EXECUTIVE SUMMARY

Governance for a Changing Climate

Adapting Boston's Built Environment for Increased Flooding

UMASS BOSTON Sustainable Solutions Lab

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1 *Ready or Not…*

If a storm the magnitude of Superstorm Sandy or Hurricane Florence hit the Boston region, would we be ready? In New York, New Jersey, and Connecticut, 65 deaths were directly attributed to Superstorm Sandy.[1] In addition to the loss of human life, there were huge financial impacts. In New York City, this single event caused $19 billion worth of losses, crippling New York's public transit system, shutting down its energy systems, damaging commercial, residential, and industrial properties, and reshaping communities. An estimated $32.8 billion was required for restoration across the state.[2] This triggered a broad range of public sector responses. One was the creation of the NYC Mayor's Office of Housing Recovery Operations, whose Build It Back program has spent over 6.5 years serving 99% of the approximately 12,500 impacted households. Another was the establishment of the Governor's Office of Storm Recovery (GOSR) in June 2013 to coordinate statewide recovery efforts for Superstorm Sandy (October 2012), Hurricane Irene (August 2011) and Tropical Storm Lee (September 2011).[3]

Damage to South Ferry 1 subway station in New York City after Superstorm Sandy.

The efforts in New York demonstrate that it is expensive and time consuming to depend on ad-hoc measures to recover from damaging coastal storms. They also demonstrate that existing modes of governance did not lead to New York being resilient in the face of these kinds of events. As climate change makes damage from storm surge, extreme precipitation, and sea level rise more and more likely, it makes even less sense to address it reactively. If we do not prepare in advance for climate change, Boston is also very likely to experience high losses in terms of impacts to people, communities, property, infrastructure, and the economy (Figures 1 and 2).

Boston has the ability to build up its climate resilience in a proactive, thoughtful manner, without the burden of simultaneously recovering from a major catastrophe. We can do this because the City has made the effort to determine what we are up against. The Climate Ready Boston (CRB) report[4] has identified the location and likelihood of various climate change impacts and many of the steps that we need to take to become resilient in the face of those impacts. In addition, the City has undertaken detailed resilience planning efforts in the most at-risk neighborhoods, including East Boston, Charlestown, South Boston and, starting in late 2018, Downtown and Dorchester. These resilience plans give us a detailed sense of the nature and scope of the investments that we will need to make to protect these parts of the city from future climate impacts.

One of the recommendations of the CRB report is to evaluate governance structures for managing the implementation, operations, and maintenance of adaptation actions. This report responds to that recommendation by outlining possible paths forward to support

wise governance for adaptation efforts that will increase our resilience. One of the challenges is that Boston cannot create a resilient future in isolation, and for this reason governance beyond the local level—including regional, state, and federal governance—is considered in this report.

While the ultimate purpose of adaptation is to ensure the long-term well-being of people and communities vulnerable to all aspects of climate change, similar to the companion report, "Financing Climate Resilience," the focus here is on governance aimed at reducing the physical risks to the built environment of increased flooding, due to both sea level rise and increased precipitation.

This report champions an approach that combines renovating and improving tools that we already have, and crafting innovative new tools of governance that are commensurate with the urgent and complex nature of climate change.

2 *Governance*

WHAT IS GOVERNANCE?

Governance extends far beyond "the government." It involves the processes that enable people and institutions to interact and societies to plan, make decisions, and implement activities. Governance includes all of us—public agencies, businesses, civic and academic organizations, and residents—and the rules and norms that shape who we are and what we do. Legal and social institutions, including mindsets, habits, and expectations, shape markets, incentives, investments, communities, and a host of other individual organizational choices. Governance refers to how things are done, rather than what is done.

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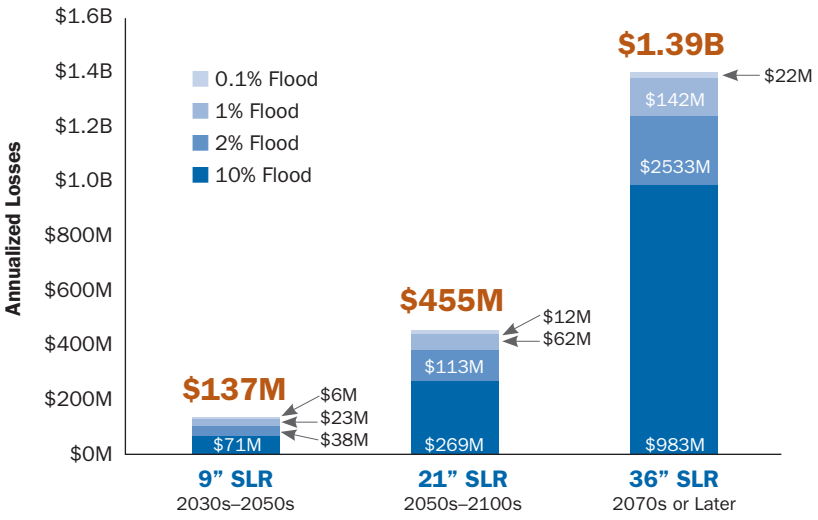
FIGURE 1

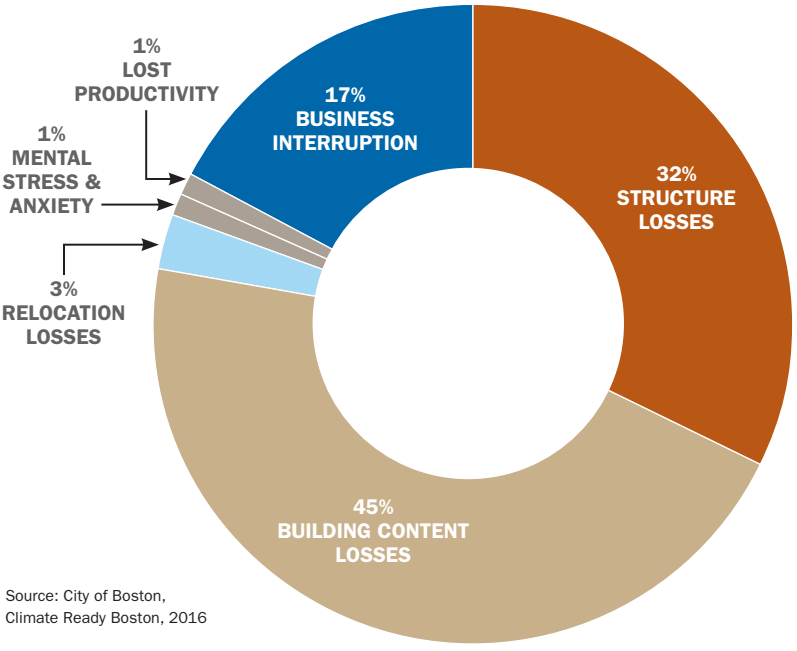
City of Boston Projected Annualized Losses



Source: City of Boston, Climate Ready Boston, 2016

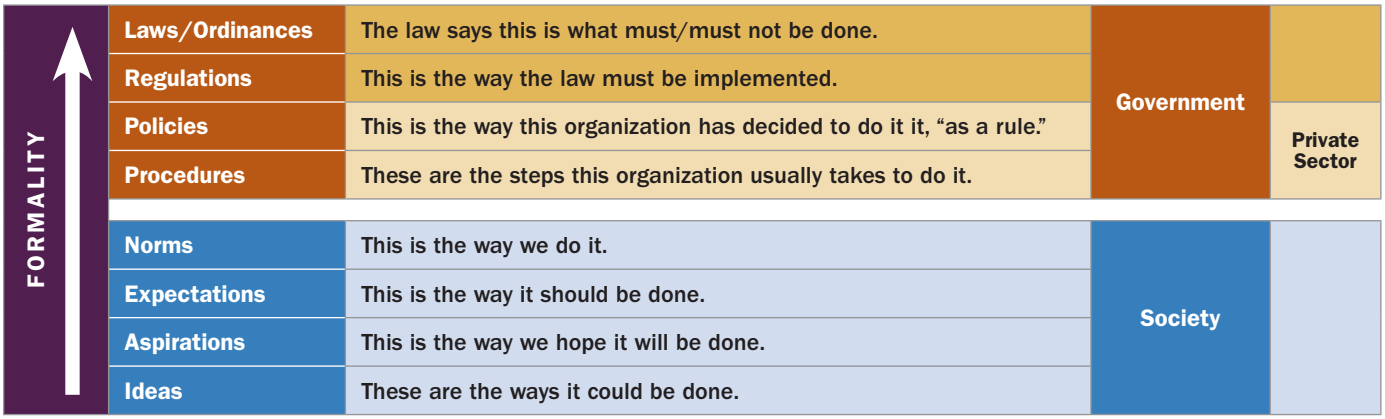
FIGURE 2

City of Boston Annualized Losses: 36 inch Sea Level Rise Condition



Source: City of Boston, Climate Ready Boston, 2016

FIGURE 3
Governance Continuum



Source: VHB

Governance can be thought of as a continuum, from using less formal concepts and tools within the realm of society, to using more formal ones in the private and government sectors (Figure 3).

Effective governance requires the coordinated actions of three types of actors: public agencies, private for-profit enterprises, and private non-profits. Each plays a different role, and each is necessary. In this report, we focus on the role that public agencies, a.k.a. the government, play in governance for a changing climate.

While many governance problems are not unique to the realm of climate change, the scope, pace, and significance of climate change may warrant unique solutions.

CHANGING CLIMATE, CHANGING GOVERNANCE

In the past, we managed our societies based on the assumption that the climate is static, because for thousands of years it generally was. But around the middle of the last century, human activity began to have dramatic impacts on the Earth's landscape and systems, driving significant atmospheric, chemical, physical, and biological changes.[5] The advances resulting from these activities have allowed many of us to experience high levels of comfort and economic opportunities in our everyday lives. However, these endeavors have also permitted us to become more ensconced in our human-created world and less cognizant of our connection to the natural world.

It is clear that the climate is not in fact static and has not been for some time. We now need to adjust our manner of governing to that reality. There is a need, therefore, to advocate for approaches to governance capable of confronting landscape-scale problems in a manner that is flexible and responsive enough to adjust to complex, often unpredictable feedback between social and ecological system components, such as those anticipated to result from a changing climate.

NECESSARY FUNCTIONS FOR RESILIENT GOVERNANCE

In the context of improving the resilience of the built environment to increased flooding due to both sea level rise and increased precipitation, our governance system needs to provide the following functions:

1. Generate, communicate, and integrate complicated, rapidly evolving **information**;
2. Conduct **outreach** and develop **plans** that engage a variety of stakeholders;
3. Develop and apply transparent, objective, and equitable criteria for project **prioritization**;
4. Create and implement **laws**, **regulations**, and **policies** that are equitable and provide both stability and flexibility while promoting a resilient built environment;
5. Develop the capacity to design, finance, construct, and maintain a system of shore-based **district-scale flood protection** measures;
6. Develop the capacity to design, finance, construct, and maintain **infrastructure** that will continue to function in a changing climate; and
7. Institutionalize flexibility through **monitoring** and **evaluating** outcomes.

Governance and Equitable Adaptation

In April 2016, the Georgetown Climate Center and the Urban Sustainability Directors Network (USDN) convened a workshop bringing together nearly 50 thought leaders on equity and climate adaptation. Participants found that "achieving equitable adaptation outcomes will require an inclusive process that gives community members, especially low-income residents and people of color, the opportunity to envision and set adaptation priorities and influence investments, policies, and programs pursued in their communities. In many cities, a long history of mistrust between public agencies and community members will need to be addressed before and throughout the process for collaborative planning to be successful. This will require a long-term commitment to relationship building that is institutionalized and not project-specific. [Furthermore,] addressing climate change and equity will involve a long process of experimentation and creativity."[6]

3 *Tools*

OUR TOOLBOX

Various governance tools at the local, regional, state, and federal levels are available to encourage implementation of flood adaptation measures on private land.[7] These tools define the set of actors that will be part of the cast during the crucial implementation process that follows program enactment, and they determine the roles that these actors will play.[8]

Public governance tools include laws, ordinances, regulations, policies, and plans. Laws are written statutes, passed by either the U.S. Congress or state legislatures. Regulations are standards and rules adopted by administrative agencies that govern how laws will be interpreted, implemented, and enforced. Regulations often have the same force as laws, since, without them, regulatory agencies wouldn't be able to enforce laws. An ordinance is simply a law enacted by a municipality. A policy is a statement of intent to guide decisions and achieve rational outcomes and is implemented as a procedure or protocol, but it is not binding law. A plan is the product of a public process whereby the land use, economic, environmental, and social trends are analyzed, and an optimal land use and infrastructure vision may be established. Plans can be adopted as binding rules or regulations, but most often serve as guidance documents that contain recommendations for implementation measures such as adopting ordinances and regulations, implementing projects, and conducting additional studies. Each of these tools has an important role in guiding climate adaptation actions.

The 22 public governance tools described in the full report are organized by level of

governance—local, regional, state, and federal. However, they could also be organized by function or when they become applicable during the development process. For example, the Massachusetts Environmental Policy Act (a state law) and Article 80 Development Review (part of the local Zoning Code) both require development impact review. Other Zoning Code articles, Chapter 91, and the Wetland Protection Act (both state laws) are part of the discretionary approval process. The former are early stage public reviews, rather than approvals, that have broad content areas and wide public participation. Their purpose is to inform agency decision making. As such, they are highly useful for addressing climate resilience in a project-specific fashion. In contrast, the discretionary approvals focus on specific subject areas and are subject to standards that originated before climate change was a policy focus. They often present more limitations in a changing climate.

There are also many private sector governance tools that can be used to implement climate change adaptation measures. The full report focuses on two additional legal tools that can have a prominent impact on both the public and private sectors' implementation of flood adaptation measures: lawsuits and professional standards of care.

4 *Climate Ready Boston Overview*

CLIMATE READY BOSTON INITIATIVES

The CRB Report is a planning document, and appropriately explores the problems related to climate change and provides recommendations for implementation measures that will help the city manage those problems. There are recommendations for education and outreach, which are needed to create the political will to accomplish the climate change adaptation goals; developing detailed neighborhood plans; and increasing coordination and adapting regulations to lower the barriers to climate adaptation. The CRB report does not outline initiatives focused on how to finance climate resilience projects, nor does it clearly establish the parties responsible or governance necessary for building or maintaining specific infrastructure projects. This should not be seen as a shortcoming, as the details around financing and implementation are not typically identified in city-wide planning documents. In addition, the CRB report does not discuss the role of ongoing monitoring and evaluation of climate adaptation activity outcomes.[9]

Street flooding at Neponset Circle in Dorchester, Boston. March 2018.

While the CRB report is an effective planning document, it is important to note that in order to create a climate resilient city and region, we must do more than implement only those initiatives recommended in the report. It will be essential to build on the success of Climate Ready Boston and the strategic planning that was done as we move toward implementation and building new infrastructure.

5 Recommendations

FROM PLANNING TO ACTION—KEY RECOMMENDATIONS

To renovate or innovate—do we improve what we have or create something new?—is a question that occurs in many fields that experience rapid changes, such as public health, technology, and information/data systems. In this report we argue that an acceptable level of resilience can be achieved only if Boston is able to do both: renovate and innovate. There are many paths forward on how to achieve our goals. As a result, we recommend that the Governor of Massachusetts and the Mayor of Boston establish a joint commission to explore the options and develop a strategy. We also recommend that the legislature take a leadership role in this effort in order to evaluate the different options available to the Commonwealth as we attempt to address this dynamic challenge. As a starting point for these groups, we have a number of specific recommendations and have explored various implementation options.

Our major recommendations include:

- Reform Existing Tools
- Establish an Infrastructure Coordination Committee
- Convene a Climate Research Advisory Organization
- Establish Governance for District-Scale Coastal Flood Protection

For the second through fourth recommendations above, several options are presented. In some cases, the options are not mutually exclusive and could be pursued simultaneously.

> "It may not be sufficient to restore or maintain historical conditions; sustainability might require creating and maintaining new environments as well."
>
> — EPA's Climate Ready Estuaries Program, 2012

REFORM EXISTING TOOLS

Chapter 3 provides a suite of ideas for increasing resilience by reforming the tools described in that chapter. Changes need to be made so we can do the following:

- Build new buildings that are resilient to the flooding conditions that they are expected to encounter during their design life;
- Adapt existing buildings to improve their resilience to existing and future flooding conditions;
- Construct coastal flood protection measures at the district scale to protect multiple buildings, neighborhoods, and infrastructure;
- Continue to meet community goals such as supporting a vibrant pubic realm;
- Create co-benefits related to stormwater management and sustainability;
- Improve regional planning and coordination; and
- Provide legal support for the consideration of risk and resilient design.

Below we identify our top priorities for reforming existing tools. Implementation of these recommendations, which would need to take place on the local, state, and federal levels, is key to being able to adapt existing buildings, build resilient new buildings, and construct district-scale flood protection measures.

- Institute Resilient Chapter 91—Massachusetts Public Waterfront Act Amendments
- Revise the Massachusetts Building Code
- Create a New Zoning Overlay District
- Update and Provide Guidance related to the Wetlands Protection Act
- Work with the US Army Corps of Engineers (USACE) to Increase Permitting Flexibility

ESTABLISH AN INFRASTRUCTURE COORDINATION COMMITTEE

The CRB report notes that coordination regarding infrastructure is needed because Boston does not have direct control over all of the infrastructure that serves its population and economy, relying partially on regional systems. It suggests organizations that should be members of a standing Infrastructure Coordination Committee (ICC) in the sectors of water and sewer, transportation, energy, and telecommunications; describes precedents for an ICC, both within and outside of Boston; and lists standards that already exist, and those that need to be developed. The CRB report recommends that the Mayor work with the Governor and other key stakeholders to establish the ICC, and that it be coordinated closely with the Metro Boston Climate Preparedness Task Force, which has been convened by the Metro Mayors Coalition.

As indicated in the CRB report, the ICC should, at a minimum, accomplish the following:

- Use updated climate projections to develop planning and design standards across member agencies for retrofitting or constructing all major infrastructure systems to an agreed-upon set of future climate conditions;

Planning and Implementing Resilient Infrastructure at the Watershed Scale

The CRB report recommends that the ICC engage in district-scale infrastructure adaptation planning to prepare existing infrastructure—and design new infrastructure—for climate change. One option is to use the Commonwealth's major drainage basins/watersheds as the organizing geography for both planning and implementation for the following reasons:

- Stormwater drainage follows topographic landforms and boundaries, and it can be better-managed by an entity that is also organized based on such boundaries;
- Watershed models provide the capability to simulate the responses of natural systems to natural forces or human activities, promoting a social-ecological perspective;
- Climate data are currently being collected at the watershed level in the Commonwealth. In March 2018, the Executive Office of Energy and Environmental Affairs published the Massachusetts Climate Change Projections—Statewide and for Major Drainage Basins report. As indicated in the title, the drainage basin level is one of the levels at which the authors (researchers from the Northeast Climate Adaptation Science Center at the University of Massachusetts Amherst) developed downscaled projections for changes in temperature, precipitation, and sea level rise;
- Research indicates that watersheds provide an ideal context in which to coordinate management of water, land, and related resources;
- An organization that crosses political boundaries can shepherd projects that will be most beneficial to the communities in the watershed and prioritize projects within the watershed; and
- Watershed-level coordination can be part of transformational governance, providing a structure which could eventually be used to address a broader range of resilience issues, and other issues as appropriate.

- Collaborate and identify cascading vulnerabilities and opportunities for joint adaptation projects that could improve effectiveness or cost efficiencies by addressing multiple systems' vulnerabilities at once;
- Integrate adaptation plans with capital improvement plans, in order to upgrade vulnerable assets over time to meet the agreed-upon planning and design standards; and
- Provide the City with regular progress reports in developing adaptation plans and bringing assets up to planning and design standards.

There are three main options for moving forward with this initiative:

- **Option 1:** Continue to Coordinate Informally
- **Option 2:** Establish the ICC through a Memorandum of Understanding (MOU)
- **Option 3:** Formally Establish the ICC through Legislation

These options are explored in more detail in the full report.

CONVENE A CLIMATE RESEARCH ADVISORY ORGANIZATION

The Boston Research Advisory Group (BRAG) was a team of scientists overseen by the School for the Environment at UMass Boston to develop the Climate Projection Consensus for the CRB report. CRB initiative 1-1 recommends establishing an organization to serve as the continuation of BRAG that would periodically produce updated climate projections and assist local and state agencies in using the projections to create and/or modify existing policy, design guidelines, and regulations.

In addition to these two tasks, such a Climate Research Advisory Organization should perform a third function: to monitor and evaluate the outreach and planning, regulatory, flood protection implementation, and infrastructure adaptation initiatives undertaken as part of the larger climate adaptation effort. A Climate Research Advisory Organization would need to:

- Include leading climate scientists from local and regional institutions, organized into working groups focused on key climate factors, such as extreme temperatures, sea level rise, coastal storms, and precipitation;
- Produce projections that reflect the most up-to-date data and theoretical understanding and include consideration of multiple emissions scenarios and time periods, extending at least 100 years into the future;

Collaborating on infrastructure investments could increase regional climate resilience.

There is a need for further research into how climate change will impact people and communities and the best options for our responses. The BRAG could be expanded to include social scientists and public health researchers in addition to environmental and climate scientists.

Flooding of the Harbor Walk in Dorchester, Boston. March 2018.

- Produce these updated climate projections every five years;
- Fill research gaps in local climate change knowledge, including social systems and impacts on people and communities;
- Assist local and state agencies in using the projections to create and/or modify existing policy, design guidelines, and regulations, in particular:
  - to the Infrastructure Coordination Committee to support the development of planning and design standards; and
  - to the Boston Planning and Development Agency to support efforts to incorporate climate readiness into zoning standards and land-use planning.
- Monitor and evaluate the outreach and planning, regulatory, flood protection implementation, and infrastructure adaptation initiatives, as described above.

Options for convening a Climate Research Advisory Organization include:

- **Option 1:** Continue and Expand the Boston Research Advisory Group (BRAG)
- **Option 2:** Establish a State-Level Climate Research Panel

These two options are explored in more detail in the full report.

ESTABLISH GOVERNANCE FOR DISTRICT-SCALE COASTAL FLOOD PROTECTION

The CRB report identifies several efforts necessary for the initial planning of shore-based district-scale flood protection measures. The local climate resilience plans, including *Coastal Resilience Solutions for East Boston and Charlestown*, describe specific flood protection measures, estimate order-of-magnitude costs for design and construction, and, in some cases, identify potential funding sources from both the public and private sectors. However, neither the CRB report nor the local plans identify the comprehensive governance strategies that would be needed to construct or maintain these measures, let alone finance them.

Three separate governance activities are necessary to construct district-scale coastal flood protection measures: planning, financing, and implementation. Responsibility for these activities could all be split among two or three organizations (the "multi-organization approach"), or they could be housed within a single organization (the "single organization approach").[10]

Three options have been identified for implementing district-scale coastal flood protection measures using the multi-organization and single organization approaches. These include:

- **Option 1.** Enhance and Expand Local and State Coordination
- **Option 2.** Expand the Massachusetts Water Resources Authority
- **Option 3.** Expand Metropolitan Area Planning Council, Massachusetts Office of Coastal Zone Management or Massachusetts Department of Environmental Protection

These options can employ different organizational approaches, which are described in the full report, followed by a description of each implementation option.

CONCLUSION

If a storm the magnitude of Superstorm Sandy hit the Boston region after all of the flood adaptation initiatives described in the CRB report were implemented, would we be ready?

As this report indicates, implementing CRB is necessary but not sufficient to prepare Boston's built environment for the fresh water and coastal flooding anticipated to result from climate change. Additional steps we must take include reforming existing tools, monitoring and evaluating flood adaptation activities, and establishing governance for district-scale coastal flood protection implementation. This report presents an array of options for moving forward. Over the next year or so, the City and relevant stakeholders will need to come together and decide which, if any, of these options provide the best paths forward for a more resilient city and region.

We recommend that the Governor of Massachusetts and the Mayor of Boston establish a joint commission to explore the options and determine a path forward. There is an opportunity for us to learn from the transition to clean energy as we prepare for climate change impacts. We recommend that the legislature take a leadership role in this effort as well, in order to evaluate the different options available to the Commonwealth as we attempt to address this dynamic challenge.

Forums for these conversations may also include the Mayor's Environment, Energy and Open Space Cabinet, the Green Ribbon Commission, and the Metro Mayors Coalition. These discussions, at multiple scales of governance, will also allow us to explore how climate resilience can be compatible with and supportive of the region's equitable economic growth—in fact, Greater Boston's economic resilience is what makes climate adaptation both more important and more doable.

This report suggests two intertwined approaches. The first would be integrating the CRB initiatives and the additional recommended steps into an incremental approach toward resilient governance. Essentially this means improving the tools we already have to respond to the dynamics of a changing climate and leverage the scientific capacities we already have to better guide decision making. Given the slow and complex nature of changing institutions, cultivating incremental change in existing legal institutions will be necessary while more transformational changes are developed. The second approach, therefore, is to consider transformative changes in governance capable of confronting landscape-scale problems and rapidly changing climate impacts. We will need governance structures that fully integrate the gathering of adequate information about ecological resources and social values, obtaining feedback through monitoring, and using this data to inform policies, programs and projects. Instituting changes in power structures and introducing new institutional arrangements and regulatory frameworks is always hard, but the extreme challenge of climate change adaptation demands these actions.

Implementing Climate Ready Boston is necessary but not sufficient to prepare Boston's built environment for the fresh water and coastal flooding anticipated to result from climate change.

ENDNOTES

1 CNN, October 19, 2017. Hurricane Sandy Fast Facts. Retrieved from https://www.cnn.com/2013/07/13/world/americas/hurricane-sandy-fast-facts/index.html

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5 Steffen, Will; Grinevald, Jacques; Crutzen, Paul; McNeill, John. Phil. Trans. R. Soc. A. January 31, 2011. The Anthropocene: conceptual and historical perspectives. 369 842-867; DOI: 10.1098/rsta.2010.0327.

6 Deas, Melissa; Grannis, Jessica; Hoverter, Sara; and DeWeese, Jamie. February 2017. Opportunities for Equitable Adaptation in Cities: A Workshop Summary Report. Georgetown Climate Center.

7 Public land and entities are not subject to many of the tools described in this section. Flood adaptation measures on public land are planned and implemented through a different set of processes.

8 Lester M. Salamon, The New Governance and the Tools of Public Action: An Introduction, 28 Fordham Urb. L.J. 1611 (2001). Available at: https://ir.lawnet.fordham.edu/ulj/vol28/iss5/4

9 With the exception of an evaluation component for initiative 8.2.

10 Stormwater would continue to be managed by existing entities and coordinated through the ICC.

Sustainable Solutions Lab

The Sustainable Solutions Lab (SSL) is an interdisciplinary partnership among four schools within UMass Boston: The College of Liberal Arts, College of Management, McCormack Graduate School of Policy and Global Studies, and School for the Environment. SSL's mission is to work as an engine of research and action to ensure that all residents of Greater Boston, and cities across the world, are prepared equitably for the impacts of climate change.

UMass Boston

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