



Municipal Responses to a Changing Climate in the Coastal Zone of the Northeast and Bay of Fundy

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Climate change wields potent and wide-scale concerns for our fragile planet. Global ocean and land temperature readings all confirm that the Earth is warming.¹ A warming climate means sea ice will melt, storm activity will increase, and sea-level will rise to engulf vulnerable communities.² A warming climate also has implications for storm activity. Warming temperatures results in a “rainier planet” because “warm air carries more water vapor than cold air does.”³ An increase in rain leads to “an increase in extreme rainfall events” which, in turn, leads to flooding. Significantly, warmer sea surface temperatures brew “fiercer storms” and hurricane intensity has already been observed in the North Atlantic Ocean.⁴

As a result of thermal expansion of water molecules and increased freshwater influx from melting ice, sea level “is predicted to rise by about 0.2-0.6 meter in the coming century.”⁵ The problem of a rising sea is particularly distressing for low-lying coastal regions, such as Miami, New Orleans, and New York.⁶ Additionally, sea level rise will “exacerbate floods and storm surges.”⁷ Glaciers are melting at an accelerated rate.⁸ Mount Kilimanjaro is projected to lose its snow by 2020; Glacier National Park will “lose its last glacier in a few decades,” and sea ice, in the Arctic, is projected to

¹ David Archer, *The Long Thaw: How Humans are Changing the Next 100,000 Years of Earth’s Climate*, 31, 34 (Princeton University Press 2010) (2009). *See also* Intergovernmental Panel on Climate Change Report 2007, Summary for Policymakers, 2, (Hereinafter “IPCC 2007”).

² *Id.* at 36-37.

³ *Id.* at 47.

⁴ *Id.* at 37, 48.

⁵ *Id.* at 49.

⁶ *Id.* (Pacific island communities, such as Tuvalu and Vanuatu, already have evacuation plans to respond to sea level rise.)

⁷ *Id.* at 53.

⁸ IPCC 2007, *supra* note 1, at 2.

vanish completely by 2050.⁹ Specifically, the Arctic is an area where the effects of climate change are readily apparent.¹⁰

It is theorized and nearly accepted in the scientific community that anthropogenic carbon dioxide (CO²) production from burning fossil fuels is the main culprit.¹¹ The Intergovernmental Panel on Climate Change (IPCC), the leading international body for the assessment of climate change, “declared a ‘discernable human influence on global climate’ in 1995.¹² Then, in 2007, the IPCC concluded “that it is 90-99% likely that ‘most of the observed increase in globally averaged temperatures since the mid-20th century is due to the observed increase in anthropogenic greenhouse gas concentrations.’¹³ Alarming, at the status quo, with “current climate change mitigation policies and related sustainable development practices, global [green house gas] emissions will continue to grow over the next few decades.”¹⁴ Therefore, “additional adaptation measures will be required to reduce the adverse impacts of projected climate change and variability.”¹⁵

In the IPCC’s latest special report, “Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation,” (IPCC 2012) the IPCC has elaborated on strategies for climate change adaptation. (IPCC 2012)¹⁶ The two main categories of climate change efforts are 1) “Disaster Risk Management” and 2) “Climate Change

⁹ Archer, *supra* note 1, at 36.

¹⁰ *Id.* at 31.

¹¹ *Id.* at 43.

¹² *Id.* at 44, IPCC 2007, *supra* note 1, at 2. (“There is *very high confidence* that the net effect of human activities since 1750 has been one of warming.”)

¹³ Archer, *supra* note 1, at 44.

¹⁴ IPCC 2007, *supra* note 1, at 7.

¹⁵ *Id.* at 8.

¹⁶ IPCC 2012 Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change 582, (Cambridge University Press, Cambridge, UK, and New York, NY, USA) (Hereinafter “IPCC 2012”). See also IPCC 2007, *supra* note 1, at 15. (Table SPM.4: Selected examples of planned adaptation by sector).

Adaptation.”¹⁷ The IPCC 2012 report advocates for a heightened understanding at the local level of cumulative weather or climate events that may not seem extreme when considered independently.¹⁸ To effectively manage disaster risk there must be both consideration of “disaster risk in national development and sector plans” and implementation of climate change adaptation “strategies into actions targeting vulnerable areas and groups.”¹⁹

Specifically, the IPCC 2012 report identified six approaches for “reducing and managing disaster risk in a changing climate” that “can be overlapping and ... pursued simultaneously:” 1) prepare, respond and recover; 2) reduce vulnerability; 3) transformation; 4) increase resilience to changing risks; 5) transfer and share risks; 6) reduce exposure.²⁰ Undoubtedly, developing climate change adaptation policies tailor-made for a specific locale can seem like an insurmountable task in the face of low funding, budget cuts, and minimal staffing. Thus, as a first step, “low-regrets measures” are “available starting points” that “have the potential to offer benefits now and lay the foundation for addressing project changes.”²¹ Examples of low-regrets measures include: “early warning systems; risk communication between decisionmakers and local citizens; sustainable land management, including land use planning; ecosystem management and restoration; improvements to health surveillance, water supply, sanitation, and irrigation and drainage systems; climate-proofing of infrastructure; development and enforcement

¹⁷ IPCC, *supra* note 16, at 5. “Disaster Risk Management” is defined as “[p]rocesses for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, resilience, and sustainable development.”

¹⁸ *Id.* at 7.

¹⁹ *Id.* at 10.

²⁰ *Id.* at 6.

²¹ *Id.* at 16.

of building codes; and better education and awareness.”²² However, a “portfolio of actions” are necessary to effectively manage risk such as a “combination of hard infrastructure-based responses and soft solutions such as individual and institutional capacity building and ecosystem-based responses.”²³ Finally, the IPCC 2012 report emphasizes that any climate change adaptation strategy must be flexible enough to evolve with new data and understandings.²⁴

The study below summarizes New England municipality adaptation efforts to climate change and provides a convenient compilation of available climate change adaptation resources. The purpose of this study is to provide a state-by-state analysis of current response efforts at the local level and to create a database of innovative approaches for municipality leaders to draw from. An in-depth analysis of local-level responses to climate change was necessary because not only are municipalities considered the front-line, or “first responder,” defense “when disasters strike,” but more importantly municipalities are the “principal legal authority,” as delegate by state legislatures, “to determine what type of development may be built in disaster-prone areas.”²⁵

As discussed below, a first step for many New England municipalities in developing adaptation strategies has been knowledge gathering. The ‘first-step’ studies, which are elaborated below in greater detail in Appendix A and on the StormSmart Coasts website, attempt to address where the vulnerabilities are occurring, the impacts of these vulnerabilities from an economic, biological, or physical standpoint, what

²² IPCC, *supra* note 16, at 16-17.

²³ *Id.* at 17.

²⁴ *Id.* at 20.

²⁵ John. R. Nolan, *Disaster Mitigation through Land Use Strategies*, 23 *Pace Env'tl. L. Rev.* 959, 963 (2006).

adaptation efforts are possible, and what adaptation efforts are needed or are already taking place.

Maine

A 1996 U.S. E.P.A. report, *Anticipatory Planning for Sea Level Rise Along the Coast of Maine*, was Maine's first systematic assessment of its vulnerability to sea-level rise associated with global climate change. The assessment made two major recommendations: "1) The state should protect and strengthen the ability of natural systems to adjust to changes in shoreline position [;] and 2) the state should prevent new development which is likely to intervene with the ability of natural systems to adjust to changes in shoreline position."

Since this report, Maine has increased efforts under relevant statutory authorities to incorporate new data, such as LiDAR and aerial photography, to delineate changes in the shoreline and encourage municipal-level adaptation efforts. In Maine's Section 309 Report, the risk inventory notes that extra-tropical storms and storm surges are the sources of highest risk to coastal zones. Coastal municipalities are required to adopt local shoreland zoning ordinances that meet state minimum standards under the "Mandatory Shoreland Zoning Act." The state has provided model ordinances to assist municipalities in this endeavor. However, research shows that municipalities are enacting only the minimum protective ordinances as required by the state.

The Saco Bay Sea Level Adaptation Working Group (SLAWG), which provides recommendations to the Saco Bay communities, developed an "Action Plan" of implementation strategies for regional solutions to coastal vulnerabilities as identified in previous studies.

The Coastal York County Case Study, addressed the potential economic impacts on Maine. By analyzing the hypothetical affects on the economy of York County from coastal damages resulting from a specified sea-level rise, the study extrapolated the economic impact of sea-level rise to the entire state. Specifically, the study looked at how climate change effected economic outputs, costs, and opportunities as well as changed perceptions of time and risk.

A review of municipality ordinances reveals that the adaptation efforts have centered on education or singular structural improvements, such as the reconstruction damaged seawalls. The research shows that there is a lack of comprehensive planning on the municipal level, despite showings of public support for sea-level rise planning process at a recent conference in Maine.

New Hampshire

The New Hampshire (NH) Coastal Adaptation Workgroup is responsible for developing a climate change adaptation plan. In NH's Section 309 Report, flooding was recognized as the source of highest risk to coastal zone. The NOAA Roadmap Tool provided a framework to assess vulnerabilities to hazards and implement relevant climate data into local planning and decision-making; it also provided a coordination strategy to eventually assist all NH municipalities in adaption to climate change.

Municipalities are empowered under the "Shoreland Water Quality Protection Act" to issue cease and desist orders to protect sensitive coastal areas. Additionally, they are given the unique authority to amend the standard building code to provide greater restrictions on flood plain development. The research revealed that while municipalities in NH are not exceeding the state's minimum requirements for hazard mitigation, they

are, however, adopting more stringent standards for protecting shoreland area, i.e. Town of Exeter set-back expanded beyond state law. The case studies below exemplify mitigation efforts from specific municipalities or other groups.

Seabrook, NH employed a study to (1) develop elevation maps of Seabrook which identify the areas of increased risk to flooding from sea-level rise and (2) identify the various regulatory and non-regulatory options that should be considered by Seabrook to protect the Town from this potential risk. The report specifically identified the needs for regulations to increase the design flood elevation for buildings and infrastructure in the high flood risk areas. This study will provide local decision makers with the tools to develop policies and ordinances to mitigate against the identified impacts.

The Portsmouth Coastal Resilience Initiative, funded by the Gulf of Maine Council on the Marine Environment (GOMC) and the Northeast Regional Ocean Council (NROC), is a project aimed at integrating adaptation strategies learned from “scenario planning” into City-wide plans, regulations, and policies, specifically the Master Plan update, the building code, and the City’s capital improvement plan.

The University of New Hampshire and the Vermont School of Law has researched legal issues concerning the use of the new floodplain data and information as municipalities attempt to build resiliency through improved plans and policies.

Massachusetts

Under the “Global Warming Solutions Act,” Massachusetts (MA) incorporated an adaptation strategy report which emphasized communities to utilize the StormSmart

Coasts website for “technical, legal, planning, and regulatory information.”²⁶ In MA’s Section 309 Report, the risk inventory notes that flooding is the source of highest risk to coastal zone. Consequently, MA has implemented mitigation strategies in their building codes and wetland regulations. One strategy utilized by MA municipalities to impose restrictions on flood-prone areas already treated in another zone is “overlay zoning.” Overlay zoning provides the advantage of addressing flood risks without re-writing the entire zoning code. MA municipalities are guided by the “Natural Hazards Mitigation Guidebook: A Community Guide,” which is provided by the MA Department of Conservation and Recreation. The case studies below exemplify mitigation efforts from specific municipalities through management plans or specific policies.

In the Town of Hull’s North Nantasket Beach, a management plan was adopted to protect and preserve wetland resources, identify climate change adaptation strategies to protect the public and town infrastructure from storm damage and flooding, and develop local regulations that are compliant with the Massachusetts Wetlands Protection Act. Under the management plan, dune development is identified as an adaptation strategy to protect against storm surge impact. The Beach Management Committee implements a successful volunteer-based beach grass planting program to promote dune creation, stabilization, improvement, and repair.

The towns of Marshfield, Duxbury, and Scituate, located south of Boston, MA, completed an adaptation study in 2011. The study identified that coastal flooding and storm surges were two coastal hazards that were highly likely to occur. The study recommended three major strategies: protection, accommodation, or retreat. Specifically,

²⁶ Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs & Office of Coastal Zone Management, Section 309 Assessment and Five-Year Strategy for CZM Program Enhancement 83 (2010), *available at* <http://coastalmanagement.noaa.gov/mystate/docs/ma3092011.pdf>.

the study identified four options to protect the existing development: land acquisition; regulation; building guidelines; and flood proofing. Although the study recommended against any new shoreline armoring, the study identified that there is a need to repair existing structures to protect existing buildings and public roads. To protect natural resources, the study encouraged preservation of green space and water resources such as wetlands. Lastly, the plan emphasized continued public outreach and education. As a result of the study, Scituate has included a 100-year flood elevation plus a factor of one-foot in its wetlands regulations. Duxbury's wetlands regulations now include performance standards for Land Subject to Coastal Storm Flowage (LSCSF) and prohibit new construction or placement of new structures and septic systems.

Rhode Island

The Coastal Resource Management Council, charged with the duty to manage and protect Rhode Island's (RI) coastal resources, has implemented climate change adaptation strategies into the coastal management plan and Special Area Management Plans, for example, via setback, coastal buffer, and dune protection provisions. State building codes also integrate mitigation techniques for structures in locations subject to a certain wave height, known as a freeboard requirement. However, due to concerns for uniformity, municipalities are limited from taking measures to increase the freeboard requirements. In RI's Section 309 Report, flooding is the source of highest risk to coastal zone. RI municipalities receive state funding under the Pre-Disaster Mitigation Program and are able to influence land use decisions through local planning and zoning boards as well as conservation and harbor commissions. The case studies below exemplify mitigation efforts from specific municipalities.

In October 2011, Block Island, New Shoreham, RI identified that its low-lying infrastructure and harbor are vulnerable to sea-level rise. The village specifically identified two interests that would be affected by sea-level rise: commercial and private transportation and deliveries. After receiving funding from the New England Municipal Coastal Resilience Initiative, NOAA grant, and developing detailed flood hazard mapping, the town plans to find temporary and long-term solutions.

In November 2011, Bristol, RI obtained a grant, under the Hazard Mitigation Grant Program, to develop a system to prevent sewage back flow. The prevention system project, the first of its kind in Rhode Island, identified fifty-three properties susceptible to sewage back flow and focuses on retrofitting existing sewage connections.

Connecticut

Connecticut's (CT) Steering Committee for Climate Change is the entity responsible for making recommendations to the legislature to address climate change. Under the "State Floodplain Management Act," the state's major mitigation tool, the Department of Environmental Protection oversees flood management. Municipalities are given a role in local land use controls and Flood and Erosion Control Boards. However, the municipalities are not required to revise ordinances to account for floodplain management. In CT's Section 309 Report, the risk inventory notes that flooding is the source of highest risk to coastal zone. CT provides an Adaptation Resource Toolkit to assist municipalities in addressing climate change and hazard mitigation at the local level. The case studies below exemplify mitigation efforts from specific municipalities.

In New Haven, ordinances have been developed to specifically address coastal and inland flooding from storm surges. Focusing on immediate solutions, the town has

hired contractors to guarantee that their 11,000 catch basins are properly maintained and cleaned. At the Tweed-New Haven airport, wetlands have been restored and tide gates have been installed to enable proper flood water retention.

Although CT municipalities are not directly mandated to revise ordinances to account for floodplain management, the floodplain management grant program provides incentives to encourage municipal hazard mitigation actions. Under this program, Norwich, CT has implemented a Floodplain and Floodway Zoning ordinance, which prohibits the storage or processing of salt and other flammable, explosive, or hazardous materials.

Summary Conclusion

Most state municipalities lack the relevant funding, staff, and information to develop long-term, integrated climate change adaptation policies. Notably, the research revealed that states are unwilling to pressure local governments to take action in hazard mitigation because of a lack of funding and staff. Specifically, there is a deficiency of information regarding inundation mapping and shoreline mapping to delineate changes in the coastal zone. In conclusion, obtaining grant money and access to analytical reports, which synthesize best practices, will be crucial to the future success of municipal, front-line, adaptation and mitigation strategies.