

**Town of Hull
Community Resilience Building
Workshop
Summary of Findings
February 2019**



Town of Hull

Community Resilience Building Workshop

Municipal Vulnerability Preparedness Program

Summary of Findings

OVERVIEW

Recent years have seen notable weather extremes in Hull. The winter of 2015 brought record-breaking snow, requiring National Guard assistance for street plowing. The following year, Hull was under a drought warning from July to November 2016. The winter of 2018 once again brought severe winter storms; the January nor'easter coastal storm surge exceeded the Blizzard of '78. In March a succession of four nor'easters pummeled the town. Hull experienced extensive power outages and coastal flooding. Globally, the years 2014 through 2018 are the five hottest years on record.

In 2017, the Commonwealth of Massachusetts inaugurated the Municipal Vulnerability Preparedness (MVP) program to assist municipalities in planning for and implementing strategies to adapt to predicted changes in our warming climate. The predicted changes include both increased flooding from large rain events and a greater likelihood of drought, increased extreme heat days and heat waves, and increased flooding from sea level rise.

The Town of Hull, in continuing its proactive efforts to address future climate threats, applied for a state grant to complete the Community Resilience Building (CRB) Workshop under the MVP program certification. In 2016, with support from a grant from MA Coastal Zone Management, the town completed an assessment of projected sea level rise and vulnerable municipal infrastructure. In 2018, the town incorporated sea level rise projections in its updated Hazard Mitigation Plan. Both documents identify and prioritize steps the town can take to mitigate projected climate impacts (see References). The CRB provided an opportunity to build on these projects and address the full range of climate impacts. Upon completion of the MVP program Hull will be eligible to apply for state grants to address identified climate risks.

The Town of Hull partnered with the Metropolitan Area Planning Council (MAPC) to complete the MVP program. The MVP Core Planning Team identified and recruited community stakeholders to participate in the CRB Workshop. Thirty-three people representing Hull town staff, Hull Boards and Commissions, Hull community organizations, and regional partners, gathered on February 9 (see Workshop Participants page 8). The Workshop's central objectives were to:

- Understand extreme weather and climate related hazards
- Identify existing and future strengths and vulnerabilities
- Develop and prioritize opportunities to take action to reduce risk and build resilience

Materials provided for the workshop included local and regional data for changes in temperature, precipitation, and sea level recorded to date, as well as future projections to the

end of the century. Posters provided data and mapping specific to Hull infrastructure, demographics, and natural resources (see Appendix A). The participants considered Hull's strengths and vulnerabilities focusing on infrastructure, society, and the environment. Working in small groups, and then together as a large group, they prioritized actions designed to increase Hull's resilience to future extreme weather events.

TOP HAZARDS AND VULNERABLE AREAS

Given Hull's coastal location and status as a low-lying barrier beach, flooding from coastal storms exacerbated by sea level rise was the top concern of workshop participants. Additional concerns included drought, severe winter storms, stormwater flooding, and changes in ocean temperature and acidity.

Top Hazards

- Coastal flooding
- Severe Storms (wind, snow, ice)
- Stormwater flooding
- Drought
- Extreme Heat

CURRENT CONCERNS AND CHALLENGES PRESENTED BY HAZARDS



Participants and town officials noted the increasing frequency and intensity of storms, including nor'easters that brought coastal flooding, damaging winds, and snowfall; as well as the recent period of drought. The principal challenges of the nor'easters included flooding to many roads and properties; extended power outages, and transportation impacts. In 2018, the extent of

coastal flooding caused Hull Emergency Management to restrict all travel in and out of Hull during periods of high tide. In addition, as is often the case during coastal storms, many roads within Hull were not passable during the higher tide cycles. As these issues are not new, the Town of Hull through its emergency management activities and hazard mitigation planning, has taken many steps to prepare for extreme weather and prevent harm to people and property.

Workshop participants shared concerns that climate projections will heighten current challenges, particularly for wastewater and stormwater infrastructure, seawalls, roadways, and the Nantasket beach and dune system.

AREAS OF CONCERN

Geographic:

Much of Hull consist of low-lying barrier beach. At least 60% of town land is in the current 1% chance flood zone. As such, all of Hull's low-lying land was identified as areas of concern. Further, participants noted that while people and infrastructure at higher elevation may not be directly impacted, all residents are vulnerable due to restrictions on travel during coastal storms and power outages.



Societal:

Populations identified include: seniors, low-income residents, and people who may be isolated. While Hull's senior and emergency services, as well as local social services were noted as a town strength, participants were concerned with barriers to emergency communication and suggested options to increase outreach. Participants also noted that some residents will have fewer resources to prepare for, endure, and recover from, severe weather events. People living in basement apartments were identified as particularly vulnerable to flooding. Solutions included identifying financial resources and social services, and public education. Additional suggestions included opening a cooling center, and establishing an emergency shelter in Hull.

Environmental:

The priority concern was protecting and improving the Nantasket Beach and Dune system. Suggestions include beach nourishment and dune repair and expansion. Other concerns included the lack of tree cover, risk to salt marsh areas, and a high degree of impervious surfaces.

Infrastructure:

Flooding risk to the Wastewater Treatment Plant and pumping stations was a very high priority. Participants also noted the many other town facilities subject to flooding including the Memorial School, A Street Fire Station, Senior Center, DPW and High School. Another significant concern – and challenge – is the number of roads that flood regularly even in relatively minor coastal storms. Stormwater flooding exacerbated by impervious surfaces, and risk to power supply due to tree damage to the main feed in Hingham rounded out the primary concerns.

CURRENT STRENGTHS AND ASSETS

Workshop participants identified numerous Hull strengths and assets that will provide resilience to future climate impacts. As shown below town strengths identified include its residents, strong organizations, communications, natural resources, and emergency management.

- Educated community, sense of community support
- Residents are experienced with storms
- Strong emergency communications: Code Red, Cable TV, social media
- Coast Guard located in town
- Strong organizations: Wellspring, Weir River Watershed Association, Interfaith community, St. Nicholas church, Chamber of Commerce, Rotary, student organizations
- Beach Management Plan, annual dune planting, Beach Management Committee volunteers
- Natural resources: WBZ marsh, Weir River Woods and estuary, wetlands protection, salt marshes, Peddocks Island, Boston Harbor National Park
- Hills and elevated areas: particularly the Jacobs School and Town Hall/Police/Fire
- Manet Medical Center
- Medical Reserve Corps
- Municipal Light Company
- Straits Pond tide gate
- WBZ dike
- Senior Housing
- Emergency Management Team pre-storm meetings
- Emergency Management registration for seniors
- Ferry evacuation option
- Generators for most critical facilities
- Community Garden
- Council on Aging
- Draper St. drainage
- Strawberry Hill Water Tank

TOP RECOMMENDATIONS TO IMPROVE RESILIENCE

Each of the four workshop groups identified vulnerabilities and suggested solutions (see Appendix B). The solutions were prioritized as High, Medium, or Low. Each group then identified their four highest priorities. The groups found there was considerable overlap in their top priorities resulting in the eight top priorities listed below. The participants then voted for their top four personal priorities. The issues identified as highest priorities below are listed in order of the number of votes they received.

Highest Priorities

Nantasket Beach and Dune System: Protect, enhance, and extend the dune that runs along Nantasket Beach seaward from Phipps Street north. Nourish the beach for enhanced protection. Protect the beach/dune system for diversity of species.

Wastewater Treatment System: Protect the WWTP and associated pump stations. Flood proof or elevate key infrastructure. Reduce infiltration.

Vulnerable populations: Improve outreach and communication to seniors and low income populations. Create a protection plan for senior housing. Form a task force to develop ideas and solutions moving forward. Assess the size and location of these populations.

Alternative Energy: Develop alternative energy sources for the town. This will address both resilience and the need for climate mitigation. Remove vulnerable trees that may impact power lines.

Low-lying roadways: Consider elevating critical roadways. Roadways identified include: Nantasket and Atlantic Avenues, Fitzpatrick Way, A Street, Hull Shore Drive, and Hampton Circle.

Seawalls: Strengthen and elevate seawalls to protect against coastal flooding.

Stormwater: Improve capacity of pipes and drainage pumps. Use zoning and Low Impact Development strategies to reduce impervious surfaces.

Communications: Harden communications with alternative sources and redundancy. Adopt First Responder Network” for improved communication.

High Priorities

- Senior Housing needs a generator and needs to be elevated.
- Plant trees strategically. Adopt a tree bylaw for new development.
- Communicate about Community Development Block Grants (CDBG) and other grants. Temporary housing after storms is needed.
- Create an infrastructure replacement plan that aligns funding, funding sources, and policy.
- Cultivate relationships with the MA Department of Conservation and Recreation (DCR).
- Keep the Beach Management Plan updated.
- Increase enforcement of Wetlands Protection Act buffers.

- Create and strengthen regional partnerships. Find funding for a regional communication system.
- Add bikeways for better access. Create an evacuation route along the railway bed.
- Review zoning (like height restrictions) to add resilience.
- Consider beach migration and a long-term closure plan for Beach Avenue.
- Implement DCR Master Plan, install snow fences.
- Invest in high water vehicles and duck boats for coastal storms and to protect equipment from salt water damage.
- Make a plan for extreme traffic congestion associated with Nantasket Beach Reservation
- Provide public education on floodplain risks.
- Do a feasibility study on the need to elevate George Washington Blvd (state-owned).
- Ensure shelters and sidewalks are American Disabilities Act (ADA) compliant.
- Address the rising cost of flood insurance. Consider low-cost loans through CDBG.
- Use eminent domain to establish dunes on private property for public safety.
- Provide pumping for Manomet and Samoset Ave. areas (including the Senior Center) to improve drainage.
- Provide flood protection and additional power sources for Memorial School Warming Station. Consider Town Hall and Jacobs School as alternate shelter locations. Establish a shelter in Hull. Encourage sheltering in place.
- Create a cooling center for days above 90 degrees.
- Designate parking areas outside of flood zones. Educate new residents about flooding.
- Consider the feasibility of raising the road, or adding a seawall along Sunset and Cadish Avenues.
- Implement the Complete Streets policy to address impervious pavement and heat impacts.
- Station a full-time ambulance at the Village Fire Station. Keep a backup truck at the Coast Guard station.
- Elevate pump stations identified as numbers 20, 33, and 38 (see base map, page 13). Replace the D Street stormwater station.
- Address water pipe leaks and corrosion (Aqurion).

Medium Priorities

- Repair the WBZ marsh tide gate.
- Increase capacity for stormwater management. Address undersized culverts.
- Protect or elevate the DPW, manage materials there.
- Elevate or relocate the A Street Fire Station.
- Improve public awareness of Hull's vulnerabilities.
- Build partnerships with Wellspring. Secure grant funding for outreach efforts.
- Encourage DCR funding for beach nourishment on Nantasket Beach Reservation.
- Address drainage issues at the Dust Bowl.
- Develop strategies to restrict overwash material from entering Straits Pond.
- Maintain Pemberton Pier for ferry service.
- Increase storm drain outfall capacity. Seek permission to work on the beach.
- Station a generator at the landfill for the main electric feed. Use battery technology.

Low Priorities

- Maintain and update Draper St. drainage pumps.
- Install a permanent generator at the Valley Beach Rd. pump station.
- Incorporate and upgrade an Emergency Operation Center at Town Hall.
- Maintain and preserve the Weir River Woods.
- Investigate alternative plant species for salt marsh that is sensitive to sea level rise.
- Develop a communication system for ferry service when flooding cuts off access to the ferry.
- Pursue Community Preservation Act funds to maintain and protect historic structures. Record historic structures.
- Subsidize commercial fishermen impacted by ecosystem changes. Support wetlands restoration and a Saltmarsh Migration Bylaw.
- Provide public education about Norway Maples and older trees.
- Monitor the seawall along Newport Avenue for rising seas and tides.
- Improve enforcement and education regarding basement apartments and utilities.

No priority listed

- Add people to the Code Red system.
- Consider the cost/benefit of underground utilities. Have National Grid clear trees in the Right-of-Way in Hingham.
- Add a generator at St. Nicholas Church.
- Add a generator at Wellspring.
- Medicaid for All – free up budgets. Look for state grants.
- Improve snow removal and add trees or canopies in the business districts.
- Adopt water conservation bylaws and guidelines. Review regional management of water supply.
- Replicate Wellspring strategies for food access.
- Evaluate emergency and every day transit needs.
- Relocate shelters. Three ADA accessible shelters with overnight capacity are needed.
- Consider propane generators.

CRB WORKSHOP INVITED PARTICIPANTS

* = representative attended

State Senator

State Representative*

Advisory Board*

Beach Management*

Capital Budget Committee*

Board of Health

Board of Selectmen*

Community Preservation Committee*

Conservation Commission*

Design Review Board

Historical Commission
Hull Redevelopment Authority*
Light Board
Planning Board*
Parks and Recreation*
School Committee
Sewer Commission
Zoning Board of Appeals*
Animal Control
Building*
Community Outreach
Conservation*
Public Works*
Council on Aging*
Emergency Management*
Fire Department*
Harbormaster*
Health*
Hull TV
Light Plant*
Planning and Community Development*
Police*
Schools
Sewer*
Town Clerk
Town Manager*
Aquarion
Chamber of Commerce*
National Grid
Weir River Watershed Association*
Straits Pond Watershed Association
Seaside Rescue
Ecumenical Council*
Wellspring Multiservice Center*
Mass Coastal Zone Management*
Mass Department of Environmental Protection*
Mass Bays program*
Mass Department of Conservation and Recreation*
South Shore Elder Services
Village Neighborhood Association
Hull Lifesaving Museum
Sustainable Hull*

CRB WORKSHOP PROJECT TEAM

Hull Core Team

Chris Krahforst	Conservation Administrator, Project Lead
Sarah Clarren	Assistant Conservation Administrator
Chris Dilorio	Director of Planning and Community Development
Bartley Kelly	Building Inspector
Phillip Lemnios	Town Manager

Facilitation Team

Anne Herbst	Metropolitan Area Planning Council (Lead Facilitator)
Martin Pillsbury	Metropolitan Area Planning Council
Barry Keppard	Metropolitan Area Planning Council
Courtney Lewis	Metropolitan Area Planning Council
Sasha Shyduroff	Metropolitan Area Planning Council
Caitlin Spence	Metropolitan Area Planning Council

CITATION

Metropolitan Area Planning Council. 2019. Town of Hull Municipal Vulnerability Preparedness Program. Community Resilience Building Workshop Summary of Findings. Hull, Massachusetts

ACKNOWLEDGEMENTS

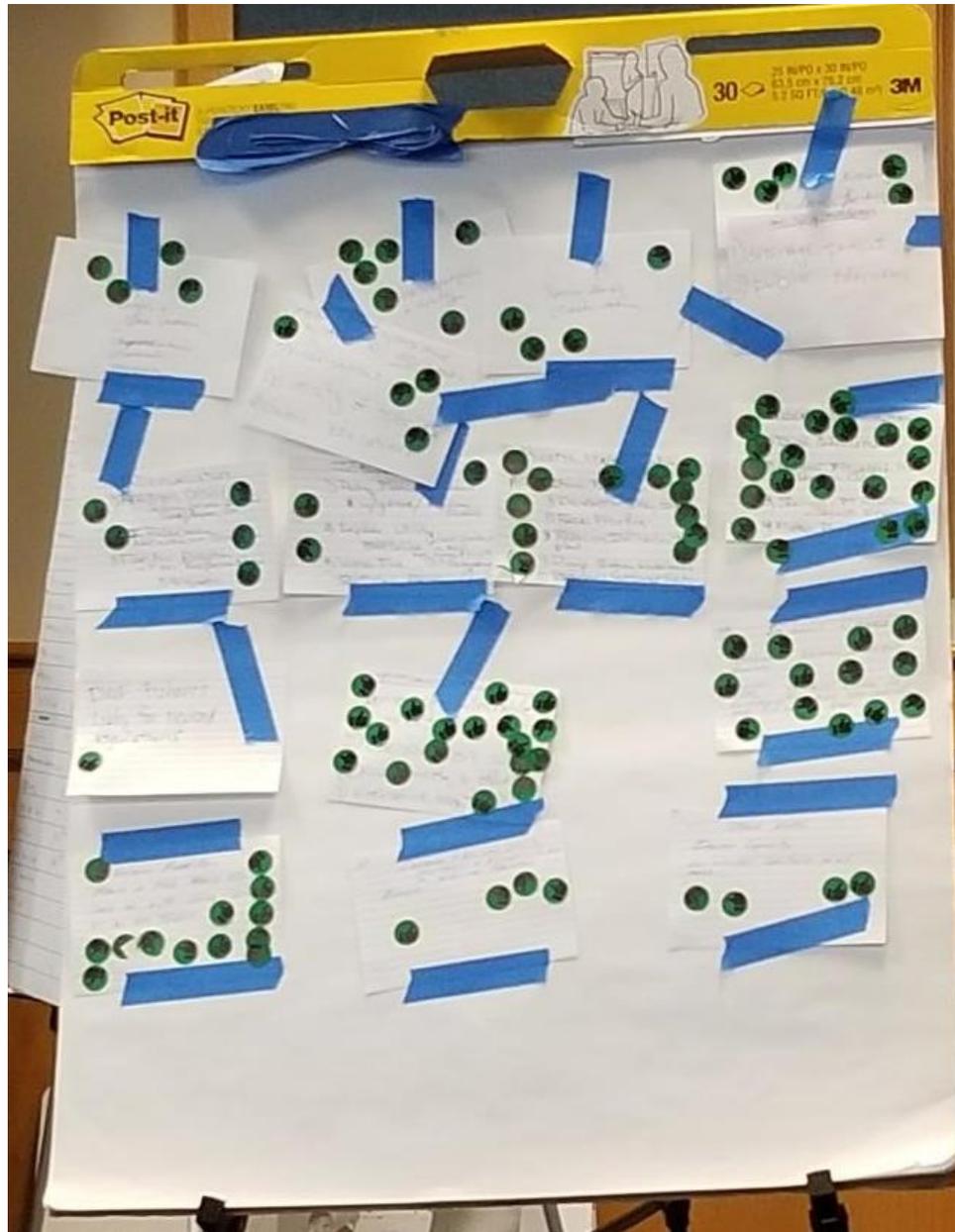
Thanks to the MVP Core Team members and CRB workshop participants. Thank you to the Tufts University students who served as note takers. Funding for the CRB Workshop was provided by the Commonwealth of Massachusetts through a grant from the Municipal Vulnerability Preparedness program.

REFERENCES

Kleinfelder. 2016. Coastal Climate Change Vulnerability Assessment and Adaptation Study Town of Hull Final Report

MAPC. 2018. Town of Hull Hazard Mitigation Plan 2018 Update

Action Prioritization



Base Map

Hull Critical Infrastructure

Sea level rise and increasing large rainfall events may subject roads, bridges, dams and buildings to more frequent or severe flooding. Areas that don't flood today may become vulnerable. Power outages affecting infrastructure and communications may become more frequent as result of high energy demand during heat waves. Winter outages could be caused by ice storms if warming results in temperatures hovering around freezing. The potential for more intense hurricanes could cause outages due to falling trees. Finally, buildings, roadways, and railways can be stressed by extreme heat. Heat can cause damage to expansion joints on bridges and highways, and may cause roadways to deteriorate more rapidly.

Other Features

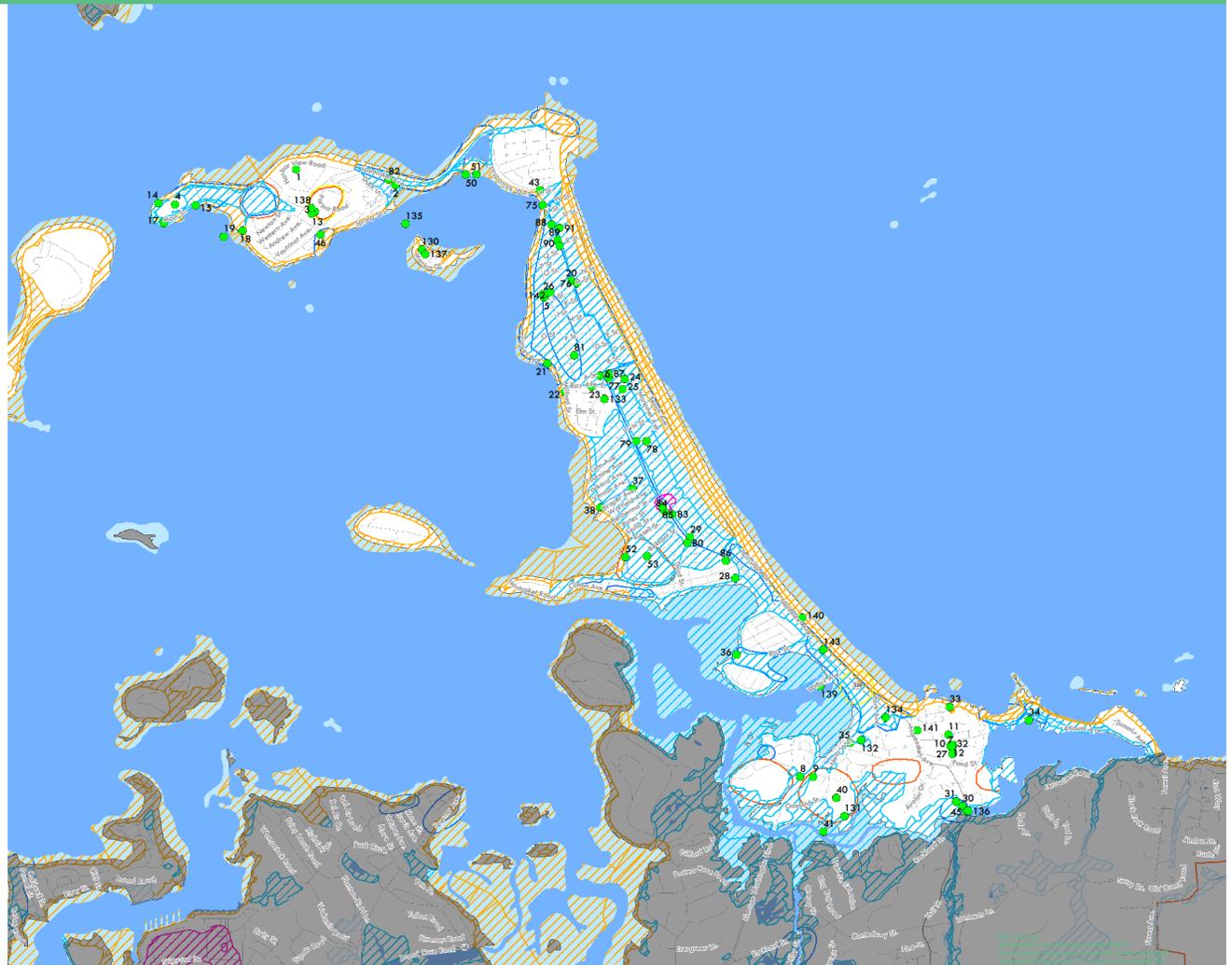
-  Rivers and Streams
-  Water Bodies
-  Critical Infrastructure

Hazards

-  Hot Spots*
 -  A: 1% Annual Chance of Flooding
 -  VE: High Risk Coastal Area
 -  X: 0.2% Annual Chance of Flooding
- Locally Identified Hazard Areas**
-  Brush Fire
 -  Flooding
 -  Snow

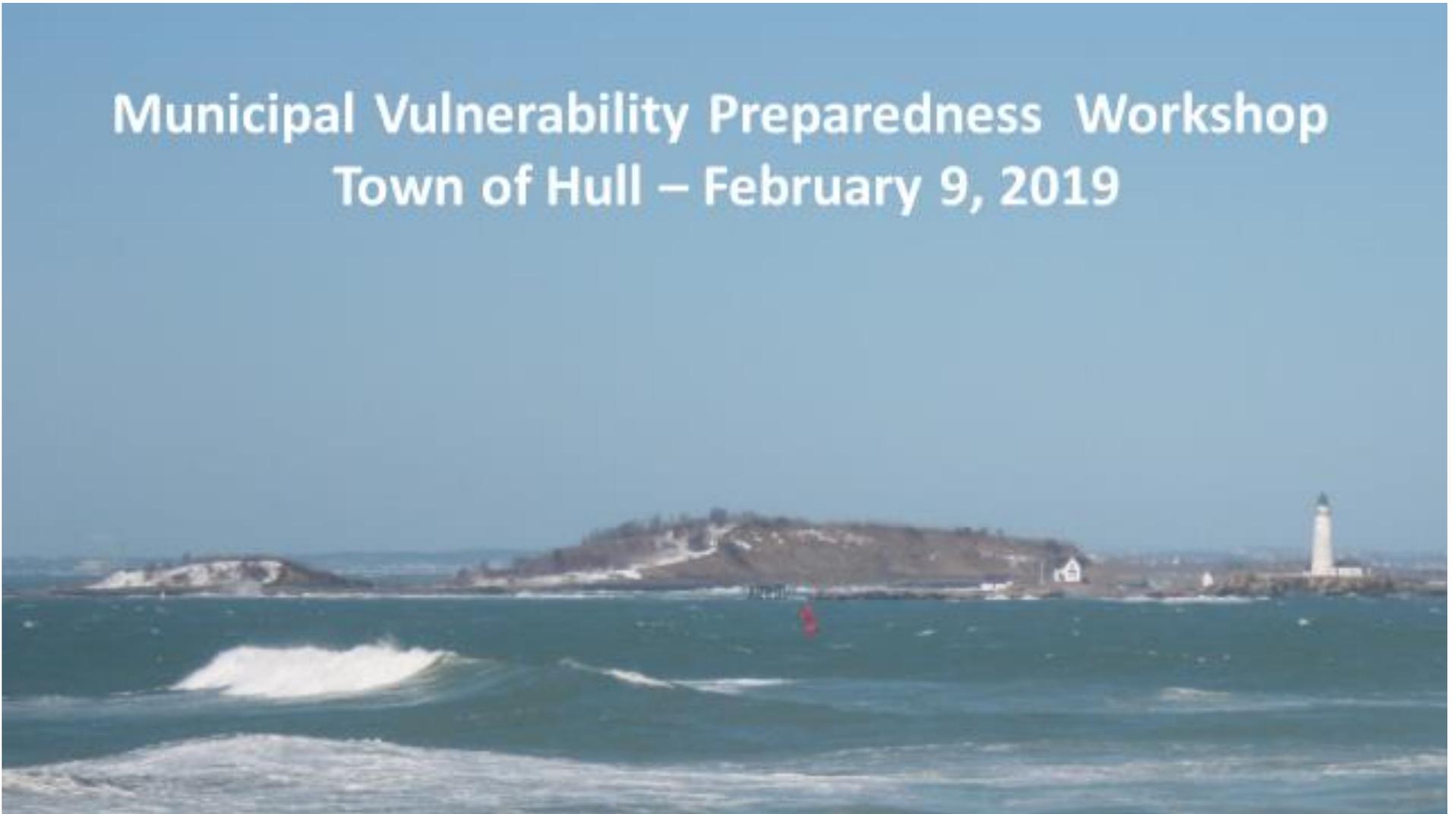
*Hot Spots are areas identified by MAPC as the hottest 5% of land area in the MAPC region. Data from 2016.

Label	Facility	Label	Facility
1	Ullian M. Jacobs School	43	Drinking Water Booster Pump
2	Hull Sewer Plant	45	West Corner Culvert
3	Gould Hall	46	Hull Public Library
4	Hull High School	50	Hull Yacht Club
5	Hull Memorial School	51	Hull Salt Water Club
6	Hull Fire Dept	52	Newport Road Dike
7	Hull Police Dept	53	WBZ TV Towers
8	Hull Medical Facility	75	Sunset Marina
9	Hull Teen & Woman's Clinic	76	Nantasket Preschool
10	Hull Fire Dept- Green Hill	77	North River Bus Company
11	McTigue Manor	78	Hodassch Way Temple Complex
12	Hull Town Hall	79	Hull Community Nursery School
13	Village Fire Station	80	Boy Scout Building
14	Hull Wind Mill 1	81	Hull Public Housing
15	Waste Water Pump Station 9	82	Hull Lifesaving Museum
17	Life Saving Boat House	83	Nantasket Pharmacy
18	Pt. Allerton Coast Guard Station	84	Village Grocery Store
19	Coast Guard Boat House	85	US Post Office
20	Waste Water Pump Station 6	86	Cumberland Farms
21	Storm Water Pump Station	87	Seven-Eleven
22	Sunset Bay Marina	88	Doley and Wanzler Moving & Storage
23	Tri Town Baptist Church	89	Cumberland Farms
24	Saint Anne's Church	90	Allerton Post Office
25	Anne Sully's Senior Center	91	Wellspring
26	Memorial School Shelter	130	Water Pump
27	Fuel Depot	131	Hull Wind Mill 2
28	Municipal Light Dep't.	132	Communications Shed
29	Knights of Columbus	133	Communications Tower
30	DPW Barn	134	Verizon Communications Tower
31	DPW Salt Shed	135	Water Pipe - 6" Main
32	Public Safety Dispatch Center	136	Gas Line
33	Waste Water Pump Station A	137	Water Tanks In Bunker
34	Waste Water Pump Station 1	138	St. Nicholas United Methodist
35	Waste Water Pump Station 3	139	Harbormaster's Office
36	Waste Water Pump Station 4	140	Nantasket Beach Resort
37	Waste Water Pump Station 5	141	Nantasket Hotel
38	Storm Water Pump Station	142	Emergency Operations Center
40	Hull Landfill	143	DCR Hqs., Fuel Station, Barracks
41	Town Power Line		

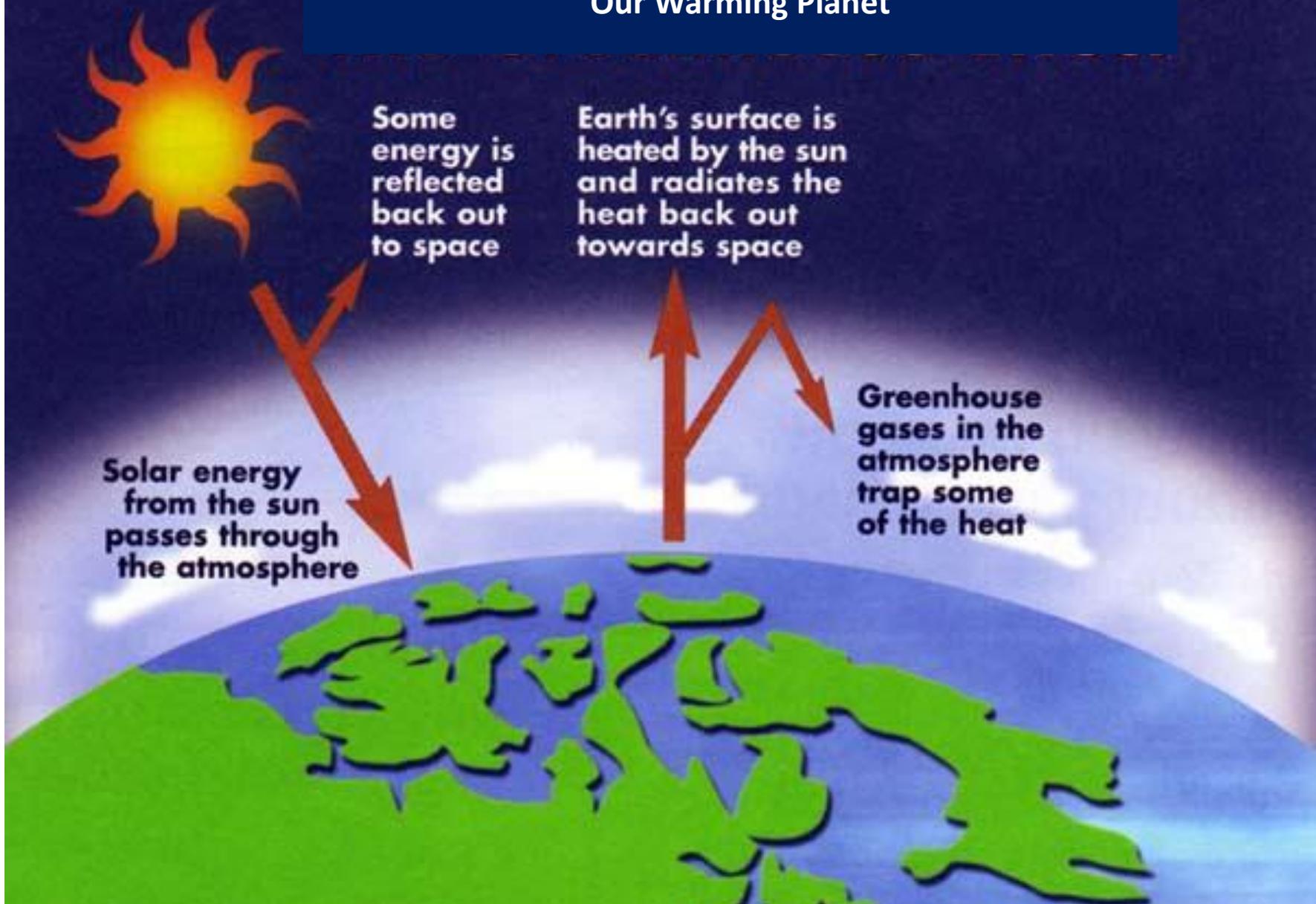


PowerPoint

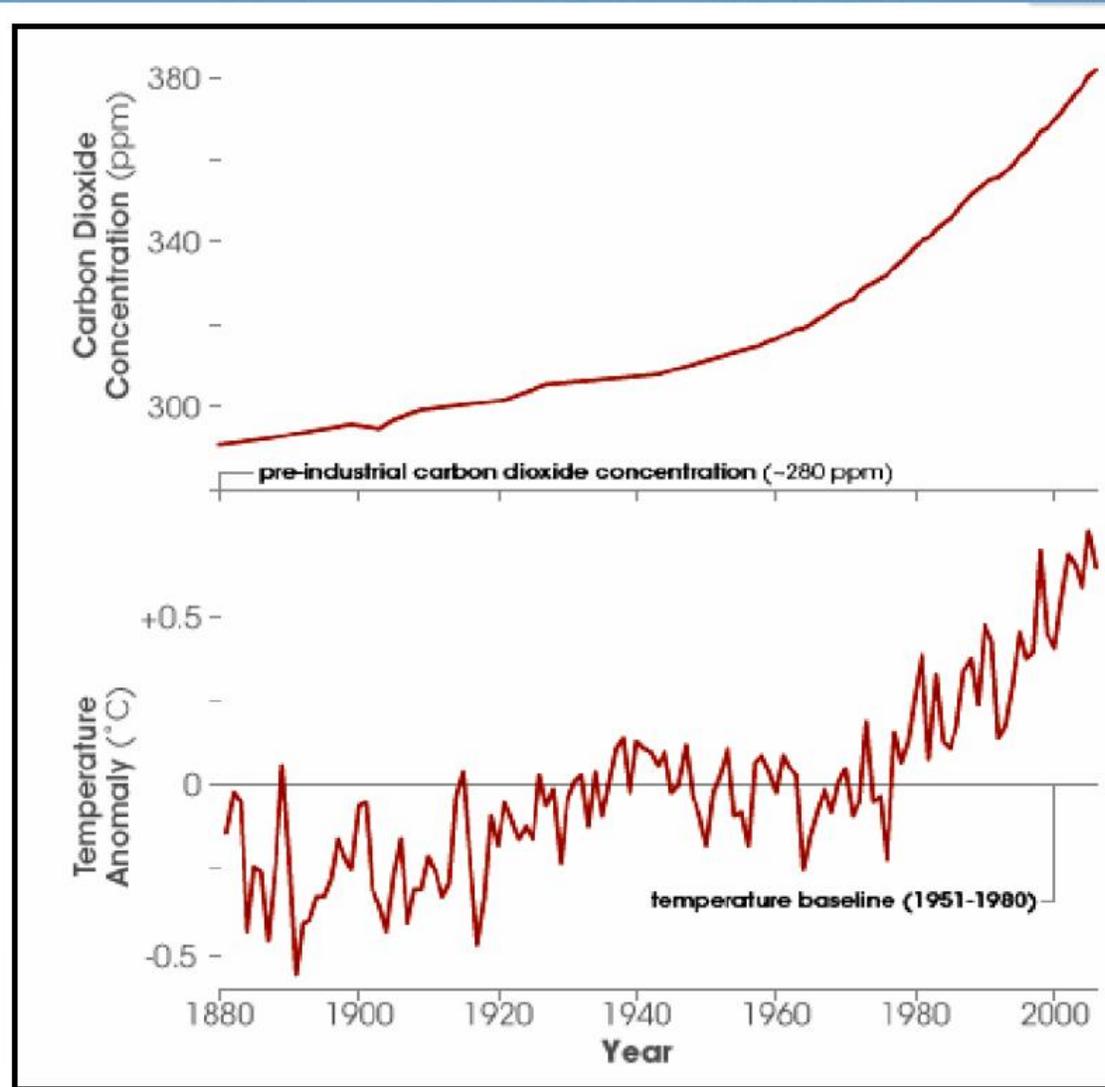
Municipal Vulnerability Preparedness Workshop Town of Hull – February 9, 2019



Our Warming Planet

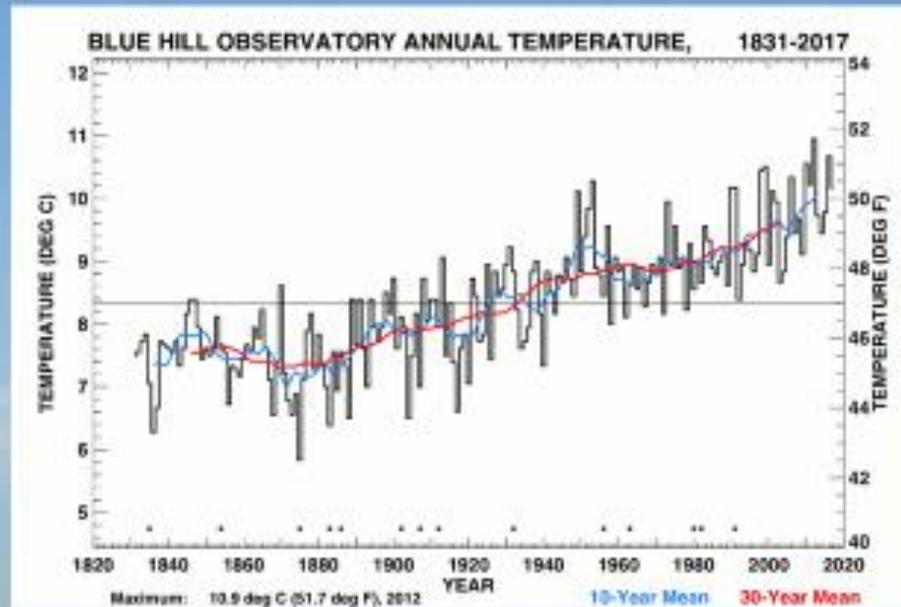


Global Temperature and CO₂ Trends



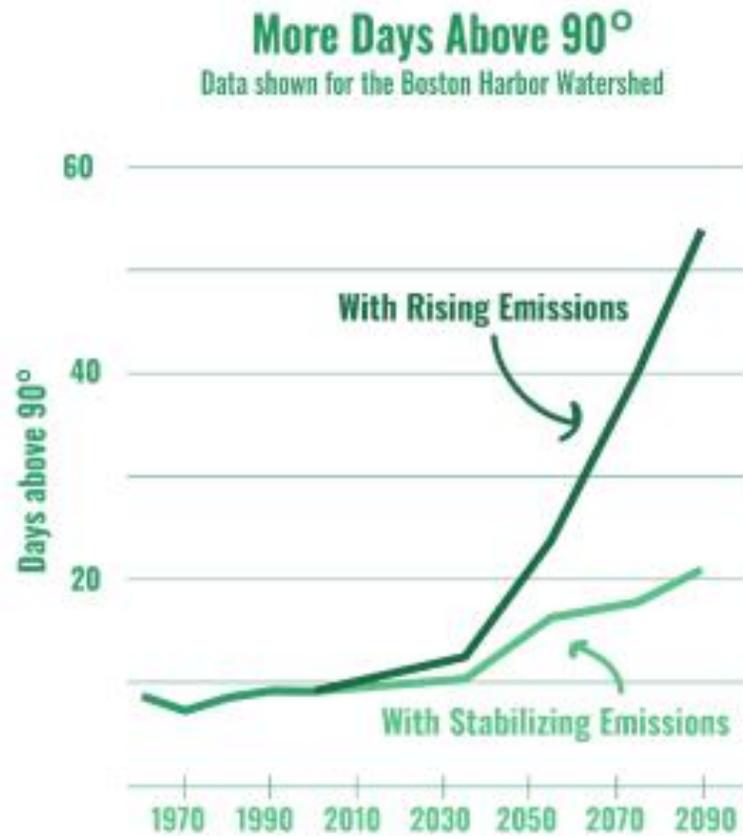
Temperature change: observed

For the Northeast United States: temperature increased by almost 2 degrees, between 1895 and 2011 (US National Climate Assessment 2014)



Blue Hill Observatory Annual Temperature, 1831-2017

Temperature
change:
projected

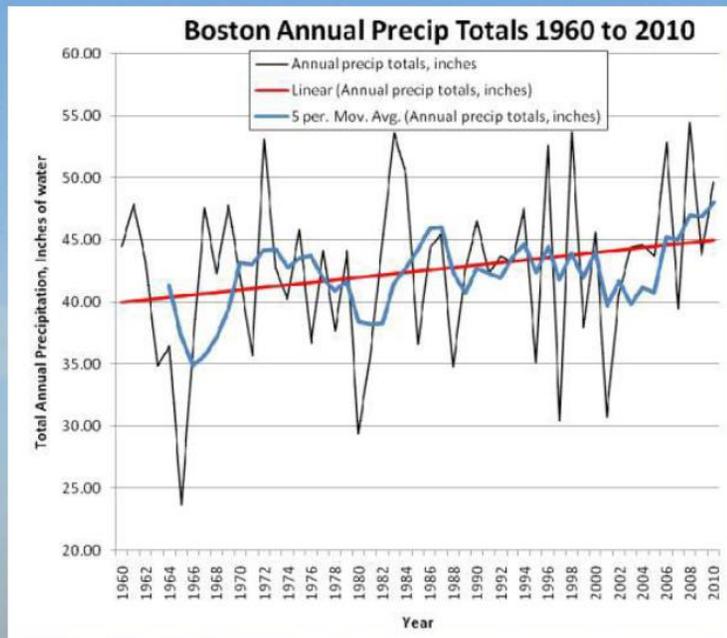
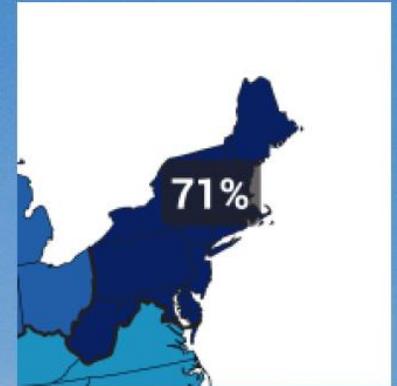


Source: Northeast Climate Adaptation Science Center

Precipitation change: observed

For the Northeast United States: 71% increase in the amount of rain that falls in the top 1% events from 1958 – 2012.

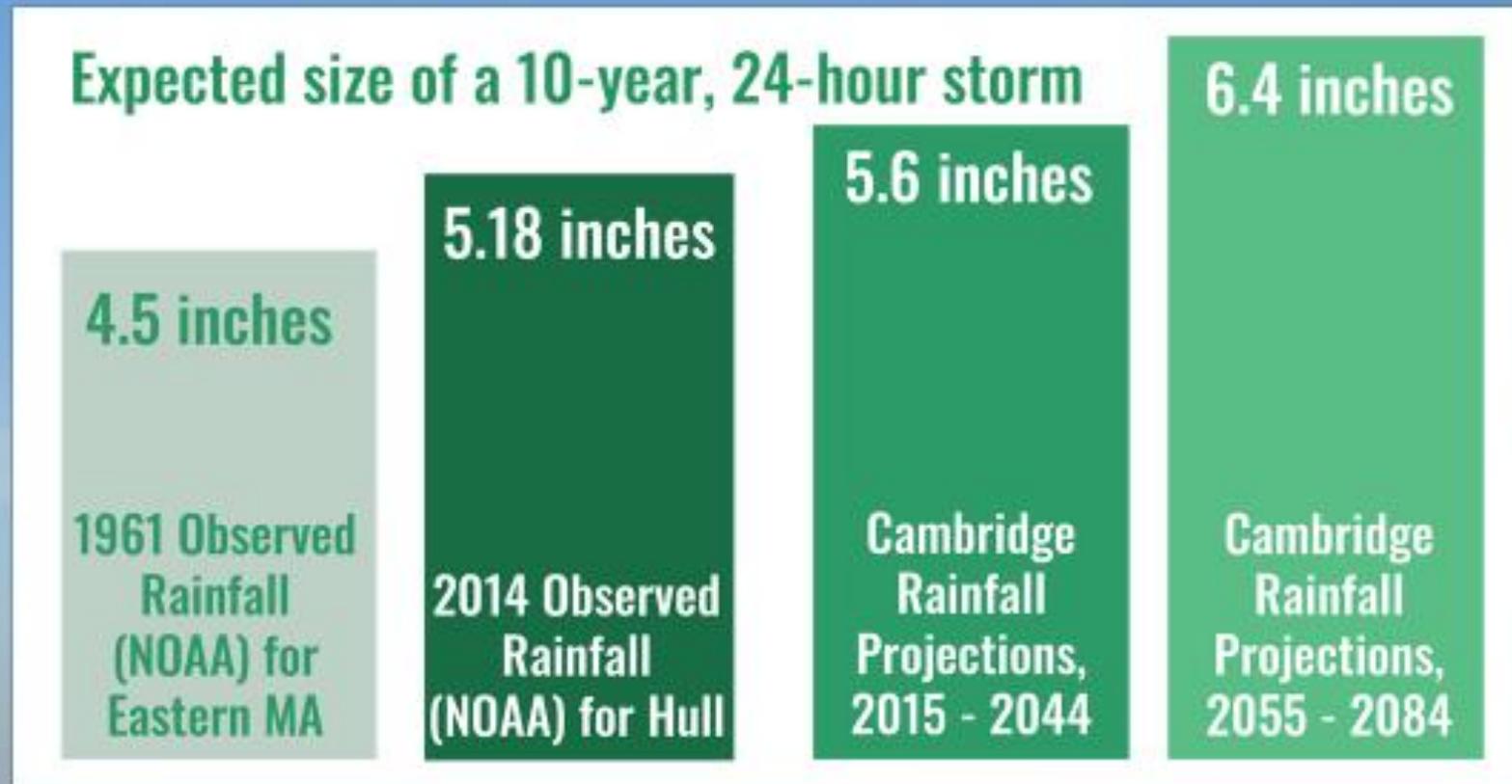
Source: US National Climate Assessment 2014



Source: MA Climate Change Adaptation Report 2011

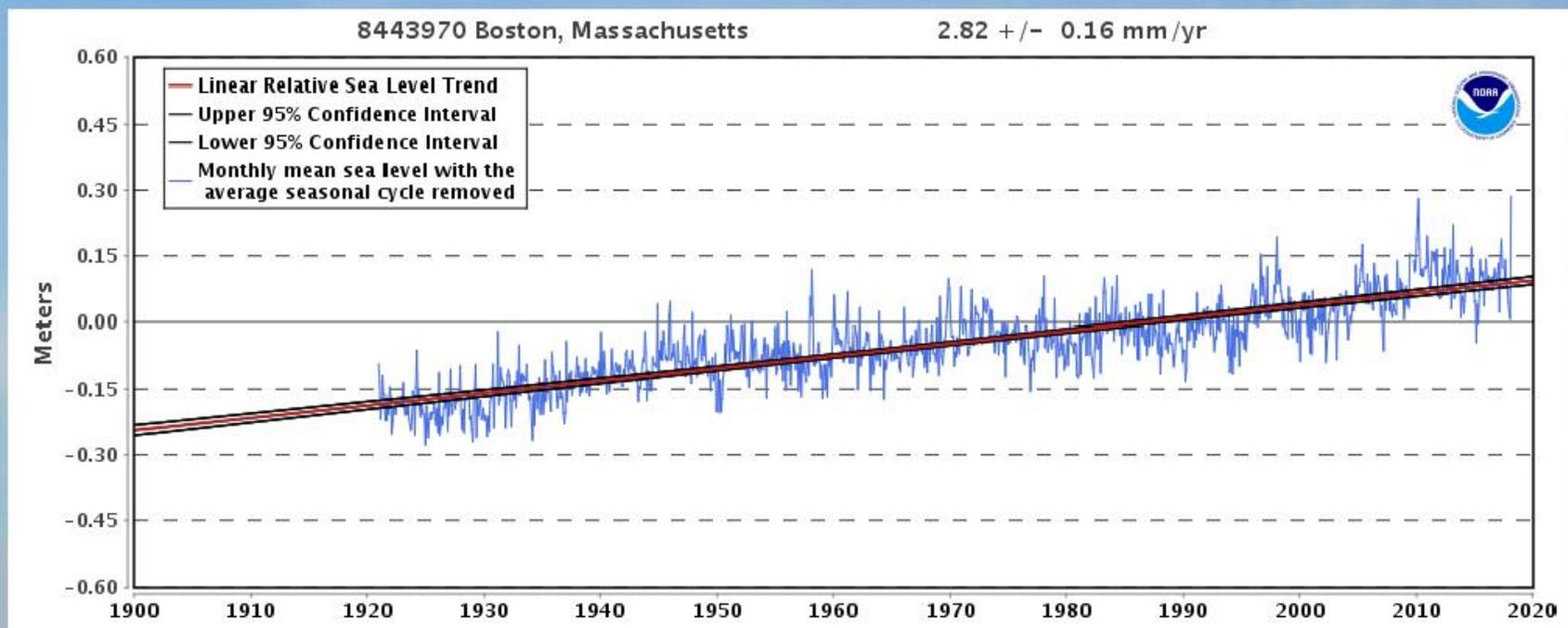
For Boston area: 10% increase over the past 50 years

Precipitation change: projected

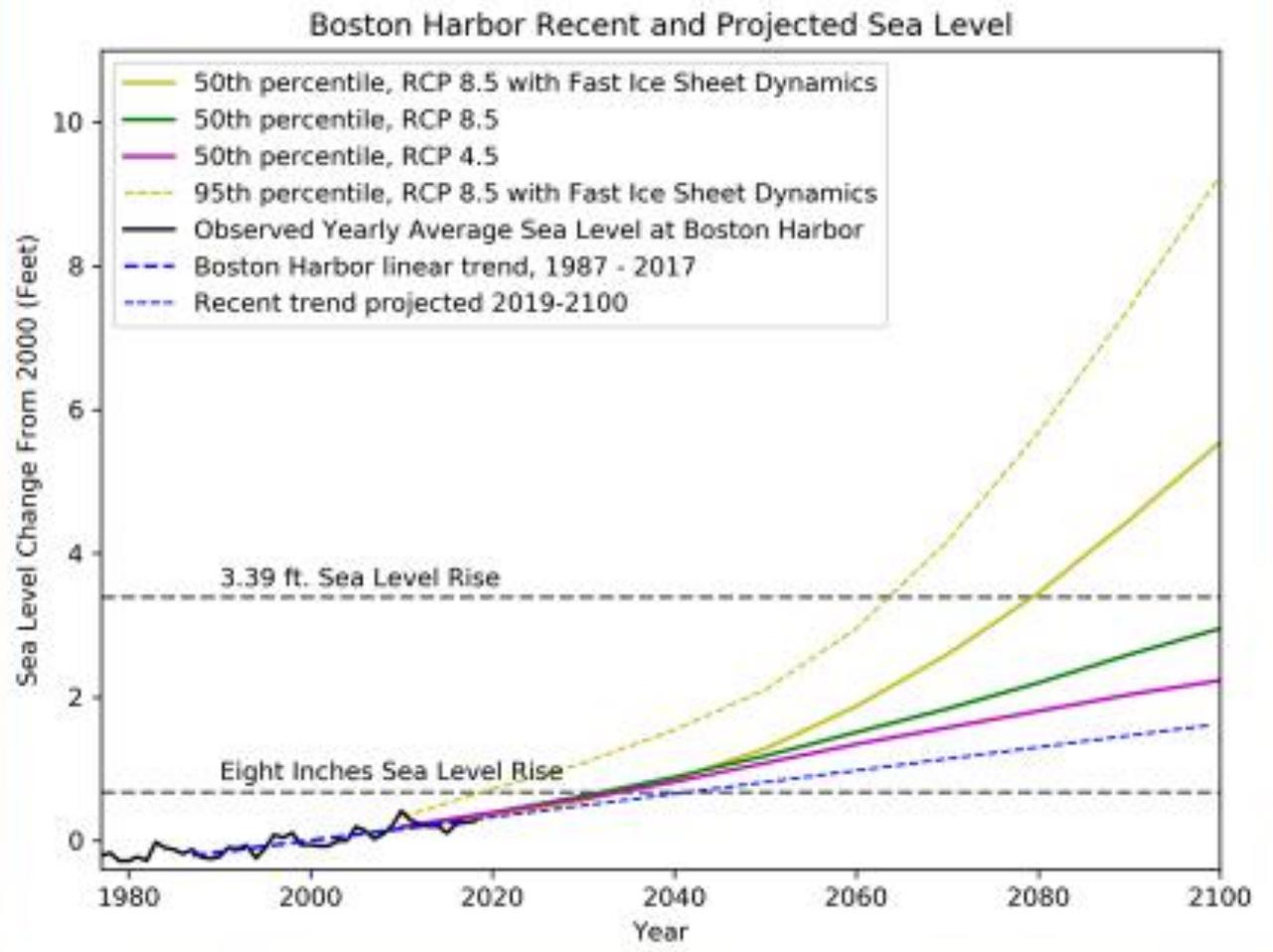


Sea level rise: observed

- Boston tide station
- Record from 1921-2017
- Equivalent to 11 inches in 100 years

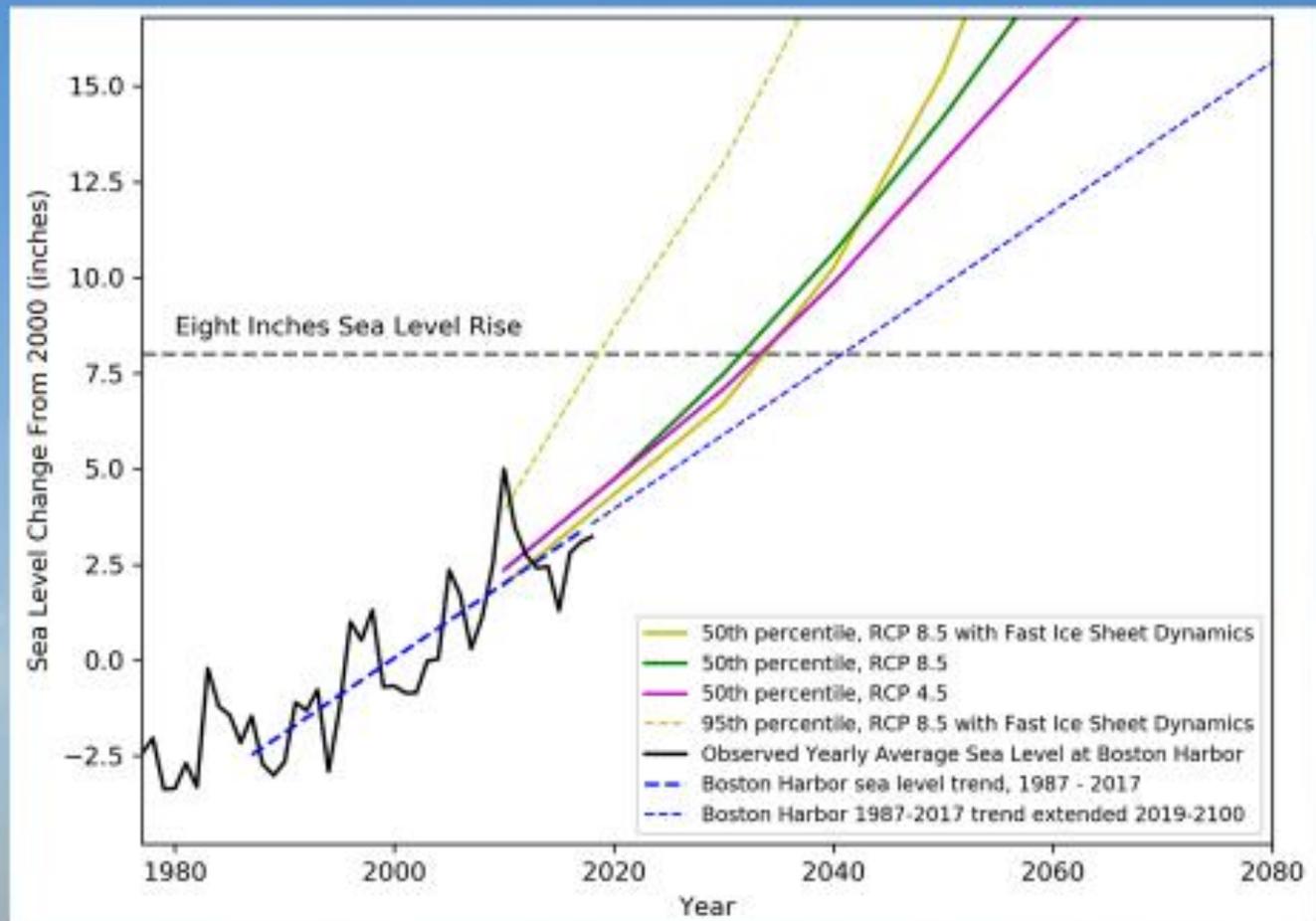


Sea level rise: Projected to 2100 for Boston Harbor



Source: Northeast Climate Adaptation Science Center and MAPC

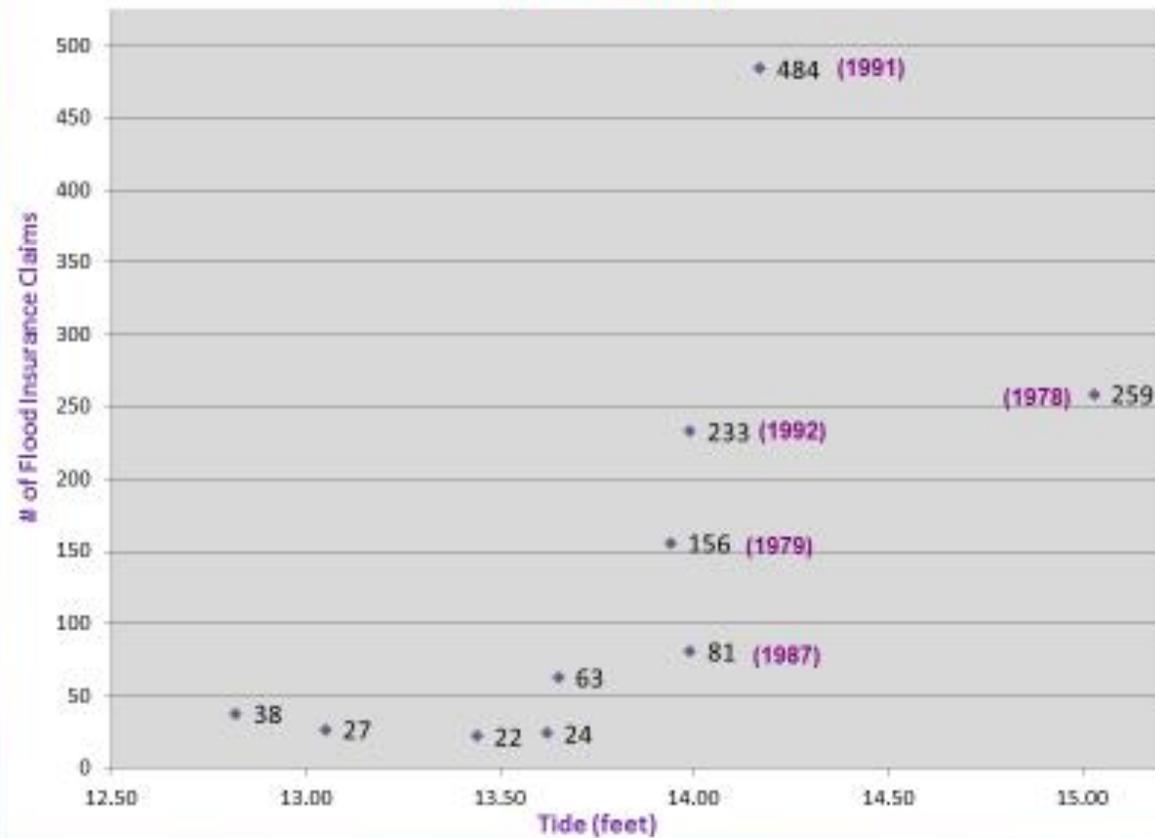
Sea level rise: projection for 8 inches



Source: Northeast Climate Adaptation Science Center and MAPC

Storm surge and flood insurance claims

Northeast Storms in Hull Top Ten Flood Insurance Claims (1978-2013)



Hull

Social Vulnerability

Social vulnerability refers to social, economic, demographic, or health factors that may make groups of people less resilient to climate change impacts. Certain vulnerabilities tend to be correlated: for example, older adults are more likely to have a disability and live alone than younger adults.

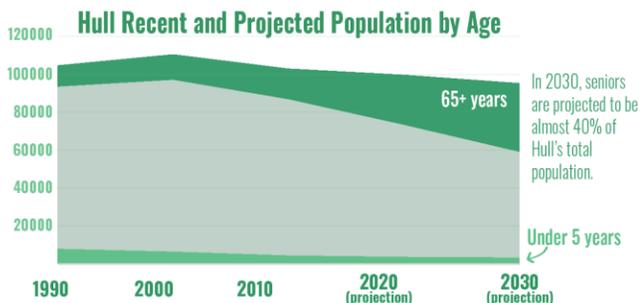
Who is most at risk from climate change impacts?

People who may be more susceptible to negative health effects: These can include older adults, young children, pregnant women, people with disabilities, and people with pre-existing health conditions, as they are more likely to be physically vulnerable to the health impacts of extreme heat and poor air quality. Individuals with physical mobility constraints, such as people with disabilities and seniors, may need additional assistance with emergency response.

People who may have more difficulty adapting to, preparing for, or recovering from extreme weather events: Socioeconomic characteristics such as income and race can influence vulnerability to climate change. Low-income people are often more susceptible to financial shocks, which can occur after extreme weather and which can impact financial security and the ability to secure safe shelter, access sufficient food, and meet medical needs. Social isolation can also influence vulnerability, as it limits access to critical information, municipal resources, and social support systems. People at the most risk for social isolation include those living alone and people with limited English language proficiency.

People who live or work in vulnerable locations: Historic or predicted floodplain, urban flooding locations, areas prone to wildfire, heat islands, neighborhoods prone to power outages. Outdoor workers, first responders, those working in hot indoor environments.

Older Adults and Young Children



People Living Alone



Low Income Households



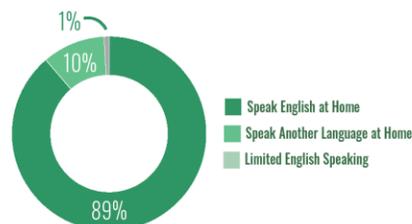
*A four-person household earning less than \$78,150 is considered low-income; a four-person household earning less than \$24,563 is below poverty level

People Who Work Outside

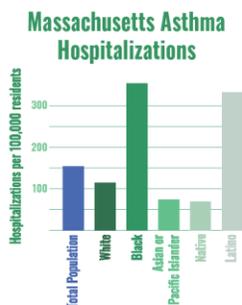
People who work outside on the land or on water, including first responders and other town employees, construction workers, or landscapers, may be at added risk from extra exposure to extreme weather and poor air quality.



Limited English Speakers



People with Health Conditions



Communities of Color

Particular racial or ethnic groups may also be more likely to have certain social vulnerabilities than others. For example, Black and Latino populations have a much higher rate of asthma hospitalizations than other groups.

Although over 94% of the town's population is white...

Populations of color have increased since 1990.



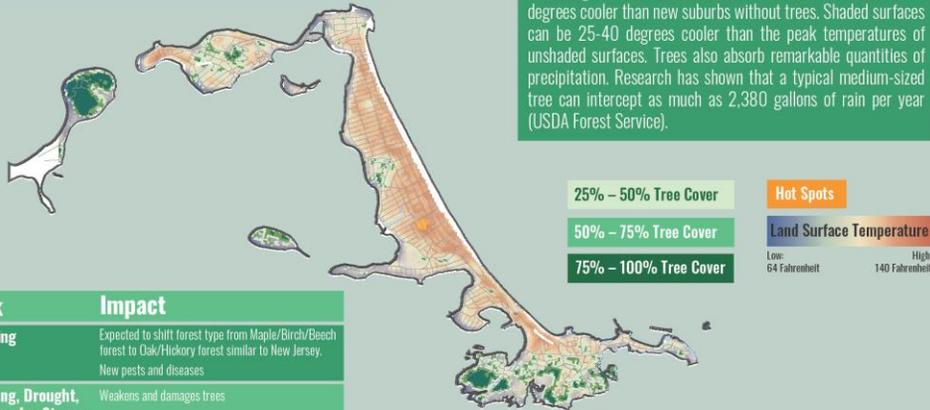
Sources: American Community Survey (ACS) 2012-2016; United States Census 1990, 2000, 2010; MAPC Projections; Massachusetts Department of Public Health Asthma Data, 2008-2012

Hull

Natural Resources

Natural Resources lessen climate impacts by absorbing and storing carbon dioxide and by serving vital protective functions. Forests, open space, wetlands, rivers, and streams protect drinking water quality and quantity, provide flood control, and give relief from extreme heat. Salt marsh and coastal beaches, banks, and dunes protect against storm surges. Healthy ecosystems are more resistant to stresses from a changing climate and better able to protect against heat and flooding.

Trees

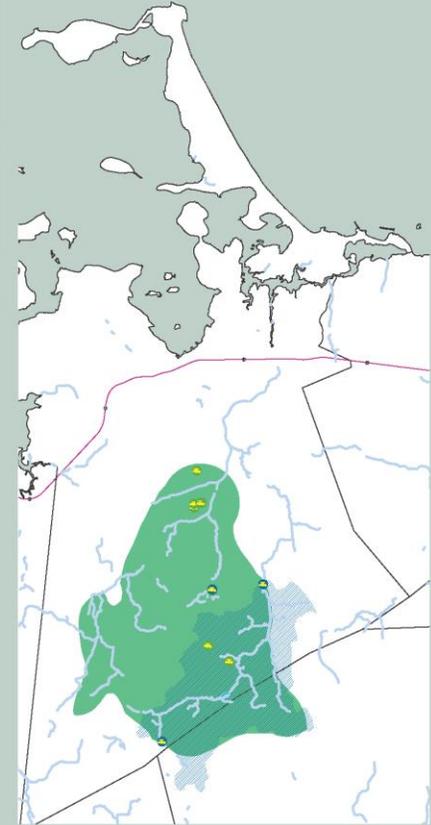


Freshwater Resources

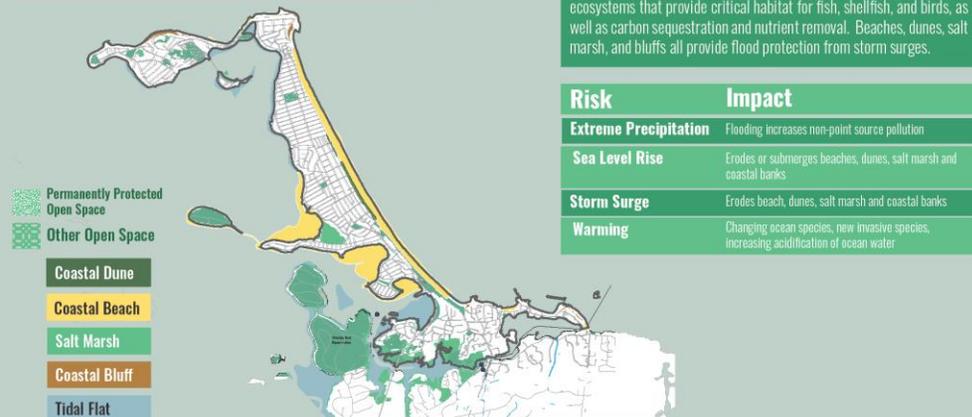
Hull has extremely limited freshwater (Weir River Woods), but its drinking water comes from the Weir River watershed. It is supplied by wells, and surface water taken from Accord Pond and Brook, in Hingham.

Risk	Impact
Drought/Warming	Seasonal no-flow/low-flow, stress to aquatic organisms, reduced drinking water supply
Flooding	Impaired waters, sewer overflows

- Community Groundwater Source
- Surface Water Intake
- Hull Surface Water Supply Area
- DEP Approved Wellhead Protection Area



Coastal Resources



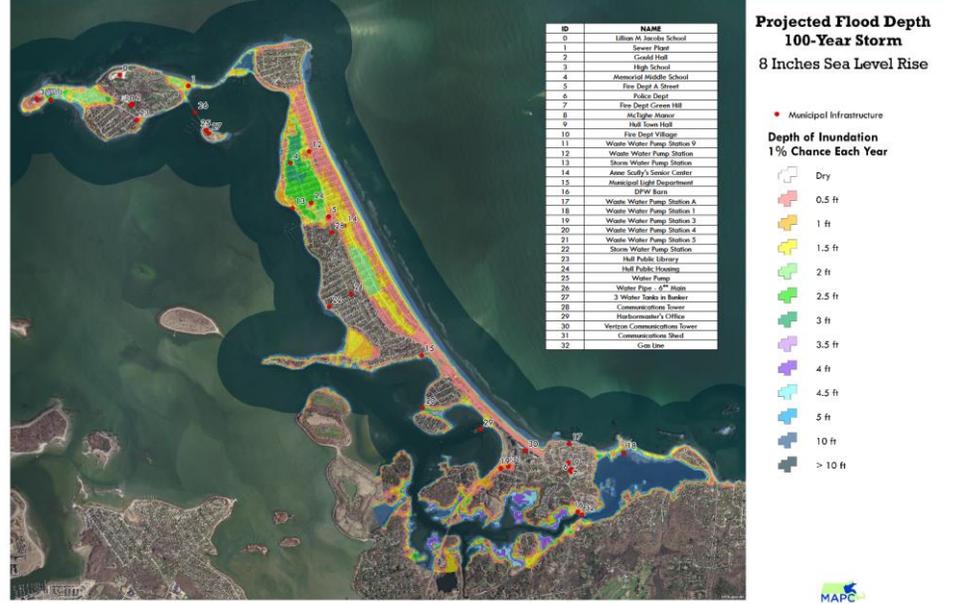
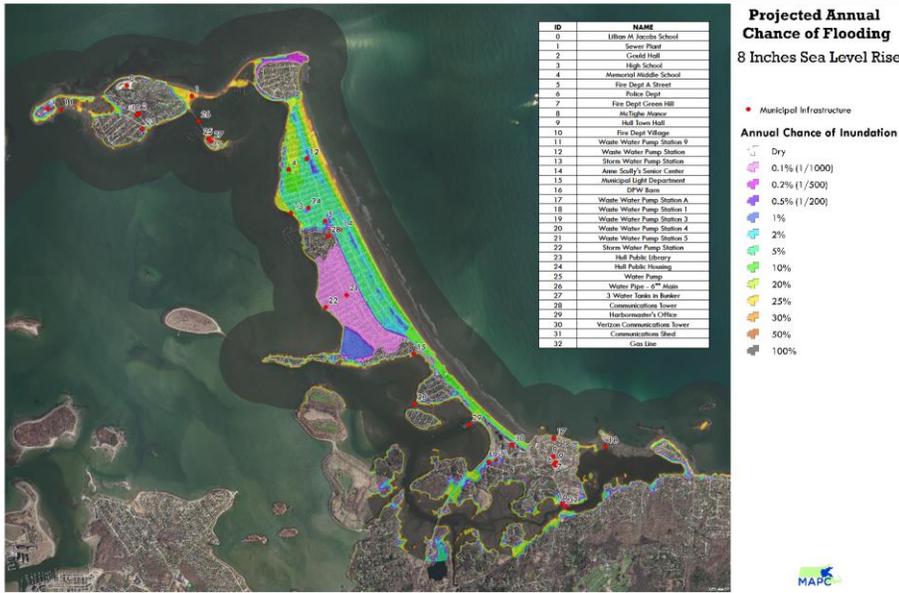
Sources:
¹ Tree Landscape, Processed on Sept. 10, 2018 | ² Natural Heritage and Endangered Species Program, Conserving the Biodiversity of Massachusetts in a Changing World
 MassGIS (Bureau of Geographic Information); BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World; Massachusetts Department of Fish and Game; Massachusetts Department of Environmental Protection; MassGIS (Bureau of Geographic Information); National Land Cover Database (NLCD)

Hull Built Environment

Coastal storms are projected to subject roads and buildings to more frequent and severe flooding. Flooding may also result from increasing large rainfall events. Power outages affecting infrastructure and communications may become more frequent as a result of high energy demand during heatwaves. Winter outages may increase as a result of more energetic winter storms and hurricanes.

Hull Built Environment

Coastal storms are projected to subject roads and buildings to more frequent and severe flooding. Flooding may also result from increasing large rainfall events. Power outages affecting infrastructure and communications may become more frequent as a result of high energy demand during heatwaves. Winter outages may increase as a result of more energetic winter storms and hurricanes.



Map Source: Kleinfelder: Coastal Climate Change Vulnerability Assessment and Adaptation Study, Town of Hull, MA, June 30, 2016. Modeling from Woods Hole Group, Boston Harbor Flood Risk Model (BH-FRM). These maps are unrelated to FEMA flood maps. The flood scenarios shown here include only coastal surge flooding, not flooding from rainfall and runoff. The future flood scenarios shown in the maps are derived from combinations of sea level rise projections and changes in coastal storm intensity (winds become more severe at the end of the century). The map was developed through rigorous but approximate physically-based modeling, so borders of the floodplain and flood likelihood categories should not be interpreted as exact. Maps should not be used to assess flood hazard at the single-building level.

Map Source: Kleinfelder: Coastal Climate Change Vulnerability Assessment and Adaptation Study, Town of Hull, MA, June 30, 2016. Modeling from Woods Hole Group, Boston Harbor Flood Risk Model (BH-FRM). These maps are unrelated to FEMA flood maps and show only storm surge depth. The future flood scenarios shown in the maps are derived from combinations of sea level rise projections and changes in coastal storm intensity (winds become more severe at the end of the century). The map was developed through rigorous but approximate physically-based modeling, so borders of the floodplain and flood likelihood categories should not be interpreted as exact. Maps should not be used to assess flood hazard at the single-building level.

APPENDIX B – TABLE MATRIX RESULTS

Participants were divided into small groups identified as Blue, Green, Purple, or Red. Concerns were categorized as Environmental, Infrastructure, or Society. Participants identified climate-related strengths and vulnerabilities for Hull. Solutions were proposed for the vulnerabilities. Solutions were then prioritized as High, Medium, or Low. Each table was asked to identify their top four priorities. The information was recorded in a matrix for each table and is reproduced in the chart below.

Table	Category	Strengths (S) & Vulnerabilities (V)	V/S	Solutions	Priority
Blue	Infrastructure	Wastewater Treatment Plant	V	Strengthen, elevate, upgrade	L
Blue	Infrastructure	DPW building, salt and sand location	V	Protect/elevate structure, manage materials use	M
Blue	Infrastructure	Fire Station (A Street)	V	Elevate or relocate	M
Blue	Infrastructure	Town Hall/Public Safety Office	S	Upgrade and incorporate EOC	L
Blue	Infrastructure	Fitzpatrick Causeway and utilities	V	Reconstruct and elevate	H
Blue	Infrastructure	Lower Nantasket Road (DCR area)	V	Beach nourishment – DCR funding	M
Blue	Infrastructure	Stormwater	V	Improve capacity – adopt LID ordinance, consider special limits	H
Blue	Infrastructure	Town power source comes from outside (Hingham)	V	Have generator for main feed at landfill. Use battery technology, renewable energy	M
Blue	Infrastructure	Seawall and dune	V	Need more and better. Consider bio-engineering options	H
Blue	Infrastructure	Development NBO	V	Emergency Management Plan	M
Blue	Society	Aging population, people who are isolated living alone, Single-room-occupancies	V	Identify best practices, start planning, assess size and location of these populations	H
Blue	Society	Weather savvy communication (town)	S		
Blue	Society	List of vulnerable residents (town)	S		

Blue	Society	Sense of community support	S		
Blue	Society	Food access (during emergencies)	V	Replicate Wellspring strategies	
Blue	Society	Limited mobility – not much public transportation	V	evaluate for emergency or everyday use	
Blue	Society	Medical services – also limited	V		
Blue	Society	Wellspring (private social services)	V	This is a strength	
Blue	Society	Hull Public Library	V		
Blue	Environment	Hull location makes it vulnerable	V	Improve awareness and outreach	M
Blue	Environment	Dune/beach system	S/V	Fill in gaps	M
Blue	Environment	WBZ Marsh	S	Repair the tide gate	M
Blue	Environment	Weir River Woods	S	Maintain and preserve it	L
Blue	Environment	Draper St. drainage	S	Maintain and update it	L
Blue	Environment	Straits Pond and Gate	S		L
Blue	Environment	Hills and elevated areas	S		
Blue	Environment	Tree cover	V	Encourage planting	L
Green	Infrastructure	Memorial Middle School - flooding	V	Flood proof, relocate emergency shelters (ADA accessibility) need 3 shelters with overnight capacity	
Green	Infrastructure	Hull Sewer plant – flooding	V	Ensure adequate pumps	H
Green	Infrastructure	Hull Shore Drive extension (State/DCR ownership) flooding, and other roadways as well	V	Raise roadway above sea level rise predictions	H
Green	Infrastructure	Nantasket Avenue/Causeway – flooding	V	Do feasibility study to elevate or consider other options	H
Green	Infrastructure	Elevation and improvement of Atlantic Avenue seawall	S/V	Finish seawall construction	H

Green	Infrastructure	Sunset Avenue/Cadish Avenue – flooding	V	Feasibility for raising the road, or adding a seawall	H
Green	Infrastructure	Senior Housing – needs to be elevated, needs a generator	S/V	Needs generator and ability to shelter in place. Approve CPC warrant at town meeting	H
Green	Infrastructure	Water supply (private-Aquarion) see Environment	V	Review regional management	
Green	Infrastructure	Electric utility – strength – town owned, loss of power – line from Hingham, wires and poles	S/V	Consider cost/benefit of underground wires. Have National Grid clear ROW from Hingham (power outages from tree branches)	
Green	Infrastructure	Stormwater – pumping stations, and lack of drainage	V	Implement actions from drainage system study, maintain catch basins, add GI/LID to Complete Streets policy	
Green	Infrastructure	Beach Avenue	V	Consider beach migration and closure long-term, need to consider ownership	H
Green	Infrastructure	George Washington Blvd (state-owned)	V	Ensure maintenance, do feasibility study on elevating road	H
Green	Infrastructure	Tide culvert/gate on the Bayside	V	Fix it, then maintain it	M
Green	Infrastructure	Pemberton Pier ferries (MBTA)	V	Keep up maintenance	M
Green	Infrastructure	Ocean Avenue flooding	V	Address drainage at the Dust Bowl	M
Green	Infrastructure	Village Fire Station – cut off during floods	V	Station full-time ambulance , keep truck at Coast Guard as backup	H
Green	Infrastructure	Town Hall (including police and fire)	S/V	Location is a strength, feasible to use as shelter if fixed up	M
Green	Infrastructure	Jacobs School – has partial generator, location is a strength	S	Possible shelter	M
Green	Infrastructure	Hampton Circle – flooding	V	Implement drainage, consider wall and elevation, ensure adequate pumps	H
Green	Infrastructure	DPW, Police and Fire – subject to salt water in storms	V	Improve maintenance, invest in high water vehicles, Duck Boats	H

Green	Infrastructure	High School – flooding	V		M
Green	Infrastructure	Lack of bike lanes and paths – multimodal options	S/V	Add bikeways for better access. Evacuation route along railroad bed	H
Green	Society	St. Nicholas Church	S/V	Add a generator , use for community collaboration/ training and education	
Green	Society	Wellspring Multiservice Center, provides services, no generator	S/V	Add a generator	
Green	Society	Business Districts	V	Add trees or canopies/ green roofs in hot spot better snow removal program	
Green	Society	Coast Guard (Federal)	S		
Green	Society	Seniors/aging population – no system of notification	V	Simplified messaging and communication in emergencies, update list and ongoing communication between senior support and emergency communications	H
Green	Society	Code Red system opt-in	S	Add people to system	
Green	Society	Low income population – inability to pay for recovery from storms	V	Communication about CDBG and other grants, need temporary housing during recovery	H
Green	Society	No cooling center, heat waves strain power system	V	Implement cooling center for above 90 degree days,	H
Green	Society	Emergency services strained by people coming to Hull (heat waves)	V	Alert people before they get over the bridge when beach closes	H
Green	Society	Town government	S/V		
Green	Society	Hampton Circle population (gets cut off during floods)	V	Make sure they have access to information, are in the emergency management plan	H
Green	Society	Strong community	S		
Green	Society	Social media and emergency management	S		

Green	Society	Educated about the issues – used to storms	S		
Green	Society	Budgeting (is a challenge)	V	Medicaid for all, free up local budget, grants from state	
Green	Society	Increasing flood insurance premiums	V	Low-cost loans to reduce premiums, possibly through CDBG	H
Green	Society	Zoning – majority built out	S/V	Review zoning to add resilience, like height restrictions	H
Green	Society	Handicap accessibility – sidewalks and shelters	V	Ensure new shelters are ADA compliant, bring sidewalks into compliance	H
Green	Environment	Dunes and beach grass planting - strength that work is done, needs more work	V/S	Need a continuous dune system and ongoing beach grass planting	H
Green	Environment	Lack of dunes on private property	V	Use eminent domain – it is a public safety hazard	H
Green	Environment	Drinking water – drought, aging pipes, no town control of system	V	Review regional management, fix pipes, implement water conservation bylaws and guidelines	
Green	Environment	Beach loss and erosion. DCR and town beach	V	Renourishment, implement DCR master plan, install snow fences	H
Green	Environment	Bayside marsh and dike culvert/tide gate. (town and WBZ?)	S/V	Fix the tidegate	
Green	Environment	Weir River estuary – vulnerable to SLR, loss of wetlands	S		
Green	Environment	Lack of trees – wind risks, maintenance	V	Street tree planting in strategic areas, tree ordinance for new development	H
Green	Environment	Amount of coastline	S/V		
Green	Environment	Too much pavement- not always walkable in the heat	V	Implement Complete Streets policy	H
Green	Environment	Rain/drainage issues	V		
Red	Infrastructure	Roads subject to flooding: Stony Beach, XYZ, Dust Bowl, Atlantic, Gun Rock	V	Drainage pumps, public outreach on flooding, solar transit	H

Red	Infrastructure	Seawalls: Allerton Lagoon (crack), Pt. Allerton,	V	Beach nourishment , move seawalls back, “sister” seawall on upland side	H
Red	Infrastructure	Seawall along Newport Avenue	V	Monitor for sea level rise and tides	L
Red	Infrastructure	Wastewater Treatment Plant	V	Inflow reduction, zoning: restrict toilets/pumps below grade, elevate critical systems, berm around WWTP	M
Red	Infrastructure	Stormwater and overwash drainage	V	Increase capacity, outfall work – permission to work on beach/communication	M
Red	Infrastructure	Manomet/Samoset – incl. senior center – low-lying, doesn’t drain	V	Pumping	H
Red	Infrastructure	School buildings: high and middle school in flood zones, elementary gets cut off	V	Road drainage improvements, pumping	L
Red	Infrastructure	Commuter ferry – gets cut off during flooding	V	Communication/management	L
Red	Infrastructure	Wastewater pump stations – vulnerable to flooding	V	Provide slope protections	M
Red	Infrastructure	Light Dept. transmission lines/ communication system – power loss issues	V	Need redundancy, microgrids, remove vulnerable trees, promote solar and wind energy	H
Red	Infrastructure	Have generators in most locations	S	Valley Beach Rd. pump station only has a portable generator	L
Red	Infrastructure	Coast Guard Station	S	Cultivate strong interagency relationships	M
Red	Infrastructure	Straits Pond tide gate	S		
Red	Infrastructure	Dikes at Draper Avenue and Sunset Point	S		
Red	Infrastructure	Culverts are undersized	V	Increase capacity for stormwater management	M
Red	Infrastructure	Water pipes leak and are corroded (Aquarion)	V	More pipe maintenance (private water co)	H
Red	Society	No shelter in town (located in Weymouth)	V	Develop a shelter. Also shelter in place	H

Red	Society	Utilities and apartments in basements are subject to flooding	V	(better) enforcement, education and permits	L
Red	Society	Lack of communication – especially with elderly	V	Hotline to provide info, develop list for code red, color coded markers of flood levels	H
Red	Society	Parked cars flood	V	Designate parking areas out of flood areas, educate newer residents	H
Red	Society	Elderly in-home services may be interrupted	V	An issues with road closures	
Red	Society	Wellspring	S		
Red	Society	Interfaith community	S		
Red	Society	Council on Aging	S		
Red	Society	Manet Medical Center	S	Provides emergency services	
Red	Society	Community Garden	S		
Red	Society	Student organizations	S		
Red	Society	Cable TV	S		
Red	Society	Reverse 911/Code Red	S		
Red	Society	Village Center and tourism areas - lower, more vulnerable	V		
Red	Society	Chamber of Commerce/Rotary	S		
Red	Society	Medical Reserve Corps	S		

Red	Environment	Dune and beach	S/V	Need contiguous dunes – no breaks, nourishment and diversity of species. Beach nourishment for long, stable sloping beach	H
Red	Environment	Salt Marshes – Weir River Estuary – sensitive to sea level rise	S/V	Investigate alternative plant species	L
Red	Environment	Floodplain	V	Public education, better zoning, conservation lands/restrictions	H
Red	Environment	Groundwater – more flooding as sea level rises	V		
Red	Environment	Lack of trees	V	Plant more trees, regulation, education	M
Red	Environment	Wetland protection buffer zones	S	Increase enforcement	H
Red	Environment	Beach management plan	S	Keep updated	H
Red	Environment	Dense development and lots of impervious surfaces	V	Use zoning, and Low Impact Development	H
Red	Environment	Overwash of material into Straits Pond	V	Raise the road, dunes/seawall/fence, explore wave attenuator or artificial reef	M
Red	Environment	Weir River Watershed Association	S		
Red	Environment	Beach Management Committee volunteers	S		
Red	Environment	DMF fisheries regulations	S/V	Lobby for regulation change	H
Red	Environment	Protected land: Weir River Woods, Peddocks and Boston Harbor Natl. Parks	S		
Red	Environment	Norway maples – older and more vulnerable	V	Public education	L
Red	Environment	DCR		Cultivate interagency relationships	H

Purple	Infrastructure	Wastewater Treatment Plans	V	Floodproof the facility. Raise key infrastructure	H
Purple	Infrastructure	Wastewater pump stations locations 20, 33, and 38 (on the table map)	V	Elevate pump stations. Replace the D Street stormwater station.	H
Purple	Infrastructure	A Street bayside, and Fitzpatrick Way	V	Construct seawall, elevate homes, improve drainage system	H
Purple	Infrastructure	Memorial Warming Station	V	Provide flood protection and additional power sources. Town Hall and Jacobs school as alternative locations	H
Purple	Infrastructure	Municipal Light Company	S		
Purple	Infrastructure	Ferry evacuation option	S		
Purple	Infrastructure	Coast Guard (in town)	S		
Purple	Infrastructure	Jacob School and faculty	S		
Purple	Infrastructure	Senior Housing	S		
Purple	Infrastructure	Strawberry Hill Water Tank	S		
Purple	Infrastructure	Utilities above and below ground	V	Create an infrastructure replacement plan that aligns with capital funding, policy, and id's funding sources.	H
Purple	Infrastructure	Natural gas generators	V/S	consider propane	
Purple	Infrastructure	Communications – weak cellular service	V/S	Create and strengthen partnerships with surrounding communities. Find funding for regional communication system	H
Purple	Infrastructure	Lack of protection for historic structures and monuments	V	Record existing structures. Pursue CPA funds to maintain and protect	L
Purple	Society	Aging population	V	Public outreach to seniors. Available social services	M
Purple	Society	Low income population	V	Build partnerships with Wellspring. Secure grant funding to further outreach efforts	M
Purple	Society	Emergency Mgmt. registration for Seniors	S		

Purple	Society	Emergency Mgmt. pre-storm meetings	S		
Purple	Society	Educated population	S		
Purple	Society	Lack of official community recovery organization/strong community spirit	S/V		
Purple	Society	Wellspring and churches	S		
Purple	Society	Lobster migration – loss of revenue for fishermen	V		
Purple	Environment	Town water supply is out of town	S/V		
Purple	Environment	Lack of dune protection, gaps in the dune	V/S	Plant dunes, reconstruct gaps in dunes, beach nourishment	H
Purple	Environment	Annual dune planting	S	Need beach nourishment, dune repair	
Purple	Environment	Lobster migration, ecosystem shifts, shellfish loss of habitat	V	Commercial fisherman subsidy, Wetland restoration, Saltmarsh Migration Bylaw	L
Purple	Environment	Lack of tree cover	V	Town-wide planting, require tree planting with new construction	M
Purple	Environment	Straits Pond	V	Need to finish Gun Rock seawall project	H
Purple	Environment	Loss of marshland in Weir river area	V		L