a 2006 Plan: the Ecosystems and Wildlife: Climate Change Adaptation Plan. This amendment was created with input from 59 state and federal agencies, researchers, non-profits, consulting biologists and towns and addresses actions to assist wildlife and ecosystems in staying healthy in the face of climate change.

New Hampshire Coastal Adaptation Workgroup

The New Hampshire Coastal Adaptation Workgroup (NHCAW) is a collaboration of 22 partners and organizations working to help communities in southeastern New Hampshire prepare for the effects of extreme weather events and other effects of long term climate change. Since inception in 2010, NHCAW has led numerous projects and events that have elevated discussions about climate preparedness at municipal, state, and regional levels. NHCAW partners incorporate peer-reviewed science and research in the development of tools and technical guidance, and outreach in the coastal watershed to help communities better prepare for the effects of a changing climate in order to protect their social, economic, human and environmental health. For more information, refer to NHCAW's website at **www.nhcaw.org**.

Regional Planning Commissions and Municipal Efforts

The Rockingham Regional Planning Commission and the Strafford Regional Planning Commission have been working directly with coastal communities since 2009 to provide downscaled data related to coastal risks and hazards from climate change that can be used by town official for planning purposes. In many cases the planning commissions have played instrumental roles in providing technical and planning expertise to municipal governments for updating Hazard Mitigation Plans, Master Plans, and other planning efforts. In other cases communities have applied for external grant sources to fund community vulnerability assessments that incorporate sea-level rise mapping. For a list of local climate change adaptation planning projects along with other project-based efforts, see Appendix G.

Other State Guidance and Activities on Climate Change

Guidance and activities in several other states, including New York, Delaware, and Maryland, informed the Commission recommendations. As one example of this guidance, the Maryland Coast Smart Guidelines are summarized here.

Maryland Coast Smart – Construction and Infrastructure Siting and Design Guidelines

In 2014, the State of Maryland released its CoastSmart guidelines for the design, siting and construction to be used for new construction, reconstruction and rehabilitation of State structures and major infrastructure improvements within the State's defined coastal zone. It also called for similar measures to be applied to non-State projects if they are partially or fully funded by State agencies or located on State lands. These guidelines are tied to the State's Sea-level rise Projections made in 2008 and revised in 2013 by the Maryland Climate Change Commission. The key design guidelines include the following:

- New and reconstructed state structures are to be avoided within areas likely to be inundated [daily] by sea-level rise in 50 years, and should be designed to avoid or minimize future impacts over their design life.
- New State critical or essential facilities shall not be constructed within NFIP Special Flood Hazard Areas and should be designed such as to be protected from damage and loss of access resulting from a 500-year (0.2-percent-annual-chance) storm.
- New, reconstructed and rehabilitated State structures shall be constructed with a minimum of two (2) feet of freeboard above the 100-year (1-percent-annual-chance) base flood elevation, as defined by NFIP.
- Ecological features that buffer future impacts from sea-level rise and storm-surge shall be identified protected and maintained.

The Maryland example, like the FFRMS, also incorporates a process by which exceptions to these guidelines can be made under certain circumstances.

New York – Community Risk and Resiliency Act

New York State enacted the Community Risk and Resiliency Act in 2014 to strengthen preparedness for the effects of climate change and to help protect communities against severe weather and sea-level rise. The legislation requires that applicants for state funding or permits consider impacts from storm surge, sea-level rise and flooding. It is the only legislation in the nation that requires climate impacts to be considered in all state planning, permitting, and funding approval processes. The law charges the State's environmental agency (Department of Environmental Conservation) to:

- Adopt a set of sea-level projections and update them every five years.
- Adopt regulations establishing science-based state sea level rise projections based on NOAA predictions and recommendations from a state Sea Level Rise Task Force.
- Develop model climate change adaptation zoning laws for use by municipalities;
- Require companies and communities seeking certain state permits or funding to incorporate the adopted sea level projections, as well as forecasts covering heavy rainfall and storm surges, into project designs.

In addition the law amends numerous other state statutes and state agency rules to require the explicit consideration of future climate change risk, in the administration of laws governing such subjects as agriculture, public infrastructure, energy and waste facility siting and acquisition of land for the conservation of open space, recreation and natural, cultural or historic resources.

2014 SCIENCE AND TECHNICAL ADVISORY PANEL REPORT SUMMARY

Sea-level Rise, Storm Surges, and Extreme Precipitation in Coastal New Hampshire: Analysis of Past and Projected Future Trends

Photo credit: Steve Miller

Climate change is expected to have significant impacts on critical infrastructure and natural and cultural resources in coastal New Hampshire over the next century and beyond.

This report is intended to help municipal and state decision-makers prepare for projected sea-level rise and other coastal hazards and minimize the risks those hazards pose to municipalities and state assets.

SEA-LEVEL RISE

Global sea levels have been rising and are expected to continue rising well beyond the end of the 21st century. Rising seas pose significant risks to our communities and ecosystems, cultural resources and other coastal property and infrastructure.

PROJECTIONS

Forecasting rates of global greenhouse gas emissions is challenging, but research shows that current greenhouse gas concentrations and current or accelerated emissions will continue to influence sea levels in the future.

PRECIPITATION

Mean annual precipitation in the northeastern United States increased by approximately 5 inches (more than 10%) between 1895 and 2011.

PROJECTIONS

Annual precipitation is expected to increase by as much as 20% between 2071 and 2099 compared to the late 20th century. Most of the precipitation increases will be in winter and spring in the form of rain or snow. Fall and summer will experience less of an increase.

EXTREME PRECIPITATION

The Northeast experienced a 50% increase in total annual precipitation from storms classified as extreme events between 1901 and 2012. Here, "extreme" is defined as the number of times each year that the 24-hour rainfall amount exceeds the largest 1% of precipitation events in that year.

PROJECTIONS

Extreme precipitation events are projected to increase in frequency and in the amount of precipitation produced. In particular, the rainfall amount produced by hurricanes is projected to increase. However, current climate models and analyses are not as good at projecting future changes in the *frequency* or *magnitude* of extreme precipitation events.

SEA-LEVEL RISE SCENARIOS AT 2050 AND 2100

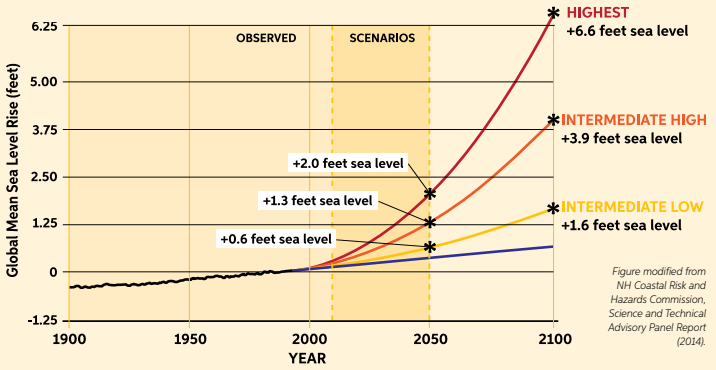
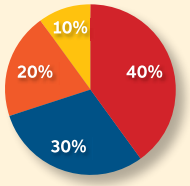


Figure modified from NH Coastal Risk and Hazards Commission, Science and Technical Advisory Panel Report (2014).

PROCESSES CAUSING SEA LEVELS TO RISE



- **40%** Ocean warming or thermal expansion
- **30%** Melting of land-based glaciers
- **20%** Melting of Antarctic and Greenland ice sheets
- **10%** Vertical land movements, shifts in Earth's gravity field and ocean dynamics

STORM SURGE

Photo credit: Ron Sher

The New Hampshire coast is significantly impacted by both Nor'easters and hurricanes. Winds from these storms drive ocean water towards the land, resulting in the short-term rise in water levels called storm surge. The actual height of a flood is determined by factors such as storm intensity, forward speed, storm area size, coastline characteristics, and angle of approach to the coast, in addition to tide height. Nor'easters can impact the region for several days and produce a storm surge with or without the addition of inland runoff from heavy precipitation. Over the past ten years the largest storm surges observed in New Hampshire occurred during Nor'easters.

PROJECTIONS

Considering changes in water levels due to sea-level rise alone, today's extreme storm surge events (i.e. 100-year flood) will have a greater inundation extent and occur more frequently over time. Due to increased coastal development, there has been a significant increase in impacts from hurricanes nationwide over the 20th century. However, there is some uncertainty in the projection of trends in hurricane frequency and intensity in any given region, and no research consistently finds a trend in the frequency and intensity of Nor'easters.

REVISED NOVEMBER 2016

To access this document, visit http://www.nhcrhc.org/wp-content/uploads/2014-STAP-report-summary.pdf.

USING THIS REPORT:
How to Prepare for the Changing Climatic Conditions in Coastal New Hampshire

PREPARING FOR SEA-LEVEL RISE

For coastal locations where the need to protect existing coastal development, infrastructure or ecosystems is high, sea level estimates should be applied as follows:

1. **Determine the time period** over which the system is designed to serve (either in the range 2014–2050, or 2051–2100).
2. **If the design time period is 2014–2050,** commit to manage to 1.3 feet of sea-level rise, but be prepared to manage and adapt to 2 feet if necessary.
3. **If the design time period is 2051–2100,** commit to manage to 3.9 feet of sea-level rise, but be prepared to manage and adapt to 6.6 feet if necessary.
4. **Be aware that the projected sea-level rise ranges may change** and prepare to adjust design considerations if necessary. The choice of management strategies can include strategies to protect, accommodate, or retreat from the flood risk.

EXAMPLES OF PREPARING FOR SEA-LEVEL RISE

A building or facility with an anticipated lifespan beyond 2050 could be constructed today:

- **For the highest sea-level rise scenario of 6.6 feet** (the most protective approach).
  OR
- **For 2 feet of future sea-level rise** —but designed to allow modifications sometime in the future to protect against 3.9 or 6.6 feet of sea-level rise.

HISTORIC SEA LEVELS

Based on local tide gauge data, sea levels in New Hampshire have been rising by an average of **0.7 inches per decade since 1900**. The rate of sea-level rise has increased to approximately **1.3 inches per decade since 1993**.

FUTURE SEA LEVELS

Using 1992 sea levels as a baseline, New Hampshire sea levels are expected to rise **0.6 – 2.0 feet by 2050** and **1.6 – 6.6 feet by 2100**.

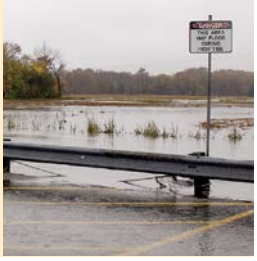


Photo credit: Tricia Miller

PREPARING FOR CHANGES IN PRECIPITATION

Consideration of historical increases in precipitation and projected future precipitation should be applied as follows:

- **If the design time period is 2014–2050**, buildings and infrastructure should be designed to withstand extreme precipitation intensities based on the most current precipitation data.
- **If the design time period is 2051–2100,** buildings and infrastructure should be designed to manage a 15 percent increase in the amount of precipitation produced during extreme precipitation events after 2050.

Photo credit: UNH Stormwater Center

PREPARING FOR CHANGES IN STORM SURGES

Coastal projects should be designed to consider future flood risks by adding projected sea-level rise heights to current storm surge heights, as measured by the 100-year and 500-year floods.

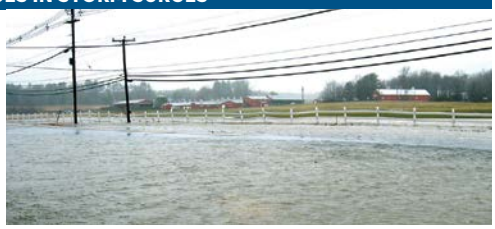


Photo credit: UNH Stormwater Center

ABOUT THIS REPORT AND THE NEW HAMPSHIRE COASTAL RISK AND HAZARDS COMMISSION

This Science and Technical Advisory Panel report is intended to guide the New Hampshire Coastal Risk and Hazards Commission in its development of recommendations to assist in planning and preparation for the changing climatic conditions in coastal areas of the state.

The New Hampshire Coastal Risk and Hazards Commission was established by the New Hampshire Legislature on July 2, 2013 by RSA 483E. The Commission is required to consider key scientific research on current and future coastal risks and hazards and is charged with recommending legislation, rules and other actions.

The Commission created a Science and Technical Advisory Panel to review available scientific information about coastal hazards and flood risks in New Hampshire.

The Panel analyzed the latest published data on historic trends and projections for the years 2050 and 2100 for sea-level rise, coastal storms, and extreme precipitation.

These findings were summarized in a peer-reviewed report, which the Commission unanimously adopted in July 2014 and used to develop its final report and recommendations released in November 2016. The Panel suggests this assessment and report be updated at least every two years as new research and data become available.

To learn more about the New Hampshire Coastal Risk and Hazards Commission, go to **www.nhcrhc.org**.

For information or questions about the Commission, contact Cliff Sinnott, Commission Chair at **603-778-0885** or **csinnott@rpc-nh.org.**

To download the complete Science and Technical Advisory Panel report, go to www.nhcrhc.org.

THE DESIGN AND PRINTING OF THIS SUMMARY WERE PAID FOR IN PART BY A GRANT FROM THE NEW HAMPSHIRE CHARITABLE FOUNDATION.

REVISED NOVEMBER 2016

To access this document, visit http://www.nhcrhc.org/wp-content/uploads/2014-STAP-report-summary.pdf.

APPENDIX E: Other Hazards and Risks

Appendix E summarizes some of the limited information known about several important hazards and risks posed to coastal New Hampshire as a result of changes in climate. Existing and emerging science and assessments should be reviewed further in future updates to the Science and Technical Advisory Panel report or in other venues.

Temperature, Drought, Snowfall, and Seasonal Shifts

As our climate continues to change we can expect warmer winters with 25-50 fewer days per year below freezing and 20-60 day increase in summer days with temperatures above 90 degrees Fahrenheit.[100] In addition to the extreme changes in temperature will lead to a shorter winter and a longer growing season.[101] The coastal watershed is expected to experience an increased frequency of hot days. On those days heat stress and its associated heat injuries and deaths become more probable.[102] Even with changes in precipitation trends, shifting seasons and extreme temperatures, New Hampshire's coastal watershed is expected to see only a slight decrease to no change in the frequency of drought.[103]

As noted in the STAP, there is an anticipated increase in extreme precipitation events. This could translate to an increase in extreme snow events and total winter snow fall. However, the combination of warmer winter and spring temperatures will lead to a decrease in the number of winter days with snow cover. In addition, as winters continue to warm over the century, a larger portion of winter precipitation will likely fall as rain. The Piscataqua/ Great Bay region is expected to see a three-week to one-month decrease in snow covered days.[104]

Due to the combination of warmer temperatures and a longer growing season, New Hampshire is expected to see an increase in number of unhealthy air quality days. The unhealthy air quality days will result from an increase in pollen production and ozone (a form of air pollution) and lead to an increase in asthma cases and cardiorespiratory illnesses respectively.[105]

Saltwater Intrusion and Groundwater Tables

Sea-level rise combined with land subsidence are already resulting in incidents of saltwater intrusion where saline ocean water infiltrates the groundwater table along the coast. This issue needs further study to identify how saltwater is likely to change the salinity of existing freshwater sources along the coast. Additionally, as sea levels rise, groundwater table elevations are pushed upward, resulting in higher groundwater elevations at significant distances from the coast. Ongoing groundwater modeling at the University of New Hampshire is investigating the effects of climate change, including sea-level rise, precipitation and temperature, on groundwater levels and the impacts to roads in coastal New Hampshire. The groundwater modeling study will have broader applications as it can be expanded to investigate the effects of climate change on drinking water supply, base flow to streams, and the hydrology of wetlands.

Ocean Chemistry

Ocean acidification in the Gulf of Maine is the result of at least two factors: increasing CO^2–carbon dioxide levels in the atmosphere, and more intense and frequent rain events.[106] The ocean absorbs more carbon dioxide from the atmosphere as carbon dioxide levels increase in the air, and this causes the pH of the sea water to decrease. Recent studies have shown that the Gulf of Maine may be particularly sensitive to watershed influences on ocean acidification. In acidic seawater conditions it is difficult for organisms to build and maintain shells.[107] Up to 90 percent of the marine resource economy of the region is dependent on harvesting shelled animals like lobsters, clams, and oysters.

Impacts to Our Well-Being and Assets

These coastal hazards will result in impacts to a variety of resources and assets in the state of New Hampshire. Increases in average temperature and resulting seasonal shifts will have impacts on agriculture, tourism, and other industries. These climatic changes will lead to more invasive species and expanded ranges for vector-borne diseases like Lyme disease and other pests, not to mention general shifts in native species composition and ecological diversity. Access to clean drinking water will likely be impacted by saltwater intrusion. Additionally, rising groundwater tables will result in more vulnerable roads and new freshwater wetlands where the groundwater table is already close to the surface. Water quality issues arising from changes in ocean chemistry and temperature are likely to arise, including increased instances of cyanobacteria at beaches and nuisance algae growth in estuarine waters. This list of impacts is not exhaustive and there are likely many impacts that researchers and others have yet to predict, therefore additional research and analysis is needed to identify, understand, and prepare for both known and unknown impacts.[108]

APPENDIX F: State of New Hampshire Comments on the Draft Guidelines for Implementing the Federal Flood Risk Management Standard

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GOVERNOR

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OEP
www.nh.gov/oep

May 6, 2015

Regulatory Affairs Division
Office of Chief Counsel
Federal Emergency Management Agency
500 C Street, SW
Washington, DC 20472

Re: Docket ID No. FEMA-2015-0006, Comments on the Draft *Guidelines for Implementing the Federal Flood Risk Management Standard*

Dear Office of Chief Counsel,

On behalf of the State of New Hampshire, the Office of Energy and Planning is submitting for your consideration comments on the draft *Guidelines for Implementing the Federal Flood Risk Management Standard* developed by the New Hampshire Coastal Risks and Hazard Commission, which includes representatives from the New Hampshire State Legislature, the New Hampshire Department of Transportation, the New Hampshire Department of Environmental Services, the New Hampshire Office of Energy and Planning, the New Hampshire Division of Historic Resources, and the New Hampshire Department of Resources and Economic Development, among other state, regional and local stakeholders.

In New Hampshire, we have experienced a number of significant flooding events in recent years and the new standard proposed by President Obama in Executive Order 13690 is a crucial step to improving our preparedness and resilience. The State of New Hampshire appreciates the opportunity to provide comments prior to the implementation of the Federal Flood Risk Management Standard. If you need additional information please contact Jennifer Gilbert, New Hampshire's National Flood Insurance Program Coordinator at 603-271-1762 or Jennifer.gilbert@nh.gov.

Sincerely,

Meredith A. Hatfield
Director

Enclosure: State Comments

TDD Access: Relay NH 1-800-735-2964

COMMENTS TO THE FEDERAL EMERGENCY MANAGEMENT AGENCY
ON THE DRAFT GUIDELINES FOR IMPLMENTING
THE FEDERAL FLOOD RISK MANAGEMENT STANDARD

WHEREAS, New Hampshire faces increasing flood risk due to several factors including land use change, extreme precipitation, storm surge and sea level rise, it is imperative that its communities, agencies, institutions and businesses prepare for these conditions by creating greater resilience to flooding; and

WHEREAS, it is essential for communities to begin acting now to adapt to these projected conditions, and to do so using multiple measures, including resilient building, landscape and infrastructure design, protection and enhancement of natural shoreline features, and strategic shoreline protection or retreat; and

WHEREAS, creating more resilient communities, both in the built and natural environment, will help protect life, and property and economic vitality from the effects of future flood risk; and

WHEREAS, to establish greater resiliency, the design and construction of public infrastructure that is built or rebuilt from this point forward should anticipate future flood conditions to ensure that such investments are not subject to unnecessary damage or loss; and

WHEREAS, higher flood management standards will increase the short term capital costs for building and infrastructure, if the standards are reasonably established and based on sound science, they will also reduce the long term costs for maintaining, repairing and replacing buildings and infrastructure due to flood damage; and

WHEREAS, in 2013 the State of New Hampshire established a Coastal Risks and Hazards Commission (CRHC) under RSA 483-E to advise the state and its coastal municipalities on policies and actions with regards to increasing coastal flood hazards; and

WHEREAS, the New Hampshire Coastal Risks and Hazards Commission subsequently established a Science and Technical Advisory Panel (STAP) to advise it on the expected sea level rise and other future flood hazards specific to New Hampshire based on the best currently available climate science, and that Panel issued its report in August 2014; and

WHEREAS, it is advisable to establish state and national standards for flood risk management to protect public investment in infrastructure, and to ensure consistency in planning and design across agencies and localities;

THEREFORE, the State of New Hampshire supports the establishment and implementation of new Federal Flood Risk Management Standards:

1. We affirm the need for a Federal Flood Risk Management Standard (FFRMS) and support the proposed framework which allows flexibility in choosing the standard that will apply in specific circumstances (including the climate-informed science approach, the freeboard value approach and the 500 year flood elevation approach). We also support the inclusion of exceptions to the standards for certain emergencies, mission critical actions, national security concerns, and where application of the standard is 'demonstrably inappropriate'.

2. The FFRMS should incorporate the timeframe of anticipated increases in flood risk along with the design life and risk sensitivity of the facility or action being proposed to determine appropriate flood management standards.
3. The FFRMS should include periodic revaluation of the standards to incorporate updated science based understanding and projections of sea level rise and other sources of flood risk.
4. Increased cost of project design and construction resulting from higher flood standards should be accommodated in the available federal funding for such projects.
5. Clear guidance should be provided for qualifying a state or region-specific 'climate science based standard' (such as the CRHC STAP report) into the FFRMS and clarifying under what circumstances higher state or local standards will take precedence over Federal standards.
6. Special attention should be given in the FFRMS implementing guidelines concerning how the standards will be applied to regulated actions pertaining to historic and archeological properties and sites.
7. The guidance to Federal agencies provided through FFRMS should seek to avoid the development of rules and standards that conflict when applied to projects that are subject to the jurisdiction of multiple agencies.

APPENDIX G: Related Projects

Since 2009, partner organizations of the New Hampshire Coastal Adaptation Workgroup (NHCAW) have worked together and partnered with communities on 70 projects totaling $6,511,292 in grant funding. This is a list of completed and ongoing projects that NHCAW partner organizations work on to help New Hampshire coastal communities become more resilient to coastal risks and hazards exacerbated by climate change. Projects are organized chronologically by start date. This is not a comprehensive list of all projects related to coastal risks and hazards in the New Hampshire region. For more information about NHCAW or any of the projects listed below, please contact the NHCAW co-chairs Sherry Godlewski of the New Hampshire Department of Environmental Services (sherry.godlewski@des.nh.gov) and Steve Miller of the Great Bay National Estuarine Research Reserve (steve.miller@wildlife.nh.gov).

New Hampshire Setting SAIL: Acting on the Coastal Risk and Hazards Commission, Science, Assessment, Implementation, and Legislation Recommendations ("NH Setting SAIL")

Project Period: October 2016 to March 2018

This project seeks to implement the New Hampshire Coastal Risk and Hazards Commission's (CRHC) final recommendations at state and local levels. The project is divided into three tracks: 1) strategically designed outreach to state agencies and municipalities about the CRHC recommendations; 2) technical assistance to implement municipal projects; and 3) a coordinated effort to ensure that state agencies identify their vulnerable assets and necessary policy changes to improve preparedness. Together, these tracks will ensure that the CRHC's recommendations move forward and that coastal New Hampshire takes key steps toward becoming more resilient in the face of climate change.

Incentivizing Resiliency through Implementation Plans in one of coastal New Hampshire's Fastest Growing Communities: Exeter

Project Period: October 2016 to March 2018

The project partners are working with community leaders in the Town of Exeter, NH to incentivize resilient development strategies through the development of a subwatershed scale implementation plan and climate adaptation policies combined with innovative communications that illustrate the economic benefits of flood adaptation. The RPC regional planner will work with the Town of Exeter to develop community-tailored Climate Adaptation Policies. The process will be guided by a Steering Committee to provide formative direction throughout. A vulnerability analysis of municipal drainage infrastructure and shorelands will be conducted in combination with an examination of flooding extent and climate adaptation strategies at the subwatershed scale for the purpose of developing site-specific implementation plans and construction ready designs. Lastly the [project will engage coastal zone communities with an outreach effort using innovative messaging to communicate the social, economic and environmental impacts from flooding to the public in vulnerable areas. Innovative visualization tools and approaches will be installed in key public places to illustrate climate vulnerability in both physical terms, such as flood elevations with high water marks, and economic terms such as the risk to the local economy and fiscal impacts.

Portsmouth Historic Resource Vulnerability Assessment

Project Period: September 2016 to September 2017

This project has not yet been approved by NH Governor's Executive Council. If approved the project will focus on the historic resources within the City's South End and quantify the value of these resources and prioritize their protection through a number of adaptation measures. The project will received input and support for a local advisory committee to assist with the creation of an adaptation plan for the historic district.

Wagon Hill Farm Erosion Control

Project Period: August 2016 to June 2017

This project seeks to assess the erosion issue at the Wagon Hill Farm shoreline in Durham. The Town of Durham will work with the NH Department of Environmental Services Coastal Program and the University of New Hampshire to monitor and assess and design alternatives for erosion control and shoreline protection.

NH Volunteer Beach Profile Monitoring Program

Project Period: July 2016 to June 2017

This project seeks to establish a volunteer beach profile monitoring program. Quantifying changes in beach contours over time will provide increased understanding of responses to storms as well as seasonal and long-term trends of erosion and accretion. In addition, the program will provide important educational experience to volunteers about beach dynamics and the response of beaches to storms. Results will provide municipal and state decision makers with important information on coastal processes for guiding beach management. In addition, beach profiles will provide critical data to inform storm surge forecasting models currently in development by the National Weather Service.

Coastal Risk and Hazards Commission

Project Period: July 2016 to December 2017

NH Department of Environmental Services Coastal Program technical assistance funds are provided to Rockingham Planning Commission, Strafford Regional Planning Commission, and the Natural Resources Outreach Coalition to fund participation and assist with outreach related to the final report and recommendations of the NH Coastal Risk and Hazards Commission.

Durham Flood Overlay District

Project Period: July 2016 to December 2017

Strafford Regional Planning Commission is funded to work with the Durham Leadership Team to develop an extended coastal flood hazard overlay district, which would apply higher standards for building freeboard height and other provisions to lessen vulnerability of new buildings and facilities to flooding due to sea level rise. This effort would build off past and existing efforts, including the Durham Climate Adaptation Chapter and the C-RiSe vulnerability assessment. This work supports Objective #1 of the NH Section 312 Metrics regarding creating informed and resilient coastal communities and Objective #2 of the NH Section 312 Metrics regarding the reduction of future risk and damage from coastal hazards.

Library project in Rockingham

Project Period: July 2016 to December 2017

The Natural Resources Outreach Coalition (NROC) team will engage with teachers as well as students and their parents in a collaborative process for gaining and demonstrating community support on municipal climate resiliency. This will involve identifying school teachers to partner with and lead the classroom activities, while NROC will lead planning and facilitating a community event to bring together students to present findings and local concerns about climate change to parents and municipal leaders at a public space such as a library. This program would likely be incorporated into the classroom in Spring, 2017, with the public presentation sessions occurring later in the season. Lessons learned from implementing this program in Durham (2015-2016) will be transferred to this project. NROC will collaborate with the Strafford Regional Planning Commission on this project.

Groundwater modeling to investigate the effect of sea level rise on saltwater intrusion and drinking water wells in the Town of Newmarket

Project Period: June 2016 to June 2017

The Strafford Regional Planning Commission, in partnership with the University of New Hampshire, will use NH Department of Environmental Services grant funds to conduct an investigation of the vulnerability of public drinking water supplies in Newmarket to saltwater intrusion. The project will include groundwater modeling, data analysis and mapping, public outreach and education, and preparation of a final report with recommended next steps

NOAA Regional Resilience Grant

Project Period: May 2016 to May 2018

This project seeks to accomplish two key objectives. First, it will improve the resolution and accuracy of inundation modeling in the Great Bay estuary through development of an unstructured grid modeling platform. Second, it will explore and promote best practices for green infrastructure installations that promote flood resiliency and shoreline protection in the Great Bay estuary and coordinate outreach through workshops and other materials. The New Hampshire project team is part of a larger regional team that includes the Northeast Regional Ocean Council, the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS), and representatives from research institutions and state Coastal Zone Management programs from all states in the Northeast Region.

Cutts Cove Restoration Project

Project Period: April 2016 to December 2017

The Cutts Cove Shoreline Restoration Project will restore shoreline that was filled and armored with rip-rap up to 12 feet above mean high tide. The entire right of way adjacent to Market Street Extension is vacant; with plans to create a city park landward of the restoration area. Our project will restore the hardened shoreline into a living shoreline, creating tidal buffer zone, intertidal marsh, and a short (18-20 inch) sill of repurposed stone from the rip-rap wall.

NHCAW Coastal Resilience Portal

Project Period: March 2016 to May 2017

This project will result in the development of a Coastal Resilience Portal website, upgrading the existing NHCAW website and integrating several other existing resilience efforts.

NH Coastal Viewer Enhancement

Project Period: February 2016 to June 2017

This project ensures that the NH Coastal Viewer is able to continue operating to support municipal officials and other users. Funds provided cover approximately 18 months of maintenance, new tool development, training resources, and user evaluation for the NH Coastal Viewer. The goal of the proposed project is to maintain, enhance, and promote the NH Coastal Viewer to 1) build community resilience to impacts of coastal erosion, flooding, and storms, and 2) enhance collaborative actions on coastal ecosystem planning.

Tides to Storms 2 - Adaptation Implementation: Hampton

Project Period: November 2015 to September 2016

The Rockingham Planning Commission (RPC) has received a grant from the Northeast Region Ocean Council to provide technical assistance to the seven Atlantic coastal municipalities $6000 in direct technical assistance to implement recommended strategies from the Tides to Storms Vulnerability Assessment. The project goal is to focus municipal efforts to adopt or implement adaptation strategies, improve municipal and community resilience to coastal flooding, protect public health and safety, and increase awareness of coastal flood risks and hazards. This assistance can include support for one or several ongoing or new projects providing the projects can be accomplished within the grant period and within available funding limits. Portsmouth is evaluating the options for incorporating freeboard for different types of structures and settings. Hampton chose to make revisions to existing floodplain management standards in their zoning ordinance.

Tides to Storms 2 - Adaptation Implementation: Hampton Falls

Project Period: November 2015 to September 2016

The Rockingham Planning Commission (RPC) has received a grant from the Northeast Region Ocean Council to provide technical assistance to the seven Atlantic coastal municipalities $6000 in direct technical assistance to implement recommended strategies from the Tides to Storms Vulnerability Assessment. The project goal is to focus municipal efforts to adopt or implement adaptation strategies, improve municipal and community resilience to coastal flooding, protect public health and safety, and increase awareness of coastal flood risks and hazards. This assistance can include support for one or several ongoing or new projects providing the projects can be accomplished within the grant period and within available funding limits. Portsmouth is evaluating the options for incorporating freeboard for different types of structures and settings. Hampton Falls chose to make revisions to Building Codes to require freeboard for residential structures in existing/future floodplains (Tides to Storms mapping) and conduct community outreach about flood hazards and options for protecting property and structures.

Tides to Storms 2 - Adaptation Implementation: New Castle

Project Period: November 2015 to September 2016

The Rockingham Planning Commission (RPC) has received a grant from the Northeast Region Ocean Council to provide technical assistance to the seven Atlantic coastal municipalities $6000 in direct technical assistance to implement recommended strategies from the Tides to Storms Vulnerability Assessment. The project goal is to focus municipal efforts to adopt or implement adaptation strategies, improve municipal and community resilience to coastal flooding, protect public health and safety, and increase awareness of coastal flood risks and hazards. This assistance can include support for one or several ongoing or new projects providing the projects can be accomplished within the grant period and within available funding limits. Portsmouth is evaluating the options for incorporating freeboard for different types of structures and settings. New Castle chose to make revisions to existing buffer standards, complete community outreach about flood impacts, and review zoning and regulations to identify ways to incorporate climate adaptations.

Tides to Storms 2 - Adaptation Implementation: North Hampton

Project Period: November 2015 to September 2016

The Rockingham Planning Commission (RPC) has received a grant from the Northeast Region Ocean Council to provide technical assistance to the seven Atlantic coastal municipalities $6000 in direct technical assistance to implement recommended strategies from the Tides to Storms Vulnerability Assessment. The project goal is to focus municipal efforts to adopt or implement adaptation strategies, improve municipal and community resilience to coastal flooding, protect public health and safety, and increase awareness of coastal flood risks and hazards. This assistance can include support for one or several ongoing or new projects providing the projects can be accomplished within the grant period and within available funding limits. Portsmouth is evaluating the options for incorporating freeboard for different types of structures and settings. North Hampton chose to make revisions to existing buffer standards in their zoning ordinance.

Tides to Storms 2 - Adaptation Implementation: Portsmouth

Project Period: November 2015 to September 2016

The Rockingham Planning Commission (RPC) has received a grant from the Northeast Region Ocean Council to provide technical assistance to the seven Atlantic coastal municipalities $6000 in direct technical assistance to implement recommended strategies from the Tides to Storms Vulnerability Assessment. The project goal is to focus municipal efforts to adopt or implement adaptation strategies, improve municipal and community resilience to coastal flooding, protect public health and safety, and increase awareness of coastal flood risks and hazards. This assistance can include support for one or several ongoing or new projects providing the projects can be accomplished within the grant period and within available funding limits. Portsmouth chose to evaluate the options for incorporating freeboard for different types of structures and settings.

Tides to Storms 2 - Adaptation Implementation: Rye

Project Period: November 2015 to September 2016

The Rockingham Planning Commission (RPC) has received a grant from the Northeast Region Ocean Council to provide technical assistance to the seven Atlantic coastal municipalities $6000 in direct technical assistance to implement recommended strategies from the Tides to Storms Vulnerability Assessment. The project goal is to focus municipal efforts to adopt or implement adaptation strategies, improve municipal and community resilience to coastal flooding, protect public health and safety, and increase awareness of coastal flood risks and hazards. This assistance can include support for one or several ongoing or new projects providing the projects can be accomplished within the grant period and within available funding limits. Portsmouth is evaluating the options for incorporating freeboard for different types of structures and settings. Rye chose to write a Climate Adaptation and Coastal Hazards Chapter, Master Plan.

Tides to Storms 2 - Adaptation Implementation: Seabrook

Project Period: November 2015 to September 2016

The Rockingham Planning Commission (RPC) has received a grant from the Northeast Region Ocean Council to provide technical assistance to the seven Atlantic coastal municipalities $6000 in direct technical assistance to implement recommended strategies from the Tides to Storms Vulnerability Assessment. The project goal is to focus municipal efforts to adopt or implement adaptation strategies, improve municipal and community resilience to coastal flooding, protect public health and safety, and increase awareness of coastal flood risks and hazards. This assistance can include support for one or several ongoing or new projects providing the projects can be accomplished within the grant period and within available funding limits. Portsmouth is evaluating the options for incorporating freeboard for different types of structures and settings. Seabrook chose to write a Climate Adaptation and Coastal Hazards Chapter for their Master Plan.

Community Resilience in the Seacoast (C-RiSe)

Project Period: September 2015 to March 2017

This project team is assessing climate change impacts to natural systems and the built environment for ten coastal municipalities. Results of the assessment will help municipalities apply climate impact data directly into programmatic changes such as facilities (infrastructure upgrades and priorities), permit processes, codes, and regulations. The project results will be built into a developing web-based platform (NH Coastal Viewer). The UNH Stormwater Center, Rockingham Planning Commission (RPC) and Strafford Regional Planning Commission (SRPC) will assess the impact of climate change on culvert performance, and natural resources and infrastructure due to tidal changes from sea level rise and storm surge and produce mapping and assessment tools to inform municipal plans and decision making. RPC and SRPC will complete a vulnerability analysis of sea-level rise and storm flooding, working closely with each of their municipalities to incorporate information into hazard mitigation plans. The UNH Stormwater Center will complete a culvert analysis based on future climate conditions including projected increases in the frequency and magnitude of extreme precipitation events.

Buffers on the Bay (BOB)

Project Period: September 2015 to August 2017

This project's goal is to enhance stakeholder capacity to make informed decisions related to the protection and restoration of buffers around New Hampshire's Great Bay Estuary. The project will be integrating existing geospatial information and the best available buffer science with economic valuation data about the benefits of buffers. This watershed scale information will then be used to select a subwatershed to work within to determine what combination of incentive and regulatory solutions can best promote good buffers around Great Bay.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: Berwick, ME
Project Period: August 2015 to October 2016
This project addresses three of the four recommendations for Berwick, ME following the publication of the 2015 Piscataqua Region Environmental Planning Assessment. The project has three goals: (1) increase shoreland setbacks for primary structures to 100'; (2) adopt 100' fertilizer application buffers on lakes and ponds; (3) adopt managed buffer width of 100'. Each of these goals will increase protection for water quality and build resiliency for the Town of Berwick in response to increase precipitation associated with climate change.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: Exeter, NH
Project Period: August 2015 to October 2016
Nitrogen loading in the Great Bay Estuary and associated tributaries is a concern for many communities within the Piscataqua Region watershed. With increasing precipitation from climate change, Exeter aims to improve fertilizer application setbacks within their community to reduce nitrogen loading. This project addresses one of the four recommendations for Exeter, NH from the 2015 PREPA report.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: Greenland, NH
Project Period: August 2015 to October 2016
Greenland, NH will be working to adopt the Southeast Watershed Alliance model stormwater ordinance. The model ordinance aims to consider projected changes in climate within the design, siting and implementation of stormwater infrastructure. Adopting the model ordinance will increase resiliency within Greenland in response to climate change.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: Hampton, NH
Project Period: August 2015 to October 2016
Hampton will strengthen its commitment to better floodplain management and implement positive measure to reduce flood risks associated with sea-level rise and coastal storms through participation in the FEMA Community Rating System (CRS). The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum National Flood Insurance Program requirements. Additionally, participation in the CRS will create strong incentives among town residents to improve buffer protection and management—key PREPA action items identified for Hampton, NH.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: Kittery, ME
Project Period: August 2015 to October 2016
The Town of Kittery Public Works and Code Enforcement Offices plan to complete a full assessment of the stream and river crossing culverts between 1' and 3' diameter on Town of Kittery maintained roadways. Preliminary field assessments have indicated that many of these smaller culverts are undersized leading to a potential threat to human health and water quality. Culverts will be assessed on location, stability, and sizing as it related to increased precipitation events relating to climate change. The culverts will be prioritized (high, medium, low) for the need for replacement.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: New Castle, NH
Project Period: August 2015 to October 2016
The New Castle Conservation Commission proposes to focus on the top priority action to increase buffers to 100' for all waterbodies as listed under the 2015 PREPA recommendations. The Conservation Commission also proposes to increase protection efforts for the Lavenger Creek salt marsh that will involve proposing more stringent regulatory standards and/or prime wetlands designation. This project builds upon the work to reduce and manage invasive species cover around the Lavenger Creek salt marsh.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: North Hampton, NH
Project Period: August 2015 to October 2016
The 2015 PREPA identified adoption of the Southeast Watershed Alliance model stormwater ordinance as one of the four priority actions for North Hampton, NH. The model ordinance aims to consider projected changes in climate within the design, siting and implementation of stormwater infrastructure. Adopting the model ordinance is a proactive and cost effective way for the town to address stormwater pollution and increased runoff from projected increases in precipitation associated with climate change.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: Rollinsford, NH

Project Period: August 2015 to October 2016

The 2015 PREPA identified adoption of the Southeast Watershed Alliance model stormwater ordinance as one of the four priority actions for Rollinsford, NH. The model ordinance aims to consider projected changes in climate within the design, siting and implementation of stormwater infrastructure. Adopting the model ordinance is a proactive and cost effective way for the town to address stormwater pollution and increased runoff from projected increases in precipitation associated with climate change. Throughout the process Rollinsford also plans to inventory stormwater related issues and assess current stormwater management practices.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: Rye, NH

Project Period: August 2015 to October 2016

Rye will institutionalize its commitment to better floodplain management—a critical focus as sea levels continue to rise and coastal storms intensify—through participation in the FEMA Community Rating System (CRS). The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum National Flood Insurance Program requirements. Additionally, participation in the CRS will create strong incentives among town residents to improve buffer protection and management—key PREPA action items identified for Rye, NH.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: Somersworth, NH

Project Period: August 2015 to October 2016

The City of Somersworth proposes to complete a natural resource inventory to guide short and long term land conservation priorities. A natural resource inventory is a tool for communities to gain a better understanding of their existing natural resource values and to establish a sustainable approach for land use planning and management in response to climate change.

Piscataqua Regional Environmental Planning Assessment (PREPA) Grant: Stratham, NH

Project Period: August 2015 to October 2016

Stratham proposes to explore all four of the proposed recommendations from the 2015 Piscataqua Region Environmental Planning Assessment and adopt as appropriate. The four recommendations are: (1) increase buffers to 100' for tidal wetlands; (2) increase septic and structure setbacks to 100' for freshwater wetlands; (3) adopt fertilizer application setbacks for all waterbodies; and (4) adopt model stormwater management regulations. Each of these goals will increase protection for water quality and build resiliency for the Town of Stratham in response to increase precipitation associated with climate change.

Library project in Durham

Project Period: July 2015 *to December 2016*

The Natural Resources Outreach Coalition (BROC) team engaged with teachers as well as students and their parents in a collaborative process for gaining and demonstrating community support on municipal climate resiliency. NROC led planning and facilitated a community event to bring together students to present findings and local concerns about climate change to parents and municipal leaders at a public space such as a library. This program would likely be incorporated into the classroom in Spring, 2016, with the public presentation sessions occurring later in the season.

Cochecho Waterfront Development, Dover, NH

Project Period: June 2015 to June 2018

This is a multi-phase project that will occur over several years involving a mixed use development of multiple stories with an architectural character and quality to conform to the appearance of surrounding downtown Dover buildings. The site consists of a 29-acre parcel with over a half mile of frontage along the Cochecho River on its westerly and northerly boundary with approximately 14.5 acres suitable for development. To the south is a residential neighborhood and Henry Law Park, to the east is Maglaras Park, and frontage on the Cochecho River. The project involves several key elements including shoreland blended with a city park and boat house, and a combination of residential and commercial properties intended to create an attractive neighborhood and park space. Project design considerations include naturalized shoreline and park space and developed areas planning for 2100 projections for sea level rise and the resultant 100-year flood plain.

NH Shoreline Structure Inventory

Project Period: May 2015 to October 2015

The NH Department of Environmental Services Coastal Program is creating a spatial inventory of engineered shoreline structures along the New Hampshire tidal shoreline. This inventory will be developed for the NH Coastal Viewer, to include information about the structure type, elevation, and size, among other attributes. The inventory will be used to inform vulnerability assessments for these structures in the future.

Analysis of Water Resources to Supplement the Land Conservation Plan for New Hampshire's Coastal Watershed
Project Period: May 2015 to May 2016
This project builds upon and provides an update to The Land Conservation Plan for New Hampshire's Coastal Watersheds (2006), which identified land protection priorities on a watershed scale. The purpose of this project is to conduct spatial analyses to identify lands that, if protected, will (1) benefit water quality in the coastal watershed, (2) attenuate flood flows and mitigate flood risks, and (3) secure public drinking water supplies. The results of this project include new data showing land protection priorities that would mitigate flood risk, reduce pollution and improve the protection of drinking water supplies for planners, municipal staff, volunteer board members, land trusts, agency staff, and others.

Building Resilience to Flooding and Climate Change in the Moonlight Brook Watershed of Newmarket
Project Period: May 2015 to June 2016
Moonlight Brook is an important tributary of the Lamprey River drainage basin. Several flood resiliency and risk studies have been performed in the Lamprey River watershed including the Moonlight Brook subwatershed. The project team is conducting a two part effort to: 1) to study flood risk associated with climate change as well as how future development and build out of the community affect these risks, and 2) design robust green infrastructure practices within the Moonlight Brook watershed to help reduce risk of flooding while reducing pollutant load into the Brook and further downstream into the Lamprey River and ultimately Great Bay.

Implementing Phase I of the Lubberland Creek Culvert Restoration and Initiating the Development of NH's Tidal Culvert Assessment Protocol
Project Period: February 2015 to May 2016
Culvert replacement at the Bay Road crossing of Lubberland Creek in Newmarket achieves three primary goals: (1) restoration of aquatic connectivity at the system's tidal/freshwater interface allowing diadromous fish passage at the perched Bay Road culvert, (2) enhancement of the resilience of Lubberland Creek salt marsh by removal of the existing tidal restriction at Bay Road with a structure that allows upstream salt marsh migration as sea levels continue to rise, and (3) remediation of the flood hazard of this road-stream crossing, which overtops during major flood events and thereby compromises public safety. Task 2 – Initiation of the Development of NH's Tidal Culvert Assessment Protocol: Creation of a tidal culvert assessment protocol via review of best practices for tidal culvert assessments through existing literature, computer models and expert interviews, as well as the assembly of a group of experts in an effort to build consensus and justification for characteristics measured as part of a field-based tidal assessment protocol.

Assessment of Hydrologic Change due to Climate Change in New Hampshire: Simulation of Current and Future Water Streamflow, Snowmelt, and Groundwater Recharge Using the Precipitation Runoff Modeling System
Project Period: February 2015 to June 2016
This project builds on work already completed that developed a watershed runoff model for the Long Island Sound Watershed, including the Connecticut, Thames, and Housatonic Rivers (Bjerklie and others, 2011), and a U.S. Geological Survey (USGS) New England Regional Precipitation Runoff Modeling System (PRMS) model that has been developed as part of a USGS effort to build a continental scale National Hydrology Model (Lauren Hay and Steve Markstrom, personal communication 2014). The models run in New Hampshire for current and future climate change scenarios, giving users an enhanced understanding of possible changes to streamflow, snowmelt, and groundwater recharge to be expected in New Hampshire as a result of climate change.

Piscataqua Region Environmental Planning Assessment
Project Period: October 2014 to March 2015
The 2015 Piscataqua Region Environmental Planning Assessment (PREPA) is designed to provide an updated information base to inform ongoing and emerging planning and environmental protection efforts, and to identify gaps and inconsistencies in the standards of environmental protection reflected in the current ordinances, development regulations, and natural resource protection strategies in each of the 52 municipalities. The 2015 PREPA also gathered information on municipal land use policies and adaptation planning strategies designed to mitigate the impacts of climate change on the Piscataqua Region watershed.

Climate Adaptation for Road Infrastructure in Coastal New Hampshire
Project Period: October 2014 to September 2016
This research will assess the impacts of climate change and sea-level rise on road infrastructure in select coastal communities. Specific attention is given to reduction in pavement performance with rising ground water, temperatures, and extreme precipitation events. The research will develop the data and tools needed to assess climate impacts on roadways and will investigate various adaptation strategies through case studies. A NH Seacoast Transportation Climate Working Group

consisting of regional planners, transportation engineers and road agents has been established to inform the research and to make the results available and useful for regional stakeholders.

RiskMAP FY14 - Developing Areas of Mitigation Interest and Conducting Discovery

Project Period: October 2014 to September 2016

This award comprises two distinct project activities. The first activity was to generate an "Areas of Mitigation Interest" data set for the 13 communities in Rockingham County and 4 communities in Strafford County that are within the footprint of the NH Coastal Mapping project described below. The data are being developed based on accessing existing statewide, regional, and community data sets, as well as collecting current localized knowledge from community officials The data for the 4 Strafford County communities are complete, were incorporated in the FEMA Flood Risk Database submitted to Map Service Center in the spring of 2016, and will become available shortly. Data for Rockingham County are in progress. The second activity was conducting "Discovery" in the 13 communities in Rockingham, Strafford, and Carroll Counties that are part of the Piscataqua/Salmon Falls Basin but outside of the footprint of the NH Coastal Mapping project. The goal of this effort was to work closely with the individual communities to help identify areas at risk for flooding and possible solutions for reducing that risk. New Zone A (approximate) flood zone boundaries will be generated as part of this effort and will be compared to the effective data. This information, along with additional input provided by the project communities, will be used to determine priorities for future floodplain mapping.

Technical Assistance to SHEA

Project Period: July 2014 to December 2015

The Natural Resources Outreach Coalition (NROC) worked with Hampton, Hampton Falls or Seabrook to provide hands-on assistance in preparedness for climate change with activities such as development of board/community outreach materials, delivery of the 2014 PREPA Study results to the community, assessing where community vulnerabilities to climate change exist, presentation of the NH Coastal Viewer, assisting with the Community Rating System in order to reduce flood risk, stormwater management, and/or implementing climate adaptation strategies.

Sustaining Champions of Climate Adaptation in Coastal Communities: A Northern New England Study

Project Period: June 2014 to September 2014

In this study, community members identified by others as "climate adaptation champions" from coastal areas in northern Massachusetts to southern Maine were interviewed. The interviews were designed to reveal what motivates and sustains these champions, what challenges and accomplishments they claim and what professional adaptation assistance providers can do to help support champions in implementing climate adaptation at the local level. A total of eight findings were developed from the champions' responses during the interviews as well as a set of recommendations for professional climate adaptation assistance providers. The study was conducted by a UNH undergraduate student, Alexandra Phillip, with assistance from four mentors affiliated with NH's Coastal Adaptation Workgroup. The final report, including findings and recommendations, can be found here:
https://seagrant.unh.edu/sites/seagrant.unh.edu/files/media/pdfs/extension/climate_champions_2014.pdf

The Hard and Soft of Shoreline Management: Conference and Follow-up Outreach

Project Period: May 2014 to August 2015

In December 2014 the Great Bay National Estuarine Research Reserve, and our partners in CAW hosted a conference focused on improving shoreline management in NH. 121 individuals attended this conference including coastal decision makers from the NH Coastal Risks and Hazards Commission, state agencies, municipalities, and NOAA, as well as shoreline professionals and experts such as engineers, environmental consultants, and researchers. Conference participants learned about and discussed how and why we manage shorelines in NH and explored how we can better manage shorelines to protect the natural, cultural, and economic resources that are impacted by shoreline management decisions. The centerpiece of the conference was a presentation on "living shoreline" treatments that have been tested in New York and New Jersey. Conference development was informed by a needs assessment conducted by GBNERR. The conference was followed by a half day workshop where select partners, presenters, and conference participants debriefed the workshop and discussed what shoreline management topics still need outreach support in NH. To continue the dialog that was started at the conference, CAW has been and will continue holding workshops that target specific shoreline management topics including: wetland and shore and permitting in NH, protecting coastal cultural resources, and a field based workshop focused on the protection provided by dunes. More follow-up workshops are expected in 2016. Additionally, CAW members are publishing an ongoing Shoreline Management Story Series to highlight how and why shoreline management is done in coastal NH. These articles have been and will continue to be published on **NHCAW.org**.

Hampton-Seabrook Estuary Sand Dune Restoration

Project Period: March 2014 to June 2015

NH Sea Grant/UNH Cooperative Extension (NHSG/UNHCE) and the University of New Hampshire (UNH) work to build coastal resilience to climate change and enhance landforms and wildlife habitat through the restoration of several dune habitats in the Hampton-Seabrook Estuary watershed. Vegetation is critical to the growth and the stability of dunes; therefore, a revegetation program engaging community members and NH Sea Grant's Coastal Research Volunteers focuses on the impacted areas. Efforts to limit pathways for beach access through all project areas include extensive outreach, educational signs, and structural fencing to divert pedestrians to designated pathways. Local citizens are engaged throughout the project in order to accomplish on the ground restoration goals and to create a network of informed citizens and landowners.

Resilient NH Coasts

Project Period: October 2013 to April 2015

This project advanced resiliency and adaptation planning for climate change related hazards by integrating tools, research, outreach, and technical assistance in the Hampton-Seabrook estuary, Dover, and Portsmouth. Outreach was also conducted to business groups throughout NH Seacoast communities. New information generated by this project included updated and expanded Sea Level Affecting Marsh Migration (SLAMM) model outputs, and current information about Fluvial Erosion Hazards. The project's integrated and innovative approach enabled project partners to learn how communities want to use and access coastal data and GIS tools in hazards and climate adaptation planning, and what steps can be taken to ensure that climate related science is relevant to local needs. The project partners collaborated on a NH Coastal Viewer product that incorporates data to help planning state agencies, commissions, municipalities, and businesses visualize what areas in their communities are the most vulnerable to coastal hazards, including sea level rise and river flooding.
http://des.nh.gov/organization/divisions/water/wmb/coastal/resilient-coast.htm

Crossing Boundaries: Integrated Planning in the Exeter-Squamscott Watershed

Project Period: September 2013 to August 2014

This project developed the foundation for an Exeter-Squamscott Watershed Integrated Plan for the communities of Exeter, Stratham, and Newfields in southern New Hampshire. The Plan helped communities meet new wastewater and stormwater permit requirements and improve water quality in the Squamscott River and the Great Bay, while supporting the economic viability of participating communities. This project developed a management plan for three communities that allows them to evaluate and manage water quality and climate impacts at the scale of the Exeter/Squamscott subwatershed project area.

New Hampshire Great Bay Estuary Ecosystem Services Assessment

Project Period: September 2013 to November 2016

This project helps to build a spatial planning framework for the Great Bay estuary, with an emphasis on successfully utilizing ecosystem services modeling to better integrate and scale-up ongoing estuarine habitat restoration work while minimizing conflicts with siting and permitting decisions pertaining to other space-dependent estuarine uses (e.g. mooring fields, marinas, aquaculture leases). The project integrates existing spatial information on climate change vulnerability into the estuarine spatial planning framework. This objective ensures that a recently completed effort to generate high quality coastal vulnerability maps for every coastal town in New Hampshire under scenarios of sea level rise and storm surge is incorporated into holistic spatial planning efforts for the state's estuaries. Blue carbon is estimated as an ecosystem service.

Climate Change and Human Health in New Hampshire: An Impact Assessment

Project Period: July 2013 to December 2014

This report provides an overview of past and future climate across New Hampshire has changed, and the potential impact of future climate change on human health in New Hampshire based on the Centers for Disease Control and Prevention – Building Resilience Against Climate Effects (BRACE) framework. The report is organized by the type of health impact:

- Temperature, heat events, and heat stress injury/death
- Extreme weather and injury/death
- Temperature, air quality, and respiratory and cardiovascular illness
- Pollen, mold, and allergies
- Temperature, precipitation, and vector-borne diseases
- Temperature, precipitation, severe weather, and foodborne diseases
- Temperature, precipitation, and waterborne diseases
- Climate change, health behaviors, and chronic disease
- Climate change, mental health, and stress-related disorders
  http://www.climatesolutionsne.org/sites/climatesolutionsne.org/files/candhreport4.30.pdf

Lee Floodplain Mapping

Project Period: July 2013 to December 2014

SRPC will work with the Lee Conservation Commission, Emergency Management Director and the Planning and Zoning Department to produce a series of maps with the new floodplain data produced for the Lamprey River Watershed. The maps will be used for land use planning and to aid in emergency response activities. SRPC will provide education and outreach assistance to the community of Newmarket on stormwater impacts and best management practices, including low impact development, to alleviate harmful pollutants discharging to the Lamprey River. These outreach efforts will target businesses, local decision-makers, public works staff and town residents. SRPC will gather municipal data from a variety of land use documents including the master plan, zoning ordinance, site plan and subdivision regulations, and other planning documents and studies in order to complete the Indicator Form and update the Piscataqua Region Environmental Planning Assessment (PREPA), which will now have a climate change component. SRPC staff will collect municipal data and fill out and update the PREPA Indicator Form.

Preparing for Climate Change in Rye

Project Period: July 2013 to December 2015

Project staff and a local steering committee organized a workshop series about climate change in Rye. The workshops introduced the science and local impacts of climate change, delivered an overview of planning tools to adapt to climate change, hosted a walking tour to understand how salt marshes are affected by sea level rise and how they contribute to resiliency, and transitioned the town's participation into a follow up project (Tides to Storms). In addition to reported increases in knowledge, the community generated a list of prioritized concerns and began a dialogue about possible action items to adapt to climate change.

Tides to Storms

Project Period: November 2012 to September 2015

This project includes 1) Production of a regional vulnerability assessment report and map set for NH coastal communities, utilizing the best available information to assess the impacts of climate change on land, natural resources and infrastructure, and provide detailed maps, risk and impact analyses, and adaptation and mitigation strategies to address the projected future effects of sea level rise and storm surge; 2) Development of a model Coastal Flood, Hazards and Adaptation Chapter to be incorporated within coastal community Hazard Mitigation Plans; 3) Local Hazard Mitigation Plan updates in each eligible coastal community to specifically incorporate the vulnerability assessment including development of adaptation and mitigation strategies that address the projected future effects of sea level rise and storm surge; 4) Development of outreach and guidance tools to enhance preparedness, create capacity and improve resiliency in the built environment, human health and safety, and natural systems; 5) Incorporation of Coastal Flood, Hazards and Adaptation Chapter into local Hazard Mitigation Plans and other state plans.

Building the Capacity of Coastal Communities to Address Climate Change Risks Through the Use of Role-Play Simulations: Dover

Project Period: September 2012 to August 2014

The Massachusetts Institute of Technology Science Impact Collaborative worked with four National Estuarine Research Reserve (NERR) sites, and the Consensus Building Institute to test an innovative way to help coastal communities understand and prepare for the potential impacts of climate change. The team engaged four at-risk New England towns in testing the use of role-play simulations as a means to educate the public about climate change threats and to help communities explore ways of decreasing their vulnerability and enhancing their resilience. The findings of this project provided valuable insights into techniques for engaging communities in public learning, risk management, and collaborative decision-making around science-intensive public disputes. They also informed the development of a model approach that communities in New England and elsewhere can use to address climate change. In NH, this project worked with the City of Dover.

Collaborative Planning for Climate Change Adaptation: A Case Study for Exeter in the Great Bay National Estuarine Research Reserve

Project Period: September 2012 to August 2014

The project undertook a collaborative planning effort to develop an integrated climate change adaptation plan for a land area exhibiting a range of land uses and location on a major tributary to the Great Bay Estuary. While the focus is on climate change, the project also considered the exacerbation, and remedies, for related challenges of stormwater, nonpoint source pollution, land use/development and the protection and restoration of habitat (marshes and fisheries habitat). The case study area is the Town of Exeter within the Exeter/Squamscott River Basin, which includes most of the town's area just upstream of Great Bay. However, because portions of other towns share the watershed, their contributions to the targeted impacts on the

river system were assessed to provide a comprehensive analysis the will yield an integrated management strategy. Benefits include an adaptation strategy for Exeter that can be incorporated into zoning ordinances, and site regulations that benefits not only the town but also Great Bay, and serve as a transferable model for collaborative and integrated adaptation planning.

Green Infrastructure for Sustainable Coastal Communities

Project Period: September 2012 to August 2014

The project proposed to build municipal capacity in coastal watershed communities for Green Infrastructure by engaging local and regional stakeholders in a planning and implementation process that was supported by technical resources and current, relevant information. The goal of creating a collaborative process was to build community resilience and improve capacity for managing water resources and related ecosystem services. The project provided a wide range of resources and numerous models and examples of regulatory and technical approaches for the implementation of green infrastructure (GI). Drawing upon knowledge gained from previously funded programs, we worked with local community leaders, regional officials, and representatives of the development community, local businesses, a local watershed entity, Low Impact Development (LID) experts, design firms and nurseries. The project implemented priorities identified by the intended users that would best develop municipal capacity for GI.

Portsmouth Coastal Resilience Initiative

Project Period: July 2012 to August 2013

This project utilized consulting services to supplement City staff hours to provide an inventory, analysis and recommendations that were easily integrated into the Master Plan update process (scheduled to start in July 2012), the building code, and the City's capital improvement plan. This project also utilized scenario planning to explore uncertainty about the future consequences of climate change on the City (both for the short-term and long-term.) This scenario planning approach sought to avoid adverse impacts on the built environment and natural resources by considering a few potential futures (in this case low, medium, and high risk scenarios). Scenario planning for this project incorporated both quantitative and qualitative information in the decision-making process. This process enabled the City to undertake a focused outreach around climate adaptation, without encumbering the Master Plan process. **http://www.planportsmouth.org/cri.html**

Navigating from Concern to Action Using the NOAA Roadmap in New Hampshire's Small Coastal Communities: Newfields

Project Period: July 2012 to June 2013

This project helped a small NH coastal community (Newfields) with a volunteer-board government move climate preparedness from concern to action by using the NOAA Roadmap for Adapting to Coastal Risks (NOAA Roadmap). The Roadmap is a community-driven process that expanded capacity in Newfields to respond to climate preparedness through (1) increased knowledge about vulnerabilities of community assets, and (2) awareness of climate adaptation options. As a result, the community has updated their stormwater management regulations, implemented an emergency generator purchasing and installation program for community members, developed and distributed a local extreme weather preparedness calendar, and more.

Climate Adaptation Chapter: Town of Durham

Project Period: July 2012 to June 2013

Strafford Regional Planning Commission assisted the Town of Durham in developing a climate adaptation chapter that was adopted as a subset of their Hazard Mitigation Plan. The chapter provides adaptation strategies to protect areas of the town that are at risk of flooding due to climate change and sea level rise, and identifies various regulatory and non-regulatory options that can be considered by Durham from this potential risk. With collaboration from Town officials and staff from the University of New Hampshire, SRPC delivered a product that provided information on how best to plan and act to address the impacts of climate change, thus protecting coastal infrastructure and resources.

Update of the Master Plan Vision Chapter: Town of Newmarket

Project Period: July 2012 to June 2013

Strafford Regional Planning Commission (SRPC) assisted the Town of Newmarket in preparing an update of the Town's Vision Chapter of the Master Plan. The process was prepared collaboratively by SRPC and a designated Master Plan subcommittee. SRPC organized and facilitated two visioning forums to solicit comments and ideas from residents for addressing current issues and challenges pertaining to various aspects of the community, including: housing, recreation, land use, zoning, business and industry, community facilities, infrastructure, and natural and cultural resources. The community was asked to consider the integration of climate adaptation measures into municipal programs, polices, and operations to reduce community risk and vulnerability.

Effects of anthropogenic change on salt marsh microbial structure and function

Project Period: June 2012 to May 2013

The goal of this project was to expand our understanding of saltmarsh microbial community structure and function and response to impending sea level rise and increasing levels of nutrient pollution. The repercussions of human activities may combine (or counteract each other) to yield unexpected effects of altered microbial activity on saltmarsh resiliency to change. This understanding informs management decisions by: 1) Guiding short-term management decisions on saltmarsh preservation more effectively through improved understanding of ecological responses to stress; and 2) Shaping long-term management goals and activities through a better understanding of environmental changes and adaptation management tools that will build saltmarsh resiliency against change.

Coastal Flooding and Erosion Forecast - Hampton, NH

Project Period: February 2012 to December 2012

An empirical relationship exists between storm tide, waves and coastal flooding or splash-over damage (NWS coastal flood study). Knowing this relationship helps predict when flooding and splash-over events (such as beach erosion) might occur based on forecast water level (tide height) and wave height data. Scientists from the University of Massachusetts at Boston, center for Coastal Environmental Sensing Networks (CESN) installed a state-of-the-art tide gauge at the Hampton Fire and Rescue pier on Hampton Harbor to support the project. The installation of the gag e was funded via a generous donation by NextEra Energy Seabrook Station. Working with the National Weather Service in Gray, Maine, NERACOOS and modelers in the Northeast region, a working prototype was developed using a water level model (NECOFS/FVCOM) and wave model (Wave Watch3). This prototype was working for Hampton, New Hampshire and Scituate, Massachusetts locations. We hope to expand to other regions depending on need. This product could be used by emergency managers, coastal homeowners and other users with interest and concern about beach erosion from large-wave storms. The capacity for the Coastal Flooding and Erosion Forecast system to predict damage days in advance of storms is extremely important to coastal property owners and emergency responders, resulting in dollars and lives saved.

NH Coastal Risk MAP Product Development

Project Period: September 2011 to December 2017

The objective of this project is to produce a suite of non-regulatory, Risk MAP products to accompany the updated floodplain maps described below for the NH Coastal Mapping project. Collectively, they extend the utility of the maps and reports, encourage community utilization and understanding, and facilitate more efficient floodplain management. Products developed include Changes Since Last DFIRM (a comparison of the new floodplain data relative to the previously effective data), Limit of Moderate Wave Action (an informational layer on the floodplain maps that defines the landward limit of the 1.5 foot wave), Coastal Flood Depth Grids (containing coastal water depths for the one-percent-annual-chance Base Flood Elevation), Riverine Flood Depth Grids (containing riverine water depths), Static Sea Level Rise, and the results of Hazus analyses for Rockingham and Strafford Counties (showing potential annualized losses from flooding). These non-regulatory products will be entered into a Flood Risk Map, Report, and Database, all of which will be available from the FEMA Map Service Center.

Stimulate innovation and increase the pace of municipal responses to a changing climate in the coastal zone of the Northeast and Bay of Fundy

Project Period: September 2011 to April 2013

This project included three components: 1) Research and documentation of the best practice/innovative municipal adaptation approaches in the Northeast; 2) Municipal technical assistance through a small grant program; and 3) Adaptation/resilience communications development in collaboration with CA-CP and partners. **http:/cpo.noaa.gov/cpo**

New Flood Plain Maps for Coastal New Hampshire and Questions of Legal Authority, Measures and Consequence

Project Period: March 2011 to February 2012

Questions of Legal Authority, Measures, and Consequences assesses various types of legal risks communities in the Lamprey River Watershed may be concerned about as a result of adopting new flood management regulations and policies. To assess these risks we identified four potential legal challenges related to: (1) municipal liability, (2) enabling authority, (3) the use of climate maps as evidence, and (4) takings. In general, the risk of municipal liability is low, so long as municipalities follow sound planning principles. Not only is the level of risk low, the federal government encourages communities to enact certain types of regulations designed to reduce flood hazards. This encouragement provides states and municipalities an additional layer of assurance with respect to adopting and defending revised or new flood regulations. Under federal floodplain guidelines, states and municipalities are encouraged to establish more stringent regulations above and beyond minimum federal requirements. For example, the Federal Emergency Management Agency (FEMA) advises communities to enact

stricter regulations through a program called the Community Rating System.1 This document, provides a list of additional regulatory and non-regulatory tools communities can use to both help reduce risk of flood hazards and avoid legal quandary. **http://100yearfloods.org/resources/pdf/2012_VermontLawSchool_LampreyRiverReport.pdf**

NH Coastal Mapping Project

Project Period: September 2010 to December 2017

The objective of this project is the creation of new Digital Flood Insurance Rate Maps (DFIRMs) and Flood Insurance Studies (FISs) for the downstream portions of the Piscataqua/Salmon Falls Basin (HUC 8 Watershed 01060003), including the ocean coastline in New Hampshire. The study area comprises 239 square miles, and includes the 17 communities that lie within New Hampshire's designated Coastal Zone. High resolution LIDAR topographic data was used to support new and/or updated modeling and mapping of the study area. The new DFIRMs and FIS were released for the Strafford County portion of the project area on September 30, 2015. Rockingham County products are in progress.

Assessment of Climate Change in Coastal New Hampshire

Project Period: August 2010 to July 2011

Produced a detailed assessment of climate change for coastal New Hampshire that describes how the region's climate has changed over the past century, and how climate may change over the course of this century based on different global greenhouse gas emission scenarios. The results were detailed in a report and series of presentations titled "Climate Change in the NH Coastal Watershed: Past, Present, and Future". Adapting to a changing climate requires both data and information at a spatial and temporal scale that is relevant to decision making. Unfortunately, information provided by existing national and broad regional climate change impact assessments are not sufficiently detailed to provide municipal and regional decision makers with key decision relevant information. This climate assessment provided decision-relevant information on a regional scale to individual, municipal, regional, and state decision-makers. The information compiled in this climate assessment provides the foundation for developing local adaptation plans to a changing climate and this project disseminated this information to seacoast municipalities as well as regional and state organizations. **http://CarbonSolutionsNE.org**

Sea Level Rise and Storm Surge Adaptation Analysis via COAST

Project Period: July 2010 to December 2012

The primary objective of this project was to provide support for climate adaptation planning processes in South Portland, ME and the Hampton/Seabrook estuary in NH. Working in partnership with PREP and CBEP, the New England Environmental Finance Center (EFC) provide visual, numeric, narrative, and presentation-based products based on the COAST decision-support tool. It was anticipated these products can help galvanize support for processes underway and represent specific action items stakeholders can evaluate. At public meetings of local stakeholder groups the EFC provided 1) single-event snapshot visualizations of 3D extruded values for each action and no-action scenario; 2) multi-decade tallies of cumulative expected damages under each adaptation scenario; and 3) interpretation of avoided costs associated with each adaptation action under consideration. Dialogue was solicited about implications for possible subsequent local action.

Seabrook Pilot Project

Project Period: July 2008 to June 2010

RPC will work with Seabrook to develop strategies/ methods to identify and protect areas of increased risk from coastal flooding due to climate change. Products will include a final report to summarize the work, and maps of areas vulnerable to flooding, as well as suggestions to regulate future development of these areas. RPC will then apply this pilot study to all RPC-member coastal communities, followed by a regional forum to describe final results. RPC will also assist those who request adaptation planning experience.

10. Endnotes

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INSIDE BACK COVER

The final report of the New Hampshire
Coastal Risk and Hazards Commission,
Preparing New Hampshire for Projected Storm Surge,
Sea-Level Rise and Extreme Precipitation,
is available for download on the Commission's website:
http://www.nhcrhc.org