Underwater: The Need for Massachusetts to Become Climate Ready

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Abstract

Massachusetts' longstanding vulnerability to flooding is on the verge of worsening due to expected impacts of climate change over the next several years. Although legislation has prompted the state to convene a multi-agency conversation on climate change adaptation, the work has yet to result in specific planning that will prime the state for reducing damage caused by flooding and other climate impacts. With renewed leadership, the state should prioritize flood risk in the policy agenda, launch a public awareness campaign, plan for infrastructure and state property investments, and facilitate municipal action. Since the issue cannot be adequately addressed by state government alone, making Massachusetts more resilient to flooding will require action by multiple levels of government and a number of private actors.

Introduction

Massachusetts is in a precarious position when it comes to flooding. With numerous coastal communities and storm water systems that are not prepared to accommodate increased flow, preparations need to be made so that the state is more resilient. Over the next several decades, as the impacts of climate change intensify, flooding will become a bigger threat for the state. The combination of sea-level rise, increased storm surge, and increased rainfall are projected to make flooding more substantial and frequent. Additionally, when storm water flow exceeds the amount the sewer system can handle, communities will flood. Major weather events will be particularly problematic in areas that have little pervious pavement because the

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increased flow will inundate the sewer system, due to lack of surfaces to absorb the water.

These major weather events stand to cause billions of dollars of damage to infrastructure and ecosystems, impacting both private and public assets. Some needs are immediate, calling for near-term action, while others can wait for implementation until benchmarks, such as a certain amount of sea level rise, are met. Accordingly, proactive planning and actions by governments and private actors will save billions of dollars by reducing the extent of damage suffered during floods.

In recent years, state legislation led to the creation of a committee for the purpose of recommending strategies for adapting to predicted effects of climate change, such as increased incidence of flood. However, after the committee released a report in 2011, the momentum has slowed and there has been little activity. Even in light of Hurricane Sandy, which resulted in a State of Emergency for Massachusetts and caused billions of dollars of damage in the neighboring states of New Jersey and New York, flood preparedness does not appear to be a high priority for the Massachusetts executive or legislative branches. Since state bureaucrats and quasi-governmental agency staff who are working on climate change preparedness are typically working on many other issues and programs, they lack the necessary focus and urgency with regard to flooding. Despite the acknowledgement on the part of several experts that more needs to be done to prepare Massachusetts, the pace of action is not as quick as it needs to be. Without heightened attention for this issue and adequate resources being directed to planning and implementation, the state will not make substantial progress in time to avert catastrophic damage.

Renewed executive and legislative leadership on the issue could raise the profile on the public policy agenda and prompt a number of actions, including launching a public awareness campaign, planning for infrastructure and state property investments, and facilitating municipal action. Even with leadership from the state, many other actors will need to get involved for our communities to become more resilient. It will take contributions from regional planning organizations, municipalities, academia, non-profit organizations, insurance companies, developers, and property owners. Although climate change may seem like a distant concern to many, near-term collaboration is necessary to adequately prepare the state for increased flooding.

I. VULNERABILITY

Massachusetts is already highly vulnerable to flooding—a vulnerability which sea level rise and increased precipitation exacerbate. Since the mid-1800s, sea level has been rising largely as a result of climate change.[1] Sea level rise plays a particularly significant role in certain locations, such as Massachusetts, where it is happening at a more rapid pace than the global rate of sea level rise due to the changes in the strength of the Atlantic Meridional Overturning Circulation (AMOC).[2] AMOC is a major current in the Atlantic Ocean which plays an important role in the Earth's climate system.[3] Over the next several decades, global mean sea level rise is expected to increase between eight inches and 6.6 feet.[4] On the more local level, by 2100, Boston is projected to have approximately 6-11 additional inches of sea level rise.[5]

Impacts of sea level rise can include the increased height of storm surges and coastal flooding frequencies, which would submerge low-lying coastal areas.[6] Today's sea level rise is also expected to substantially increase the frequency of today's 100-year flood events.[7] For the past 50 years, precipitation has been on the rise in the Northeast and it is predicted that high precipitation events in the area will take place with increasing frequency: 8% increase in extreme precipitation events by about 2050 and 13% by the end of the century.[8] Increased sea level rise and precipitation are likely to contribute to more flooding and increased harm to people, infrastructure, buildings, and ecosystems.[9]

1. *Oceans & Sea Level Rise*, CLIMATE INST., http://www.climate.org/topics/sea-level/index.html#sealevelrise (last visited Dec. 8, 2012).

2. Exec. Office of Energy & Envtl. Affairs & Climate Change Adaptation Advisory Comm., *Massachusetts Climate Change Adaptation Report,* MASS.GOV, 15-16 (Sept. 2011), http://www.mass.gov/eea/docs/eea/energy/cca/eea-climate-adaptation-report.pdf.

3. U.S. Geological Survey, *Atlantic Meridional Overturning Circulation*, ENCYCLOPEDIA OF EARTH (May. 31, 2012, 5:31 PM), http://www.eoearth.org/view/article/150290/.

4. *Global Sea Level Rise Scenarios for the United States National Climate Assessment*, CLIMATE PROGRAM OFFICE, 1 (Dec. 6, 2012), http://www.cpo.noaa.gov/reports/sealevel/NOAA_SLR_r3.pdf.

5. Exec. Office of Energy & Envtl. Affairs, *supra* note 2, at 16.

6. *Id.*

7. *Id.* at 17.

8. *Id.* at 19.

9. *Id.* at 20.

II. Cost of Inaction

Flooding poses a substantial economic threat to Massachusetts.[10] The total residential, commercial, and industrial building damage—as well as damage to the contents contained therein—and emergency costs resulting from sea-level rise is estimated at $7 billion over the next 100 years, even without taking into account the impacts of climate change.[11]When taking into consideration some degree of climate change, however, the projected costs skyrocket. Under various climate change scenarios, if we do not implement climate change adaptation measures, the costs could be anywhere from $20 billion to $94 billion (in 2000 dollars).[12]

Potential damage to Boston—the economic engine of the state—is a top concern. One of Boston's key vulnerabilities is the Charles River dam, which is just two feet above the present 100-year flood level.[13] Climate expert Paul Kirshen of University of New Hampshire (UNH) has stated, "Our biggest threat is probably that by mid-century, we will have two feet of sea level rise, and so a 100-year flood would overtop the dam."[14] This would flood areas such as Back Bay, East Cambridge—MIT, Central, and Harvard—and Boston Common, causing huge amounts of damage to historically significant sites, sophisticated hospital and research facilities, and thousands of residences.[15]

Recent meteorological events in the Northeast demonstrate that the potential billions of dollars in economic damage described above can quickly become a reality if preparation is not made in earnest. In October 2012, Category 1 (the most minimal categorization for a storm) Hurricane Sandy wreaked havoc in locations such as New York City.[16] While one weather event cannot be directly attributed to climate change, Sandy was consistent with a pattern of more severe weather influenced by climate change.[17] The damage caused by just

10. *Id.* at 2.

11. Paul Kirshen et al., *Climate Change in Metropolitan Boston*, 20 New Eng. J. Pub. Pol'y 89, 96-97 (2005), *available at* http://scholarworks.umb.edu/nejpp/vol20/iss2/7.

12. *Id.* at 97.

13. Telephone Interview with Paul Kirshen, Research Professor, Envtl. Research Grp., UNH Civil Eng'g Dep't & Inst. for the Study of Earth, Oceans and Space (Nov. 23, 2012).

14. *Id.*

15. *Id.*

16. *Saffir-Simpson Hurricane Scale*, The Weather Channel, http://www.weather.com/encyclopedia/charts/tropical/saffirscale.html (last visited Dec. 8, 2012).

17. Beth Daley & Eric Moskowitz, *Boston Could Be Vulnerable to More Severe Storms: Scientists Want City to Gird for Warning of Flood Risks*, The Bos. Globe, Nov. 1, 2012,

this one storm is estimated at $33 billion, not to mention at least 97 deaths in the area.[18] Were a Category 4 storm to hit New York City, it is estimated the city would experience $500 billion worth of damage.[19] Scientists and bureaucrats alike, in Massachusetts and elsewhere, have called Hurricane Sandy a "wake-up call" indicating the need for heightened preparedness.[20]

Storms and flooding pose a substantial threat not only to the economy of Massachusetts, but also to public health and the lives of all Massachusetts residents, now and in the future. Immediate action is required to minimize the damage. Decisions need to be made about what level of risk we will tolerate. It is necessary for Massachusetts to develop an understanding of options, evaluate them, and then form priorities based on a number of factors: the likelihood and scale of potential impacts; the vulnerability of the groups or individuals affected; the feasibility of available alternatives; extensive stakeholder input; and, information about effective existing practices.[21]

III. MOVING, BUT NOT FAST ENOUGH

In recent years, Massachusetts has taken steps to mitigate or reduce contributions to climate change, but has failed to simultaneously direct sufficient attention and resources to adaptation planning and implementation projects that will prepare the Commonwealth to gracefully handle the likely impacts of climate change.[22] Whereas mitigation is directed at slowing climate change by reducing carbon dioxide (CO_2) and other greenhouse gas emissions, adaptation is about reducing the impacts of climate change that are happening now and increasing resilience to future impacts.[23]

In 2008, Governor Deval Patrick signed the Global Warming Solutions Act (GWSA), which set aggressive goals for reducing CO_2 emissions supported by a series of energy efficiency and renewable en-

http://www.boston.com/news/local/massachusetts/2012/11/01/boston-could-vulnerable-more-severe-storms/isUNbeXRaS4COZTRLJvxqL/story.html.

18. Matt Sledge, *After Hurricane Sandy, The Costs of Doing Nothing to Protect New York Come Into Focus*, THE HUFFINGTON POST, Nov. 21, 2012, http://www.huffingtonpost.com/2012/11/21/hurricane-sandy-new-york_n_2171199.html.

19. *Id.*

20. Daley & Mosckowitz, *supra* note 17.

21. Exec. Office of Energy & Envtl. Affairs, *supra* note 2, at 28.

22. Telephone Interview with Martin Pillsbury, Envtl. Planning Dir., Metro. Area Planning Council (Nov. 26, 2012).

23. *Adaptation*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/adaptation/items/4159.php (last visited Dec. 8, 2012).

ergy targets.[24] The legislation also called for the creation of a Climate Change Adaptation Advisory Committee, for the purposes of studying and making recommendations to the Executive Office of Energy and Environmental Affairs (EOEEA) on strategies for adapting to climate change.[25] In September 2011, the Advisory Committee produced a Massachusetts Climate Change Adaptation Report, which included a number of recommended strategies.[26] Eight months later, in May of 2012, EOEEA Secretary Richard K. Sullivan Jr. convened an Implementation Advisory Committee (IAC) to advise the Patrick Administration's implementation of the GWSA.[27] Subsequently, one of the subcommittees established by IAC to focus on climate change adaptation[28] reported that state agencies have been involved in several climate change adaptation activities: evaluating existing capabilities, resources, and programs; obtaining funds for surveys, outreach, and inventory assessments; and, evaluating vulnerabilities of their resources.[29] In addition, the subcommittee reported that discussions about ongoing adaptation activities—among EOEEA departments, the Massachusetts Department of Transportation (MassDOT), the Department of Public Health (DPH), and stakeholders—revealed the need for more information sharing and collaboration.[30] Thus, while Massachusetts has started taking the necessary steps towards preparing for flooding and developing more resilient communities, there is still a long way to go to ensure that major destruction is averted. Four years after the passage of GWSA, the state is not noticeably more prepared to handle floods and other climate impacts. Indeed, several people involved in climate change adaptation work in Massachusetts, including

24. Mass. Dep't of Envtl. Protection, *Overview of the Global Warming Solutions Act (GWSA)*, MASS. GOV, http://www.mass.gov/eea/agencies/massdep/air/climate/overview-of-the-global-warming-solutions-act-gwsa.html (last visited Dec. 8, 2012).

25. *Id.*

26. Exec. Office of Energy & Envtl. Affairs, *supra* note 2.

27. *See* Exec. Office of Energy & Envtl. Affairs, *Implementation Advisory Committee*, MASS.GOV, http://www.mass.gov/eea/air-water-climate-change/climate-change/massachusetts-global-warming-solutions-act/implementation-advisory-committee.html (last visited Dec. 8, 2012).

28. Exec. Office of Energy & Envtl. Affairs, *Implementation Subcommittees*, MASS. GOV, http://www.mass.gov/eea/air-water-climate-change/climate-change/massachusetts-global-warming-solutions-act/implementation-subcommittees.html (last visited Dec. 8, 2012).

29. Global Warming Solutions Act Implementation Subcommittees, *Clean Energy & Climate Plan for 2020: Summary Reports*, MASS. GOV, 8 (Sept. 19, 2012), http://www.mass.gov/eea/docs/eea/gwsa/gwsa-implementation-subcommittees-summary-reports-fall-2012.pdf.

30. *Id.*

state bureaucrats, have expressed an interest in an accelerated rate of progress.[31]

IV. Filling the Leadership Void

When a Governor, Secretary, or Commissioner prioritizes an issue, progress is more likely at a certain rate of speed.[32] Accordingly, executive leadership could go a long way in accelerating the process of mitigating climate change and adapting Massachusetts to changes in the climate that are likely to occur.

The rise and fall of smart growth during former Governor Mitt Romney's administration illustrates the pivotal role that executive leadership has in getting an issue on the policy agenda and achieving progress in a timely fashion.[33] Smart growth is purposeful planning that reduces sprawl and makes communities more dense and walkable.[34] Governor Romney prioritized smart growth by creating a new Office for Commonwealth Development, which served as an umbrella for the transportation, environment, and housing departments.[35] He named Douglas Foy, a reputable, independent-minded environmentalist, as its chief, despite some concerns from the business community.[36] Romney and Foy then got to work on smart growth policies, including the release of a highway-design manual to help make towns more pedestrian-friendly.[37]

The following year, Romney signed legislation (Chapter 40R) which provided a carrot to municipalities: commit to allowing more high-density, multi-family housing, and become eligible for funds.[38] However, the Governor was not necessarily the reason the legislation came about; a coalition of housing advocates and developers pushed for its passage. In fact, Romney made certain moves that undercut the potential impact of Chapter 40R, such as cutting the budget for land conservation, making it more difficult for communities to prevent de-

31. Telephone Interview with Kathy Baskin, Director of Water Policy, Exec. Office of Energy & Envtl. Affairs (Oct. 26, 2012).

32. Telephone Interview with Rob Garrity, Executive Director, Mass. Climate Action Network (Dec.5, 2012).

33. *Id.*

34. Alec MacGillis, *Urban Outfitter Mitt Romney Versus Cars*, The New Republic (Nov. 9, 2011, 12:00AM), http://www.tnr.com/article/politics/magazine/97226/romney-massachusetts-chauvinism-liberal#.

35. *Id.*

36. *Id.*

37. *Id.*

38. *Id.*

velopments from getting built in undeveloped areas.[39] Consequently, as Governor Romney's interest in smart growth waned, so did the overall progress of smart growth.[40] Moreover, shortly after Foy consolidated several grant and loan programs into a centralized $500 million fund, which was distributed to towns willing to revise their zoning in conformity with smart growth principles, Foy's resignation went into effect.[41] As a result, smart growth receded further into the background, having lost its tenuous executive support from Governor Romney and its vigorous leadership by program champion, Secretary Foy.[42]

As the foregoing events reveal, lack of executive support is salient to the climate change adaptation issue. Regardless of events that indicate its importance, if there is not strong, sustained, genuine interest and prioritization from the executive branch, the issue is less likely to develop or maintain momentum. For instance, although Governor Deval Patrick demonstrated an early commitment to climate change by signing the GWSA during his second year in office, the reason the particular adaptation aspect of the topic has never received the same level of interest or attention can be explained by examining the communications that took place during Hurricane Sandy.

In 2012, despite the damages caused by Hurricane Sandy in Massachusetts, and much more severe damage nearby in New York and New Jersey, Governor Patrick's office did not issue one press release containing the words "climate," "flood," "prepared," "resilient," or "adaptation" in the title.[43] Instead of using the storm's aftermath as an opportunity to serve as a leader on the topic of adaptation and communicating the need for us to make our communities more resilient, Governor Patrick's remarks did not go beyond stating that Massachusetts was "very, very fortunate" to avoid more severe damage.[44] During the storm, the Governor's focus was rightly on ensuring that the utility companies maintained and quickly restored power to customers. In the storm's aftermath, however, Governor Patrick missed a chance to raise the profile of climate preparedness and rally the support of businesses,

39. MacGillis, *supra* note 34.

40. *Id.*

41. *Id.*

42. Telephone Interview with Rob Garrity, *supra* note 32.

43. *See generally* Governor of Massachusetts, *Press Releases*, MASS.GOV, http://www.mass.gov/governor/pressoffice/pressreleases/ (last visited Dec. 9, 2012).

44. Brian Ballou et al., *Governor Deval Patrick Says 'fortunate' Massachusetts Avoided Major Hurricane Sandy Damage*, BOSTON.COM (Oct. 30, 2012, 3:37PM), http://www.boston.com/metrodesk/2012/10/30/hundreds-thousands-remain-without-power-across-massachusetts-state-officesreopen/sbPMblpCvBl2upgLn1KsYO/story.html.

organizations, and individuals.[45] Imagine if, in the weeks after Sandy, Governor Patrick had highlighted the catastrophic damage the storm caused to the transit system in New York City and had announced that his administration would be making it a high priority to ensure that the Massachusetts Bay Transportation Authority (MBTA) and other regional transit authorities throughout the state were taking measures to reduce their vulnerability to flooding. That sort of position, backed up by resources and sustained attention, could prompt increased activity throughout the Commonwealth.

A handful of political leaders have stepped in to fill the void. Within a month of Hurricane Sandy, U.S. Congressman Edward Markey and organizations such as the Environmental League of Massachusetts hosted a public event at Faneuil Hall. The purpose of the event was to highlight the catastrophic costs to Boston if climate change is left unchecked.[46] During the event, the Congressman stated, "Sandy was a warning of what the sea could do . . . if Sandy had hit Boston at high tide, five feet of water would have entered Boston. . ..in the wake of Sandy, we on the east coast hear the alarm."[47] In addition, lawmakers on the state level, such as State Senator William Brownsberger, whose District includes Back Bay, have indicated an intention to use policy to advance climate adaptation during the 2013-2014 legislative session.[48] As this article was going to press, Senator Brownsberger filed Senate Bill 344, titled *An Act creating a process to evaluate exposure to catastrophic flooding as a result of climate change*.)[49]

The deficiency of executive leadership on climate change adaptation is one of the key reasons the Commonwealth has lacked a sense of urgency to take action. With a heightened level of attention to the issue—perhaps driven by grassroots efforts, legislators, and agencies in the absence of gubernatorial initiative—key steps can help to accelerate the rate of progress.

45. *Id.*

46. Congressman Edward Markey, *What If Sandy Happened Here? Faneuil Hall Town Hall to Explore Climate Change Threat to Boston, New England* (Nov. 20, 2012), http://markey.house.gov/press-release/what-if-sandy-happened-here-faneuil-hall-town-hall-explore-climate-change-threat.

47. Edward Markey, U.S. Representative, Seventh Congressional District of Mass., Address at Faneuil Hall, Boston, Mass.: What If Sandy Happened Here?: Faneuil Hall Town Hall to Explore Climate Change Threat to Boston, New England (Nov. 25, 2012).

48. Meeting with William Brownsberger, Mass. State Senator, Second Suffolk & Middlesex District (Dec. 10, 2012).

49. The 188th General Court of the Commonwealth of Massachusetts, https://malegislature.gov/Bills/188/Senate/S344 (last visited Aug. 2, 2013).

V. A WAY FORWARD

With the Executive or other elected officials leading the way, or at least playing an active role, there are several steps that can be taken in Massachusetts to prepare for flooding. Potential steps may include a public awareness campaign, a plan for infrastructure and state property investments, and a plan to facilitate municipal action. To be effective, the state cannot act alone. It will take contributions from multiple levels of government, non-profits, businesses, and individuals for the state to make headway on this issue.

A. Launch a Public Awareness Campaign

A public awareness campaign that connects to people and their interests is critical for helping produce informed land use decisions on the individual and community level. Many of those involved in climate adaptation work believe that greater public awareness is essential to making headway.[50] For individuals and communities to embrace the investments and changes that will need to happen to improve climate resiliency, the public needs to understand the issue better, believe that the risks are likely to have a personal impact, and embrace a conviction that action is preferable to inaction.[51] In general, people do not tend to think that their property is going to get flooded, so denial has been a substantial barrier to the public taking flood risk seriously.[52]

As they have done with sustainability, universities can play a key role in increasing visibility for the issue and raising public awareness.[53] Many universities such as Columbia Law School and Georgetown Law already have climate change centers—with websites that are user-friendly and engaging, and interface with social media tools—offering quick ways for the public to spread information about reports and other resources.[54] In Massachusetts, work with scientists at University of Massachusetts Boston (UMB) and UNH has proven

50. Interview with Richard Zingarelli, Acting State Hazard Mitigation Officer & Nat'l Flood Ins. Program Coordinator, DCR Flood Hazard Mgmt. Program & Julia Knisel, Coastal Shoreline & Floodplain Manager, Mass. Office of Coastal Zone Mgmt. (Oct. 23, 2012).

51. *Id.*

52. *Id.*

53. Telephone Interview with Hubert Murray, Manager of Sustainable Initiatives, Partners HealthCare Inc. (Oct. 29, 2012).

54. Center for Climate Change Law, COLUMBIA LAW SCHOOL, http://web.law.columbia.edu/climate-change (last visited Dec. 9, 2012); Georgetown Climate Center, GEORGETOWN LAW SCHOOL, http://www.georgetownclimate.org/ (last visited Dec. 9, 2012).

fruitful and should be cultivated. Funds are needed, however, so that additional research and more sophisticated analysis can be conducted.[55] Especially in a time when community and state level budgets are being slashed, governments stand to benefit from partnering with institutes to take advantage of expertise and the potential for grant funded work that can deepen our understanding of the needs we face.

In addition to academia, several community-based non-profit organizations are seeking to increase the profile of climate change adaptation. For instance, the statewide non-profit Massachusetts Climate Action Network (MCAN) is dedicated to building local, grassroots power to bring climate change to the forefront of the public policy debate.[56] With several local chapters comprised of community members who tend to participate in multiple local boards and commissions, MCAN advocates for policies that advance mitigation and adaptation.[57] In addition, MCAN helps translate policies into meaningful, actionable opportunities for the people of the Commonwealth.[58] The Boston Harbor Association (TBHA) is another example of a non-profit organization playing an active role in raising awareness about flood risk and the expected adverse impacts of climate change.[59] In 2010, TBHA collaborated with scientists at UMB and UNH to develop a series of sea-level rise maps.[60] That same year, TBHA hosted a Sea Level Rise Forum with support from the Barr Foundation, which drew hundreds of participants.[61]

By working with scientists to conduct studies and produce maps to convey the level of risk for various parts of the city, as well as hosting events that bring together hundreds of people, non-profit organizations such as TBHA help to make the public aware of the issues. However, since 2010, TBHA's climate change adaptation work has not been as robust. Accordingly, TBHA and other organizations need to work to ensure that flood risk is part of the public dialogue. As this article was going to press, TBHA released *Preparing for the Rising Tide*, a report on Boston's vulnerabilities to rising sea levels which ex-

55. Telephone Interview with Paul Kirshen, *supra* note 13.

56. Email from Mass. Climate Action Network, *Moving Forward on Climate Together* (Nov. 30, 2012).

57. Telephone Interview with Rob Garrity, *supra* note 32.

58. *Id.*

59. *Climate Change Adaptation*, THE BOS. HARBOR ASS'N, http://www.tbha.org/climate-change-adaptation (last visited Dec. 10, 2012).

60. *Boston Harbor Sea Level Rise Maps*, THE BOS.HARBOR ASS'N, http://www.tbha.org/boston-harbor-sea-level-rise-maps (last visited Dec. 10, 2012).

61. *2010 Boston Harbor Sea Level Rise Forum*, THE BOS. HARBOR ASS'N, http://www.tbha.org/2010-boston-harbor-sea-level-rise-forum (last visited Dec. 10, 2012).

plores how commercial property owners and public agencies can prepare, available at http://www.tbha.org/preparing-rising-tide-report.

One organization that has generated attention for climate change adaptation recently is Partners HealthCare (Partners), which has demonstrated forward thinking with its new building projects.[62] In 2010, Partners broke ground on its building design for the Spaulding Rehabilitations Hospital in the Charlestown Navy Yard, and went above and beyond building requirements, creating a hospital that is well equipped to handle the expected impacts of climate change over the years.[63] For instance, in designing the hospital, Partners ensured that the windows would be operable to provide fresh air if the air conditioning goes down (as occurred at hospitals impacted by Hurricane Katrina). Additional measures taken by Partners in its design include: landscaping and pervious pavement that will help to absorb storm water; placing mechanical equipment on the roof to protect it from flooding; and, locating critical patient programs above the ground floor.[64] Hospitals are well situated to incorporate expected climate impacts into their planning because they tend to think in terms of a century, not just a budget cycle.[65] With leadership from the Director of Capital and Facility Planning, dedication from the Manager of Sustainable Initiatives, and encouragement from the City of Boston, Partners prioritized long-term financial stability over short-term savings.[66] Accordingly, the city and Commonwealth should further promote these types of initiatives by issuing and publicizing case studies to highlight concrete, pragmatic ways property owners can lead the way in resilient building practices.

To further encourage best practices, the Commonwealth should also engage with professionals in key industries such as planning. An efficient and effective way to achieve this is to strengthen connections with trade organizations such as the Massachusetts Chapter of the American Planning Association and the Massachusetts Association of Consulting Planners.[67] These organizations play a key role in supplying consultants to municipal Planning Boards.[68] Due to home rule,

62. Joan Wickersham, *Spaulding Rehab Puts Climate Change in Concrete Terms*, THE BOS. GLOBE (Apr. 20, 2012), http://www.bostonglobe.com/opinion/2012/04/19/spaulding-rehab-puts-climate-change-concrete-terms-preparing-for-great-flood/VIv8s4C42oWkFX0wFaVuiI/story.html.

63. Telephone Interview with Hubert Murray, *supra* note 53.

64. *Id.*

65. *Id.*

66. *Id.*

67. Telephone Interview with Rob Garrity, *supra* note 32.

68. *Id*.

municipalities in Massachusetts have substantial power to implement changes and make decisions that have implications for issues such as flooding.[69]

State government, working with a number of partners, needs to do more to make the public aware of climate change adaptation and why it is important. With a better understanding of the expected impacts of climate change, such as the increased risk of sea level rise and flooding, the public will be better equipped to participate in decision-making and may be more likely to support financial investments to improve resiliency.

B. Plan for Infrastructure and State Property Investments

Elected politicians often have a hard time committing to measures that involve near-term costs in exchange for long-term benefits.[70] One reason for this difficulty is the fact that it has been difficult to garner public support for projects whose benefits are uncertain and potentially distant.[71] To combat this quandary, infrastructure and property investments can be framed to influential parties as a choice between avoiding short-term pain and achieving more substantial long-term gain.[72] For instance, a study conducted in 2009 on the economic costs and benefits of natural-disaster preparedness revealed the long-term economic benefits that could be attained through investments in disaster preparedness—such as flood-control infrastructure—concluding that such investments offer a real compound annual rate of return of up to 40%; hence, it is clear that an economic argument can be made to take action.[73]

Accordingly, to prepare Massachusetts for the increased risk of flooding, Massachusetts needs to establish common scenarios and risks, command that resiliency be included in agency planning processes and investments, and then provide funding for implementation. This work needs to be done in conjunction with a variety of public and private actors, with independent authorities and quasi-public agencies playing a key role.

69. Exec. Office of Energy and Envtl. Affairs, *supra* note 2, at 29.

70. ALAN M. JACOBS, GOVERNING FOR THE LONG TERM: DEMOCRACY AND THE POLITICS OF INVESTMENT 28 (Cambridge Univ. Press 2011).

71. *See generally* Mireya Navarro, *New York Is Lagging as Seas and Risks Rise, Critics Warn,* N.Y. TIMES, Sept. 11, 2012, at A1, *available at* http://www.nytimes.com/2012/09/11/nyregion/new-york-faces-rising-seas-and-slow-city-action.html?pagewanted=all.

72. JACOBS, *supra* note 70, at 31.

73. *Id. at 37.*

C. Conduct Vulnerability Assessments

While Massachusetts does have maps indicating how various scenarios of sea level rise will impact certain parts of the state, many scientists and bureaucrats feel more analysis is needed to have a comprehensive picture of the risks we face. For instance, global climate models need to be downscaled to reflect the particular impacts that Massachusetts is expected to experience.[74] Through monitoring and modeling, scientists can track climate trends and simulate climate change scenarios.[75] The "bathtub" methodology that has been used in Massachusetts so far fails to take into account the wide variety of factors that affect the movement of floodwaters resulting in local differences in extent of flooding.[76] However, scientists are in the process of seeking grant funding to enable them to conduct more sophisticated, dynamic analyses.[77] The information provided by additional studies will be used to identify key vulnerabilities, such as infrastructure, that are highly susceptible to flooding.[78] In turn, a combination of public and private actors responsible for addressing the vulnerable resources will need to develop strategies for action.[79]

Some agencies, such as the Boston Water and Sewer Commission, are already utilizing consultants to help identify climate change strategies.[80] Others, however, seem to be getting left behind. For instance, the Massachusetts Port Authority (Massport), which operates facilities such as Logan Airport, has not yet conducted an assessment of potential costs of inaction.[81] Massport officials are hopeful that under the leadership of new CEO, Tom Glynn, the strategic planning effort will emphasize climate change issues and lead to adaptation being included in design and construction guidelines.[82]

Through legislation, Massachusetts could require EOEEA to develop a set of emission scenarios so that there is consistent information

74. Exec. Office of Energy and Envtl. Affairs, *supra* note 2, at 26-27.

75. *Id.*

76. *Flood Plain Scenario- Central Range Sea Level Rise (2020/2050/2080)*, NYC OPEN DATA, https://nycopendata.socrata.com/Environmental-Sustainability/Flood-Plain-Scenario-Central-Range-Sea-Level-Rise-/mu44-3ky4/about (last visited Dec. 10, 2012).

77. Telephone Interview with Paul Kirshen, *supra* note 13.

78. Email from Ellen Douglas, Assistant Professor of Hydrology, Hydromorphology, Water Resource Management, Environmental, Earth, & Ocean Sciences, Coll. of Science & Mathematics, Univ. of Mass. Boston (Nov.19, 2012).

79. *Id.*

80. *Id.*

81. Telephone Interview with Andrew Hargens, Senior Project Manager, Econ. Planning & Dev. Dep't, Mass. Port Auth. (Nov. 9, 2012).

82. *Id.*

across agencies and a uniform framework.[83] The scenarios would describe future potential conditions, so as to support decision-making under conditions of uncertainty.[84] For instance, California has already developed assessments on climate change that explore local and statewide vulnerabilities to climate change, with a focus on opportunities for taking action to reduce climate change impacts.[85]

D. Issue Requirements for State Agencies

Legislation could also mandate that state agencies and quasi-governmental agencies utilize a set of climate scenarios (to be developed by EOEEA) to conduct vulnerability assessments and create adaptation plans.[86] The legislation could compel the agencies to submit the assessments to EOEEA and use them to inform agency planning;[87] this could be especially valuable for certain agencies such as MassDOT, Massachusetts Water Resources Authority, and DPH.

Another potential action is for EOEEA to revise the Massachusetts Environmental Policy Act (MEPA) to incorporate minimum standards.[88] For instance, in Maine, it is required that developers plan for two feet above the present 100-year flood.[89] MEPA requires that state agencies study the environmental consequences of their actions and take all feasible measures to avoid, minimize, and mitigate damage to the environment.[90] State officials are currently considering options for revising MEPA, which could include simply requiring project proponents to answer certain questions about their plans, or a higher level of control by mandating certain adaptation related measures.[91] It is also possible that the Commonwealth could start by only issuing requirements for certain types of projects, such as hospitals, which provide vital public health and emergency services.[92]

83. Meeting with William Brownsberger, *supra* note 98.

84. Climate Program Office, *Global Sea Level Rise Scenarios for the U.S. National Climate Assessment*, 1 (2012), http://www.cpo.noaa.gov/reports/sealevel/NOAA_SLR_r3.pdf.

85. *California Climate Change Adaptation*, CA.GOV, http://www.climatechange.ca.gov/adaptation/(last visited Dec. 12, 2012).

86. Meeting with William Brownsberger, *supra* note 48.

87. *Id.*

88. Telephone Interview with Paul Kirshen, *supra* note 13.

89. *Id.*

90. Exec. Office of Energy & Envtl. Affairs, *About MEPA*, MASS.GOV, http://www.mass.gov/eea/agencies/mepa/about-mepa/ (last visited Dec. 11, 2012).

91. Meeting with Kathleen Baskin, Dir. of Water Policy, Exec. Office of Energy and Envtl. Affairs (Dec. 10, 2012).

92. *Id.*

E. Fund Priority Projects

It is important for the state to have a sense of which projects are immediately ready for construction that will protect people and infrastructure. The Implementation Advisory Committee Adaptation Subcommittee is just getting started on this endeavor, reaching out to various agencies regarding their priority adaptation-related projects.[93] This is urgent work that deserves attention from commissioners and secretaries.

One example of an agency that is quite vulnerable and could benefit from near-term funding is the MBTA, which plays an important role in the economy of eastern Massachusetts, accommodating 1.4 million passenger trips per weekday.[94] The system already has a history of vulnerability to flooding, as evidenced by the 1996 flooding of the Kenmore Station.[95] Although MBTA officials say that the flood—which called for $40 million in repairs—served as a "wake-up call," little has since been done to make the MBTA more prepared for the next big flood.[96] More than 15 years later, a feasibility study about one of the top concerns—tunnel vulnerability for the Green and Blue lines—is being conducted.[97] Federal agencies, such as the U.S. Department of Transportation Federal Transit Administration (FTA), have helped to foster an industry-wide conversation about public transportation and climate change adaptation. MBTA officials are hopeful that federal actions, such as the Transportation Authorization Bill in 2014, will have a strong focus on encouraging adaptation for transit agencies.[98] The MBTA has also started including climate change in its asset management program; as the agency inventories its equipment and identifies needs, considerations such as the potential need for larger pumps or higher bridges are being included.[99]

Agency staff are concerned that feasibility studies and the like are not a worthwhile use of time if there is not a change to the agency's

93. *Id.*

94. Morgan Rousseau, *Despite fare hike, MBTA Ridership Continues to Grow*, METRO, (Oct. 31, 2012), http://www.metro.us/boston/local/article/1155369—despite-fare-hike-mbta-ridership-continues-to-grow.

95. Telephone Interview with Andrew Brennan, Director of Envt'l Affairs, Mass. Bay Transp. Auth. (Nov. 30, 2012).

96. Adam Gaffin, *MBTA Cuts Riverside Service to Protect Kenmore Station from Muddy River Floodwaters*, UNIVERSAL HUB (Mar.14, 2010, 10:14PM), http://www.universalhub.com/2010/mbta-throws-towell-cuts-riverside-service-protect; Telephone Interview with Andrew Brennan, *supra* note 95.

97. Telephone Interview with Andrew Brennan, *supra* note 95.

98. *Id.*

99. *Id.*

funding that would allow for necessary projects to be implemented:[100] "We worry that [things like planning for flood gates on the portals of the green line] are just an academic exercise."[101] For instance, in New York City, years before Hurricane Sandy, studies warned that storm surges could paralyze transportation in and around Manhattan and that inundated subway tunnels could cause billions of dollars of economic loss.[102] After a 2007 rain storm, the Metropolitan Transportation Authority (MTA) put $34 million into improvements—such as elevating some ventilation grates nine inches above sidewalks and building steps that go up, before going down—at stations highly susceptible to flooding.[103] While these measures may have been sufficient for certain weather events, they were not enough to keep the system running or prevent widespread economic loss brought on by Hurricane Sandy, which left the MTA with $5 billion of damages.[104] Thus, without major investments, Boston is likely to suffer a similar fate should it be hit with a storm the way Sandy hit New York City.

F. Facilitate Municipal Action

At times when infrastructure fails to meet our needs, our dependence on it is highlighted and we ought to pause to consider how to proceed in a sensible, cost-effective way so that our access in the future is not so severely impacted. Governments are increasingly looking at post-storm rebuilding as an opportunity to do things differently in order to move forward. As a home rule state, Massachusetts municipalities are a key player in shaping development.[105] While land-use planning is one of the most substantial ways communities can have an impact,[106] they face a number of challenges and can benefit from federal and state government support. Approximately half of cities participating in a 2012 worldwide study conducted by the Massachusetts Institute of Technology reported that they are either in the prepara-

100. *Id.*

101. *Id.*

102. Navarro, *supra* note 71.

103. *Id.*

104. Kate Hinds, *Totaling Sandy Losses: How New York's MTA Got to $5 Billion*, WNYC, (Nov. 27, 2012, 3:10PM), http://www.wnyc.org/blogs/transportation-nation/2012/nov/27/totalling-sandy-losses-how-new-yorks-mta-got-to-5-billion/.

105. Exec. Office of Energy & Envtl. Affairs, *supra* note 2, at 29.

106. Telephone Interview with Andrew Brennan, *supra* note 95.

tory or initial planning stages of adaptation planning;[107] this study demonstrates an opportunity for federal and state governments to provide support so that cities can catch up and get closer to actual implementation. Thus, Massachusetts should help its communities take advantage of available tools, lend support through funding, and use mandates to foster change.

G. Municipalities as Key Players

During a storm, government officials tend to focus on ensuring safety and availability of utilities.[108] After a storm, the focus has traditionally been on cleaning up debris and getting things back to how they were through rebuilding key infrastructure, homes, and businesses.[109] However, there are signs that rebuilding practices are starting to change.

In the wake of Hurricane Sandy, the rebuilding process is being looked at by many as an opportunity to think prospectively and take proactive instead of reactive measures to minimize damage caused by the next major storm.[110] Because the infrastructure that was built decades ago was not designed to stand up to the types of weather events we expect to see with greater frequency and intensity in the coming years, there is a growing realization that we need to rebuild with an emphasis on resiliency.[111] Building or repairing structures to be climate change resilient, is referred to as "here and now" action by climate expert Paul Kirshen of UNH.[112]

Through zoning regulations, communities have substantial power in deciding where and how development can occur.[113] In some cases, refraining from rebuilding as close to the coast may be the most

107. JoAnn Carmin et al., *Progress and Challenges in Urban Climate Adaptation Planning: Results of a Global Survey*, MASS. INSTITUTE OF TECHNOLOGY, 14 (2012), http://web.mit.edu/jcarmin/www/urbanadapt/Urban%20Adaptation%20Report%20FINAL.pdf.

108. Governor Deval Patrick, *Preparations Underway for Potential Impact of Hurricane Sandy*, MASS.GOV (Oct.26, 2012), http://www.mass.gov/governor/pressoffice/pressreleases/2012/20121026-preparations-for-hurricane-sandy.html.

109. Geoff Mulvhill, *Hurricane Sandy: New Jersey Rebuilding Ahead of Thoughtful Decisions?*, THE HUFFINGTON POST (Nov. 25, 2012, 1:25 PM), http://www.huffingtonpost.com/2012/11/25/hurricane-sandy-new-jersey-rebuild_n_2188025.html.

110. E. Robert Thieler et al., *What's Next After Superstorm Sandy?* CNN, (Nov. 10, 2012, 12:11 PM), http://www.cnn.com/2012/11/10/opinion/thieler-superstorm-sandy/index.html.

111. *Rebuilding After Natural Disasters: Harvard Panel Explores Policy Implications Post-Hurricane Sandy*, THE HUFFINGTON POST (Dec. 10, 2012, 10:14 AM), http://www.huffingtonpost.com/2012/12/10/rebuilding-natural-disaster-harvard_n_2258961.html.

112. Telephone Interview with Paul Kirshen, *supra* note 13.

113. Robin Kundis Craig, *A Public Health Perspective on Sea-Level Rise: Starting Points for Climate Change Adaptation*, 15 WIDENER L. REV. 521, 540 (2010).

cost-effective and safest decision.[114] As they seek to minimize future damage, coastal communities in particular should adopt siting and construction restrictions for infrastructure—such as power plants, chemical factories, waste treatment and disposal facilities, sewage treatment plants, and coastal septic systems—possibly to be accompanied by a move away from the ocean.[115] In addition, communities and agencies can engage in a "prepare and monitor" approach, whereby they protect existing infrastructure that is not currently threatened, but will be in a couple of decades.[116] This strategy provides a way for communities to do the planning now, while holding off on the physical infrastructure investments until they are necessary.[117]

H. Challenges Facing Municipalities

Communities face several challenges when it comes to adaptation planning. A recent survey identified the following obstacles:

- Accessing accurate scientific data,
- Obtaining funding for adaptation,
- Incorporating adaptation into existing work,
- Stimulating interest among businesses,
- Allocating staff time,
- Reallocating existing resources to adaptation,
- Linking to the international community,
- Communicating the need for adaptation to elected officials, and
- Garnering commitment to adaptation from political decision-makers.[118]

It is not realistic to expect each of our communities to overcome these challenges on their own. State government should take the lead in helping communities address these challenges, by connecting them with tools, providing funding, and issuing mandates. Federal government policy changes, for instance by the Federal Emergency Management Agency (FEMA), are also expected to serve as a major driver for shifting local practices.

114. Thieler et al., *supra* note 110.
115. Craig, *supra* note 113.
116. Telephone Interview with Paul Kirshen, *supra* note 13.
117. *Id.*
118. Carmin et al., *supra* note 107, at 20.

I. State Support for Municipalities

1. Connect with Tools

There are a number of tools available to communities about which they may be unaware or only minimally engaged. Massachusetts should encourage more communities to take advantage of existing resources provided by The Climate Resilient Communities Program, including the Adaptation and Database Planning Tool (ADAPT), a standardized adaptation planning process for communities.[119] ADAPT provides a framework for the user to assess community vulnerabilities, establish resiliency goals, and develop effective strategies that work with existing local planning efforts.[120]

The Commonwealth should build off the success of the Storm Smart Coasts (SMC) program and work to involve more communities.[121] The SMC program is designed to assist coastal communities in addressing the challenges arising from storms, floods, sea level rise, and climate change; it also provides various tools for coastal floodplain management.[122] If additional funding is obtained, Massachusetts will be able to scale up the program and increase impact.[123] Program administrators hope to help communities learn from each other and adopt and adapt practices that have worked well elsewhere.[124]

Internationally, there are examples of programs that craft downscaled global climate models so that communities have information that is place-specific. Massachusetts would be wise to follow the lead of Climate Futures for Tasmania, which provides fine-scale climate information for Tasmania by downscaling six global climate models with two emission scenarios (a high emissions scenario and a lower emissions scenario) to generate climate information through 2100.[125] By doing so, Massachusetts could facilitate planning on the

119. *Eight Local Governments First to Get Climate Adaptation Help,* ENV'T NEWS SERVICE (Nov. 18, 2010), http://www.ens-newswire.com/ens/nov2010/2010-11-19-091.html.

120. *Id.*

121. Meeting with Bruce Carlisle, Director, Office of Coastal Zone Mgmt. (Dec.10, 2012).

122. Mass. Office of Coastal Zone Mgmt., *Storm Smart Coasts- Helping Communities and Homeowners with Coastal Erosion, Flooding, and Storm Damage*, MASS.GOV, http://www.mass.gov/czm/stormsmart/(last visited Dec.12, 2012).

123. Meeting with Carlisle, *supra* note 121.

124. *Id.*

125. Corney SP et al., *Climate Futures for Tasmania: Climate Modelling Technical Report*, ANTARCTIC CLIMATE & ECOSYSTEMS COOP. RESEARCH CTR. (2010), http://www.dpac.tas.gov.au/data/assets/pdf_file/0015/151125/CFT_-_Climate_Modelling_Technical_Report.pdf.

local level because all communities would be able to work from a common set of scenarios.

State elected officials and bureaucrats can also encourage municipalities to take advantage of technical assistance offered by regional planning agencies, such as the Metropolitan Area Planning Council (MAPC), which has hosted regional workshops on coastal adaptation.[126] MAPC is currently developing a regional climate change adaptation strategy for the 101 cities and towns within its region of eastern Massachusetts.[127] With funding from federal Sustainable Communities, MAPC is partnering with the Tellus Institute to conduct a vulnerability analysis to reveal high-level risks—such as population demographics—that may be disproportionately impacted by flooding and other impacts of climate change.[128] The study also involves developing goals and objectives, which will be incorporated into the organization's long-range Metro Future regional plan.[129] For 2013, MAPC also has plans to reach out to communities to raise awareness about climate change adaptation issues.[130] Accordingly, to maximize the number of engaged communities, elected officials can play a role by encouraging constituents to take part.

2. Provide Funding

The state should provide grants for projects that incorporate adaptation planning; this would not necessarily require new grant programs or additional funding. One option would be to add an adaptation-related eligibility criterion to the Mass Works Infrastructure Program, which issues millions of dollars of grants each year to support economic development and housing creation.[131]

In addition to providing funding to communities, the state can help communities by raising awareness about federal and private grant opportunities. The state could create and manage an online clearinghouse of climate adaptation grant opportunities, partner with a non-profit to do so, or, at a minimum, promote the existing federal government grant website—www.grants.gov. This type of resource

126. *South Shore Coastal Adaptation Workshop*, METRO. AREA PLANNING COUNCIL, http://www.mapc.org/events/2011/oct/27 (last visited Dec.11, 2012).

127. Telephone Interview with Martin Pillsbury, *supra* note 22.

128. *Id.*

129. *Id.*

130. *Id.*

131. Exec. Office of Hous. & Econ. Dev., *MassWorks Infrastructure Program*, MASS.GOV, http://www.mass.gov/hed/economic/eohed/pro/infrastructure/massworks/ (last visited Dec. 20, 2012).

can help connect communities with opportunities such as the National Oceanic and Atmospheric Administration Sea Grant, which is making available up to $1 million for a national competition to fund climate adaptation efforts for FY 2012-2013 as part of an overall plan to augment climate adaptation in coastal communities.[132] The Sea Grant requires matching funds, so perhaps Massachusetts could provide matching funds for a certain number of projects or help communities connect with other funding sources.[133]

3. Issue Mandates

To impact how structures are built throughout Massachusetts, the state could add a section to the State Building Code to mandate certain resiliency measures. The State Building Code is aimed at protecting public safety by ensuring that buildings that are intended for occupancy are structurally sound; built with appropriate materials; have adequate exits for fire safety; promote energy conservation; and have adequate sanitary facilities.[134] The building code is written by the State Board of Regulations and Standards, and is managed locally by board-certified building inspectors.[135] Thus, changes to the building code are one way Massachusetts could enhance preparedness, without having to allocate additional public funds.[136]

In addition to state mandates, federal policies are expected to serve as drivers for change on the local level. The Biggert-Waters Flood Insurance Reform Act of 2012,[137] signed into law and passed by the Congress as part of the Moving Ahead for Progress in the 21st Century Act (H.R. 4348) in June 2012, has a number of provisions that could advance climate preparedness.[138] FEMA is currently in the process of updating flood insurance maps from the 1980s, but to date, FEMA has

132. *NOAA Sea Grant Community Climate Adaptation Initiative 2011*, GRANTS.GOV, http://www07.grants.gov/search/search.do?oppId=103673&mode=VIEW (last visited Dec.11, 2012).

133. *Id.*

134. Mass. Office of Coastal Zone Mgmt., *Massachusetts State Building Code*, MASS.GOV, http://www.mass.gov/czm/permitguide/regs/buildingcode.htm (last visited Dec. 11, 2012).

135. *Id.*

136. Telephone Interview with Robert Stowe, Exec. Director, Harvard Envtl. Econ. Program; Manager, Harvard Project on Climate Agreements (Nov. 20, 2012).

137. Biggert-Waters Flood Insurance Reform Act of 2012, Pub. L. No. 112-141, 129 Stat. 916.

138. Georgetown Climate Center, *Analysis of the Flood Insurance Reauthorization and Reform Law (2012)*, GEORGETOWN LAW, (Aug. 1, 2012), http://www.georgetownclimate.org/analysis-of-the-flood-insurance-reauthorization-and-reform-law-2012.

based its analysis on historical data, which is increasingly problematic due to the growing likelihood of extreme weather and future sea level rise caused by climate change.[139] The Biggert-Waters Flood Insurance Reform Act allows FEMA to update Flood Insurance Rate Maps (FIRMs) to include "relevant information and data" on flood hazards caused by land-use changes and "future changes in sea levels, precipitation, and intensity of hurricanes."[140] It also phases out subsidies for many types of properties, including severe repetitive loss properties and second homes.[141]

If insurance rates are set based on predicted future damages, it will be less financially attractive to build in flood zones.[142] With storms like Hurricane Sandy causing severe damage to areas that are not in flood zones—and properties that are not flood-ready or insured for floods—FEMA officials are increasingly stating the need to make changes to how the FEMA maps are crafted.[143] The agency is even looking to update the maps sooner than planned in areas recently hit hard by Hurricane Sandy that call for increases in building elevations.[144] FEMA's actions, as well as practices adopted by reinsurance agencies such as Munich-re, are expected to have widespread implications for development and rebuilding throughout the country.[145]

CONCLUSION

Massachusetts is in danger of experiencing billions of dollars of damage and loss of life as a result of floods. This risk is only going to increase in the coming years, due to climate change impacts. The Commonwealth needs to ramp up its resilience efforts to avoid the magnitude of damage that Hurricane Sandy caused in New York City in October 2012. With leadership from the executive and legislative branches, the state can take many steps to be proactive about the issue. The state should help communities engage with available tools,

139. Juliet Eilperin, *Flood Risk will Rise with Climate Change, Experts Say*, THE WASH. POST (Nov. 1, 2012), http://articles.washingtonpost.com/2012-11-01/national/35507223_1_flood-insurance-flood-risk-climate-change.

140. Georgetown Climate Center, *supra* note 138.

141. *Id.*

142. Telephone Interview with Paul Kirshen, *supra* note 13.

143. Georgetown Climate Center, *Washington Post: Flood Risk will Rise with Climate Change, Experts say*, GEORGETOWN LAW (Nov. 2, 2012), http://www.georgetownclimate.org/washington-post-flood-risk-will-rise-with-climate-change-experts-say.

144. Associated Press, *FEMA Likely to Expand Flood Zones Along N.J. Coast in Wake of Sandy*, INSURANCE JOURNAL (Dec. 9, 2012), http://www.insurancejournal.com/news/east/2012/12/09/273237.htm.

145. Telephone Interview with Robert Stowe, *supra* note 136.

lend support through funding, and use mandates to foster change. In addition, for Massachusetts to become more resilient, the federal government and communities, with involvement from a broad group of stakeholders, will need to step up their efforts and coordination. With broad engagement from the public and private sectors, we can develop plans and practices that safeguard our communities against the catastrophic impacts of flooding.