New England **Climate Adaptation** PROJECT

Stakeholder Assessment **Barnstable, Massachusetts**

PRODUCED BY:
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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.

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About the Waquoit 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 Waquoit Bay Reserve is located on the south shore of Cape Cod, Massachusetts, on the border of the towns of Falmouth and Mashpee. The Reserve's more than 2,700 acres encompass open waters, saltwater and freshwater marshes, barrier beaches, sand dunes, rivers, mixed pine and oak forests, and sand plain grasslands. The Waquoit Bay Reserve provides educational and outreach opportunities for communities throughout the Cape Cod region.

Visit the Waquoit National Estuarine Research Reserve website for more information: http://www.waquoitbayreserve.org/index.aspx

Executive Summary

The purpose of this document is to capture the opinions of diverse Barnstable stakeholders about the possible local impacts of climate change and the intensity of their concerns, as well as the extent of current local action and potential barriers and opportunities to climate change adaptation. Climate change adaptation refers to a suite of actions that a community may take to reduce its vulnerability and increase resilience to the potential impacts of climate change. This report was used to guide the New England Climate Change Adaptation Project in developing a role-play simulation that focuses on climate change risks and stakeholder dynamics that are relevant to Barnstable.

Climate Change-Related Concerns and Identified Risks

Stakeholders in Barnstable hold a range of opinions about climate risk. Some are afraid of serious risks to the whole town, while others are unconvinced that climate change will create any new risks in the town. A majority of stakeholders are unsure of the long-term effects of climate change, but they expect some increased risk in the next few decades.

Almost all interviewed stakeholders identified problems that could arise from more frequent and intense storms and coastal flooding. Barnstable's waterfront homes and businesses, homes in low-lying inland areas, businesses in Hyannis, and public and private coastal infrastructure were all cited as at risk. Several stakeholders thought that sea level rise could potentially affect flood insurance rates, groundwater resources, and water quality. In addition, a few stakeholders mentioned changes in Barnstable's ecosystem, which could affect recreational activity and commercial fisheries and hatcheries. A few stakeholders viewed a warming climate as a bonus because they felt it would expand Barnstable's tourist economy.

Local Activity

There were no major collective actions underway in Barnstable to adapt to the risks posed by climate change at the start of this assessment. However, there have been individual adaptation efforts by private and public actors, including increased armoring along the coast and attempts to raise coastal infrastructure. One private actor commented, "even if global warming is for real or phony, there's nothing bad that comes out of raising things a little bit higher." Still, stakeholders mentioned several ways they thought the town could begin to adapt to the risks posed by climate change: more research, stakeholder outreach and education, emergency preparedness, and changes in state and local flood plain management and insurance.

Opportunities and Challenges

The most commonly cited challenges for adaptation include: disagreement on the extent of the town's climate risk, lack of funding, limited downscaled research, inadequate coordination, and lack of community engagement and "buy-in." Some stakeholders thought that new flood insurance maps and the experiences from recent storms could prompt local action. Others thought that state action could create major opportunities for local adaptation. Nearly every stakeholder said that new downscaled information – like the projections created during this project – would allow the Town to begin to make informed decisions about climate risk.

Project Overview

The Massachusetts Institute of Technology Science Impact Collaborative (MIT SIC) is working with four National Estuarine Research Reserve System (NERRS) sites, and the Consensus Building Institute (CBI) to test an innovative way to help coastal communities understand and prepare for the potential impacts of climate change. With a grant from the NERRS Science Collaborative, the team is engaging four New England communities – Barnstable, Massachusetts; Wells, Maine; Dover, New Hampshire; and Cranston, Rhode Island – 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 NERRS sites is the Waquoit Bay Reserve in Massachusetts. The nearby community they have chosen to engage is the Town of Barnstable.

The purpose of this stakeholder assessment is to reveal the different attitudes and perspectives of key groups of people in Barnstable 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 these risks. Since climate change risks will be managed within the context of other risks and opportunities, we are also interested in understanding the top priorities of Barnstable stakeholders, whether they are directly related to climate change or not. This assessment will guide the project team in developing a role-play simulation that will include roles and perspectives that are relevant in the context of Barnstable's local decision-making.

With the assistance of partners from the Town of Barnstable's Growth Management Department, we developed an initial list of approximately twenty interviewees. In creating this list, we attempted to capture a range of key stakeholders in Barnstable, including elected and appointed officials, town staff members, environmental groups, regional government, and business owners. Over the course of approximately six weeks, a graduate student research assistant from MIT interviewed nineteen different stakeholders in Barnstable; a list of interviewees is included in Appendix A. Each interviewee agreed to provide his or her name and title in this document, although the opinions and ideas of each stakeholder will remain confidential.

During the course of these interviews, stakeholders were asked about their vision for the town's future, their perspective on climate change risks and adaptation options, and their reactions to new climate projections downscaled specifically for Barnstable. A summary of their responses and key findings are provided below. Any errors or omissions are the sole responsibility of the MIT SIC and CBI project team.

Key Findings

This section summarizes the perspectives shared by the nineteen interviewees from Barnstable during late 2012 and early 2013. These perspectives may be contradictory in some cases and largely overlap in many others. The statements and generalizations made below are an expression of opinions, viewpoints, and understandings. This assessment is not an attempt to create an independent set of facts on the issue, but rather to uncover a range of views, interests, and values on the issue of climate adaptation. The section below summarizes interviewed stakeholders' reactions to and perspectives on climate change risk and awareness, local adaptation efforts, possible risk management strategies for the future, key players, and key opportunities and challenges in Barnstable.

Climate Change Awareness and Level of Concern

While stakeholders expressed varied levels of concern about the short- and long-term risks posed by climate change, interviewees had an overall understanding of climate risks in coastal cities. Many stakeholders expressed a cautious recognition of the need to adapt to climate risk.

Many stakeholders were not only concerned about future climate impacts, but were also troubled by changes they are already seeing in their community. A majority of interviewees were not concerned about climate change in the abstract; rather, they focused on vulnerabilities that could affect their daily lives and the character of their community. Several stakeholders expressed deep, near-existential concern about the long-term viability of key infrastructure and development in Barnstable, questioning the town's ability or willingness to respond to risks. Yet the majority of stakeholders expressed a more nuanced, less fearful understanding of climate risk, and almost all stakeholders expressed impressive scientific literacy of the key issues facing Barnstable, even before examining any climate data or projections. For example, a number of stakeholders explained their worry about sea level rise by connecting it to more what they saw as troubling storm surge risk. Most were hesitant to talk in certainties, and one interviewee noted, "Like most other people, we've got just an anecdotal understanding [of climate change risk]. There are lots of things that we just don't know, even if we can anticipate significant changes occurring."

While many interviewees expressed some concern and awareness of climate change risks, a number of interviewees either did not think that climate change was a real phenomenon or did not think that it required much public action. Some of these stakeholders thought that the climate could be changing, but that its effects were too long-term to worry about in the present. For example, one said, "Climate change risk is certainly not on people's radar anywhere as much as other issues. It's not like we're seeing water level come up a foot a year, you know?" On the other hand, one stakeholder commented, "It's amazing to me how many 100-year storms we've had in the last ten or fifteen years. People are still in denial about it, but it's clear what's going on."

Interestingly, many public stakeholders and all private sector stakeholders hedged their concerns with reminders of climate science's inherent uncertainty. As one interviewee said, "I don't have a crystal ball." Every stakeholder was willing to discuss impacts, but quite a few would only do so with an added "if this is true…and that's a big if." Once stakeholders put aside their concerns about the uncertainty of decades-long projections and forecasts, almost all of them were willing to discuss the day-to-day risks of a changing climate and rising sea level – no matter the magnitude of its change in the very long term, or why it could change.

Climate Change Risks and Vulnerabilities

During the interviews, interviewees identified a broad range of risks and vulnerabilities in Barnstable, which were mostly related to sea level rise, more severe and frequent storms, and changes in air and water temperatures.

When asked about risks in Barnstable, almost every interviewee began by expressing concern about the town's coastal properties. Stakeholders recognized that Barnstable's economy relies upon tourism and waterfront residential properties; any increase in coastal storms, storm surge, erosion, and flooding could put homeowners at risk, depress property values, or ultimately require retreat from the coastline. Stakeholders expressed concern about low-lying areas in the town, especially residential and marine business areas on the town's southern coast. Several stakeholders expressed concern that residential properties farther inland, but still within several feet of sea level, may be harmed with increases in major storm or flooding events combined with a rising sea level. Several also noted that Hyannis, Barnstable's major economic center, is prone to flooding during major storms. One stakeholder expressed concern that, even if properties are not directly affected by storm surge or flooding, climate change risks may bring increases in insurance premiums across the town.

In addition to noting Barnstable's general vulnerability to flooding, stakeholders discussed a variety of other complications associated with rising sea levels and more frequent and intense storms. Several noted that the town's public and private harbors, docks, seawalls, and bulkheads could be vulnerable to hurricane impacts and sea level rise; others expressed general concern about infrastructure like roadways. One stakeholder worried that increased hurricanes could deter tourists or depress tourist activity. Another worried that boating costs could become too high, given the potentially necessary investments in boating-related infrastructure, thereby possibly deterring boaters in the Barnstable area in the future. Several interviewees expressed concern about evacuating the town in the event of a major storm, which is something that has never been done before but could present significant problems given limited road and bridge capacity on the Cape. Finally, several stakeholders expressed concern that rising sea levels could raise groundwater levels. That scenario could theoretically put septic systems at risk of failure due to lack of adequate separation from groundwater resources, affecting Barnstable's water quality. Two stakeholders also mentioned that Barnstable's sole-source aquifer could be negatively affected as a consequence of sea level rise, but that this risk is currently unstudied.

Many stakeholders recognized that the town's ecosystems and wildlife would be affected by climate change, and several noted that they have already seen changes in the pests, cherry trees, and salt marshes in their own backyards. Multiple stakeholders were concerned that milder winters on the Cape would result in more pests, like ticks and winter moths, as well as more invasive species. Others focused on the climate's effects on key resources like the Sandy Neck Reserve, already migrating salt marshes, and other key habitats. However, not all stakeholders viewed a warming climate as a risk or a problem. Several noted that milder winters and warmer summers could create a longer tourist season, improving Barnstable's economy.

Finally, many stakeholders were concerned about how a changing climate, particularly when combined with rising sea levels, could affect the town's shellfishing industry. Ocean acidification and pH changes would create problems for fisheries and hatcheries. While longer summers could potentially elongate the growing season for shellfish, warmer water temperatures could have a negative effect on shellfisheries, and warmer air temperatures could have significant impacts on shellfishery operating costs. Rising sea levels could also make shellfish operations more challenging by reducing accessibility to existing aquaculture grants.

In sum, almost every stakeholder mentioned the town's vulnerability to more frequent and intense storms, given its development along the waterfront and its low-lying neighborhoods. While most stakeholders were concerned about this climate risk as well as an assortment of other storm and ecosystem hazards, several expressed no concern about climate change and saw it as an opportunity to expand Barnstable's tourist economy. A majority of stakeholders focused on a few of the risks described above, and most expressed a moderate level of concern about these risks manifesting in the next decade or two.

Current Local Adaptation Efforts

While stakeholders did not describe any comprehensive adaptation efforts already underway, a few public and private interviewees mentioned small, individual actions that they think could help address the possible changes in the climate they have already seen or expect to see in the next few years.

For example, one oyster company owner has already begun training his staff for new protocols to help deal with warmer air temperatures, even though regulators have not yet enforced this protocol. The owner also noted that aquaculture grantees are generally using real-time pH, temperature, and water quality information in their operations. However, he commented that they could use more scientific information about how shellfish and fish will respond to the effects of any changes in climate, and how they can best manage their grants to retain economically viable businesses.

A private marina owner mentioned that he's been preparing his marina for hurricanes by setting aside some money every year since the early nineties. By raising his electric services and utilities and building higher, he hopes to make his marina more hurricane resistant. Even though he remains skeptical about climate projections for the near or long term, he thinks that, "even if global warming is for real or phony, there's nothing bad that comes out of raising things a little bit higher." While he continues to make his marina more resistant to coastal storms, he expressed concern that similar storm-preparedness efforts were not being uniformly applied across public and private harbor infrastructure. That said, public authorities have also begun to respond to the changes they have seen in water levels; most prominently, they raised pilings that hold town floats in place by about two feet during a major dredging project.

Several stakeholders noted they have seen increased armoring of the coastline on private residential properties in recent years in response to storm events and rising sea levels. While such efforts protect individual properties in the short run, one stakeholder expressed concern that such adaptation efforts could actually exacerbate flooding of adjacent properties in the short term, and even the armored properties themselves in the long run.

Local environmental groups have recently been mostly focused on wastewater management, rather than climate change concerns. However, they are actively involved in studying the risks posed by climate change, ranging from sea level rise and storm surge to impacts on the Cape's sole-source aquifer. The Cape Cod Commission and the Town of Barnstable have focused mostly on updating the Town's Multi-hazard Mitigation Plan, which addressed the risks posed by climate change as best as it could in the absence of detailed climate projections.

Besides these isolated actions, interviewees did not describe any collective efforts occurring in Barnstable. One interviewee stated, "We know we should be thinking about this more…but it's so hard to just keep up with the day-to-day! We'll have to change how we think about this and how we operate – and that's hard."

Proposed Ways to Manage Risk

Stakeholders often felt overwhelmed by the number of risks posed by climate change, and were unsure of the best public response. Even so, stakeholders mentioned several possible ways they thought Barnstable could begin to adapt to the risks posed by climate change: stakeholder outreach and education, emergency preparedness, research, and changing state and local flood plain management.

Most stakeholders agreed that the first step to managing climate risk was to increase stakeholder education and participation across the town. Many were concerned that constituents did not have enough knowledge of climate risk – or that they wanted more before their elected officials acted. Other stakeholders agreed that adaptation efforts were needed, but they wanted more detailed information so local businesses, town officials, and residents could make the best investment of their time and resources.

Several stakeholders saw adaptation as an extension of emergency preparedness and management. Most stakeholders have a great deal of confidence in the emergency response team in Barnstable, and are not concerned about the public response to small or medium-sized storms on the Cape. However, several stakeholders mentioned that, if storms became more intense, the Cape would have to plan for possible evacuations in a way that it has not in the past. Many stakeholders also noted that private property owners are reducing the vulnerability of their own properties at varying rates, especially through armoring, and that increased collaboration could prove valuable.

Finally, several stakeholders mentioned that Barnstable could reduce its vulnerability to climate risk by changing the way it regulates development in flood plains and low-lying areas through zoning. Most stakeholders noted that this strategy could be contentious and challenging, and several argued that the state would have to take action before the town could. One argued that, "we can't change zoning because builders will just go to the next town over! We need state change if we are going to be better prepared for flooding." In contrast to education and emergency preparedness, which most stakeholders agreed on, this last item was often proposed with more uncertainty.

Overview of Town Interests and Concerns

Although several stakeholders expressed strong concerns about climate change, all but two stakeholders agreed that the interconnected issue of water quality, nutrient loading, and wastewater management was the Town's top priority now and for the foreseeable future. Many tied water quality to the town's economic growth and vitality; others expressed concern for their drinking water, shellfish quality, and ability to enjoy recreational activities deeply ingrained in the town's culture. One stakeholder expressed the sentiment that "the very thing that makes the Cape attractive is starting to slip away! So it's our highest priority." Every stakeholder had a different idea about how to best address the issue, and the Cape Cod Commission and the Town of Barnstable are both currently undertaking extensive research and planning activities to manage water quality.

Besides wastewater management and water quality, which were by far the top-mentioned issues facing the Town of Barnstable, other key issues that were mentioned include: growth management, economic development and jobs, community engagement and participation, and crime. Several interviewees mentioned the town's ongoing challenge of promoting smart growth and development in the town, and others emphasized that the town should continue to or expand its focus on economic development and job creation. A few stakeholders wanted to see more community engagement around a variety of town and Cape-wide issues, and several others noted that the town was facing challenges related to crime, drug abuse, and homelessness.

Key Players

Stakeholders mentioned a variety of public and private players that they feel are going to be key in any adaptation efforts, especially focusing on officials within town government. Barnstable's Town Council and Town Manager were most frequently mentioned, followed by appointed officials on the Board of Health, Planning Board, and Conservation Commission. Town staff members within the Growth Management Department, Department of Public Works, Department of Conservation and Natural Resources, Department of Marine and Environmental Affairs, and Emergency Management team were variously mentioned as key players in adaptation efforts.

Several stakeholders noted that key players in the private sector could include the local and regional Chamber of Commerce, waterfront business owners, fisheries and hatcheries, and coastal property owners. Environmental nonprofits like the Association to Preserve Cape Cod, interviewed for this assessment, may also play important roles. Several stakeholders mentioned that including local middle and high schools in adaptation outreach and awareness could prove useful for the community, and one noted that engaging Barnstable's civic associations could ensure participation from all of Barnstable's villages.

Regional bodies like the Cape Cod Commission and Barnstable County were also mentioned, especially related to regional wastewater planning and emergency preparedness. Regional research centers like the Woods Hole Oceanographic Institute, the Cape Cod National Seashore, and the Waquoit Bay NERRS Site (a participant in this project) were thought to be potentially useful partners for adaptation efforts.

Stakeholders did not mention many particular state officials or agencies, although one noted that the Cape's Coastal Zone Manager could be a key player. Many stakeholders thought that the Federal Emergency Management Agency (FEMA) could play a major role as it releases new Flood Insurance Rate Maps for the region. Finally, one stakeholder mentioned that the Massachusetts Department of Environmental Protection (MA DEP) and the federal Environmental Protection Agency already are important players in Barnstable's water quality issues.

Opportunities and Challenges for Adaptation

There was no widespread agreement on opportunities for adaptation efforts, though several stakeholders had ideas about this. One stakeholder thought that changes in flood insurance maps and rates may raise the profile of storm and flooding risk, which could eventually encourage residents to support adaptation efforts to protect their homes. Another thought that recent storms in the Northeast, including Hurricane Sandy, could encourage residents to move forward on adaptation to better prepare for major storms in the future. Several stakeholders thought that the town could focus on improving emergency preparedness–especially evacuation plans–in the foreseeable future. Others thought that the town could begin to consider options for protecting development from rising sea levels, storm surge, and coastal flooding.

Several stakeholders believe that state action, like regulatory changes or increased funding, could create major opportunities for adaptation at the local level. These stakeholders thought that the town could potentially enact more protective building and zoning standards in low-lying areas if the state paved the way; otherwise, they were concerned that local activities to encourage less vulnerable development could potentially discourage new development within Barnstable.

The most commonly cited challenges for adaptation include: disagreement about the extent of the town's climate risk; lack of funding; limited locally relevant research on climate risks and potential impacts; inadequate coordination; and lack of community engagement and "buy-in". Several stakeholders believed that disagreement about the implications of climate change, as well as about whether it is even occurring, could hamper efforts to adapt to climate risk. Many other interviewees thought that limited data could create too much uncertainty, which would limit coordinated action. Most stakeholders thought that money and financial limitations are the primary obstacle to implementing adaptation efforts. Several mentioned the cost of raising docks and protecting the coastline. In light of the town's current substantial investment of funds and time in wastewater planning, these stakeholders did not see significant comprehensive action being taken in the near future without additional outside funding.

One stakeholder noted that public agencies and private utilities would need to coordinate better in the event of a major hurricane or storm. Several other stakeholders thought that private property owners would need to coordinate better to reduce overall flooding risk and property damage in the event of a major storm. A few stakeholders noted that seasonal residents own some of the most vulnerable coastal properties, and that this could potentially complicate coordinated public decision-making relating to such development. Finally, most stakeholders thought that engaging private property owners on the coastline and residents throughout Barnstable would be necessary for climate adaptation, but were concerned that such an effort would prove challenging, at least in the near-term.

Appendix A. List of Interviewees

Name	Title	Organization(s)
Jessica Rapp Grassetti	VP of Town Council; Chair of Historical Commission	Town of Barnstable
Dennis Houle	Chair	Conservation Commission
Wayne Miller	Chair	Board of Health
Matt Teague	Chair	Planning Board / Cape Cod Builder
Ed DeWitt	Executive Director	Association to Preserve Cape Cod
Wayne Kurker	Marina Owner	Hyannis Marina
Chris Gargiulo	Aquaculture Grantee	Cotuit Oyster Company
Skip Simpson	Owner	Anchor Inn
Heather McElroy	Natural Resources Specialist	Cape Cod Commission
Paul MacDonald	Police Chief / EM Coordinator	Barnstable Police Department
Craig Tamash	Deputy Police Chief	Barnstable Police Department
Dan Horn	Harbor Master	Marine and Environmental Affairs
Eric Shufelt	Assistant Harbor Master	Marine and Environmental Affairs
Tom Marcotti	Shellfish Biologist	Marine and Environmental Affairs
Rob Gatewood	Administrator	Conservation and Natural Resources
Fred Stepanis	Conservation Assistant	Conservation and Natural Resources
Roger Parsons	Town Engineer	Department of Public Works
Jo Anne Buntich	Director	Growth Management
Elizabeth Jenkins	Principal Planner	Growth Management

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 Barnstable?
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.

   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 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 Barnstable, MA

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); and 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, CCSM3, and HadCM3 have medium 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 stations in East Wareham, Edgartown, Hyannis, New Bedford, and Rochester, which are the closest stations to Barnstable. Sea level rise is projected using data from Barnstable.

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 Barnstable 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 Barnstable, MA (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	43.0	1.2	1.1	2.1	3.6	2.8	6.1
Average winter minimum temperature	24.5	1.5	1.4	2.6	3.6	3.1	6.3
Average summer minimum temperature	61.4	1.2	1.2	2.3	3.8	2.8	6.2
Average annual maximum temperature	59.2	1.4	1.3	2.4	3.8	2.9	6.4
Average winter maximum temperature	40.4	1.1	1.0	2.0	2.6	2.2	4.3
Average summer maximum temperature	77.9	1.6	1.7	2.9	4.8	3.6	7.7
Temperature Extreme *(days per year)*							
Colder than 32 °F	103	-11	-10	-16	-25	-20	-41
Hotter than 90 °F	2	2	2	5	9	6	24
Precipitation (in)							
Annual average	47.7	-.01	0.1	0.7	0.8	2.8	2.7
Winter average	11.6	0.7	1.1	1.4	1.1	1.7	2.2
Summer average	11.2	0.0	-1.0	-0.3	-0.7	0.2	-0.5
Extreme Precipitation *(events per year)*							
1" in 24 hrs	12.9	0.7	0.9	1.3	2.4	2.4	2.8
2" in 48 hours	5.6	1.3	1.0	1.9	2.9	2.9	3.9
Extreme Precipitation *(events per decade)*							
4" in 48 hours	1.8	1.2	0.0	1.3	0.9	0.8	2.3
Sea Level Rise *(Increase relative to the year 2000 in feet)*							
		0.6	0.9	1.1	1.8	2.2	4.9

The projections in this table are based on meteorological information from five stations around Barnstable, located in East Wareham, Edgartown, Hyannis, New Bedford, and Rochester. Sea level rise is projected using data from Barnstable.

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