New England
Climate Adaptation
PROJECT

Stakeholder Assessment
Cranston, Rhode Island

PRODUCED BY:
Massachusetts Institute of Technology Science Impact Collaborative
Consensus Building Institute
National Estuarine Research Reserve System
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About the MIT Science Impact Collaborative

The Massachusetts Institute of Technology Science Impact Collaborative (MIT SIC) is a research group focused on developing and testing new ways of harmonizing science, politics and public policy in the management of natural resources and resolution of environmental disputes. MIT SIC's tools and approaches include collaborative adaptive management, joint fact-finding, scenario planning, collaborative decision-making and multi-stakeholder engagement, and the use of role-play simulation exercises.

MIT SIC was established in 2003 with initial support from the United States Geological Survey. Today, the research group has numerous partners and supporters, ranging from the U.S. National Estuarine Research Reserve System to the Dutch research organization TNO. By engaging in community-based action research projects, MIT SIC researchers—including doctoral students, masters students, and faculty from the MIT Department of Urban Studies and Planning—train emerging environmental professionals while simultaneously testing the latest environmental planning methods and providing assistance to communities and policy-makers who seek our help.

Visit the MIT Science Impact Collaborative website for more information: http://scienceimpact.mit.edu

About the Consensus Building Institute

The Consensus Building Institute (CBI) is a not-for-profit organization founded in 1993 by leading practitioners and theory builders in the fields of negotiation and dispute resolution. CBI's experts bring decades of experience brokering agreements and building collaboration in complex, high-stakes environments — and possess the deep understanding required to tackle negotiation and collaboration challenges in our practice areas. CBI's Founder, Managing Directors, and many of our Board members are affiliated with the Program on Negotiation at Harvard Law School and the MIT-Harvard Public Disputes Program.

Visit the CBI website for more information: http://www.cbuilding.org

About the Narragansett Bay National Estuarine Research Reserve

The National Estuarine Research Reserve System (NERRS) is a network of 28 areas representing different biogeographic regions of the United States that are protected for long-term research, water-quality monitoring, education and coastal stewardship. The reserve system is a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. Reserve staff work with local communities and regional groups to address natural resource management issues, such as non-point source pollution, habitat restoration and invasive species. Through integrated research and education, the reserves help communities develop strategies to deal successfully with these coastal resource issues. Reserves provide adult audiences with training on estuarine issues of concern in their local communities. They offer field classes for K-12 students and support teachers through professional development programs in marine education. Reserves also provide long-term water quality monitoring as well as opportunities for both scientists and graduate students to conduct research in a "living laboratory".

The Narragansett Bay National Estuarine Research Reserve is located on four islands in the Narragansett Bay and encompasses 4,400 acres of land and water. Habitats within the Reserve include salt marsh, eelgrass beds, rocky intertidal zone, forest, and meadow. The Reserve's Coastal Training Program serves decision-makers in the Narragansett Bay Watershed, which is comprised of 1,657 square miles in Massachusetts and Rhode Island.

Visit the Narragansett Bay National Estuarine Research Reserve website for more information: http://www.nbnerr.org

Executive Summary

The purpose of this stakeholder assessment is to guide the New England Climate Change Adaptation Project team in developing a role-play simulation specifically for Cranston that includes roles that represent the interests and concerns of stakeholder groups present in local decision-making. The stakeholder assessment is designed to reveal the potential impacts of climate change on diverse stakeholders, the intensity of stakeholder concern about climate change risks, stakeholder views of climate change adaptation, and potential barriers and opportunities for climate change adaptation.

Climate Change-Related Concerns and Identified Risks

Many interviewees expressed a high level of concern about the increased risk of flooding due to climate change. Nearly every interviewee discussed flooding risks in Cranston. This high level of concern around flooding is likely due to recent flooding events in Cranston; most interviewees mentioned the March 2010 floods. Interviewees consider sea level rise and more frequent or intense storms as important drivers of climate change-related flooding risks. Several interviewees named specific neighborhoods and infrastructure located close to the rivers and their floodplains that are vulnerable to climate change-related flood risks.

Several interviewees are concerned about climate change potentially causing increased variability in rainfall, fluctuating from periods of flooding to periods of drought. Interviewees described two groups in Western Cranston that could be vulnerable to drought: those relying on groundwater wells for their drinking water and farmers whose crops could be stressed by drought.

Interviewees expressed less concern about extreme heat even though the climate change projections show up to ten times more extreme heat days (over 90 degrees Fahrenheit) in the future. This finding is illustrative of the difficulty of planning for climate change risks that are out of the realm of historical experience. Nevertheless, one interviewee is concerned about low-income people potentially not being able afford their energy bills as a result of more extreme temperatures.

Some interviewees did not express concern about the risks posed by climate change. These interviewees tend to think that climate change impacts will occur far in the future and do not currently warrant attention. In addition, some interviewees are optimistic that people will find ways to adapt with little to no government intervention.

Local Activity

There is a significant amount of disparate activity underway in Cranston to reduce the community's vulnerability to climate change risks. There are several projects underway at the City level, policies and programs at the State and Federal levels, non-profit organizations that are active on floodplain restoration, and businesses that are making adaptation-related investments.

Opportunities and Challenges for Moving Forward with Adaptation

Many stakeholders think that the time is ripe for action on managing climate-related flood risks in Cranston given that the March 2010 flood is still fresh in residents' minds. Several interviewees are interested in seeing more floodplain restoration activities and an increased emphasis on public education to help manage risk. Nevertheless, interviewees identified several challenges to pursuing adaptation action, especially a lack of financial resources and gaining broad public support for managing long-term risks.

Project Overview

The Massachusetts Institute of Technology Science Impact Collaborative is working with four National Estuarine Research Reserve (NERR) sites and the Consensus Building Institute to test an innovative way to help coastal communities understand and prepare for the potential impacts of climate change. With a grant from the NERR Science Collaborative, the team is engaging four New England communities in testing the use of role-play simulations as a means to educate the public about climate change threats and to help communities explore ways of decreasing their vulnerability and enhancing their resilience. One of the NERR sites is Narragansett Bay in Rhode Island and the nearby community they have chosen to engage is the City of Cranston. The project partner in Cranston is the City Planning Department.

The purpose of this stakeholder assessment is to guide the project team in developing a role-play simulation specifically for Cranston that includes roles that represent the interests and concerns of stakeholder groups present in local decision-making. The assessment is designed to reveal the different attitudes and perspectives of key groups of people in Cranston regarding managing the risks of climate change impacts. Of particular interest to the team is stakeholders' level of concern about climate change risks and what they think should be done to manage the risk. Since climate change risks will be managed within the context of other risks and opportunities, the team also wanted to understand the top priorities of Cranston stakeholders and whether they pertain to climate change or not.

With assistance from the Cranston Planning Department, the project team developed an initial list of approximately 20 interviewees and the list expanded as interviewees recommended other stakeholders to interview. The interviewees spanned many different stakeholder groups, from elected officials to social service providers to business owners. Over the course of approximately six weeks, a graduate student research assistant from MIT interviewed 16 different stakeholders in Cranston. See Appendix A for a complete list of the interviewees.

Stakeholder Group	Number of Interviews
Local government – Elected and Appointed Officials	2
Local government – Civil Service Officials	5
State government	2
Federal government	1
Business – Environmental Services	2
Business – All Other	3
Environmental Organization	3
Social services/Public health	1
Total Interviews	*19*

Table 1: Interviewees by stakeholder group

The interviews took place in-person and over the phone. The interview questions covered the topics of general background on the interviewee and their connection to Cranston, local climate change-related risks, activity to reduce climate-related risks, and local decision-making. During the course of the interview, the interviewees were shown a table of climate change projections for temperature and asked about their reactions to those forecasts. See Appendix B for the interview protocol and Appendix C for the climate change projections.

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Findings

This section reflects perspectives shared by participants during the interview process. Their perspectives may be contradictory in some cases and largely overlap in others. The statements are an expression of viewpoints, understanding, and opinions. The assessment does not attempt to create an independent set of "facts" on the issue, but rather uncover a range of views, interests, and values on the issue.

Key Players

Many interviewees think that government agencies have an important role to play in adaptation efforts. Interviewees frequently mentioned several departments within the City of Cranston.

- **Planning Department** for their role in land use planning, permitting, floodplain management, and public education
- **Public Works Department** for their role in managing the City's stormwater and wastewater infrastructure
- **Police and Fire departments** for their role in emergency response
- **Mayor's office** for leadership role in setting priorities
- **City Council** for their role in legislative efforts

A smaller number of interviewees discussed some of the non-governmental actors that play a key role in local infrastructure.

- **Veolia Water, NA** has a contract to operate the Cranston Wastewater treatment plant
- **Providence Water** is the regional water utility that provides potable water service to Cranston
- **National Grid** is the electric utility that provides electricity to Cranston

Stakeholders also mentioned an array of state and federal governmental agencies involved in programs and policies related to hazards and the environment that would be important to involve in local adaptation activities.

- **Natural Resource Conservation Service (NRCS)** for their role in developing a plan for floodwalls on the Pocasset
- **Rhode Island Emergency Management Agency (RIEMA)** for their role in hazard mitigation, preparedness, response and recovery
- **Federal Emergency Management Agency (FEMA)** for their role with Flood Insurance Rate Maps, hazard mitigation, and flood recovery efforts
- **Environmental Protection Agency (EPA)** for their role in stormwater and wastewater regulations

- **RI Department of Environmental Management (RIDEM)** for their low impact development regulations, and primary oversight of wastewater and stormwater
- **Coastal Resources Management Council (CRMC)** for their role in permitting coastal uses and planning for sea level rise
- **Rhode Island Department of Health** for their oversight of drinking water

Many interviewees think it is important to have business stakeholders involved in adaptation efforts, such as the Chamber of Commerce. In addition, interviewees think it's important to involve people living and working in vulnerable areas in adaptation efforts. At this time, such communities don't appear to be well organized; interviewees did not discuss any active neighborhood associations. Due to their vulnerability, some of the neighborhoods that interviewees think are important to include in decision-making around climate change risks are Pawtuxet Village and Edgewood.

Many interviewees think it is important for youth and schools to be involved in climate change adaptation efforts. While young people may not be key players in decision-making in the near-term, interviewees think it is important that they be aware of climate change risks and adaptation. This perspective seems to come from two different logics. Some interviewees acknowledge that climate change is something that our society will have to deal with for long time to come, so there is the need to get the next generation prepared. On the other hand, this perspective may be driven by a logic that climate change risks are a long ways off, so it's something to be dealt with by future generations rather than something to be dealt with today.

Level of Concern about Climate Change Risks

Stakeholders in Cranston exhibit wide-ranging levels of concern regarding climate change risks, from very concerned to not concerned at all. As a general trend, interviewees working in the public sector conveyed a higher level of concern about climate change impacts than those working in the private sector. Nevertheless, there were definitely exceptions to that trend. A small number of government stakeholders did not express concern and some business stakeholders expressed concern because they have been directly affected by climate-related disruptions or they work in the environmental services industry.

A common refrain from stakeholders when they reviewed climate change projections was, "Well, I won't be around for that." For some, it was a stretch to be concerned over changes they perceive as occurring far in the future. Others are not concerned about climate change impacts because they are optimistic that people will find ways to adapt. For example, one stakeholder noted that people in Florida already deal with hot summers so people in Cranston should be able to as well. Some believe that adaptation will happen among individuals and groups spontaneously, without the need for government intervention. As an example of this type of adaptation, one stakeholder noted how the construction industry has developed new technolo-

gies and practices to be able to work through the winter. In addition, several interviewees think that some of the impacts of climate change will be positive, such as less snow.

Several interviewees are skeptical that climate change is caused by human activity. In general, however, these interviewees think that weather patterns appear to be becoming more severe and unpredictable, which may require some adaptation activities. Even interviewees that expressed skepticism about climate change were still willing to engage in conversation about flooding risks in Cranston. In general, these stakeholders were less concerned about climate change-related risks.

On the other hand, many stakeholders are very concerned about climate change impacts, especially the increased risk of flooding. These stakeholders are more likely to believe that these risks require proactive management and are concerned that this is not already happening to a sufficient degree. In general, stakeholders who expressed a higher level of concern are responsible for public services that have been, or will be, affected by climate change. In addition, businesses that have already experienced disruptions due to a climate-related event or work in the environmental services industry are likely to express a high level of concern.

Identified Climate Change Risks and Vulnerabilities

In addition to the general community concerns mentioned above, Cranston stakeholders expressed interest in matters that are directly linked to the climate and climate change. These are discussed in much greater detail below, but in summary, the climate-related concerns fell broadly into two categories: natural resource protection or environmental stewardship, and protecting residents' health and safety during natural disasters, such as Nor'easters or hurricanes.

Flooding

Interviewees most frequently identified river flooding as the most important climate change risk in Cranston. Stakeholders are concerned that climate change could result in more frequent or severe storms that could cause the rivers to spill their banks and thus damage homes, businesses, and infrastructure. Flooding is an impact that has historically affected Cranston. For example, nearly every interviewee mentioned the March 2010 floods. Most stakeholders expect that flooding will continue and possibly worsen as the climate changes.

Cranston has a significant amount of development in the floodplains. Interviewees noted several neighborhoods have experienced repeated flooding impacts, such as Perkins Avenue, Fordson apartments, Riverview Terrace, Amanda Court, Fletcher Avenue (near Plainfield and Atwood), Elmwood, and Willow Brook apartments (off of Pontiac Avenue). Stakeholders also noted that some major bridges and roadways are vulnerable to flooding, such as the Pawtuxet River crossings of State Route 37 and Interstate 95.

One stakeholder is particularly concerned about the potential impacts of flooding on the city's wastewater infrastructure, including the treatment plant, pump stations, and sewer lines. This stakeholder is also concerned that because a contractor operates the plant, coordination between the contractor and the City on risk management could potentially be lacking. While

working on a previous project in the wastewater sector, the interviewee found that clear channels of responsibility and communication had not been adequately established between a contract operator and a City government. According to another stakeholder, there are important pieces of wastewater infrastructure built in low-lying areas and near the coast, making them susceptible to flooding impacts or storm surge.

Some stakeholders are concerned about helping households and businesses recover after flooding. One stakeholder noted that low-income people have had a particularly hard time recovering from recent flood events. Another stakeholder spent considerable time working to get businesses back up and running after recent flooding events and thinks that FEMA does not offer enough resources to help businesses recover. This stakeholder thinks there is a need to provide businesses with grants rather than loans for disaster recovery.

Sea Level Rise

Many interviewees are concerned about the potential combination of coastal storms (with storm surge) and sea level rise, which could cause both coastal flooding and river flooding in Cranston. Not many stakeholders are concerned about the impacts of sea level rise in regards to inundation from daily high tides. Stakeholders noted that the Cranston coastline has quite a bit of elevation and has been hardened so it is less vulnerable to tidal inundation and erosion.

Storms

Some stakeholders are concerned about the potential impacts from more frequent or more intense storms, such as hurricanes and nor'easters. Some are particularly concerned about the potential for storm surge to render the Pawtuxet Neck neighborhood inaccessible by land. Others storm-related concerns include roof damage, downed trees, and power outages.

Drought

Several stakeholders are concerned about the potential for fluctuations in precipitation, from periods of flooding to periods of drought. Some are particularly concerned about the impacts of drought on two groups in Western Cranston: residents that are dependent on groundwater wells for their drinking water and farmers whose crops could be stressed by drought.

Extreme Temperatures

A smaller segment of interviewees are concerned about extreme temperatures in Cranston. For example, one stakeholder expressed concern about the ability for low-income residents to pay for heating and cooling costs. Many interviewees, however, noted that Cranston's location on the Narragansett Bay helps moderate temperatures. Most stakeholders do not think that heat waves will be a problem, despite the climate change projections showing up to ten times more extremely hot days in the long-term compared to the current climate.

Health

In general, health impacts do not appear to be a widespread concern among stakeholders, but rather more of a concern among environmental non-profits and agencies. Only one stakeholder expressed concern about pests and vector-borne diseases increasing as a result of warmer weather and more stagnant water. Another interviewee expressed concern about the health effects of hotter temperatures combined with the urban heat-island effect and air pollution.

Current Local Activity

Many interviewees were able to identify and discuss local activities underway to reduce Cranston's vulnerability to climate change impacts. This is not an exhausted list of local activity, but rather the activities that stakeholders discussed in their interviews. The City of Cranston should consider it a positive sign that people are aware of these activities and that there is a constellation of groups active on these issues.

City of Cranston

The City Planning Department is active on three different projects to reduce vulnerabilities in Cranston: (1) applying to FEMA for the opportunity to update the Hazard Mitigation Plan a year earlier than originally scheduled and deal in greater depth with the City's flooding hazards than the typical hazard mitigation plan; (2) purchasing homes that have been repeatedly damaged by flooding; (3) partnering with the Natural Resource Conservation Service (NRCS) to study the potential for floodwalls to help mitigate flooding on the Pocasset. In addition, the Public Works Department is working to make low-lying wastewater pump stations less vulnerable to flooding. The Police and Fire Departments have had considerable practice with flood response recently and many interviewees think that they are well prepared in that respect.

State of Rhode Island

In terms of policy changes, some stakeholders noted the new "Rhode Island Stormwater Design and Installation Standards Manual" that requires enhanced stormwater management for new developments. The regulations call for the use of low impact development (LID) techniques to control stormwater on site. The RI Department of Environmental Management also published the "Rhode Island Low Impact Development Site Planning and Design Guidance Manual" to provide communities with guidance on how to revise their land use regulations to comply with the RI Stormwater Manual's minimum standards. Some interviewees have already had experience putting these new standards into practice in recent development projects.

Another policy change has been a sea level rise policy at the Rhode Island Coastal Resources Management Council (CRMC). The CRMC is responsible for issuing permits in the coastal zone. The CRMC adopted its Climate Change and Sea Level Rise policy as part the RI Coastal Resources Management Plan (RICRMP) in January 2008. The policy specifies that the CRMC will proactively plan for and adapt to climate change and sea level rise, including integrating climate change and sea level rise scenarios into its planning and operations.

In addition to the sea level rise policy, the CRMC received a National Ocean Atmospheric Administration (NOAA) grant in 2012 that funds a collaborative effort between the CRMC, Rhode Island Sea Grant, The Nature Conservancy, and the Narragansett Bay National Estuarine Research Reserve to evaluate sea level rise impacts to coastal marshes for all of Rhode Island's 21 coastal communities. The information developed from this new effort will assist the state and local communities in planning to protect natural resource and economic assets.

State Department of Transportation is working on a continuity of operations plan, that is, how best to provide services if any of their assets are impaired (for example, key highways closed due to flooding). In addition, whenever they make capital investments, they are reviewing floodplain maps to make sure they keep their infrastructure out high-risk areas.

Non-Profit Environmental Organizations

The Pawtuxet River Authority (PRA) has been involved in floodplain restoration and dam removal on the Pawtuxet. One of their largest projects is a gift 48 acres of land from the State of Rhode Island along the Pawtuxet at the eastern end of the Howard Industrial Park. The PRA has plans to improve this area as a recreation area, wildlife habitat, and floodplain by removing waste materials and abandoned structures, encouraging native plants growth, and providing walking trails.

Federal Programs

EPA Climate Ready Estuaries program is a partnership between EPA and the National Estuary Programs to address climate change in coastal areas. One of their project sites is the lower Pawtuxet. They evaluated 15 projects identified from previous initiatives that would foster ecological restoration and climate preparedness. Based on the evaluation, they are moving forward into a conceptual design phase with four projects. The selected projects are the RIDEM Supply Depot, Pontiac Mills Dam and Riverbank Restoration, Pavement Removal Sites, and a Greenway connecting Warwick, West Warwick and Cranston.

EPA Climate Ready Water Utilities initiative assists the water sector, including drinking water, wastewater and stormwater utilities, in addressing climate change impacts. The program has developed tools to help utilities assess vulnerabilities and make adaptation decisions. In 2011, the EPA, DEM, and the Warwick Sewer Authority hosed a workshop called "Wastewater Treatment in the Face of a Changing Climate," which many waste water treatment facility and pump station personnel from the region attended.

University of Rhode Island

Some interviewees mentioned that the University of Rhode Island (URI) is active on climate change adaptation and provides helpful technical resources. URI has a Sea Grant Program, which provides trainings, sea level rise data, and mapping to local decision-makers in Rhode Island.

Private Sector

One company has decided to change its policy regarding the purchase of properties at risk of flooding. As a result of the change, the company will not purchase properties that have previously experienced flooding or are at risk of flooding. Previously, the company's policy was not to purchase properties in the 100-year floodplain, but now the company also examines how close the property is to the 100-year floodplain to determine if they are willing to purchase it.

Another company decided to purchase an emergency generator and co-generation system so they can continue to operate if there is a blackout. The March 2010 flood provided the impetus for National Grid, the electric utility that serves Cranston, to work on elevating substations that are susceptible to flooding.

Proposed Ways to Manage Risk

Emergency Response and Preparedness

Some interviewees tend to think of adaptation as a disaster response and recovery activity and they think it is a critical issue, particularly for low-income people and businesses. They expressed the need for the City, in concert with appropriate state and federal agencies, to be prepared to accommodate residents and businesses that are affected by flooding and get them back on their feet as soon as possible. These stakeholders referred back to experiences during the March 2010 flood where they thought that the recovery effort was lacking.

Flood Risk Management

Many stakeholders believe that there is a need to make areas of Cranston less prone to flooding. Some noted structural measures such as reinforcing bridges and riverbanks while others noted non-structural measures, such as continuing to move people and structures away from flood-prone areas and expanding open space around the rivers. Several stakeholders believe that property acquisition in the floodplains and subsequent ecological restoration of the floodplains to enhance floodwater storage is the best way to move forward with flood risk management.

Education and Awareness

Several stakeholders mentioned the need for enhanced public education about climate change risks, especially while the March 2010 flood is still fresh in residents' memories. Some interviewees thought that education about climate-related risks should take place in the schools and involve experiential and service learning. Others thought that the Planning Department

should shift gears towards public education activities. Nevertheless, some interviewees expressed skepticism that public education will make a marked difference on this issue, because they believe that adaptation activity really comes down to having sufficient financial resources for projects.

More information and awareness were key themes of what people thought was needed to manage risk. Some mentioned the need for better storm forecasting. Another stakeholder thought there was a need for climate change projections of storm frequency and intensity and it would be great to put them in the common storm parlance in Rhode Island, such as nor'easters and tropical storms.

Open Planning and Decision-Making

Two stakeholders thought that making open and transparent decision-making on climate change adaptation and risk management was the most important way to move forward. They thought there should be a forum for communication with clear data and facts that parties can agree on and use going forward in their operations and planning.

Some would like to see capacity building efforts so that groups are not so fragmented. For example, one organization that provides first responder services felt fragmented from the City's emergency management and planning activities. Another interviewee was concerned that there is not clear responsibility in the event of an emergency with regards to the contract operation of the wastewater treatment plant. In addition, several interviewees noted the need for improved coordination between the many local, state, and federal agencies with oversight on issues related to climate change risks.

Overview of Other Interests and Concerns

Climate change risks will be managed in the context of other risks and opportunities. As such, this section describes some of the other top priorities for Cranston stakeholders.

Jobs and Economic Development

Jobs and economic development are the top priority for many stakeholders in Cranston. Business stakeholders are most interested in growing their businesses and keeping costs down. For example, for one business, their biggest priority was continuing to grow in Cranston. They are expanding their facilities and are thus concerned about the costs of complying with all of the necessary environmental regulations. Another business was concerned about the quality of the neighborhood in which they are located as well as the potential for power outages to disrupt their business. The businesses we interviewed seem very invested in Cranston and are not considering moving away, but they noted room for improvements in the face of climate change.

Some local officials are very interested in retaining and attracting businesses in Cranston. They serve the needs of existing business by offering programs and helping handle the processes of regulations and permitting.

Another stakeholder was concerned about poverty and thought that Cranston could do a better job of identifying and addressing the needs of the poor in Cranston. Their needs are ever-evolving, especially as the recession drags on. According to the 2010 American Community Survey, Cranston has an unemployment rate of 9.6% and 9.7% of people live in poverty. This stakeholder also noted that the 2010 flooding in Cranston was especially devastating for low-income people who lost their homes and some of them never fully recovered.

Environment

Many stakeholders mentioned environmental concerns not directly related to climate change risks. Some of the highest priority issues for interviewees were:

- Water quality and stormwater management
- Wastewater management, including the costs of compliance with EPA regulations and having a better understanding of the vulnerability of assets
- Open space preservation, especially in Western Cranston
- Waterfront access
- Recreational opportunities on the rivers

Local Services

Many of the interviewees serve in Cranston's local government, and for some their top priority, is to provide effective and efficient services to Cranston residents during a time of dwindling resources. Many local government stakeholders would like to be able to upgrade aging infrastructure, such as stormwater infrastructure and school facilities. Some local officials would also like to see increased emergency response training opportunities for their staff. Nevertheless, one interviewee who does work not in local government, expressed a high degree of concern about the City's fiscal situation, where spending has outpaced revenues.

Opportunities and Challenges for Moving Forward on Adaptation Action

Opportunities

It appears that people with a wide variety of interests and perspectives are interested in having an open and transparent dialogue about managing flooding risks. Many stakeholders think the time is ripe to move forward with actions to improve flood risk management given that the memories of the March 2010 floods are still fresh in peoples' minds. The City could continue to build upon its experience with managing flood risk. One stakeholder thought that it was positive that the City has developed some experience with buying out properties that have been flooded repeatedly and has taken advantage of state and federal assistance.

Several stakeholders also noted that it might be a good time for the Planning Department to shift gears towards public education and hazard mitigation planning since they recently completed their comprehensive land use and zoning plan.

Many stakeholders believe that a federal initiative on climate change adaptation that includes funding would help get Cranston moving on adaptation. Some noted that it would help if the City could prioritize adaptation projects and have them "shovel-ready" if and when federal funding become available.

Challenges

The lack of funding is a major challenge for moving forward with climate change adaptation activities. Property acquisition in the floodplains and upgrading infrastructure require more funds than are locally available. Unfortunately, the legacy of development built in hazard-prone areas is an expensive one to deal with. Furthermore, some stakeholders are concerned that the lack of local funding has led to a sense of dependency that solutions must come from the outside rather than be generated locally.

Some interviewees think that people need to see the effects of climate change before they will commit to any adaptation actions. In that sense, managing flooding risks may be a prime area of activity given the recent floods. However, other climate risks such as heat waves may have more difficulty gaining traction. Another stakeholder discussed how climate change does not have enough urgency and is not sure that the general public sees it as an important issue yet. As a result, it's easier for people to put off making investments in climate resiliency.

They also noted that working with the necessary constellation of state and federal agencies that have jurisdiction over different areas of environmental risk management would be challenging because of their fragmentation. For example, some noted that implementation of any project related to climate change adaptation must get through the environmental review and permitting process, which can be lengthy and costly.

Appendix A. List of Interviewees

Name	Position/Role	Organization	Stakeholder Group
Kyle Adamonis	Senior VP Human Resources	Taco HVAC	Business
Thomas Ardito	Restoration Program Manager	Naragansett Bay Estuary Program	Environmental organization
Joe Baker	Acting Administrator	Rhode Island Dept of Transportation	State government
Sheryl Bezak-Guglielmo	Project Engineer	Diprete Engineering	Business
Michelle Burnett	Floodplain Manager	Rhode Island Emergency Management Agency	State govt, Emergency preparedness
Kelly Coates	Senior VP	Carprionato Properties	Business/ Real estate
Larry Diboni	Economic Development Director	City of Cranston	Local government
Allan Fung	Mayor	City of Cranston	Elected and appointed officials
Peter Lapolla	Planning Director	City of Cranston	Local government
Ken Mason	Public Works Director	City of Cranston	Local government
Scott Millar	Administrator, Sustainable Watersheds Office	RI Department of Environmental Management	State government
Joanne McGunagle	Executive Director	Cranston Community Action Program	Public health
William McKenna	Fire Chief	City of Cranston	Local govt, Emergency preparedness
Mark Motte	Commissioner	City Planning Commission	Elected and appointed officials
Robert Nero	Executive Director	Pawtuxet River Authority & Watershed Council	Environmental organization
Bill Patenaude	Principal Engineer, Office of Water Resources	RI Department of Environmental Management	State government
Brian Plummer	Director of Operations	Cadence Corporation	Business
Gina Snyder	Environmental & Compliance Assistance Unit	US EPA	Federal government
Steve Torregrossa	Commissioner and business owner	Cranston Historic District Commission	Business, Appointed official
Jennifer West	Coastal Training Program Coordinator	Narragansett Bay Research Reserve	Environmental organization
Joel Zisserson	Plant Operations and Transportation	Cranston School District	Local government

Appendix B. Interview Protocol

General Background

1. Please confirm your name, title, and affiliation.
2. Could you briefly explain what your organization does?
3. What is your connection to Cranston?
4. Briefly, what are the top issues you would like to see your community address in the next five to ten years?

Local Risks

5. In what ways might climate change affect your community in the next few decades?
6. What specific climate change risks or impacts are you most concerned about? If none, why?

   a. Prompt, if needed: First level impacts: sea level rise, coastal flooding, increased intensity of storm events, drought, etc.

   b. Second level impacts: beach erosion, property value loss, water shortages, impacts on agriculture, increased risk of disease (West Nile virus, etc.), etc.
7. Here's a map of the town. Could you mark on the map areas or locations you think are most vulnerable to the climate change risks we have been discussing?
8. How prepared do you believe your community is to handle the impacts you have named?

Local Activity, Context & Politics

9. What is your connection to climate change adaptation work, if any?
10. Are there actions underway (currently or in the planning stages) to reduce the vulnerability of your community to climate change risks?

    a. If so, what are they?
11. What obstacles does your community face when working to reduce climate change risks?

    a. Prompt: lack of technical information; lack of financial resources; lack of state or federal guidance; lack of political leadership at local level; lack of awareness, etc.
12. What would it take to overcome the obstacles that your community and other communities are likely to face in reducing vulnerability to climate change risks?

    a. Prompt: Assistance from federal government; public education; partnerships with local universities, etc.
13. What do you think are the biggest opportunities for taking action in your community?

Data

14. We have been looking through federal and state forecasts of climate change risks facing your town. I'd like to show you a few numbers. Do you have any preliminary reactions to these forecasts? [HAND OUT SIMPLIFIED CLIMATE CHANGE PROJECTION GRID WITH A FEW NUMBERS IN BOLD OR CIRCLED.]
15. What data or information about climate change risks would be most helpful to your community at this point?

Decision-making

16. We are going to organize some community meetings to talk about climate change risks that may be facing your town. Who do you suggest we invite?
17. Are there specific organizations in your community who might want to co-host such an event?

Other

18. Who else do you think I should talk to about these issues?

Appendix C: Downscaled Climate Projections for Cranston, RI

These projections were generated as output from four different global climate models (GCM) that have been well-established and evaluated in the peer-reviewed scientific literature: the US National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory (GFDL) CM2.1; the United Kingdom Meteorological Office's Hadley Centre Climate Model version 3 (HadCM3); the National Center for Atmospheric Research's Parallel Climate Model (PCM), and Community Climate System Model Version 3 (CCSM3). These models have different climate sensitivities, where sensitivity refers to the amount of temperature change resulting from a doubling of atmospheric C02 concentrations relative to pre-industrial times. GFDL and CCSM3 have medium sensitivity; HadCM3 has a medium-high sensitivity, and PCM has a low sensitivity.

Each global model produces output in the form of geographic grid-based projections of daily, monthly, and annual temperatures, precipitation, and other climate variables. Global climate models operate on the scale of hundreds of miles, which is too coarse a resolution to distinguish changes across different towns and cities in a given region, such as New England. However, scientists used state-of-the-art statistical downscaling models to capture historical relationships between large-scale weather features and local climate, and use these to translate future projections down to the scale of local weather station observations. In this project we used a relatively new statistical downscaling model, the Asynchronous Regional Regression Model.[1] This report uses the projections downscaled to the meteorological station in Kingston, RI, because it is the closest station to Cranston.

Two different climate change scenarios drove the projections from the global climate models: a high emissions scenario (A1fi) and low emissions scenario (B1). The high emissions scenario assumes that the world will experience economic growth dependent primarily on fossil fuels and that atmospheric concentrations of carbon dioxide reach 940 parts per million by 2100. The low emissions scenario assumes that economies will shift to cleaner, less fossil-fuel intensive technologies, and that atmospheric concentrations of carbon dioxide reach 550 parts per million by 2100.[2] The purpose of choosing a high emissions and a low emissions scenario is to create a likely range of future climate change that Cranston may experience during the 21st century.

The projections are also presented in three time frames: short term, medium term, and long term. The short term refers to the time period between 2010 and 2039, the medium term refers to the time period between 2040 and 2069, and the long term refers to the time period between 2070 and 2099. The historical baseline refers to the years 1980 to 2009. We average the results of the historical baseline period and climate projections over 30 years. This period is long enough to filter out any interannual variation or anomalies, and short enough to show longer climatic trends.

1 More information on the statistical downscaling method used is provided in: Stoner, AMK, K Hayhoe, X Yang and DJ Wuebbles (2012) An asynchronous regional regression model for statistical downscaling of daily climate variables. *Int. J. Climatol.* DOI: 10.1002/joc.3603.

2 The emissions scenarios and GCM simulations used in this report consist of models that contributed to phase 3 of the Coupled Model Intercomparison Project (CMIP3). These are the results presented in the Intergovernmental Panel on Climate Change (IPCC) Third (2001) and Fourth (2007) Assessment Reports. More recent scenarios combined with CMIP5 climate projections were recently released (September 2013) in the IPCC Fifth Assessment Report.

Climate Change Projections for Cranston, RI (Change from Historical)

Indicators	Change from historical (+ or -)						
	Historical 1980-2009	Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Temperature (F)							
Average annual minimum temperature	39.8	1.3	1.5	2.5	4.3	3.2	7.2
Average winter minimum temperature	21.9	1.5	1.2	2.8	3.6	3.2	6.4
Average summer minimum temperature	58.4	1.2	1.7	2.7	4.9	3.1	7.5
Average annual maximum temperature	61.3	0.8	0.6	1.6	3.1	2.1	5.5
Average winter maximum temperature	41.6	0.5	0.5	1.3	2.0	1.5	3.7
Average summer maximum temperature	80.4	0.3	0.1	1.1	2.6	1.9	5.4
Temperature Extreme *(days per year)*							
Colder than 32 °F	129	-11	-11	-17	-28	-24	-46
Hotter than 90 °F	3	3	2	6	11	8	29
Precipitation (in)							
Annual average	52.7	-1.0	0.0	-1.2	1.8	2.0	5.1
Winter average	12.4	0.4	0.9	1.0	0.8	1.4	2.2
Summer average	12.3	-0.5	-0.7	-1.4	-0.2	-0.6	0.4
Extreme Precipitation *(events per year)*							
1" in 24 hrs	14.8	1.0	1.3	0.8	2.1	2.3	4.2
2" in 48 hours	7.6	1.8	1.6	1.7	3.0	3.0	5.3
Extreme Precipitation *(events per decade)*							
4" in 48 hours	2.7	1.9	0.6	1.1	1.7	2.0	4.4
Sea Level Rise *(Increase relative to the year 2000 in feet)*							
		0.5	0.8	1.0	1.7	2.0	4.7

**All projections are based on meteorological information from Kingston, RI, the closet weather station to Cranston.*

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