

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[RSA 483-E:1 repealed by 2013, 188:2, effective December 1, 2016.]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[RSA 483-E:2 repealed by 2013, 188:2, effective December 1, 2016.]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

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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/I/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 Assessment⁸⁹ 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 an exception to these standards can be made under certain circumstances, relating to emergency, national security and in circumstances where their 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 sea 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 released⁹² the New Hampshire Climate Action Plan⁹² 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 Plan⁹⁴, (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.

APPENDIX D: Science and Technical Advisory Panel (STAP) Report Summary

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

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

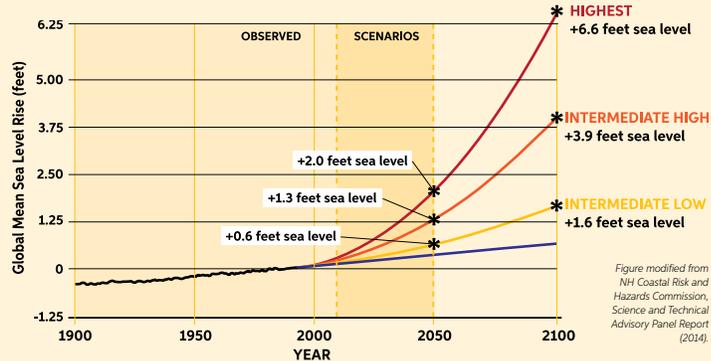
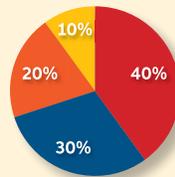


Figure modified from NH Coastal Risk and Hazards Commission, Science and Technical Advisory Panel Report (2014).

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

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.

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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 CO²–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



MARGARET WOOD HASSAN
GOVERNOR

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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 reevaluation 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 (NERACOO), 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 GBNER. 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/cr.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

Stafford 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

Stafford 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, policies, 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 gauge 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.