CITY OF QUINCY MULTI-HAZARD MITIGATION PLAN

5-YEAR UPDATE

Adopted April 2, 2019

Prepared for the City of Quincy by Tighe & Bond

FEMA

Volume 2 - Appendices

APPENDIX A- BIBLIOGRAPHY

Appendix A- Bibliography

Quincy Hazard Mitigation Plan 2019 5-year Update References

American Planning Association (4/17/2000) Policy Guide on Planning for Sustainability, Report.

American Planning Association (3/15/2017) Regional Green Infrastruture at the Lanscape Scale, Report.
Arikan, Yunus, Maryke van Staden, Jen Bogle (5/2016) The Paris Climate Change Package: A Basic Guide for Local and Subnational Governments, ICLEI Local Governments for Sustainability, Report.
Berman, Greg and Juliet Simpson (12/10/2017) Massachusetts Homeowner's Handbook to Prepare for Coastal Hazards, County of Barnstable, MA, Report.
Boots, Michael and Rohan Patel (11/2014) The President's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience , Recommendations to the President, Report.
Boston Harbor Association (8/2014) Designing With Water: Creative Solutions From Around the Globe, Preparing for the Rising Tides Series, Volume 2, Report.

City of Chelsea (5/16/2014) City of Chelsea Hazard Mitigation Plan 2014 Update, , Report.

City of Quincy (4/20/2012) Hazard Mitigation Plan 2012 Update, Quincy Revised Draft Plan 4/20/2012, Report.

City of Quincy (9/2012) 2012 - 2018 Open Space and Recreation Plan Update, Park Department, Report.

City of Quincy (3/18/2013) Certificate of Adoption, Quincy Resolution Adopting FEMA Hazard Mitigation Plan, Letter.

City of Quincy (1/1/2014) Property Owner's Guide to FEMA Flood Insurance Changes, , Brochure.

City of Quincy (10/17/2014) Tidegate and Pump Station Map, , Map.

City of Quincy (1/9/2015) Capital Improvement Plan, , Report.
City of Quincy (6/12/2015) City of Quincy: Hydrodynamic Modeling and Community Education, Coastal Community Resilience Grant Program Proposal RFR ENV 15 CZM 01, Grant Proposal.

City of Quincy (10/28/2015) LOCAL HAZARD MITIGATION PLAN UPDATE REPORT- 2015, , Spreadsheet.

City of Quincy Repetitive Loss Plan Policy, NFIP 255219 Activity No. 510, .

City of Quincy, MA and The Quincy HOME Consortium (1/12/2015) 2010-2014 Consolidated Plan, Report.
City of Quincy, MA and The South Shore HOME Consortium (3/2015) Citizen Participation Plan for Community Development, Housing, Homelessness and Special Needs, Report.

Commonwealth of Massachusetts (9/1/2013) State Hazard Migation Plan, MEMA and DCR, Plan.

EPA (7/2014) Flood Resilience Checklist, Checklist.
EPA (12/2015) Tools Strategies and Lessons Learned From EPA Green Infrastructure Technical Assistance Projects, Office of Wastewater Management, Report.

FEMA (9/1/2006) A Comprehensive Approach in the City of Quincy, Mitigation in Massachusetts, Newsletter.

FEMA (10/1/2011) Local Mitigation Plan Review Guide , Plan Review Guide - Final 9/30/2011, Report.

FEMA (3/2013) FEMA Local Litigation Handbook, Report.
FEMA (3/29/2013) FEMA FP 302-094-1 Handbook Policy, Federal Insurance and Mitigation Administration (FIMA) Policy, Report.

FEMA (6/18/2013) Hazard Mitigation Plan FEMA Approval, FEMA Letter and Comments on Plan, Letter.

FEMA (6/24/2014) FEMA 543 Chapter 1, Critical Facility Design Considerations, Report.
Golden, Brian (4/2014) A Citizen's Guide to Development Review Under Article 80 of the Boston Zoning Code, City of Boston and Boston Redevelopment Authority, Report.
Harrington, Dennis E. and Thomas P. Koch (7/20/2015) Quincy Letter of Commitment: Overcoming Perceptual Barriers to Coastal Flood Resilience, Quincy Department of Planning and Community Development, Letter.
IPCC (3/31/2014) Climate Change 2014: Impacts, Adaptation, and Vulnerability, IPCC WGII AR5 Summary for Policymakers, Report.

Kleinfelder (7/18/2013) Sea Level Rise Study, Towns of Marshfield, Duxbury, Scituate, MA, Report.
Knisel, Julia and Dan Sampson (3/2017) Technical Report for the Massachusetts Sea Level Rise and Coastal Flooding Viewer, Massachusetts Office of Coastal Zone Management, Report.

Koch, Thomas P. (1/5/2015) Quincy Midterm Address, Speech.

Koch, Thomas P. (5/14) Resilient Quincy, Public Forum About Coastal Planning, Focus on Strategy, Meeting Notice.
Koch, Thomas P., Daniel G. Raymondi, Shawn Hardy (12/3/2014) Flood Letter to Public, City of Quincy, MA Department of Public Works, Letter.
Lineham, Amanda (6/2/2014) Massachusetts to Develop First New Food System Plan in 30+ Years, Metropolitan Area Planning Council, Article.
Lineham, Amanda and Stevens, Robert (2/29/2016) Quincy Starts Coastal Adaption Plan: Community Meeting 2/25 to gather citizen input on plan, MAPC, Letter.
MA Coastal Zone Management (5/20/2014) Fact Sheet 4: Case Study Massachusetts Communities Reduce Storm Risk in Developed Areas, StormsSmart Coasts- NOAA Grant Funded Project, Brochure.

MAPC (2012) VIII. Hazard Mitigation, City of Quincy Hazard Mitigation Plan, Report.

MAPC (10/30/2012) VIII. Hazard Mitigation Strategy Supplement Information, Notes on Chapter Text, Report.

MAPC (12/13/2013) City of Quncy Hazard Mitigation Plan , FEMA Conditional Approval Dec 13, 2012, Map/report.

MAPC (6/30/2014) Metro Boston Regional Climate Change Adaptation Strategy Report, Report.

MAPC (11/2014) Metropolitan Area Planning Council Strategic Plan 2015-2020, Report.

MAPC (6/11/2015) Metro Boston Climate Preparedness Taskforce, Meeting Agenda.

MAPC (9/2015) Quincy Coastal Adaptation Plan Rising Temperatures, Heat Island Compounding- Figure, Map.

MAPC (9/2015) Quincy Coastal Adaptation Plan, Heat Island Resource- Figure, Map.
MAPC (4/27/2016) Metropolitan - Boston Climate Change Strayegy-Quincy Climate Change Planning, Quincy Climate Change Project Presentation, Report.

MAPC (5/20/2016) City of Quincy Neighborhoods, Maps.

MAPC (5/20/2016) Quincy Point Shipyard Flood Maps, Maps.

MAPC (10/2016) Resilient Quincy Plan, Report.

MAPC (12/6/2017) Quincy Populations Vulnerable to Climate, Vulnerable Populations With QHC Properties, Map.
MAPC (3/31/2016) Quincy Resilience and Climate Change 101, MAPC, City of Quincy Plannining Department, Woods Hole Group, Presentation.
Gawler, Soumya Chaturvedula, Igor Albuquerque, Steven Bland, Stephen Davis (3/2016) From Strategy to Delivery: Measuring, Reporting, Verification (MRV) of Urban Low Emission Development, ICLEI's Green Climate Cities Handbook
MassDOTBoston Harbor Flood Risk Model, MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability and Adaptation Options for the Centreal Artery/Tunnel System (Pilot Projet Report), Report.
NOAA (12/6/2012) Global Sea Level Rise Senarios for the United States National Climate Assessment, Climate Program Office, Report.
Nutters, Heidi (6/2012) Addressing Social Vulnerability and Equity in Climate Change Adaption Planning , Adapting to Rising Tides White Paper, Report.

Quincy PCD (7/28/2015) Commission for Envirnmental Coorporation 2015 Meeting, Memo.

Quincy Sun Newspaper (11/6/2014) Climate Action Group Leadership Summit, Newspaper.

Quincy Sun Newspaper (6/4/2015) Flood Maps a Work in Progress, Newspaper.

Schleck, Brent (7/8/2014) Climate Funding Opportunities, NOAA, Report.
Stultz, Missy (6/14/2017) Integrating climate change into hazard mitigation planning: Opportunities and examples in practice, Climate Risk Management http://cx.doi.org/10.1016/j.crm.2017.06.004, Article.
Suzel, Melissa and Lawrence Susskind (2/10/2016) Susskind Article in Planning Bostons Article 80, American Planning Association, Article.

Urban Land Institute (9/2014) The Urban Implications of Living With Water, The Kresge Foundatoin, Report.

Walsh, Martin J. (2014) Greenovate Boston 2014 Climate Action Plan Update, , Report.
(3/19/2014) An Act Promoting the Planning and Development of Sustainable Communities, House Docket No. 4065, Report.

(3/25/2015) Metropolitan Boston Climate Preparedness Commitment, Report.

(4/27/2016) Quincy Climate Plan - Municipal Working Group Meeting, Spreadsheet.

Appendix B- Climate Change Vulnerability Analysis

RESILIENT QUINCY PLAN

OCTOBER 2016

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Executive Summary

New England is considered a leader in climate planning analysis and initiatives. One of the first comprehensive analyses of adaptive actions by a major metropolitan area was conducted by a group of nationally-leading climate practitioners in development of the Climate's Long-Term Impacts on Metropolitan Boston (CLIMB) report in 2004. This study described how global warming could impact a major U.S. coastal metropolitan area, what those impacts are likely to cost, and what adaptive measures can be taken to protect the region from the worst of these effects.1

The CLIMB study paved the way for the State, and the Metropolitan Area Planning Council (MAPC), to provide municipalities with additional details regarding regional and subregional climate vulnerabilities and a framework for adaptation and mitigation actions. Specifically, the Executive Office of Energy and Environmental Affairs (EEA) published the Massachusetts Climate Change Adaptation Report (MCCAR) in 2011, which was followed by the Regional Climate Change Adaptation Strategy (RCCAS) by MAPC in 2014. The regional strategy builds on findings of the CLIMB and MCCAR reports to provide the Metropolitan Boston Region with an analysis of the key climate-related vulnerabilities across five municipal sectors (natural resources, coastal zones, built environment, public health, and local economy), objectives for climate resiliency, and recommendations for municipal action. Since the development of the RCCAS, MAPC is taking a leading role in climate change planning via its District Local Technical Assistance and Planning Technical Assistance programs to assist municipalities in this emerging arena.

Commonwealth municipalities are direct benefactors of a robust academic community who have been studying the effects of climate change. During the 2015-2016 Climate Ready Boston (CRB) project several academic institutions were called upon to conduct a peer review of the most current and best available data for assessing vulnerabilities within the Metropolitan Boston area (Greater Boston Harbor communities). Specifically, the Boston Research Advisory Group (BRAG) assessed data relating to sea level rise, coastal storms and flooding, precipitation, and heat. MAPC served as an advisor to this group regarding the use of this data in planning. MAPC participated in the BRAG efforts, and has utilized its findings, within the Resilient Quincy Plan's vulnerability assessment. (See Appendix for the full *Climate Change and Sea Level Rise Projections for Boston* findings report by BRAG.)

Planning Process & Purpose

The development of the Quincy Resiliency Plan was a collaborative planning effort amongst a wide-ranging group of practitioners: planners, climatologists, coastal engineers, academics, and the like. This effort brought together leaders within the community, and across the region, to create a plan that would provide the City with critical information regarding potential climate-related impacts and suggested goals and objectives for community planning moving forward. Specifically, the aim of the assessment and planning process was to offer "no regrets" solutions for resiliency; i.e., long-term land use changes, which will benefit the City regardless of the reason implemented. No regrets solutions suggested are aimed at providing social, economic, and environmental benefits that are consistent with all of the various plans.

The secondary purpose of this planning process was to develop a template for resiliency planning that can be replicated across all of the MAPC coastal cities, which would best serve the needs and budgets of municipal planning departments. This will also create a platform from which to view

climate vulnerabilities, and the actions to address them, across municipal boundaries. Developed methodologies, processes, and the resulting resiliency plan template will eventually be made available to MAPC municipalities to use as a guide to their resiliency planning efforts. MAPC is extremely grateful for the City of Quincy's willingness to serve as a pilot community and to provide a direction forward to its fellow municipalities.

Plan Structure

This Plan includes a series of sections that can be utilized separately by the City during various stages of educating the community, and planning and implementation, as follows:

1. Climate Change Primer: providing education regarding climate change and impacts.
2. Vulnerability Assessment: a characterization of the City's' coastal and inland vulnerabilities, based upon recent regional scientific climate projection data and analysis.
3. Goals and Objectives: a description of the stakeholder engagement process, and critical feedback including survey results, that frame included resiliency goals and objectives.
4. Resiliency Actions: near, mid, and long-term recommendations for mitigation and adaptation.
5. Appendix: important technical documentation and references.

Unlike other land use plans with a mid-term planning horizon (approximately 20-30 years), climate adaptation and mitigation plans must incorporate longer-terms changes to the environmental, social, and economic landscapes from climate impacts and present incremental resiliency measures. Therefore, recommended actions included herein are categorized in the following manner:

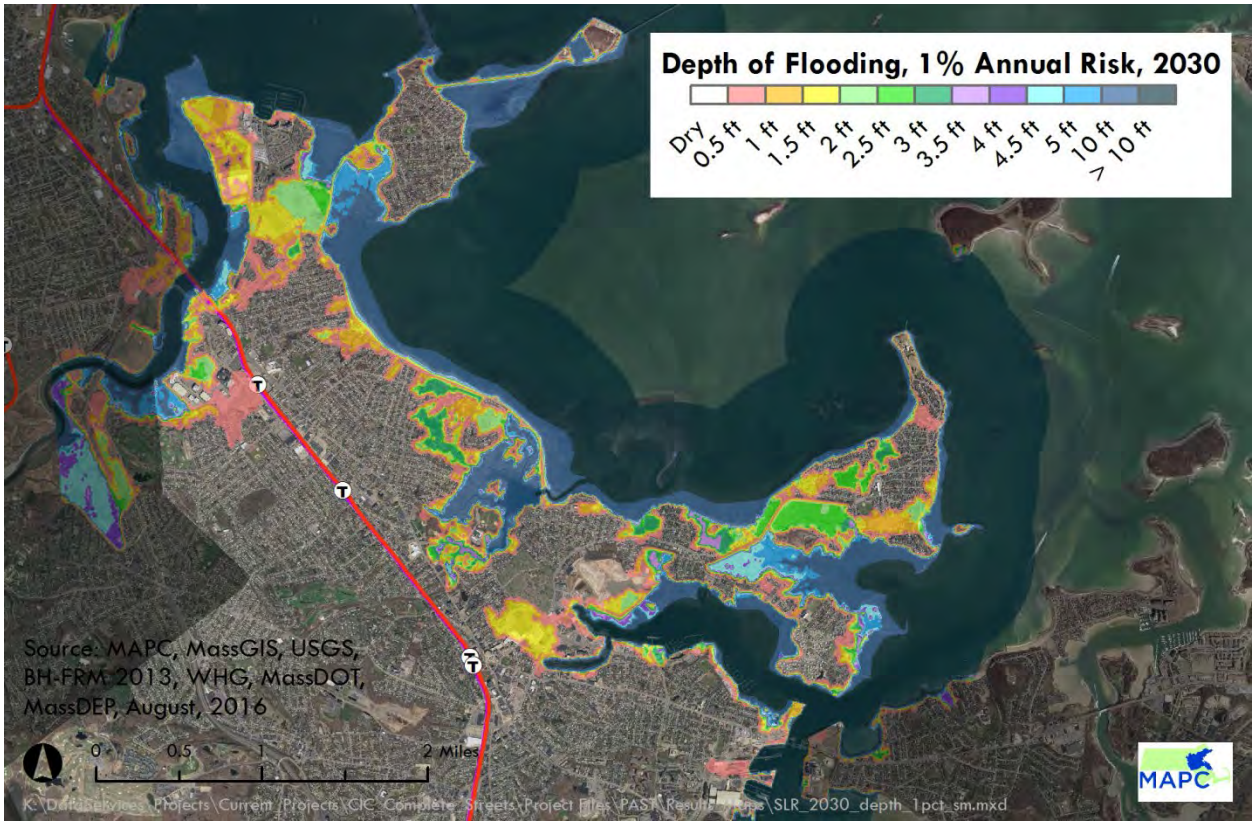
- Near-term: actions that should be implemented within the near future (present day to 2030) due to increased impact frequencies and elevated risks within certain municipal sectors. Sometimes, these actions may also represent the "low-hanging-fruit" in that they are easier to implement and/or are more politically palatable. More importantly, these near-term actions will set the stage for mid and long term actions, as they generally include policy and regulatory changes designed to protect current and future development. By-in-large, these actions will result in significant adaptive capacities across the City's sectors, as proactive measures taken now will create a momentum for continued change towards sustainability.
- Mid-term: these are actions designed to be implemented during the 2030-2050 timeframe, which typically are based upon near-term policy change, coordination, and capacity-building activities. Mid-term actions include the implementation of innovative incentives, design guidelines and regulations, and projects/programs to protect City sectors. Actions included within this timeframe also include an assessment of resiliency measures already taken and their lessons learned in order to make additional policy and regulatory changes needed, which may be more progressive in nature.
- Long-term: actions that are aimed at preparing the City for the latter end of the century 2050-2070. These actions include policy and regulatory changes designed to guide land use patters over time, particularly to decrease or eliminate elevated risk to land uses. These actions are generally designed to address a higher risk magnitude, may be subregional in nature, and would require additional assessment and planning. Further, long-term actions are those in which the City may require additional time to implement due to political or social receptiveness.

It is important to note that this Plan also differs from other land use plans in scope and scale, which is far more vast in comparison, lending it to serve as an "umbrella" by which related municipal planning efforts fall under. Akin to comprehensive or master planning processes, climate planning touches upon all municipal branches: health and welfare, environmental protection, economic development, and hazard mitigation. Further, the magnitude of projected climate impacts and the interdisciplinary nature of work required to implement adaptation and mitigation measures calls for a proactive, coordinated implementation effort. Therefore, it is strongly recommend that the City maintain its climate working group to continue to coordinate the implementation of this Plan. Further, we recommend that relevant actions included within this Plan be incorporated into other existing City plans (i.e., capital improvement, urban renewal, downtown redevelopment, open space, etc.) to ensure a streamlined, coordinated effort moving forward.

Due to the evolving science and analysis relating to climatology and weather, and projections regarding future demographics and development, it is also recommended that the City update this Plan on at least a five (5) year cycle, similar to the City's Hazard Mitigation Plan (HMP). However, it is important to note the fundamental differences in scale, scope, and assessment methods between the HMP and this Resiliency Plan. The HMP is a mandated plan by the Federal Emergency Management Agency (FEMA) under the Code of Federal Regulations Title 44, Part 201, for communities who wish to participate in the National Flood Insurance Program (NFIP) Community Rating System (CRS). The CRS program provides discounts on NFIP premiums for property owners in communities that participate in the program. The key difference is that the HMP assesses vulnerabilities to a community based on historic conditions of specific natural disasters. Although based upon a similar subject matter (naturally occurring weather events), a climate change plan examines current conditions, forecasts future conditions, assesses impacts to a community from both conditions, and offers recommendations for long-term land use changes to ensure environmental, economic, and social landscapes of a community are able to continue under changed conditions.

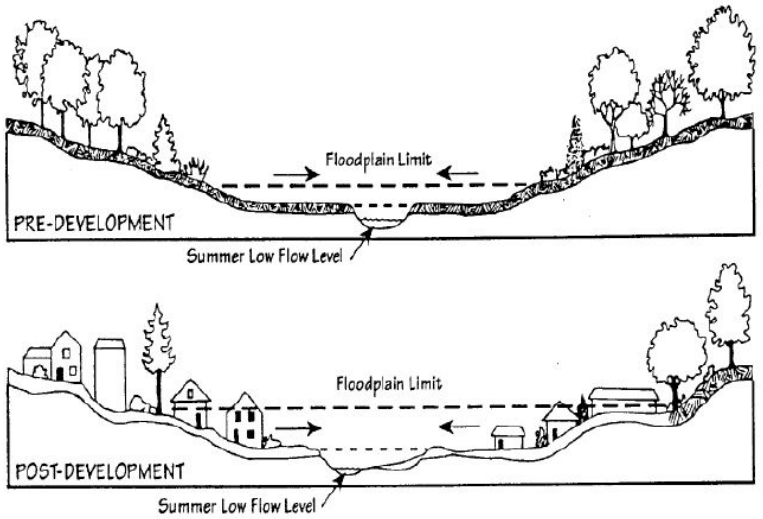
Vulnerabilities Summary

Through the completion of a vulnerabilities assessment for the City, it has become clear that the City will face challenges under changing climate conditions, particularly stemming from to its dense, urban coastal characteristics. The City is flanked on either side by the largely urbanized Neponset and Fore Rivers that discharge stormwater flows to Quincy Bay; further compounding its vulnerabilities. Quincy's developed, northeast facing coastline exposes its assets to impacts from Nor'easter storms; the primary type of coastal storm in New England. Developed shoreline areas throughout Quincy, particularly altered by engineered structures, are currently affected by rising seas and intense storms, as shown in the adjacent photo. [2] When these storms are paired with continuously rising sea levels, the risk of impacts increases exponentially.

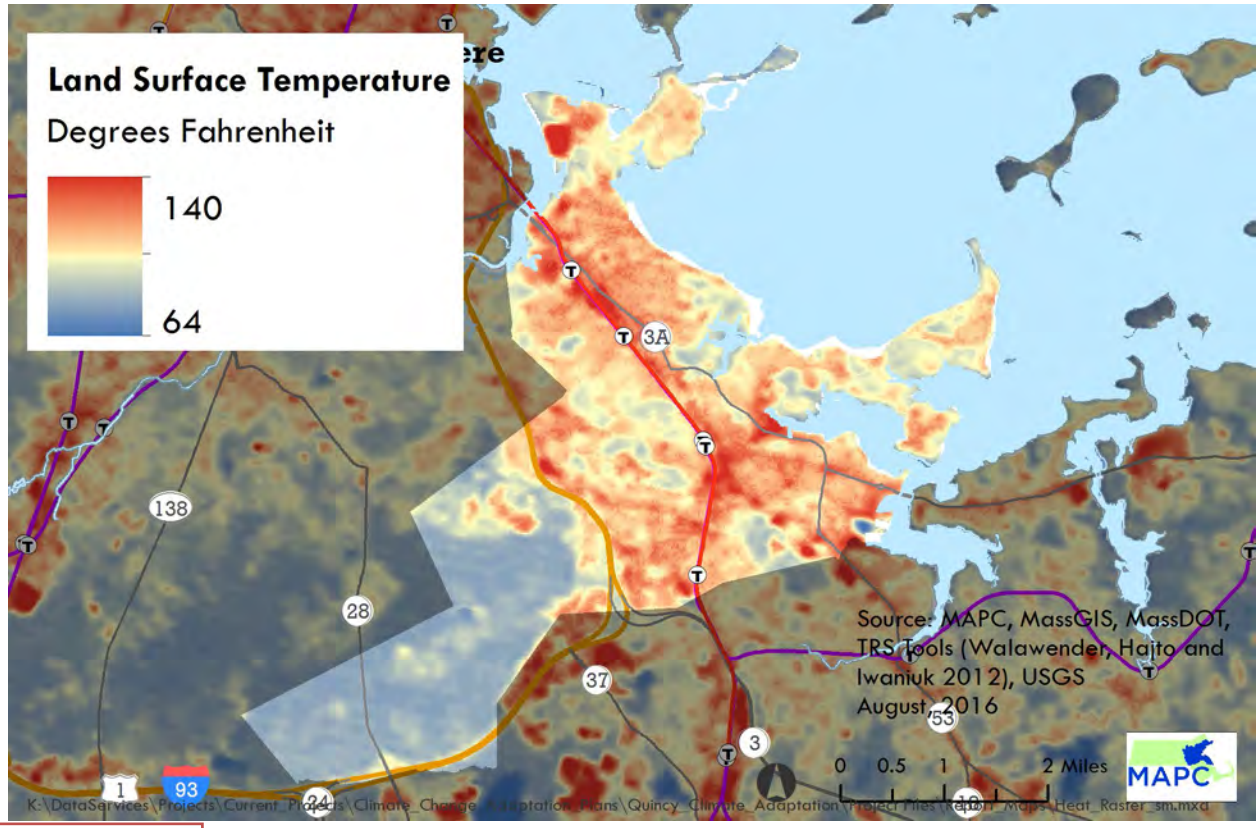


The adjacent map illustrates the projected flooding depths (at 0.5 foot increments) associated with the 1% probability of flooding. Although these projections are not exclusively linked to the2030 timeframe (i.e., this level of flooding can occur at present day under some storm conditions), the planning team felt it best to illustrate impacts within three timeframes: present day to 2030, 2030 to 2070, and 2070 to 2100. As shown, there are several areas of the City that are predicted to receive coastal flooding in excess of 2 feet such as Wollaston Beach, Squantum, and Houghs Neck/Germantown, as well as portions of North Quincy and Merrymount. Although Quincy is somewhat shielded by the Boston Harbor Islands and Hull peninsula, rising seas, and frequent and intense coastal storms have already been in conflict with existing coastal development throughout the City and this tension will amplify.

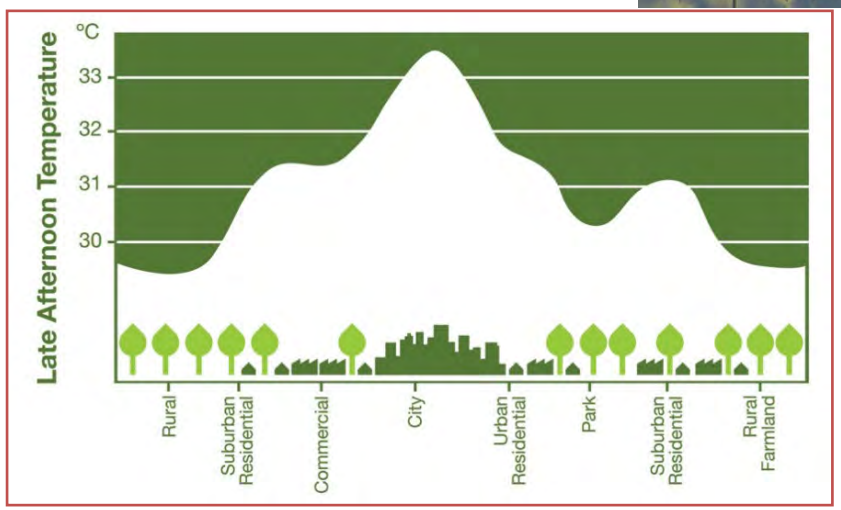
Precipitation-based flooding has historically been a concern for the City. Regional precipitation is projected to increase in intensity and frequency due to climate changes. These changes in precipitation will create expanded floodplain areas and localized flooding due to inundation of the existing water infrastructure. Flooding has already occurred under current conditions in both historic floodplain areas, and within river and stream beds, as shown in the adjacent photos of development and catchment areas along the Furnace Brook, respectively. Urbanization along, and within, floodplain areas has placed development in harm's way of the natural pathway of rivers, streams, and tributaries. Proper buffer areas are required to absorb and attenuate these waters. Altered river and stream banks often exacerbate flooding conditions. When these surface waterbodies are channelized and constrained, flow velocity increases and spillage occurs, as illustrated in the adjacent graphic[3]. Furthermore, precipitation is expected to increase by approximately fourteen percent (14%) by 2030, intensifying flood conditions, expanding floodplain areas, and overloading existing infrastructure.



The adjacent map illustrates impacts that the City will face from increased temperatures due to climate changes. The planning team analyzed land surface photography layered with extreme temperatures (a day when the high at Logan Airport was above ninety degrees Fahrenheit [90^{0}F][4]). These temperature increases will create associated impacts for vulnerable populations across the City such as elderly, minority, lower income, chronically ill or other populations that may currently be predisposed to greater impact due to physical or mental limitations, or living and/or working conditions.



Surface temperature is highly correlated with the concentration of impervious surfaces such as black tar rooftops, asphalt, or concrete pavement, as shown in the adjacent graphic (ranging from 86 to 91^{0}F).[5] Highly urbanized centers with large impervious areas are likely to have higher air temperatures, particularly at night, creating an "urban heat island effect". These areas are important for the City to consider, as these "hot spots" will compromise infrastructure and building materials, as their ability to cool-down will be diminished.



1. Climate Change Primer

The planning team felt it was important to offer some context regarding this concept. During the course of this planning process the City of Quincy, and the planning team, regularly used this phrasing to describe the changes that are occurring in the earth's system and the impacts these changes are having on the earth and all living creatures.

Definitions

A series of key terms and their definitions have been provided below, due to the complexities within these topics. These terms have been utilized periodically throughout the Plan.

Anthropogenic: Relating to or resulting from the influence of human beings on nature (i.e. human-induced).

Anthropocene: A term used to define Earth's most recent geologic time period as being human-influenced, or anthropogenic, based on overwhelming global evidence that atmospheric, geologic, hydrologic, biospheric and other earth system processes are now altered by humans.

Base Flood Elevation: The flood having a one percent chance of being equaled or exceeded in any given year. This is the regulatory standard also referred to as the "100-year flood." The base flood is the national standard used by the National Flood Insurance Program (NFIP) and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development. Base
Flood Elevations (BFEs) are typically shown on Flood Insurance Rate Maps (FIRMs).

Climate Change Adaptation: The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Climate Change Mitigation: Efforts to reduce or prevent emission of greenhouse gases. Mitigation includes the use of new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior.

Climate Resiliency: The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

Floodplain: Also sometimes called the "floodway," is the area next to a river that experiences flooding when water comes out of the banks of the main channel. Floodplain is the term FEMA used to include: "any land area susceptible to being inundated by flood waters from any source." Therefore, generally this is the term used within the Strategy unless also describing the areas listed below.

Floodprone Area: Is an area bordering a stream that will be covered by water at a height of twice the maximum bankfull depth.

Special Flood Hazard Area (SFHA): are areas designated by FEMA as "having special flood, mudflow, or flood-related erosion hazards, and shown on a Flood Hazard Boundary Map or a Flood Insurance Rate Map (Zone A, AO, A1-A30, AE, A99, AH, AR, AR/A, AR/AE, AR/AH, AR/AO, AR/A1-A30, V1-V30, VE, or V)." NOTE: in determining Community Rating System premium discounts AR and A99 zones are treated as non-SFHAs.)

Green Infrastructure: An approach to infrastructure and natural resource management that includes sustainable water infrastructure, preserving and protecting natural or "green" systems, decentralized solutions, or other innovative approaches and technologies that provides multiple benefits.
Techniques include but are not limited to: decentralized wastewater systems; water conservation and reuse, stormwater recharge (bioretention, rain gardens, tree boxes), porous pavement, green roofs, water efficient landscaping, preservation and restoration of natural landscape buffers (i.e. forests, floodplains, and wetlands); restoration of natural stream channels.

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.

Impact: Effects on natural and human systems. In this report, the term impact is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system.

Low Impact Development (LID): This is a development process that begins with smart growth-based best site planning practices to identify critical natural resource areas for preservation and uses Green Infrastructure to maintain natural drainage flow paths and reduce impervious surfaces. LID also includes a specific set of innovative strategies to treat stormwater management at the site level, ensuring that water is managed locally rather than engineering the discharge of water away from its source.

Non-Potable Water: Water that has not been examined, properly treated, nor approved by appropriate authorities as being safe for consumption.

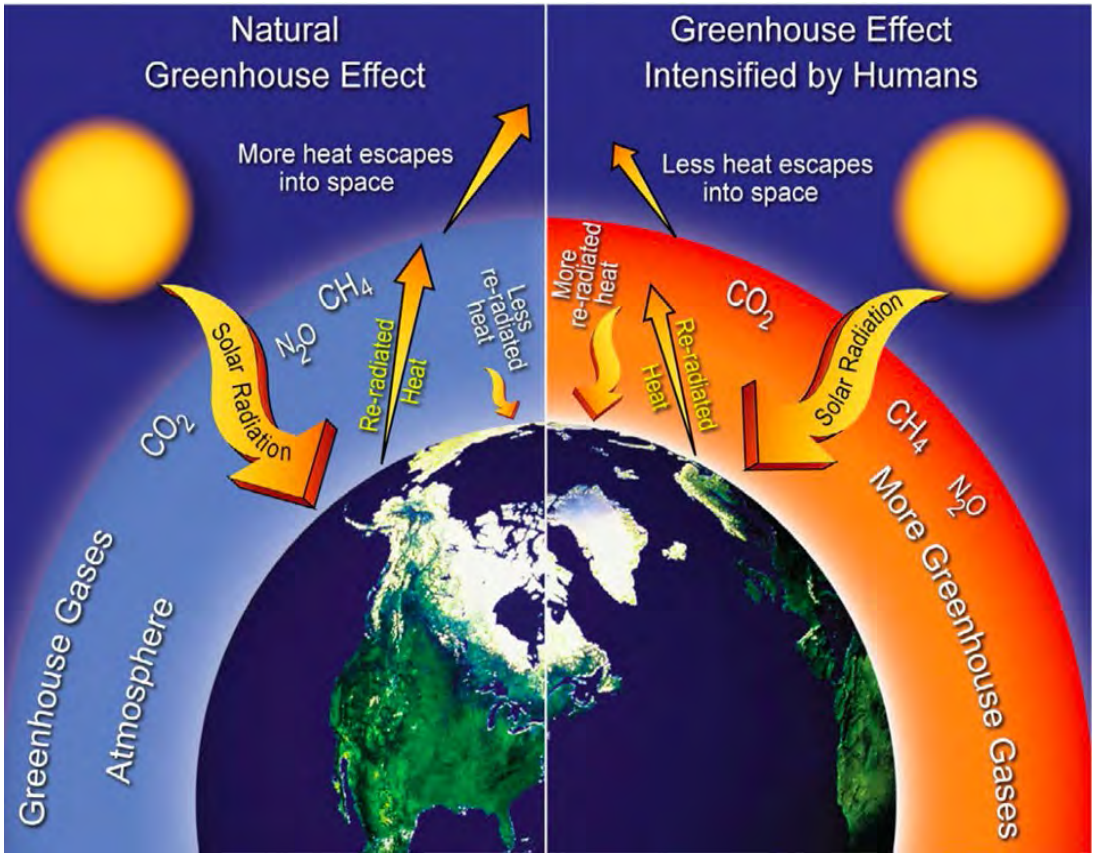
Potable Water: Water suitable for drinking.

Riparian Zone: i.e., riverbank; is the land located immediately adjacent to a channel, and it provides the buffer between a channel and upland areas. Parts of active floodplains and riparian zones are often times the same areas of land.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Climate Change Cause and Effect

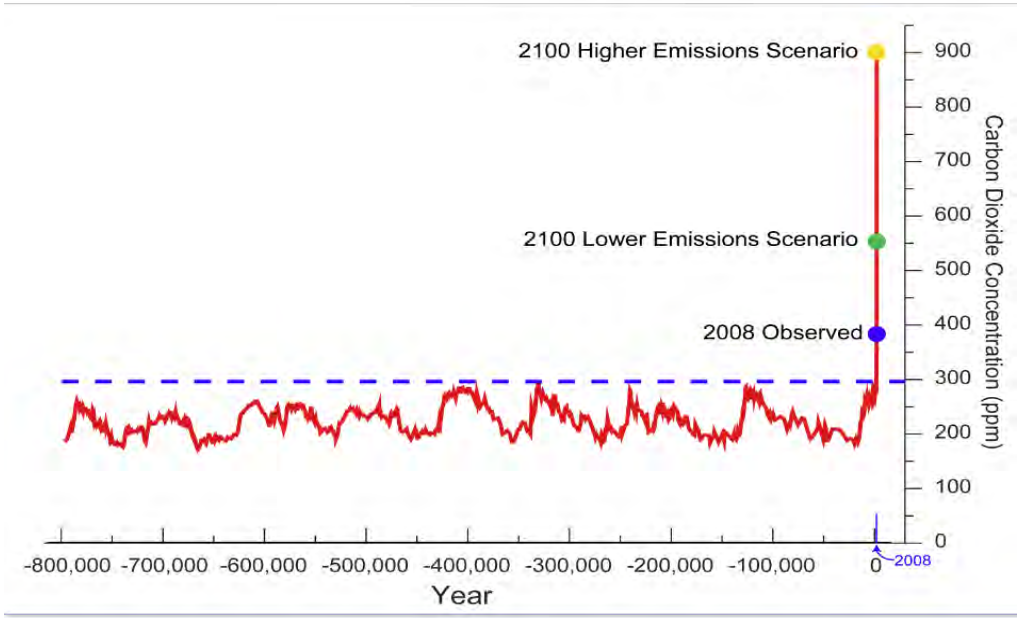
Assessment and planning methods were guided by the widespread consensus that there are natural causes of climate change, as well as anthropogenic changes, which have rapidly amplified over the past century. Natural climate changes result from any tip in the balance between energy entering and leaving the Earth's atmosphere, as shown in the following graphic.[6]



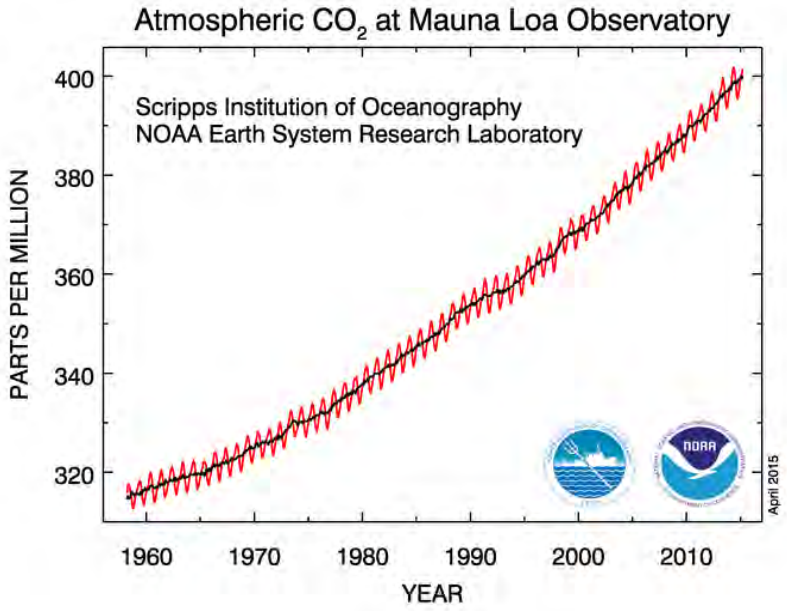
Changes in the Earth's climate over time are often due to natural causes such as changes in solar energy, volcanic eruptions, and natural changes in greenhouse gas (GHG) concentrations. GHGs like water vapor (H2O), carbon dioxide (CO2), and methane (CH4) absorb energy, slowing or preventing the loss of heat to space. In this way, GHGs act like a blanket, making Earth warmer than it would otherwise be. This process is commonly known as the "greenhouse effect."[7]

Although the earth's climate is known to experience these natural shifts over time, there has been a documented increase in GHGs due to human activity. Hence, the interest in the scientific community to potentially define a new geologic era: Anthropocene, as a human-dominated geological epoch, based upon recent global environmental changes (e.g. mass extinctions of plant and animal species, polluted the oceans and altered the atmosphere, among others). Anthropogenic climate change is a difficult subject to comprehend because its causes are largely invisible to the human eye. However, every day, all around us, carbon dioxide, methane, nitrous oxide, and other greenhouse gases pour from automobiles, buildings, airplanes, factories, and power plants. Everything requires energy to respire, move, grow and reproduce. Current human sources of energy generally come from non-renewable energy sources such as the following (in order of use): petroleum, natural gas, coal, and nuclear electric power. The first three categories are also known as "fossil fuels," because they were created as a result of biomass being compressed and "fossilized" under the Earth's surface over the course of millions of years. Fossil fuels have extremely high energy content and have historically served as the driving force behind industrialization, population growth, and economic development.

However, there are a number of problems associated with the conversion technologies used to turn the stored chemical energy in fossil fuels into active thermal energy (e.g., combustion), including the generation of GHGs. An exponential "spike" in GHG emissions occurred during the 1800-1900's (industrial revolution), as illustrated by the National Oceanic and Atmospheric Administration (NOAA) graphic to the right. This 800,000 year record of carbon dioxide concentration used to produce this graph came from ice core air samples, trapped in ancient ice bubbles. What is most important to note is the extreme jump from the pre-industrial revolution era (approx. 1800) to 2008, revealing approximately a thirty-three percent (33%) increase in GHGs.



The second graphic provides a zoomed-in viewing of a portion of the "Anthropocene" timeframe; the post industrial revolution era where the spike in GHG have been documented. As shown, there has been a steady increase in GHG emissions from approximately 320 parts per million (ppm) to over 400 ppm.



Data such as this has resulted in pervasive consensus within the scientific community that human-induced greenhouse gas emissions have caused major alterations in the Earth's climate. This led to the Intergovernmental Panel on Climate Change (IPCC) producing their fifth assessment report (AR5)[8], which included a new approach to climate change forecasting built around the concept of Representative Concentration Pathways (RCPs).[9] RCPs are concentrations of greenhouse gases and pollutants resulting from human activities, including changes in land use. RCPs provide a quantitative description of concentrations of the climate change pollutants in the atmosphere over time, as well as their "radiative forcing" - a measure of the additional energy taken up by the Earth due to increases in climate change pollution. The four RCP scenarios are consistent with certain socio-economic assumptions as follows:

1. RCP 8.5 – **Highest emissions** - A future with no policy changes to reduce emissions with increasing greenhouse gas emissions that lead to high

greenhouse gas concentrations over time.[10] This scenario includes the following conditions:

- Three times today's CO2 emissions by 2100 and rapid increase in methane emissions,
- A world population of 12 billion by 2100,
- Increased use of croplands and grassland, and
- Lower rate of energy efficient technologies and heavy reliance on fossil fuels

2. RCP 6 – **Intermediate high emissions** - Stabilization of radiative forcing shortly after year 2100, via the application of a range of energy efficiency technologies and strategies that reduce greenhouse gas emissions.[11] This scenario includes the following conditions:
   - CO2 emissions peak in 2060 at 75% above today's levels, then decline to 25%,
   - Reliance on fossil fuels yet with stable methane emissions, and
   - Increasing use of croplands yet declining use of grasslands.
3. RCP 4.5 – **Intermediate low emissions** - Stabilization of radiative forcing shortly after year 2100, consistent with a future with relatively ambitious emissions reductions.[12] This scenario includes the following conditions:
   - CO2 emissions increase only slightly before decline starting in 2040,
   - Stringent climate policies and strong reforestation programs,
   - Stable methane emissions,
   - Decreasing use of croplands and grasslands due to yield increases and dietary changes
4. RCP 2.6 – **Lowest emissions** - Ambitious GHG emissions reductions resulting in a reduced radiative forcing.[13] This scenario includes the following conditions:
   - CO2 emissions stay at today's level until 2020, then decline in 2100, OR
   - CO2 concentrations peak around 2050, followed by a modest decline to around 400 ppm by 2100,
   - Methane emissions reduced by 40%,
   - Declining use of oil,
   - A world population of 9 billion by year 2100, and
   - Use of croplands for bio-energy production.

It should be noted that this is a simplified summary of very complex analyses of climate change scenarios; yet it is offered to explain how scientists have arrived at regional climate impact projections, by which vulnerabilities within the City o f Quincy were determined.

This information justifies a compelling need to plan for communities' future, and to remain adaptive and responsive to challenges as they arise. This can be done by engaging communities on the local level to better understand their vulnerabilities and the community assets that protect them, and to develop a plan for action. Further, stakeholder building is absolutely critical in order for much needed societal changes to occur. Therefore the question must be posed to residents, government officials, businesses, etc.: *What do you want your future to look like?* This concept is discussed in the recommendations section of this Plan.

2. Existing Conditions

Understanding a community's character, socio-economic make-up, and environmental features is critical in order to build both the climate vulnerabilities analysis and the adaptation/mitigation recommendations upon. This information tells the story of the community and how it became as it is, and provides the basis by which existing climate change resiliency features exist. Climate Resiliency recommendations provided herein are closely tied to the City's profile to ensure the actions are relevant and realistic. There are numerous plans that best describe existing conditions within the City such as the City's Open Space Plan, Urban Renewal Plan, Hazard Mitigation Plan, etc. Therefore; descriptions included within this section are limited to relevant features of the City that may be vulnerable to a changing climate, if measures are not taken to protect or alter these features.

Community Character

There are a few key phrases that best capture the character of Quincy such as "the City of Presidents" and the "Granite City;" both indicating the balance between has maintained between its rich historic roots and industrial prosperity. The City is rather large in scale, occupying approximately 16.7 square miles ranging from inland and coastal residential neighborhoods, to commercialized urban centers, to marine industrial havens. Quincy also still tries to hold the delicate balance between its foundational environmental resources and economic development opportunities. The City is bounded on each side by a major river way, estuary or forested area. Its northern boundary includes the Neponset River (with the City of Boston to its immediate north); the Weymouth Fore River at its southern boundary (with Braintree and Weymouth); the Blue Hills Reservation on its western boundary (shared with Milton), and Quincy Bay/Boston Harbor on its eastern shore. Quincy has 27 miles of shoreline and contains several flowing bodies of water, including the Furnace Brook, Town Brook, Town River, and Black's Creek.

These characteristics set the stage for the rich historic and economic growth the City enjoyed over the past century. Its story began in 1625 when the area was first visited by Captain Myles Standish, military adviser for Plymouth Colony, guided by Squanto, a Native American of the Patuxet tribe. A trading post was later established by Captain Richard Wollaston of the Plymouth Colony within the neighborhood known as Merrymount. Quincy then remained an unincorporated village that was divided between Boston and Braintree, and was composed of outposts of small farms, fishing villages, and boat-building enterprises. The politically prominent Adams family lived in Braintree (now Quincy Square) where both John Adams, 2nd U.S. President, and his son John Quincy Adams, 6th U.S. President resided. In 1792 Quincy split from Braintree to become its own municipality, which was named after Colonel John Quincy -maternal grandfather of Abigail Adams. Quincy became widely known for its granite industry by the early 1800's, particularly after the construction of the Granite Railway. The railway was one of the first U.S. railroads constructed, which was built to carry granite from the Quincy quarries to the Neponset River for international export. Quincy's granite was used to construct several of the nation's most adored monuments and buildings such as the Bunker Hill Monument, and the Titanic Memorial. The City also became known for its shipbuilding industry that stemming from the extensive shipbuilding industry located at the Fore River Shipyard.

Neighborhood Snapshots

The City of Quincy was classified in the 2008 MetroFuture Regional Plan as a "sub-regional urban center;" or considered predominately urban. In developing the Regional Plan MAPC realized that the conventional urban vs. suburban dichotomy embedded in most conversations about Metro Boston had little utility for regional analysis and was a major barrier to regional thinking, inter-municipal collaboration, and innovative approaches. In order to overcome this barrier, MAPC used a data-driven process to define five major types of municipalities in Massachusetts, and nine subtypes that range from the highest density cities in the core of the region to various smaller urban centers. Quincy was classified as a regional urban center due to its high population density, large proportion of multifamily housing, and its moderate and high-density neighborhoods that surround a historically significant downtown.

Natural resources, along with much industrial economic activity, contributed to the development of distinct residential patterns throughout the City that endure today in Quincy's unique neighborhoods, as described in the subsequent sections.

Quincy Point/Fore River

The Fore River Shipyard area became a shipbuilding center beginning in the 1880s; founded by Thomas Watson, assistant to Alexander Graham Bell in developing the telephone. The Shipyard was home to the second-largest shipbuilding crane in the world, resulting in the construction of hundreds of ships for both military and civilian clients such as the USS Lexington aircraft carrier and the USS Nevada battleship. The Quincy Point neighborhood was once one of Quincy's most dense and diverse neighborhoods, dominated by small multi-family properties (primarily two to three units) centered on the shipyard (circa 1900-1980). Numerous workers required to support the phenomenal output of shipbuilding attracted many local and immigrant laborers to this neighborhood to establish their livelihoods. However, as the shipbuilding industry diminished, the neighborhood began a transition from primarily a marine-industrial area to a mix of industrial, commercial, and large residential complexes. As a state Designated Port Area, marine-industrial activities still line the Fore River with various uses including shipping and research and development, yet there is significant infrastructure decay and dilapidated structures that prohibit a more robust port area.

Quincy Center/West Quincy

The first substantial transportation routes in Quincy were established through Quincy Center and these conduits became major thoroughfares from Boston to the rest of the South Shore. Quincy Center developed into the main retail center in Quincy; the downtown has become home to more mixed-use development as the city continues to grow. Expansive square footage of office space has been created in new mixed-use developments such as Presidents Place. These new offices exist alongside numerous historic sites and civic buildings such as City Hall, Thomas Crane Library and the YMCA. Financial and health institutions and small businesses have contributed to a revived business district that offers an array of services and retail products to tourists, employees, and residents. Neighborhoods immediately adjacent to Furnace Brook and its wetlands, and residential open spaces (golf courses and playgrounds), are less densely populated as you travel away from the center of downtown toward the Blue Hill Reservation. This area is mostly populated by single- and multi-family homes, with more apartment complexes and larger-scale developments closer to the Center.

Houghs Neck/Germantown Peninsular

This residential peninsula, one of the first established south of Boston, is comprised of a few distinct sub-neighborhood areas: Adams Shore, Houghs Neck, and Germantown; orientated west to east, and southeast, respectively. The neighborhood of Adams Shore developed as a summer resort mainly for Bostonians, yet it has evolved into a year-round community that greatly benefited from the Boston Harbor cleanup initiative. Further out on the peninsula, the neighborhood of Houghs Neck is densely developed; the aging housing stock has experienced rejuvenation as the neighborhood offers spectacular ocean views. Development in this area is somewhat sparser than some of Quincy's other neighborhoods, as it is surrounded by a number of healthy salt marshes. The Houghs Neck peninsula was once deemed the "Flounder capital of the world" as the area used to be a popular recreational fishing spot for flounder and other fish such as haddock, striped bass, bluefish, and cod. However, fish stocks have been heavily impacted by a variety of human activities including a loss of salt marsh habitat that provide important nursery and spawning areas. The neighborhood just south of Houghs Neck, Germantown, was settled as the home to shipbuilders and their families who were primarily of German heritage. Today Germantown is home to several affordable housing complexes, with 900 units operated by the Quincy Housing Authority. Germantown also includes numerous small-sized apartment buildings (2-4 units) and single-family homes circa 1940-1969, which are primarily renter occupied. The area is also home to one of the first planned industrial community in the United States, resulting from the expansion of the Fore River Shipyard.

Merrymount

Merrymount is bordered by Quincy Bay, Black's Creek, Quincy Center and Adams Shore. Founded in 1625 by Thomas Morton, the neighborhood was the initial site of Quincy's settlement and was home to a large Indian population until the Adams family acquired it. Primary residential, the neighborhood was sold off as housing lots during Quincy's burgeoning residential development in the early 1900s. The subsequent development consisted of single-family dwellings and the area was fairly built out by the WWII postwar period. The hilly terrain provides some of the best vistas of the bays and marshlands in Quincy, which contributes to the popularity of this neighborhood for homebuyers. The neighborhood encompasses just over 1 square mile and has a population of approximately 6,000 people.

North Quincy/Wollaston Neighborhoods

North Quincy's relatively flat terrain allowed for a dense pattern of single family housing construction that boomed during the early 1900s. In the 1970s, the North Quincy Red Line subway station was constructed to service increasing numbers of area residents and commuters to downtown Boston. Today, North Quincy is densely populated, with the presence of multi-family homes increasing along Newport Avenue, and more single-family residences closer to the northwest boundary of the City. Commercial activity is present and flourishing along Newport Avenue and along the Neponset River to the north. The Wollaston Red Line station is located along Newport Avenue in the southeastern part of the neighborhood. The Wollaston Beach area is the longtime home of seasonal vacationers, and commuters to Boston, with growth aided by the creation of the MBTA Commuter Rail and Red Line. The area has developed into a dense neighborhood composed of a grid of residential streets with apartment buildings present in sections close to the MBTA Red Line, and a clustering of multi-family residences closer to Newport Avenue.

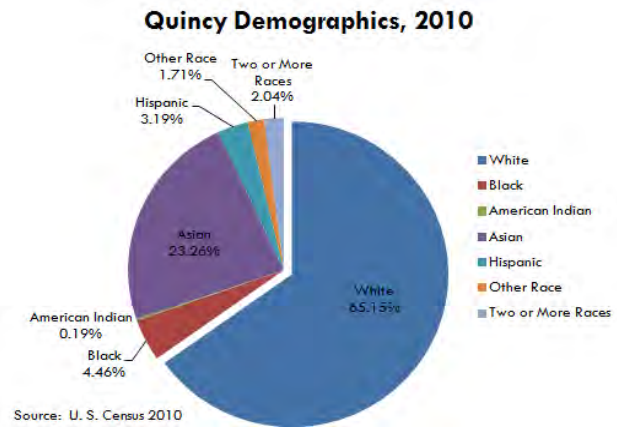
Squantum/Marina Bay

The neighborhood of Marina Bay is on Squantum Peninsula, bordered on the north and the west by Dorchester Bay. Marina Bay is a planned development area comprised primarily of residential multi-unit condo buildings and large housing development clusters. Some commercial businesses line the coast, including marinas, restaurants, and retail. The neighborhood area of Squantum, a former luxury summer resort area, is now populated year-round via the conversion of summer cottages to permanent homes after a causeway was built to allow vehicle access. Today, Squantum primarily includes medium-density residential development alongside some multifamily residences and some commercial activity. Salt marshes line the border between Squantum and Marina Bay, but unlike Marina Bay, the coastline of Squantum is primarily lined by beaches.

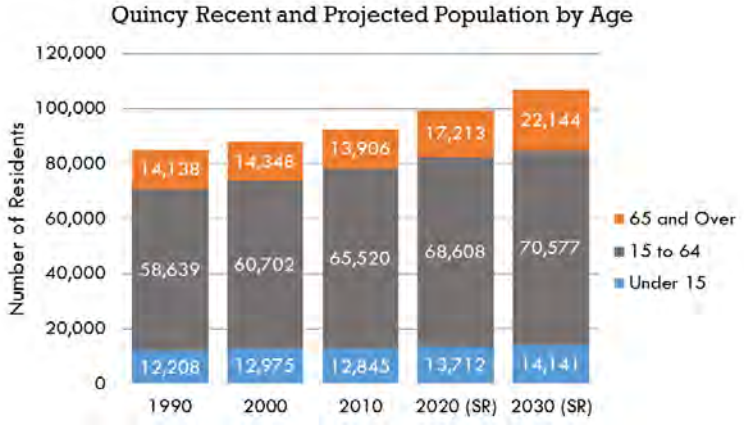
Socio-Economics

Quincy is a large city - eighth largest in the state - with a population recorded in 2010 as roughly 93,000 people. The demographic projections included herein reflect the "Stronger Region" scenario from the Metropolitan-Boston Regional Plan (MetroFuture). MAPC identified a range of possible futures during the regional planning process, because the future cannot be predicted with certainty. Each scenario reflects different assumptions about key trends. The "Status Quo" scenario is based on the continuation of existing rates of births, deaths, migration, and housing occupancy. Alternatively, the "Stronger Region" scenario explores how changing trends could result in higher population growth, greater housing demand, and a substantially larger workforce. This scenario has been adopted by the Massachusetts Executive Office of Housing and Economic Development as the basis for the Commonwealth's multifamily housing production goal. Therefore, the climate planning team believed it was critical to utilize this scenario of projections to ensure that climate impacts and subsequent resiliency recommendations accommodate the demographic trends of the community moving forward.

Demographics



Quincy's population aged 65 years and older are of particular interest to the planning team, as their numbers are projected to increase over time. Additionally, the population segment that is likely to form new households - ages 25-44 - is also projected to continue to increase. These increases will require roughly 8,800 more housing units (and associated services) by 2030 according to the MAPC *Stronger Region* scenario projections.[14]



The Asian population continued to grow from 2000 to 2010 with 22,174 Asian residents in 2010, representing 24% of Quincy's overall population. Chinese ancestry (67%), Asian Indian (13%) and Vietnamese (11%) are the largest Asian subpopulations within this demographic. Quincy provided election ballots in both

English and Chinese for the first time in 2012. According to federal law, a community must provide bilingual ballots when more than 5% of voting age residents have limited English proficiency and the percentage of that group with a fifth grade education or less is higher than the national average. Quincy was the only City in the Commonwealth to meet this threshold.[15] Quincy's increasing diversity is also inclusive of increases in the African American (+423%), Hispanic (+118%), and Multi-racial populations. According to the City of Quincy Demographic & Census Data report from May 2013, the highest minority populations were located in the North Quincy, Montclair, and Adams Shore & Germantown Census Tracts, each with at least 50% non-white population.

Health and Welfare

Information regarding current health and welfare conditions within the City will reveal what health issues are currently being experienced by residents and provide a look into how these types of issues might change in the future. Data particular to hospital and emergency room visits reveal acute, or current, issues that are affecting residents. Health behavior and risk data provides the glimpse into what health issues might persist, which might arise, and which may fall away under climate change conditions.

Hospitalization data identifies immediate health issues experienced in a community. Quincy had a slightly higher rate of cardiovascular hospitalizations than the state, but experienced much fewer asthma-related hospitalizations in 2012, as shown in the table of compiled hospitalization data.

City of Quincy Hospitalizations (2012-2013)

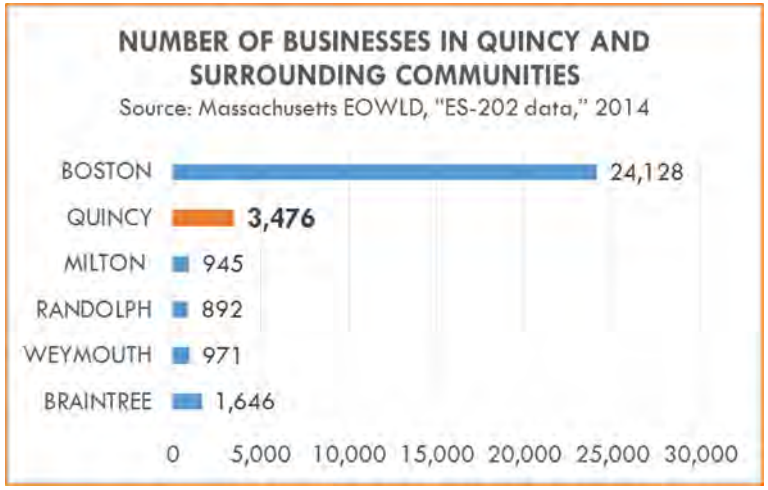
	Heart-Attack		Asthma		Heat Stress		Mental Health[2]	
	Quincy	State	Quincy	State	Quincy	State	Quincy	State
Male	41.9	39.2	55.5	70.9	10.4	16.4		
Female	21.6	22.9	56.1	76.8	4.1	9.9		
Total	31.1	30.7	55.8	73.9	7.1	13.1	3,005.2	2,397.6

Source: Massachusetts Center for Health Information and Analysis, 2012 & 2013
1. Age-adjusted rate per 10,000 people.
2. Age-adjusted rate per 100,000 people.

In 2012, Quincy had a lower rate of heat stress emergency department visits. Women in the city also had a lower rate than men living in the City. Quincy does may have an elevated rate of mental health hospitalizations[16]. Based on 2012 data, the rate is higher than the state's rate of 2397.6 per 100,000 people. Mental health hospitalizations includes a variety of mental disorders, such as anxiety and schizophrenia, as well as acute reactions to stress and drug dependence.

Economy

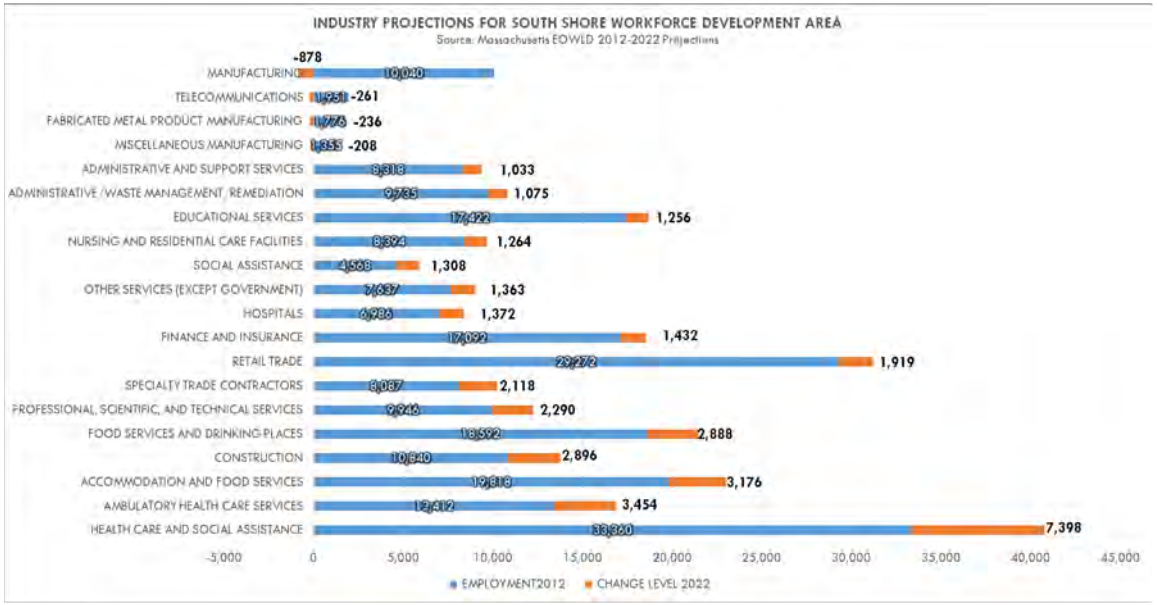
Quincy has a larger economic base relative to Braintree (twice the size), as well as its other neighbors of Milton, Randolph and Weymouth (3-4 times larger.)[17] However, Quincy's economy is smaller than that of Boston.[18] In 2014 Quincy had 3,476 businesses employing approximately 48,000 individuals. When measured by the number of jobs, the top four industry sectors are finance (25% of all jobs); education and health services (24%); professional and business services (12%); and transportation and utilities (12%).[19]



The City principally has four distinct commercial areas located in the following neighborhoods:

1. ***Marina Bay (Anchored by Commander Shea Boulevard.)*** Marina Bay is comprised of a mixed-use "New Urbanist" development that includes condominiums, office complexes, restaurants, and a 685-slip marina at the mouth of the Neponset River into Dorchester Bay. This area also includes the Boston Scientific Corporation's prominent distribution warehouse and the Atria Marina Place assisted living facility (each employing between 50 and 100 individuals).
2. ***North Quincy (Adjacent to the MBTA Red Line station and Newport Ave.)*** This commercial district is home to one of the six largest employers in Quincy: Granite Telecommunications, who employees between 500 and 1,000 individuals. Other notable employers include Blue Cross Blue Shield of Massachusetts and the State Street Corporation.
3. ***Quincy Center (Flagged by the MBTA Red Line station, Hancock and Coddington Streets.)*** Of the six largest employers in Quincy, three are located within this commercial district: Quincy Medical Center, Fallon Ambulance Services, and Stop & Shop Supermarket. Two of the City's largest employers are located just southwest of the Center within the Crown Colony/State Street business area: Boston Financial Data Services and the Patriot Ledger newspaper company.
4. ***Fore River Shipyard (Delineated by the Fore River and East Howard Street.)*** This area has been designated as a maritime industrial working port of regional significance, protected by the State as part of the Weymouth (Fore River) Designated Port Area. There are two large employers in this commercial/industrial district: Bluefin Robotics Corporation, and Twin Rivers Technologies. These two businesses combined employ between 200 and 500 individuals. Other noteworthy businesses include the Citgo Petroleum Corporation (oil tank farm), the Sprague Energy (oil and natural gas tanks and terminal), and the United States Naval Shipbuilding Museum.

The State of Massachusetts Executive Office of Workforce and Labor Development provides long-term industry employment projections statewide and for sixteen (16) Workforce Development Areas (WDA). Employment is projected for approximately 80 industries, based upon the North American Industry Classification System (3-digit code), over the 2012-2022 timeframe. The City of Quincy is included in the South Shore WDA. The following graph highlights a selection of the industries with the greatest positive and negative projected employment changes. The following industries are projected to add the most jobs and provide critical services that must be accommodated in a resilient manner: health care and social assistance (+7,398 jobs), ambulatory health care services (+3,454 jobs), hospitals (+1,372 jobs), and nursing and residential care facilities (+1,265 jobs).



Growth and Development

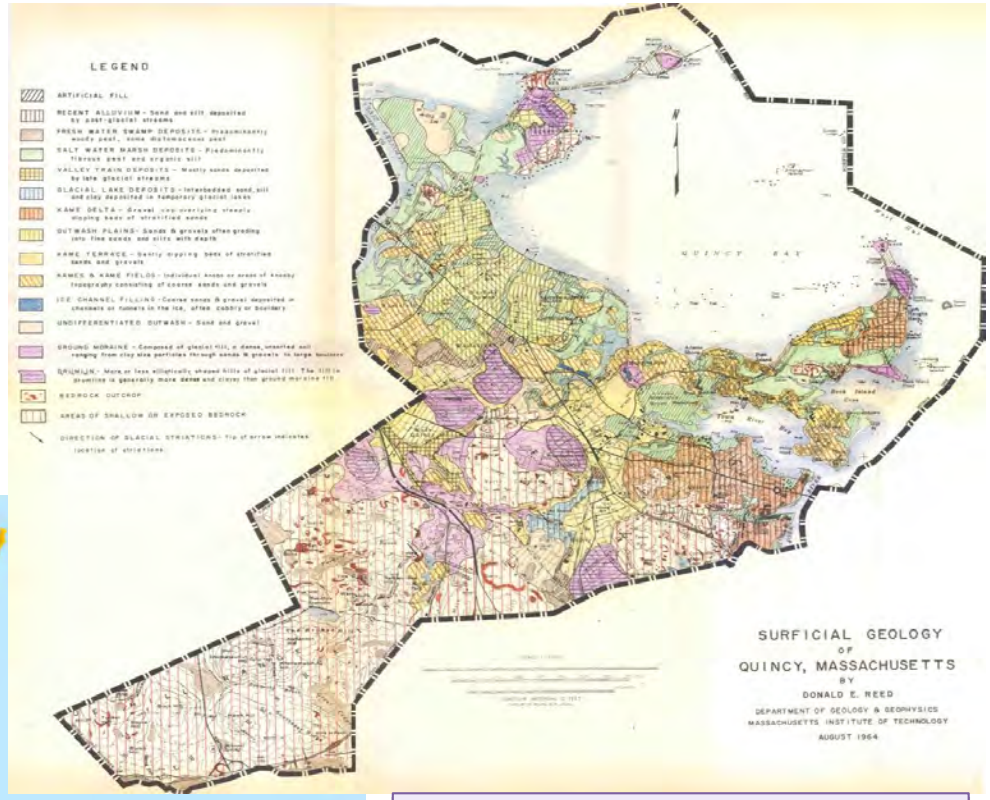
The City's three largest commercial areas, North Quincy, Wollaston and Quincy Center, are located along the north-south rail line. Each district has taken advantage of the presence of passenger rail service serving as public transportation hubs. However, the decline of both the quarrying and shipbuilding industries gave way to modern auto-centric development patterns. Locations with close access to I-93, became highly desirable as they were easy accessible to employees outside of Quincy who drive to work.

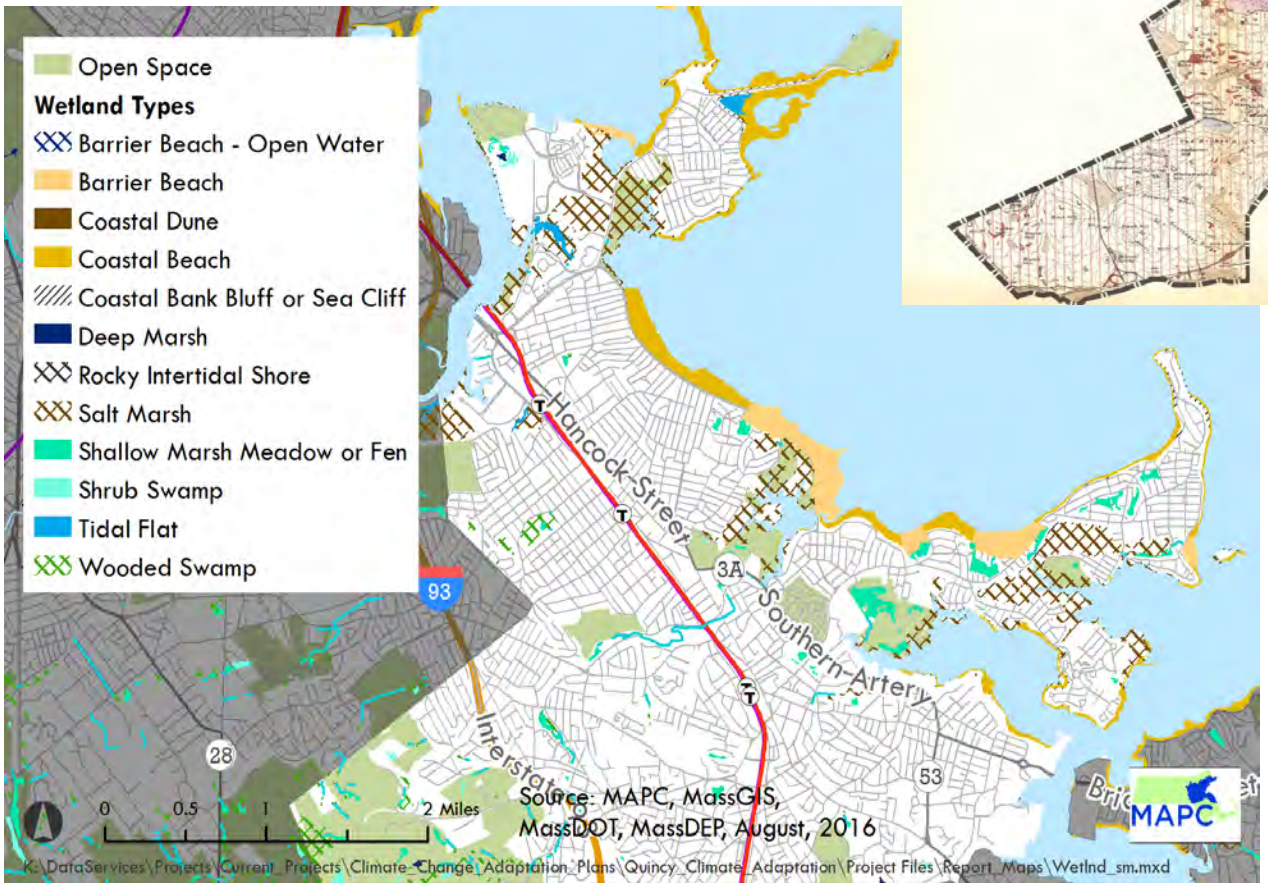
At the start of the 21st Century Quincy, like other developed urban areas, the City of Quincy experienced an increased interest in private investment. Quincy's location adjacent to Boston, its transportation networks, and quality of life, make it very attractive to many who want to live and work in an urban area. Much growth has occurred within infill and redevelopment sites near MBTA stations, however; steady development has been prevalent throughout the City. Over $600 million in new residential and commercial development projects have created approximately 2,000 residential units and over 180,000 square feet of commercial space across the City, as described in the spring 2015 Quincy Economic Development Snapshot. Since the 1970s most residential development has been multi-family. The residential development patterns between 2000 and 2009 show that 93% of new residential units have been multi-family. Eighty percent of the residential developments have been in structures that house 8 or more units.

It is anticipated that the conditions that make Quincy a highly desirable location to live and work will continue to spur commercial and retail development. Therefore, there is great potential for the City to ensure that this particular redevelopment utilizes innovative, "no regrets" best practices for climate adaptation and mitigation. Further discussion regarding these specific opportunities is included in the recommendations chapter.

Environmental Resources

Environmental characteristics of the City provide a vital underpinning for climate resiliency. The City of Quincy is a rather unique municipality in that it includes ultra-urban industrial revolution





"The Earth's crust hosts most of the life on the planet, as well as the water, energy, and mineral resources that sustain society. The crust contains the answers to questions about the location and origins of these resources, the evolution of life, climate change, natural hazards, and the movements of nutrients and toxicants. A comprehensive understanding of the Earth's geologic framework is needed to inform the critical decisions the Nation and the world will make about resource utilization, environmental quality, and hazard mitigation."

Geology for a Changing World 2010–2020: Implementing the U.S. Geological Survey Science Strategy, USGS 2011

characteristics alongside historic sites, and fairly intact natural resources. For instance, a number of salt marshes that are still scattered across the coastal areas of the City can offer climate change resiliency services, if protected and restored. This is unique to Quincy, as most of the Commonwealth's major cities, including Boston, has filled or eliminated most of their wetland areas. The historic geology of the City also paints a portrait for underlying conditions upon which the City was built, and remains as another foundation for resiliency. The adjacent map provided illustrates the historic surficial geologic make-up of the City of Quincy; that is the distribution of loose materials such as till, sand and gravel, or clay, which overlie solid ledge (bedrock) As shown, the City's surficial geology included, and to some degree continues to include, salt marshes and sandy outwash plains (fundamental substrate for coastal beaches).[20]

Comparing this historic map to the adjacent existing conditions map indicates that some historic coastal wetland resources still remain throughout the City, particularly within the Wollaston, Merrymount, Houghs Neck/Germantown, and Squantum neighborhoods (areas shown in light green on the historic map and brown cross-hatching on the current map). Additionally, there are several areas of beachfront remaining throughout the City (shown in yellow and hatching on the historic map, and yellow on the current map).

Forestry and Open Spaces

The most common type of forested vegetation in Quincy is deciduous trees, which are found in large quantities in the wooded uplands of the Blue Hills Reservation (2,436 acres), Faxon Park (57 acres), Squaw Rock (15 acres), Montclair Bog (16 acres), and Merrymount Park (80 acres).

Deciduous tree pockets are also scattered throughout the City's residential areas, particularly the Wollaston, Montclair, North Quincy, Quincy Point, South Quincy, and Hough's Neck neighborhood. Over the past four years, the City has planted an additional 2,000 trees to offset the number of older trees that must be removed due to disease and decay. The City of Quincy Field Guide to Trees is a recent project undertaken by the City offering a tree "census" of approximately 480 trees in the Downtown Quincy area. The census includes recorded information on tree species, health, growing conditions, height, caliper, vascular, foliar, & mechanical damage, location, and individual photographs of each specimen. The City has been designated as a "Tree City USA" community by the National Arbor Day foundation for 18 consecutive years[21]. This honor acknowledges the City's commitment to its urban forest, which is a critical factor for climate mitigation, as discussed in the assessment section.

In addition to multiple state parks and green spaces, Quincy has numerous aquatic resources: salt marshes, brackish estuary systems, rivers, streams, and inland wetlands. Salt marsh systems line the coast of the Quincy including those adjacent to Wollaston Beach, Black's Creek, Squantum Point, Houghs Neck and Germantown. Inland wetlands such as shrub swamps and meadows are common to the Blue Hills Reservation, and are also found in Quincy Point, Wollaston, and the banks of the upper Neponset River. Quincy has approximately 43 certified vernal pools and 13 potential vernal pools that are NHESP Priority Habitats of Rare Species. Critical Habitat Landscapes are located at Squantum Point Park, Merrymount Park, and Rock

Island Cove where endangered and threatened species exist such as the Marbled Salamander (Ambystoma Opacum). A. Opacum is a sensitive indicator of environmental quality, and therefore is used as an example species in the vulnerabilities analysis. Understanding the environmental conditions of Quincy's large river and brook systems is critical to complete the City's vulnerability analysis, as these conditions are directly related to flood potential to adjacent developed areas. The following subsections provide a brief synopsis of key conditions in riverine areas that are relevant to Quincy's climate resiliency.

The Blue Hills Reservation comprises a significant portion of Quincy's upland landmass (approximately 24 percent). The Blue Hills Reservation adds a contrasting natural setting to the Southwestern corridor of the City. Its thick woods, hills, trails, and ponds offer a whole other range of recreational opportunities compared to the oceanfront areas. Two of Quincy's streams originate in the Blue Hills: Town Brook flows from the Reservation through to Quincy Center and opens into the tidal Town River, and Furnace Brook travels through West Quincy before emptying into Black's Creek and Quincy Bay, as discussed further below.

Aquatic Resources

Town Brook

Town Brook originates in Braintree as a tributary to the Old Quincy Reservoir and flows through the City, finally discharging into the Town River estuary. It has a complicated history. The original brook system has been altered (channeled, moved, and culverted) over time, commencing in the late 1800's and continuing into the 1970's. To date, the majority of Town Brook in Quincy is underground and mostly culverted. Wetland resource areas presently associated with the Brook that are protected under the Massachusetts Wetlands Protection Act regulations (M.G.L. c. 131, § 40; & 310 CMR 10.00) include Riverfront Area and Bank along the open channel sections and Land Under Water Bodies and Waterways that underlie Anadromous or Catadromous Fish Runs. Culverted sections of the brook have been designed to convey the 100-year flood and 500-year flood by the U.S. Army Corps of Engineers (ACOE). Currently, the Brook regulates stormflow via weirs at the Center Street junction box and a deep rock tunnel inlet behind Star Market, constructed by ACOE.

Given the highly urbanized nature of the Brook's historic catchment area (watershed) and its extensive alteration, it experiences "flashy" flows. In other words, the Brook rapidly collects flows that are channelized within the steep slopes of its primarily engineered banks, resulting in flood peaks soon after a precipitation event. Aquatic life within the Brook was documented in the 2003 DEP Weir River Watershed Water Quality Report[22] as impaired, evidenced by smelt egg mortality in 2008. The smelt that live and spawn in the brook are the primary food source of the Atlantic cod, a focal point of the New England fishing industry. The City of Quincy recently partnered with the Massachusetts Department of Environmental Protection (MA DEP) and the Massachusetts

Division of Marine Fisheries (DMF), to monitor and preserve smelt habitat in the brook. The City values the ecological importance of the brook and has made efforts over the past decade to improve its functionality. The Town Brook Enhancement project of 2013 daylighted portions of the brook via the removal of above-ground obstructions and uncovering culverted sections within the Downtown area.

Neponset River

The Neponset River Estuary Area of Critical Environmental Concern (ACEC) is approximately 1,300 acres in size and is located primarily in Quincy (470 acres), as well as in Boston (435 acres) and Milton (355 acres). The ACEC boundary is based on the Wetlands Protection Act Regulations (wetlands resource areas and a 100-foot buffer) plus adjacent public open space and historic districts. The ACEC begins at the Lower Mills Dam in Milton and Dorchester, which separates the coastal estuary from the inland fresh water portion of the Neponset, and extends to the mouth of the river at Squantum Point in Quincy. The central resource features of the Neponset River Estuary ACEC are the Neponset River and portions of its tributaries, the estuary, salt marshes, floodplains, fishery habitat, and diverse wildlife habitat. Substantial soft-shell clam beds are located at the mouth of the River near Squantum Point. This area also provides habitat for a tremendous diversity of bird species and is one of the most important wildlife habitats in the urbanized Boston area.

Weymouth Fore River

Historic observations by DMF indicate the Weymouth Fore River was one of the largest smelt runs in Massachusetts supporting a large recreational fishery in Quincy Bay. The Fore River remains one of the largest smelt runs in Massachusetts with relatively higher catches of American eel and Atlantic cod. However, due to the industrialized nature of the former Fore River Shipyard area, polychlorinated biphenyls (PCBs) are still present in fish samples within the Weymouth Fore River; specifically within the headwaters at the Route 3a Bridge to the mouth of the River between Shipyard and Germantown Points.[23] The River has also tested positive for traces of fecal coliform from urban stormwater, which has impacted the past shellfishing industry in the estuary.

Furnace Brook

Furnace Brook originates near Chickatawbut Road in the Blue Hills Reservation and travels approximately four miles through West Quincy to Black's Creek. As noted in the City's 2012 Open Space and Recreation Plan, Furnace Brook serves as the primary storm water conveyance for the watershed area. Furnace Brook is culverted underground upstream of Quarry Street and daylights near the Bernazzani Elementary School. The Massachusetts Bays Program identifies Furnace Brook as habitat for rainbow smelt. According to the MA DEP 2004 Water quality assessment, the spawning habitat is degraded due to urban stormwater influences, sedimentation, and excessive periphyton growth. The City, in its Hazard Mitigation Plan, has identified areas adjacent to Furnace Brook as susceptible to frequent and, at times, intense flooding and notes that tidal conditions at Black's Creek can exacerbate flooding. The plan recommends inspection and cleaning of the culverts to assess their condition and avoid clogging. These are critical pieces of information to consider with respect to the potential resiliency of the stormwater system under climate conditions, as further discussed in the vulnerabilities section.

3. Vulnerability Assessment

The vulnerability assessment prepared for the City of Quincy was guided by several regional analyses and collaborative efforts currently occurring within Metro-Boston. These processes/initiatives include the Metro-Mayors Climate Task Force, the Boston Research Advisory Group Climate Data Consensus initiative, and the Metro-Boston Regional Climate Change Adaptation Strategy (RCCAS). MAPC's involvement in these collaborative initiatives resulted in the development of a municipal and multi-municipal vulnerability assessment methodology, which has been vetted by peers and utilized for this pilot planning project. This method is also based upon an expansive literature review of methodologies utilized by U.S. Cities such as New York City, New Orleans, and Cambridge, as well as national science-based agencies engaged in climate assessment (e.g. U.S. Fish and Wildlife, National Oceanographic Atmospheric Administration, U.S. Geologic Survey).

In keeping with the RCCAS, this method includes an assessment of vulnerabilities in the following municipal sectors: Natural Environment, Coastal Zone, Development and Infrastructure, Public Health and Welfare, and Local Economy. Our general approach to conducting a vulnerability assessment is reflected in the following graphic. Further details regarding assessment methods can be found in the Appendix.

However, it must be noted that although our methodology is aimed at predicting future conditions, the analysis always includes current conditions as a critical baseline. In assessing these conditions, the planning team noted that the City has already been impacted by climate changes in the form of erratic and extreme weather events, as well as a historic increase in sea level rise along its shoreline. These effects have been exacerbated by aging infrastructure throughout the City.

Future Conditions

The term "future" conditions includes changes in weather patterns that have already been documented, which provide a critical baseline by which future predictions are based upon. As described previously, a set of scenarios was developed by the Intergovernmental Panel on Climate Change's (IPCC) to represent the range of driving forces and Greenhouse Gas emissions, which were predominately utilized by the planning team: *Highest* emissions (RCP8.5), *Intermediate High* (RCP 6), *Intermediate Low* (RCP 4.5), and *Lowest* emissions (RCP 2.6). These emissions scenarios are used as input to global climate models (GCMs), which are complex, three-dimensional mathematical representations of the Earth's climate system, including atmosphere and ocean circulation and biogeochemical processes, while accounting for land use change, etc.[24] These forecasts have then been utilized by global and U.S. agencies to create more national or regional (U.S. Regions) climate projections such as those created during the U.S. National

Climate Assessment. These global and national projections are then applied to local environmental conditions data such as high water/tidal data, temperature and/or precipitation measurements, etc., to output more localized conditions.

Firstly, the planning team was fortunate to be involved with the BRAG in the development of their Climate Change Data Consensus initiative, and was then able to utilize these findings, along with the RCCAS, to prepare the most up-to-date assessment for the City of Quincy. Additionally, the planning team had the benefit of utilizing the Boston Harbor Flood Risk Model developed by the Woods Hole Group for the Massachusetts Department of Transportation and the Federal Highway Administration for the Central Artery. This model inputs sea level rise projections into a hydrodynamic model to project the extent and probability of future coastal flooding. Further information regarding this model and its outputs are described in detail in the following sections. Lastly, MAPC's vulnerability assessment methodology for this analysis was enhanced by the Boston University City Planning Symposium during the spring of 2013, which included a student-driven assessment of anthropogenic vulnerabilities.

Impacts of climate change are dynamic and, in some cases, are already being observed across the City in various ways, including those within the four primary categories listed below.

1. Local sea level rise and coastal flooding = property damage and losses, loss of water-dependent recreation (fishing, swimming, boating), damage to and loss of transportation services, economic losses (decreased tourism, degraded fishing/shellfishing areas).
2. Intense and more frequent precipitation (rain and snow) = altered surface and groundwater hydrology causing plant and animal species loss or migration, increased stormwater runoff causing flooding, inland flooding causing damage to and loss of property and transportation services, other economic losses (decreased eco-tourism, degraded fishing areas), stress to aged infrastructure.
3. Droughts (from erratic precipitation patterns) = food crop loss, low streamflow and fish kills, loss of drinking water supply, loss of water-based recreation, stresses to local flora and fauna.
4. Localized temperature extremes (heat waves and cold snaps) = heat-related illnesses (asthma, cardiovascular, mental health) and mortality, property damage (intense snow and ice), brownouts and energy-related loss.

Studies by the National Oceanographic and Atmospheric Administration (NOAA) have shown that some climate impacts in the New England Region, primarily increased precipitation and sea level rise, may be greater than in other parts of the U.S. Changing weather conditions will include increased rainfall in winter and a shorter duration of winter snow fall, resulting in a shorter season. Very recent research indicates that rising sea levels are likely to be higher along the New England coastline than those projected globally, due to the combination of Arctic ice sheet melt, northeast storm direction/patterns, and local land subsidence (sinking of land mass), as further described in subsequent sections.

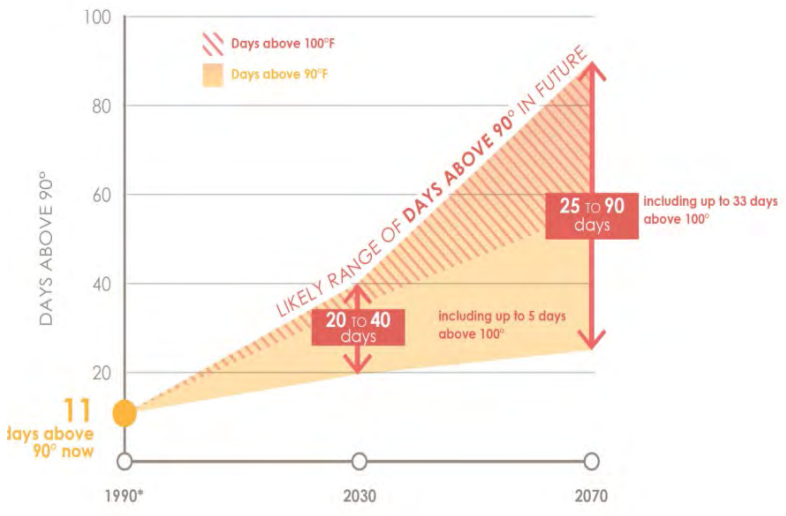
Temperature

The IPCC forecasts temperatures continuing to increase worldwide during the 21st century due to the GHG emission trajectory we are on. The latest scenarios from the 2015 United Nations Paris Climate Summit for average temperature changes across all RCP greenhouse gas emissions scenarios show a continuation of increased global temperatures. The average temperature in Massachusetts between 1961 and 1990 has been approximately 46.4 degrees Fahrenheit (°F). By mid-century this is anticipated to increase by approximately four to five degrees (3.6 to 5.4°F). By the latter part of the 21st century (2100) average temperatures are expected to increase by five to nine degrees (5.4 to 9°F). Increases in temperature are expected to be more dramatic in urban areas where there is less shade and a higher fraction of dark, absorbing surfaces such as rooftops, roadway pavement and parking.

Predicted Temperature Ranges (degrees Fahrenheit) – CRB Consensus Report

	1961-2010	2010-2030	2035-2064	2070-2100
Annual Average	46 to 50	53 to 54	n/a*	56 to 59
Winter Average (Dec., Jan., Feb.)	23 to 28	30 to 33	30 to 36	34 to 42
Summer Average (Jun., Jul., Aug.)	68 to 69	70 to 72	71 to 76	74 to 84

*Annual averages were not produced for the 2035-65 timeframe.



For Quincy, we utilized the most recent temperature findings from the BRAG consensus report for the Climate Ready Boston initiative. The current annual average temperature in the greater Boston Harbor area was calculated as approximately 50°F.[25] The BRAG's draft findings show annual temperatures increasing ***from this baseline*** by 3 to 9 degrees Fahrenheit between 2030 and 2100, as shown in the adjacent table. A six to fourteen degree (6 to 14°F) increase during the winter months will have adverse impacts on aquatic habitats, public health, and aging infrastructure.

It should be noted that increases in temperature within urban areas such as Quincy are expected to be more dramatic than shown here due to less available shade and a higher fraction of dark, absorbing surfaces (impervious surfaces). This phenomenon has been termed "urban heat island effect."

Precipitation

According to the Northeast Climate Impacts Assessment report of 2007, annual precipitation levels are expected to increase across New England by as much as fourteen percent (14%) by the end of this century, with an estimated thirty percent (30%) increase in precipitation during winter months. Due to the uncertainty of precipitation forecasting, the Boston Research Advisory Group conducted a literature review and analysis of precipitation

studies conducted within New England to attempt to create consensus regarding future precipitation. One study referenced was completed by the City of Boston Water and Sewer Commission (BWSC). Rain gauges installed throughout Boston documented variations and increased intensity of rainfall within the greater Boston Harbor area. Information from these gauges was used to create rainfall projections for short-term precipitation extremes by the BRAG academic team. The following table provides projections for 10-year/24-hour precipitation (i.e. the 24-hour precipitation amount that has a 10% chance of occurring in a given year). Predictions for two different greenhouse gas emissions scenarios are provided. For 2100, the results show a 17% and 29% increase in precipitation, for the medium and highest emissions scenarios respectively.

Detailed projections for multi-day precipitation extremes are not yet available; however the Cambridge Climate Vulnerabilities Assessment predicts that the magnitude of multi-day precipitation events will also increase. Their projection is that five-day precipitation amounts will increase up to thirty percent (30%) by 2030 and up to forty percent (40%) by 2070[26].

Predicted Precipitation (BWSC 2015)

	Baseline (1961-2010)	2035	2060	2100
RCP 6 GHG Scenario (Intermediate high)	5.2 in.	5.5 in.	5.8 in.	6.1 in.
RCP 8.5 GHG Scenario (Highest)	5.2 in.	5.6 in.	6.0 in.	6.7 in.

It should be noted, however; that these precipitation projections could still be considered somewhat conservative, as they are based upon a limited amount of data. As a comparison, the Northeast Regional Climate Center created an "Extreme Precipitation in New York & New England" data repository and guidance to offer practitioners with a wider, more robust base of data. This work was based upon the premise that previous climatology methods assume that rainfall series data is static, and therefore; does not reflect current conditions. Recent analyses by the Center indicated that the frequency of 2 inch rainfall events across New England have already increased since the 1950s and storms once considered a 1 in 100 year event have become far more frequent - almost twice as often.[27] Using the Center's web-based tool, the planning team determined that the current 10-year (frequency) 24-hour storm for the City is measured at 5.42 inches. This baseline is already higher than the baseline utilized by BWSC, and it statistically significant to the projected rainfall amount for 2030.

With increased temperatures, winter precipitation will more often be in the form of rain, meaning a decrease in snow cover and earlier and less intense spring snow melt. The projected decrease in snow cover in the Boston metro area is consistent with a broader regional trend throughout the Northeast. According to the Northeast Climate Impacts Assessment Report, under the highest GHG emissions scenario, a typical snow season may become "increasingly rare" in the Northeast towards the end of the century.[28] Precipitation changes will impact analysis of future floodplain areas as discussed below.

Riverine (Inland) Flooding

Prior to describing local climate change impacts related to inland or coastal flooding, it is important to make a distinction between ***existing*** flood conditions and ***future*** flood conditions, and to define the terms associated with each. Existing Federal Emergency Management Agency (FEMA) floodplain areas are based on both historic and existing conditions; they do not include future or projected climate conditions. FEMA administers the National Flood Insurance Program (NFIP), established in 1968 to reduce the nation's flood losses via local floodplain management practices. A floodplain is defined by the NFIP as any land area susceptible to being inundated by floodwaters from any source[29]. FEMA's flood maps, the Flood Insurance Rate Maps (FIRM) delineate flood zones that are defined according to varying risk of, or potential for, flooding due to the land area's characteristics (proximity to a waterbody, topography/slope) and ***current*** waterbody conditions (water/sea levels, wave action, historic storm experience) as follows:

1. High Flood Risk: an area likely to be subject to a "100-year flood event" - having a 1% chance of flooding within a year (and 26% chance of flooding over life of 30-year mortgage). These are coastal areas called Velocity Zones (V or VE Zones) or A-AE Zones along inland waterbodies. In coastal V Zones the flood event also includes calculated storm-induced velocity wave action (a 3-foot or higher breaking wave).
2. Moderate Flood Risk: an area likely to be subject to a "500-year flood event" - having a 0.2% chance of flooding within a year (Shaded Zone X on FIRMs).
3. Low Flood Risk: areas outside the 1%- and 0.2%-annual chance floodplains (Unshaded Zone X on FIRMs).

Existing flood conditions that are mapped by FEMA provide an important baseline for predicting future flood conditions. Although this vulnerability assessment focuses primarily on flooding in coastal areas, the relationship between coastal ecosystems and inland river systems within the City should be noted. For instance, increases in river flow and velocity will result in erosion and flooding within coastal estuaries, and vice-versa. Further, the City of Quincy is located at the terminus of both the Neponset River and Weymouth Fore River where these systems meet Quincy Bay. These rivers carry abundant sediment and deposit it at the mouth of Quincy Bay. Existing floodplain delineations

completed by FEMA for the National Flood Insurance Rate Program are shown in the adjacent graphic produced by the City of Quincy, which illustrates current flood-prone areas (shown in blue).

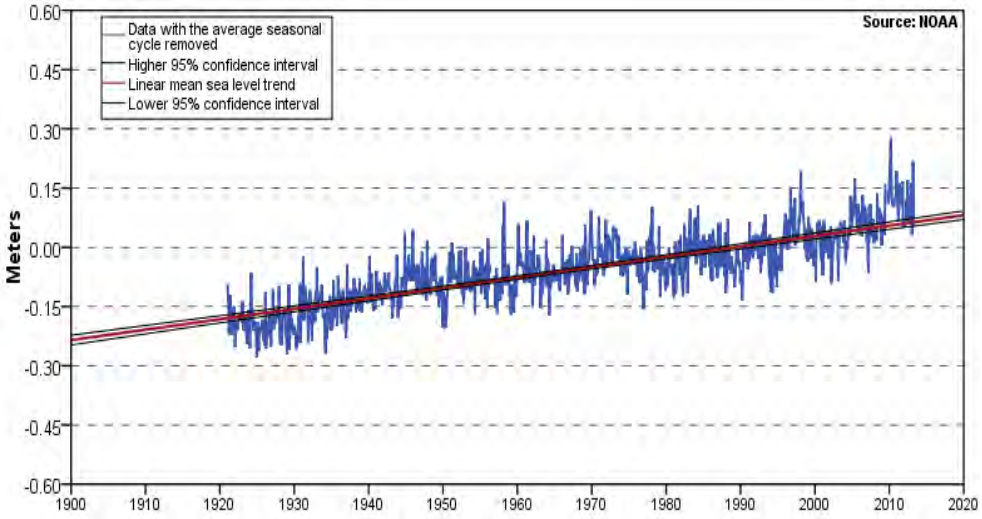
Hydrologic modeling to predict inland floodplain expansion is not currently available for the Neponset River or Weymouth Fore River Watersheds, similar to all watersheds across eastern Massachusetts. Therefore, we are referencing the general floodplain expansion projections developed for the Greater Boston Harbor area by the BRAG. Participating scientists utilized precipitation forecasts, including those referenced above, to determine the range of potential increase in river flooding. Results from their analysis indicate a 20-50% increase in the 2% chance storm floodplain, and a 15-70% increase in the 1% chance storm floodplain, between 2055 and 2085. However, it must be noted that these flooding projections include much uncertainty due to limitations associated with climate model simulation of extreme precipitation, downscaling, and flood modeling. For instance, according to the BRAG report, "rain on frozen ground without significant snow cover is an important flood generating process in New England, yet the relative importance of that process compared to rain on saturated soils is unknown."[30] According to the BRAG findings report, river flooding projections should be treated with caution, due to said limitations.

In the future the City may wish to keep updated on modeling under development that will be useful to prepare an analysis of riverine flooding within developed areas, particularly for critical transportation corridors such as Furnace Brook.[31]

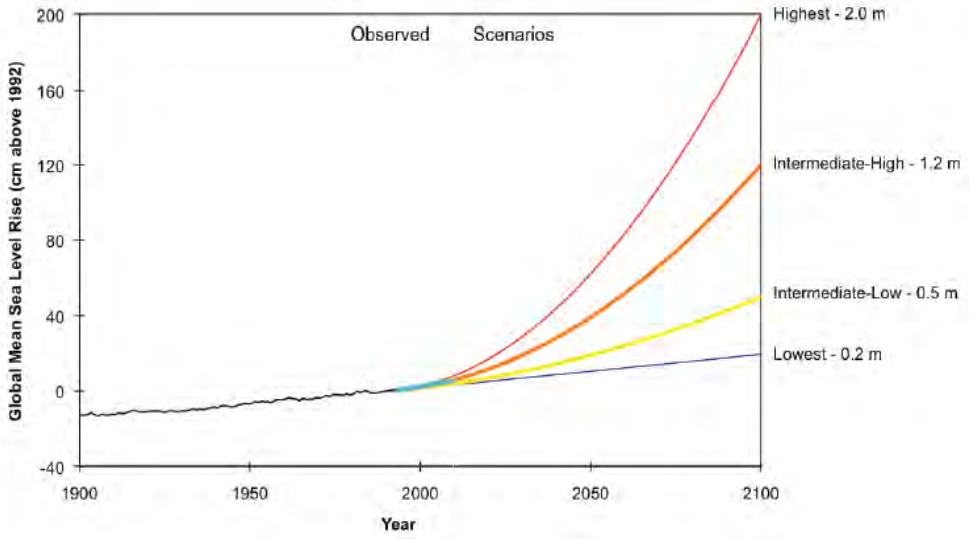
Coastal Storms and Flooding

Currently, coastal storms present a threat to development along the Quincy coastline due to storm surges that overtop coastal structures and natural shorelines, resulting in coastal flooding. Coastal storms can be a result of tropical hurricanes or ex-tropical northern storms (nor'easters). Hurricanes typically do not penetrate the Quincy shore as it is protected by adjacent coastal barrier landmasses including the Town of Hull and the Boston Harbor Islands. Nor'easters pose the biggest threat to Quincy and other east facing communities on Boston Harbor and Massachusetts Bay. Damage from nor'easters is exacerbated when combined with spring tides and when they extend across multiple high tides. Projected future sea level rise will intensify flooding concerns along the Quincy shoreline.

Sea level refers to the height of the ocean's surface; it is used as the basis for determining land elevation. Mean sea level is an average measurement of the water's surface elevation, accounting for the tidal fluctuations that occur daily and over the course of a year. Tide gauges can be used to measure and track mean sea level over time. For Quincy, the nearest tide gauge is located in Boston Harbor (#8443970). The adjacent graph illustrates annual sea level rise measurements at this tide gauge from 1920-2010 showing approximately a 0.3 meter (11 inch) rise over the 21st century.



Although sea level has been rising and ebbing globally for many centuries, starting in the late 19th century this rate of this natural rise has been increasing. The National Climate Assessment (NCA) observed conditions starting in 1900 and future projections in global sea level rise by 2100, as illustrated in the adjacent graphic.



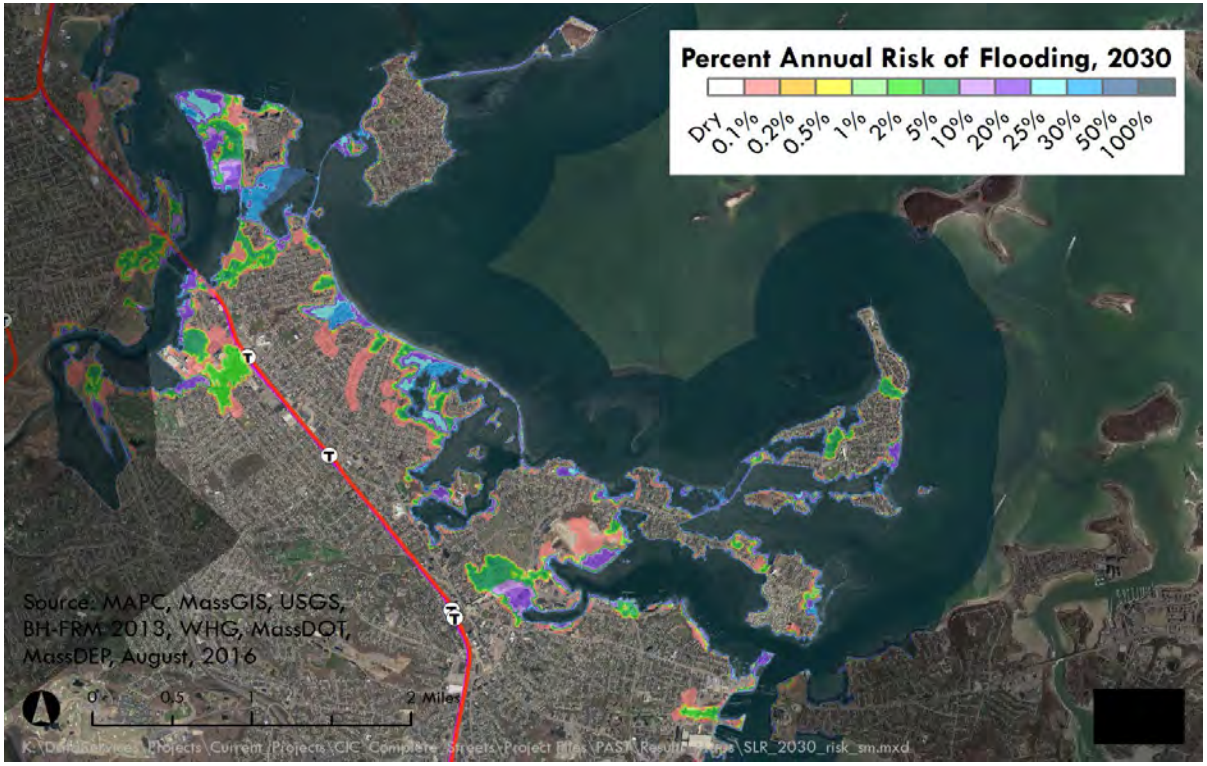
In 2013, the Massachusetts Office of Coastal Zone Management (CZM) prepared regional sea level rise projections based upon four Global Sea Level Rise Scenarios prepared by the United States.32 These projections include adjustments to the NCA global scenarios to account for local vertical land movement (+/- 0.03 in/yr), using methods published by the U.S. Army Corps of Engineers.33 MA CZM estimated that the rate of change in Mean Sea Level Rise for Boston Harbor ranges from a low of 0.2 feet by 2025 to a high of 5.3 feet by 2100. The MA CZM projections correspond well with the recent BRAG research, as shown in the table. The range of sea level rise (in feet) from the BRAG findings, inclusive of a similar land subsidence factor, represents the "likely" range of projections; that is, projections that have a 50-90% probability, per GHG emissions scenario. Our analysis utilized the CZM sea level rise projections.

Greater Boston Harbor: Predicted Sea Level Rise (in Feet)

	2025-2030		2038-2050		2063-2070		2088-2100	
Emissions Scenario	CZM	BRAG	CZM	BRAG	CZM	BRAG	CZM	BRAG
Highest (RCP 8.5)	0.5	0.3-0.7	1.08	0.7-1.5	2.8	1.5-3.1	5.3	3.2-7.4
Intermediate High (RCP 6)	0.4	n/a	0.7	n/a	1.8	n/a	3.3	n/a
Intermediate Low (RCP 4.5)	0.2	0.3-0.7	0.4	0.7-1.4	0.92	1.3-2.6	1.5	2.4-5.1
Lowest (RCP 2.6)	0.2	0.3-0.7	0.3	0.6-1.4	0.50	1.1-2.3	0.71	1.8-3.8

The next step in the vulnerability process was to utilize SLR data to project the extent of future coastal flood zones. The City of Quincy was fortunate to receive data output from a nationally recognized hydrodynamic model: Boston Harbor Flood Risk Model (BH-FRM), which was initially prepared to assess the vulnerabilities of the Central Artery Tunnel system. This model was run for the City of Quincy to provide projections of the future extent and probability of coastal flood inundation along its shoreline. The model is based upon NCA global SLR scenarios, in which 2030 and 2070 scenarios assume the highest RCP emissions trajectory (while the 2100 scenario assumes an intermediate high trajectory).[34] The model combines the Advanced Circulation Model and the Simulating Waves Nearshore Model that provides the probability of a range of storm types, such as Hurricanes and Nor'Easters, and associated flooding conditions.

The probability analysis, illustrated in the adjacent map, provides stakeholders with the ability to evaluate whether locations are at risk of coastal flooding, and the projected frequency of flooding. This is valuable to assist in weighing the tolerance for risk and evaluating when adaptation options may need to be considered. This illustrative map displays the projected likelihood of flooding by 2030. As an example, this means that an area shown as having a 2% risk, is projected to have a 2% chance of being flooded (with any depth of water) in a given year, or could expect to flood approximately once every 50 years. Detailed information regarding coastal flood projections for each neighborhood can be found in the Appendix.



While the upward trend in sea level is clear and evident, the wide range of projected future increases (particularly in the latter part of the century) and the high level of uncertainty regarding future conditions, provide a distinct challenge to planners in coastal communities. Therefore, our analysis also includes projections for 2070, as well as 2030, as it is valuable to consider possible conditions and whether new or unforeseen challenges may arise. Additionally, we present scenarios for the near-mid-term timeframe (present day to 2030) and mid to long-term scenarios (2030-2070) because we fully recognize that the City must make more immediate capital improvement planning decisions, as well as decisions regarding possibilities of future land uses.

It must be noted that this model is intended to be used for planning purposes (see model disclaimer in the Appendix). Therefore, we recognize that the use of output materials from this model regarding flood depth and risk for specific project sites may be warranted. The planning team has provided the City with associated Geographic Information Systems files to be used for this purpose. Further, it should be noted that while it was valuable to use this model to project inundation of natural coastal systems such as salt marshes, further analysis of marsh habitat response to sea level rise is warranted.

Mitigating Factors

Mitigating factors are any existing conditions or resources (natural or man-made) within a community that would offer adaptive capacity or GHG mitigation services. It is important to explore these critical services offered by these systems in order to understand future vulnerabilities.

Protection by Natural Resources

The vast majority of mitigating factors are typically protection provided by natural resources, as they are inherently adaptive to changing climate. For instance, functioning coastal and inland wetlands and beach frontage naturally absorb flood waters and deflect wave action, which protects adjacent developed areas. Forested areas also provide a number of important ecological services, both mitigation and adaptation that are important to consider.

Forested Areas/Green Spaces

One of the most important services provided by forested and tree-lined areas is carbon sequestration, thereby reducing GHGs. Trees help to reduce the amount of carbon dioxide in the atmosphere because as trees grow, they absorb carbon dioxide from the air and convert it into carbon that is stored in their trunks, roots and foliage. In 2005, forests throughout Massachusetts were estimated to sequester nearly 85 million metric tons of carbon or about 13.3% of all carbon emissions in the region. There is a diverse mix of deciduous tree species within the City that can accomplish this critical task such as oak, maple, and hickory. According to the I-tree landscape software created by the USDA Forest Service, there are approximately 5,600 acres of tree canopy within Quincy (33% of the total land mass), as shown in green within the following graphic.[35] The brown areas shown are those in which there is the greatest potential for replanting.

The results of the tool assessment indicated that the current tree canopy in Quincy can store 21,000 tons of $C0^2$ per year, and that service was estimated to equate approximately $800,000 annually in monetary value.

Trees can also absorb vast quantities of precipitation. Research has shown that a typical medium-sized tree can intercept as much as 2,380 gallons of rain per year. Estimates for the amount of water a typical street tree can intercept in its crown range from 760 gallons/tree/year to 4,000 gallons/tree/year.[36] Intercepted rainfall lands on tree leaves and is stored or evaporated back into the atmosphere; therefore, it never reaches the ground where it would become stormwater runoff.

Aquatic Resources

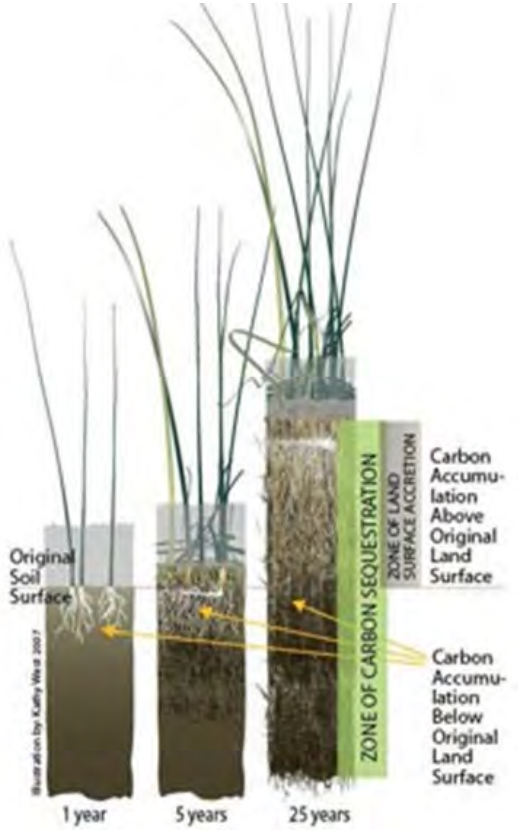
Salt marsh plants also absorb large quantities of the greenhouse gas carbon dioxide (CO^2) from the atmosphere and store it, thus decreasing the effects of global warming. This type of ecosystem service is known as a "carbon sink;" where wetlands contain large stores of carbon accumulated over hundreds to thousands of years, as shown in the adjacent graphic by USGS[37]. Salt marshes are extremely productive habitats that remove significant

amounts of carbon from the atmosphere, large amounts of which are stored in marsh soils. Unlike many freshwater wetlands, saltwater tidal marshes release only negligible amounts of methane, a powerful greenhouse gas; therefore, the carbon storage benefits of tidal salt marshes are not reduced by methane production. In addition, as sea levels rise, tidal marsh plains continue to build up to match the rise in water level, if suspended sediments are adequate, continually pulling carbon dioxide out of the air in the process.[38]

A list of natural resource features offering resiliency services the City of Quincy are listed below, along with a brief description of the service. A primary principle of mitigation is that the healthier the natural system, the greater protection it will provide, therefore it is important for the City to prioritize protecting or restoring these critical ecosystems, as discussed in the Resiliency Actions chapter.

Potential Climate Mitigation via Natural Features, City of Quincy

Name/Area	Type	Restoration	Mitigation Service
Wollaston Beach	Enhanced cobble beach	Yes: restoration project to repair boardwalk, update infrastructure and public facilities, and improve signage	Wave attenuation, coastal flood absorption
Broadmeadow Marsh	Salt Marsh	Yes: restoration of over 31 acres: removal of sediment and *Phragmites*; recreation of salt panes, tidal channels, wet meadow and coastal grasslands	Flood absorption, carbon sequestration
Houghs Neck Marshes (Mallard Rd.)	Salt Marshes	Yes: tidal flow restored, fill removal & regrade for salt marsh vegetation	Flood absorption, carbon sequestration
Blue Hills Reservation	Forest	No	Heat absorption, carbon sequestration
Citywide	Urban Tree Canopy	Replacement 2:1	Heat absorption, carbon storage and sequestration



A primary example of the condition of Quincy's salt marshes, and the type of restoration efforts often required to preserve salt marsh function, is illustrated by the Mallard Road salt marsh project in Houghs Neck. Historically, this marsh was a part of the adjacent Post Island Marsh until it was cut-off in the early 1900's by the construction of a footbridge that was eventually expanded to a dirt road providing residential access. A culvert was placed under the road in 1997, yet it was insufficient in size to allow for adequate tidal exchange into the marsh, which lead to decreased salinity levels and the growth of the common reed (*Phragmites australis*). This invasive species of reed outcompetes native salt marsh vegetation such as cordgrass (*Spartina alterniflora*), salt marsh hay (*Spartina patens*) and hornwort (*Salicornia sp.*) and degrades habitat for fish by eliminating nursery and spawning areas. However, a restoration effort led by Houghs Neck residents and City officials was undertaken to replace the undersized culvert with a larger culvert, stabilize the gravel road to prevent erosion of sediments, and regrade elevations adjacent to the road to allow for regrowth of salt marsh vegetation. It is important to note that a self-regulating tide gate was

installed to the reduce flood potential to nearby low-lying houses. The impact of the tide gate on this (and other) salt marsh(es) was not assessed during this study therefore; we recommend that the City consider undertaking assessment studies on specific salt marshes, as discussed in the recommendations section, to ensure continued resiliency ecosystem functions of key fringe marshes.

Protection by Engineered Coastal Structures

Engineered or "hard" structures such as seawalls and revetments, and jetties are designed to hold back ocean waters and waves from inland properties and infrastructure, and to hold beach sediment in place respectively. Hard structures are often put into place as a means to "shore up" a coastline vulnerable to flooding based on historic conditions, such as damages from past storms or ongoing erosion. Although installed for protection, unintended consequences of hard structures can include alteration of wave action, currents, and natural sand movement. These alterations can have undesirable consequences including loss of sediment to down drift beaches and erosion of the adjacent shoreline. Nevertheless, existing coastal structures, such as the seawall along Wollaston Beach and the peninsulas (E. Squantium and Houghs Neck) continue to provide protection from wave action and coastal flooding. Although these structures may not be able to withstand projected rising seas and storm conditions, they do provide protection in the near-term, which is why they are included as potential mitigation elements within this section. It should be noted that we include only structures in "good" condition, as reported in the latest inventory and assessment by the Massachusetts Coastal Hazards Commission and the Massachusetts Office of Coastal Zone Management. These structures are defined in the report as "exhibiting very minor problems," and that "minor erosion to landform is present." The report further describes these structures as having adequate structure and landform to provide protection from a "major coastal storm with no damage." Structures that are more vulnerable to climate change impacts are described in the vulnerabilities section.

Impacts/Vulnerabilities

In determining impacts to each community sector: environment, developed areas, coastal zone, public health and welfare, and local economy; MAPC drew upon data regarding future conditions, as well as mitigating factors (both described above). This type of analysis has also been referred to as a "sensitivity analysis." Vulnerability or sensitivity is generally defined as the degree to which a sector (built, natural or human system) is directly or indirectly affected by changes in climate conditions. MAPC utilized a combination of a quantitative analysis and stakeholder input process to combine the future conditions and mitigation capacity information and identify potential vulnerabilities. First, starting with the quantitative analysis and research are conducted to identify potential vulnerabilities. The analysis began with a thorough review of previous studies listed previously, moving into a critical stakeholder engagement program, particularly engaging the Municipal Working Group to "groundtruth" initial findings, which resulted in determinations of impacts or sensitivities to each sector, described in the sub-sections below.

Impacts to Natural Resources

One of the most important items of note in the IPCC AR5 Report is that "climate-change impacts are strongest and most comprehensive for natural systems."[39] This underscores the need for natural resource protection and restoration, as they are a primary source of "defense" from climate-related impacts to developed areas due to their built-in resiliency. Vulnerabilities to these natural resources are described in the following sections.

Forested Areas/Green Spaces

Climate change is projected to increase the vulnerability of trees and forests as a result of fire, insect infestations, drought, and disease outbreaks. Impacts will be a result of extreme events such as drought, fire, high wind, and ice storms, as well as long-term changes in temperature and precipitation patterns. Changing conditions are projected to increase mortality rates for trees. Forested areas, including the Blue Hills, will likely experience an increase in wildfires. These impacts will limit, or in some cases, eliminate their ability to provide critical GHG mitigation and adaptation services described previously.

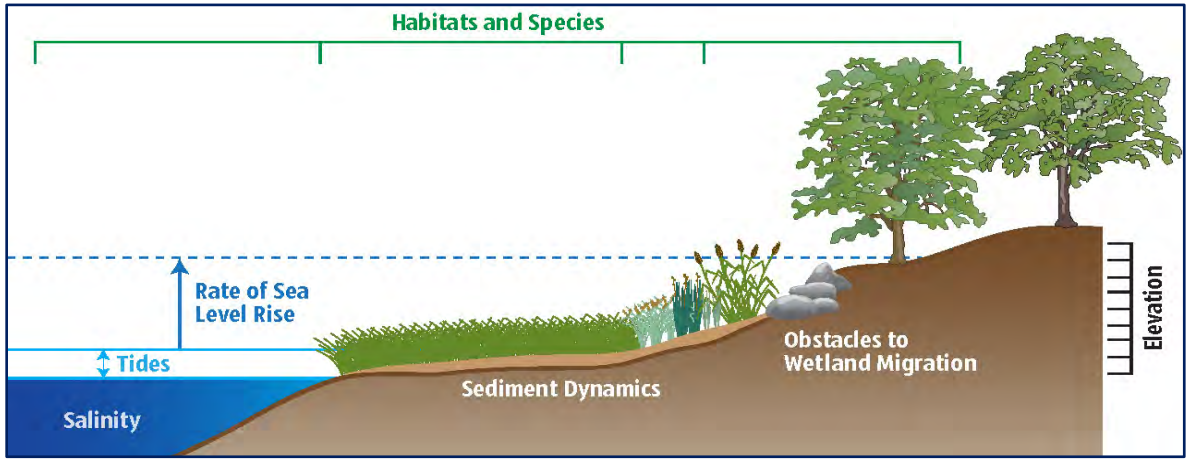
Aquatic Resources

A quantitative analysis completed by BU provided the team with an estimate of the percentage of coastal wetland resources that could be impacted by projected sea level rise, as shown in the following table. What became clear was that the immediate rocky shoreline and salt marsh resources would bear the brunt of impacts along the coastline. Approximately 91-100% of the immediate shoreline (beach) areas will be inundated by 1-6 feet of rising tidewaters. Approximately 84-100% of the City's salt marsh resources could be inundated by a range of 1-6 feet of rising tides. While salt marshes will provide flood protection to adjacent development, as previously described, they will also be susceptible to impacts from increased salinity, wave action, and depth of water. Research has shown that salt marsh "zones" will shift as plant species become unable to thrive under these changed conditions, as described further below.

Resource Type	Total Area	Percent Impacted		
		1 foot SLR	3 ft SLR	6 ft SLR
Coastal Dune	.64 acres	48%	95%	100%
Coastal Beach	70.4 acres	84%	95%	100%
Bluff or Sea Cliff	32 acres	26%	40%	65%
Salt Marsh	448 acres	76%	95%	100%
Rocky Intertidal Shore	3.2 acres	91%	100%	100%
Tidal Flat	32 acres	65%	95%	100%

Salt Marshes

Salt Marshes exist via a close relationship with daily tides. They provide essential ecosystem services due to their ability to store floodwaters and reduce the amount of coastal floodwater coming from the Greater Boston Harbor/Quincy Bay system. However, climate changes will have adverse impacts on salt marshes, particularly from sea level rise.

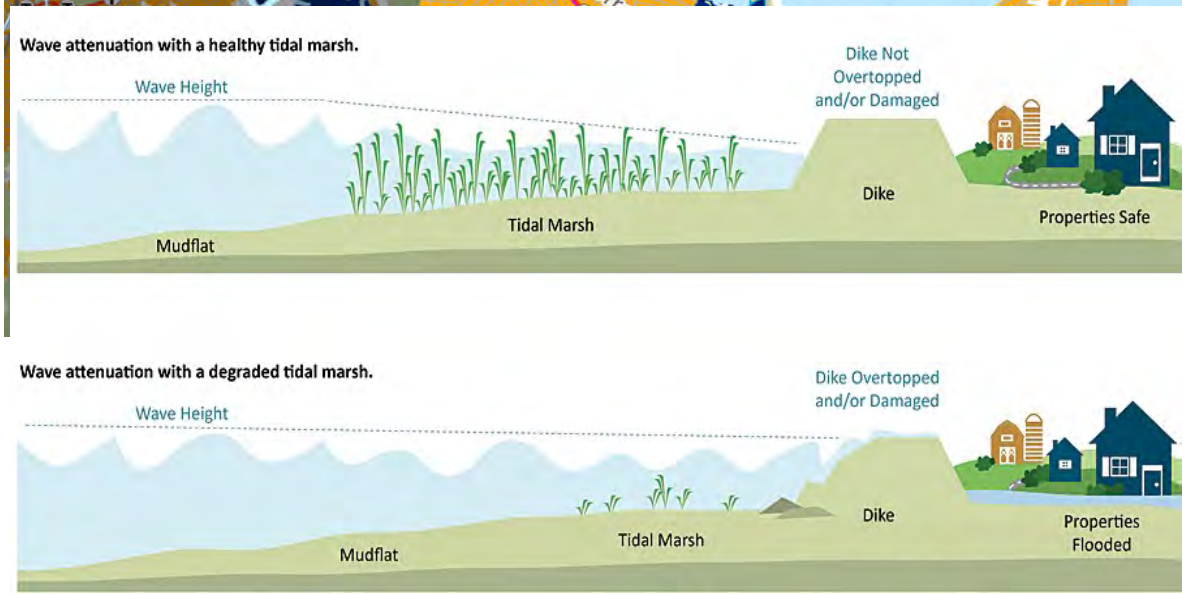


There is a delicate balance between salinity, dissolved oxygen, turbidity, bottom composition, and temperature within coastal wetland systems, as shown in the adjacent graphic. A change in any of these factors will affect the health and survival of the wetlands themselves, as well as the organisms dependent upon these systems for habitat and food. Changing sediment loads, extreme tide and storm events, and shifting salinity levels due to

rising seas will affect tidal marshes by altering the plant community and structure. Depending upon their location, coastal wetland composition may be altered or even "drown."

Across New England, plant species found in low marsh areas have begun to migrate to upper marsh zones, resulting in altered plant communities with recent changes in sea level and storms.[40] In order for salt marshes to survive sea-level rise, they must be able to migrate landward and form new salt marsh as older salt marsh becomes flooded. The adjacent map shows the anticipated migration needs of existing salt marshes in Quincy. Existing wetland resources (show in dark blue) will need to upland (show in light blue). However, development (e.g., homes, seawalls/berms, roads, etc.) within the coastal zones (orange color) will be in conflict with these natural migration processes.

Impacts to coastal wetlands will have a direct effect on communities in a number of ways, as illustrated by the adjacent graphic by The Nature Conservancy[41].



Degradation or loss of coastal wetlands will eliminate their functionality as flood barriers to adjacent development. Loss of vegetation will reduce or eradicate their ability to remove carbon dioxide from the air, thereby eliminating the function of wetlands as "carbon sinks, as previously described as a critical mitigation feature." Approximately one-half to two-thirds of fish harvested from the Atlantic Ocean spend part of their lives in salt marshes or estuaries[42]; the loss of wetland habitat leads to economic loss for commercial fisheries and shellfisheries. Economic impacts are further described in the Local Economy analysis section.

Impacts to the Built Environment

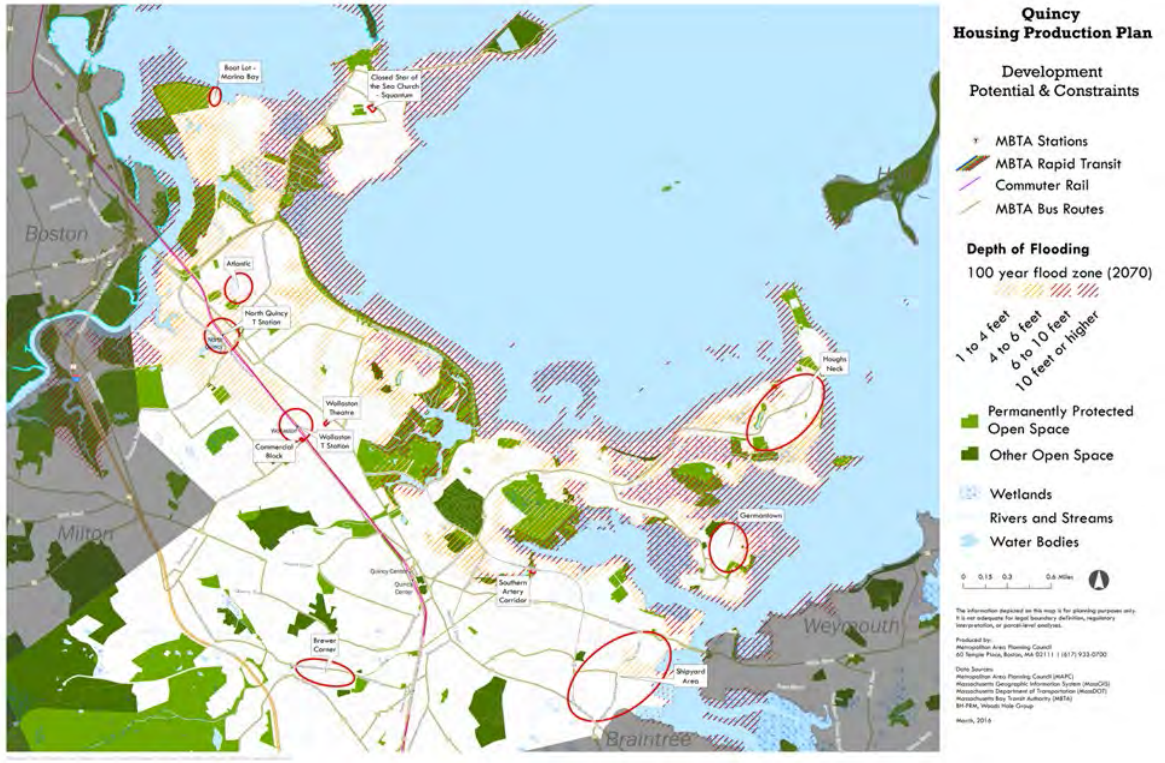
Like most coastal communities in Massachusetts, development and infrastructure within the City of Quincy is vulnerable to coastal flood inundation and coastal storm impacts (both precipitation and storm surge). The City gains some protection from the Boston Harbor Islands and Hull Barrier Beach landmasses (wave and some wind attenuation), which help shield the Quincy shoreline from Nor'easter storms. However, Quincy cannot be fully shielded from the impacts of sea level rise and nearshore storm impact, nor will it elude impacts of increased temperatures because, as with most historic industrial-based communities, much of the coastline in Quincy has been developed. As previously described, many of the protective coastal resources, which shielded development from the ocean for many years, have been altered and/or eroded resulting in an inland migration and degradation of these resources. In the meantime, development and infrastructure remain in the same location without the natural resources. In the meantime, development and infrastructure remain in the same location without the natural barriers that protected them originally.

Land Use	# of Parcels	Total Assessed Value	Assessed Land Value	Assessed Building Value	Est. # of Units
Commercial	152	$464,490,900	$136,484,100	$305,647,900	161
Housing Auth.	11	$69,391,600	$12,665,700	$56,174,500	11
Industrial	25	$45,020,100	$24,670,500	$17,949,000	34
Institutional	39	$153,301,300	$47,971,100	$103,290,000	39
Mixed Use	18	$7,446,400	$3,794,600	$3,557,300	18
Municipal	353	$266,425,500	$121,916,700	$141,448,400	355
Residential	4,046	$2,257,571,300	$736,187,600	$1,507,021,500	8,247
U.S. or State	58	$105,049,700	$73,084,100	$30,457,800	58
Total	***4,726***	***$3,368,696,776***	***$1,156,774,376***	***$2,165,546,376***	***8,923***

Development

The planning team conducted a spatial analysis to assess the magnitude of direct flood damages that Quincy might expect by combining the BH-FRM Coastal Flooding data and the Massachusetts Land Parcel Database. The adjacent map illustrates developed land uses for parcels projected to have a 1% yearly chance of experiencing one foot or more of flooding under climate change conditions. Residential land uses (shown in yellow hues) are most affected as a result of their proximity to the coast. Commercial land uses in a number of neighborhoods such as North Quincy, Fore River and portions of Quincy Center may also be impacted by 2070. However, as discussed in the previous sections, the majority of these areas are still adjacent to some form of green or open spaces, which may provide the City with some level of protection, depending upon the type/condition of these areas (further described in the recommendations section).

A quantitative analysis was also conducted to determine the estimated value of properties impacted, as shown in the adjacent table. A total of 4,726 properties with a current assessed value of $3,368,696,776 would have a 1% yearly chance of experiencing one foot or more of flooding by 2070. The majority of these properties are in the residential sector (including the 11 Housing Authority parcels).



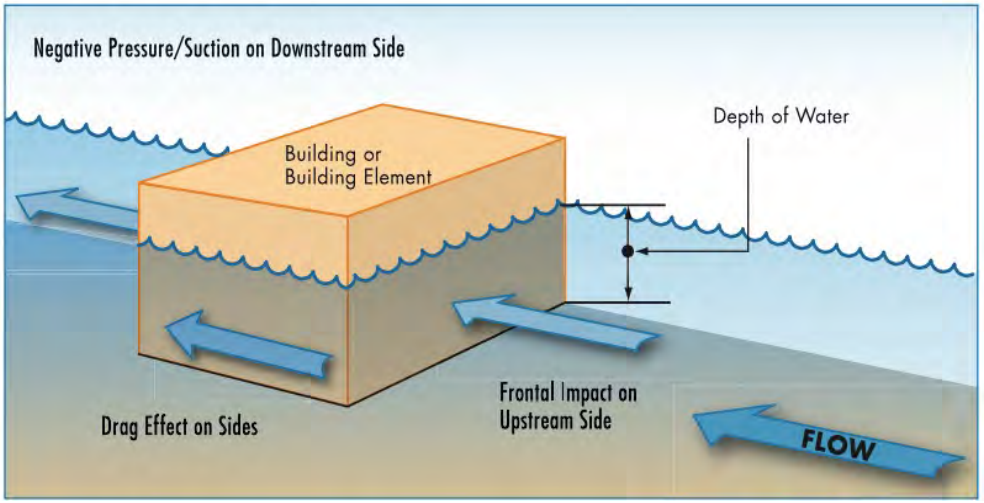
The City's recent Housing Production Plan included an assessment of housing stock and in particular its inventory of affordable housing. Particularly vulnerable is the City's population of residents 65 and over, which are expected to increase from just under 14,000 as of the 2010 US Census to over 22,000 by 2030 (an increase from 18% of the City's population to 26%). The vulnerability analysis identifies a number of senior housing and assisted living facilities (circled in red) that could be prone to sea level rise, as shown in the figure below. Additionally, the Plan identified potential sites for future housing, including areas that are likely to see mixed use or commercial development. A number of these sites are located within flood-prone areas of the City, both under current conditions and even more so by 2070.

In highly urbanized environments such as Quincy, the urban center of the City will likely suffer from the highest temperature increases due urban heat island effect. The degree of human risk to heat-related illness is related to a number of factors including age and existing health conditions, as well as socioeconomic status, which may determine access to air conditioning.[43] The heavily urbanized areas along the MBTA's Red Line and Route 3A tend to trap heat leaving infrastructure and vulnerable populations at risk.

Development in Quincy, especially with its aging housing stock, is not conducive to mitigating the potential health impacts from the heat island effect and could impact the more vulnerable sectors of the population including young children and senior citizens. Over 40% of the City's housing stock was constructed prior to 1939 and 82% was built before 1978. Older structures may lack heating and cooling energy efficiencies and may not be code compliant, which may put more residents at risk over the long term if improvements are not made to the structures. Many of the Quincy Housing Authority properties are older structures that may not adequately protect against the negative health impacts of the heat island effect. These buildings are likely to absorb rather than deflect heat.

Critical Facilities & Coastal Flooding

In climate planning the term "critical facilities" or "critical infrastructure" takes on a broader meaning and is inclusive of all facilities that are important for the City to be able to function properly. The planning team conducted a probability analysis of coastal flooding for these facilities; previously identified in the City's Hazard Mitigation Plan and confirmed by the Municipal Working Group. Critical elevation information was obtained from LiDAR.[44]



There were a total of fifteen (15) critical facilities identified during the vulnerability analysis that are currently located within a projected coastal flood inundation zone. The adjacent and following tables list each critical facility, its approximate location and their respective flooding depth between the years of 2030 and 2070. The planning team thought it best to show the range of flooding potential in the near to longer term, as the City will need to make decisions regarding more immediate capital improvements, as well as adaptation of facilities in the future. The first table lists facilities owned or operated by the City of Quincy within the inundation zone. Specifically, these properties have at least a 1% and above chance of experiencing coastal flooding annually. The depth of flooding range for this risk probability between 2030 and 2070 are listed. The adjacent graphic from FEMA illustrates impacts to facilities from floodwaters.[45]

The second table provides the same information for facilities that have either been leased by private entity from the City or state or are owned by a private entity.

Critical Facilities Vulnerable to Coastal Flooding, City of Quincy (Privately Owned)

Name	Address	Flood Depth (2030-2070)	*Comments*
Marina Bay Skilled Nursing Cntr.	2 Seaport Drive	0 – 1 ft	*Elevation data was taken from building location. Area surrounding building could be further inundated*
Fallon Ambulance	199 Commander Shea	0 – 1.3 ft	*Elevation data was taken from building location*
Esther Sanger Crisis Cntr.	282 Billings Road	0 – 1.7 ft	
Squantum Yacht Club	646 Quincy Shore Drive	0.9 – 3.7 ft	*Model does not include Piers. Site elevation data taken from water around pier. Building elevation assumed to be equivalent to the st.*
Wollaston Yacht Club	692 Quincy Shore Drive	0.2 – 3 ft	*Model does not include Piers (see above)*
MWRA Sludge Plant	95 East Howard Street	0 – 2.8	

Critical Facilities Vulnerable to Coastal Flooding, City of Quincy (Privately Owned)			
Name	**Address**	**Flood Depth (2030-2070)**	***Comments***
MWRA Sewer Pump Stn.	Island Ave	0.2 – 3 ft	
Bay Point Marina	64 Washington Court	0.9 – 3.6 ft	*Site elevation taken from lowest point in parking area - closest to shoreline*
Sprague Energy	780 Washington Street	2.1 – 4.8 ft	*Site elevation was extracted from near center of facility, yet there are areas here that likely get flooded more frequently (aerial photography often shows standing water)*
Stop and Shop	495 Southern Artery	0 – 1.3 ft	*Elevation data was taken from building location.*
Manet CHC	110 West Squantum Street	0 – 1.6 ft	
Marina Bay Atria Place	4 Seaport Drive	0 – 0.7 ft	*Elevation data was taken from building location. Area surrounding building could be further inundated*

The purpose of identifying and mapping critical facilities in impact areas is to make municipal officials aware of the near and long-term impacts to these facilities, resulting in adverse effects on government functions. Recommended actions provided in Chapter four are intended to help officials prioritize these vital facilities for climate resiliency.

The BH-FRM model was then used to conduct a detailed flood depth and risk analysis for critical facilities under the sea level rise scenarios. To illustrate the analysis methodology and results, the Quincy Public Schools Bus Barn is described here and the results are shown in the following table. Exceedance Probability indicates the chance or probability of coastal flooding occurring annually, expressed as a percentage. Larger coastal flood events may occur (are exceeded) less often and will therefore have a lesser annual probability. For instance, the 2% exceedance probability equates to the designated site having a 2% chance of flood occurring in a year, and the 20% exceedance probability flood level has a20% chance of occurring in a year, and so on.

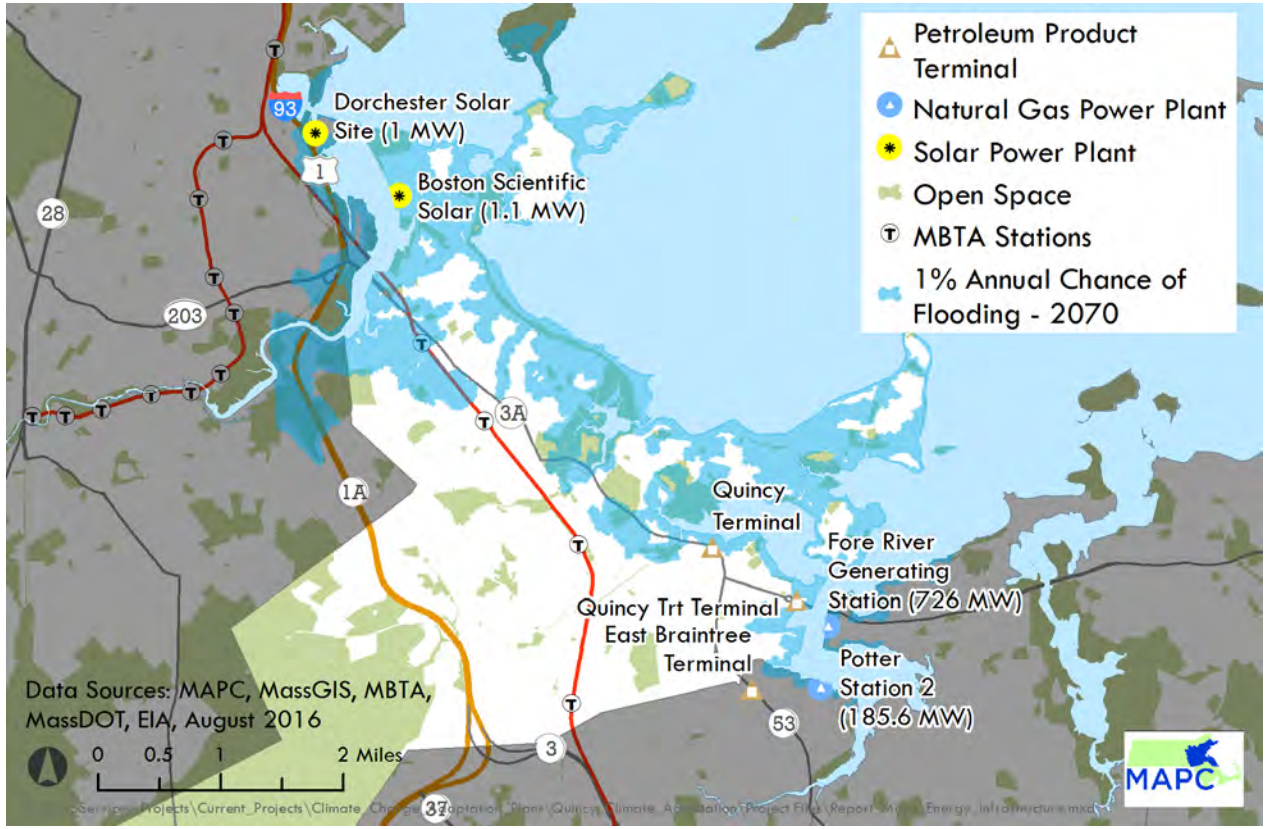
As shown, the Bus Barn's "critical elevation," or the elevation at which flood waters would impact the operation of this facility, is approximately 8.5 feet above sea level (ASL). The table shows that under current conditions, the water surface elevation has a 5% chance of exceeding this critical elevation in a given year (or roughly once every 20 years). A flood 0.4ft deep has a 1% annual risk of occurring in a given year. Between 2030 and 2070, depending on GHG emissions scenario, a flood 1.5 feet deep could be expected. The analysis was also completed for far-reaching future conditions (2070-2100) to accommodate building lifespan and potential redevelopment, yielding a 4.3 foot flood depth at the site in the 1% flood risk zone. It is important to note that elevations provided are approximations from the MassDOT-FHWA BH-FRM hydrodynamic model grid, which includes an interpolation of multiple LiDAR points needed to create the grid. The base elevations and water depths are approximations for the site specific locations, and therefore; these values, particularly the critical elevation, should be ground-truthed prior to implementation of resiliency measures (i.e. review of as-built plans or survey).

Infrastructure

Infrastructure is commonly defined as the various components of the built environment that support modern society.[46] These components encompass utilities, transportation systems, communication networks, water systems, and other elements that include some of the most critical underpinnings of the developed City. Therefore, modest disruptions to infrastructure may have significant effects on daily life, and any systematic change in the frequency or intensity of those disruptions could have profound consequences for the City's economy, and public health and welfare.

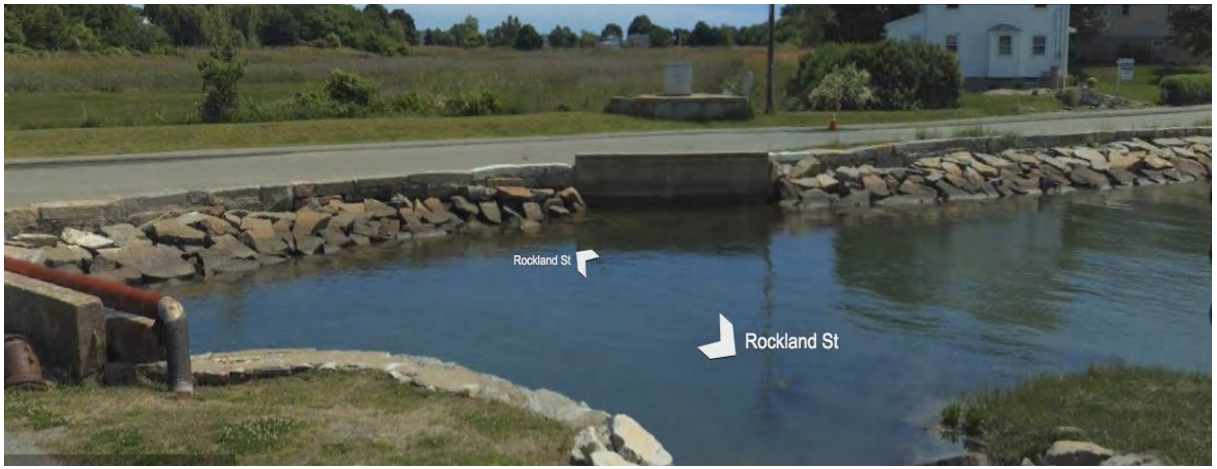
Energy Infrastructure

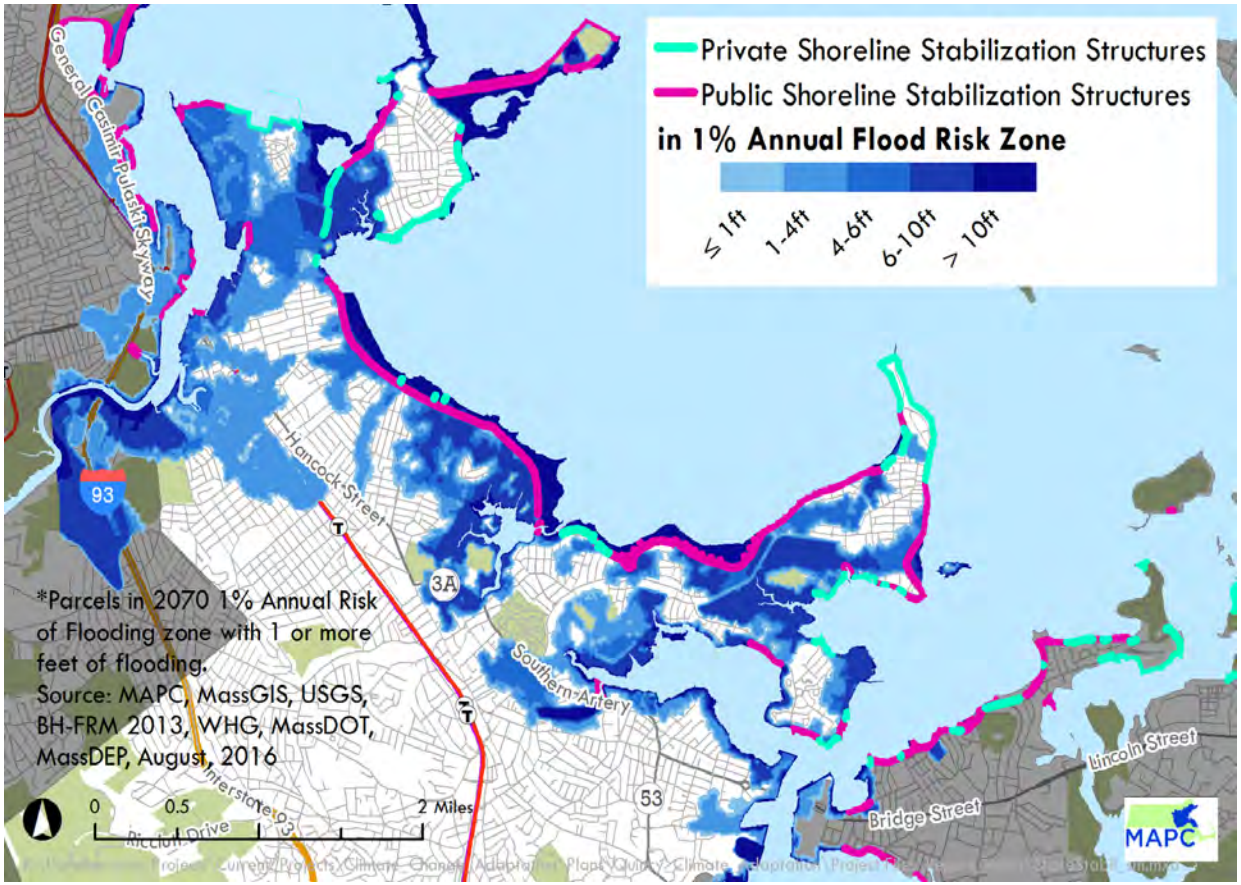
Increased temperatures will have an adverse impact on the City's infrastructure, particularly the electricity network. Some infrastructures are more resistant than others, but there is a growing reliance on the energy network to provide the power for future critical infrastructure networks. High temperatures will increase energy loadings as demand increases for air conditioning, refrigeration, electrified transport network, and a high-speed information and technology network. Failures within the energy network could quickly cascade across other critical infrastructure sectors such as transportation, water service, etc. as transportation, water service, etc. It should be noted that energy infrastructure locations are strictly secured by all levels of government due to their critical nature. The adjacent map shows the primary energy sources located within the City such as solar fields, petroleum terminals, and natural gas plants to illustrate the sensitivities of these critical regional infrastructure facilities. As shown, most of these facilities are located within projected flood zones.



Engineered Coastal Structures

The City of Quincy coastline has a number of locations in which engineered coastal structures were built, as shown in the map below. The purpose of these coastal structures was to provide protection to private properties and public infrastructure adjacent to, and in the vicinity of, the shorelines. However, due to a number of factors including age, natural environmental processes (e.g., erosion) and climate change impacts; these structures are in varying states of decline.





As sea level rises, the existing conditions under which most of the coastal structures were designed and built will no longer be applicable. For example, a sea wall is designed to protect against loss of lands along the shoreline by reducing erosion and protecting against wave and tide action. They are designed under an existing set of assumptions including shoreline type (coastal banks, sandy beach, etc.), water levels (e.g., mean water/sea level, tides, storm surge, etc.) and wave characteristics (e.g., height and periods). Rising sea levels, combined with the effects of the projected higher frequency and intensity of coastal storms, will result in damage to coastal stabilization structures and additional over-topping of the structures due to storm wave action. Higher tidal elevations will result in deeper water depths in front of coastal stabilization structures during high tides, resulting in larger ocean waves hitting the structures. This intense wave action then accelerates structural damage and the rate of beach erosion in front of the structures.

Location	Type of Coastal Structure(s)	MA CHC Rating
Rockland Street	Stone Bulkhead/Seawall	D
Post Island Rd.	Concrete Bulkhead/Seawall	C
Prescott Terrace	Stone Bulkhead/Seawall	C
Prescott Terrace	Groin/Jetty	C
Taffrall Rd.	Stone Revetment	C
Squantum Point Park	Steel Bulkhead/Seawall	F
Commander Shea Blvd.	Stone Revetment	C
Moon Island (Boston Fire Academy)	Stone Bulkhead/Seawall	C
Moon Island	Stone Bulkhead/Seawall	D
Moon Island	Stone Revetment	C
Dorchester St	Concrete Bulkhead/Seawall	C

There are 15 engineered coastal structures in Quincy that remain particularly vulnerable to climate impacts, based on their rating status by the Massachusetts Coastal Hazards Commission in their 2009 report. These structures were rated a grade of "C" (fair condition), "D" (poor) or "F" as in critical need of repair. These structures are currently vulnerable to coastal storms, and therefore; will be highly vulnerable to storm conditions due to climate changes. All of these structures are owned by the City except for approximately 2,000 linear feet of bulkhead/seawall at Squantum Point Park, which is owned by the MA DCR. The City of Quincy has previously retained consultant services to assess their engineered costal structures, primarily tide gates. This information, as well as the MA CHC ratings for vulnerable structures, are included within the adjacent table.

Coastal stabilization structures along Rockland Street (Germantown), Squantum, and Moon Island were confirmed to be of the highest priority for repair to enhance potential resiliency of the adjacent neighborhood due to a number of factors including the high susceptibility of damage to properties, the presence of above-ground electric utilities and pump stations, and the poor condition of the existing coastal structures.

Transportation Infrastructure

Transportation modes will be impacted by high heat and coastal flooding. Results of the hydrodynamic model show a number of roadways within Quincy's coastal areas that will eventually be impassable due to coastal flood conditions. Critical roads will be greatly affected

by rising sea levels alone - excluding the effects of storm surge - as shown in the table below. Some of these critical roadways provide access to heavily populated areas in the business districts of the City while others provide the main access and egress to residential areas such as Marina Bay, Squantum and Houghs Neck. Additionally, numerous bus routes in North Quincy, Squantum, Wollaston, Houghs Neck, Germantown, and to some extent, Quincy Center, as well as the MBTA's Red Line in and around the North Quincy Station, would be affected.

Exposure to flooding and extreme snow events also shortens the life expectancy of highways and roads. The stress of water and snow may cause damage, requiring more frequent maintenance, repairs, and rebuilding. Road infrastructure in coastal areas is particularly sensitive to more frequent and permanent flooding from sea level rise and storm surges.[47] High heat and heat island effects exacerbating localized temperature increases will also have an adverse effect on Quincy's roadway infrastructure such as the creation of ruts and potholes caused by the softening and expanding of the pavement. This can also lead to the buckling of roads and place stress on bridge joints. Additionally, railroad tracks are prone to damage from heat including expansion and buckling, which can increase the danger of derailments. High traffic areas are particularly vulnerable to these stresses including the roadways listed in the table below. One of the criteria used to identify these roadways is whether segments of the roadway or causeway constitute a neighborhood's only means of access to the rest of the City. For example, Palmer Street connects Germantown, Sea Street connects Houghs Neck, and East Squantum Street connects Squantum to the rest of the City. This could potentially affect thousands of residents and hundreds of businesses.

Roadway	**Flooding Impact**	**Base Elevation (NAVD88, ft)**	**Comments**
BABCOCK STREET	2013 1% zone, NE end shows approx. 1.5ft of flooding	8	*Node taken in NE corner (lowest elev.) - intersection with Manet Ave.*
BRIDGE STREET	Roadways on each side in 2070 1% flood zone	12.5	*Elevation taken from eastern bridge approach. Bridge remains out of the flood level. Need to further evaluate.*
COMMANDER JOHN SHEA BOULEVARD	Entire segment in 2070 1% zone, northern end of segment in 2013 1% zone	9.3	*Elevation extracted at northern end of road.*
EAST SQUANTUM STREET	Entire segment in 2013 1% zone, projected flooding: 4.5 ft in 2017 1% zone	8.7	*Elevation taken from low point in road. Need to further evaluate.*

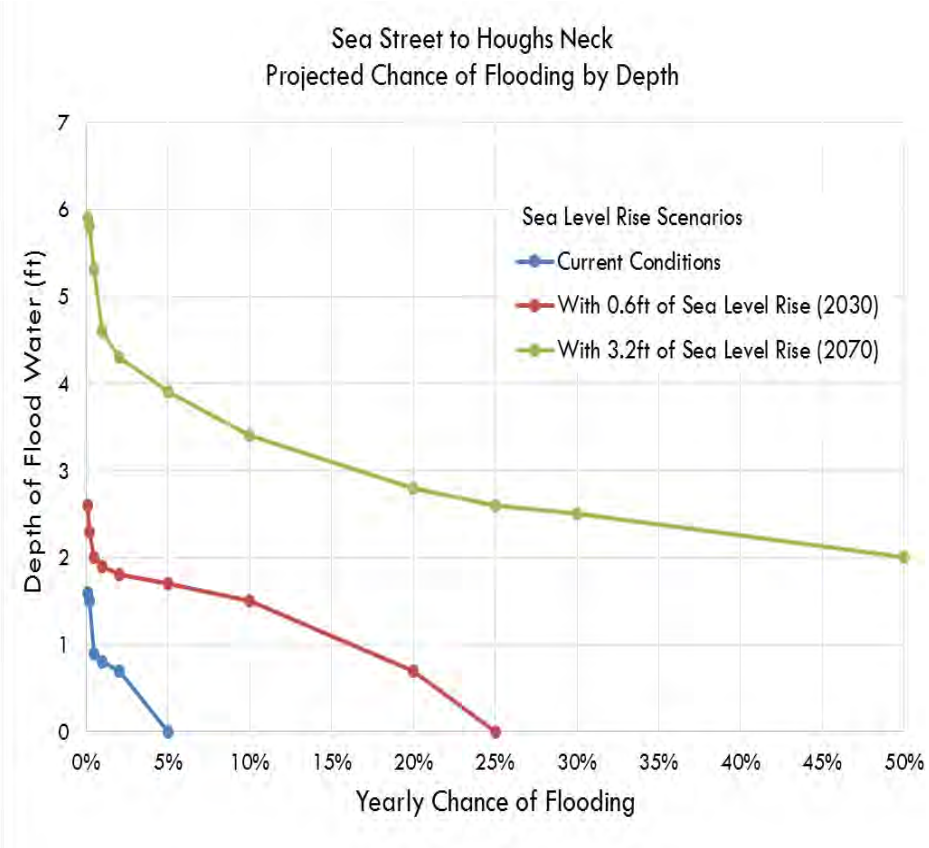
Roadway	Flooding Impact	Base Elevation (NAVD88, ft)	Comments
FURNACE BROOK PARKWAY	Entire segment in 2013 1% zone, at center point, projected flooding: approx. 5 ft deep in 2070 1% zone	8.9	
MERRYMOUNT PARKWAY	Entire segment in 2013 1% zone, projected flooding: 2.5 ft	7.7	*Elevation taken from center of road segment close to Black's Creek*
MOON ISLAND ROAD	Road is in 2013 1% flood zone, provides only connection to Moon Island facilities	N/A	*Road is fairly high in elevation thus remains dry except overtopping from waves could cause flooding*
NEPONSET AVENUE	Eastern end of segment - MBTA red line	11.8	*Bridge and Neponset Ave is raised above flood elevations, so focus is on red line -*
NORTON ROAD	Center of this segment is in 2013 1% zone	7.7	
PALMER STREET	Most of segment edges 2013 1% zone, much of this ithsmus is in 2070 1% zone	10.6	*Poor model resolution in area. Need to further evaluate.*
RHODA STREET	Entire segment is in 2013 1% flood zone, center of segment projected approx. 2.5 ft of flooding	6.6	*Exact elevation of road not known – elevation taken at marsh crossing – lower point. Road is likely higher. Need to further evaluate.*
ROCK ISLAND ROAD	Inundation by 2070	7.4	*Elevation taken from center of segment*
SAMOSET AVENUE	Center of segment in 2030 1% zone, projected flooding: 3ft deep in 2070 1% zone	9.5	*Lower elevation on southern end*
VICTORY ROAD	Entire segment in 2013 1% zone, projected flooding: 10 ft in 2017 1% zone	8.1	*Elevation taken at Center of road segment*
WINTHROP STREET	Inundation by 2070	7.2	
QUINCY SHORE DRIVE	Entire segment is on edge of 2013 1% zone. by 2070, flood way forming up Vassal St by Milton Rd. SE section of roadway is projected to flood by 2070 1% zone	8.4	*Elevation taken near Milton Road (a relatively low point) along the road. Segment too long and variable to analyze comprehensively - depths and probabilities will fluctuate along road. However, lower segments are anticipated to flood intermittently due to SLR & wave overtopping.*
SOUTHERN ARTERY	Western end of bridge is in 2070 1% flood zone	12.2	*Elevation taken on far western end near the Southern Tide Mill*
SEA STREET at Southern Artery	Intersection is in 2030 1% zone, projected flooding by 2070, particularly S end of Coddington St.	8.9	*Elevation extracted from southern end of Coddington St.*

Roadway	Flooding Impact	Base Elevation (NAVD88, ft)	Comments
SEA STREET at Post Island Road	Entire segment in 2013 1% zone, projected flooding: 2.5ft	8.2	*Elevation taken at Ingram Street*
SEA STREET at Moffat Road	Center of segment in 2030 1% zone, projected flooding by 2070	10	
SEA STREET at Bay View Ave	Segment is in 2030 1% zone, projected flooding by 2070 1% zone	9.7	
SEA STREET at Newton St	Center of this segment is in 2013 1% zone, approx. 1.5ft flooding	8.7	
NEWPORT AVENUE EXTENSION	Center of this segment is in 2070 1% zone, projected flooding: 3ft	10.3	*Flood pathway seems to be delayed (according to model), yet depths become high.*
BRACKETT STREET	Western end of this segment projected flooding: 5 ft by 2070 1% zone	9.4	

It is important to note that emissions from transportation (car and truck use) account for 31 percent of Massachusetts' total carbon emissions, thereby causing impacts of their own. This is an important statistic for the City to consider as a center of development/redevelopment potential. There will be a need to change transportation modes and patterns to reduce GHG emissions. These techniques are explained in Chapter 4.

Intersection/ Connection	Est. Base Elev.	Flood Prediction		Impacts		
		10 % Probability	20% Probability	Residents	Businesses	Jobs
Palmer St to Germantown	10.6 ft	1 ft	4.8 ft	2,768	12	136
Sea St to Houghs Neck	8.2 ft	8 in	10 in	4,014	67	588
East Squantum Street	8.7	8 in	1.5 ft	3,828	159	1520

Like roadways, coastal railways and subways are subject to inundation from sea level rise and storm surges. This is particularly true in underground pathways and tunnels such as those within the City for the MBTA Braintree Red Line system, some of which are currently at or below critical sea level. Increased flooding from heavy precipitation and storm surges could disrupt rail travel as well as freight operations. Damages from flooding may require rail lines and subway infrastructure to be rebuilt or raised in future expansion projects.[48] High temperatures cause rail tracks to expand and buckle. More frequent and severe heat waves may require track repairs or speed restrictions to avoid derailments. Heavy precipitation could also lead to delays and disruption, as Quincy is well aware due to the extreme snow storms of 2014 and its impact on the MBTA Redline.



The planning team also identified areas of "critical connections" where coastal flooding in a specific location will, in turn, create impacts in adjacent areas and/or impassable roadway infrastructure to neighborhoods. These critical connections, and their projected flood impacts, are listed in the included table.

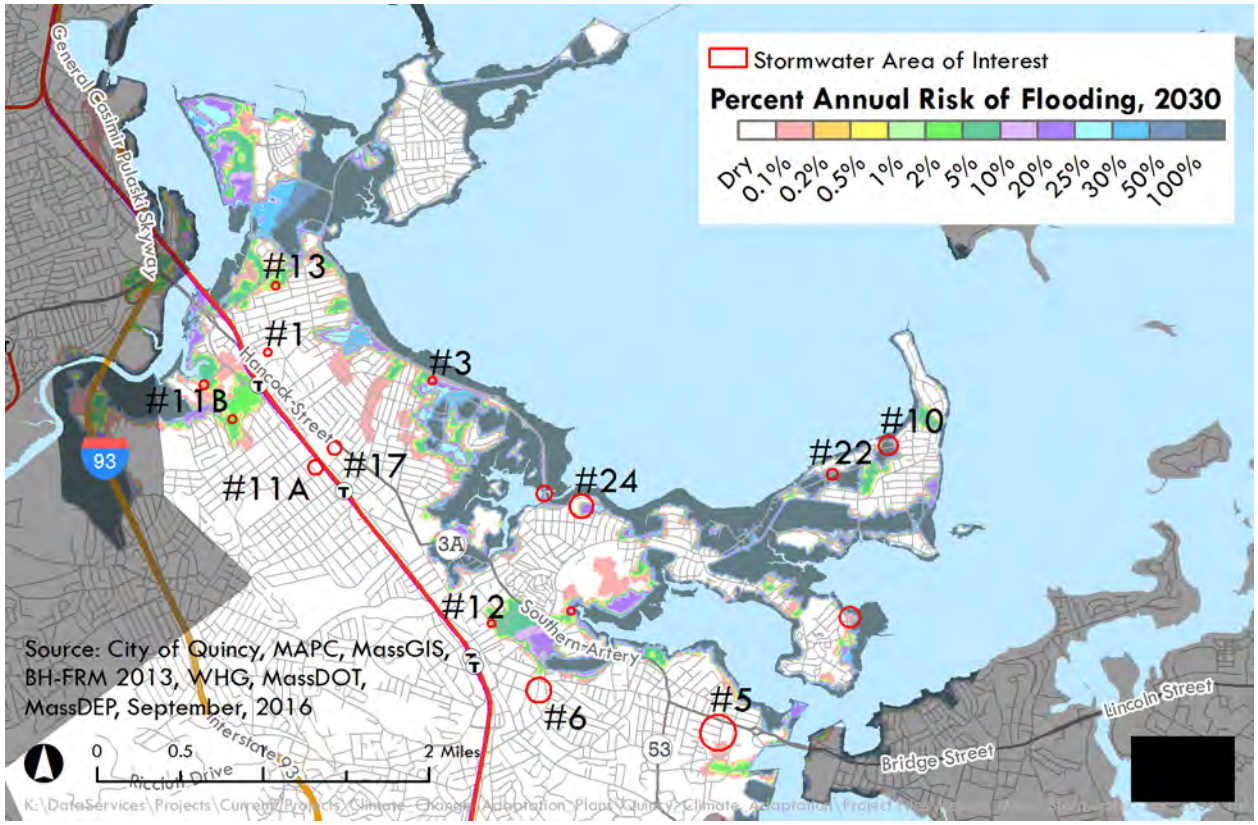
The adjacent graph illustrates the results of the probability of flooding analysis conducted for these critical transportation intersections. The figure essentially shows the inverse relationship between more extreme conditions (flood depth) and probability of flooding. Larger flood events are less likely than smaller events. For instance, under a 0.6 foot

sea level rise scenario, shown in red, there is a lower likelihood of nearly 2 feet of floodwater - inundation - occurring annually (5% chance) than the likeliness of nearly 1 foot of floodwaters (20% chance). The same trend is shown for the 3.2 foot sea level rise scenario except at a more extreme scale. In this case, there is a 50% chance of 2 feet of floodwaters occurring, but a lesser likelihood of a 4 foot flood inundation annually (5%). More importantly, this graph shows the direct correlation between sea level rise and flood probability, in that the probability of flood inundation increases as sea levels rise over time. This is a critical factor that the City must consider when conducting development review for buildings and facilities with a 10-30 year lifespan.

Water Infrastructure

The vast majority of Quincy properties are tied-into the Massachusetts Water Resource Authority's potable water and wastewater systems, thereby reducing the potential for climate impacts to this supply. However, the technology used for advanced water treatment processes is energy intensive, thereby increasing GHG emissions. Impaired water quality due to climate change will require the increased use of advanced water treatment processes that will increase the energy intensity of potable water systems. Therefore, the MWRA must continue to assess their contributions and track GHG emissions to find ways to reduce their impact on the environment. There are a number of strategies for energy efficiency the City of Quincy, as an MWRA client, could starting with regular energy audits, implementation of renewable solar, wind and bioenergy; use of high efficiency pumps and electrical systems; and application of low energy technologies.

Quincy's stormwater system is highly vulnerable to climate change impacts, primarily inundation by enhanced and increased coastal and inland flood conditions and particularly within the Furnace Brook Parkway area. An analysis of impacts to the stormwater system due to coastal flooding is shown in the table and map, specifically the range of flooding under all probability statistics (100 – 0% probability). The City hired a consultant to prepare an assessment of each of the coastal stormwater facilities mapped above to determine their current condition, potential issues and estimated costs associated with basic upgrades. These cost estimates for priority locations are included in the table below.



The City of Quincy Small MS4 General Permit Annual Report to EPA outlines numerous stormwater management improvement projects that either have been completed or are planned to commence in the near future, such as:

- Miller Street/ Cross Street/ Furnace Brook Flood Improvement Project (stormwater pump station to alleviate flooding issues)
- Furnace Brook Open Channel Improvements (restoration of approximately 1700 linear feet of Furnace Brook to a more natural stream state)
- Spence Avenue Drainage Improvements Project (upgraded existing stormwater infrastructure to increase hydraulic capacity and reduce flooding)
- Wollaston Beach Outfall Rehabilitation Project
- Atlantic Middle School Campus Improvement Project (repairs/rehabilitation of the existing drainage system to address deficiencies)
- Black's Creek Tide Gate Operations Protocol (manage tidal flow into and out of the estuary while minimizing potential flooding)
- North Quincy High School Public Works Improvement Project (improve long-standing neighborhood flooding problems)

Vulnerable Stormwater Infrastructure

Facility #	Location	Base Elev. (NAVD88, ft)	Projected Flooding (feet)		Issues	Est. Cost of Upgrades
			Present-2030	2070		
1	Teal Playing Fields	10.4	0	2.3	Inadequate Pipe Capacity/Tidal Inundation	$1.3 mil.
3	Sachem St.	7.4	2.6	5.4	Inadequate Pipe Capacity/Tidal Inundation	(portion of #1 upgrade cost)
10	Bayswater Rd.	6.8	2.2-3.2	6	Inadequate Pipe Capacity/Tidal Inundation	$385,000
11A	Arlington/ Brook St.	10.5	0	2	Inadequate Pipe Capacity	(portion of #1 upgrade cost)
11B	John/Division St.	10	0	2.6	Inadequate Pumping Capacity	$150,000
12	Russell Park	9.2	0.8	3.6	Inadequate Pipe Capacity/Tidal Inundation	$650k-7.7 mil.
13	Carlisle St.	9.5	0.5	3.3	Inadequate Outlet Topography	Unknown
24	Chickatabot St.	7.9	2.2	4.9	Unknown	Unknown
	Broad Street	8.7	0.3-1.4	4.1	Unknown	Unknown
*1% chance storm						

Currently, based on state and local regulation, the design and anticipated performance of stormwater infrastructure is based on either the presumed characteristics of a "design rainstorm" or the continuous simulation of streamflow driven by a time series of precipitation. The time series required, to-date, is based upon historic records that do not show increased intensity and frequency of rainfall within the Greater Boston Harbor area. Therefore, while these projects are critical to improve the existing conditions of the system, future precipitation and flooding projections should be factored into design of all stormwater management projects, as discussed further in Chapter 4.

Impacts to Public Health

The changing climate will affect health of individuals, families, and communities. The projected changes, such as higher temperatures and extreme weather, will exacerbate existing health conditions, such as asthma and cardiovascular disease. New health issues will also emerge as vectors and water borne diseases are facilitated by the warmer and wetter conditions. While our physical places will be vulnerable so will be the health of people that define, live, work and gather in these places.

Although long-term climate changes across Quincy will certainly have a marked effect on public health, extreme weather events will repeatedly cause disturbances in people's lives and the systems that they rely on. Further, the vulnerabilities previously described for the development and infrastructure are directly associated with vulnerabilities to public health (i.e. vulnerabilities to land use patterns create vulnerabilities within the demographics of each neighborhood). Therefore, this section focuses on vulnerabilities to populations resulting from extreme weather events: frequent storms and intense precipitation and periods of high heat and drought.

Intense Precipitation/Flooding

Flooding within the City can be expected to disrupt transportation systems potentially isolating people in their homes, as well as inundating property and creating unhealthy conditions such as mold growth and contaminated potable water. Those who rely on public transit will be particularly at risk if a breakdown in transit connections prohibits them from seeking medical care or securing daily needs (i.e. food and water). Older adults, people with disabilities, and those with acute health needs like those requiring dialysis are at particularly high risk when these disruptions occur.

Often storms are accompanied by disruptions in electrical systems. When this occurs, heating, air conditioning, and ventilation systems can be put at risk if there are not backup power systems. As result, residents may face difficulties in maintaining indoor temperatures. Longer term impacts of reduced air circulation in combination with increased moisture can lead to more indoor mold and contaminants[49]. Those who suffer from respiratory issues like asthma face challenges during these situations and others become susceptible to developing similar health issues.

Extreme Heat

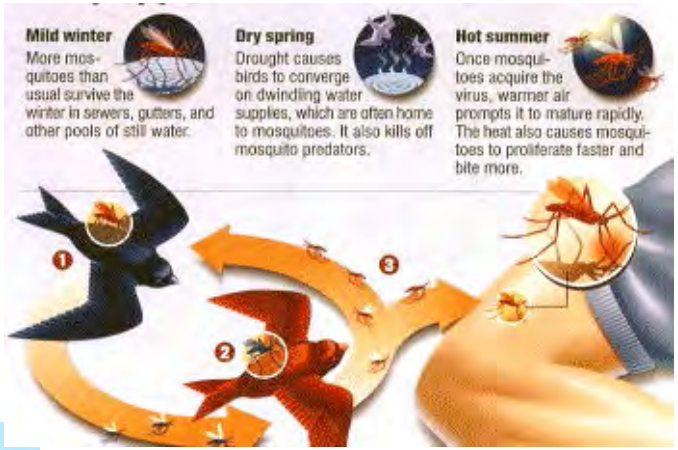
Extreme heat is currently the leading weather-related cause of death in the United States[50]. Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat syncope, heat exhaustion, heat stroke, and death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. Additionally, heat is expected to contribute to the exacerbation of chronic health conditions[51]. In particular, hyperthermia—elevated body temperature due to failed thermoregulation can be caused by heat stroke — is a contributing factor to cardiovascular, metabolic, and other causes of death.[52]

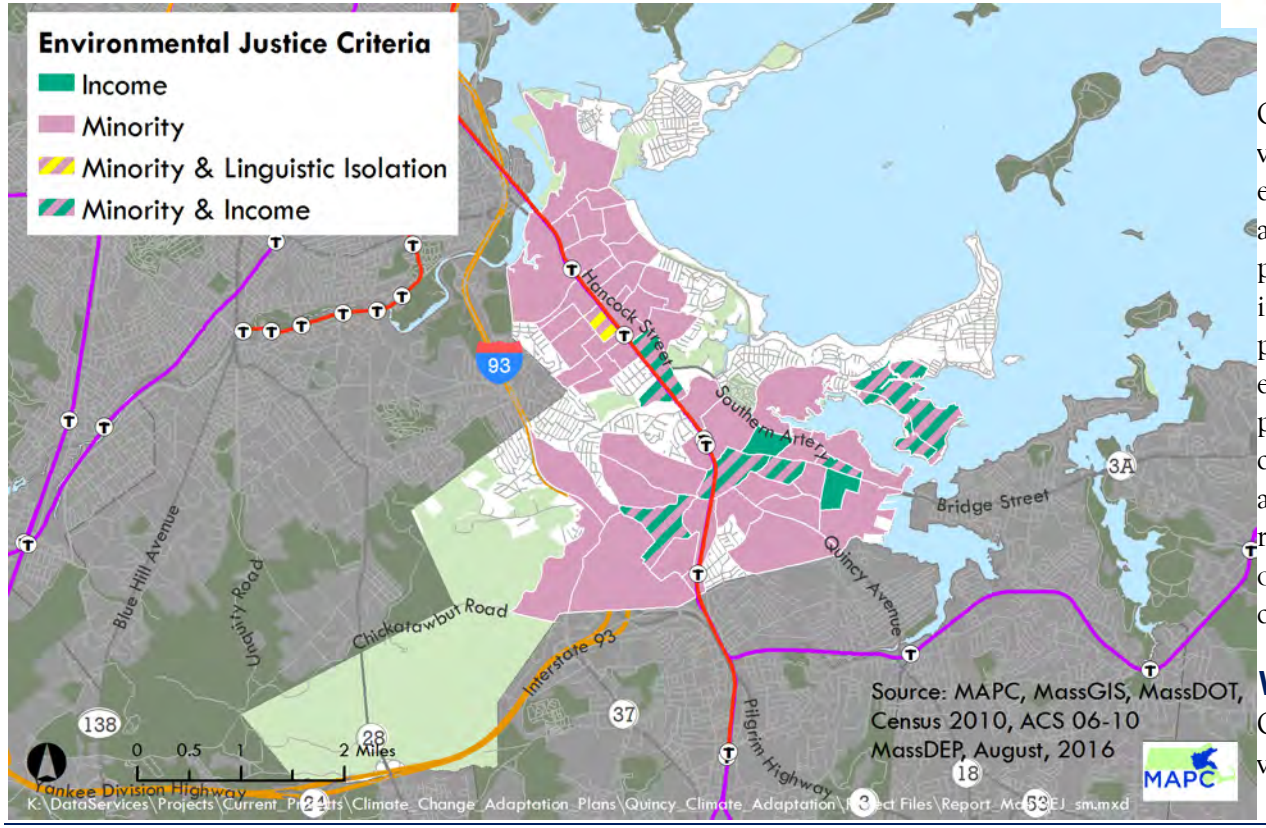
Extreme heat expected to occur within Quincy, particularly surrounding highly impervious areas, has the potential to contribute to greater levels of ground level air pollution and allergens. Heat helps form bi-chemical reactions between NOx and volatile organic compounds (typically from by vehicle emissions) in the presence of sunlight, creating Ozone. Breathing ozone can irritate the respiratory system, reduce lung function and heighten sensitivity to allergens[53]. Likewise, increased temperatures in the presence of higher concentrations of CO_2 has been linked to earlier blooming of flowers (shrubs and trees), which in turn affects the timing, distribution, and composition of pollen and other allergens[54].

Those at particularly high risk of adverse health effects from extreme heat exposure are older adults, children, those living alone and/or with chronic illnesses, urban residents, minorities, lower income families, people with less education, and people without access to air conditioning. In addition, people with chronic mental disorders or pre-existing medical conditions (e.g., cardiovascular disease, obesity, diabetes, neurologic or psychiatric disease), and those participating in outdoor manual labor or sports in hot weather also are at increased risk for heat-related illness[55].

Vector Borne Diseases

The public at large will likely be subject to greater exposure to disease vectors under projected climate change conditions such as Eastern equine encephalitis ("triple E"), West Nile virus, St. Louis encephalitis virus and Lyme disease. The adjacent graphic by ecowatch.com illustrates the connections between climate alterations, disease-carrying species, and how disease transmitted to humans. Massachusetts is predicted to have a general trend of warmer temperatures, which may lead to higher mosquito and tick numbers and greater activity. This may prolong transmission seasons for all vector-borne diseases, extending the risk of transmission outside of the traditional late spring through early fall timeframe.





Climate change will impact all populations in a variety of ways, but these impacts will not be felt equally by all. Because of this, the following assessment focuses on the most vulnerable populations in within the City of Quincy including low-income residents, older populations, those living alone, and those with existing physical and mental health issues. These populations face additional health risks with climate change. Data regarding climate impacts and social vulnerability were taken together to reveal "hotspots" – places where both high levels of social vulnerability and high risk for hazardous climate events overlap.[56]

Vulnerable Populations

Climate change will impact all populations in a variety of ways, but these impacts will not be felt

equally by all and not only according to pre-existing health conditions. Because of this, the following section provides information on populations that might be more vulnerable due to their social or economic conditions. In Quincy, these vulnerable populations include low-income residents, younger and older populations, those living alone, and those who speak languages other than English. The map above illustrates concentrations of these populations across the City.

As shown, there are concentrations of minority populations in vast areas the City; within North Quincy, Wollaston, Quincy Center, Germantown, Merrymount, and Fore River. Many of these neighborhoods have high concentrations of low income residents as well, primarily within North Quincy, Quincy Center, and Germantown (shown in hatched pink and green). Disadvantages based solely on low income are concentrated within the Merrymount/Fore River Shipyard neighborhoods. These populations, particularly those without strong support systems, may face significant challenges in responding to climate change threats. In many cases, vulnerability is amplified by being situated in geographic locations and/or development conditions that are more susceptible to higher impact risks.

Lower Income

Income is an important determinant of a household's ability to prepare for, manage, and respond to climate change risks. Low income populations have fewer resources to adapt to new realities, for example, buying and running air conditioners as summers grow hotter and hotter. They are also less able to keep up with increased energy costs, as well as increased costs of many products that depend on energy, including food.

Many low income housing residents are located within in more heavily urbanized and denser neighborhoods across the City, as shown on the previous map. Historically, lower income neighborhoods within the Commonwealth's industrial cities have the lowest percentage of urban tree canopy as well, which is the case in Quincy. This creates unique challenges to facing climate change such as the urban heat island effect due to greater impervious surfaces and higher levels of air pollution from adjacent and busy roadways. Lung-related diseases such as asthma disproportionally affect children of lower income populations. Lower income populations are vulnerable to climate change not just in their homes, but also in their workplaces. In extreme weather conditions such as heat waves, cold snaps or floods, many lower income employees may be forced to work in dangerous conditions due to the insistence of their employer, or by their own financial need. Examples include jobs done outside like landscaping, or in non-climate controlled interiors such as a hot kitchen. Weather extremes can also significantly reduce income if work days are curtailed due to dangerous working conditions or the inability to get to work due to transportation shut-downs.

Youngest and Oldest Populations

The City's youngest and oldest populations are expected to rise in the coming decades. The number of residents who are aged 65 and over are projected to increase by 60% while those under the age 14 will grow by at a smaller percentage (10%). Both of these population groups should be monitored since they are likely more susceptible to climate impacts like heat and vector-borne diseases.

Characteristic	2010	2030	% Change
Children under the age of 14	12,845	14,141	10%
People aged 65 and over	13,906	22,144	59%

Source: MAPC projections, Stronger Region scenario/

The Massachusetts Healthy Aging Collaborative has developed municipal profiles for cities and towns that show the health of older residents. This dataset provides great detail for a population that may be at more risk from the effects of a changing climate.

Health Profile of Older Residents, City of Quincy			
Health Metric	**Quincy**	**State**	**Quincy Performance**
WELLNESS and PREVENTION			
% with self-reported fair or poor health status	18.60%	20.70%	Similar
% with 15+ physically unhealthy days last month	11.30%	14.00%	Similar
NUTRITION/DIET			
% with 5 or more servings of fruit or vegetables per day	23.10%	24.90%	Similar
% obese	23.10%	22.60%	Similar
% high cholesterol	73.00%	73.60%	Similar
% current smokers	8.20%	9.10%	Similar
% excessive drinking	12.00%	9.20%	Similar
MENTAL HEALTH			
% with 15+ days poor mental health last month	6.00%	6.70%	Similar
% satisfied with life	95.60%	95.80%	Similar
% receiving adequate emotional support	80.70%	80.70%	Similar
% ever diagnosed with depression	28.60%	28.60%	Similar
CHRONIC DISEASE			
% with Alzheimer's disease or related dementias	14.70%	14.40%	Similar
% with diabetes	32.90%	32.10%	Similar
% with stroke	13.80%	12.60%	Worse
% with chronic obstructive pulmonary disease	27.10%	23.30%	Worse
% with asthma	11.60%	11.80%	Similar
% with hypertension	78.70%	77.50%	Worse
% ever had a heart attack	5.70%	5.00%	Worse
% with ischemic heart disease	49.70%	44.10%	Worse
% with congestive heart failure	27.20%	24.80%	Worse
% with 4+ chronic conditions	63.30%	61.50%	Worse
% with 0 chronic conditions	8.40%	7.80%	Similar
LIVING WITH DISABILITY			
% disabled for a year or more	31.10%	31.00%	Similar

Source: MA Healthy Aging Collaborative, 2014[57]

This data shows that on most measures the older population in Quincy is line with state percentages. However, there are some areas where the data demonstrates that older Quincy residents are doing worse, particularly regarding chronic diseases and issues related to cardiovascular health. Additionally, while other conditions are similar to the state's numbers, the percentages themselves do provide useful information to consider. For example, the data indicate that older residents are receiving emotional support and mostly satisfied with life. Conversely, the data conveys that nearly a third of the older adult population has dealt with depression and has a disability and that almost two-thirds report having multiple chronic health conditions.

Social isolation is a risk factor that increases a household's vulnerability to climate change impacts. Approximately 15,340 people in Quincy live alone, comprising 17% of the city's population. Of those living alone, it is estimate that more than a third are senior (5,175, ± 527 / about 36% ±3%). The percentage of senior living alone is comparable to the percentages in the MAPC region and slightly below that of the state. Seniors are more likely than younger people to live alone, so as the senior population rises the percentage of people living alone is likely to increase as well. Monitoring these numbers, and the locations of the individuals living alone, especially seniors, is critical as these populations could easily become isolated if extreme weather causes disruption to local transportation and utility networks.

Health Risks

In 2013, a statewide health dataset was released as part of the Prevention and Wellness Trust Fund initiative.[58] This dataset represents one of the most comprehensive health data reports in the past five to 10 years. The table below presents how the City of Quincy performed across multiple behavioral health risk factors in comparison to the Commonwealth. Its characterization of the population in Quincy suggests that residents are not engaging in health behaviors, such as daily physical activity or consumption of fruits and vegetables, in line with or better than state averages. If these conditions persist into the future, the information indicates that residents in Quincy, on average, may have continued or higher risks for preventable health conditions, like heart and respiratory diseases under climate change conditions.

Prevention Health and Wellness Study Results for City of Quincy	
Health Factor	**City Ranking[59]**
Three years average prevalence of **current smoker** among adults in MA (CY2008 - 2010)	Worse
Three years average prevalence of **diabetes** among adults in MA (CY2008-2010)	Worse
Three years average prevalence of adult **eating 5 or more fruits and vegetables** in MA (CY2005, 2007, 2009)	Worse
Three years average prevalence of **hypertension** among adults in MA (CY2005, 2007, 2009)	Worse
Three years average prevalence of **overweight or obese** among adults in MA (CY2009 -2011)	Worse
Five years average prevalence of **lack of physical activity** among adults in MA (CY2001, 2003, 2005, 2007, 2009)	Worse

Prevention Health and Wellness Study Results for City of Quincy	
Health Factor	**City Ranking[59]**
Three years average **prevalence of good physical health** (<15 days poor mental health) among adults in MA (CY2008, 2009, 2010)	Worse

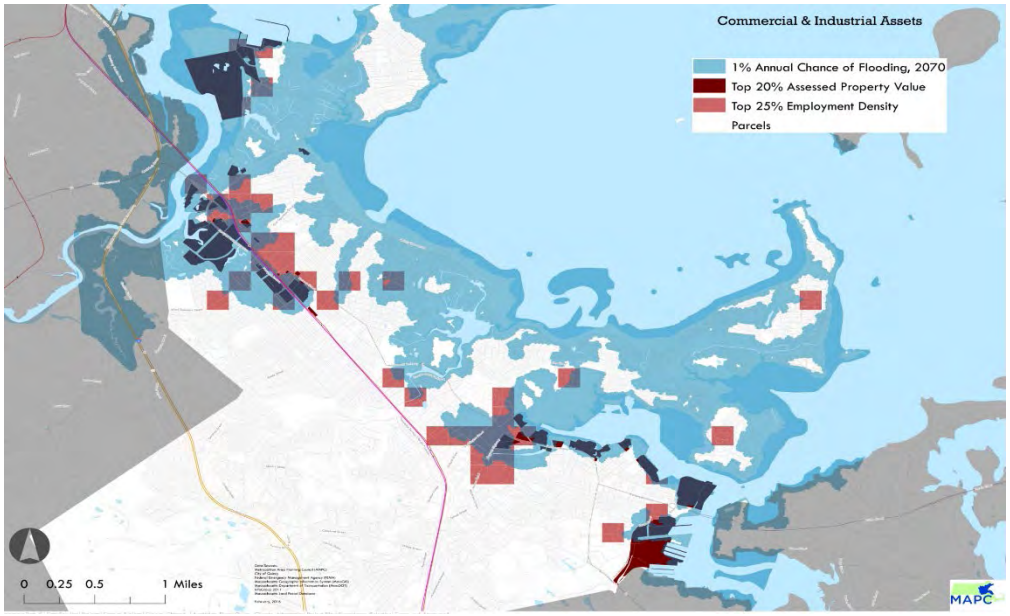
Language Barriers

Language can also be a barrier to create additional vulnerabilities within minority populations. Quincy has a rather large population that speaks a language other than English. According to the latest American Community Survey, approximately ten percent (10% ± 1%) of households in Quincy are Linguistically Isolated, as compared with the six percent (6% ± 1%)) across the Commonwealth in MA. Asian languages are the primary languages spoken within minority households comprising seventeen percent (17% ± 1%) of Quincy households, as compared to four percent (4% ± 0.1%) in Massachusetts.

Impacts to the Local Economy

While climate change poses risks to community health and safety, it can also result in large economic consequences. This comes not just from the initial property damage that may occur after an extreme weather event, but from the prolonged economic disruptions due to climate changes (e.g. increased temperature and coastal flooding). Near-term impacts such as short term job interruptions for hourly wage earners, which are harmful to those living from paycheck to paycheck. In addition, there may be long-term job losses as a local economy struggles to rebound from extreme events and/or inundation of an area that is no longer ripe for economic activity. The economic damage also extends to businesses that serve as local employers as well as providers of vital goods and services to low income communities.

The Boston Harbor Flood Risk Model predicts flooding by the year 2070 that would adversely impact several commercial and industrial areas of the City. An evaluation of the coastal inundation maps, in tandem with the existing location of employment centers with large concentrations of employees and projected industry growth, provided insight into potential loss of Quincy's economic base in certain areas, and whether there are current resiliency features protecting its economy. Additionally, understanding the projected job growth in industries that serve vulnerable populations and provide critical services allowed the planning team to determine the potential for more severe impacts to these populations. The following map identifies the four major commercial districts in relation to the depth of coastal flooding projected to occur between



2030 and 2070 (shown in light blue on the legend and map). Of the four major employment centers and business with high assessed value (shown in pink and maroon), the two with the most dramatic potential for being largely inundated are Marina Bay and North Quincy.

Rising seas would impact the North Quincy Commercial District in a fragmented manner with more permanent flooding along the Neponset River, and pockets of inland water bodies traversing properties. However fragmented or less severe, this flooding will impact the local economy since one of Quincy's sixth largest employers is located within the commercial district as well as other important businesses and critical facilities. Marina Bay will be inundated by coastal flooding, primarily along its two critical roadway connections (Commander Shea Boulevard and East Squantum Street) creating vulnerabilities to commercial businesses within the Marina Bay complex. The Sprague Terminal oil tanks in the Fore River Shipyard are most vulnerable to coastal flooding and could pose significant environmental risks. Facilities operated by two large employers: Bluefin Robotics and Twin River Technologies would be impacted and, in turn, hindering local economic revenue. Rising seas are also shown to inundate portions of the working port's bulkhead and adjacent landmass that are necessary to support marine industrial operations.

Vulnerabilities Summary

There are a number of neighborhoods across the City that have been identified as highly vulnerable to sea level rise, coastal flooding, storm conditions, as well as heat increases and drought. Prior to moving into recommendations for these areas, it's important to compare vulnerabilities across sectors because there are trends that emerge between sectors and municipalities themselves that can be addressed jointly, as shown in the following table.

Vulnerabilities Summary				
Neighborhood	**Primary Impacts**	**Primary Sector**	**Secondary Sectors**	**Vulnerabilities**
Squantum/ Marina Bay	Coastal flooding, storm damage	Development	Natural Resources, Economy	Low-lying residential and commercial areas
North Quincy	Coastal and inland flooding, high heat	Development	Economy, Public Health	Low-lying residential and commercial areas
Wollaston	Coastal flooding, potential storm damage, some heat (inland neighborhood)	Natural Resources	Development, Public Health	Low-lying residential and commercial areas, minority populations (housing and illness)

Vulnerabilities Summary				
Merrymount (Blacks Creek Area)	Inland (some coastal surge flooding), heat	Economy	Government, Development, Public Health	Low-lying government facilities, mixed uses, and employment clusters; minority populations (housing and illness)
Quincy Center	Inland flooding, high heat	Economy	Development, Public Health	Low-lying commercial and government facilities, low income and/or minority populations (housing and illness)
Houghs Neck/ Germantown	Coastal flooding, storm damage	Development	Public Health, Natural Resources	Low income and/or minority populations (housing and illness), degraded wetlands and shoreline resources
Fore River	Coastal flooding	Economy	Development	Low-lying employment centers and industries, low-lying adjacent neighborhoods with minority and/or low-income populations

Impacts that occur regionally trickle-down to municipalities and their sectors, which in turn have an effect on their neighboring municipalities. For instance, regional sea level rise will have a direct effect locally, and in time these effects will increase to a point in which some properties along the immediate coast may no longer be viable for residential use. Therefore, these property owners may consider moving inland or to a neighboring community that is reminds them of their former residence. The Massachusetts Institute of Technology, Center for Advanced Urbanism, completed a study in 2015 that investigated these social inclinations in light of regional impacts. Further, they also studied what implications these impacts may have on a cluster of neighboring municipalities. These inter-municipal dependencies, which although they exist today; would become far more pronounced in the face of a changing climate. Regional interdependencies are factored into the resiliency recommendations offered in the following chapter.

1 This study culminates a four-year research effort, funded by the United States Environmental Protection Agency (EPA); conducted by experts at Tufts University, the University of Maryland, and Boston University, in consultation with officials from the EPA, the Massachusetts Executive Office of Environmental Affairs (EEA), and the Metropolitan Area Planning Council.
2 Photo by Hans Dietrich, October 23, 2014.
3 Citation: Ramachandra T. V. and Pradeep P. Mujumdar, 2009, Urban Floods: Case Study of Bangalore, Journal of the National Institute of Disaster Management, Vol. 3, No. 2, April 2009, pp. 1 – 98.
4 Walawender J., Hajto M., Iwaniuk P., 2012, A new ArcGIS toolset for automated mapping of land surface temperature with the use of LANDSAT satellite data. Proc. IEEE International Geoscience and Remote Sensing Symposium (IGARSS), 22-27 July 2012, Munich, Germany, 4371-4374, doi: 10.1109/IGARSS.2012.6350405
5 Victorian Centre for Climate Change Adaptation Research (VCCCAR)
6 Source: http://braceillinois.publish.uic.edu/files/2014/12/greenhouse.jpg.
7 U.S. Environmental Protection Agency, "The Greenhouse Effect." https://www3.epa.gov/climatechange/science/causes.html#greenhouseeffect.

[8] IPCC, 2014: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[9] The leading international body for the assessment of climate change established by the United Nations Environment Programme and the World Meteorological Organization.
[10] International Institute for Applied System Analysis in Austria
[11] National Institute for Environmental Studies in Japan.
[12] Pacific Northwest National Laboratory in the US.
[13] PBL Netherlands Environmental Assessment Agency.
14 MetroBoston Population and Housing Demand Projections 2014. Data sources for MAPC's population projection analysis is based upon the 1990, 2000, and 2010 Census.
15 Patriot Ledger. September 15, 2012.
[16] Based on ICD-9 codes 290–319
17 Braintree: 27,733 employees; Milton: 5,936 employees; Randolph: 8,713 employees; Weymouth: 18,422 employees.
18 Boston employs over 12 times the number of employees than Quincy (595, 527 versus 48,077), and approximately 7 times the number of businesses (24,128 versus 3,476). Source: Massachusetts EOWLD, "ES-202 data," 2014
19 Source: Massachusetts EOWLD, "ES-202 data," 2013
[20] Reed, Donald E. Surficial Geology of Quincy, Massachusetts. 1964
[21] https://www.arborday.org/programs/treeCityUSA/directory.cfm
[22] Department of Environmental Protection Weir River Watershed Water Quality Assessment 2003.
[23] U.S. Environmental Protection Agency, 2014 Waterbody Report for Town River Bay, Segment MA74-15.
[24] Boston Research Advisory Group, Draft Climate Change and Sea Level Rise Projections for Boston, January 18, 2016. (BRAG 2016)
25 Cash, D. et al. (2011). Massachusetts climate change adaptation report. Executive Office of Energy and Environmental Affairs and the Adaptation Advisory Committee.
26 Demariaa, E. et al. "Regional climate change projections of streamflow characteristics in the Northeast and Midwest U.S." Journal of Hydrology: Regional Studies. Volume 5, March 2016.
27 Northeast Regional Climate Center, Cornell University "Extreme Precipitation in New York & New England: An Interactive Web Tool for Precipitation Analysis." (http://precip.eas.cornell.edu/)
[28] Northeast Climate Impacts Assessment Report 2007.
[29] FEMA defines floodwaters as "Overflow of inland or tidal waters, unusual and rapid accumulation or runoff of surface waters from any source, mudflow, collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood."
[30] Climate Ready Boston, Boston Research Advisory Group Report. June 1, 2016.
[31] MAPC is currently developing a methodology for riverine floodplain analysis suitable for scenario planning by municipalities.
[32] United States National Climate Assessment. Global Sea Level Rise Scenarios. December, 2012. (http://www.cpo.noaa.gov/sites/cpo/Reports/2012/NOAA_SLR_r3.pdf)
[33] Matching Mean Sea Level Rise Projections to Local Elevation Datums20 and the U.S. Army Corps of Engineers.
[34] While, unfortunately, we currently appear to be on the higher emissions path, this feature of the model output should be noted.
[35] U.S. Department of Agriculture Forest Service. I-tree landscape software (https://www.itreetools.org/about.php). Note: I-tree uses NLCD 2011 data for tree canopy.
[36] Charles River Watershed Association. Stormwater, Trees, and the Urban Environment: A Comparative Analysis of Conventional Street Tree Pits and Stormwater Tree Pits for Stormwater Management in Ultra Urban Environments. March 2009. (http://www.crwa.org/pubs/StormwaterTreesUrbanEnvMar09.pdf)
[37] U.S. Department of the Interior, U.S. Geological Survey. (http://ca.water.usgs.gov/Carbon_Farm/index.html)
[38] Trulio, Lynne, Ph.D., Professor, Department of Environmental Studies, San Jose State University; "Notes on Carbon Sequestration and Tidal Salt Marsh Restoration."
[39] IPCC
[40] Rapid shoreward encroachment of salt marsh cordgrass in response to accelerated sea-level rise Jeffrey P. Donnelly*† and Mark D. Bertness‡ Departments of *Geological Sciences and ‡Ecology and Evolutionary Biology, Brown University, Providence, RI 02912
[41] Zach Ferdaña, The Nature Conservancy, and George Raber, University of Southern Mississippi. *GIS Helps Integrate Coastal Hazard Risk and Sea Level Rise*. ArcNews Summer 2014.
[42] http://www.werc.usgs.gov/ProductDetails.aspx?ID=5071
43 Metro Boston Regional Climate Change Adaptation Strategy Report, MAPC, March 2015
44 A survey was not undertaken for this project.
45 FEMA, Design Guide for Improving Critical Facility Safety from Flooding and High Winds, Risk Management Series #543, January 2007.
46 Choguill CL (1996) Ten steps to sustainable infrastructure. Habitat Int 20(3) 389-404.
47 https://www3.epa.gov/climatechange/impacts/transportation.html
48 2. USGCRP (2009). Global Climate Change Impacts in the United States . Karl, T.R., J.M. Melillo, and T.C. Peterson (eds.). United States Global Change Research Program. Cambridge University Press, New York, NY, USA.
49 IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley (Eds.), 1535 pp. Cambridge University Press, Cambridge, UK and New York, NY. http://www.climatechange2013.org
50 Luber, G., & McGeehin, M. (2008b). Climate change and extreme heat events. American Journal of Preventive Medicine, 35(5), 429–435. http://doi.org/10.1016/j.amepre.2008.08.021
51 Kravchenko, J., Abernethy, A. P., Fawzy, M., & Lyerly, H. K. (2013). Minimization of heat wave morbidity and mortality. American Journal of Preventive Medicine, 44(3), 274–282. http://doi.org/10.1016/j.amepre.2012.11.015
52 O'Neill, M. S., & Ebi, K. L. (2009). Temperature Extremes and Health: Impacts of Climate Variability and Change in the United States. Journal of Occupational and Environmental Medicine, 51(1), 13–25. http://doi.org/10.1097/JOM.0b013e318173et22
53 MassDEP. 2012a. "Ground-Level Ozone." MassDEP. http://www.mass.gov/dep/air/aq/aq_ozone.htm#trends.
54 USGCRP, 2016: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M.D. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, DC, 312 pp. http://dx.doi.org/10.7930/J0R49NQX

55 Holstein, J., Canouï-Poitrine, F., Neumann, A., Lepage, E., & Spira, A. (2005). Were less disabled patients the most affected by 2003 heat wave in nursing homes in Paris, France? Journal of Public Health (Oxford, England), 27(4), 359–365.

[58] Preventative Health Trust, Source: Preventative Health and Wellness Study, Appendix A1, October 2013

59 A 'Better' designation means that Quincy residents perform better for reporting the health condition, risk factor, or protective factor as compared to other municipalities in the state; an 'Average' designation means that residents perform similar as compared to other municipalities in the state; and a 'Worse' designation means that residents perform not as well when compared to other municipalities in the state. The information is based on the Behavioral Risk Factor Surveillance System (BRFSS) data for Massachusetts and analysis into quintiles for cities and towns in the Commonwealth.

Appendix

1. Vulnerability Assessment Methodology summary; MAPC.
2. Climate Change and Sea Level Rise Projections for Boston; Climate Ready Boston / Boston Research Advisory Group, June 2015
3. Coastal Flood Inundation Maps – By Neighborhood; MAPC.
4. Boston Harbor Flood Risk Model Disclaimer; Massachusetts Department of Transportation / Woods Hole Group.

Appendix C- Public Outreach

MAPC
METROPOLITAN AREA PLANNING COUNCIL
SMART GROWTH AND REGIONAL COLLABORATION

Metro Boston Climate Preparedness Taskforce
Meeting Agenda

Thursday, June 11th, 2015, 1:30 – 3:30 pm

- Introductions (5 mins)

- Metro Mayors Coalition Summit recap and debrief (15 mins)
    - Opportunities for action
    - Needs of Taskforce municipalities moving forward

- Discussion of the role of Taskforce and year-long workplan (20 mins)
    - Quarterly goals
    - Meet every two months: Sept, Nov, Jan, March
    - Phasing in other sectors when useful: academia, non-profits, private sector
    - What preparedness projects are currently in the works? What opportunities exist to collaborate/coordinate on activities?

- Presentation: MassDEP Chief Emergency Planning Officer Nicholas Child (10 mins)

- Presentation: MEMA *(invited)* (10 mins)

- Updates on the Climate Smart Cities program, Trust for Public Land MA Director Kevin Essington (10 mins)

- Capacity building opportunities for local municipal vulnerability assessments (20 mins)
    - MAPC-hosted webpage for climate preparedness resources: http://www.mapc.org/climatepreparedness
    - EPA climate change planning tools and databases
    - Best practices from Cambridge's vulnerability assessments
    - Institute for Sustainable Communities (ISC) summer workshop opportunity
    - Hazard mitigation planning

- Regional critical infrastructure vulnerability assessment (20 mins)
    - Inventory
    - What are existing gaps in information?
    - Grant opportunities

- Goals for next Taskforce meeting in September and Summer tasks (10 mins)
    - Collect climate vulnerability assessments and climate preparedness plans and projects of the metro region,
    - Look to best practices from other regions, to develop a comprehensive understanding of existing and planned climate preparedness strategies,
    - Identify opportunities for better coordination of ongoing regional climate preparedness action

Taskforce Year 1 Workplan:

Summer 2015

- Collect climate vulnerability assessments and climate preparedness plans and projects of the metro region
- Look to best practices from other regions, to develop a comprehensive understanding of existing and planned climate preparedness strategies
- Identify opportunities for better coordination of ongoing regional climate preparedness action

Fall 2015

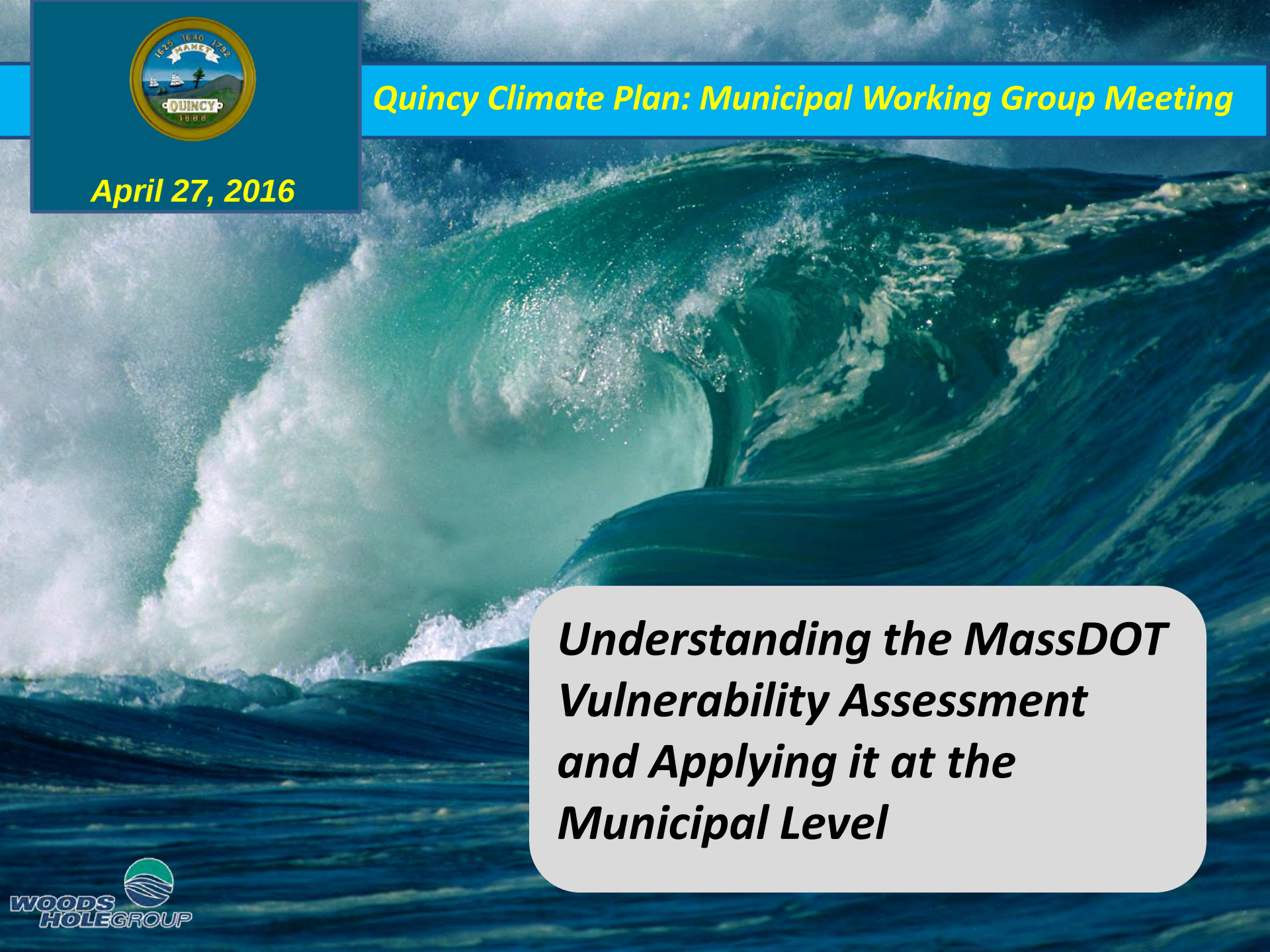
- Identify any crucial gaps in knowledge and propose means to address them
- Identify critical regional infrastructure for which there are inadequate climate preparedness plans

Winter 2016

- Prioritize the needs of vulnerable critical regional infrastructure
- Identify opportunities for joint or collective action

Spring 2016

- Prepare a report on the first year of activities and make recommendations for the Mayors, City Managers, and Town Managers of the Metropolitan Mayors Coalition by May 30, 2016



Quincy Climate Plan: Municipal Working Group Meeting

April 27, 2016

Understanding the MassDOT Vulnerability Assessment and Applying it at the Municipal Level

WOODS HOLE GROUP

Climate Change Preparation

The **Central Artery** is a critical link in regional transportation and a vitally important asset in the Boston metropolitan area.

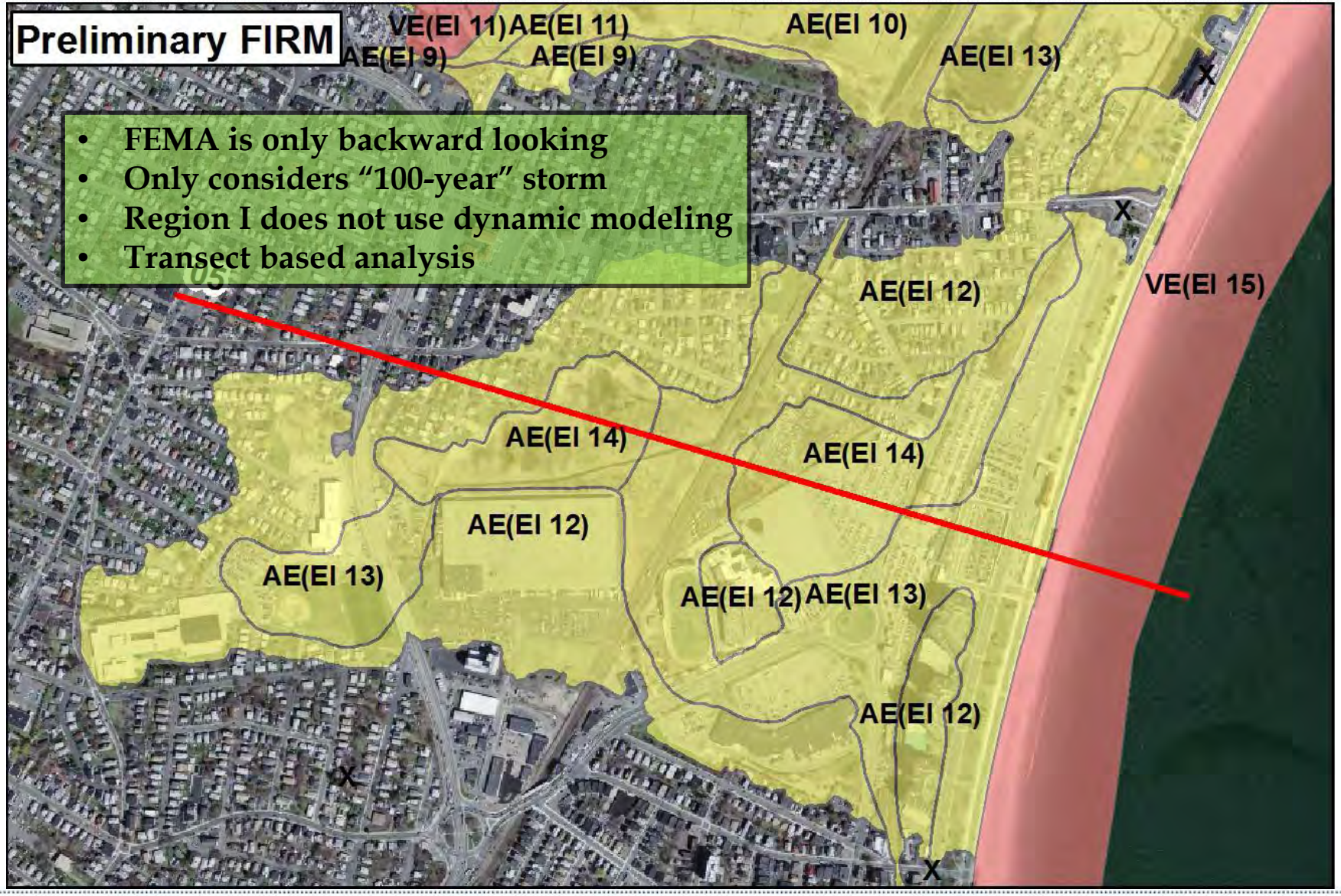
1. What is the probability of flooding?
2. What is vulnerable and what is the priority?
3. What interventions are available and what is the plan?

Project Team:

Kirk Bosma, Woods Hole Group, Inc.
Ellen Douglas, Paul Kirshen, and Chris Watson, UMass Boston
Steven Miller and Katherin McArthur, MassDOT

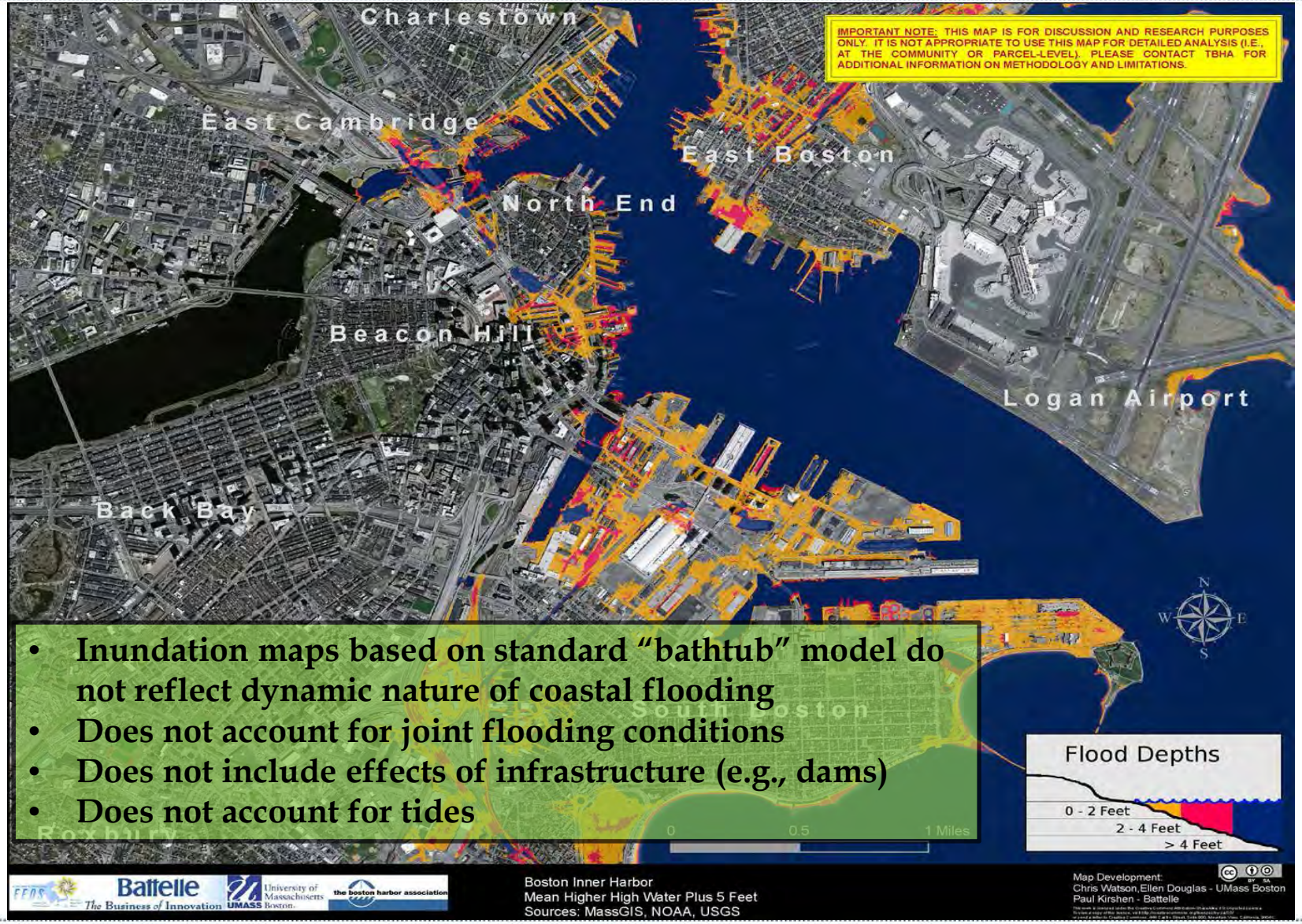
WOODS HOLE GROUP

Probability of flooding options



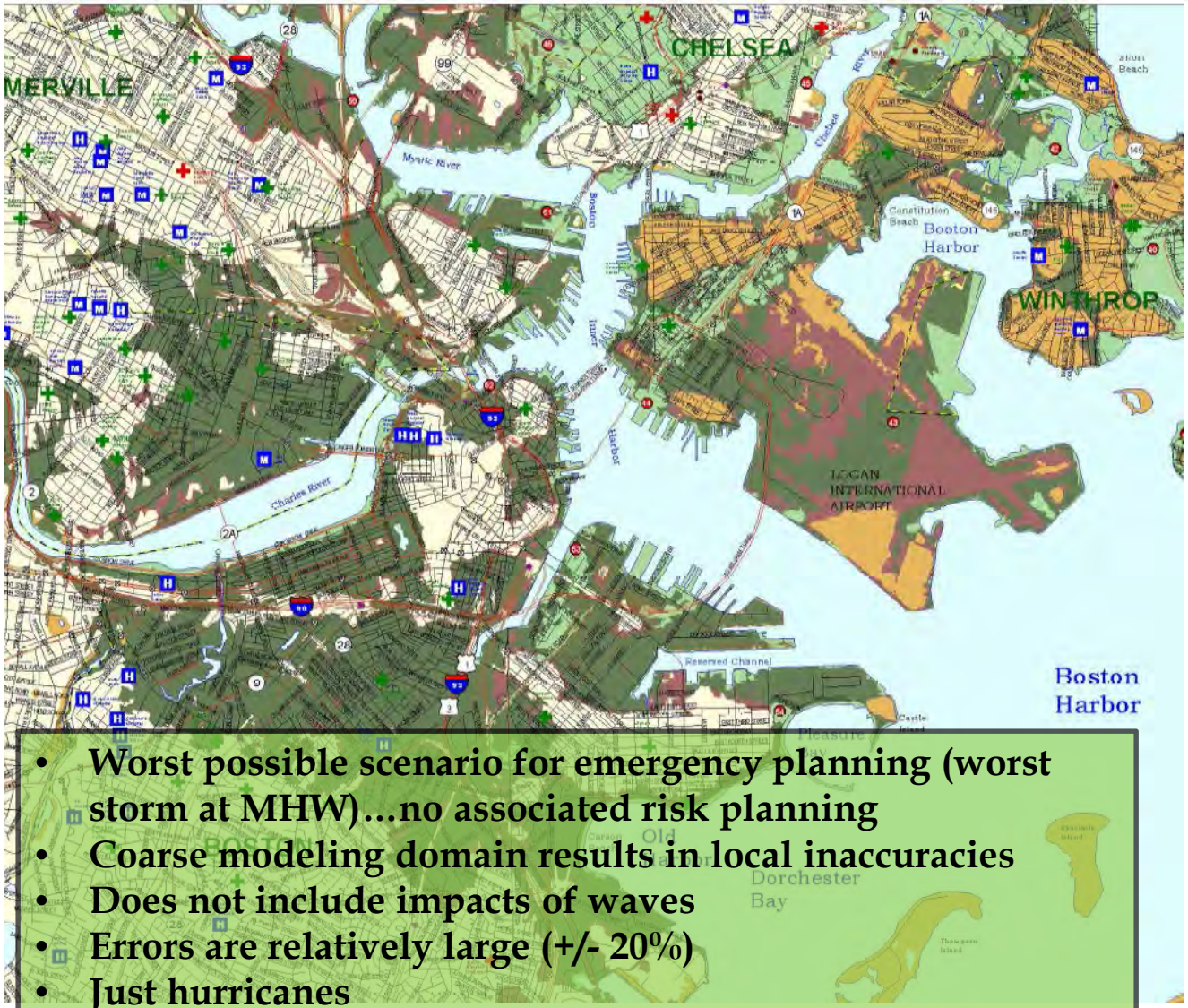
- FEMA is only backward looking
- Only considers "100-year" storm
- Region I does not use dynamic modeling
- Transect based analysis

Probability of flooding options



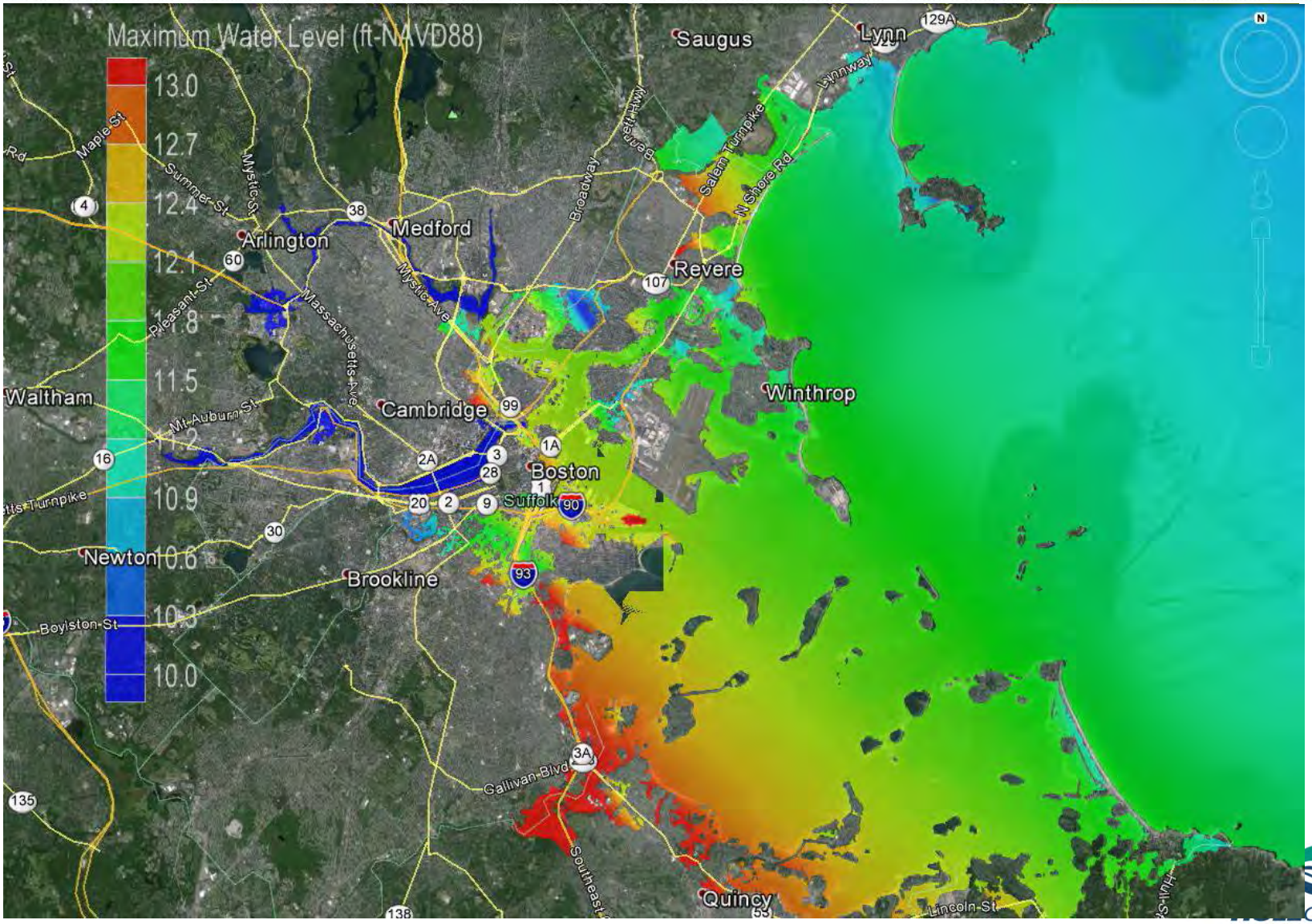
- **Inundation maps based on standard "bathtub" model do not reflect dynamic nature of coastal flooding**
- **Does not account for joint flooding conditions**
- **Does not include effects of infrastructure (e.g., dams)**
- **Does not account for tides**

Probability of flooding options



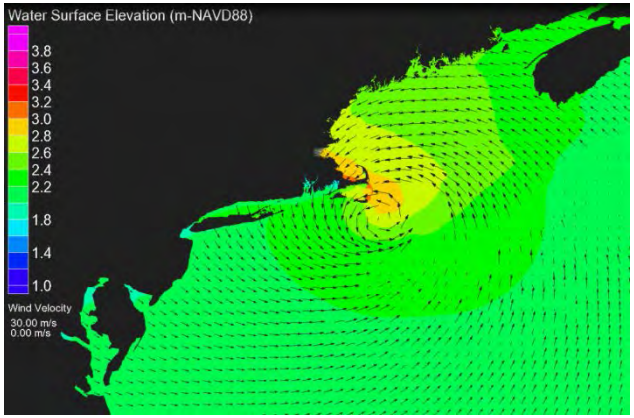
- **Worst possible scenario for emergency planning (worst storm at MHW)…no associated risk planning**
- **Coarse modeling domain results in local inaccuracies**
- **Does not include impacts of waves**
- **Errors are relatively large (+/- 20%)**
- **Just hurricanes**

Why existing maps were not good enough

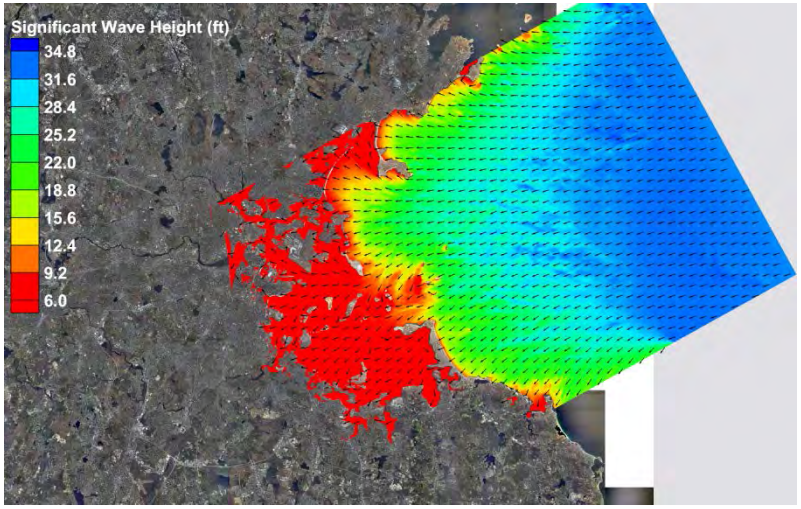


Hi-Res Hydrodynamic Modeling

- Includes relevant physical processes (tides, storm surge, wind, waves, wave setup, river discharge, sea level rise, future climate scenarios)



- **Currents**
- **Storm Surge**
- **Tides**
- **Water Levels**
- **Winds**
- **SLR**
- **Discharge**
- **Infrastructure**



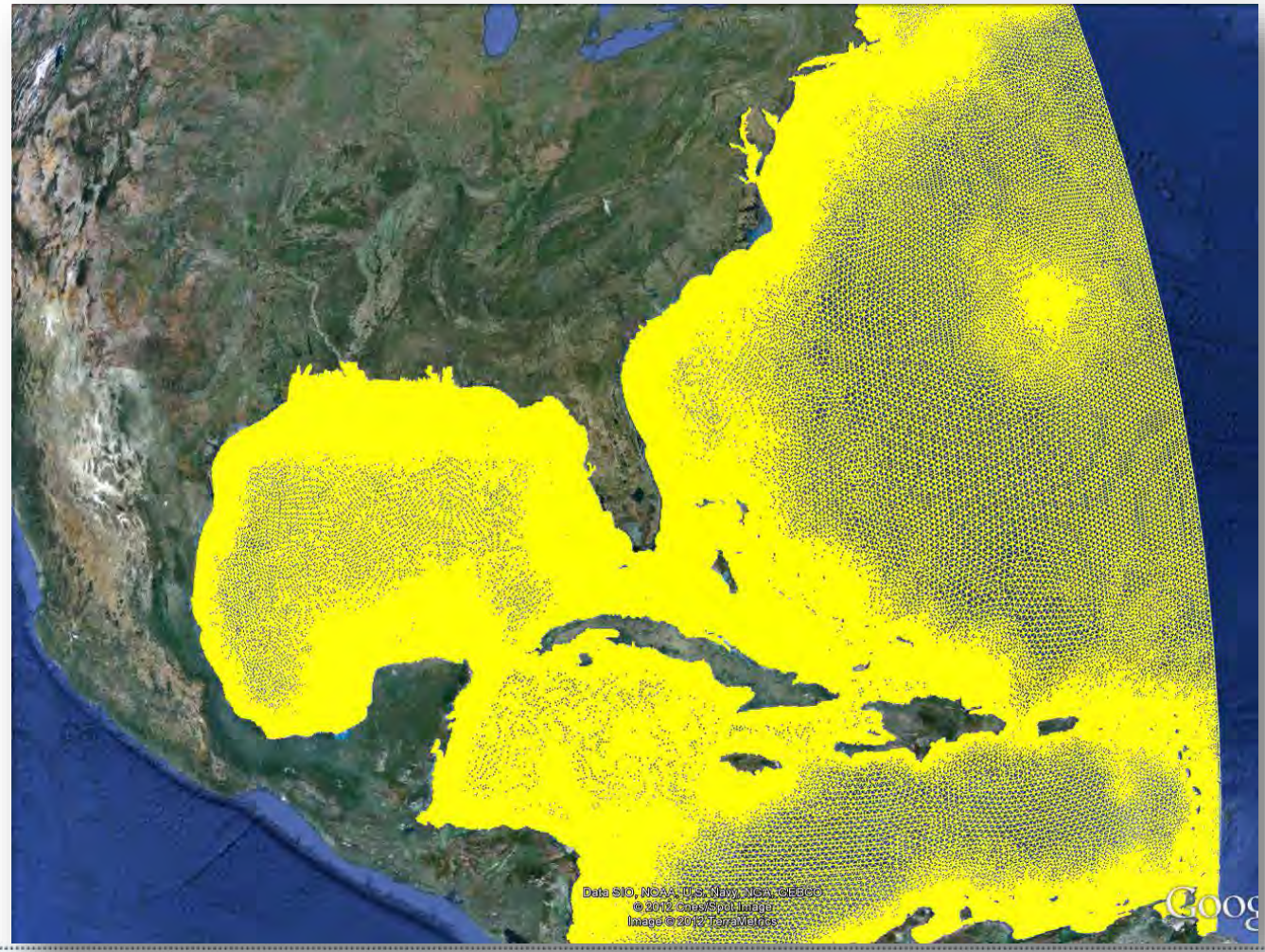
- **Waves**
- **Wave Setup**

Tightly Coupled

WOODS HOLE GROUP

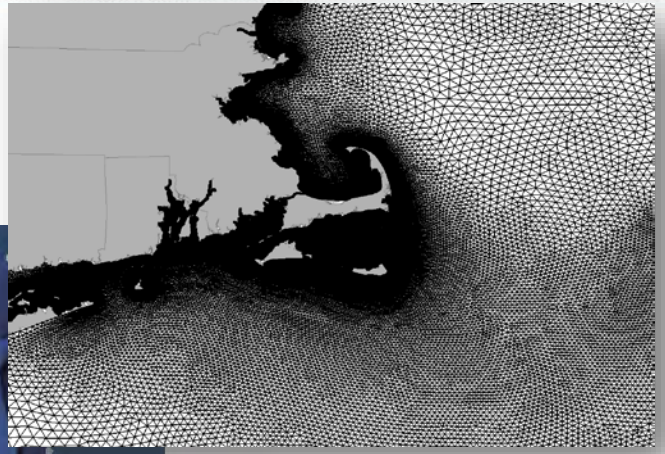
Regional Grid Requirements

Grid covers a large regional area (North Atlantic) to capture large-scale storm (hurricane, nor'easter) dynamics.



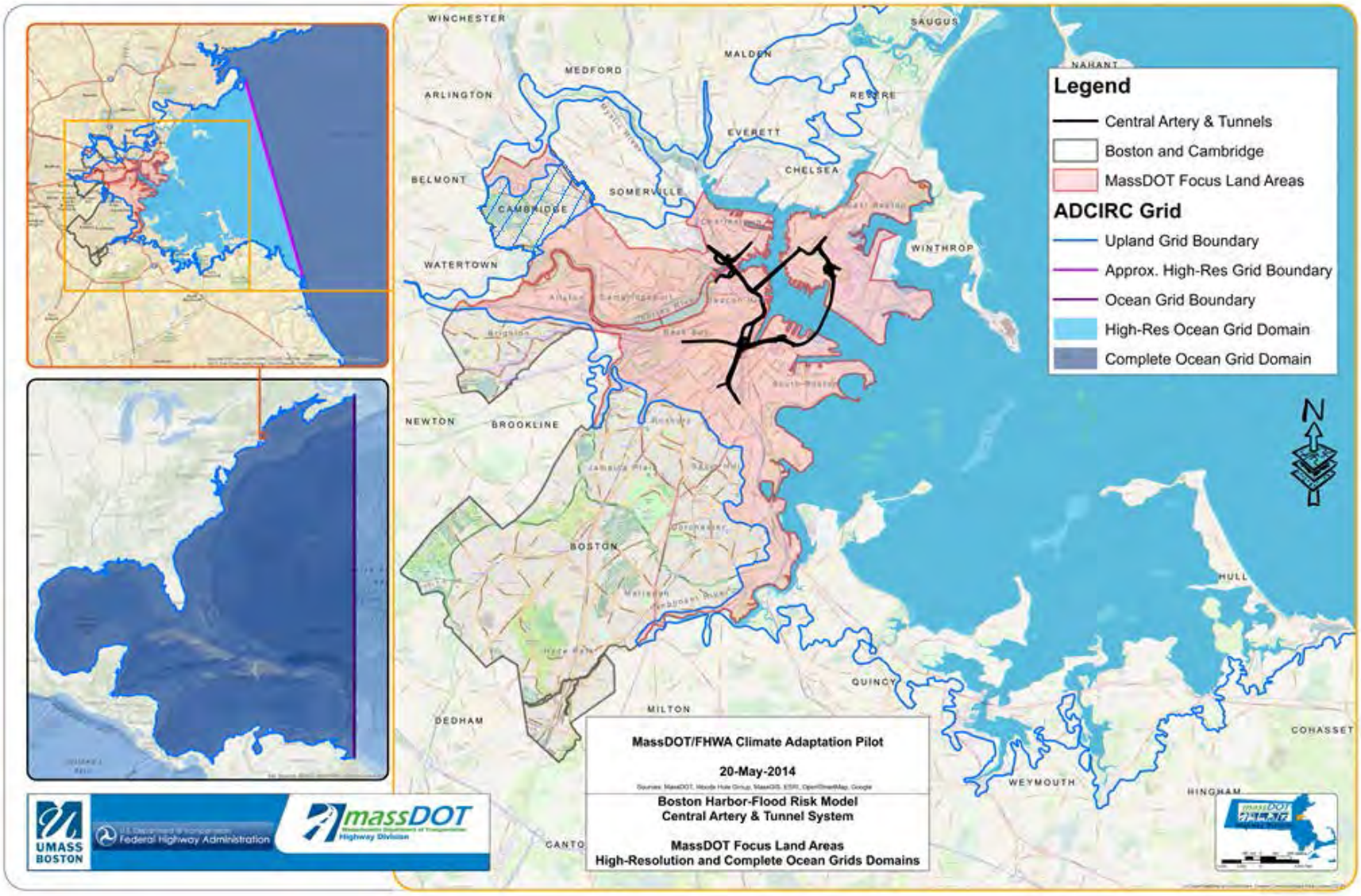
Unstructured Grid

Varying resolution with high resolution in areas of interest



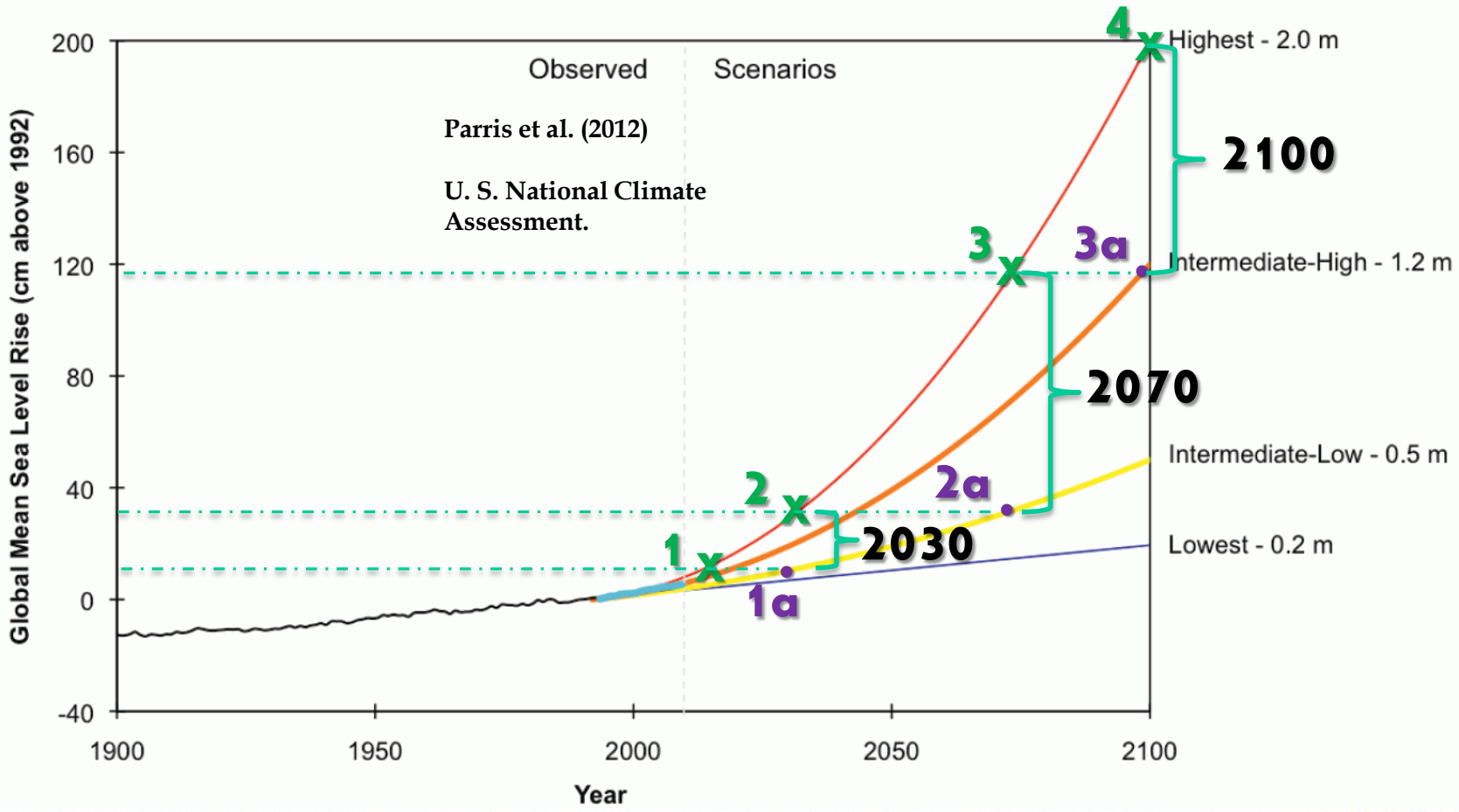
Boston Grid

Focus Areas


WINCHESTER
MEDFORD
MALDEN
SAUGUS
NAHANT
ARLINGTON
REVERE
EVERETT
CHELSEA
BELMONT
SOMERVILLE
CAMBRIDGE
WINTHROP
WATERTOWN
NEWTON
BROOKLINE
BOSTON
HULL
QUINCY
MILTON
DEDHAM
COHASSET
WEYMOUTH
HINGHAM
CANTO
Legend
Central Artery & Tunnels
Boston and Cambridge
MassDOT Focus Land Areas
ADCIRC Grid
Upland Grid Boundary
Approx. High-Res Grid Boundary
Ocean Grid Boundary
High-Res Ocean Grid Domain
Complete Ocean Grid Domain
N
MassDOT/FHWA Climate Adaptation Pilot
20-May-2014
Boston Harbor-Flood Risk Model
Central Artery & Tunnel System
MassDOT Focus Land Areas
High-Resolution and Complete Ocean Grids Domains
UMASS BOSTON
Federal Highway Administration
massDOT
Highway Division

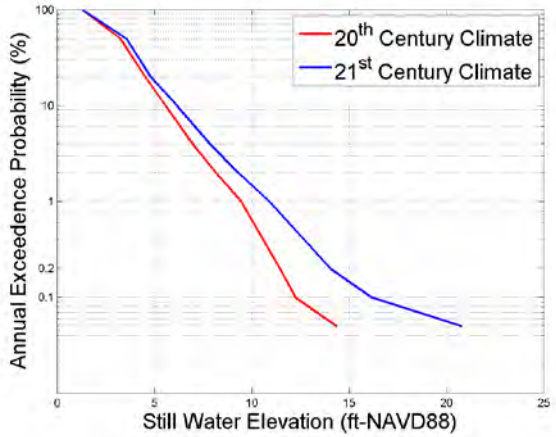
Using Projections to Bracket Risk

Scenarios	2020	2030	2040	2050	2060	2070	2080	2090	2100
"Highest" Global SLR (from 2013-2020) (feet)	0.21	0.61	1.10	1.70	2.40	3.21	4.11	5.12	6.23
Land subsidence (feet) @ 0.003 ft/yr	0.02	0.06	0.09	0.12	0.15	0.19	0.22	0.25	0.29
"Highest" Relative SLR (from 2013-2020) - (feet)	**0.24**	**0.66**	**1.19**	**1.82**	**2.56**	**3.39**	**4.33**	**5.37**	**6.52**

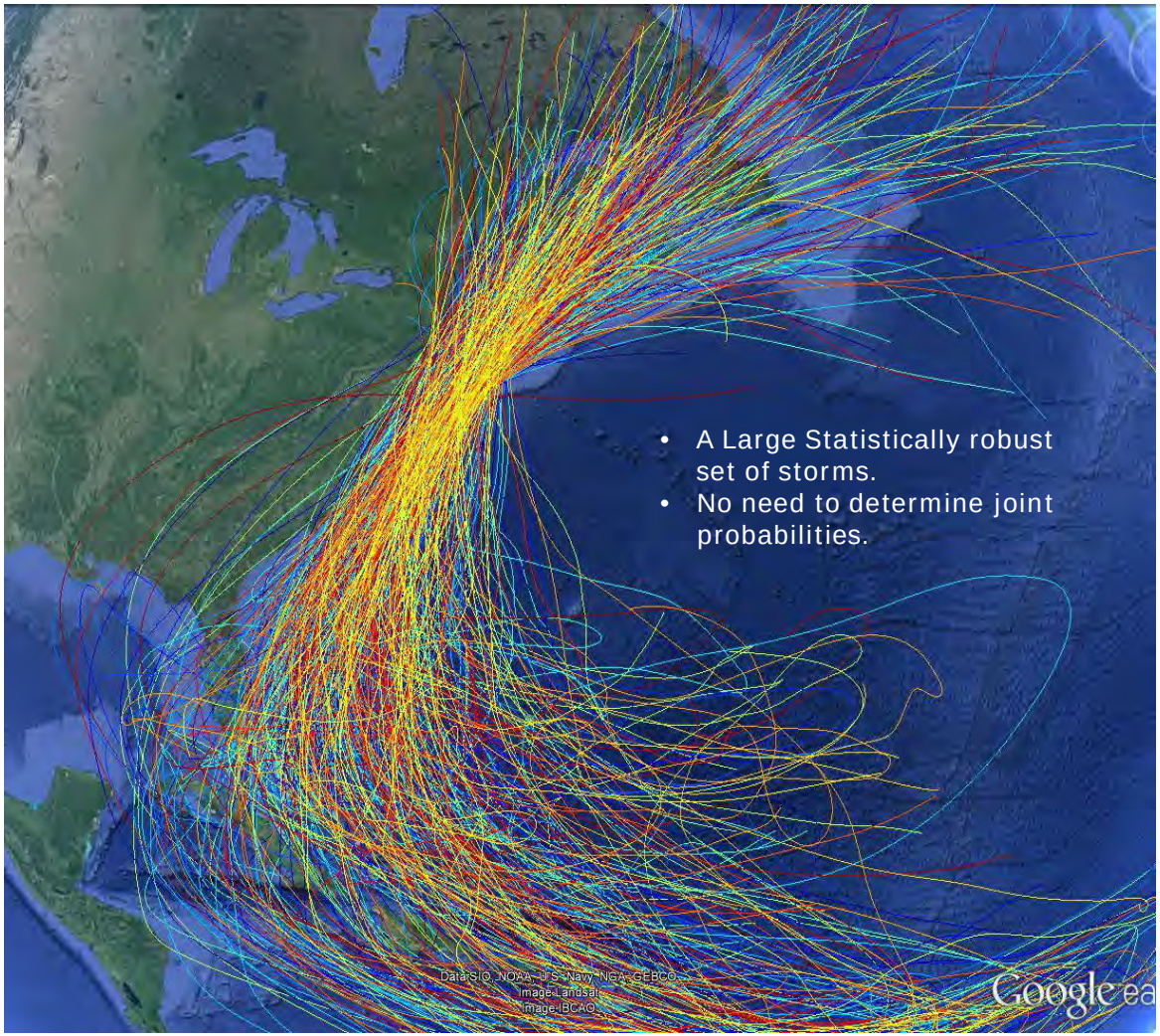


Storm Climatology - Hurricanes

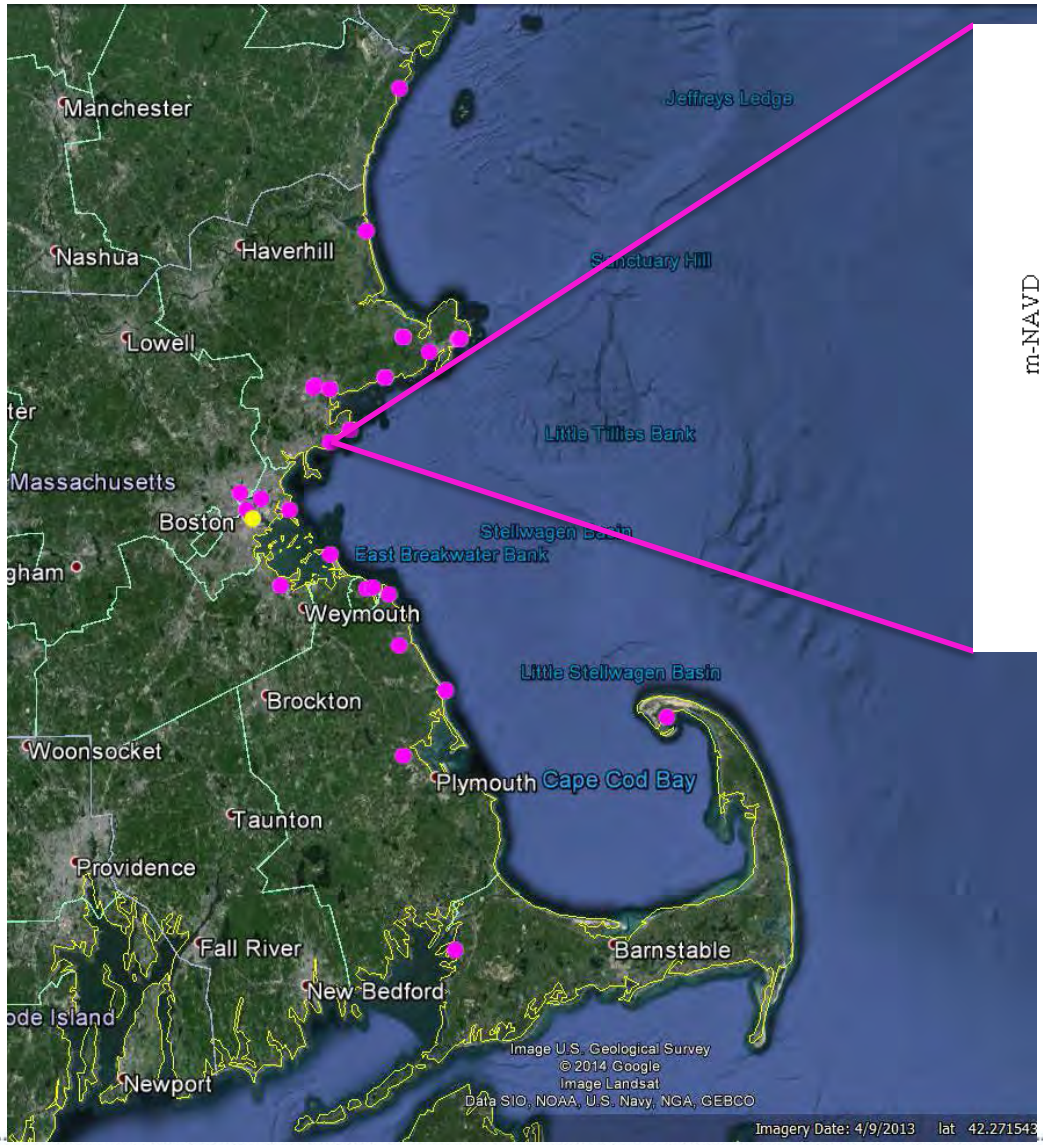
- Monte Carlo simulations, using a large statistically robust set of storms (Emanuel, et al., 2006) and a physics based approach
- Present and future climate change scenarios

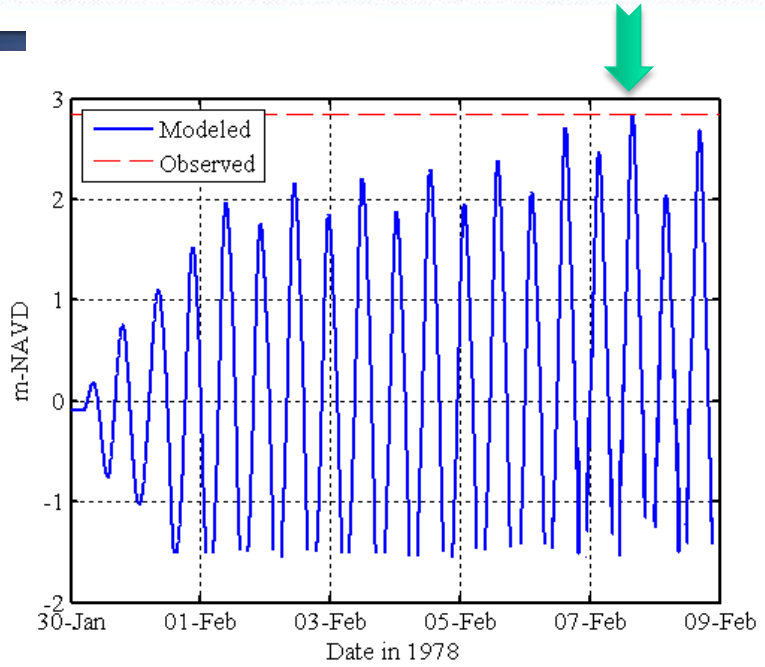


- Simulates storms (both hurricane and nor'easter) combined with SLR and precipitation

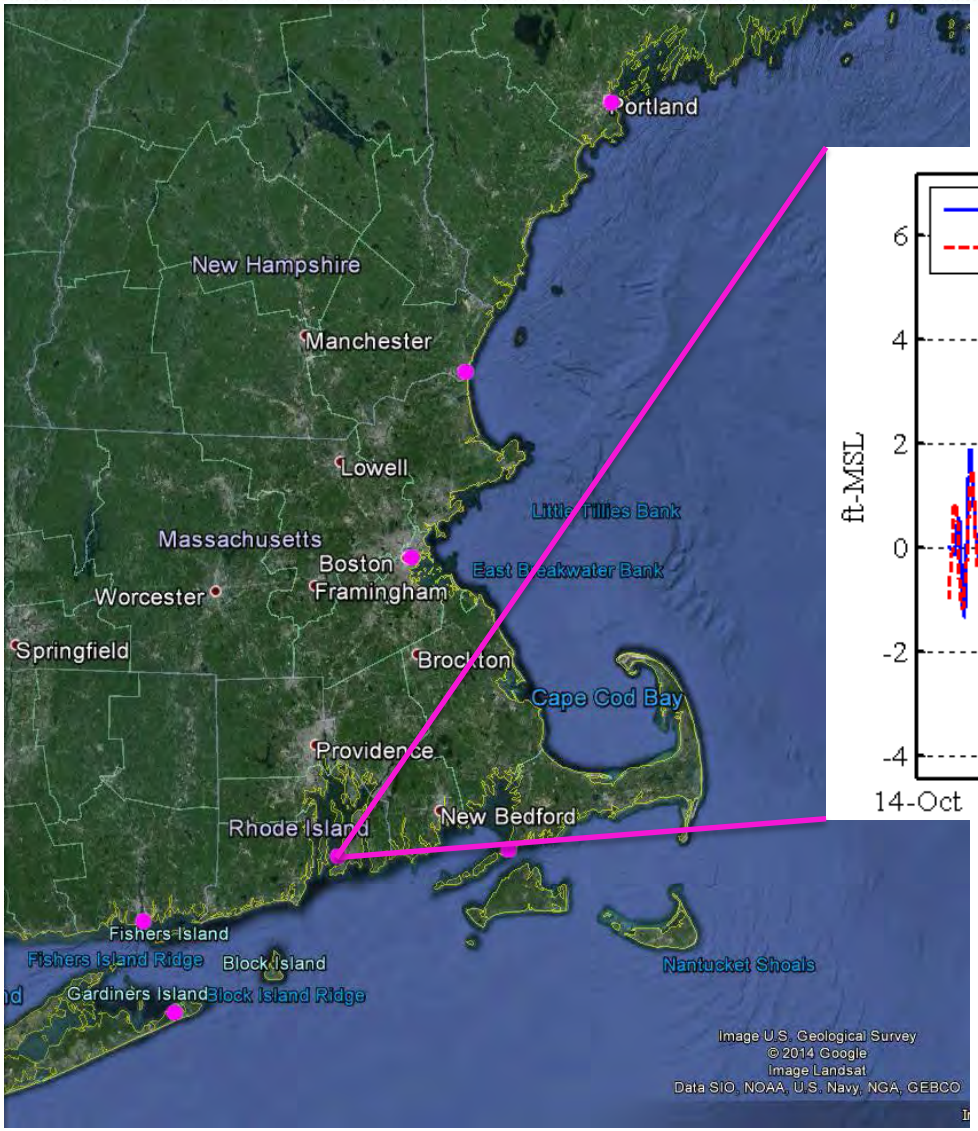


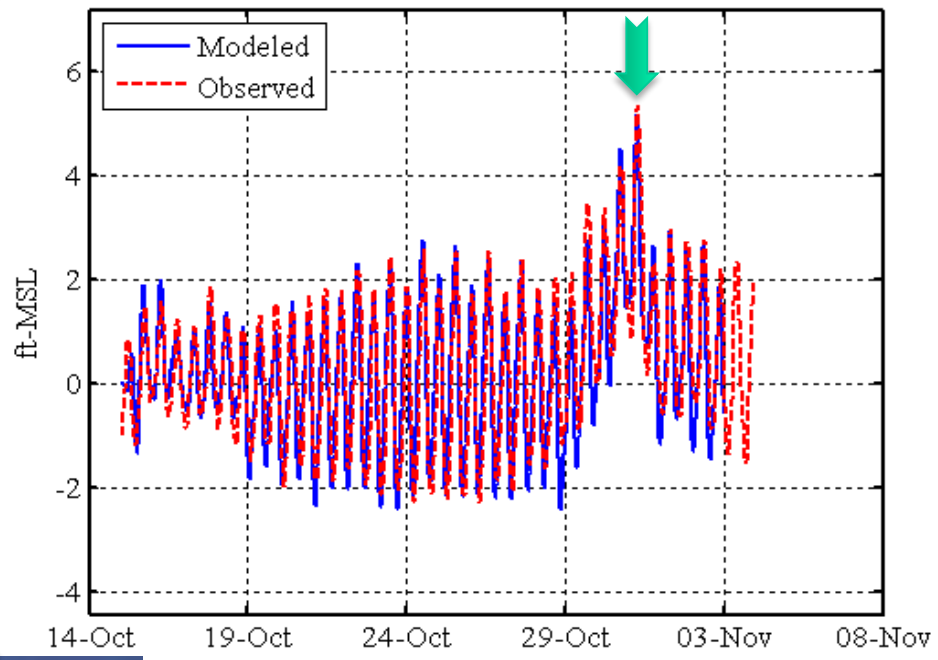
Model Calibration – Blizzard of '78





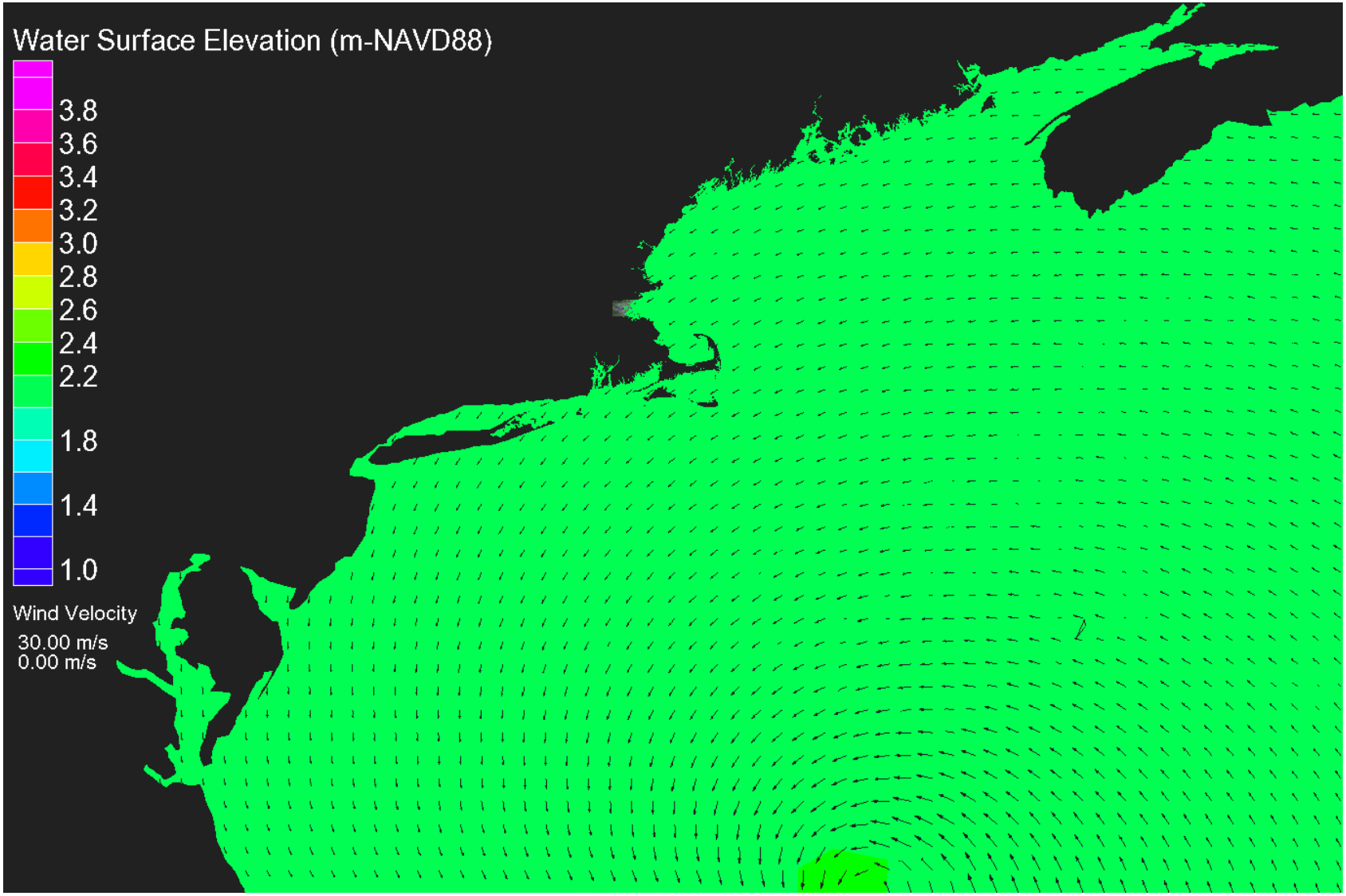
Model Validation – Perfect Storm



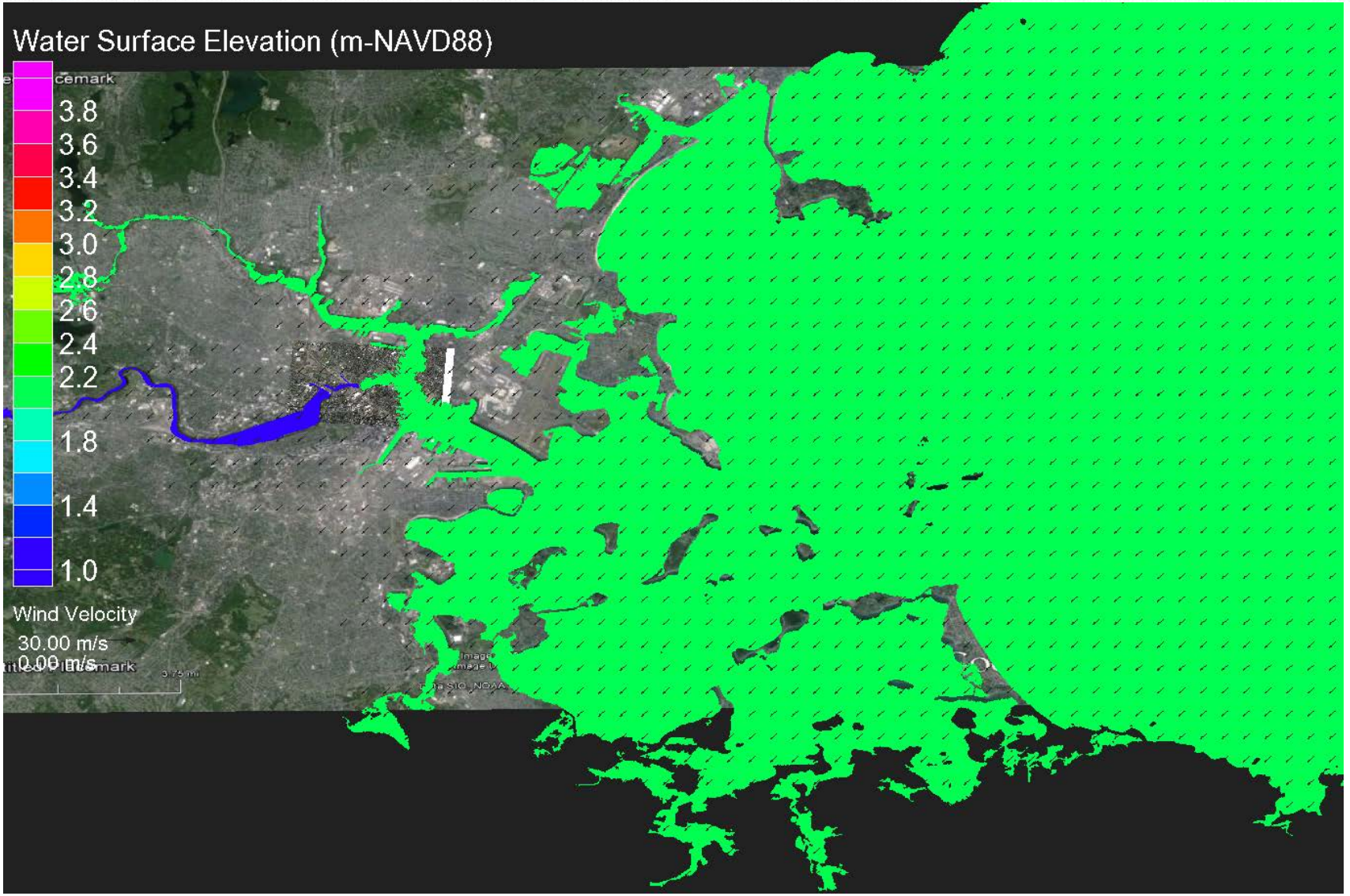


WOODS HOLE GROUP

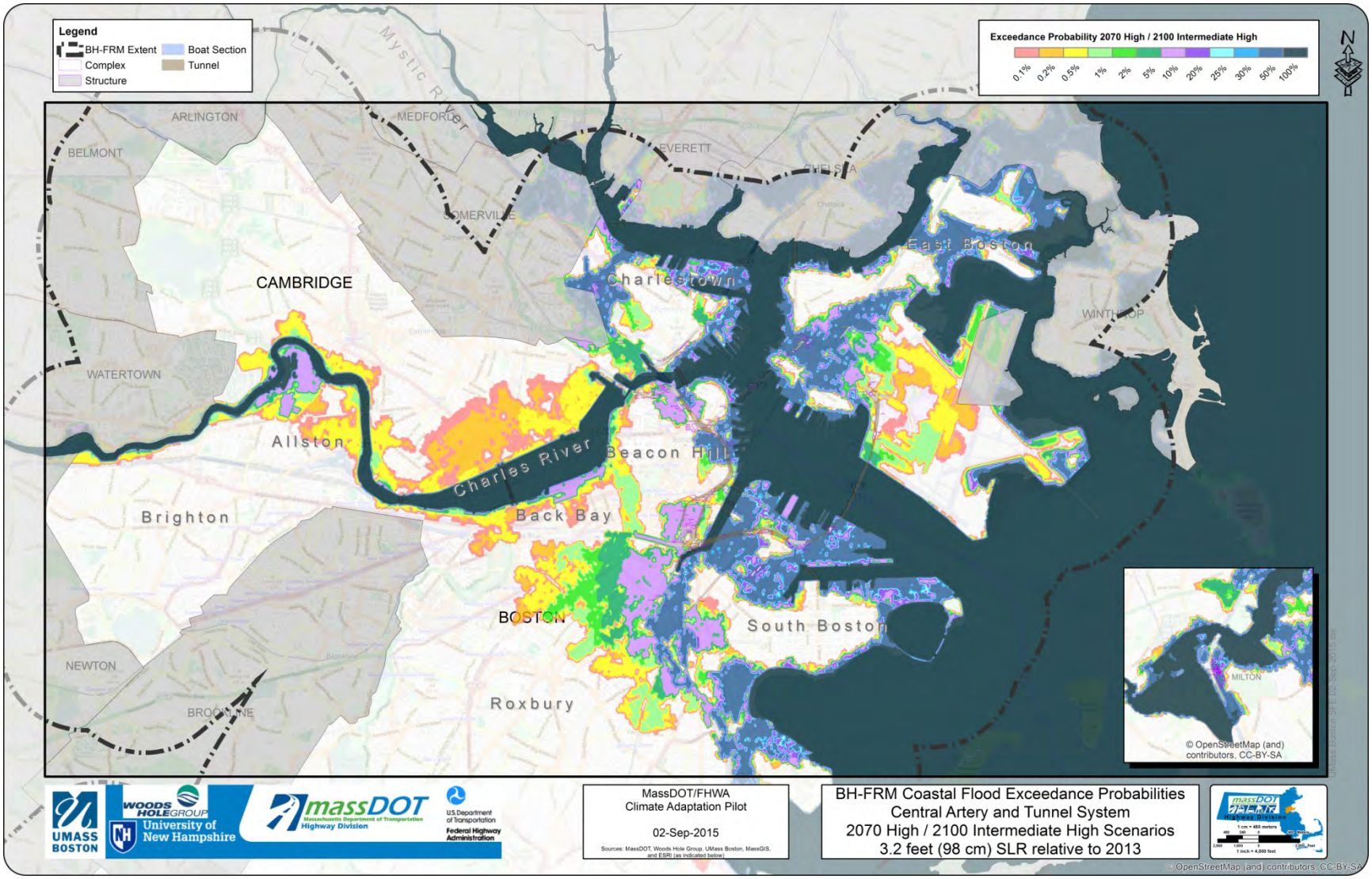
Example Results – Winds



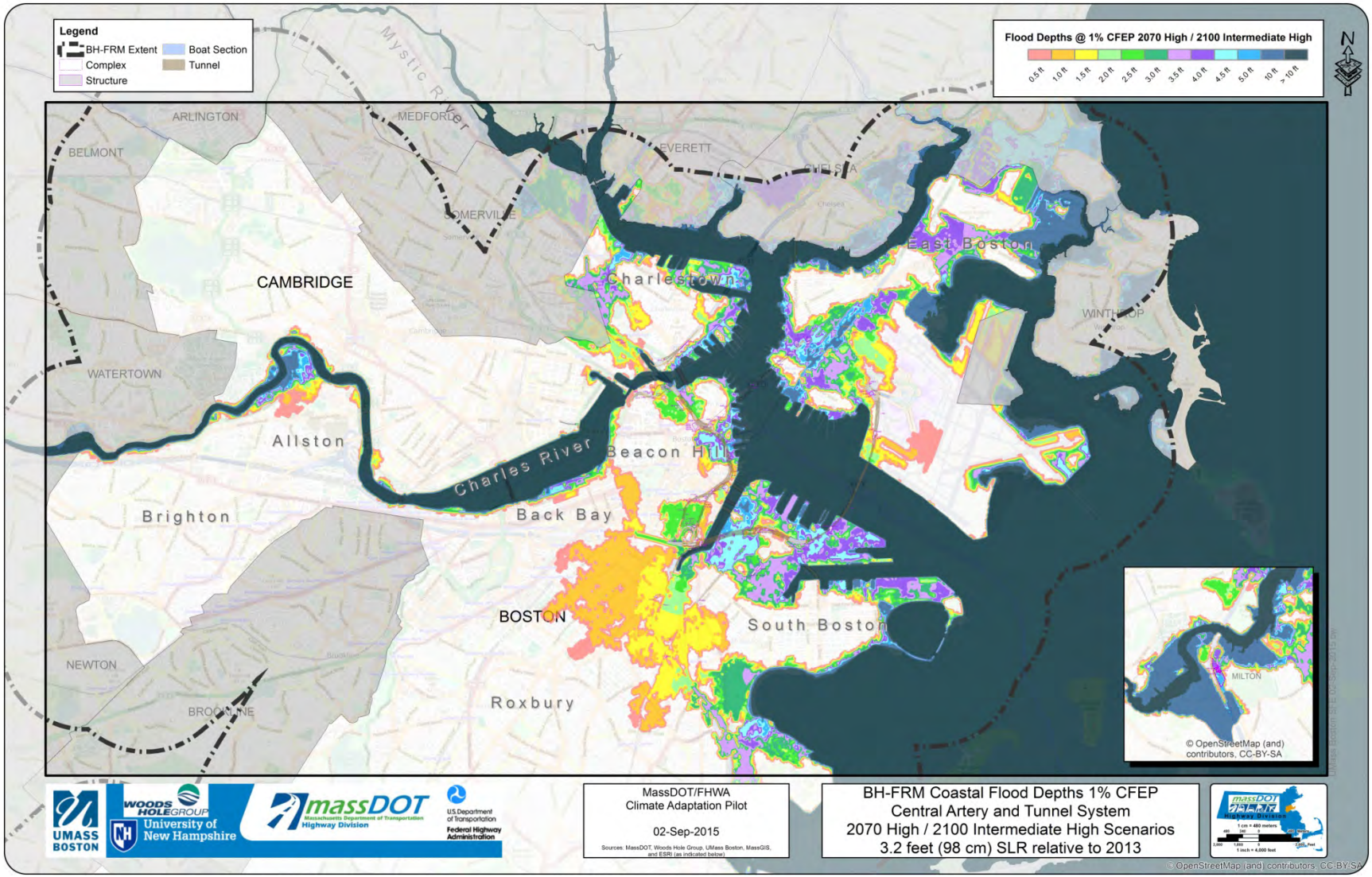
Example Results - Hurricane



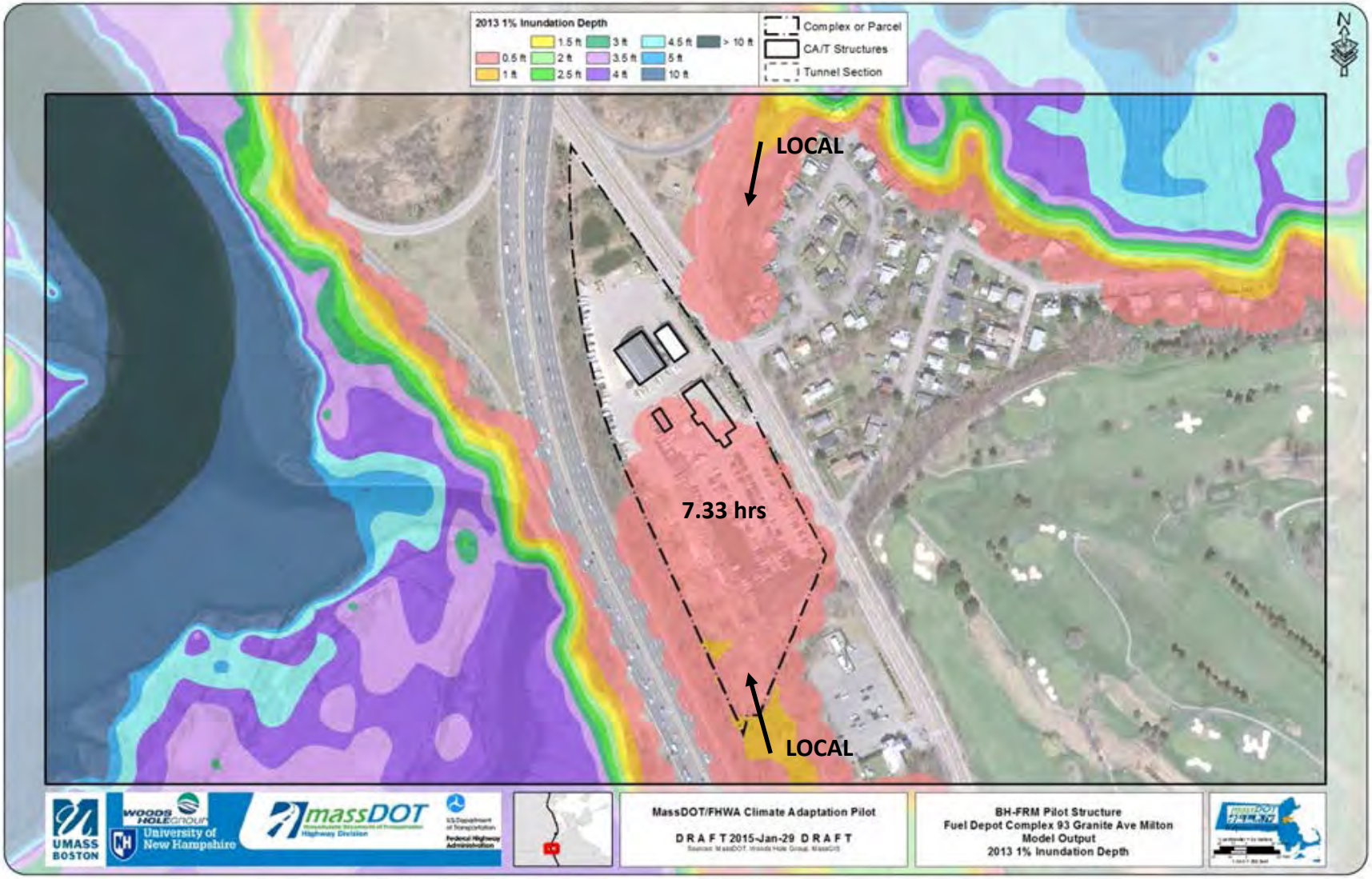
Exceedance Probability Maps



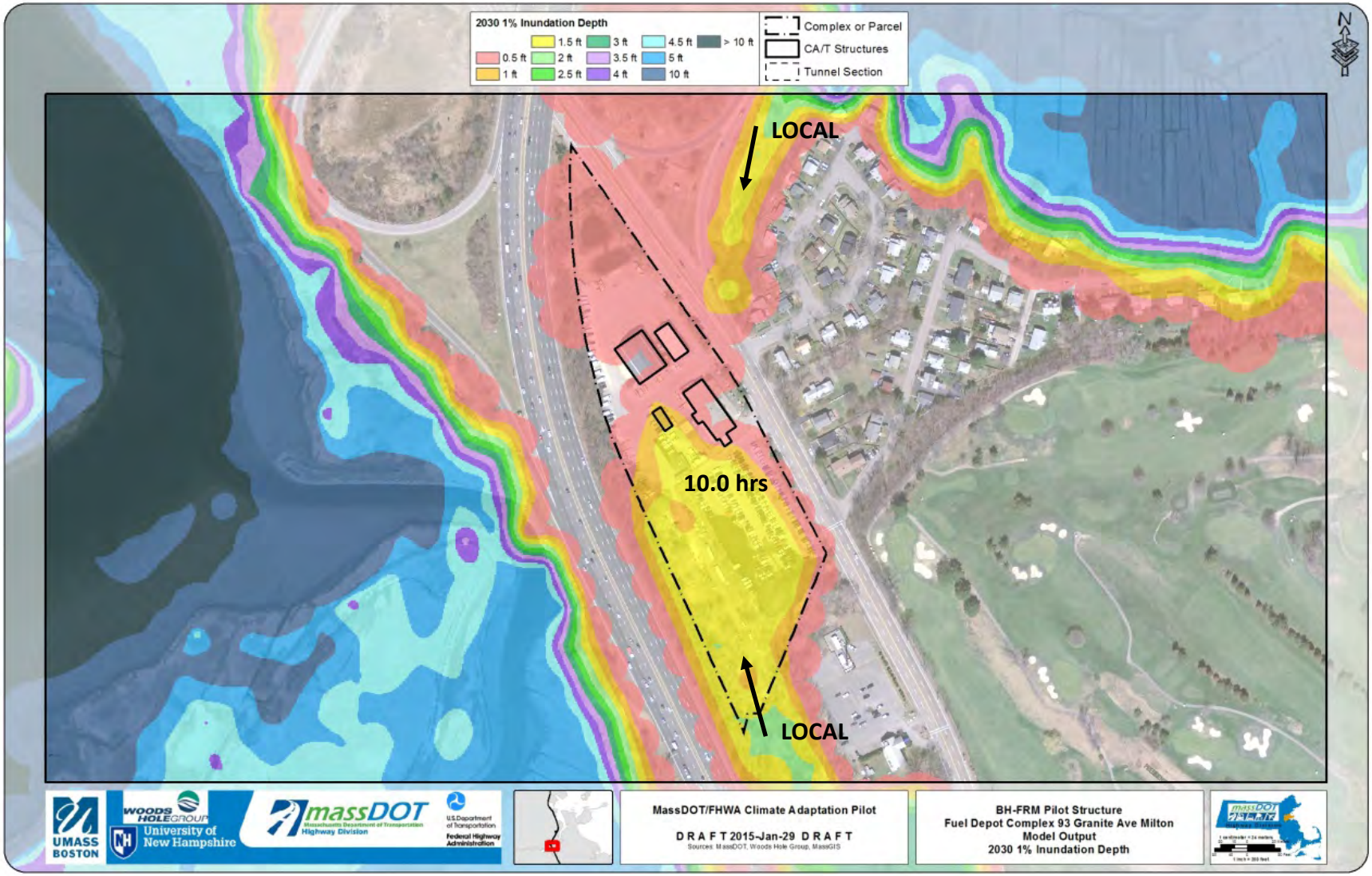
Depth of Inundation Maps



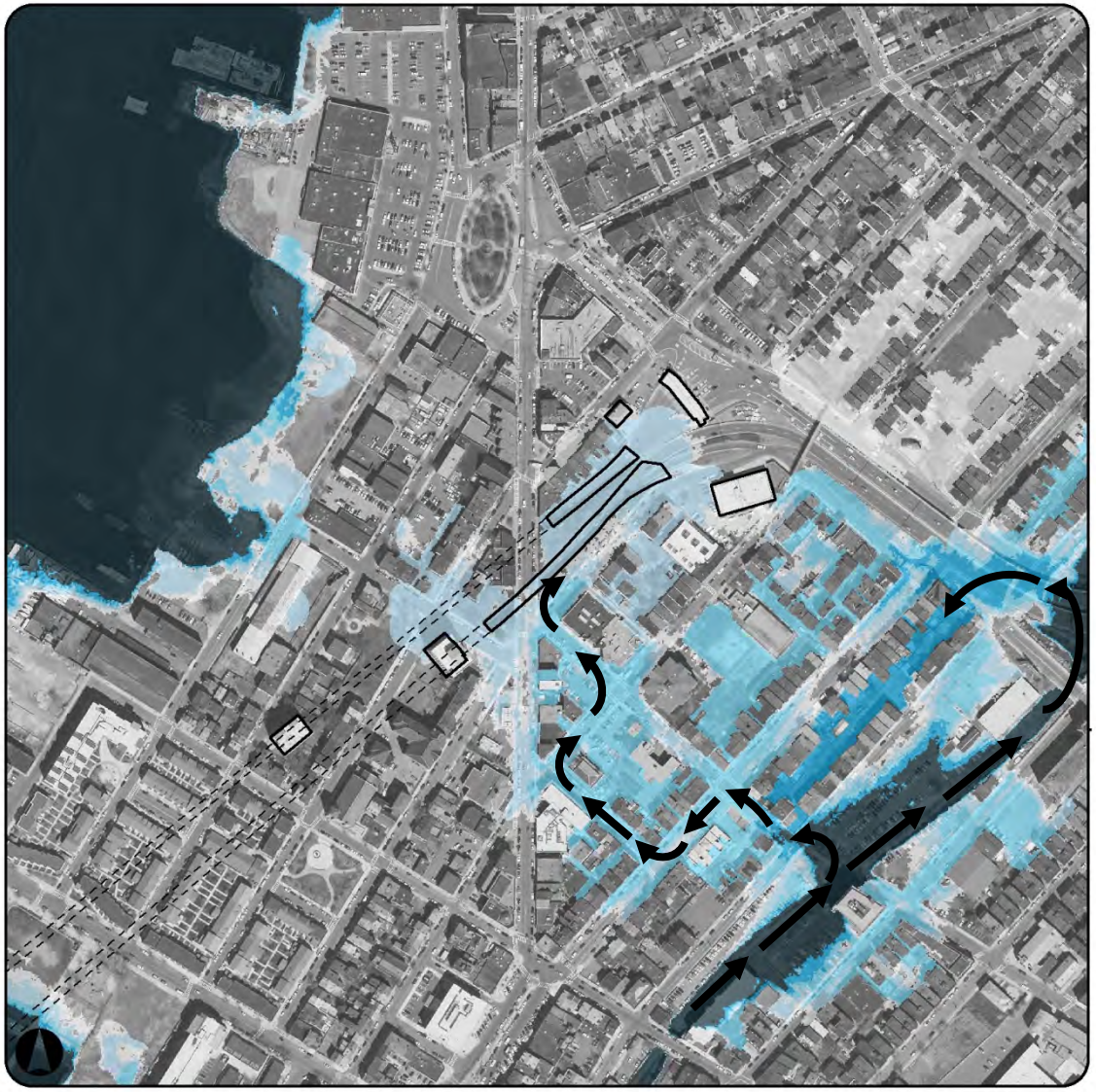
Example Assessment



Example Assessment



Flood Pathways



MassDOT/FHWA Climate Adaptation Pilot
BH-FRM Flood Pathway Analysis

2013 Regional and Local Flood Pathways

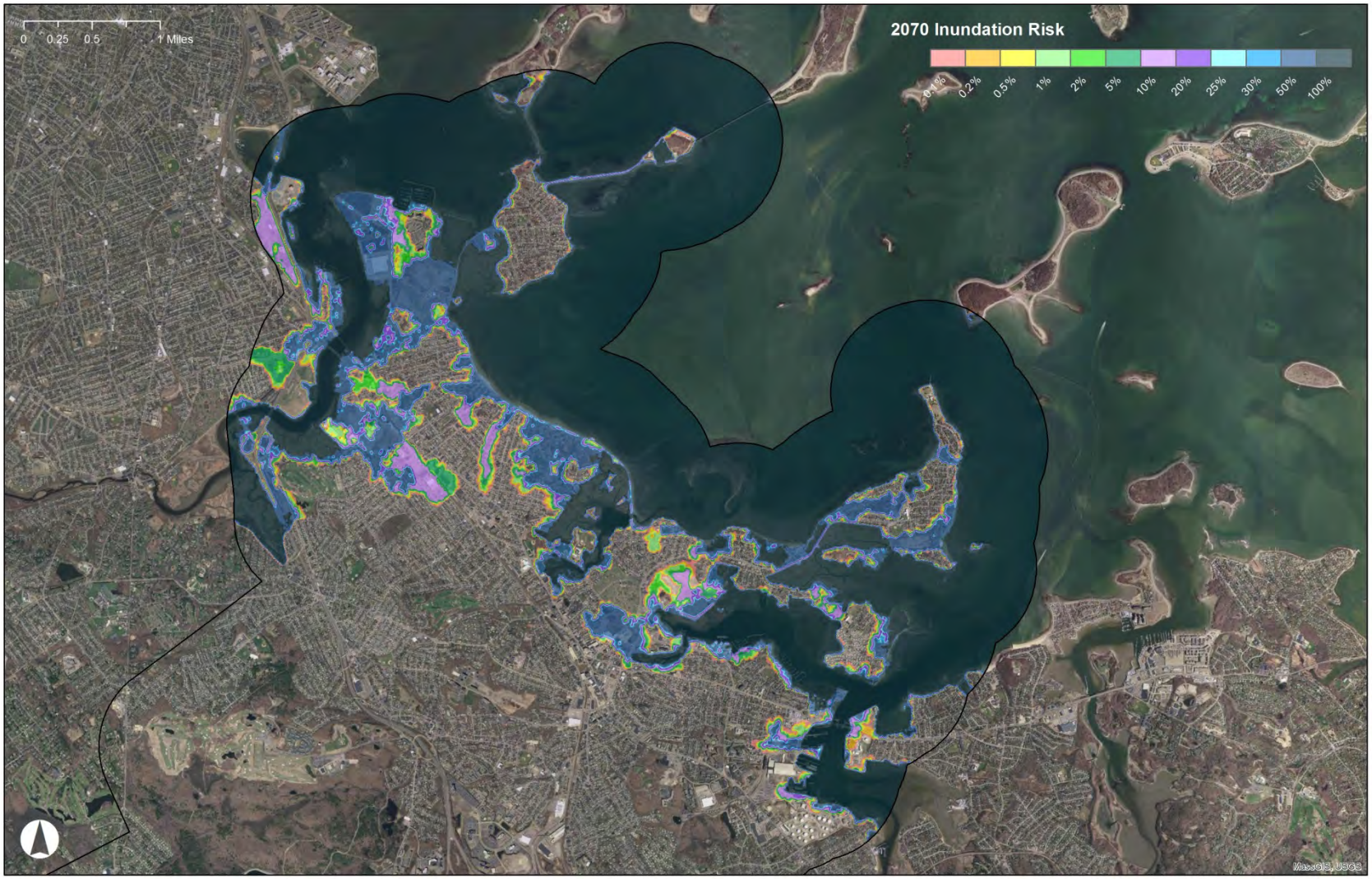
Callahan Tunnel
East Boston, MA

UMASS BOSTON
WOODS HOLE GROUP
University of New Hampshire
massDOT Massachusetts Department of Transportation Highway Division
U.S. Department of Transportation Federal Highway Administration

CA/T System

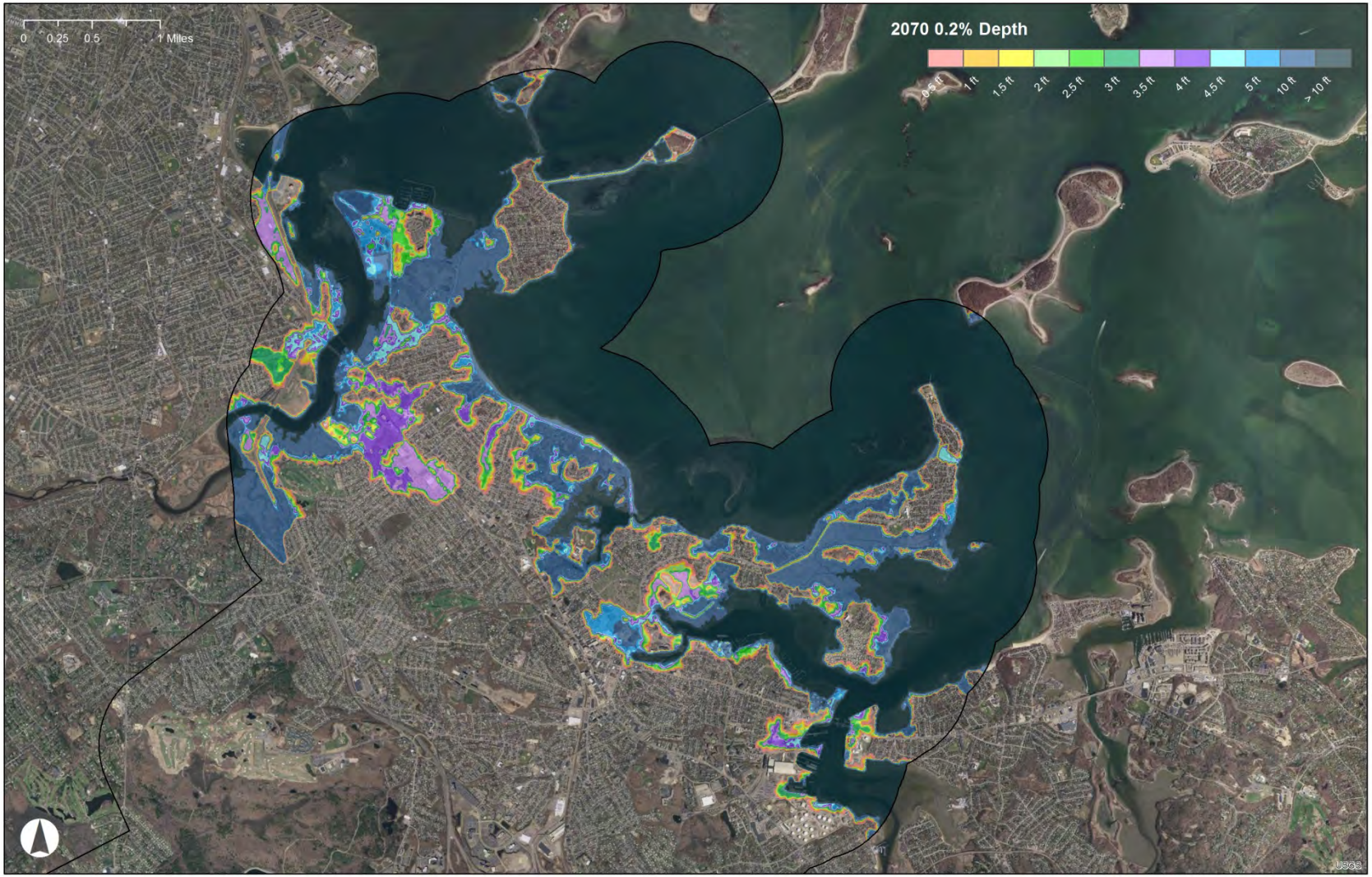
Complex or Parcel | CA/T Structures | Tunnel Section

Exceedance Probability Maps



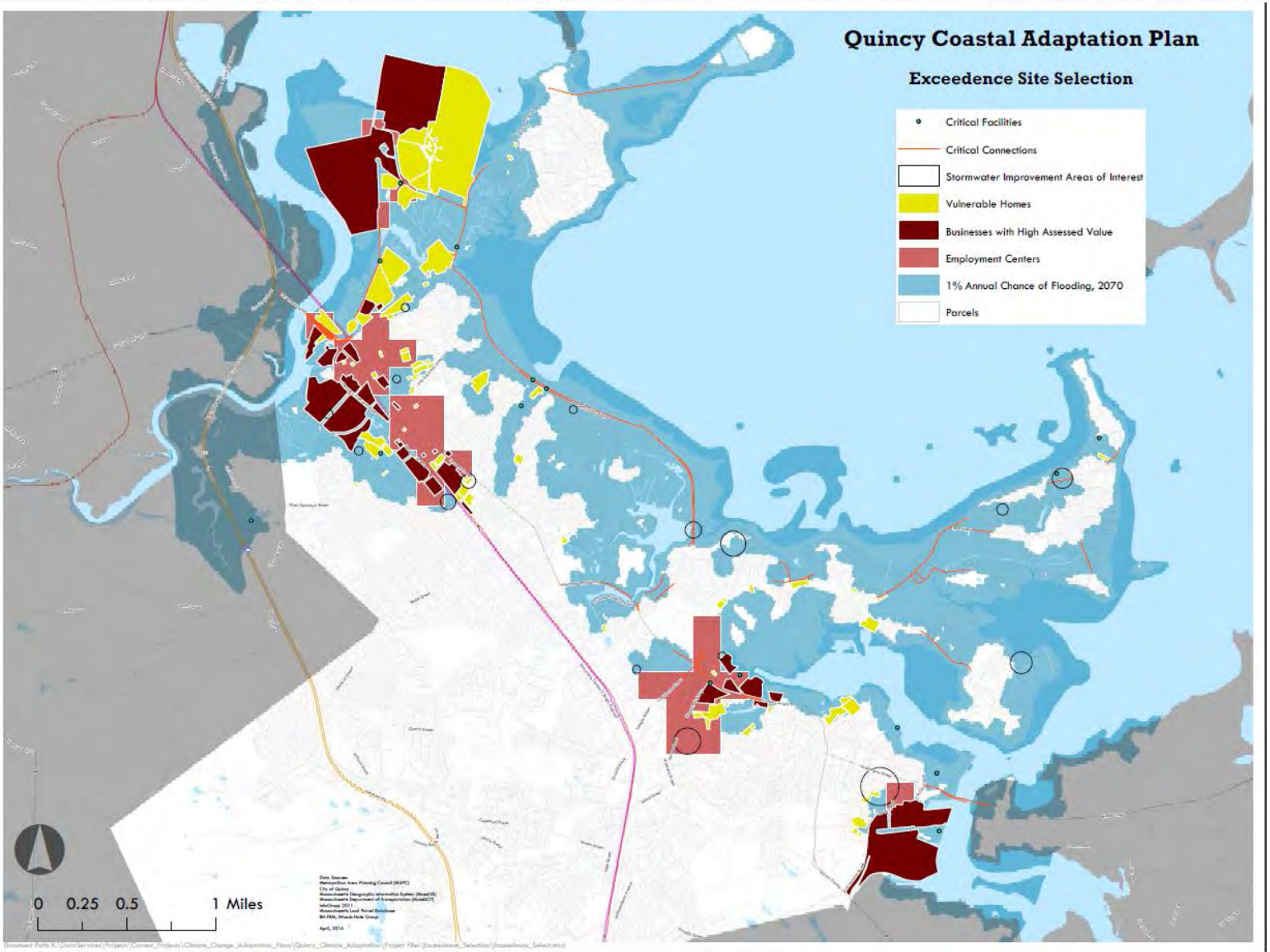
WOODS HOLE GROUP

Depth of Inundation Maps



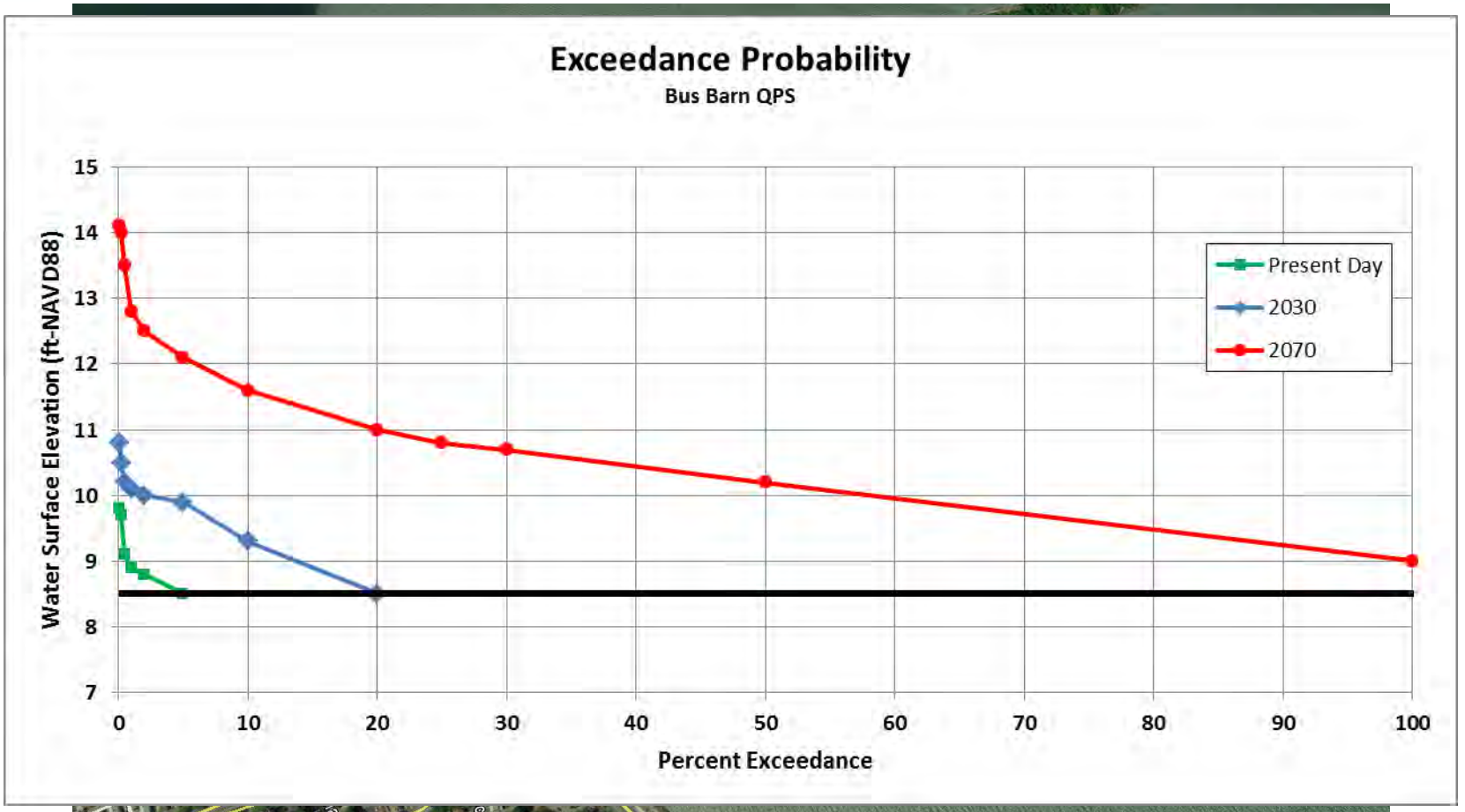
WOODS HOLE GROUP

Local Assessment



WOODS HOLE GROUP

Local Assessment

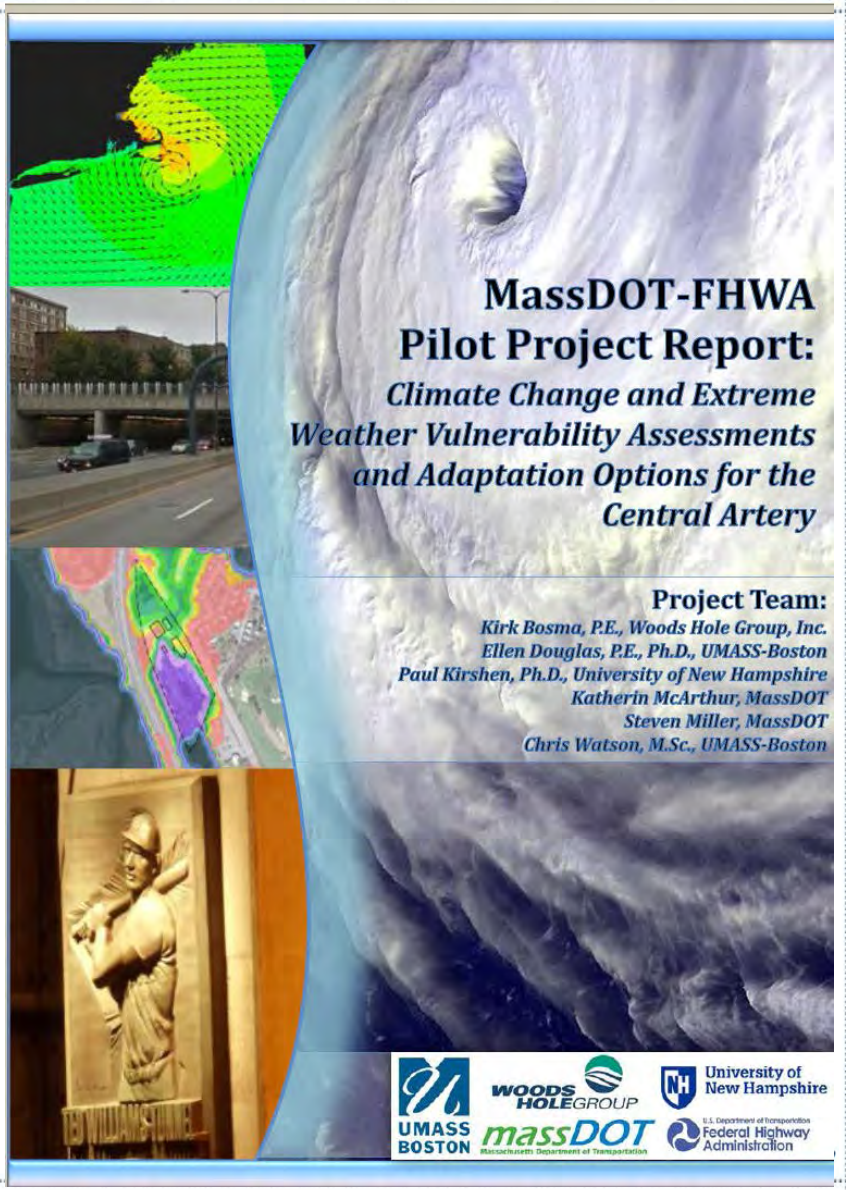


WOODS HOLE GROUP

Summary

https://www.massdot.state.ma.us/highway/Departments/EnvironmentalServices/EMSSustainabilityUnit/Sustainability.aspx

1. The MassDOT BH-FRM model provides high-resolution flooding results for projected climate change scenarios.
2. Peer-reviewed by WHOI, USGS, NOAA, USACE, and USEPA
3. The BH-FRM includes relevant processes, storm types, and joint probabilities.
4. The BH-FRM provides realistic probability based results that can be more effectively used to assess vulnerabilities for planning.
5. The model can be used to test various adaptation and engineering options, connected to ecological, piped infrastructure, and economic models.
6. The BH-FRM is currently being extended to the entire coastline of Massachusetts, with time varying topography.



CITY OF QUINCY
Zoning Board of Appeals
Business Agenda

Pursuant to the provisions of Title 17 of the *Quincy Municipal Code*, the Quincy Zoning Board of Appeals will hold a ***Public Hearing*** on ***Tuesday, April 26, 2016*** at ***7:15pm,*** on the ***First floor,*** in the ***Meeting Room*** of Quincy City Hall, ***1305 Hancock Street***, Quincy, MA 02169, for the purpose of considering the following:

MINUTES OF PREVIOUS HEARING - MOTION –

OLD BUSINESS:

NEW BUSINESS:

16-019 **REDOUANE AKBIL** for a **FINDING** to change the use of the site form a Lawyers Office to a Glass Repair Company on the premises numbered **19-21 COPELAND STREET, QUINCY – Continued to 24May16**

16-020 **DANIEL MARCANTONIO** for a **VARIANCE/FINDING** to construct a second floor addition for a bedroom on the premises numbered **46 BIRD STREET, QUINCY - Granted**

16-021 **GARY A. JENNISON, JR.** for a **SPECIAL PERMIT/FLOOD PLAIN/VARIANCE/FINDING** to demolish the existing single family dwelling and construct a new 2.5 story single family dwelling on the premises numbered **125 DORCHESTER STREET, QUINCY - Granted**

16-022 **PAULETTE CHEVALIER** for a **VARIANCE** to attach a 2-story garage to the existing house at the street line on the premises numbered **153 BAYSIDE ROAD, QUINCY – Continued to 24May16**

ROBERT A. STEVENS, URBAN RENEWAL PLANNER, CITY OF QUINCY for a presentation of the **QUINCY CLIMATE PLANNING UPDATE**

ANY OTHER BUSINESS:

City Clerk	Fire Chief	Quincy Neighborhood Housing
Councilors	Braintree Planning Board	Patriot Ledger
Traffic & Parking	Commonwealth of MA	Quincy 2000
Public Works	Dodge Reports	Water/Sewer Department
Mayor	Milton Planning Board	MBTA
City Solicitor	Randolph Planning Board	MDC
Planning Department	Weymouth Planning Board	Engineer

Quincy Conservation Commission Meeting

AGENDA

May 4, 2016

The regular meeting of the Quincy Conservation Commission will be held on Wednesday, May 4, 2016 at 7:30 PM in the Meeting Room, First Floor, 1305 Hancock Street, Quincy, MA 02169. The public is invited to attend.

1. Call to Order-Acting Chairman.
2. Motion for addition, correction, and/or acceptance of Minutes of April 6, 2016

Robert A. Stevens, Urban Renewal Planner, City of Quincy.
Presentation for Quincy Climate Planning Update.

Continued Case----1-15 Arlington Street & 22-30 Fayette Street
Notice of Intent filed by**: Rob Simmons.** The proposed redevelopment project is comprised of the construction of a 140-room hotel with associated site improvements, 97 off-street parking spaces, stormwater management, utilities, and landscaping. Work will also include improvements to a portion of Arlington Street, which will consist of 13 new on-street parking spaces and sidewalk improvements.
LAND SUBJECT TO COASTAL STORM FLOWAGE.
Contd. to May 4, 2016

Continued Case----25 Columbia Street
Notice of Intent filed by: **James Sullivan/94 Liberty Street LLC.** The applicant proposes a new 7, 290 Sq. Ft. storage building per plan.
BORDERING LAND SUBJECT TO FLOODING

21 Deerfield Street
Request for Determination of Applicability filed by: **Thomas & Joanna Dalabon**. The applicant proposes to add 8' x 32' porch to the front of existing house per plan.
LAND SUBJECT TO COASTAL STORM FLOWAGE

139 Bayside Road
Request of Determination of Applicability filed by: **Patricia Long.** The applicant proposes to remove existing deck and add 24ft. x 14ft. deck as shown on plan.
LAND SUBJECT TO COASTAL STORM FLOWAGE

88 Lenox Street
Notice of Intent filed by: **Victor Christensen**. The applicant proposes to raze existing dwelling and replace with new dwelling per plan.
BORDERING VEGETATED WETLANDS

125 Dorchester Street
Notice of Intent filed by: **Gary Jennison**. The applicant proposes to raze existing dwelling and construct a new single family dwelling.
LAND SUBJECT TO COASTAL STORM FLOWAGE, COASTAL BANK

Other Business:

Long Island Bridge (Utility Relocation) DEP File # 059-1355
Request for **Certificate of Compliance** filed by: **Para Jayasinghe, City of Boston Public Works Dept. Engineer** for Utility Relocation.

Long Island Bridge (Demolition) DEP File # 059-1354
Request for **Certificate of Compliance** filed by: **Para Jayasinghe, City of Boston Public Works Dept. Engineer** for Demolition of Long Island Bridge.

Plans and Specifications are on file at the Inspectional Service Department located at 55 Sea Street, Quincy, MA 02169 and may be reviewed during regular business hours.

Any items discussed but not listed on the agenda are items not reasonably anticipated as a topic by the chair 48 hours in advance of the meeting.

Sponsored by Mayor Thomas P. Koch and the City of Quincy

Resilient QUINCY:

An important public forum about coastal planning

Saturday, May 14 | 10:00 am - 2:00 pm
Quincy High School, 100 Coddington St, Quincy

HOW CAN QUINCY GET READY FOR EXTREME WEATHER?

YOUR INPUT NEEDED.

How should your neighborhood prepare for extreme weather? What should you expect?

Please join us for the free Resilient Quincy Public Forum to learn about and give you insights into Quincy's Coastal Resiliency Plan.

For more information about the Quincy Coastal Resiliency Plan, please visit http://mapc.ma/QuincyCAP.

LUNCH PROVIDED.
CHILDCARE ON REQUEST.

RSVP

Call or email
Axum Teferra
(617) 933-0759
ateferra@mapc.org

Call MAPC: (617) 933-0700
Accomodations cannot be guaranteed without adequate notice.

Photo credit: Jeff Walls

MAPC METROPOLITAN AREA PLANNING COUNCIL

MASSACHUSETTS OFFICE OF COASTAL ZONE MANAGEMENT

WOODS HOLE GROUP

Amanda Linehan
Communications Manager
Metropolitan Area Planning Council (MAPC)
617-933-0705
alinehan@mapc.org

For Immediate Release: Friday, May 6, 2016

Quincy Hosts Coastal Planning Forum

City, MAPC sponsor community meeting on planning for extreme weather and coastal resilience

Quincy – Do you live in **Quincy**? Are you interested in learning more about how the community can plan for coastal resilience and extreme weather, and how your neighborhood can prepare?

Join the City of Quincy and the Metropolitan Area Planning Council (MAPC) for a public forum on **Saturday**, **May 14** from **10 a.m. to 2 p.m.** at **Quincy High School**, at 100 Coddington Street.

This meeting will be a chance for the public to provide input on issues of climate resilience and planning in the face of extreme weather such as heat and flooding, to help craft **Quincy's Coastal Resiliency Plan.** The interactive workshop-style meeting will feature information on coastal issues, public health, climate changes, and green infrastructure and how it can help. There will be speakers from MAPC and the city, and opportunities for residents to break out into mini sessions with their own neighbors to discuss hyper-local concerns. There are also some special activities planned and chances to win prizes!

A buffet-style lunch will be provided and childcare is available upon request.

For more information about the project, contact Axum Teferra at MAPC at 617-933-0700 or ateferra@mapc.org, or Rob Stevens in the Quincy Department of Planning and Community Development at rstevens@quincyma.gov or 617-376-1411. For more information on MAPC, visit www.mapc.org.

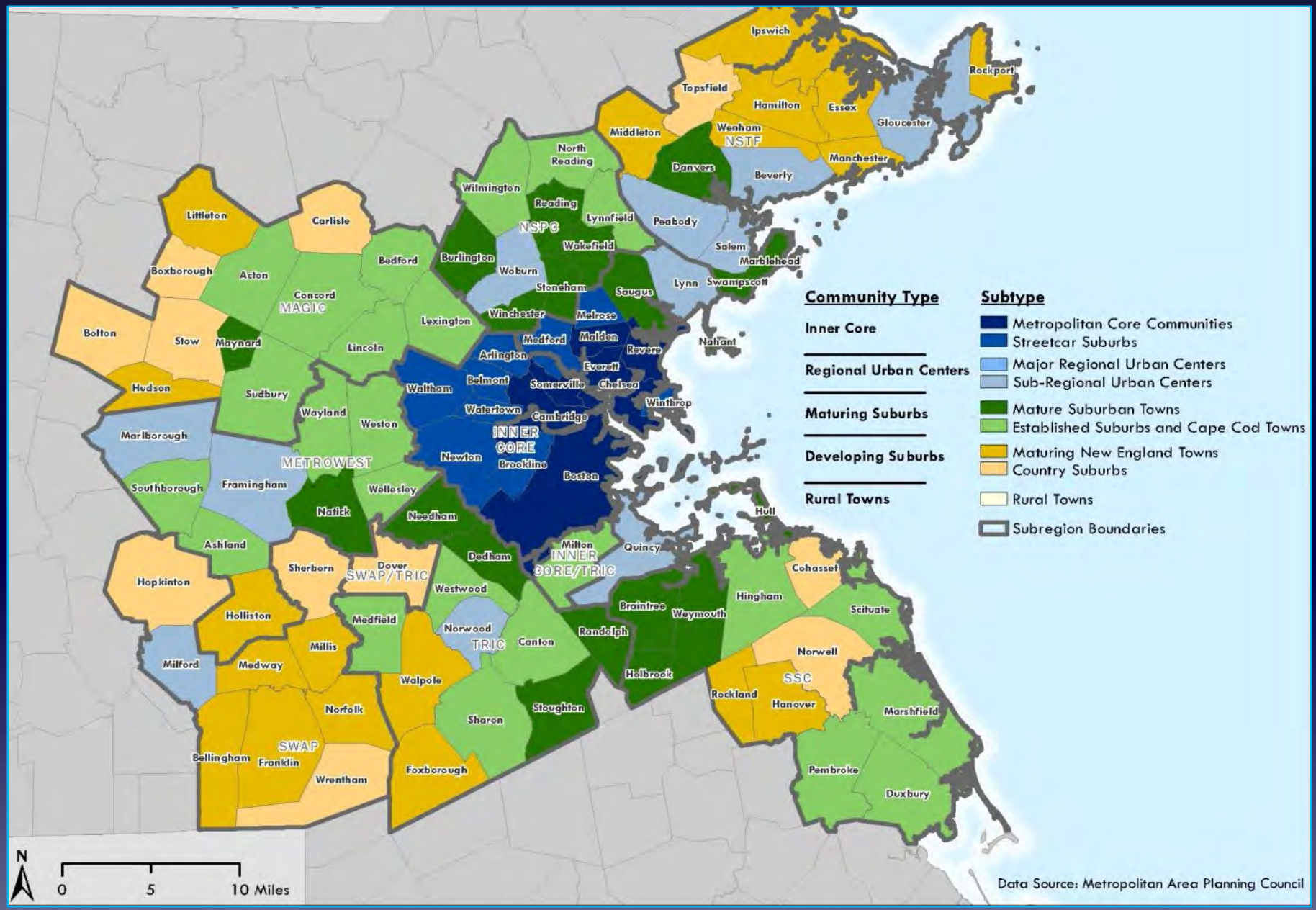
Register online:
events.constantcontact.com/register/event?llr=jqfo5obab&oeidk=a07ecj9z55129e569a0.

This event is sponsored by Mayor Thomas P. Koch and the City of Quincy.

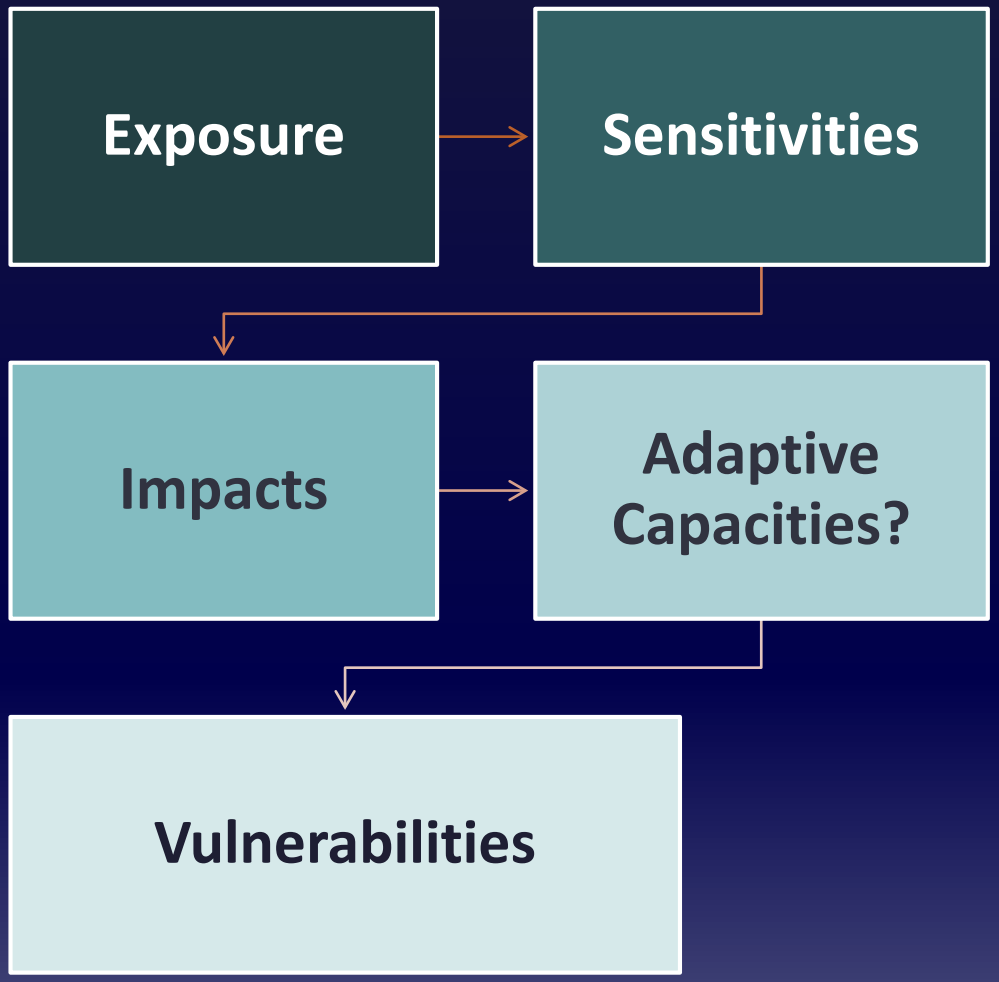
Metropolitan-Boston Climate Change Strategy / Quincy Climate Change Planning

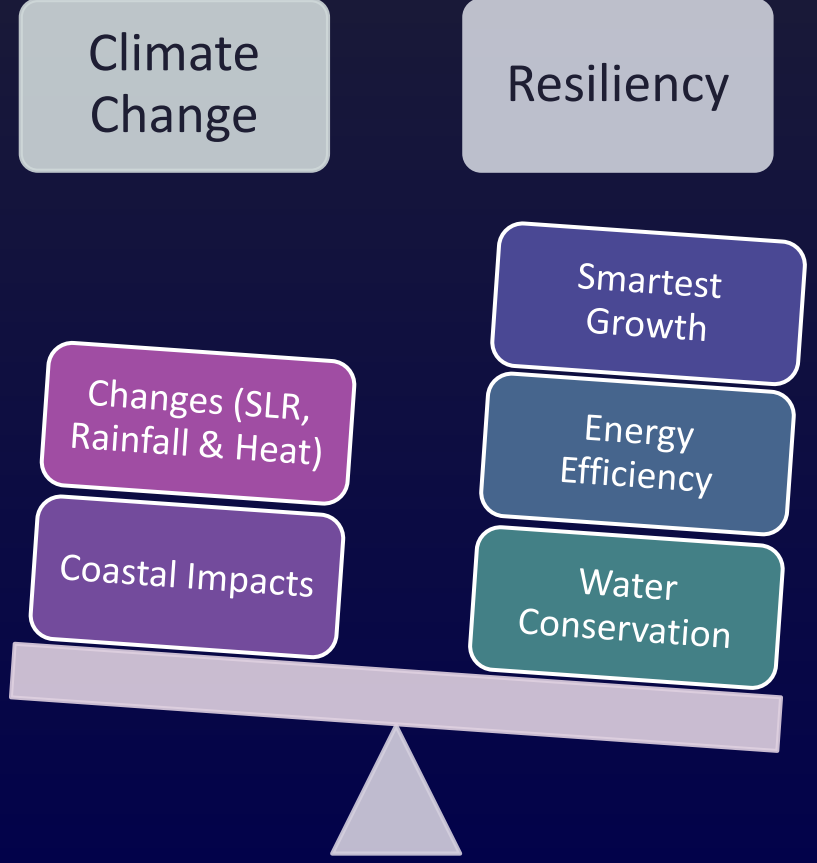
Julie Conroy, AICP, Sr. Environmental Planner; Metropolitan Area Planning Council

MAPC Region


Ipswich
Rockport
Topsfield
Hamilton
Essex
Gloucester
Middleton
Wenham
NSTF
Manchester
North Reading
Danvers
Beverly
Wilmington
Reading
Lynnfield
Peabody
NSPC
Littleton
Carlisle
Wakefield
Salem
Marblehead
Bedford
Burlington
Boxborough
Acton
Woburn
Lynn
Swampscott
Stoneham
Saugus
Concord
MAGIC
Winchester
Melrose
Bolton
Stow
Maynard
Lexington
Medford
Malden
Nahant
Lincoln
Arlington
Revere
Everett
Belmont
Somerville
Chelsea
Hudson
Sudbury
Waltham
Winthrop
Wayland
Watertown
Cambridge
Weston
INNER CORE
Marlborough
Newton
Brookline
METROWEST
Boston
Framingham
Southborough
Wellesley
Natick
Needham
Hull
Ashland
Dedham
Milton
INNER CORE/TRIC
Quincy
Sherborn
Dover
SWAP/TRIC
Cohasset
Hopkinton
Westwood
Hingham
Braintree
Weymouth
Scituate
Holliston
Medfield
Norwood
Randolph
Millis
TRIC
Canton
Norwell
Milford
Medway
Holbrook
SSC
Walpole
Rockland
Hanover
Norfolk
Stoughton
Marshfield
Sharon
SWAP
Bellingham
Franklin
Pembroke
Foxborough
Wrentham
Duxbury
Community Type
Inner Core
Regional Urban Centers
Maturing Suburbs
Developing Suburbs
Rural Towns
Subtype
Metropolitan Core Communities
Streetcar Suburbs
Major Regional Urban Centers
Sub-Regional Urban Centers
Mature Suburban Towns
Established Suburbs and Cape Cod Towns
Maturing New England Towns
Country Suburbs
Rural Towns
Subregion Boundaries
N
0
5
10 Miles
Data Source: Metropolitan Area Planning Council

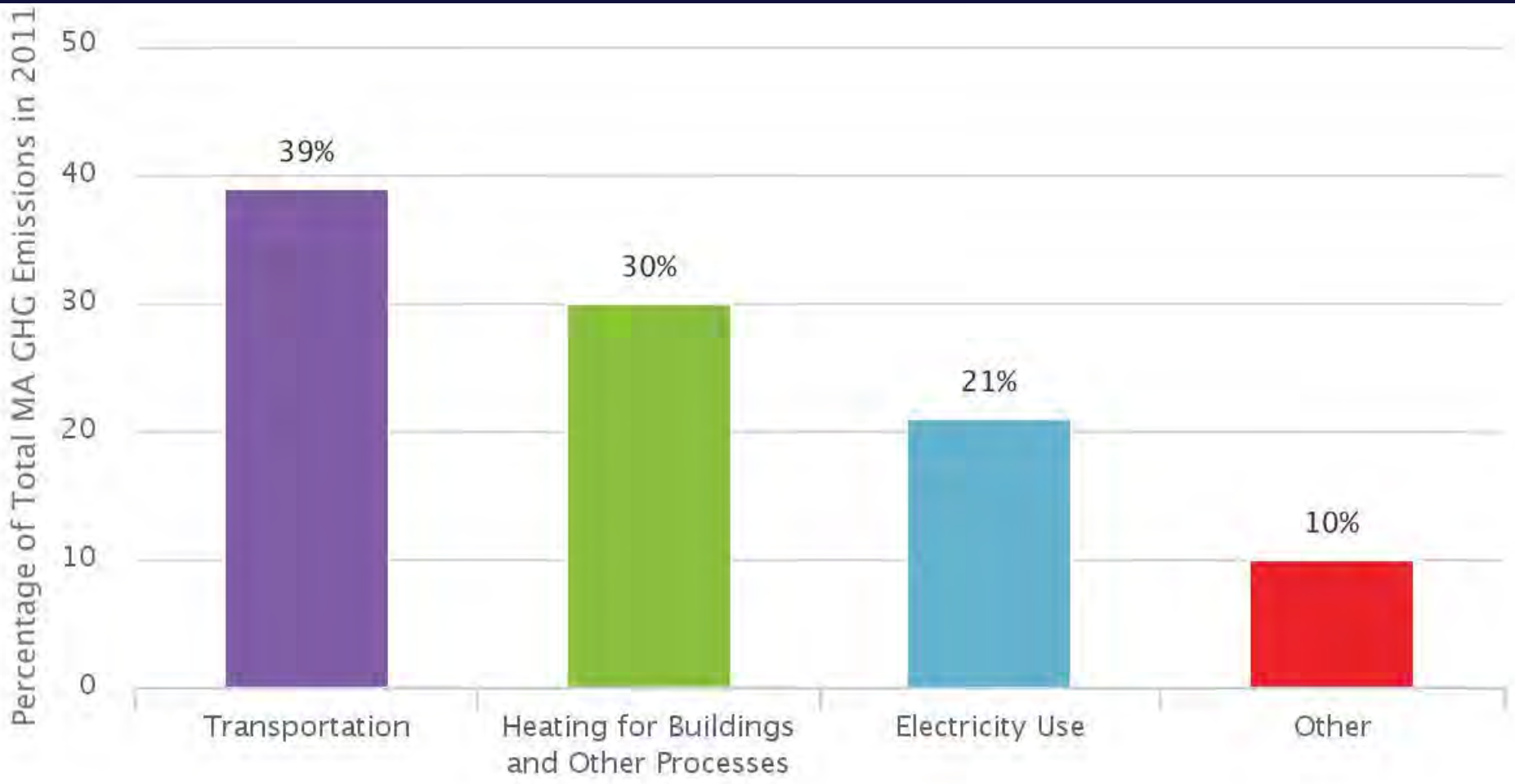
Assessing Vulnerabilities



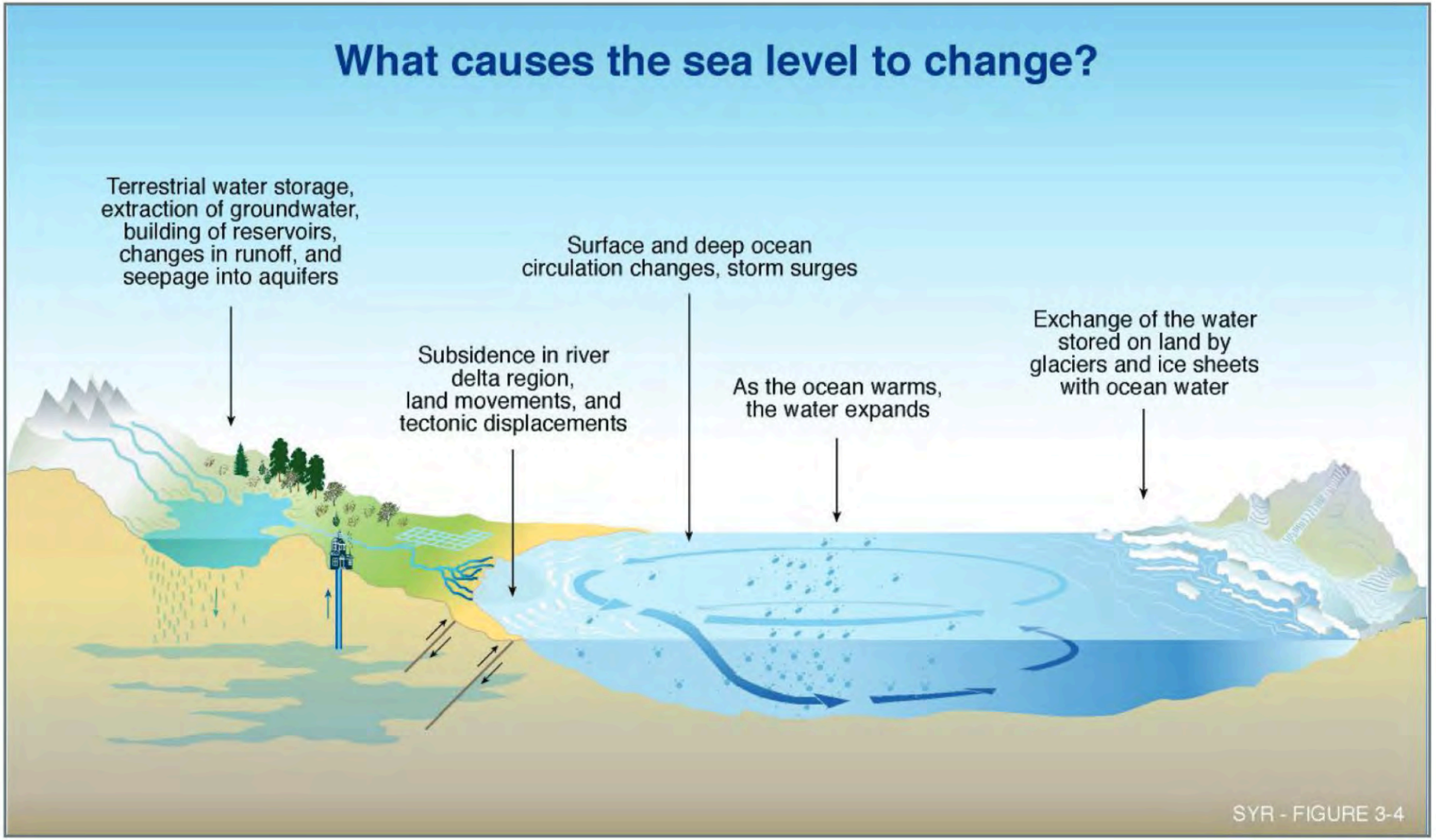


- What's Happening (Impacts)
- What to do (Resiliency)

Massachusetts GhG Sources



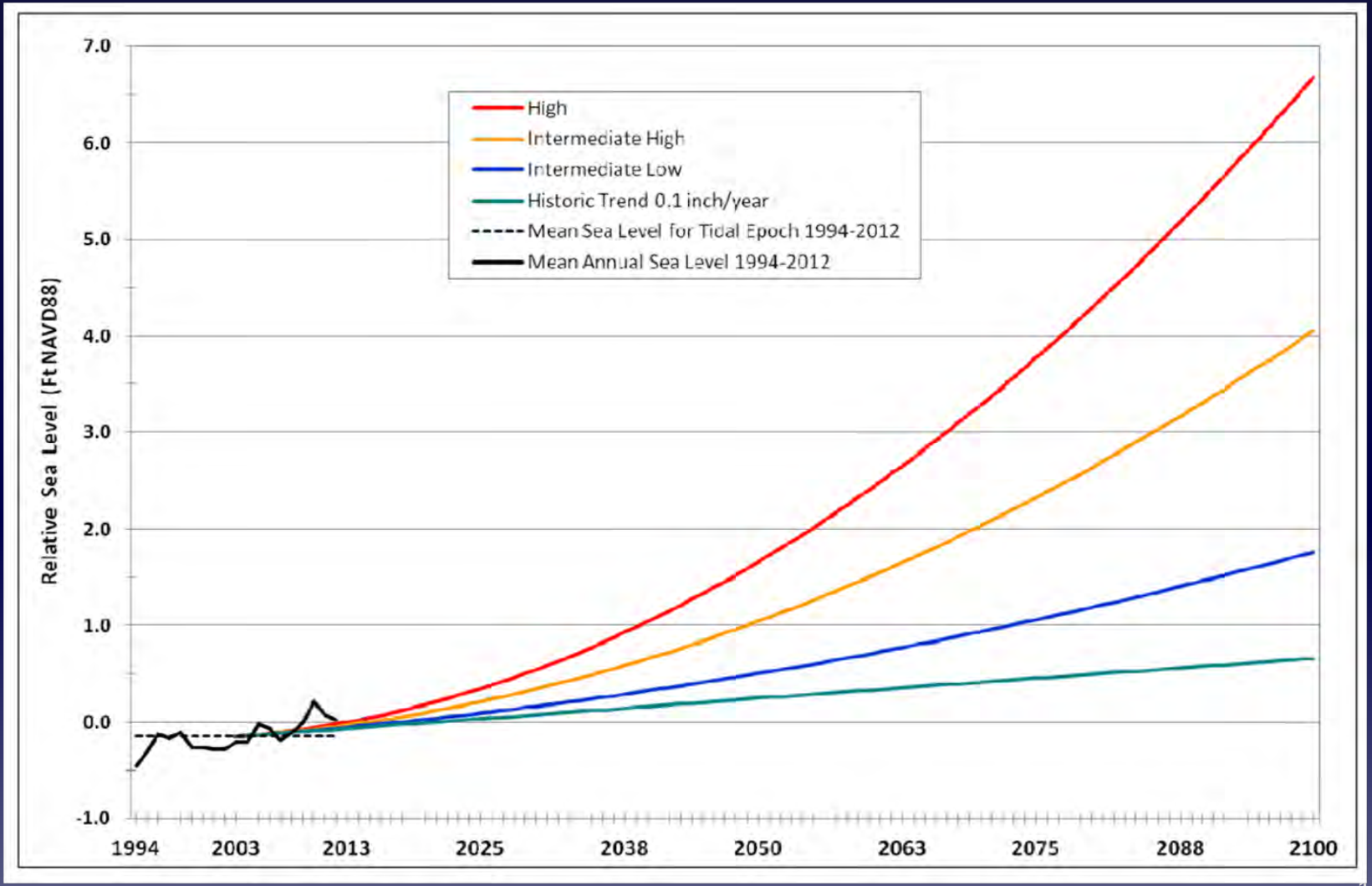
Air/Ocean Warming - Sea Level Rise



Source: IPCC Third Assessment Report, Climate Change 2001 Synthesis Figure 3-4

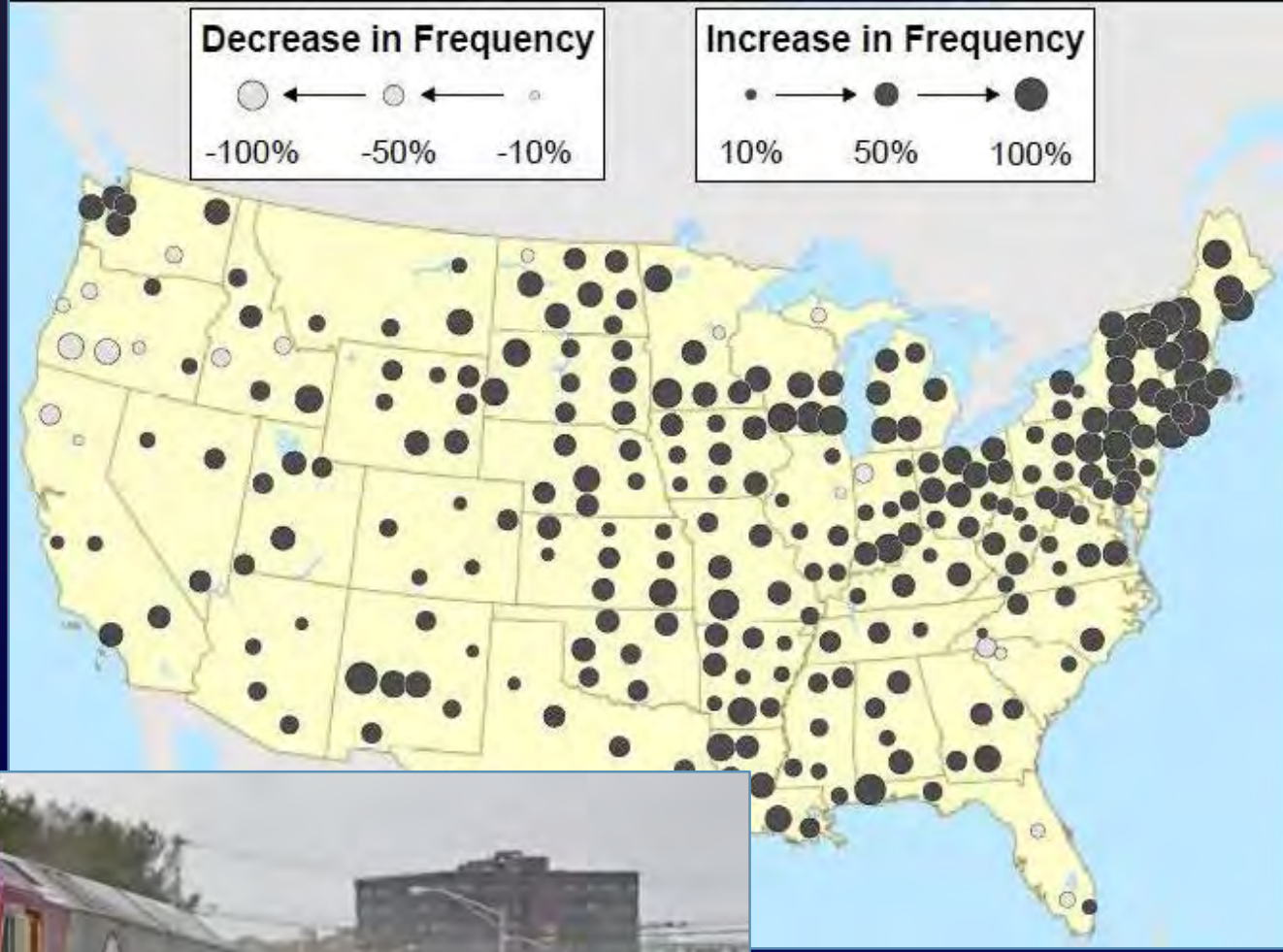
Regional Impacts: Sea Level Rise

Relative Seal Level Rise Projections – Greater Boston Harbor

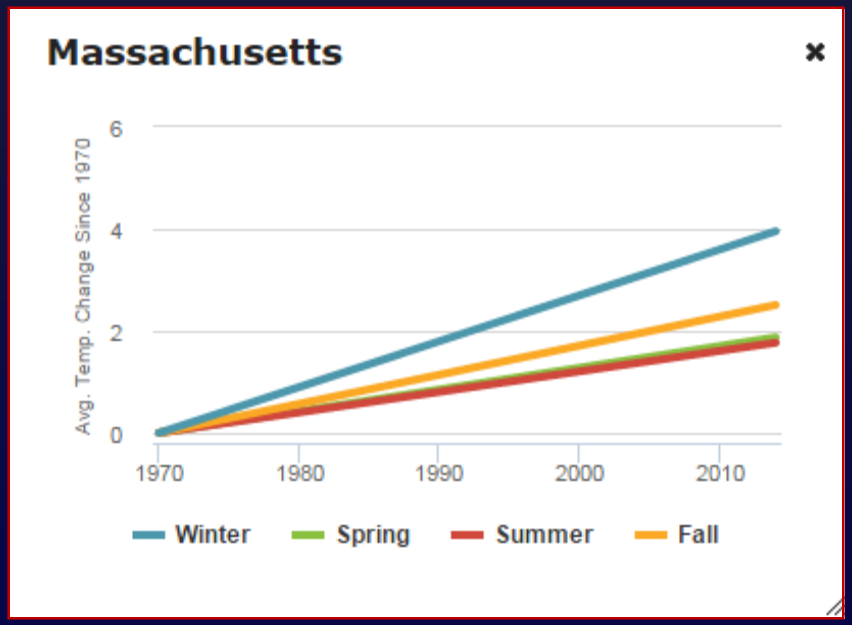


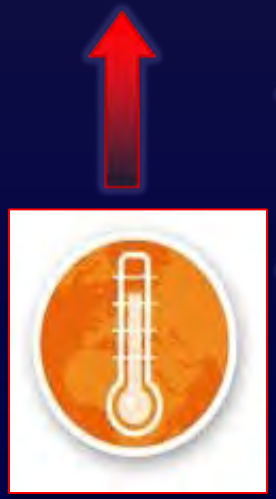
Credit: Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning, Massachusetts Office of Coastal Zone Management, December 2013.

Regional Impacts: More Frequent & Intense Storms



Regional Impacts: Heat/Health





- Heat-related morbidity & mortality
- Vector-borne diseases (Lyme, EEE, West Nile)
- Pollen, Ozone → Asthma

Regional Impacts Summary

Parameter	Current Conditions (1961-1990)	Predicted Range by 2050	Predicted Range by 2100
Annual temperature (°F)	46	50 to 51	51 to 56
Winter temperature (°F)	23	25 to 28	27 to 33
Summer temperature (°F)	68	72 to 73	72 to 78
Annual sea surface temp. (°F)	53	56	61
Annual precipitation (in.)	41	5% to 8%	7% to 14%
Winter precipitation (in.)	8	6% to 16%	12% to 30%
Summer precipitation (in)	11	-1% to -3%	-1% to 0%
Streamflow (spring peak: days following Jan. 1)	85	77 to 80	72 to 74
Droughts lasting 1-3 months (#/30 yrs)	13	18 to 20	16 to 23
Sea-level rise	--	1 to 1.5 feet	2 to 6 feet

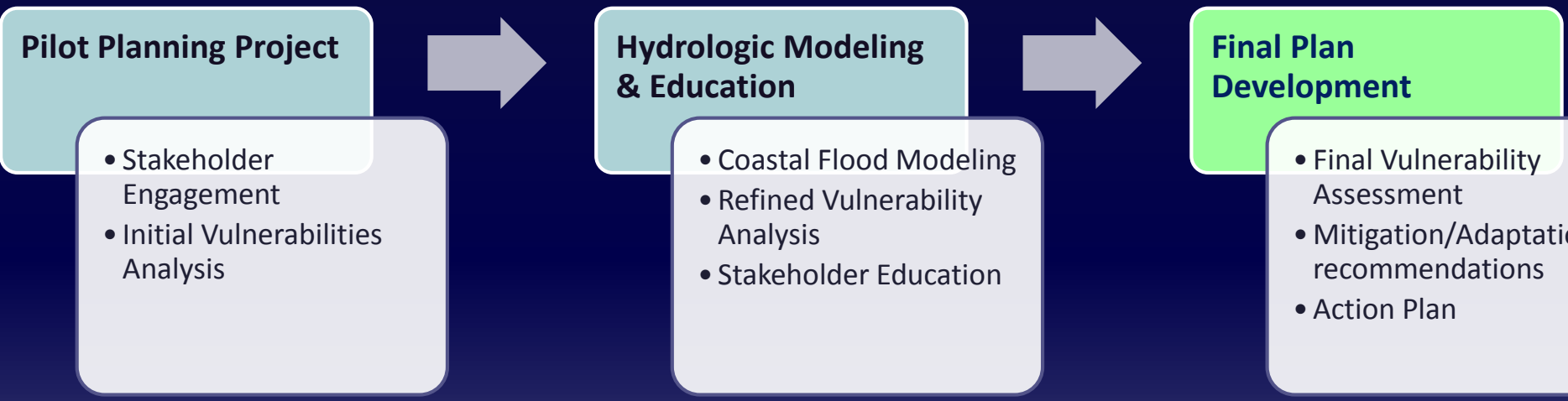
Sources:
MA Climate Change Adaptation Report, Tables 1 and 2
Sea Level Rise: IPCC B1 scenario with CO2 concentration at 550 ppm or above and A1F1 scenario with CO2 at 970 ppm

Regional Climate Change Strategy: Objectives

Sector	Subtopic	Objectives
Built Environment	**Development, Green Infrastructure**	1) New development/redevelopment designed to adapt to climate impacts (heat, precipitation, etc.)
	Development	2) Redevelopment located outside of the highest hazard areas
Natural Resources	**Protection**	3) Natural functions of ecosystems, shorelines and critical habitat areas will be restored
	Management	4) Conserve and manage habitats to support healthy fish, wildlife and plant populations and ecosystem functions
	Restoration	5) Restore ecosystem processes to increase capacity to adapt
Coastal Zone	**Protection**	6) Coastal areas resilient to climate change impacts
Key Infrastructure	**Energy, Water, Transportation**	7) Resilient transportation, water/wastewater, and energy infrastructure
	Roads & Crossings	8) All existing tide and flood control structures assessed for flood control
Local Govt./ Econ.	**Asset Mgmt & Capacity**	9) Local and regional asset management preparation and monitoring
Human Health & Welfare	**Vector Diseases, Vulnerable Populations**	10) A public protected from extreme climate change health impacts, with particular focus on vulnerable populations

Quincy Climate Planning Project

Team: Metropolitan Area Planning Council
City of Quincy Planning Department
Woods Hole Group, Inc.



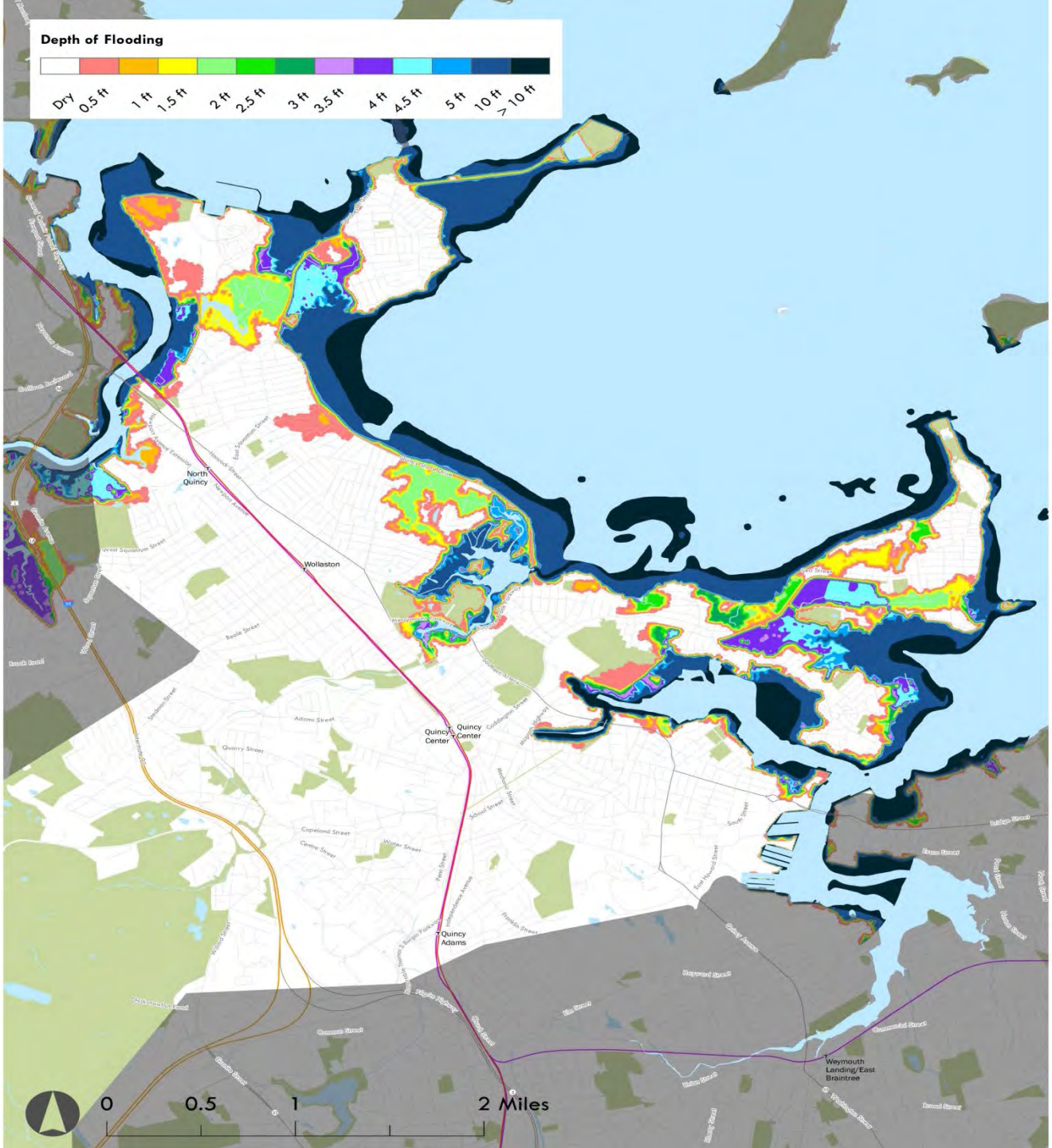
Quincy Project

Engagement

- Community At Large (April 22, 2015 Forum)
- Vulnerable Populations
- Community Leaders
- Municipal Leaders
- Business Community

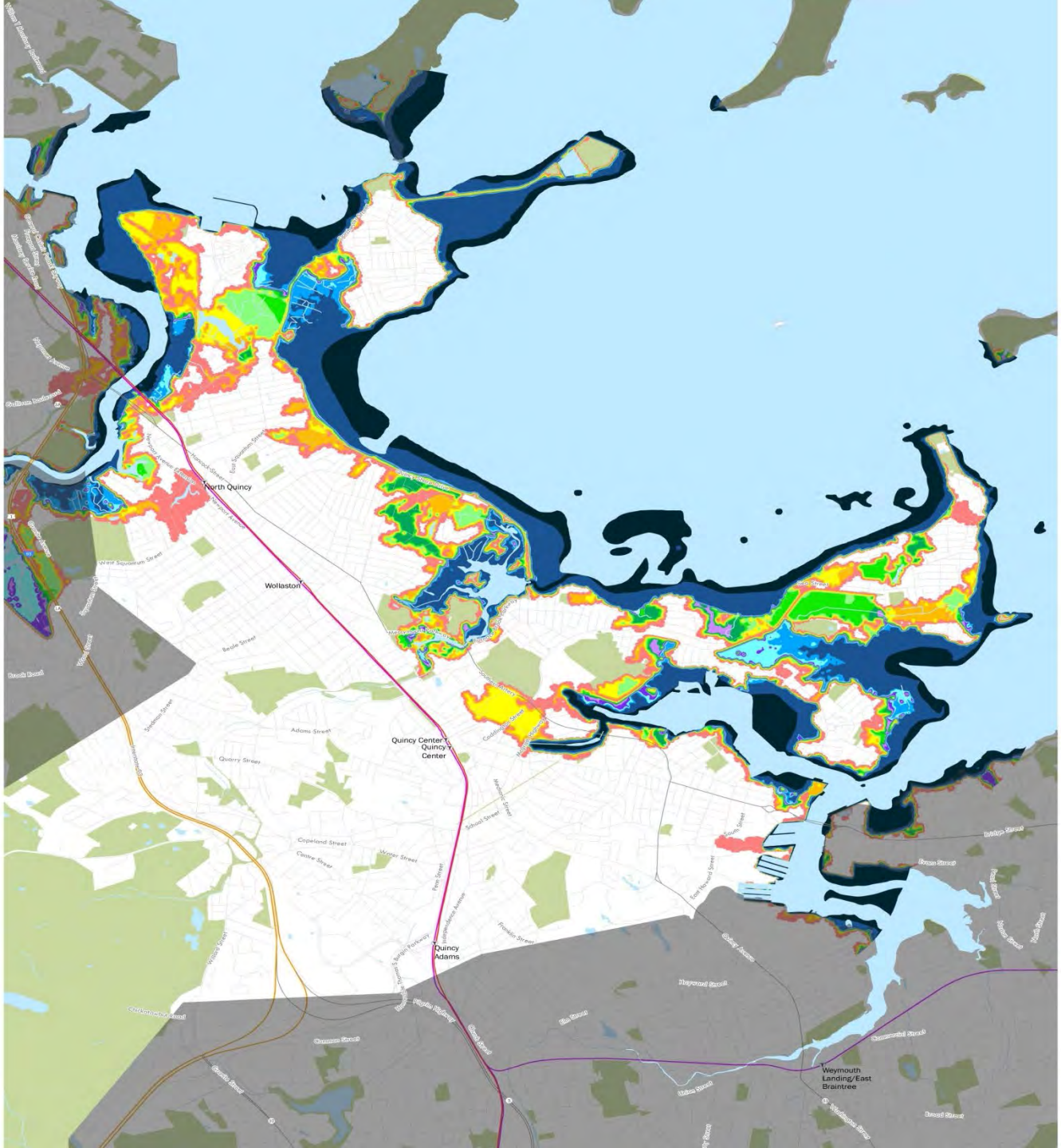
Quincy Project

Coastal Flood Depth - 2013



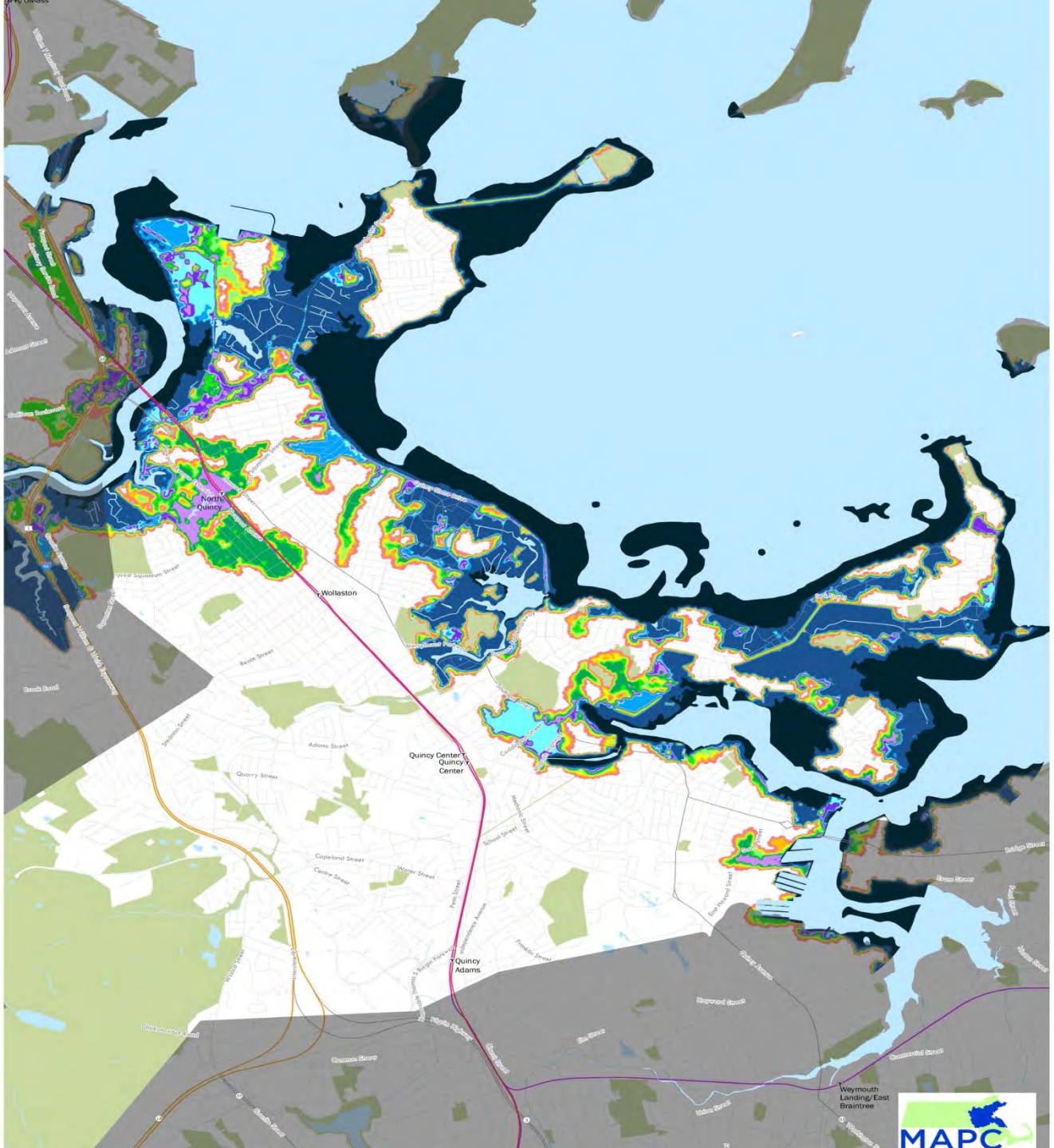
Quincy Project

Coastal Flood Depth - 2030



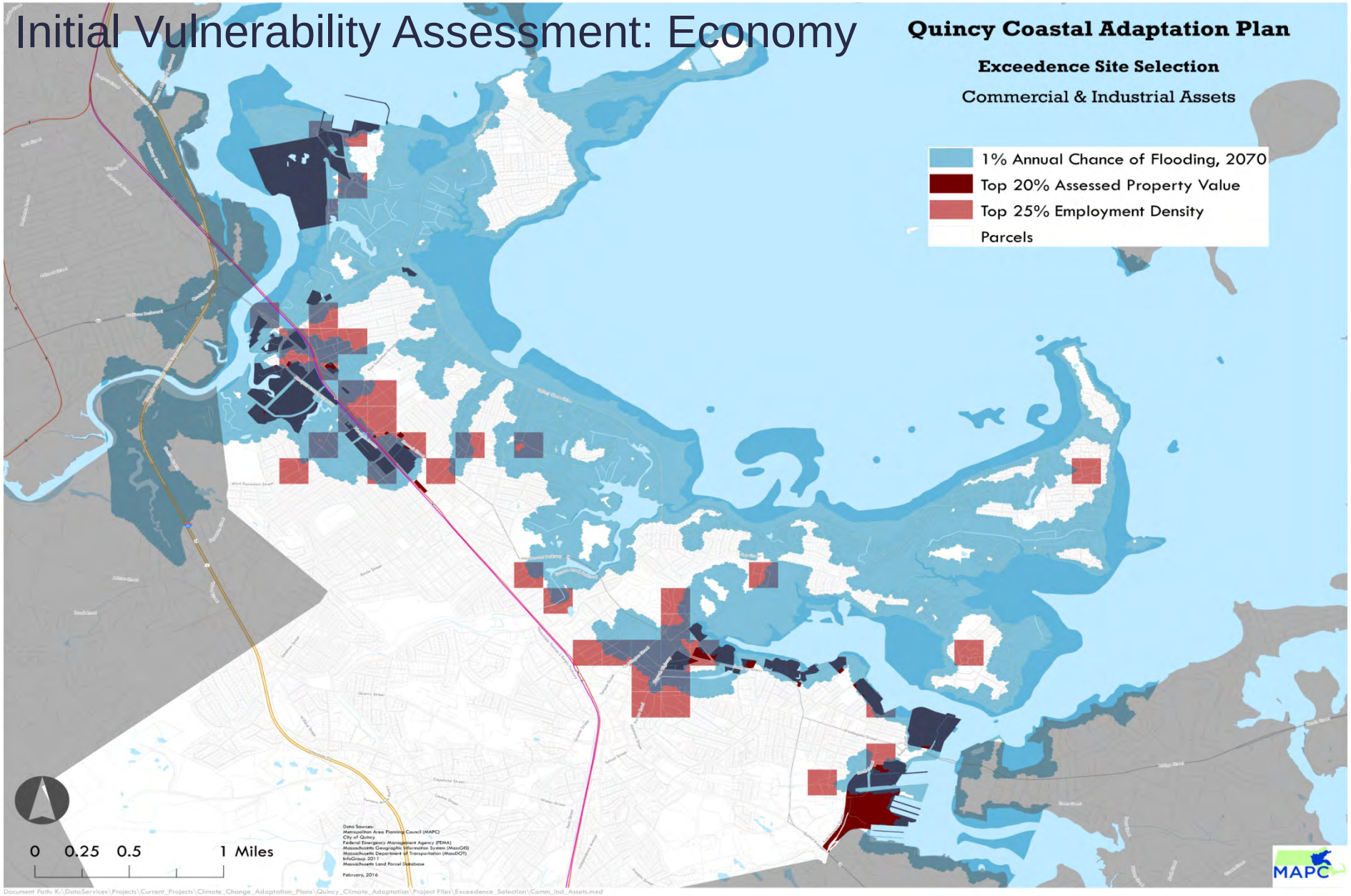
Quincy Project

Coastal Flood Depth - 2070



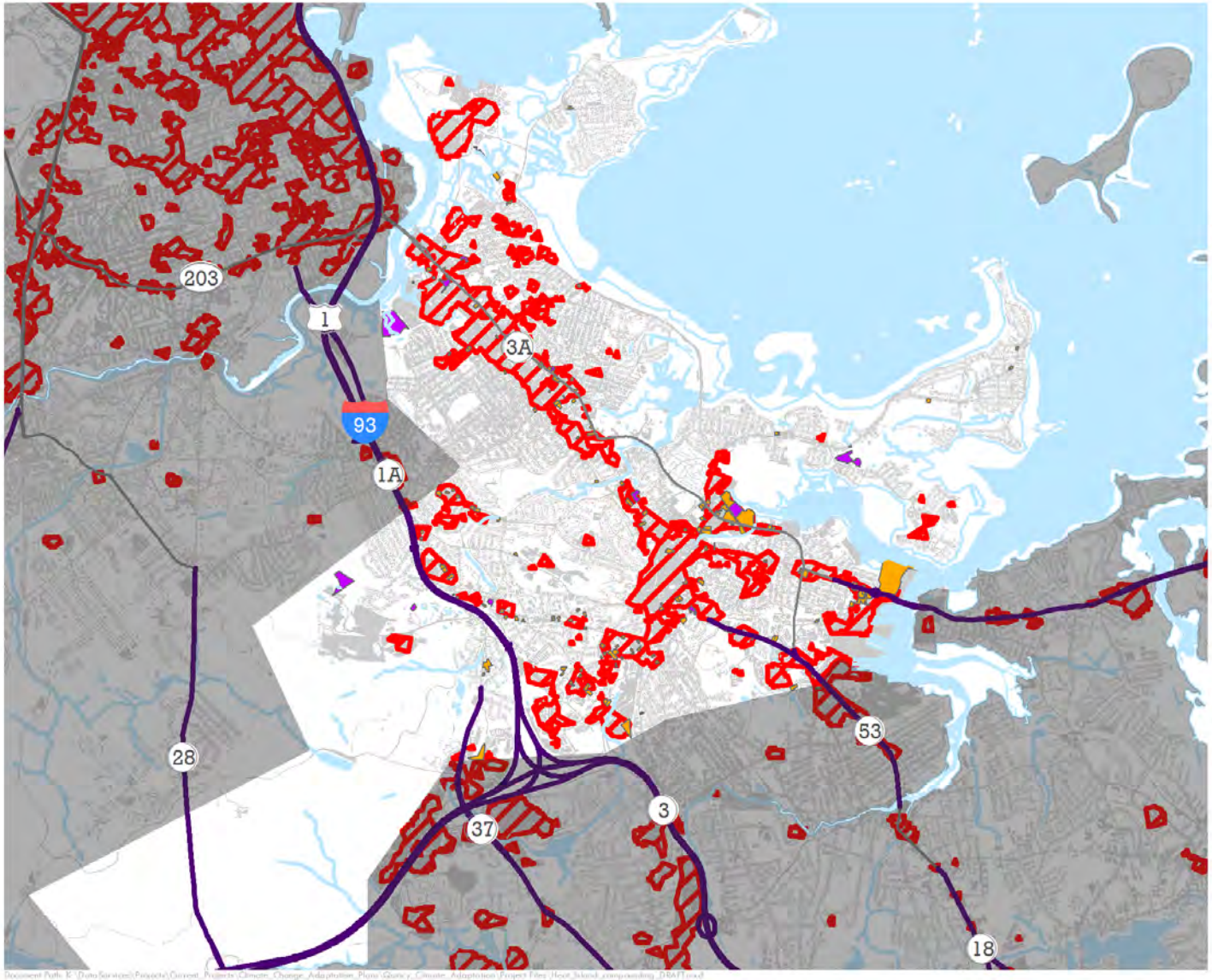
Quincy Project – Economic Impacts

Initial Vulnerability Assessment: Economy



Quincy Project

Initial Vulnerability Assessment: Heat Impacts



Quincy Coastal Adaptation Plan: Urban Heat Island Effect Compounding Factors

- Hot Spots: Highest 5%
- Impervious Surfaces
- Auto Uses
- Infrastrucutre and Utilities
- Truck_Route
- Interstate
- U.S. Highway
- State Route

0 0.5 1 Miles

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

Produced by:
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111 | (617) 933-0700

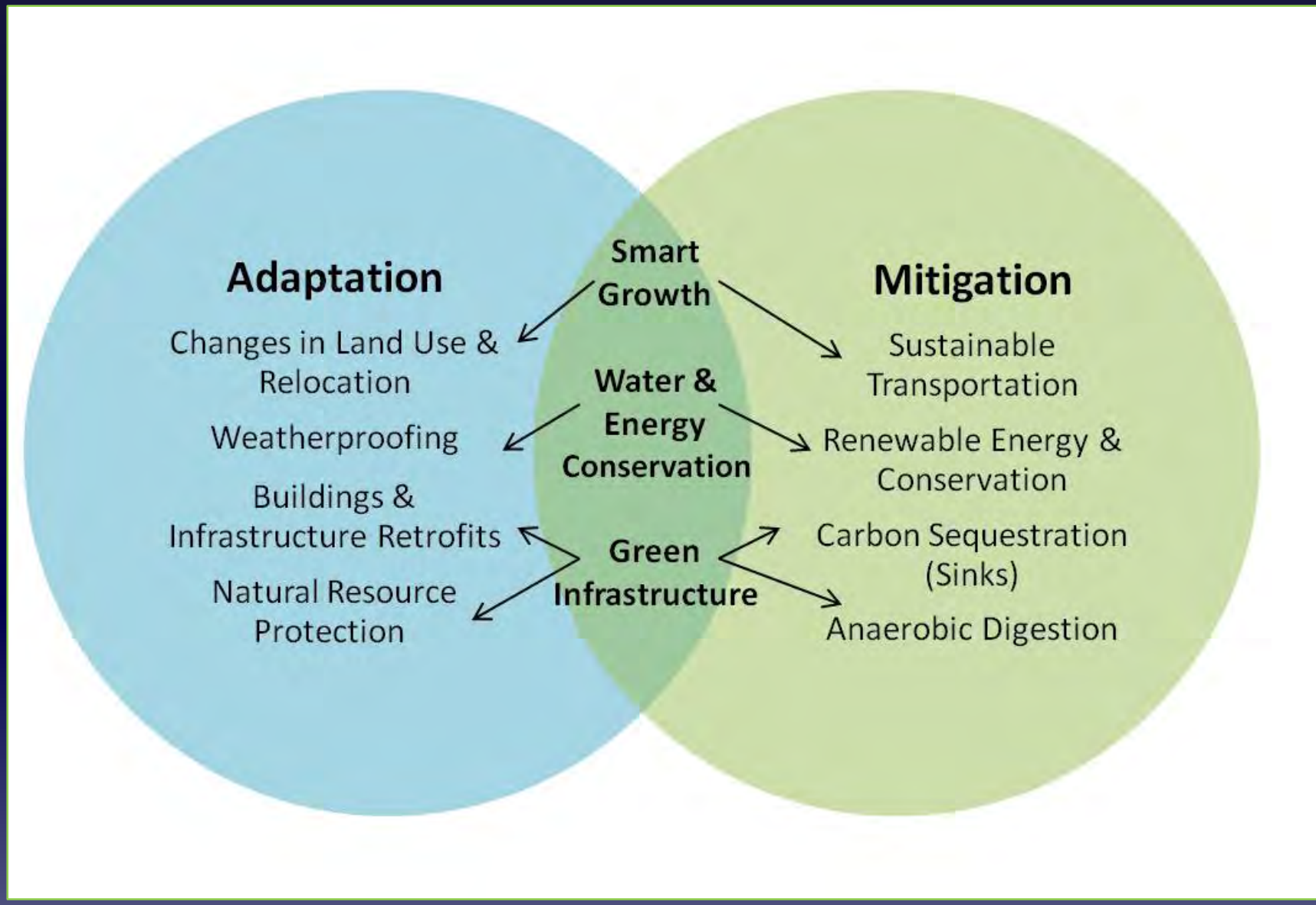
Data Sources:
Metropolitan Area Planning Council (MAPC)
City of Quincy
Federal Emergency Management Agency (FEMA)
Massachusetts Geographic Information System (MassGIS)
Massachusetts Department of Transportation

MAPC

August, 2015

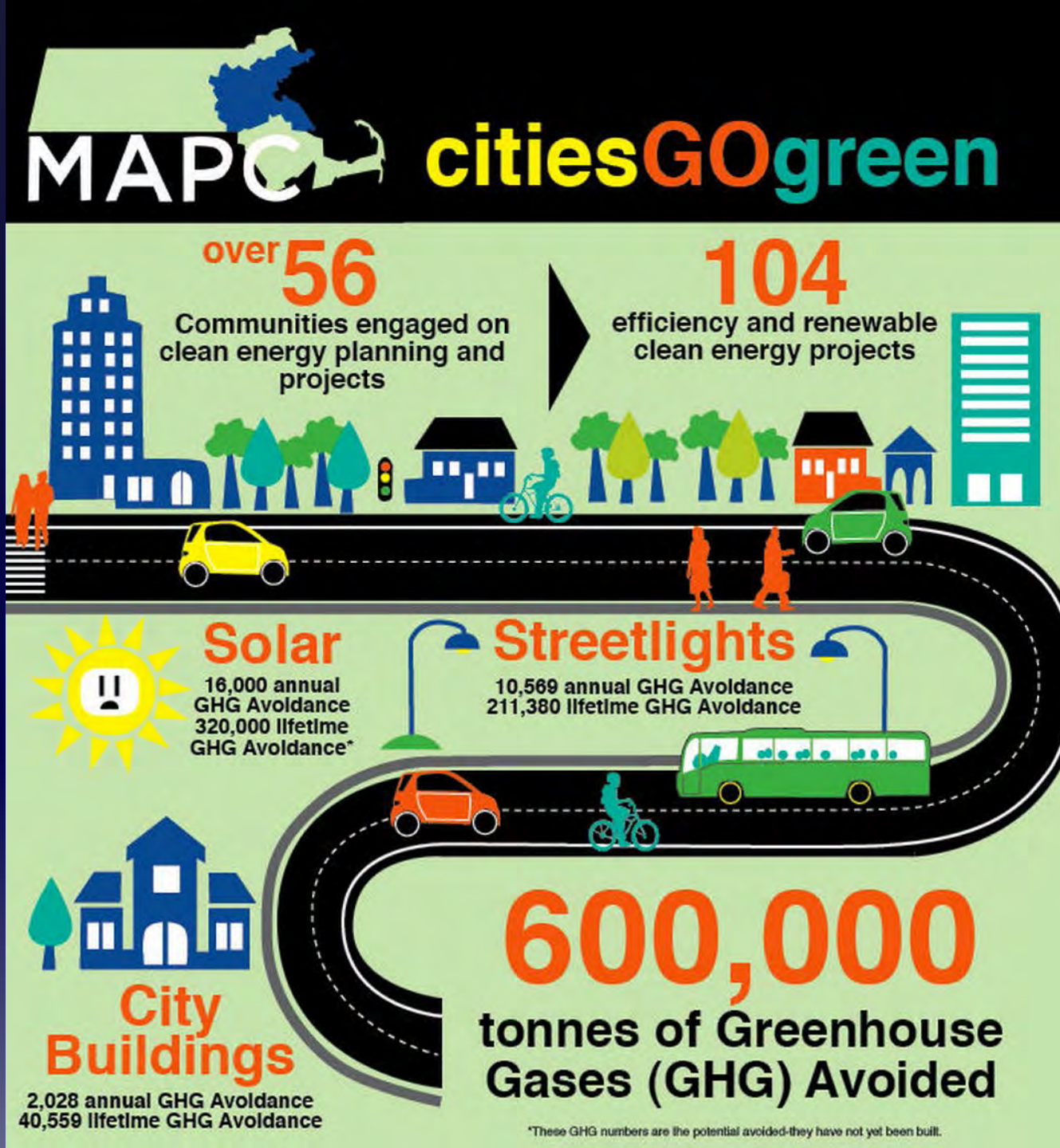
Potential Adaptation/ Mitigation Strategies

Source: Prudent Baby



Adapted from the Center for Clean Air Policy's "Connecting the Dots: Adaptation & Mitigation Synergies"

Energy Conservation



Solar Opportunities

Landfills, Rooftops, Canopies

Municipal Energy Efficiency

LED Street Lights

Clean Energy Program Assistance

MAPC
METROPOLITAN AREA PLANNING COUNCIL

Our goal is to advance markets for clean technology while reducing greenhouse gas emissions and dependence on fossil fuel consumption in the Commonwealth.

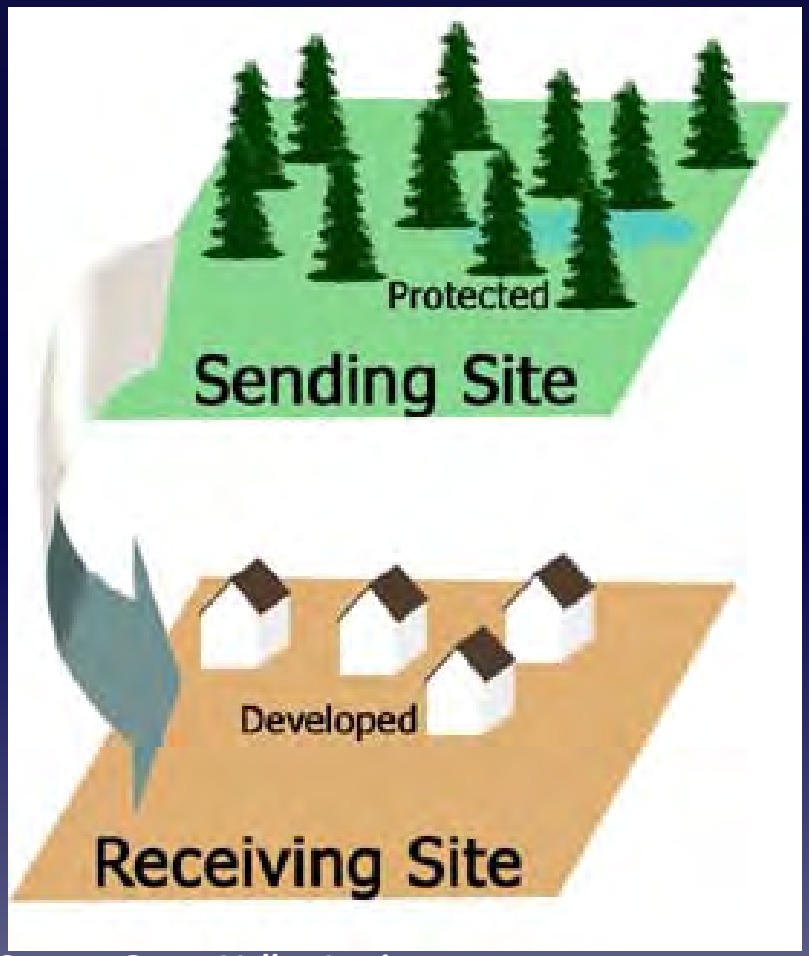
Regional Energy Projects

Local Energy Action Program

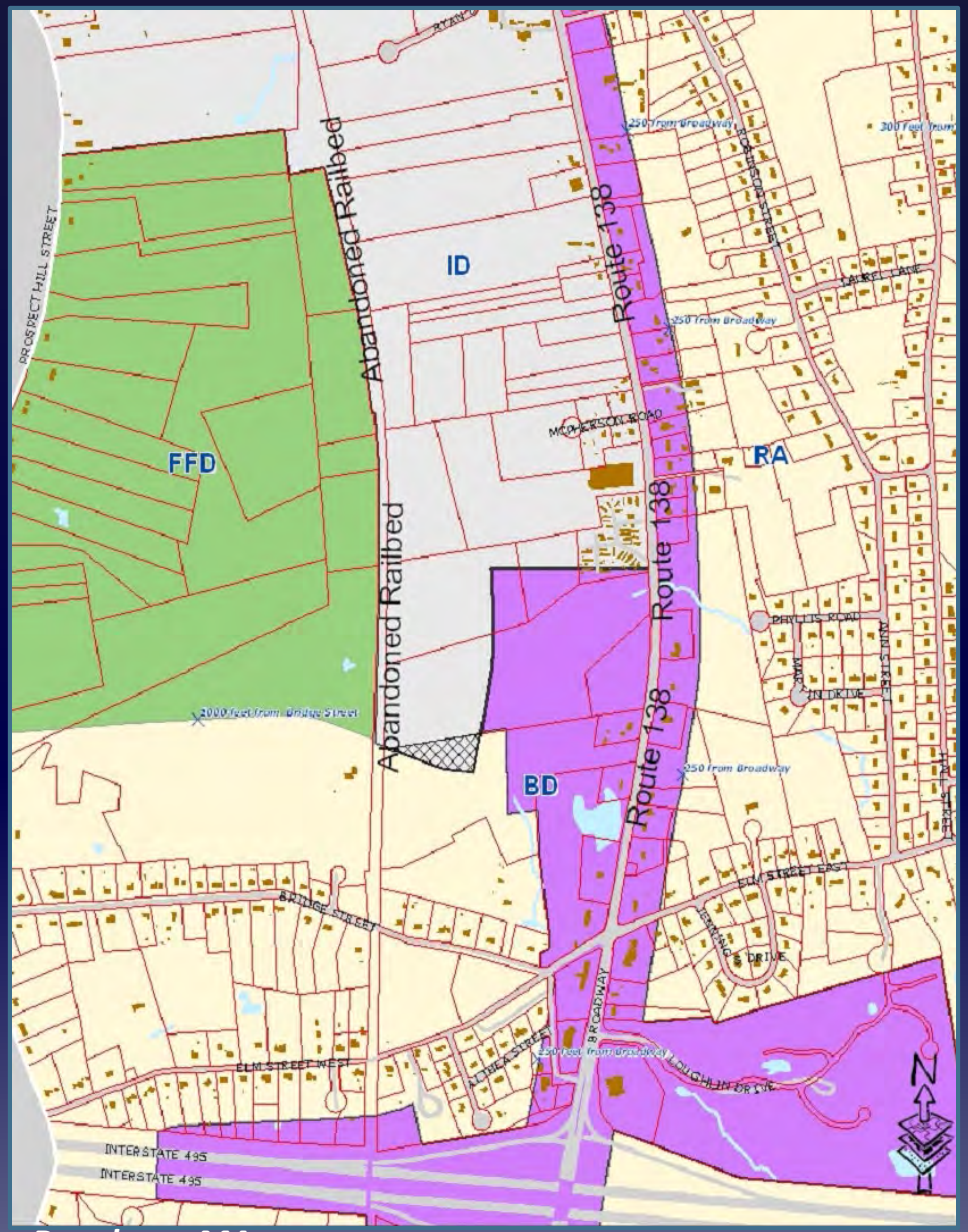
Energy Technical Assistance

TDR: Resource Protection

Receiving area land owners gain density, developers gain an administrative advantage!



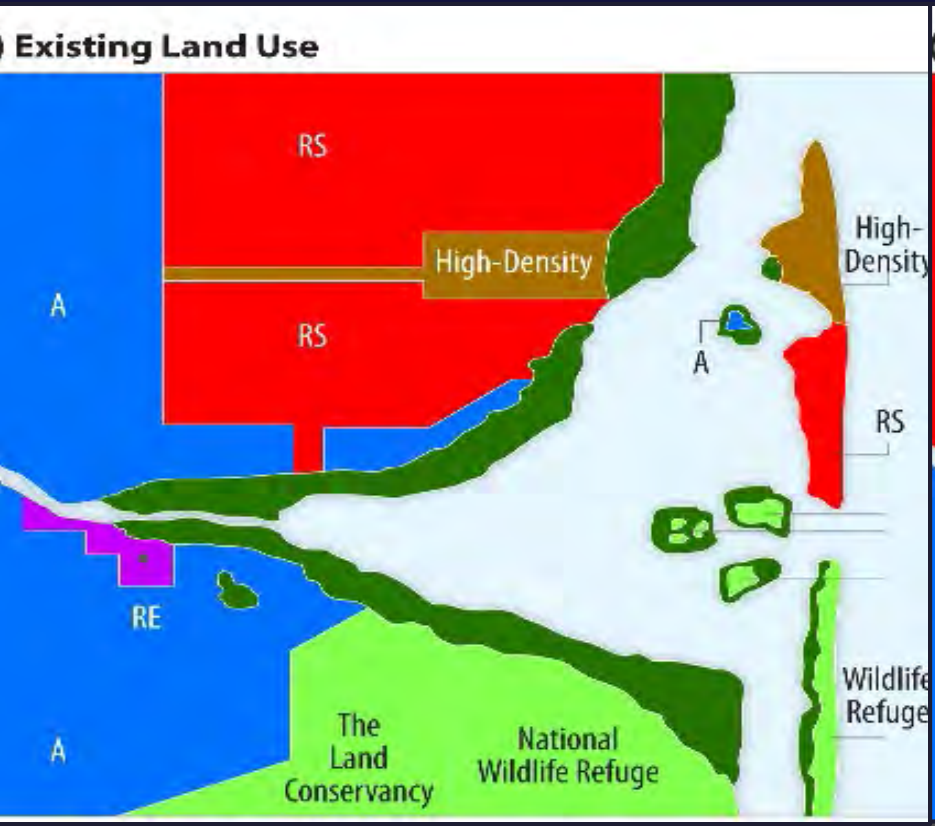
Source: Green Valley Institute



Raynham, MA

Rolling Easements

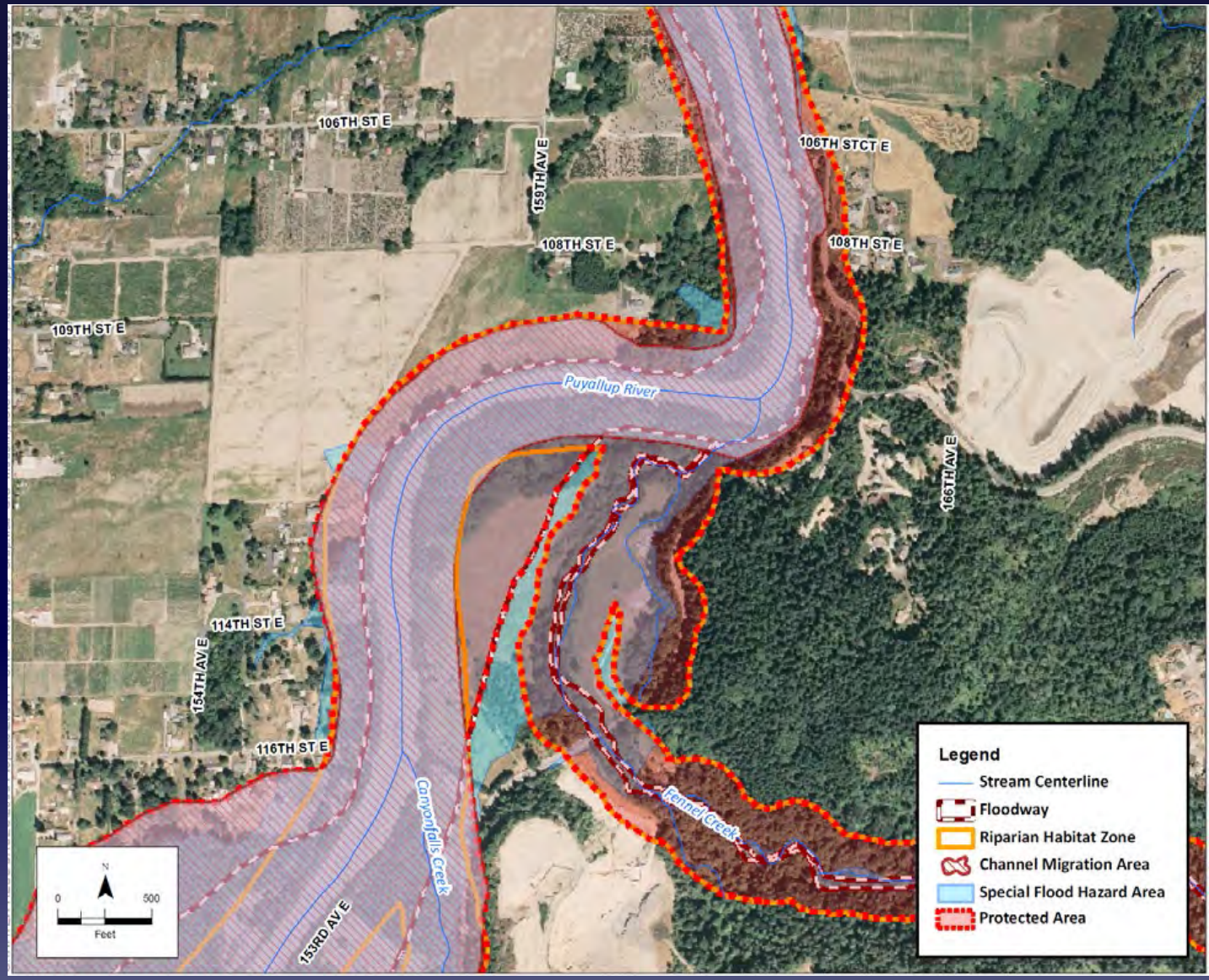
Allows development to occur recognizing that land will be abandoned when sea/floodwaters rise



A: Zoning	B: Land Use	C: Revised Zoning	D: Shore Protection Plan
Commercial/High-Density Mixed Use (CM)			Protect
		RS-P	
Residential Single Family (RS)	RS-A	Accommodate	
Rural Estate (RE)		RE-P	
		RE-R	
Agriculture (A)			Retreat
Open Space and Conservation (O/S)			
Wetlands			

Source
For Pub

Floodplain Zoning & Regulation

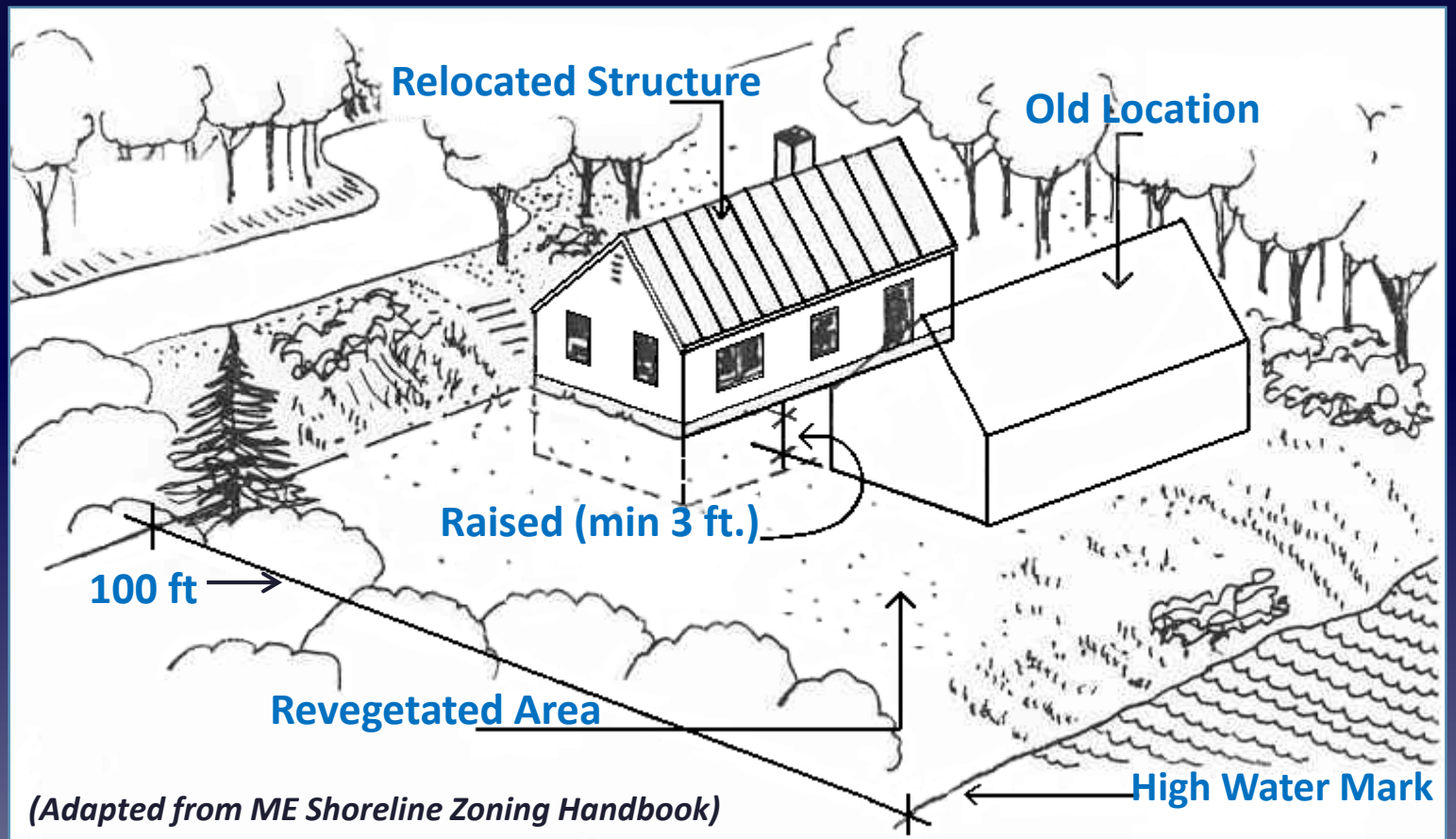


Source: Pierce County, 2007, GeoEngineers, 2005; USDA, 2006

Shoreline Protection Rules/Regs.

Establishes minimum requirements that all towns must abide by in developing their local ordinances:

- Creation of Resource Protection Districts with standards for development within
- Mandates municipalities to develop equal or more stringent standards

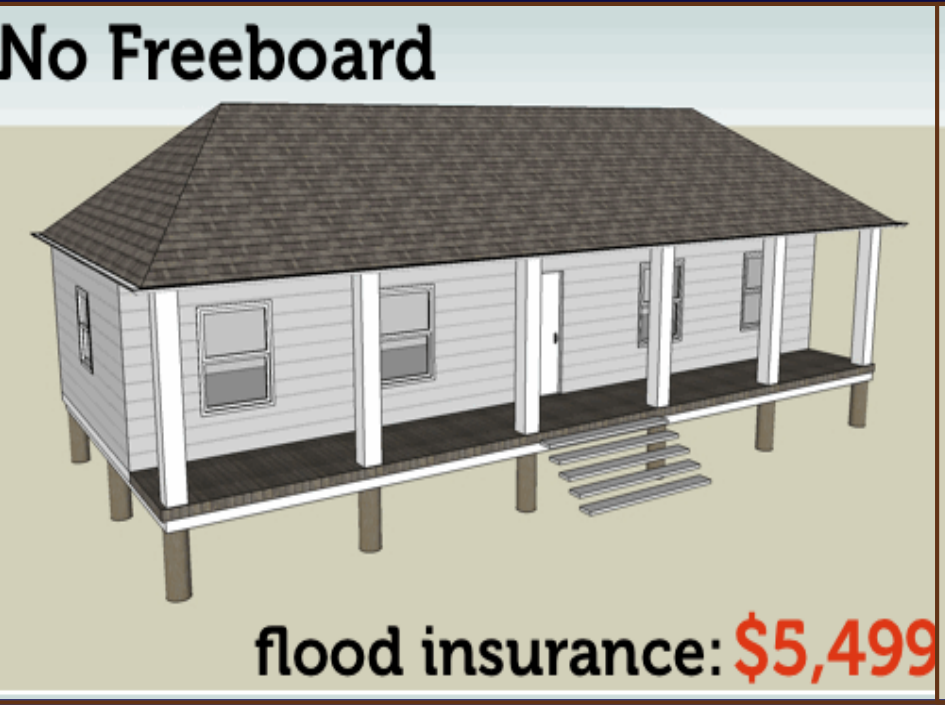


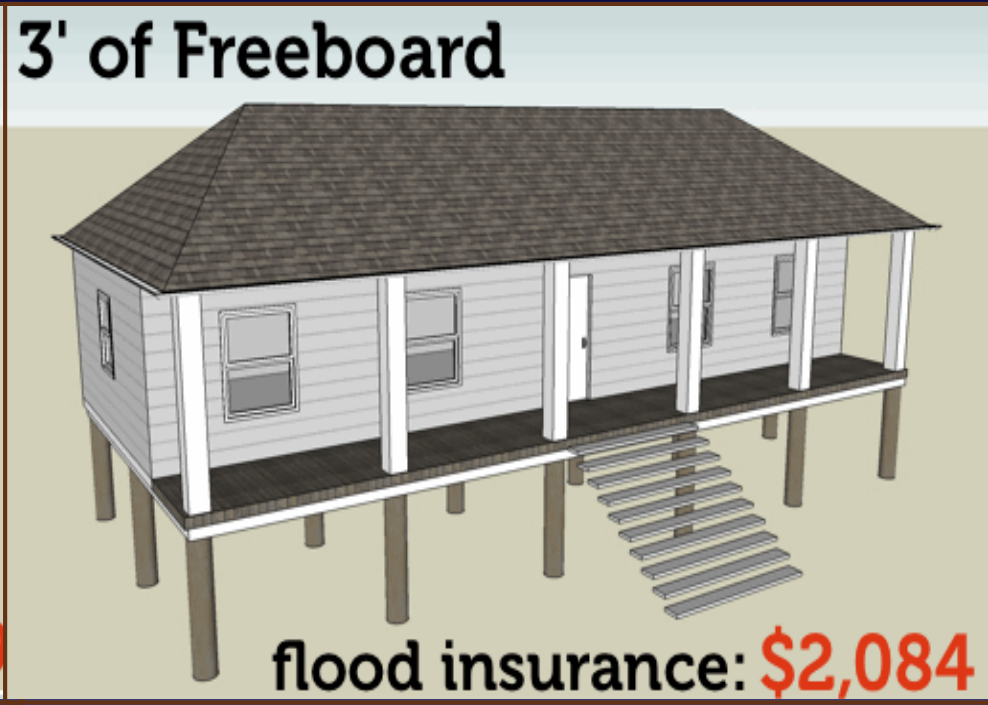
Zoning Overlay

- Non-habitable first-floor uses
- Energy-efficient design
- Rooftop mechanical and HVAC

Redevelopment/Building Guidelines

FEMA Credits for Higher Regulatory Standards





Source: LA Storm Smart Coasts

Green Infrastructure

Green Infrastructure

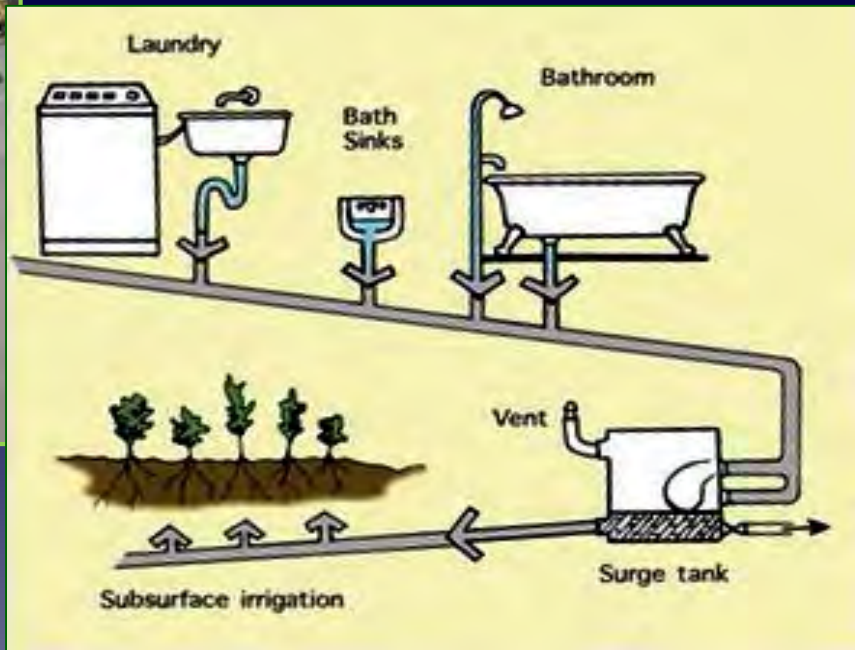
Conventional (Gray) Infrastructure	Green Infrastructure
Singe function	Multi-functional and aesthetically pleasing
Manufactured materials	Mostly natural materials
Transports stormwater away from site	Manages stormwater on site
Concentrates stormwater and pollutants	Naturally treats and disperses pollutants
Roads built for cars only	Roads that accommodate bicycles, pedestrians, and the natural system
Electricity from fossil fuels	Electricity from renewable energy
Cookie-cutter approach, no room for creativity or complementariness	Unique and complimentary to other types of infrastructure

Source: Janak, Germond et al. 2008

Integrated Water Management

Source: City of Portland, Environmental Services

1. Restore Wetland Functions
2. Recharge Stormwater/WW
3. Reuse & Conserve Water



Vulnerable Populations

Make them less vulnerable!

- ✓ Weatherized
- ✓ Energy Efficient
- ✓ Flood & Heat Protected

Positive & Proactive!

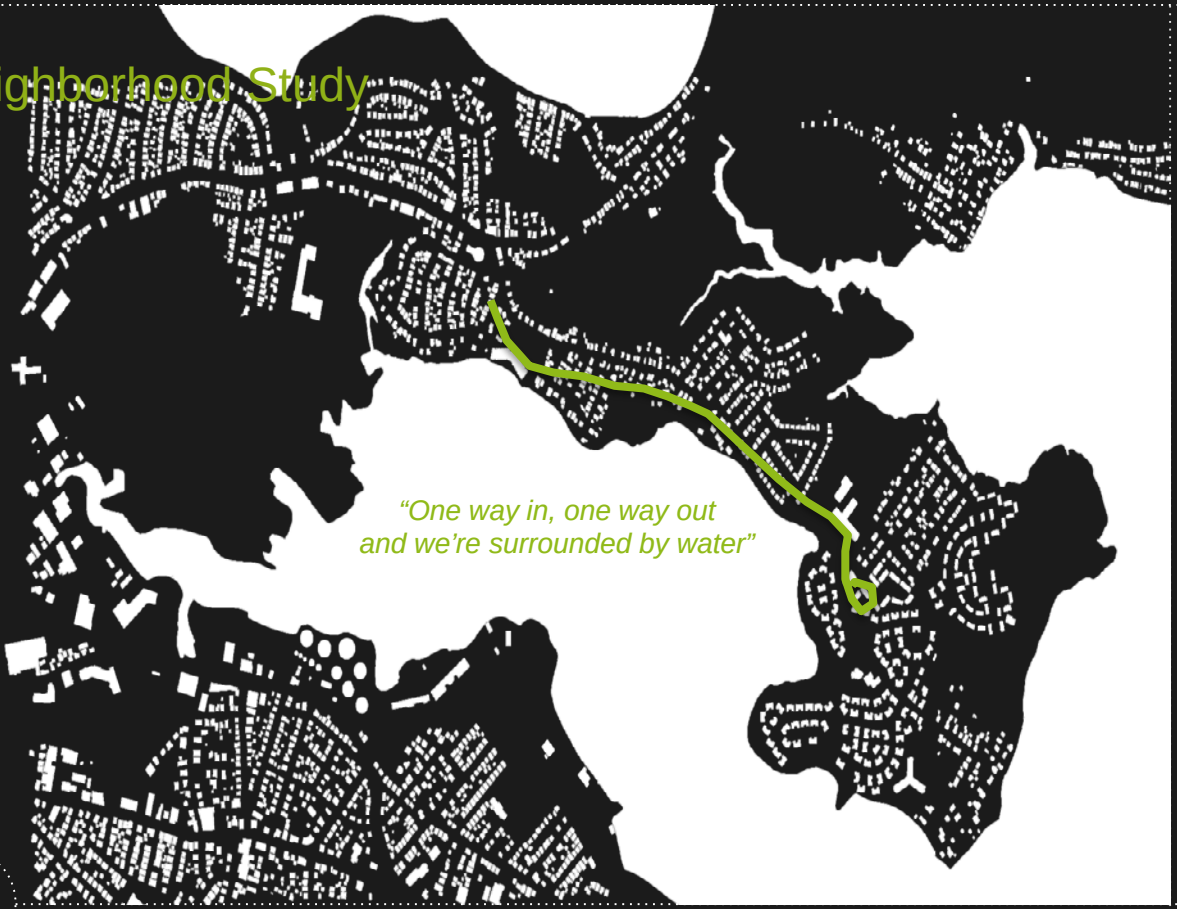
http://planbox.mapc.org/mapc/quincycap/

Climate Vulnerability Assessment Quincy, MA

Graduate Urban Symposium 2015

City Planning and Urban Affairs
Boston University

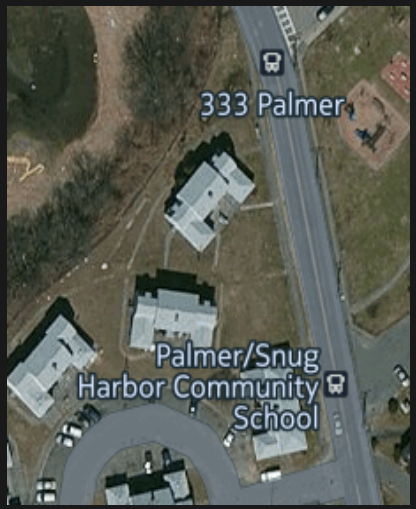
Neighborhood Study



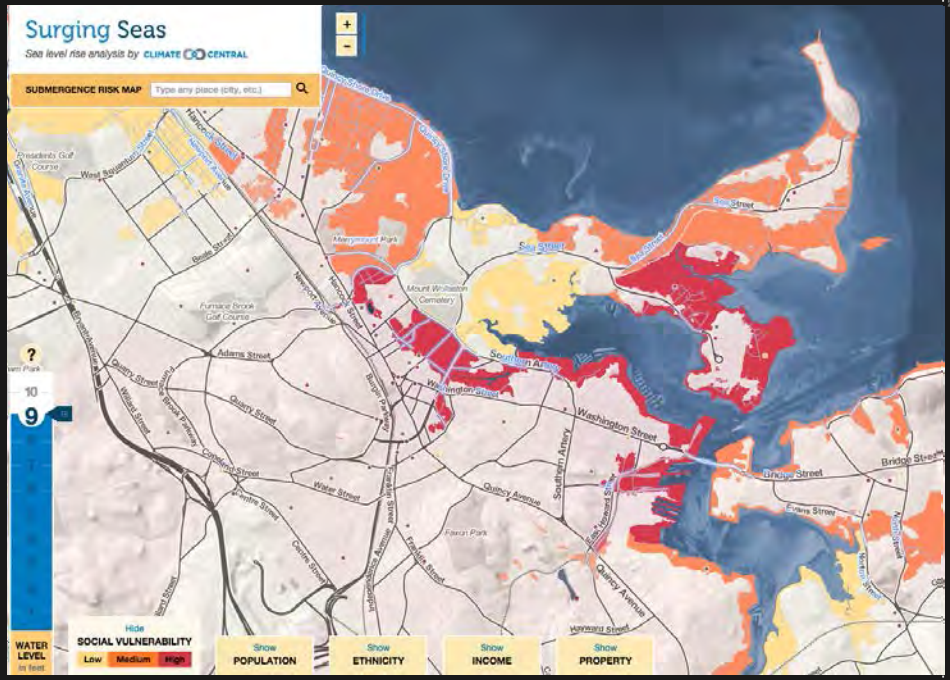
Affordable Housing Units & Municipal Owned Parcels

Pilot Neighborhood Study:

Germantown



Germantown Social Vulnerability



Germantown Snapshot:

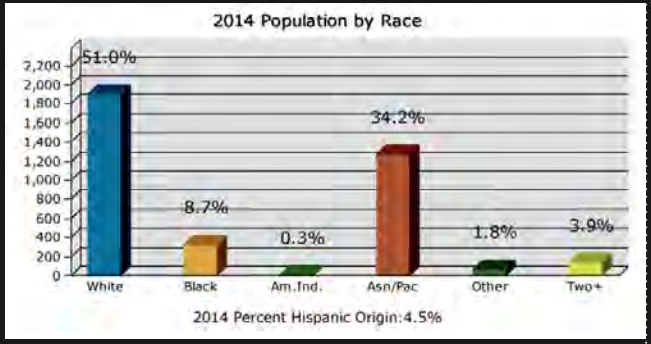
Aging housing stock (46% of housing built before 1949)

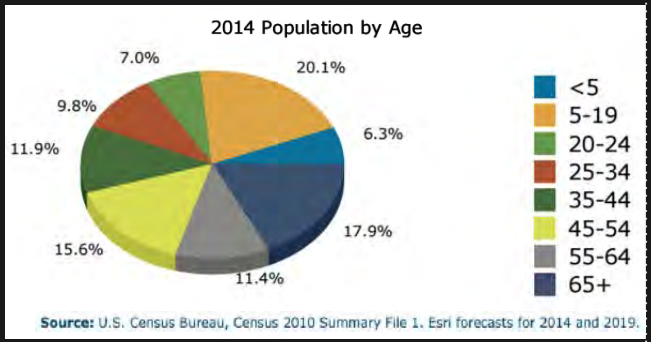
High population of renters (77%)

Germantown Snapshot:

Different languages
(18% of residents do not speak English very well or at all)

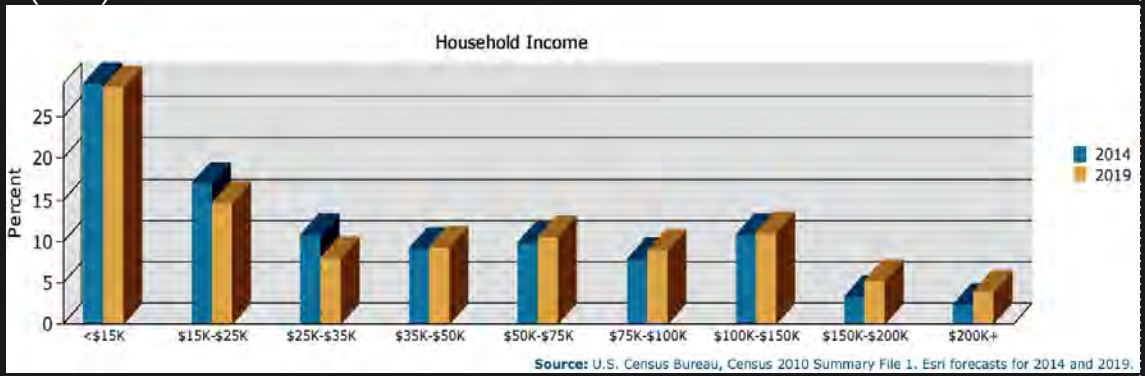
High population of seniors (17.9%) and young children (20.1%)





Germantown Snapshot:

	Germantown	Quincy	Boston-Cambridge-Quincy
MSA Median Household Income (2014)	$27,356	$61,328	$72,907



View from O’Brien Towers

Interviews

Germantown Neighborhood Center

Kathy Quigley
Executive Director
South Shore YMCA

Survey Methodology

Survey Practice

General Survey for Residents of Germantown

Hello! We are graduate students from the Boston University City Planning and Urban Affairs program working with City of Quincy Planning Department. We are conducting surveys of Germantown residents to understand how you are affected by the natural environment in order to better serve you. May we have a moment of your time?

1. **Gender?** ☐ **Female?** ☐ **Male** ☐ **Other**

1. **Age range?** ☐ **Less than 18** ☐ **26-35** ☐ **46-55** ☐ **66-75**
   ☐ **18-25** ☐ **36-45** ☐ **56-65** ☐ **75+**

1. **How long have you lived in Germantown?**
   ☐ **0-5 years** ☐ **6-10 years** ☐ **11-20 years** ☐ **20+ years**

4. **How long do you plan on staying in Germantown?**
   ☐ **0-5 years** ☐ **6-10 years** ☐ **11-20 years** ☐ **20+ years**

Creating Awareness & Linking Impacts

What are some of the biggest problems you have in your home? (Check all that apply)

- ❑ **Too hot during the summer**
- ❑ **Too cold during the winter**
- ❑ **Roof leakages**
- ❑ **Flooding**
- ❑ **Fear of damage from storms such as hurricanes/nor'easters/tornadoes**
- ❑ **Problems with water pipes**
- ❑ **Problems with sewer pipes**
- ❑ **Gutters**
- ❑ **Not enough trees or green spaces**
- ❑ **General appearance**
- ❑ **Other: _____**

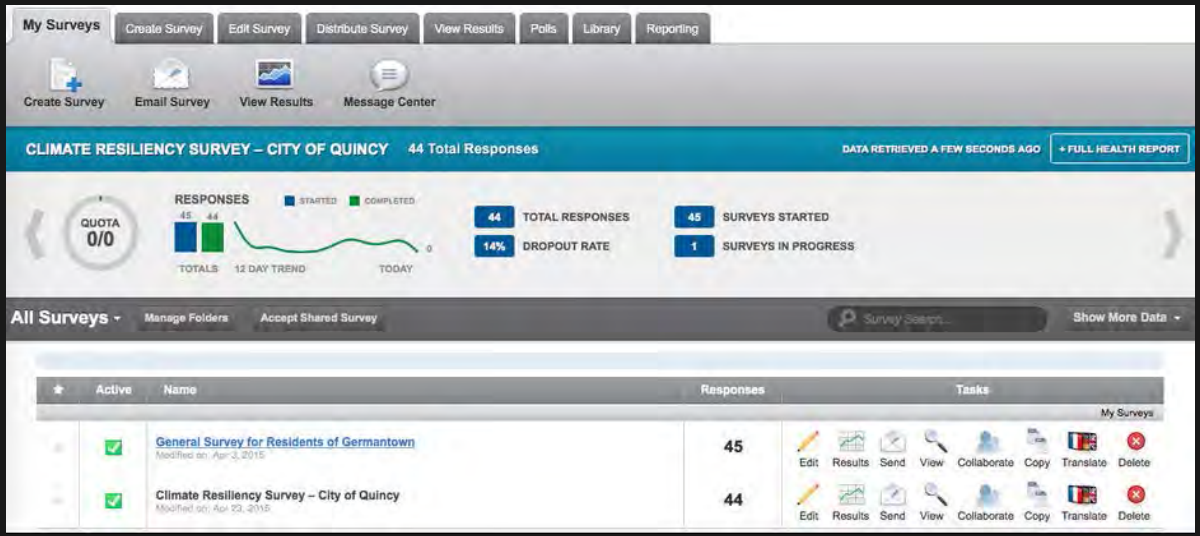
How much do you know about climate change?

- ❑ **Know a great deal**
- ❑ **Know something about it**
- ❑ **Aware**
- ❑ **Not aware**
- ❑ **Other _____**

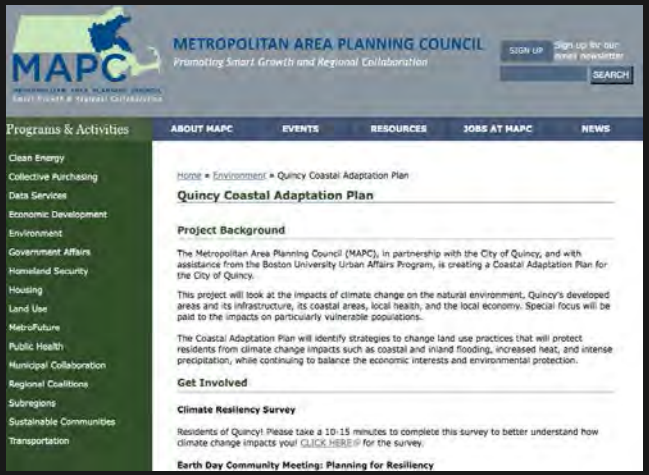
Did you know that green spaces and trees…

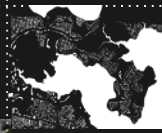
- ❑ **Can reduce flooding?**
- ❑ **Improve air quality?**
- ❑ **Keep your surroundings cooler?**

Gathering Data Beyond the Semester

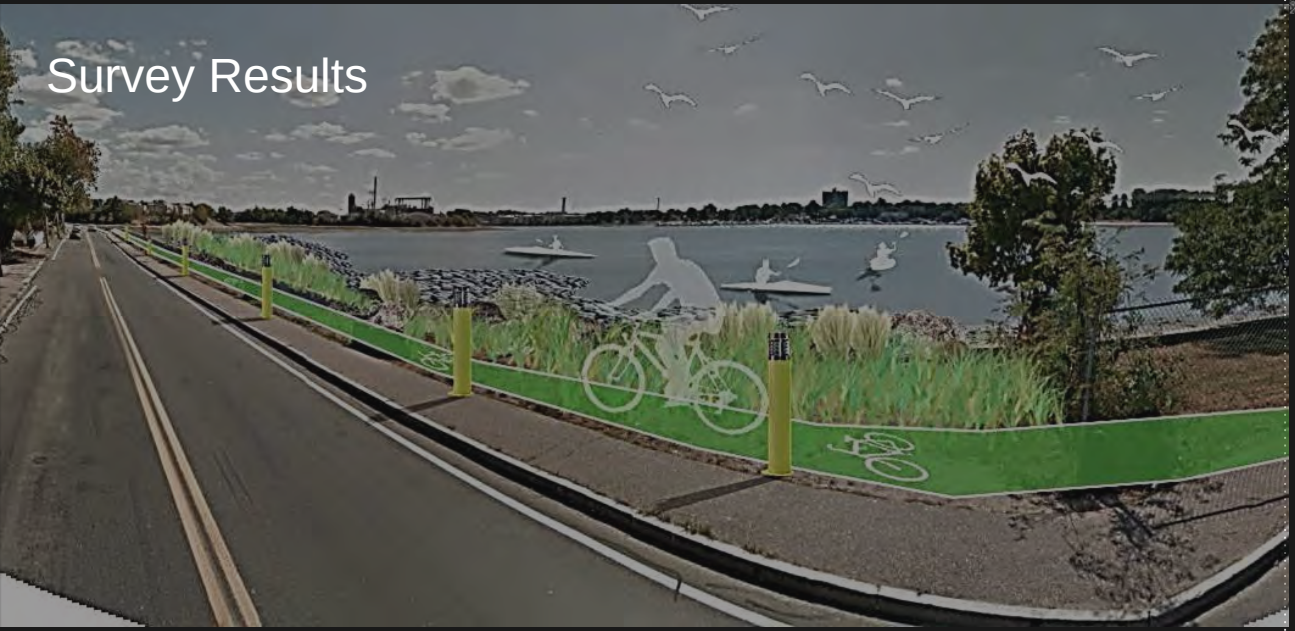


Gathering Data Beyond the Semester





Survey Results

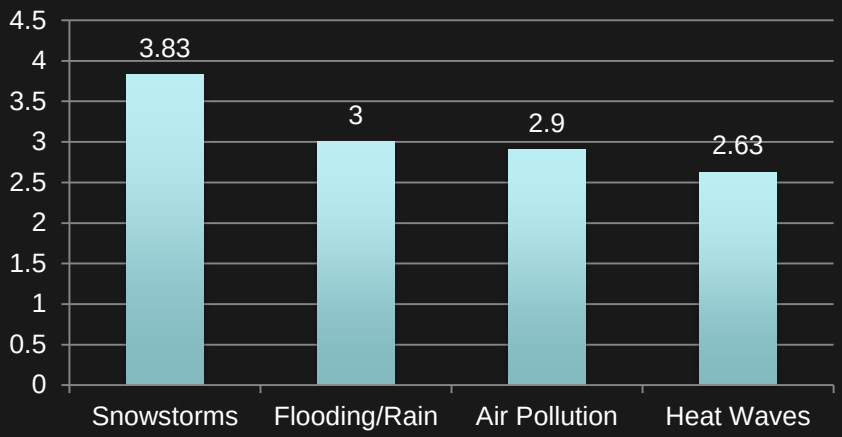


Germantown Survey Results

Q: On a scale of 1 to 5, what are your biggest environmental concerns while living in this neighborhood? *(average answer shown)*

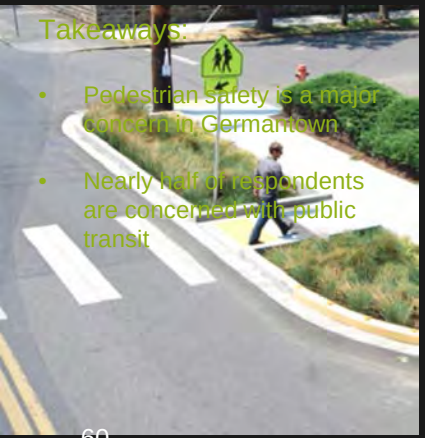
Takeaways:

- Snow storms are the greatest concern
- They can have the greatest level of impact



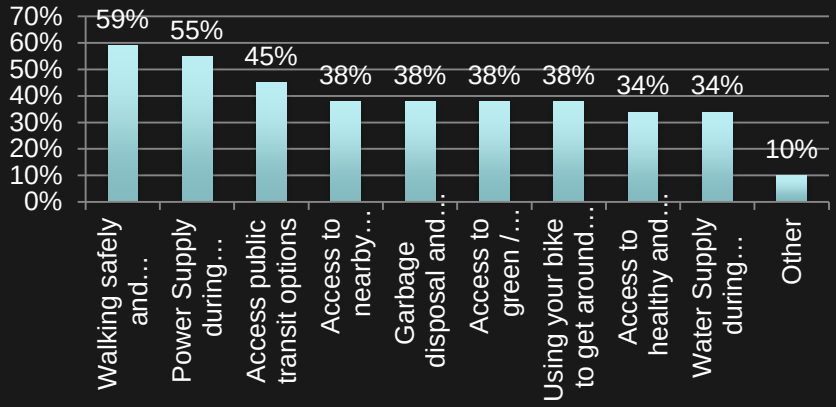
Germantown Survey Results

Q: What are some concerns you have in this neighborhood?



Takeaways:

- Pedestrian safety is a major concern in Germantown
- Nearly half of respondents are concerned with public transit



Germantown Survey Results

Did you know that?

1) Green Spaces and trees can **reduce flooding risks?**

48% Yes

2) Green Spaces and trees can **improve air quality?**

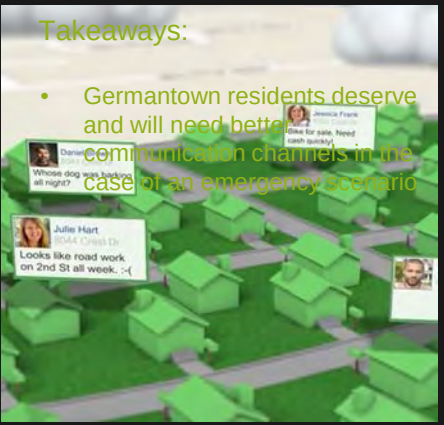
77% Yes

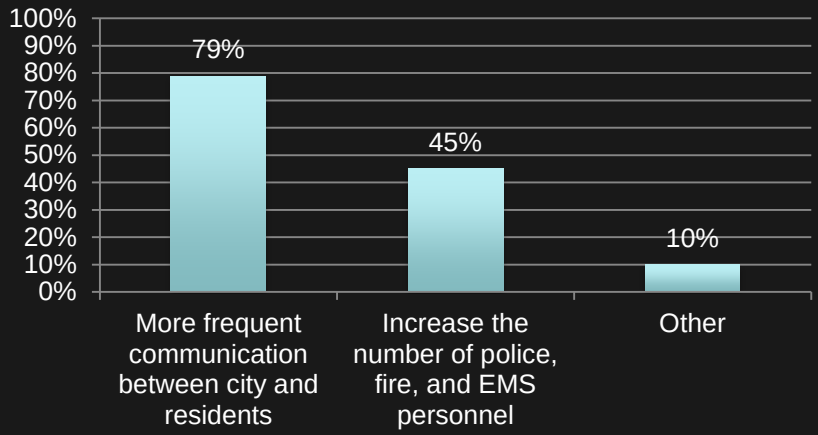
3) Green Spaces and trees can **keep your surroundings cooler?**

58% Yes

Germantown Survey Results

Q: What would increase your confidence in Quincy's emergency services?



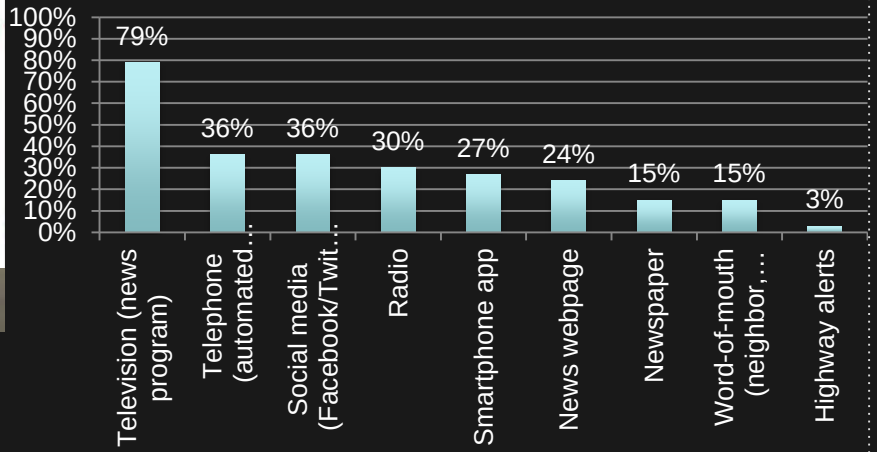


Germantown Survey Results

Q: How do you currently receive news regarding weather conditions?

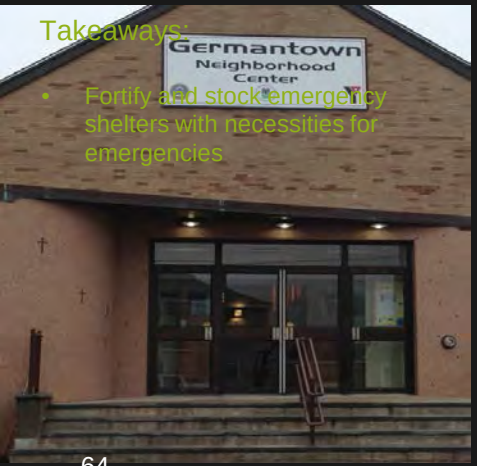
Takeaways:

- Maximize the use of television to inform the public
- Maximize the use of cell phones to inform the public



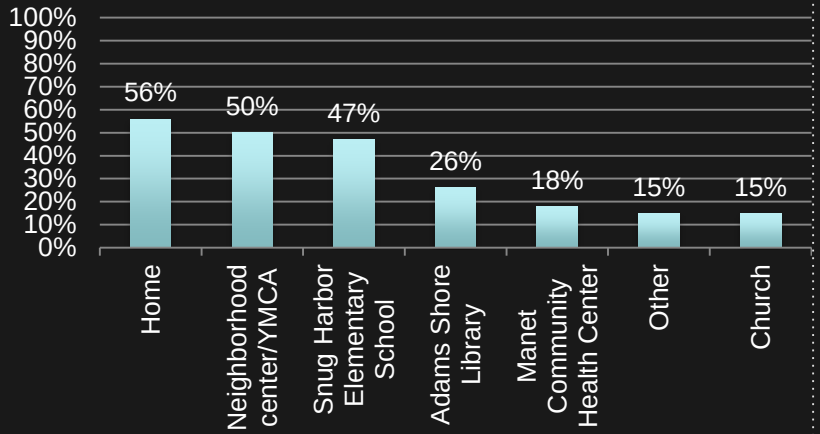
Germantown Survey Results

Q: Would you go to any of these in the case of extreme weather events?



Takeaways:

- Fortify and stock emergency shelters with necessities for emergencies



Appendix III: Survey and Interviews

Hello! We are graduate students from the Boston University City Planning and Urban Affairs program working with the City of Quincy Planning Department and Metropolitan Area Planning Council. We are conducting this survey to understand how you may be affected by climate change impacts. The survey is only 4 pages and should take 5-10 minutes of your time. We thank you in advance for participating. Your responses will greatly inform the planning team that will be developing a Climate Resiliency Plan for the City of Quincy.

An online live version of the survey can be found at:
https://bostonu.qualtrics.com/SE/?SID=SV_7O4XDKPtgNzU9KZ

1. Please choose the neighborhood of Quincy where you live.
□ Adams Shore □ Hough's Neck □ Germantown □ Merrymount
□ Montclair □ North Quincy □ Quincy Center □ Quincy Point
□ South Quincy and West Quincy □ Squantum □ Wollaston

2. Please choose the gender that applies to you.
□ Female □ Male □ Other _____

3. Please choose the ethnicity that applies to you.
□ White □ Black/African American □ Asian □ Hispanic/Latino
□ American Indian/Alaskan Native □ Native Hawaiian/Other Pacific Islander
□ American Indian/ Alaskan Native & White □ Asian & White
□ Black/African American & White
□ American Indian/Alaskan Native & Black African American
□ Other (please specify) _____

4. Age range?
□ less than 18 □ 18-25 □ 26-35 □ 36-45
□ 46-55 □ 56-65 □ 66-75 □ 76 and above

5. Please choose the household income that best applies to you.
□ $0 - $20,000 □ $20,001 - $35,000 □ $35,001 - $50,000
□ $50,001 - $75,000 □ $75,001 - $100,000 □ $100,001 and above

6. How long have you lived in Quincy?
□ 0-5 Years □ 6-10 Years □ 11-20 Years □ 20+ Years

7. How long do you plan on staying in Quincy?
□ 0-5 Years □ 6-10 Years □ 11-20 Years □ 20+ Years

8. I am responding to this survey primarily as:
□ Tenant □ Homeowner □ Business Owner □ Work in Quincy
□ Volunteer in Quincy □ Other _____

9. Please choose the type of home where you live.
□ Single Family □ 2-Family □ 3-Family
□ Multi-family (4 units and above) □ Other _____

10. Please choose the number of people living in your household.
□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 and above

11. How much do you know about climate change?
□ Know a great deal □ Know something about it □ Aware
□ Not aware □ Other (please specify) _____

12. On a scale of 1 to 5, what are your biggest climate impact concerns?
- Snowstorms
  No challenge 1 2 3 4 5 Most challenging
- Flooding/Rain
  No challenge 1 2 3 4 5 Most challenging
- Air Pollution
  No challenge 1 2 3 4 5 Most challenging
- Heat Waves
  No challenge 1 2 3 4 5 Most challenging

13. Of the following concerns, what are some issues you have encountered in Quincy?
(Check all that apply)
□ Poor indoor or outdoor air quality
□ Drinking water contamination
□ Mold
□ Illness (resulting from any of the above)
□ Walking safely and comfortably around the neighborhood
□ Property damage
□ Using your bike to get around the neighborhood safely and comfortably
□ Business needing to close
□ Damage to beach and other recreational areas
□ Lack of public transportation
□ Access to public transit options
□ Access to green / recreation spaces
□ Access to healthy and affordable food
□ Garbage disposal and recycling options
□ Access to nearby healthcare and emergency services
□ Water supply during emergencies
□ Power supply during emergencies
□ Other _____

14. Of the concerns you included above, what are some of your specific issues?
_____

15. Did you know that green spaces and trees...
□ can reduce flooding?

□ improve air quality?

□ keep your surroundings cooler?

16. What are some of the biggest problems you have in your home? (Check all that apply)
□ Too hot during the summer

□ Too cold during the winter

□ Roof leakages

□ Flooding

□ Fear of damage from storms such as Hurricanes / Nor'easters or tornadoes

□ Problems with water pipes

□ Problems with sewer pipes

□ Gutters

□ Not enough trees or green spaces

□ General appearance

□ Other _____

17. On a scale of 1 to 5, what city-based changes would you support?
- More trees

  Not wanted 1 2 3 4 5 Most wanted
- More biking options

  Not wanted 1 2 3 4 5 Most wanted
- Pedestrian walkways to get around

  Not wanted 1 2 3 4 5 Most wanted
- More green/open spaces

  Not wanted 1 2 3 4 5 Most wanted

18. On a scale of 1 to 5, which of the following climate change resiliency measures would you be willing to consider doing?
- Rain barrels for water conservation and flood reduction

  Not likely 1 2 3 4 5 Most likely
- Grey water reuse (Water from kitchen/bathroom sinks, dishwashers, tubs and showers)

  Not likely 1 2 3 4 5 Most likely
- Small increase in water/sewer taxes ($1-5) for the city to invest in better infrastructure

  Not likely 1 2 3 4 5 Most likely
- Solar panels

  Not likely 1 2 3 4 5 Most likely
- Planting Trees

  Not likely 1 2 3 4 5 Most likely
- More Recycling Options

  Not likely 1 2 3 4 5 Most likely
- Website and/or app to communicate and resolve issues in the neighborhood

  Not likely 1 2 3 4 5 Most likely

Appendix IV: Neighborhood Survey Results

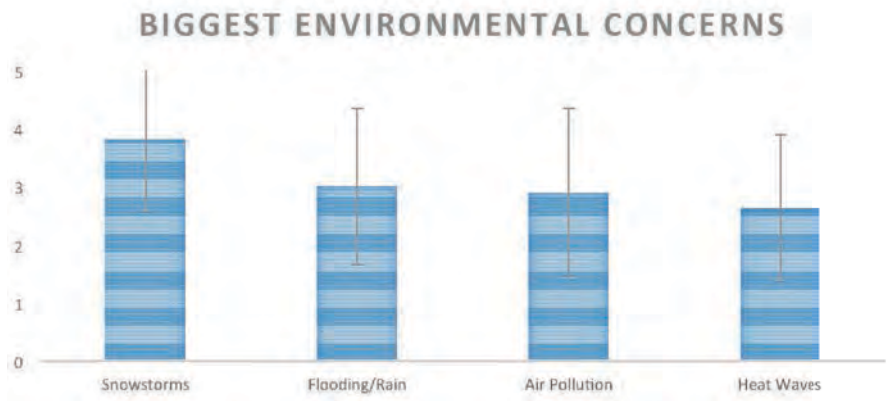
"Neighborhoods in the Northeast that are facing the greatest threat of climate changes are typically characterized by population vulnerabilities that include high percentages of elderly people and people living in geographic and social isolation with limited social networks, access to public services, and a high prevalence of existing health problems."(Frumhoff et al, 2007)

Germantown, a neighborhood on a peninsula, is a particularly vulnerable neighborhood because of its geographic location and socio-economic vulnerabilities. Germantown has several public housing properties and 30% of the population of the neighborhood lives below the poverty line. Many residents speak Spanish, Mandarin, Cantonese, or Vietnamese as a first language, which causes a language barrier between many of the residents and public officials and representatives. To better understand the unique vulnerabilities of Germantown, a pilot survey was conducted in the neighborhood to assess the priorities of the residents. Generally, the results show that Germantown residents have many environmental concerns and are willing to implement a wide variety of conservation measures.

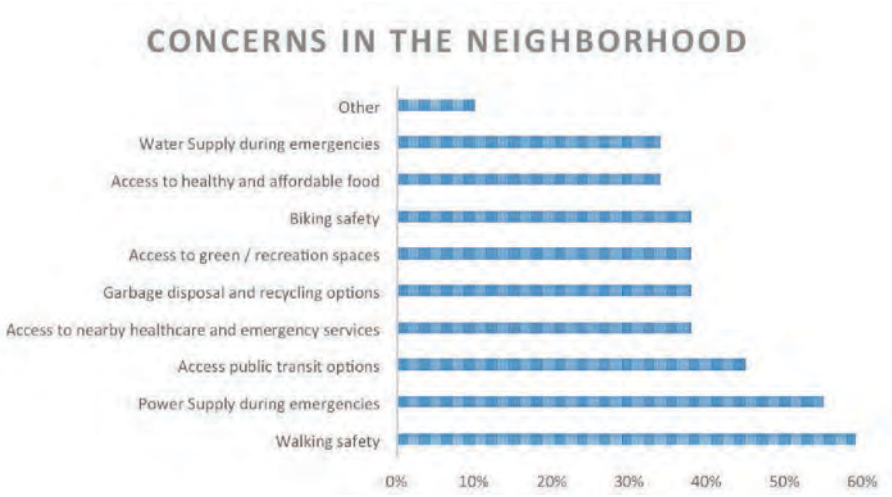
Survey Methods

The survey was developed and administered to renters, homeowners, business owners, workers and volunteers in the neighborhood. The survey contained eighteen questions that were designed to gauge residents' knowledge about climate change and specific climate change impacts and determine their emergency preparedness experiences in Germantown. Prior to distribution, the survey was reviewed for content and clarity by MAPC and the City of Quincy. The survey was distributed in English and administered by Climate Quincy team members who visited the Germantown neighborhood. After four days of survey administration 44 surveys were completed. The Climate Quincy team used the Qualtrics survey tool to analyze the results and key findings are summarized below.

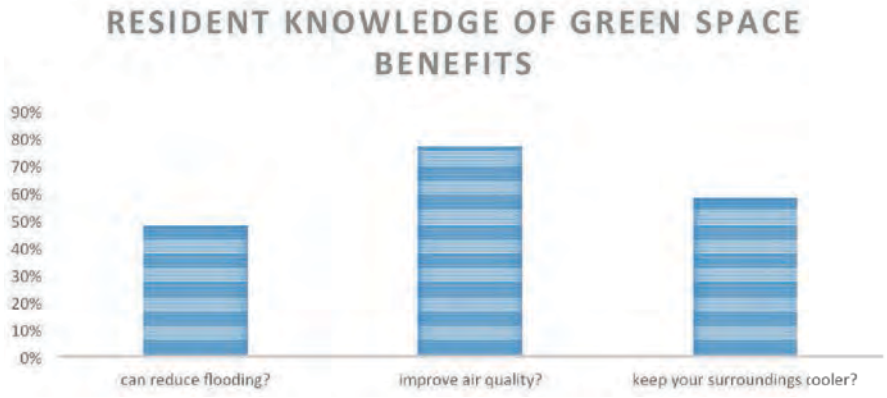
Survey Results



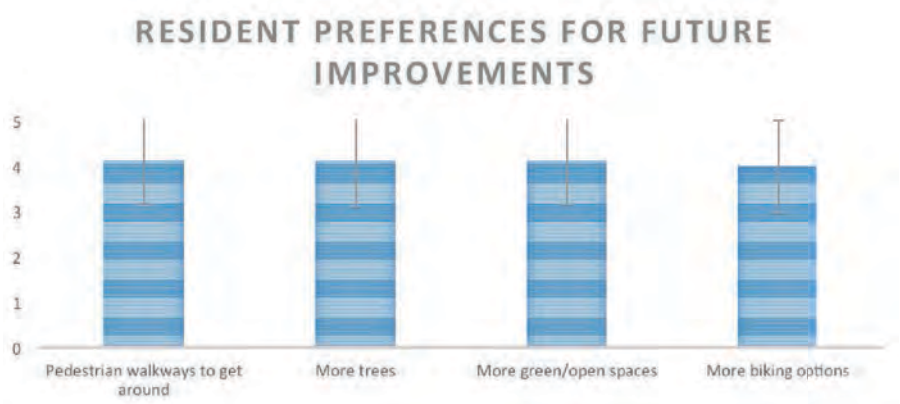
The largest neighborhood concerns related to safety concerns and day-to-day life. Having safe walking routes garnered the most responses and access to public transit options also scored high results. This may indicate that for Germantown residents, challenges in their daily life are of greater concern than more long term issues such as recycling. Almost 60% of residents are concerned about the power supply during emergencies, which may be attributed to the recent winter storms and subsequent power losses.

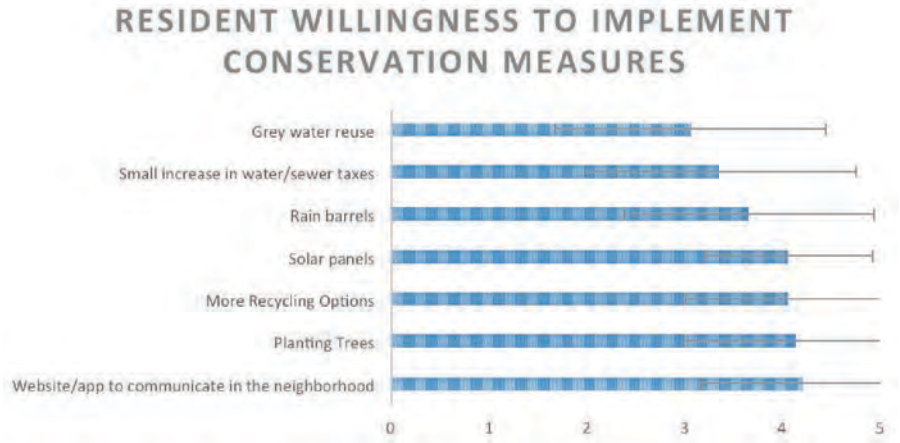


Over half of residents responded that home heating in the winter is one of their biggest problems. Storm damage, lack of tree and open space, and cooling in the summer were also cited as problems. These issues have direct applicability to climate change adaptation and should be included in proposals to help communicate the benefits.



Residents were generally aware that green spaces can improve air quality, but fewer knew the cooling effects and flooding mitigation benefits. This presents an opportunity for education and communication with the community.





Department of Planning and Community Development
34 Coddington Street 3rd Floor, Quincy, Massachusetts 02169
Tel. (617) 376-1362 FAX (617) 376-1097
TTY /TDD (617) 376-1375

JAMES J. FATSEAS
Planning Director

THOMAS P. KOCH
Mayor

News Release

FOR IMMEDIATE RELEASE

DATE: **January 19, 2018**

CONTACTS: **Christopher Walker**
Policy and Information Director
617-376-1990

James Fatseas
Planning Director
617-376-1363

Robert Stevens
Deputy Planning Director
617-376-1411

Hazard Mitigation Plan 5-year Update

The City of Quincy has received a $18,000 ***Pre Disaster Mitigation Grant*** from the Federal Emergency Management Agency (FEMA) to update the City's 5-year Hazard Mitigation Plan (HMP) that is set to expire this coming June. For the first time the City will incorporate climate vulnerability assessments into the HMP instead of relying solely on information from historical events.

The Hazard Mitigation Plan will address all natural hazards that have impacted Quincy in the past, or may impact it in the future including hydrologic hazards (coastal and inland flooding and drought), atmospheric hazards (extreme temperatures, winds and winter weather), geologic hazards (landslides and earthquakes) and other natural hazards (wild fire and invasive species). A City-wide inventory of community assets and their vulnerability to identified hazards of concerns will include evaluation of vulnerable populations, cultural assets, economic sectors, critical buildings and infrastructure and natural resources that are important to the community's character and protection of clean air and water. Updating the plan will identify proactive opportunities for the City to address long-term resilience in the face of current and future natural hazards, help Quincy be better prepared for a natural disaster and recover more quickly after an event occurs. Updating the Plan is also a requirement for the City to continue to be eligible for hazard mitigation grant funds.

An inter-departmental city government team will work closely with the civil engineering firm Tighe & Bond to conduct the HMP update over the next several months. The public will have multiple opportunities to participate in the planning process this spring including public workshops and web surveys. Maps and data will be available for public review on the City Department of Planning and Community Development website http://quincy.ma/dpcd/hmp

Quincy Hazard Mitigation Plan Update - Meeting Agenda

ATTENDEES: Hazard Mitigation Plan Update Working Group
Gabrielle Belfit, CPM, Tighe & Bond
Lauren Bergman, EIT, Tighe & Bond
David Murphy, P.E., Tighe & Bond

LOCATION: Lower Conference Area, 1305 Hancock Street

DATE: December 12, 2017

TIME: 1:30 PM – 3:00 PM

Meeting goals: Introduce Project Team, discuss Working Group roles & responsibilities, understand outcome of Hazard Mitigation Plan Update & City's Goals

1:30 PM **Welcome, Introductions & Planning History**

1:40 PM **Quincy's Hazard Mitigation Plan (HMP) Update Process**

PowerPoint Presentation

2:00 PM **HMP Update Nuts & Bolts**

Handouts: Workplan, Schedule, Bibliography

2:10 PM **Break**

2:15 PM **Working Session: City's Working Group Tasks**

Update Community Asset Inventory

Handout: Memorandum

Update Capabilities Assessment

Handout: Memorandum

3:00 PM **Adjourn**

J:\Q\Q0019 Quincy, MA Consultant Review Services\Q0019-P017 Hazard Mitigation&Resiliency Plan Update\Task 2- Planning Process\12.12.17 Meeting\Agenda.docx

Tighe&Bond

Quincy Hazard Mitigation Plan 5-year Update

Kick-Off Meeting Sign In

Please place a check next to your name.

Chris Walker

Name	Title	Department	Attendance
Mayor Thomas Koch	Mayor	Mayor's Office	☑
James Fatseas	Planning Director	Planning	☐
Robert Stevens	Deputy Planning Director	Planning	☐
Sean Glennon	Community Development Director	Planning	☐
Liz Manning	Principal Planner	Planning	☐
Al Grazioso	Commissioner	DPW	☐
Paul Costello	City Engineer	Engineering Department	☑
Cheung Tsang	Engineer	Engineering Department	☐
John Sullivan	Waste/Recycle	DPW	☑
Peter Hoyt	Sr. Civil Engineer	Water/Sewer Dept.	☑
Mark Vialpando	General Foreman	Water/Sewer Dept.	☑
Mike Coffey	Director	TPAL	☐
Paul Hines	Commissioner	Public Buildings	☐
Gary Cunniff	Head Engineer	Public Buildings	☐
Shelly Dein	Sustainability Director	Public Buildings	☑
Drew Scheele	Commissioner	Health Department	☐
Cindy DeCristofaro	Chief Sanitarian	Health Department	☑
Ruth Jones	Director of Nursing	Health Department	☐
Don Martin	Director	Park & Forestry Department	☑
Lisa Aimola	Director of Community Preservation	Park & Forestry Department	☐
Jay Duca	Director	Inspectional Services Department	☑
Rob Conlon	Inspector	Inspectional Services Department	☑
Capt. Rich Bryan	Emergency MGMT	Fire Department	☐
Lt. Robert Gillan	Marine Unit	Police Department	☐
Tom Clasby	Director	Elder Services	☑
Chuck Phelan	Director	IT	☑
Colleen Healy	Chief Assessor	Assessors	☐

Capt. Rick McCusker QPD — Police ✓

Lisa Aimola — Director, CPC — CPC ✓

Nathan Robinson, Housing Prgm Mgr, PCD ✓

Chris Cassani — TPAL ✓

Laura Owens — QPS ✓

Cheung Tsang — Engineering — DPW ✓

Tighe&Bond

Engineers | Environmental Specialists

CITY OF QUINCY MULTI-HAZARD MITIGATION PLAN 5-YEAR UPDATE

Kickoff Meeting

Quincy City Hall
December 12, 2017

Tighe&Bond

Agenda

- **Overview- History of Quincy Multi-Hazard Mitigation Planning**
- **Hazard Mitigation 5-year Update**
  - Presentation
  - Handouts: Workplan/ Schedule/ References
- **Review City Goals**
- ***BREAK***
- **Working Group Assignments**
  - Community Asset Inventory
  - Capabilities Assessment
  - NFIP Repetitive Loss Update

Tighe&Bond

Community Involvement

Hazard Mitigation Plan Working Group

- *Mayor's Office*
- *Planning Department*
- *Fire Department*
- *Police Department*
- *Engineering Department*
- *Department of Public Works*
- *Water/Sewer Department*
- *Public Buildings*
- *Health Department*
- *Park & Forestry*

- *Elder Services*
- *Inspectional Services*
- *School Department*
- *Assessors Department*
- *TPAL*
- *IT*
- *MEMA*

Tighe&Bond

MEETING GOALS

1. Meet the Planning Team
2. Review Hazard Mitigation Planning Process
3. Discuss Quincy 5-year Update Workplan
4. Review HMP Goals

Hazard Mitigation Terminology

- Hazard Mitigation Plan (HMP)
- Natural Hazards, Multi-Hazards, Manmade Hazards
- Natural Hazard Risk Assessment- Magnitude and Frequency (RA)
- Climate Change
- Community Asset
- Community Asset Vulnerability Risk Assessment (VRA)
- Capability Analysis
- Hazard Mitigation Measures vs Mitigation Actions
- Resiliency
- Adaptation
- 2013 Plan- current Quincy HMP adopted by FEMA in 2013

WHAT IS THE BIG PICTURE?

Risk Assessment to Adaptation

- Define potential risk due to natural hazards including climate change
- Identify vulnerability of key community assets using best science
- Define mitigation projects for assets most at risk

Risk Assessment to Adaptation

- Evaluate **capacity** of City to implement projects
- Prioritize **mitigation** projects
- Evaluate **adaptive capacity** of most critical assets

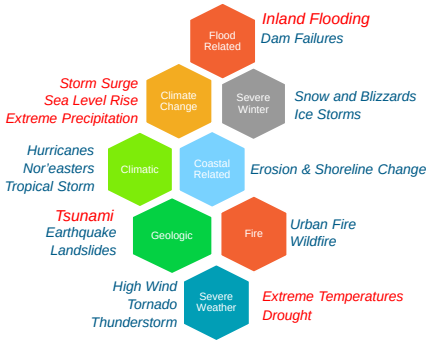
Multi- Hazard Mitigation Plan Guidance

- **Disaster Mitigation Act of 2000, 44 CRF Part 201.6**
- **Commonwealth of Massachusetts State Hazard Mitigation Plan 2013**
- ***FEMA Local Mitigation Plan Review Guidance, October 2011***
- ***FEMA Local Mitigation Planning Handbook, March 2013***
  1. Document the Planning Process
  2. Document Methodologies Used
  3. Involve Larger Community
  4. Address FEMA concerns from 2013

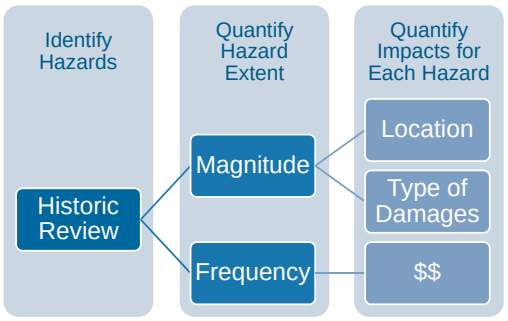
FEMA

NATURAL HAZARDS RISK ASSESSMENT

Natural Hazards Potentially Impacting Quincy



Multi-Hazard Risk Assessment



Multi-Hazard Risk Assessment

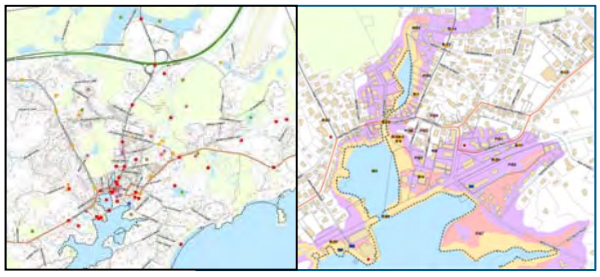
NEW Technical memo- review flooding due to climate change and inland flooding

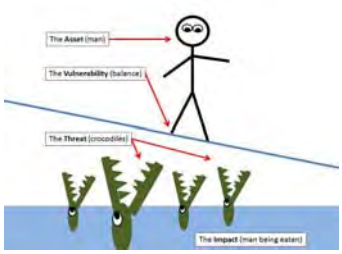
Community Asset to Include

FEMA Community Asset Categories	Critical Sectors	Characteristics of Community Assets
People	Schools, Vulnerable Populations, Cultural Facilities	Areas of greater population density, or population with unique vulnerabilities or less able to respond and recover during a disaster.
Built Environment	Critical Municipal Facilities, Water, Wastewater, Energy, Stormwater, Transportation, Cultural Resources	Critical facilities necessary for a community's response to and recovery from emergencies, infrastructure critical for public health and safety, economic viability, or needed for critical facilities to operate.
Economy	Marinas, Business and Industry	Major employers, primary economic sectors and commercial centers where loss or inoperability would have severe impact on the community and ability to recover from a disaster.
Natural Environment	Natural Resources	Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc.

IUpdate Risk Assessment Maps

- **Maps must be large enough to visualize impacts for property owner**
- **Consider unintended risk of climate change mapping**





VULNERABILITY ASSESSMENT

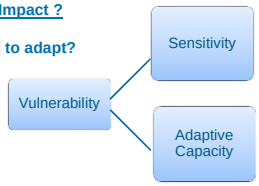
Community Asset Vulnerability Assessment

Measure Sensitivity of Asset to Hazard Risk

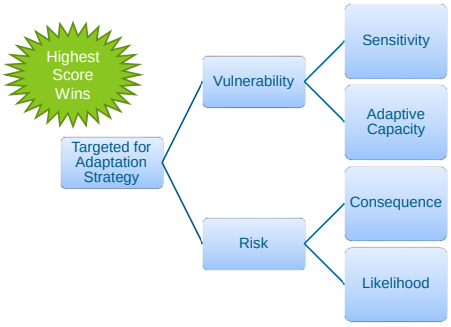
- Are critical components of the asset Vulnerable to Risk?

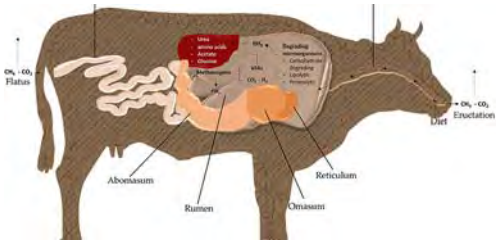
Evaluate Adaptability of Asset

- Can assets be Adapted to Resist Impact ?
- How much intervention is needed to adapt?



Community Asset Risk/Vulnerability Assessment



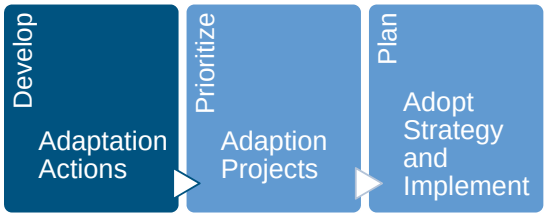


MIGITATION STRATEGY

Mitigation Strategy- Part 1

- Review Mitigation Goals and Objectives
- Review previous mitigation actions and changes in priorities
- Identify new mitigation actions
- Identify barriers or obstacles to implementation
- Complete cost–benefit for mitigation projects and prioritize

Mitigation Strategy- Part 2
Adaptation to Prepare for Changing Climate



Quincy's 2013 Goals

1. Ensure that critical infrastructure sites are protected from natural hazards.
2. Protect existing residential and business areas from flooding.
3. Maintain existing mitigation infrastructure in good condition.
4. Continue to enforce existing zoning and building regulations.
5. Educate the public about zoning and building regulations, particularly with regard to changes in regulations that may affect tear-downs and new construction.

Quincy's 2013 Goals

6. Work with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities.
7. Encourage future development in areas that are not prone to natural hazards.
8. Educate the public about natural hazards and mitigation measures.
9. Make efficient use of public funds for hazard mitigation.

IMPLEMENTATION STRATEGY

Multi- Hazard Mitigation Plan Implementation Strategy

Evaluate Capacity to Implement

Adopt Plan

Implement Plan

Maintain Plan

MEETING GOALS

1. Meet the Planning Team
2. Review Hazard Mitigation Planning Process
3. Review HMP Goals
4. Discuss Quincy 5-year Update Workplan

Contacts

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DEPARTMENT OF PLANNING & COMMUNITY DEVELOPMENT

34 Coddington Street, 3rd Floor – Quincy, Massachusetts 02169
Tel. 617-376-1362 Fax 617-376-1097
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JAMES J. FATSEAS
Director

THOMAS P. KOCH
Mayor

October 12, 2018

Dear HMP Advisory Group Member:

The Planning Department is pleased to present to you the ***First Complete Draft of the Hazard Mitigation Plan 5-year Update*** for review and comment. We ask that comments be provided directly to Robert Stevens no later than **Friday, October 19th**. This will ensure a Final Draft HMP can be prepared for City Council endorsement and public consumption prior to submission to FEMA for final approval.

Below you will find a link to view an electronic version of the Hazard Mitigation Plan Update. In addition, you are receiving a hard copy of the draft by ID mail. Please note that the maps in the hard copy are printed as 8.5"/11" size. Please use the electronic version to review the map details if needed.

https://www.quincyma.gov/civicax/filebank/blobdload.aspx?t=44546.99&BlobID=32148

(If you have trouble with web-link, contact Rob Stevens who will make arrangements for you to receive an electronic version of the HMP)

Comments can be provided by:

- Email a list of comments edits. Note the appropriate page, paragraph, sentence or the map/table;
- Write the edits directly in the hard copy, scan and email or ID Mail the hardcopy of the edits to Planning.
- If a rewrite of a paragraph is warranted, contact Rob Stevens who can provide a Word version of the HMP section for you to edit.
- Rob Stevens can be reached at 617-376-1411 and rstevens@quincyma.gov

Thank you to those who have provided valuable information and insight into the development of this HMP Update. We look forward to your hearing from you on this draft.

Sincerely,

James Fatseas
Planning Director

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JAMES J. FATSEAS
Director

THOMAS P. KOCH
Mayor

Notice of Public Hearing
Draft Hazard Mitigation Plan 5-year Update
City of Quincy Planning Board

Notice is hereby given that in accordance with the provisions of Robert T. Stafford Act and Title 44 Code of Federal Regulations (CFR) §201.6, the Quincy Planning Board will hold a public hearing on **Wednesday December 5, 2018 at 7:30 p.m. in the Lower Level Conference Room, Old Town Hall, 1305 Hancock Street, Quincy, MA.** The purpose of this hearing is to give interested parties the opportunity to comment on the Draft Hazard Mitigation Plan 5-year Update.

Written comments may be provided to the Department of Planning and Community Development, which will be accepted until 4:00 p.m. Friday, December 7, 2018. Comments received before the Public Hearing on December 5, 2018 will be reviewed and included in the Public Hearing record. A record of the Public Hearing will be included in the Draft Hazard Mitigation Plan 5-year Update submitted to The Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA).

Copies of the Draft Hazard Mitigation Plan 5-year Update, compiled pursuant to Robert T. Stafford Act and Title 44 Code of Federal Regulations (CFR) §201.6, may be reviewed in the Department of Planning and Community Development at 34 Coddington Street 3rd Floor, the Thomas Crane Public Library main branch at 40 Washington Street, and an electronic copy is available at www.quincyma.gov.

Quincy Planning Board

The Patriot Ledger
To be published: **Wednesday, November 28, 2018.**

Please send copy of proof to Planning Department, 34 Coddington Street 3rd Floor, Quincy, MA 02169.

Patriot Ledger: Send the bill to:

James J. Fatseas
Director of Planning and Community Development
34 Coddington Street, 3rd Floor
Quincy, MA 02169
Phone: 617-376-1362
Email: jfatseas@quincyma.gov

Public Comments on Quincy Hazard Mitigation Plan - December 2018

- As a resident of Squantum I'm curious regarding the time we have before the causeway gets routinely overtopped by normal king tides as what happens along Morrisey Ave (near JFK).

  I'm curious if you were involved in the Living with Water design competition by the BSA and BRA 2 years ago. I think some of these concepts especially marsh restoration or creation should play a part in the adaptation plan.

- First our thanks for all the very detailed work you have dedicated to the Hazard Mitigation Plan and for your presentation and discussion at the 12/5/ Planning Board meeting. The few of us who attended and spoke obviously represent the concerns of many hundreds and potentially thousands of Quincy residents who are or will be affected by climate change, sea level rise and flooding.
  (A reminder to all that the very detailed 200 plus page plan is available for review on line City's website, under the Planning & Community Development section, and at the Thomas Crane Public Library.)

  Below are excerpts from emails we have sent out previously that outline critical needs, short and long term, which we believe must be included (if they have not already been) in this and future Hazard Mitigation plans.

- The proposed compressor station next to the Fore River Bridge must be confronted for the blatant safety ,health and environment danger it poses to area residents and drivers. This is a prime case of "hazard mitigation", preventing a catastrophe before it is allowed to happen due to bullying by a private power company. We need the energy but not at this risk. And potential cost.

- With 27 miles of coast, Quincy needs a designated Coastal Manager to coordinate the City's flooding prevention and response efforts.

- There is a range of possibilities for sea level rise and flooding depending upon the study and methods – but most agree ,and recent Hurricanes Florence affecting the Carolinas ,and Michael devastating the Florida Panhandle, demonstrate that we can expect higher sea levels, more frequent and more fierce storms, resulting in severe flooding. We need to prepare as effectively as possible.

  With some predictions of sea level rise for the Boston area by 2100 (a mere 81 years) ranging from 2 feet to 7 feet, at base level, not including astronomically ever higher tides, super storm winds and tidal surges, some favor a 4 foot seawall construction from the outset, rather than in less likely 2 foot future increments. As has been noted, the choice for seaside residents may be between having a home or a view. Of course all voices need to be heard in the final decision.

- The December 1st Patriot Ledger feature "Existential Threat" on climate change characterized the situation exactly for Quincy and the South Shore: we are facing a threat to our very existence, that of our homes and neighborhoods.

- Please keep us informed on the status of project funding, up-coming public meetings and construction plans.

- Thank you so much for the public meeting of the Planning Department and for all your work on the report. Quincy needs to prepare for the more extreme storms and sea level rise that will surely cause more flooding.

- *I understand that usually the Municipal Vulnerability Assessment is done before the Hazard Mitigation Plan. In fact, in the last debate Gov. Baker had with his challenger for governor, Jay Gonzalez, he said he would be working on first the Municipal Vulnerability Grants and then the Hazard Mitigation Plans. Why is Quincy doing them in reverse order? Is this significant? Exclude?*

- The report should include recommendations for not only seawalls but also for a stop to plans for the Weymouth compressor station that will only exacerbate climate change and for an increase in renewables like wind, solar and an electric fleet of cars for the city.

- The flooding that strikes Post Island, blocks Sea St.,isolates all of Houghs Neck,and makes everyone in Houghs Neck vulnerable to potential catastrophic fires and medical emergencies.

- We continue to actively work in close cooperation with Quincy City Officials, Quincy Department of Public Works, Tighe and Bond and construction partners to assure essential neighborhood input for the optimal outcome of this complex project, addressing drainage, flood control, seawall design/construction/maintenance and emergency management. In the face of undeniable sea level rise and the greater frequency of "super storms" due to climate change, the survival of our neighborhoods depends upon this project succeeding in every critical aspect.

  We realize that the funding and execution of the 8000 linear foot new seawall from the Willows to Chickatabot (Phase 1) is very complex in every aspect- from funding to design, to construction and follow up maintenance. Community meetings 10/2 and 10/9 and 11/1 have been characterized by good communication and cooperation among residents, DPW and Tighe and Bond, all with the goal of providing the best drainage, flood control, and seawall design possible to protect our neighborhoods from increasing sea level rise and climate change. We realize that the seawall project if it begins in 2019 will likely not be completed until 2022 or later.

  The BIG question asked at community meetings is : "What do we do in the meantime?"

- About 30 area residents met 10/24/18 and have developed these priorities which we hope the project partners will address in specific detail as soon as possible.

#1- Drainage -Drainage - Drainage
It cannot be emphasized strongly enough that the water that comes over even the best designed seawall, whether 2 or 4 feet higher, must be able to drain from Sea St., our marshes and neighborhoods. Drainage problems must be addressed before and as the wall is built to prevent the "the bathtub effect.

#2-Pumping Stations –
A more immediate help mentioned at the 10/9 meeting would be pumping stations. These are separate in funding and implementation from the seawall project, but complementary and integral to it. We understand there is money available from MEMA for this type of project right now. It has been noted that with such pumping stations in place and other proper drainage measures (outfalls, seawall drains, etc.) the additional 2 foot seawall height might be sufficient. We want to receive, as soon as possible, plans for appropriate capacity wireless pumping stations at the 2 lowest most flood prone areas on Post Island: Mallard Rd and near 68 Post Island Rd. configured to drain marshes and streets. As previously stated, mitigating Post Island flooding, mitigates the surrounding 123 homes from flooding as well as keeping the only access to Houghs Neck open to all residents

#3-Twin Barrel Culverts under the Dike near Sea St boardwalk –
As has been noted, the opening of these long closed enormous culverts (each 10 feet x 10 feet, originally designed for drainage and flood control) could greatly reduce Sea St area flooding – and hopefully could be achieved relatively quickly and inexpensively. We hope that the November 2018 meeting with the Army Corps of Engineers, MWRA, Quincy Officials/DPW reps, Tighe and Bond reps, PJ Foley and others will coordinate this essential flood control effort as soon as possible. We understand an agreement between the City, the Army Corps et al is forthcoming. Opinion is that the actual work could begin in Spring 2019.

#4-The Post Island Marsh-
Among the hardest hit by the March 2 Winter Storm Riley was the home of Jean, Kerrin and Nolan Curran at 30 Elcott Rd. on Post Island, located at the lowest point of the Post Island Marsh. A number of other area homes were very badly flooded and severely damaged. Residents cannot return home during reconstruction and must shoulder the burden of paying mortgages, taxes and insurances on their homes while paying apartment rents. The Curran home was condemned by the City Building Dept. They have been entangled in insurance policy red tape and appeals to the City to resolve their status. We call upon the City to assist them in resolving their dilemma.
Ongoing undermining of their property may have occurred due to improper management of water flow into the Marsh. The Post Island Rd. tide gate (not meant to be a flood control device) needs to be properly maintained for correct saltwater flow level for a healthy marsh, and the Marsh evaluated for needed creek dredging/maintenance to prevent future problems with flooding and mosquitos.

#5- Flooding between 11 and 15 Post Island Rd. –
The easement between these homes has been a conduit for flooding events over the years, for these 2 and 5 other homes next to and behind them. A proper culvert to provide drainage to the marsh may be part of the solution.

#6-Stairs to the Beach–
final drawings should exhibit permanent concrete over the stairs at Mallard Rd. Elcott Rd., Poplar Rd. and next to 68 Post Island Rd to assure year round access to beaches.

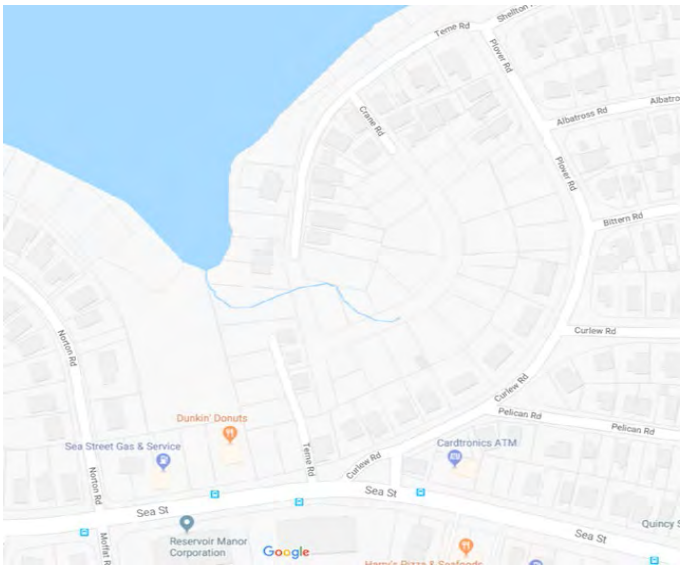
#7 "Be Prepared!"-
When will the planned widening of the Dike path from Palmer St to Labreque Field for emergency access be completed?

The ongoing efforts of the DPW to keep catch basins and outfalls open and tide gates operational for flooding prevention are essential and greatly appreciated.

We look forward to the Director of Emergency Management updating on the City Website plans for emergency evacuation, shelter, emergency alerts via cell phone texts. etc.

- I was impressed with the Draft HMP presented at The Planning Board Meeting this past Wednesday. My main comment is that I would like to see some areas designated and designed as marsh restoration areas. I think this a key design consideration for living with water.

Terne Road



I assume map used in the HMP draft shows is not for close inspection. However, it does have some problems. I bring this up because of reality of Terne Road is that many people, including First Responders, have a very difficult time finding Terne Road and then they must find the correct part of Terne Road. The Sea Street entrance is very hard to find. Many that do find it have no way of telling that a creek divides the road and only allows access to three homes. Were we to need help from first responders, they can, and do, find themselves lost. If the city wants first responders to respond promptly to a future hazard, <u>the city needs to minimize the possibility of the responders not finding the correct location.</u>

Looking closely at the HMP map, it shows a "paper" map of Terne Road that does not exist. Terne Road was to be built east of the 3 homes, but the "private way" Terne Road, that exists, is on the west of the homes. Google shows this correctly.

Initially, all utilities were on the paper road. Because the paper road was overgrown ten years ago, the gas company ran a new gas line down the private way of Terne Road. T<u>he city needs to track changes like this to mitigate the possibility that a digging project starts without this knowledge.</u>

Terne Road Saltmarsh

Section 7/Mitigation Strategy/ Protection of Natural Resources/page 7- 2 has as an objective to "Preserve and restore ecosystems along coastline..."

In the early 1940s, my parents bought a cottage in the TR salt marsh. There was no seawall. Average high tides surrounded the cottage. Kids could sit in the creek and catch a big bucket full of fish in 15 minutes

In 1960, the city and state build a seawall and tide gate intended to kill the salt marsh. My parents were not informed that the salt marsh was to become a containment area for the nearby storm water runoff and 17 storm drains. When the city rebuilt the tide gate in 1994, I have been told there was no permit for the work. I believe had the permit been pursued, the city would have been required to help maintain what remained of the salt marsh.

The city has not treated this small marsh with much respect. I have been crusading for the city and T&B, as part of the Adams Shore/Hough's Neck Seawall Repairs and Improvements Restoration, to consider the following:

- Separate outfall and pump for storm water from all storm drains.
- Replacing the tide gate to allowed salt water to the landside of the Seawall to help restore the salt marsh.
- If the city is determined to restore our natural resources, I suggest that a Rain Garden be created in the open space area behind Dunkin Donuts and the gas station. This would be an environmental home run!

Wildfire

Highly flammable phragmities cover most of the Terne Road Marsh. Phragmities burn hot and fast. Many houses have phragmities that can grow right up to their homes. Shortly after Dunkin Donuts moved to its present location, a cigarette thrown over the donut shop fence into the marsh set the phragmities ablaze. Please be advised of this potential hazard. First responders need to know the location of Terne Road and other hard to find roadways.

Clamming is mentioned at least couple of times. I Introduction / 1.4.1 /Water Resources /Page 1-6. Probably an oversight, perhaps it could be replaced with "beachcombing".

Natural Resources

I really have a great love for natural resources. However, listing Furnace Brook Parkway and other man-made resources, like Wollaston Beach, could have there own category or at least something in (parentheses). The city can be proud of these resources, but we should not confuse our citizens and visitors.