

MASHPEE

2017 Hazard Mitigation Plan





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Introduction

Introduction

The purpose of hazard mitigation is to reduce loss from future natural disasters. Storms and other natural disasters can cause loss of life, damage to buildings and infrastructure and have devastating consequences to a community's economic, social, and environmental well-being. One step to reducing loss in a community is to have a plan for the future. To accomplish this task, most communities develop a local Hazard Mitigation Plan, also known as a Single Jurisdiction Hazard Mitigation Plan. It is drafted and reviewed by town officials and residents and then approved by the Massachusetts Emergency Management Agency (MEMA) and by Federal Emergency Management Agency (FEMA).

The purpose of the Mashpee Hazard Mitigation Plan is to reduce damages resulting from natural hazards by implementing sustained actions to reduce or eliminate long-term risk to human life and property from hazards. The Mashpee Hazard Plan is also about building a successful, long-term outreach strategy to educate residents about natural hazards that could affect the town, to prepare them in case a storm impacts the town, and to create a resilient town that can recover after a storm event. Over the last several months, Town staff and the residents of Mashpee have worked diligently to meet the FEMA requirements for developing a new single jurisdiction hazard plan while maintaining the character and individuality of Mashpee.

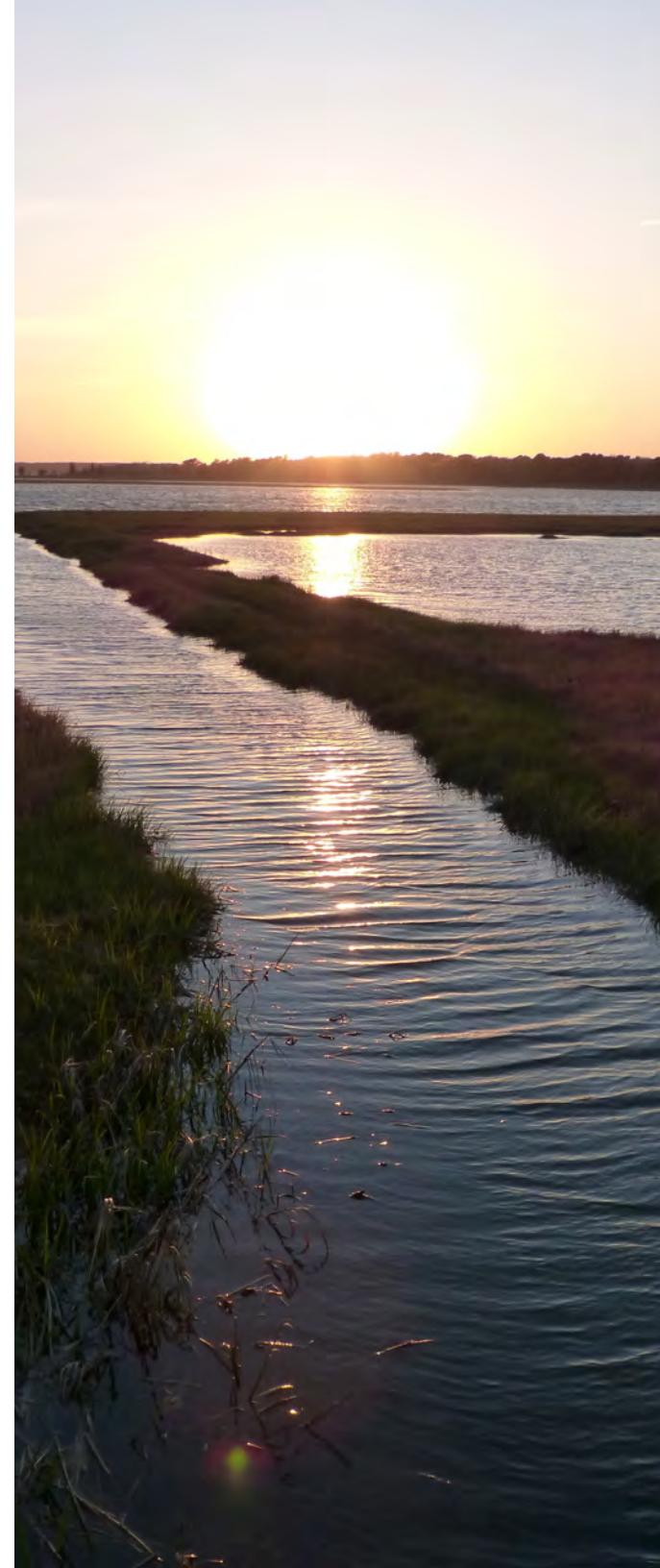
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It is important to note that if and when the 2017 Mashpee Hazard Plan Update is approved by FEMA and adopted by the Board of Selectman, the town becomes eligible to receive funding from FEMA's Hazard Mitigation Assistance (HMA) program, which includes the following programs:

- **Hazard Mitigation Grant Program (HMGP):** assists in implementing long-term, "forward thinking" hazard mitigation measures following a major disaster
- **Pre-Disaster Mitigation (PDM):** provides funds for hazard mitigation planning and projects on an annual basis
- **Flood Mitigation Assistance (FMA):** provides funds for projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis.

Review Tool Description:

FEMA developed a "Local Mitigation Review Guide" to help Federal and State officials assess Local Hazard Mitigation Plans in a fair and consistent manner and to ensure approved local plans meet the requirements of the Stafford Act and Title 44 Code of Federal Regulations (CFR) 201.6. The "Local Mitigation Review Guide" was used as guidance in updating the Mashpee Hazard Plan. When text in the Mashpee Hazard Plan meets an element identified in the Review Guide, it is called out in a colored box in the margin.



The Planning Process

CHAPTER ONE

Municipal plans require expertise from a core team of Town officials and input from stakeholders, the public, and neighboring communities. When community-wide plans have the support from a diverse cross-section of stakeholders, residents, and Town officials, the final plan becomes a “living” document that is useful for the community on a long-term basis. In particular, a hazard plan is considered successful if it educates residents about the risk and vulnerability related to natural hazards and builds support for policies, actions, and tools that reduce future losses from natural hazards. **Chapter 1 is a narrative on the hazard planning team and the outreach process used to develop the 2017 Mashpee Hazard Plan.**

Planning Team

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Planning Team

A1d

Members and Responsibilities

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The Planning Team is an interdisciplinary group of town staff members with expertise to develop the plan and the authority to implement the action items in the plan. Several staff members from the Cape Cod Commission provided technical support to the Planning Team.

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Table 1.1 lists the names, titles and affiliations of the Mashpee Hazard Planning Team. The Town's Emergency Management Manager is the Fire Chief, Thomas C. Rullo.

Name	Title	Affiliation
Scott Carline	Chief	Police Department
Rodney Collins	Town Manager	Town Manager
Tom Fudala	Town Planner	Planning Department
Glen Harrington	Health Agent	Board of Health
Catherine Laurent	Director	Department of Public Works
Andrew McManus	Conservation Agent	Conservation Commission
Michael Mendoza	Building Commissioner/ Zoning Official	Building Department
Clay Nicholson	GIS Coordinator	GIS - Emergency 911
John Phelan	Deputy Chief	Fire Department
Wayne Taylor	Assistant Town Manager	Town Manager
Cally Harper (through 1/2017)	Planner	Cape Cod Commission
Chloe Schaefer (starting 2/2017)	Planner	Cape Cod Commission
Gary Prahm	GIS Analyst	Cape Cod Commission

Table 1.1 | Mashpee Hazard Planning Team

Planning Team

This core group was responsible for developing and reviewing drafts of the Hazard Plan, creating the mitigation strategy and submitting the plan for adoption by the Federal Emergency Management Agency (FEMA) and the Mashpee Board of Selectman. **Table 1.2** outlines the responsibilities of each member of the Planning Team.

Meeting Schedule and Involvement

The Planning Team worked collaboratively in large and small group meetings. Beginning in August 2016, the Planning Team met several times to develop sections of the hazard plan.

Town Manager/Assistant Town Manager	Attended team meetings, reviewed drafts of the plan
Town Planner	Assisted with the development of the hazard profile, reviewed/developed mitigation actions, assisted with public outreach strategy
Police Chief	Developed the critical facilities list, reviewed/developed mitigation actions, assisted with the public outreach strategy
Deputy Fire Chief	Developed the critical facilities list, provided data on historical fires in Mashpee, reviewed/developed mitigation actions, assisted with the public outreach strategy
Public Works Director	Developed the critical facilities list, provided data on hazard impacts , reviewed/developed mitigation actions
Building Commissioner	Organized team meetings, reviewed/developed mitigation actions, assisted with the public outreach strategy
Health Agent	Assisted with the development of the hazard profile, reviewed/developed mitigation actions, assisted with public outreach strategy
Conservation Agent	Reviewed/developed mitigation goals and actions, assisted with public outreach strategy
GIS Coordinator	Developed the critical facilities list, prepared maps or provided feedback on maps for the plan
Planners, Cape Cod Commission	Facilitated meetings with the Planning Team; coordinated the development of the hazard plan
GIS Analyst, Cape Cod Commission	Prepared maps for the town hazard plan; used GIS software to conduct a risk assessment for the town

Table 1.2 | Planning Team Responsibilities

Outreach Strategy

Below is a list of dates and topics covered at each of these large group meetings.

- **August 2, 2016:** identified critical facilities, reviewed definition of a hazard profile, discussed draft hazard maps and the relevance and future probability of natural hazards in town, reviewed draft of public survey
- **October 4, 2016:** reviewed vulnerability assessment, critical facilities review, reviewed old mitigation goals; finalized public survey; developed new Mitigation Actions for the plan
- **November 1, 2016:** reviewed Mitigation Actions for the 2017 Mashpee Hazard Plan
- **April 18, 2017:** reviewed results from public survey; reviewed and refined mitigation goals; refined and prioritized Mitigation Actions for the 2017 Mashpee Hazard Plan; discussed capabilities assessment

For a list of meeting attendees, see “Team Meeting Attendance” in **Appendix 1**.

There were several instances where the expertise of only a few team members was required for a specific task in the Mashpee Hazard Plan. Therefore, small group meetings were also held from August to October 2016 with the Planner, GIS Department, Fire Chief, Police Chief, and Department of Public Works.

Outreach Strategy

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With the Public

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The public was engaged at two different times during the planning process: during plan development and prior to submission of the draft plan for MEMA/FEMA review.

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During Plan Development

The Planning Team developed an online survey to gather data on the significance and relevance to Mashpee of the natural hazards identified in the Massachusetts State Hazard Plan, the impact of those significant natural hazards, and preparedness efforts in Mashpee. The survey also gathered data on how residents would like to be engaged in the future. The survey was launched on January 13, 2017 and the public was given at least three weeks to fill out the survey. A link to the survey was available to residents and to the people who work in Mashpee via the main page of the Town Website, as well as on the Mashpee Police Facebook page and through several local news outlets. The Planning team received 112 respondents to the public survey. For a copy of the survey, see “Public Survey” in **Appendix 1**.

Documentation for the launch of the survey can be found in the “Public Survey Notices” section of **Appendix 1**.

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The Planning Team incorporated survey responses into the plan in the following ways:

- The public was asked to identify specific hazards they experienced or are most concerned about while living or working in Mashpee. They were presented with the 11 hazards identified in the Massachusetts State Hazard Plan and could select as many of these hazards as they wanted. These selections were used to determine whether or not a hazard is significant to the town (*see Column 3, Table 2.2*).
- The public was asked to identify steps that the local government could take to reduce risk from natural hazards and protect the buildings and people of Mashpee. They were presented with a list of mitigation actions to reduce risk and loss and given the opportunity to suggest additional actions. These actions were considered for the Mitigation Actions of the hazard plan. For example, several respondents selected debris removal and improving drainage on roads. There are specific mitigation actions that address debris removal and road drainage.

Prior to Submission to MEMA/FEMA

The Mashpee Hazard Mitigation Plan was presented at the Board of Selectmen's meeting on July 24, 2017. During the meeting, the public had the opportunity to provide verbal comments. Prior to the meeting, the Plan

was posted on the Town website and the public had the opportunity to provide written comments. The following comments were received:

- Jim Rogers, Mashpee Resident, commented that he is glad the Town is developing this Plan.
- Amy Dray, Mashpee Homeowner, inquired about the approval process of a dock, parking area, and volleyball court developed in a flood zone near her home.

With Stakeholders

A stakeholder is someone who may be affected by or have an interest in the Mashpee Hazard Plan and its implications, but did not regularly participate in Planning Team meetings. Stakeholders for hazard planning efforts can be public officials, agency heads, members of neighborhood or civic organizations, business associations or staff from academic institutions.

Stakeholders were actively engaged in updating the Mashpee Hazard Plan. The stakeholder process involved three important steps:

1. Stakeholders were identified by the Planning Team
2. The Planning Team designed a strategy to engage and gather input from stakeholders
3. Stakeholders provided input during the planning process and prior to plan approval

Outreach Strategy

Identification of Stakeholders

Members of the Planning Team identified stakeholders and staff at the Cape Cod Commission assisted in identifying stakeholders at the county, state, and federal levels.

Stakeholders included employees and volunteers from many different organizations and groups in Mashpee and across Cape Cod, including:

- Mashpee Chamber of Commerce
- Mashpee Conservation Commission
- Mashpee Council on Aging
- Mashpee Environmental Coalition
- Medical Reserve Corps
- Mashpee Men's Club
- Mashpee Women's Club
- Barnstable County Regional Emergency Planning Committee
- Barnstable County Department of Health and Environment
- Cape Cod Cooperative Extension
- International Fund for Animal Welfare

Table 1.3 is a list of individuals from each of these organizations who participated updating the Mashpee Hazard Plan.

Stakeholder Participation

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Stakeholders were engaged twice during the planning process – once during plan development and again prior to submission of the draft plan to MEMA and FEMA. During plan development, stakeholders were invited to complete an online survey (to view the survey, see “Public Survey” in **Appendix 1**). Stakeholder input from the survey resulted in the following:

- Provided data on whether or not specific hazards were significant to the town (**See Table 2.1**)
- Identified problem areas in town and specific projects that they wanted to see implemented (i.e., creation of an evacuation plan), which helped inform the Mitigation Actions of the Hazard Plan

Prior to plan submission, the Mashpee Hazard Mitigation Plan was presented at the Board of Selectmen's meeting on (date TBD). At this meeting, stakeholders had the opportunity to provide verbal comments. Stakeholders were also sent a draft of the plan prior to the Board of Selectmen's meeting for the opportunity to provide written comments. The following comment was received:

- Shannon Jarbeau, CRS Coordinator at the Cape Cod Cooperative Extension, asked for clarification on the public comment process, the repetitive loss properties, and provided some additional information for flooding impacts on buildings, which was incorporated into the plan.

A3d

Name	Affiliation
Mary Lou Palumbo	Executive Director, Mashpee Chamber of Commerce
Andrew McManus	Conservation Agent, Mashpee Conservation Commission
Mashpee Conservation Commission	All members
Lynne Waterman	Director, Mashpee Council on Aging
Michael Talbot	President, Mashpee Environmental Coalition
Diana Gaumond	Director, Medical Reserve Corps
Deane Turner	President, Mashpee Men's Club
Jeanne Dennis	President, Mashpee Women's Club
Sean O'Brien	Coordinator, Barnstable County Regional Emergency Planning Committee; Interim Director, Barnstable County Department of Health and Environment
Michael Maguire	Director, Cape Cod Cooperative Extension
Jennifer Gardner	Animal Rescue Program Officer, International Fund for Animal Welfare
Kristen Patchett	Stranding Coordinator, International Fund for Animal Welfare

Table 1.3 | Stakeholders for updating the Mashpee Hazard Plan

With Neighboring Communities

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A2c

Neighboring communities were given the opportunity to participate in the planning process at a Barnstable County Regional Emergency Planning Committee monthly meeting.

Barnstable County Regional Emergency Planning Committee (BCREPC)

The Planning Team gathered input from towns across Cape Cod during the March 2, 2016 meeting of the Barnstable County Regional Emergency Planning Committee. During the meeting, Cally Harper, Planner at the Cape Cod Commission, informed the committee that several towns on Cape Cod, including Mashpee, are updating their Hazard Plans and asked committee members to comment on the history and impact of specific hazards on Cape Cod and their level of concern for future hazard events. The presentation and survey results are located in the “BCREPC Presentation” and “BCREPC survey results” section in **Appendix 1**.

The process for incorporating input from the BCREPC meeting into the hazard plan was as follows:

1. The Planner and GIS coordinator from Mashpee and the Planner from the Cape Cod Commission reviewed the impact and probability ranking and the comments from the BCREPC meeting

Incorporation with Other Town Plans and Reports

- Those rankings and comments were incorporated into the plan and used to determine whether or not a hazard is significant to the town (*see Column 3, Table 2.7*).

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Continuing Outreach Efforts During Plan Maintenance

Once the 2017 Mashpee Hazard Plan is approved by MEMA and FEMA, it will be forwarded to the Mashpee Board of Selectmen for adoption. Once adopted, the 2017 Mashpee Hazard Plan enters into the “Maintenance Period” and will be active for five years. During this maintenance period, FEMA requires the Planning Team to continue engaging with the public.

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The following is a list of engagement activities that the Planning Team will complete during this five-year maintenance period:

- **Online surveys** to gather data on whether or not Mashpee residents are prepared for nor’easters, hurricanes, and severe winter weather. These surveys will be posted on the Town website and on the Police Department’s Facebook page.
- **Presentations** to school and community groups about the science of hazards and/or how to prepare for specific weather events.

Incorporation with Other Town Plans and Reports

Technical Information Used in the Plan

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The 2017 Mashpee Hazard Plan was drafted using existing plans, studies, reports and technical information from local, county, state, and federal agencies. Technical data used to formulate the Hazard Profile is cited under each Hazard Profile and is not explicitly cited in the list below.

Below is a list of the resources from federal, state, and local agencies that were used and incorporated into the 2017 Mashpee Hazard Plan:

■ Technical Information from Federal Agencies:

- Local Mitigation Planning Handbook (2013) prepared by FEMA
- How-To Guide: Getting Started – Building Support for Mitigation Planning (FEMA 386-1, 2002) prepared by FEMA
- How-To Guide: Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA 386-2, 2001) prepared by FEMA
- How-To Guide: Developing the Mitigation Plan (FEMA 386-3, 2003) prepared by FEMA

Incorporation with Other Town Plans and Reports

- How-To Guide: Bringing the Plan to Life – Implementing the Hazard Mitigation Plan (FEMA 386-1, 2002) prepared by FEMA
 - Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (2013) prepared by FEMA
 - Hazard Mitigation Assistance Guidance (2015) prepared by FEMA
 - National Flood Insurance Program Community Rating System Coordinator’s Manual (FIA-15/2013 prepared by FEMA
 - National Flood Insurance Program Floodplain Management Requirements: Study Guide and Desk Reference for Local Officials (FEMA 480, February 2005) prepared by FEMA
 - Risk Management Series Design Guide for Improving Critical Facility Safety from Flooding and High Winds (FEMA 543, January 2007) prepared by FEMA
 - Mitigation Assessment Team Report Hurricane Ike in Texas and Louisiana: Building Performance Observations, Recommendations, and Technical Guidance (FEMA P-757, April 2009) prepared by FEMA
 - Recommended Residential Construction for Coastal Areas: Building Strong and Safe Foundations (FEMA P-550, 2nd Edition, December 2009) prepared by FEMA
 - Wind Retrofit Guide for Residential Buildings (FEMA P-804, December 2010) prepared by FEMA
 - Home Builder’s Guide to Coastal Construction Technical Fact Sheets Series (FEMA P-499, December 2010) prepared by FEMA
 - Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas Volume I and II (4th edition, FEMA P-55, August 2011) prepared by FEMA
 - Highways in the Coastal Environment: Assessing Extreme Events (2014) prepared by the U.S. Department of Transportation and the Federal Highway Administration
 - National Climate Assessment (2014)
- **Technical Information from State Agencies:**
- Massachusetts State Hazard Mitigation Plan (2013) prepared by Tetra Tech on behalf of the Massachusetts Emergency Management Agency and the Department of Conservation and Recreation
 - Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers, and Municipal Officials (2003) prepared by Franklin, Hampden, Hampshire Conservation Districts

Incorporation with Other Town Plans and Reports

- Massachusetts Climate Change Adaptation Report (2011) prepared by Executive Office of Energy and Environmental Affairs and the Adaptation Advisory Committee
- Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning (2013) prepared by the Massachusetts Office of Coastal Zone Management
- Massachusetts Coastal Erosion Commission Report (draft released in 2015) prepared by Coastal Erosion Commission
- Commonwealth of Massachusetts All Hazards Disaster Debris Management Plan (2010) prepared by the Massachusetts Emergency Management Agency
- Massachusetts Homeowner's Handbook to Prepare for Coastal Hazards (2014) prepared by Barnstable County, Woods Hole Sea Grant and MIT Sea Grant
- **Technical Information from County Agencies:**
 - Barnstable County Multi-Hazard Mitigation Plan (2010) prepared by the Cape Cod Commission
 - Barnstable County Wildfire Preparedness Plan (2012) prepared by Barnstable County and the Cape Cod Cooperative Extension

- **Technical Information from Mashpee:**

- Mashpee Local Comprehensive Plan (2008) prepared by the Town of Mashpee
- Town of Mashpee Zoning Bylaws (2015)
- Town of Mashpee Open Space Conservation and Recreation Plan (2009)

How Technical Information was Incorporated

A4b

The technical information listed above was incorporated into the 2017 Mashpee Hazard Plan in the following ways:

- Federal documents, especially all FEMA documents, were used to:
 - Guide the activities of the planning process
 - Provide technical guidance on successful mitigation practices in coastal communities
 - Help the Planning Team develop mitigation actions
 - Provide current data on climate change and adaptation strategies

Incorporation with Other Town Plans and Reports

- State and County documents were used to:
 - Provide current data on hazard events affecting Massachusetts and Barnstable County especially climate change, sea level rise and coastal erosion
 - Guide the Planning Team on current state mitigation actions and plans; these documents were used as reference for the Planning Team
- Mashpee specific documents were used to:
 - Ensure that mitigation actions in the 2017 plan were consistent with current activities and plans already in place in Mashpee

Space and Recreation sections of the LCP. Below are a few examples of Mitigation Goals that will be integrated in the update of the Mashpee LCP:

- Reduce the potential for loss of life, property, infrastructure, and environmental, cultural and economic resources in Mashpee from natural disasters.
- Mitigate repetitive damage caused by natural hazard events.
- Ensure that mitigation measures are sensitive to the natural features, historic resources, and community character of Mashpee.

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Integrating the Hazard Plan into other Town Plans

The Mitigation Goals and Objectives identified in the 2017 Mashpee Hazard Mitigation Plan will be incorporated into the objectives and policies of the Mashpee Local Comprehensive Plan (LCP).

- **Mashpee Local Comprehensive Plan:** The Mashpee LCP describes goals, policies and actions on land use, growth management, natural resources, open space and recreation, historic preservation and community character, economic development, affordable housing, and community facilities and services. Mitigation Goals, Objectives and Actions will be incorporated in the Coastal Resources, Wetlands/Wildlife and Plant Habitat and Open

New FEMA guidance requires that the 2017 Mashpee Hazard Mitigation Plan Update describes how the plan was integrated with other plans over the last five years. Because this is a new requirement, Mashpee does not have a process in place to collect such information. Going forward, Mashpee will keep a running list of the new and updated town plans on their website and the Town Planner will be responsible for ensuring that town planning efforts are consistent with the 2017 Mashpee Hazard Mitigation Plan.

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Contents of Chapter 1 Appendix

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Contents of Chapter 1 Appendix

Contents in the Chapter 1 Appendix include:

- Planning Team Meeting Attendance
- Public Survey
- Public Survey Notices
- Public Survey Results
- Draft Plan Public Comment Website
- Draft Plan Public Comment Notices
- Barnstable County Regional Emergency Planning Committee Meeting Notes (March 2, 2016)
- BCREPC Presentation (March 2, 2016)
- BCREPC Survey Results (March 2, 2016)

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Natural Hazards

CHAPTER TWO

Mashpee is vulnerable to a wide range of natural hazards that threaten life and property. Current FEMA regulations and guidance under the Disaster Mitigation Act of 2000 require, at a minimum, an evaluation of a full range of natural hazards identified in the most recent Massachusetts State Hazard Plan. An evaluation of human-caused hazards (i.e., technological hazards, terrorism, etc.) is encouraged but not required for plan approval. Mashpee has included an assessment of natural hazards only in the 2017 Mashpee Hazard Plan. **Chapter 2 provides a detailed description of the natural hazards that could impact Mashpee in the future or have impacted Mashpee in the past.**

Hazard Identification

Hazard Identification

State Hazards

The 2013 Massachusetts State Hazard Plan identifies 11 natural hazards that could impact or have a history of impacting communities in the Commonwealth of Massachusetts. These hazards are listed below:

- Coastal Erosion
- Dam Failure
- Earthquake
- Fire (urban and wildland)
- Flood
- Hurricane and Tropical Storms
- Landslide
- Nor'easters
- Severe Weather (includes high winds, thunderstorms, extreme temperatures, tornadoes and drought)
- Severe Winter Weather (includes snow, blizzards and ice storms)
- Tsunami

Selection of Hazards that affect Mashpee

As suggested under FEMA planning guidance, the Planning Team reviewed the full range of natural hazards identified in the 2013 Massachusetts State Hazard Plan and identified natural hazards that could impact Mashpee in the future or that have impacted Mashpee in the past (**Table 2.1**). This determination was made using local expertise from Planning Team members, input from the Barnstable County Regional Emergency Planning Committee, data from the 2013 Massachusetts State Hazard Plan, and other resources. All resources are referenced in the text of each hazard profile.

Larger versions of the maps of Mashpee in this chapter can be found in the Appendix.

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Hazard Identification

B1a,b

Type of Natural Hazard	According to weather data, is there a history of this hazard happening in Mashpee?	What resources were used to make that determination?	According to the Planning Team, could this hazard happen in Mashpee?	Why was this determination made?
Coastal Erosion and Shoreline Change	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan 2015 Coastal Erosion Commission Draft Report Massachusetts Coastal Zone Management Storm Coasts application Local knowledge from Town Staff 	Yes	There is a history of erosion and shoreline change in Mashpee
Dam (Culvert) Failure	No	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	There are aging culverts in Mashpee therefore increasing the probability of failure
Earthquake	No	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	There is no history of earthquakes in Mashpee but there is a history of earthquakes in Massachusetts
Fire (Urban and Wildland)	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff www.capecodfd.com Barnstable County Wildfire Preparedness Plan 	Yes	Fire-adapted vegetation puts the town at risk for wildfire
Flood	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan FEMA 480 Local knowledge from Town Staff Newspaper articles 	Yes	There is a history of flooding in Mashpee
Hurricane and Tropical Storms	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan National Hurricane Center Local knowledge from Town Staff 	Yes	There is a history of hurricanes and tropical storms in Mashpee
Landslide	No	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	Loose soils and likelihood of flooding create a risk of landslides

Table 2.1 | List of relevant natural hazards for Mashpee

Hazard Identification

Type of Natural Hazard	According to weather data, is there a history of this hazard happening in Mashpee?	What resources were used to make that determination?	According to the Planning Team, could this hazard happen in Mashpee?	Why was this determination made?
Nor'easters	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	There is a strong history of nor'easters in Mashpee
High Winds	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	There is a history of high winds in Mashpee
Thunderstorms	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	There is a history of thunderstorms in Mashpee
Extreme Temperatures	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	There is a history of extreme cold and hot temperatures in Mashpee
Tornadoes	No	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	There is no history of tornadoes in Mashpee, but there have been tornado warnings in Barnstable County
Drought	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	There is a history of drought in Barnstable County
Severe Winter Weather	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Yes	There is a history of severe winter weather in Mashpee
Tsunami	No	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff 	Possibly	The probability of a damaging tsunami impacting Massachusetts is unknown
Sea Level Rise	Yes	<ul style="list-style-type: none"> 2013 Massachusetts Hazard Mitigation Plan Local knowledge from Town Staff Cape Cod Commission Sea Level Rise Viewer 	Yes	There is a history of sea level rise in Mashpee

Table 2.1 | List of relevant natural hazards for Mashpee (continued)

Hazard Profiles

Coastal Erosion and Shoreline Change

Overview

Coastal shorelines—especially beaches, dunes and banks—change constantly in response to wind, waves, tides and other factors including seasonal variation, sea level rise and human alterations to the shoreline system.¹ Every day, wind, waves, and currents move sand, pebbles, and other materials along the shore or out to sea. This dynamic and continuous process of erosion, transportation, and accretion shape the coastal shoreline. Shorelines change seasonally, tending to accrete gradually during the summer months when sediments are deposited by relatively low energy waves and erode dramatically during the winter when sediments are moved offshore by high energy storm waves, such as those generated by nor'easters.

Hazard Location

Through the Shoreline Change Project at the Massachusetts Office of Coastal Zone Management (CZM), the ocean-facing shorelines of Massachusetts were delineated and statistically analyzed to demonstrate trends from the mid-1800s to 2009. An

update of the Shoreline Change Project was completed in 2001 using 1994 National Oceanic and Atmospheric Administration (NOAA) aerial photographs of the Massachusetts shoreline. CZM established an agreement with the U.S. Geological Survey (USGS), the Woods Hole Oceanographic Institution Sea Grant Program, and Cape Cod Cooperative Extension to produce the 1994 shoreline and calculate shoreline change rates. CZM then incorporated the shorelines and shore-perpendicular transects with shoreline change rates into MORIS, the Massachusetts Ocean Resource Information System, to provide better access to the shoreline change data and encourage the public to browse the data using this online mapping tool. To launch the MORIS tool, use the following link: <http://www.mass.gov/eea/agencies/czm/program-areas/mapping-and-data-management/moris/>

Using the data from the Shoreline Change Project, the Planning Team concluded that the entire coastline of the planning area is vulnerable to shoreline change.

Figure 2.1 is a series of three maps of the planning area showing how the shoreline has changed from the mid-1800s to 2009.

B1c

1 Massachusetts Coastal Erosion Commission Draft Report, January 2015

Hazard Profiles

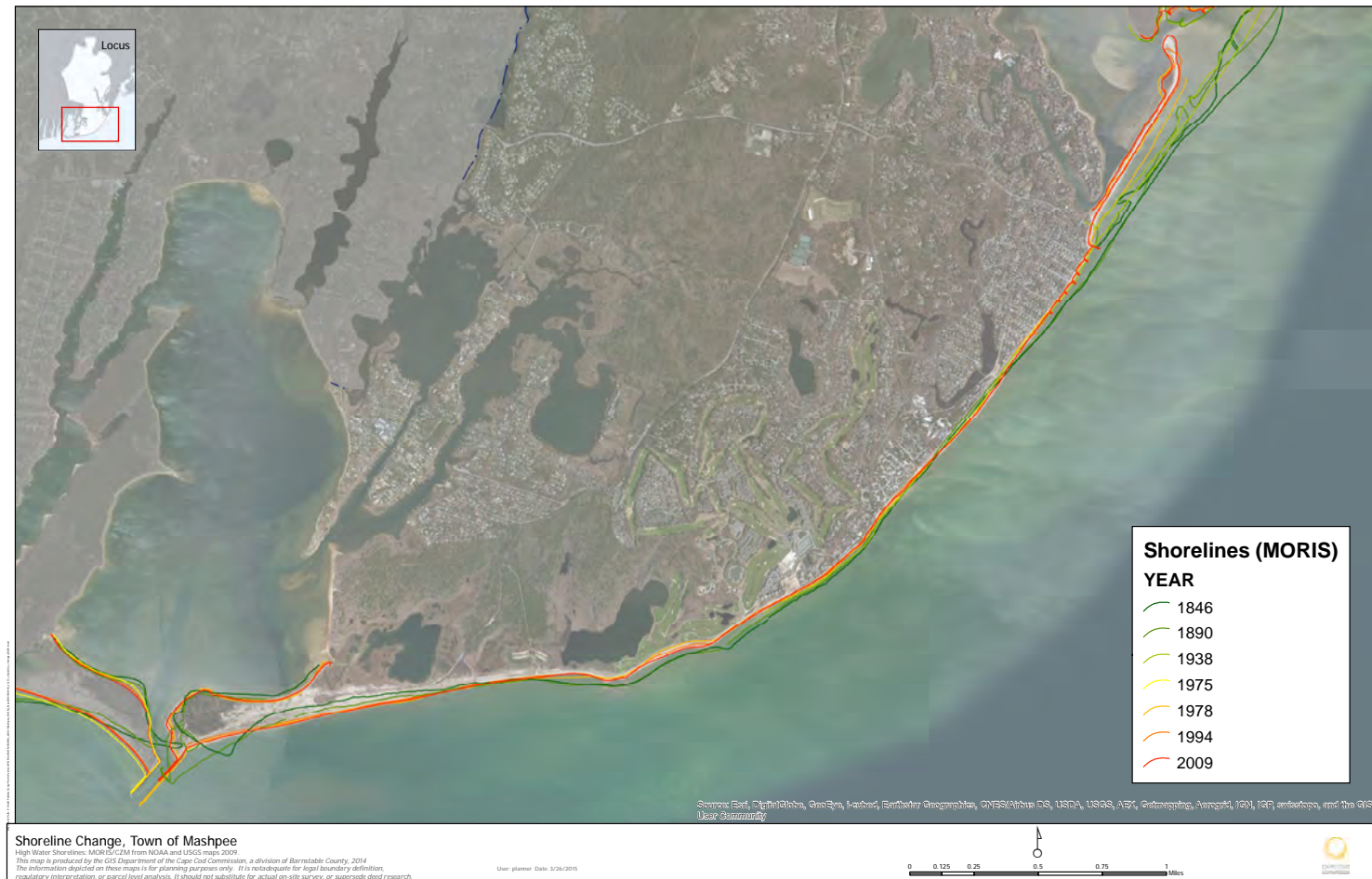


Figure 2.1a | Historic shoreline change along the entire coast of Mashpee. Map was created using data from the Massachusetts Ocean Resource Information System

Hazard Profiles

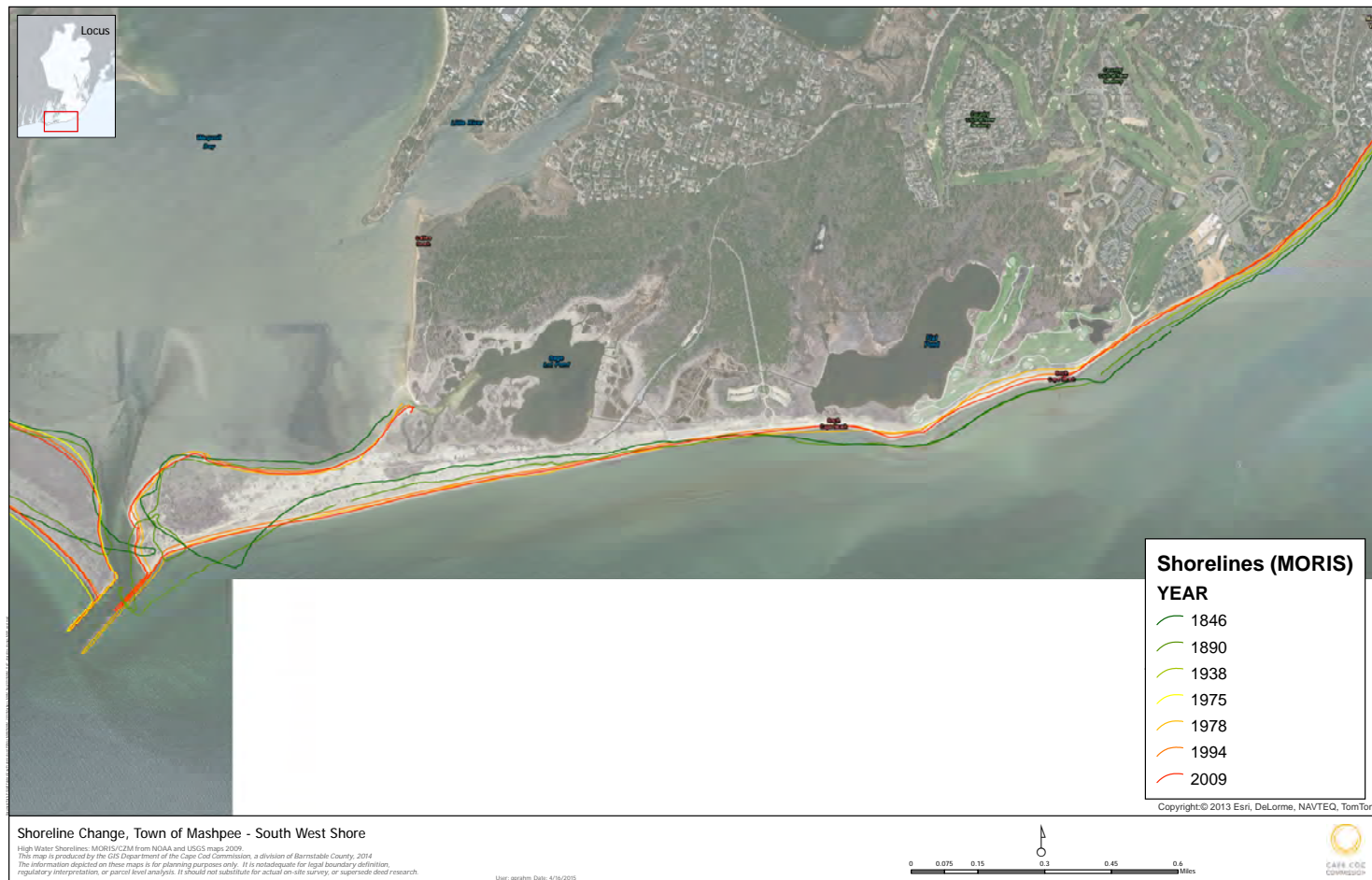


Figure 2.1b | Historic shoreline change along the western coast of Mashpee. Map was created using data from the Massachusetts Ocean Resource Information System

Hazard Profiles



Figure 2.1c | Historic shoreline change along the eastern coast of Mashpee. Map was created using data from the Massachusetts Ocean Resource Information System

B1c,
B2a,c

Previous Occurrences and Extent

Coastal erosion is measured as the horizontal displacement of a shoreline over a specific period of time, measured in units of feet or meters per year.² Shoreline change can be monitored over short-term and long-term time scales. Monitoring shoreline change on a relatively short period of record does not always reflect actual conditions and can misrepresent long-term erosion rates. However, long-term patterns of coastal erosion are difficult to detect because of substantial, rapid changes in coastlines over days or weeks from storms and natural tidal processes.

The Massachusetts Coastal Erosion Commission's 2015 Draft Report³ states the average shoreline change rates for Mashpee, where positive values indicate accretion and negative values indicate erosion, as the following:

■ Nantucket Sound Shoreline:

- Short-Term Rate: -0.7 ± 2.6 ft/year
- Long-Term Rate: -1.0 ± 1.6 ft/year

It is important to note that these data represent averages for shoreline change throughout Mashpee and that within the town there might be areas with greater or lesser erosion and accretion rates.

² Massachusetts State Hazard Plan, Coastal Erosion and Shoreline Change, 2013

³ Massachusetts Coastal Erosion Commission Draft Report, January 2015

Impact

While erosion is a natural process, it causes damage to coastal property and related infrastructure—particularly when development is sited close to the shoreline in unstable or low-lying areas. Below is a list of possible damages that could result from shoreline change⁴:

- **People:** public safety is jeopardized when buildings collapse or water supplies are contaminated; erosion can cause roadways to collapse which would increase the response time of emergency vehicles
- **Infrastructure:** erosion can expose septic systems and sewer pipes risking contamination of shellfish beds and other resources; accreting sand can block storm water pipes, causing urban drainage issues in town
- **Buildings:** erosion reduces the embedment of foundations in the soil, causing shallow foundations to collapse and making buildings on foundations more susceptible to settlement, lateral movement or overturning; once a building moves or is overturned, construction materials and other debris can be swept out to sea; seawalls and other hard structures open downdrift property owners to similar or greater losses

B3a

⁴ Massachusetts Coastal Erosion Commission Draft Report, January 2015

Hazard Profiles

- **Economy:** if businesses are affected by coastal erosion, there could be loss of business function; damage to inventory; relocation costs; wage losses
- **Natural Systems:** where engineered structures are used to stabilize shorelines, the natural process of erosion is altered, changing the amount of sediment available and erosion rates at adjacent areas; the town's natural ecosystem attractions—beaches, dunes, barrier beaches, salt marshes, and estuaries—would also be threatened and could slowly disappear as sand sources that supply and sustain them are eliminated; under conditions of reduced sediment supply, the ability of coastal landforms to provide storm damage and flooding protection would be diminished, increasing the vulnerability of infrastructure and development
- **Transportation:** roadways can become damaged due to shoreline recession

B2b

Probability

The Planning Team determined that it is **HIGHLY LIKELY** that shoreline change will impact the planning area. High probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years

- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

Data from the Shoreline Change Project, local knowledge, and the Report of the Massachusetts Coastal Erosion Commission were used to make this probability determination.

Dam and Culvert Failure

Overview

A dam is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water.⁵ Dam failure is a catastrophic type of failure characterized by a sudden, rapid, and uncontrolled release of impounded water.⁶

There are several dams in Mashpee and culverts that could act like dams during flooding events (shown in *Figure 2.2* and *Figure 2.3*). Therefore the Planning Team decided to also profile culvert failure in the Mashpee Hazard Plan. The text below focuses on the definition of culverts and how they fail.

⁵ Massachusetts State Hazard Mitigation Plan, 2013

⁶ Massachusetts State Hazard Mitigation Plan, 2013

Hazard Profiles

B1c

A culvert is a structural opening under a roadway that allows water to pass from one side of a roadway to the other.^{7,8}

B2a,c

Water flowing under the road typically comes from two sources – streams and road runoff – and these water resources require different types of culverts⁹:

- A stream crossing culvert is located where the roadway crosses over a stream channel and the culvert allows water to pass downstream
- A runoff management culvert is a strategically placed culvert to manage roadway runoff along, under, and away from the roadway. Typically, these culverts are used to transport upland runoff that accumulated in ditches to the lower side of the roadway for disposal.

Culverts are typically made of concrete, steel or aluminum and can have various cross-sectional shapes (i.e., oval, circular, arched, or rectangular).¹⁰ The size of the culvert opening is calculated using location-specific data on the amount of precipitation, snow accumulation,

⁷ Massachusetts Highway Department: Project Development and Design Guide 2006

⁸ http://water.epa.gov/polwaste/nps/urban/upload/2003_07_24_NPS_unpavedroads_ch3.pdf

⁹ Failing culverts: Structural problems and economic considerations, Tenbusch, Inc, June 2013, www.tenbusch.com/underground_equipment/files/FailingCulvertsStructuralAndEconomicConsiderations.pdf

¹⁰ http://water.epa.gov/polwaste/nps/urban/upload/2003_07_24_NPS_unpavedroads_ch3.pdf

and the probability of hurricanes impacting the area. The primary function of a culvert is to prevent flooding during normal and extreme weather conditions and provide proper road and highway drainage.

Culverts can fail and when failure occurs, it can be catastrophic. There are several reasons why culverts fail, including but not limited to¹¹:

- Buildup of flood waters on the upstream side of the culvert that exceed the capacity of the culvert (video of a culvert failure in Maine, see: <https://www.youtube.com/watch?v=NTbhyHNA1Vc>)
- The pipe inside the culvert becomes occluded because of debris or improper maintenance
- The pipe inside the culvert loses its structural integrity and begins to cave in
- The culvert and road are washed out during a heavy rain event or from snowmelt runoff
- The soil/material around the culvert pipe begins to move; without support from such material, the culvert will buckle or sag and the culvert will collapse.

¹¹ Failing culverts: Structural problems and economic considerations, Tenbusch, Inc, June 2013, www.tenbusch.com/underground_equipment/files/FailingCulvertsStructuralAndEconomicConsiderations.pdf

Hazard Profiles

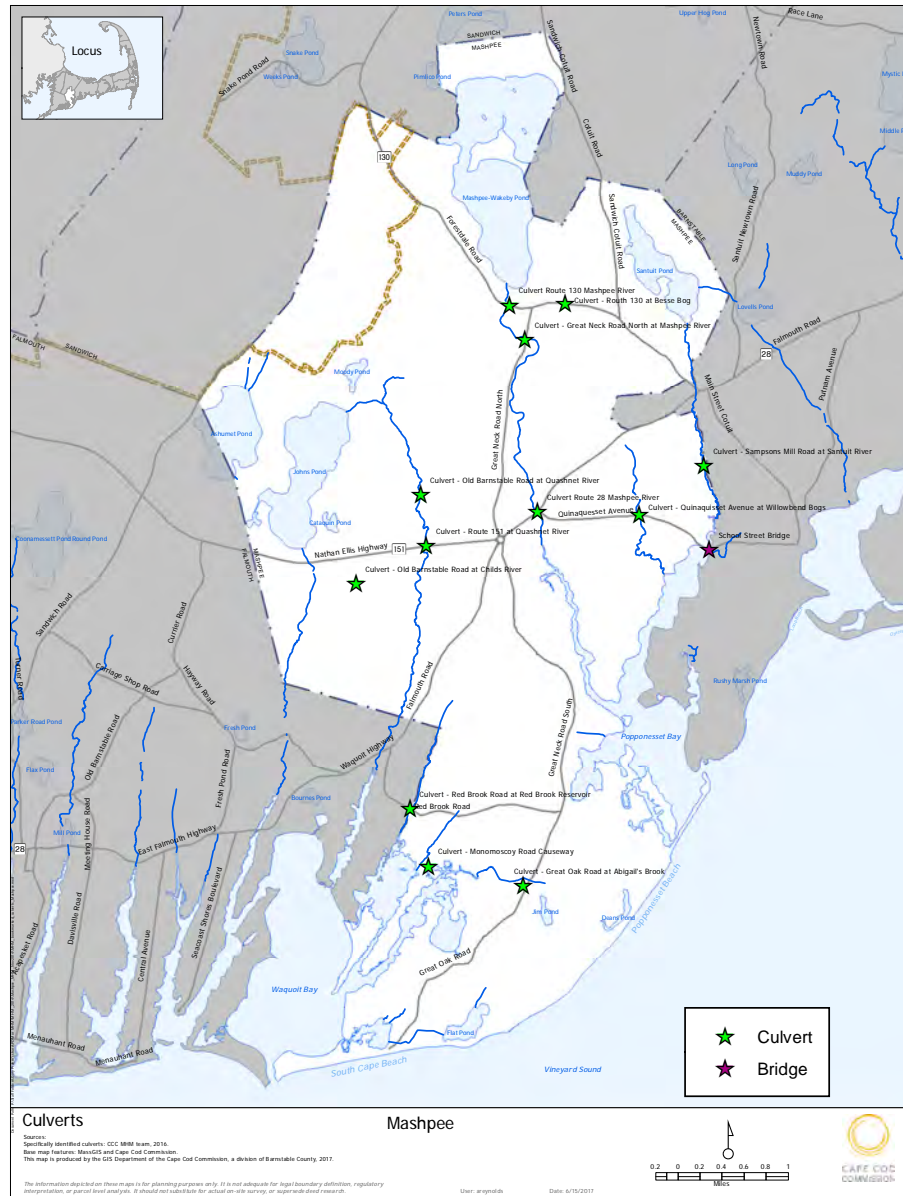


Figure 2.3 | Map of Mashpee showing the locations of culverts (green) and one bridge (maroon)

Hazard Profiles

B1c

Hazard Location

There are 3 dams, 9 culverts, and 1 bridge in Mashpee (locations shown in *Figure 2.2* and *Figure 2.3*).

B1c,
B2a,c

Previous Occurrences and Extent

There is no record of dam or culvert failure for the culverts listed above.

Since Mashpee has not experienced dam or culvert failure, the following description of the extent of culvert failure is taken from events that occurred in the state of Vermont during Tropical Storm Irene.¹² In August of 2011, Tropical Storm Irene brought heavy precipitation to New England and eastern New York. During Irene, the state of Vermont incurred damages to state and local infrastructure:

- Over 200 state road segments and 200 state-owned bridges were damaged
- 2,000 local road segments, 277 locally-owned bridges, and nearly 1,000 locally-owned culverts were damaged

The extent of the culvert and bridge damage in Vermont was:

¹² Gillespie et al., 2014, Flood effects on road-stream crossing infrastructure: economic and ecological benefits of stream simulation designs, Fisheries, volume 39 (2), page 62 - 76

- Large river and stream bank failures delivered a tremendous amount of woody debris downstream and plugged bridges, causing streams to overtop the bridge and wash out the bridge approach
- Culverts became plugged with debris and redirected a large volume of water over areas of towns.
- In Rochester, NH water was redirected onto cemetery grounds – unearthing caskets and scattering human remains throughout the downtown area.

Impact

Below is a list of additional possible impacts from culvert failure:

- **People:** community isolation from impassable roads, often leaving residents without power and water
- **Infrastructure:** power outages from disruption of underground utilities; no water due to disruption of pipes near the failed culvert; the high cost of relief and recovery may adversely affect investment in infrastructure or other development activities
- **Economy:** impacted traffic flow and impassable roads may prevent people from returning to work and tourists from visiting the area; expensive infrastructure repairs; residents will bear the extra cost of circumventing damaged roads

B3a

Hazard Profiles

- **Natural Systems:** bank erosion, debris in natural systems
- **Transportation:** impaired traffic flow and impassable roads

B2b

Probability

The Planning Team determined that it is **POSSIBLE** that a culvert failure will impact the planning area. This determination was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

Culvert age was used to make this probability determination.

Earthquake

Overview

An earthquake is movement or trembling of the ground produced by a sudden displacement of rock in the

Earth's crust. Scientists have formulated several theories to explain the causes of earthquakes but the theory of plate tectonics is commonly used to explain much of the earthquake activity in the world.¹³

The theory of plate tectonics postulates that, at one point, the earth was covered by a single crust, or plate, with no oceans. Over time, this plate started to split and drift into separate plates of land or ocean crusts. Now the earth's surface looks much like a spherical jigsaw puzzle; all the plates fit together. The plates over the earth are in constant slow motion. They generally move in one of three ways—they collide, spread, or slide. Any one of these plate movements can cause an earthquake. Maps of earthquake activity throughout the world show that earthquakes most frequently occur at the boundaries of plates.

Plate movement or other forces create tremendous stress on rocks that make up the earth's outer shell. When rock is strained beyond its limit, it will fracture, and the rock mass on either side will move. This fracture is called a fault. Not all faults will cause earthquakes, but if there is a sudden rupture, energy is released that creates the motions associated with an earthquake. Once the sudden rupture occurs, the earth begins to shake. This shaking is caused by a series of waves known as

¹³ Earthquake Causes and Characteristics, FEMA Emergency Management Institute Training Guide, <https://training.fema.gov/emiweb/is/is8a/is8a-unit3.pdf>

Hazard Profiles

seismic waves moving from the center of the earthquake outward to surrounding areas. Two scales are frequently used to measure earthquakes:

- **THE MODIFIED MERCALLI INTENSITY SCALE** measures the intensity or impact of an earthquake on people and the built environment. It measures the impact of an earthquake by sending out trained observers to look at the damage done to the built environment and the earth (landslides, etc.) and at the reaction of people to the event (*Table 2.2*).
- **THE RICHTER SCALE** measures the maximum recorded amplitude of a seismic wave. This measurement quantifies the ground motion and the energy released at the source of an earthquake, which is referred to as its magnitude.
 - **Richter Magnitude of 3.5 -5.4:** often felt but rarely causes damage
 - **Richter Magnitude of 5.5 - 6.0:** slight damage to well-designed buildings, major damage to poorly constructed buildings
 - **Richter Magnitude of 6.1 – 6.9:** destructive
 - **Richter Magnitude of 7.0 – 7.9:** major earthquake, causes serious damage over large areas
 - **Richter Magnitude of 8.0 or higher:** named Great Earthquakes, cause serious damage over extremely large areas

Both the Modified Mercalli Intensity Scale and Richter Scale are used to describe earthquakes because they utilize different data sets; the Richter Scale describes an earthquake’s magnitude while the Modified Mercalli Intensity Scale describes the earthquake’s impact on people and structures.

Hazard Location

The greatest earthquake threat in the United States is along tectonic plate boundaries and seismic fault lines in the central and western states. The eastern United States does experience earthquakes, but they are less frequent and less intense than the ones in the central and western U.S. *Figure 2.4* shows relative seismic risk for the United States.

B1c

Previous Occurrences and Extent

Between 1627 and 2008, there were 366 earthquakes recorded in Massachusetts.¹⁴ Generally, most earthquakes that occur in the Northeast region of the United States tend to be small in magnitude and cause little damage. However, 104 earthquakes between 1924 and 2012 have measured at a magnitude of 4.5 or greater on the Richter scale. Due to the geologic composition and rock structure in the Northeast, seismic shaking for many of these larger earthquakes were felt throughout all of New England.

B1c,
B2a,c

¹⁴ Massachusetts State Hazard Mitigation Plan, 2013

Hazard Profiles

Level	Description
I	Not felt except by a very few under especially favorable circumstances.
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably indoors, especially on upper of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.
IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
VI	Felt by all, many frightened and run indoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motor cars disturbed.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rail bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (sloped) over banks.
XI	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII	Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen of ground surface. Lines of sight and level are distorted. Objects are thrown into the air.

Table 2.2 | Modified Mercalli scale, from Earthquake Causes and Characteristics, Chapter 3 of Emergency Management Institute Training Guide

Hazard Profiles

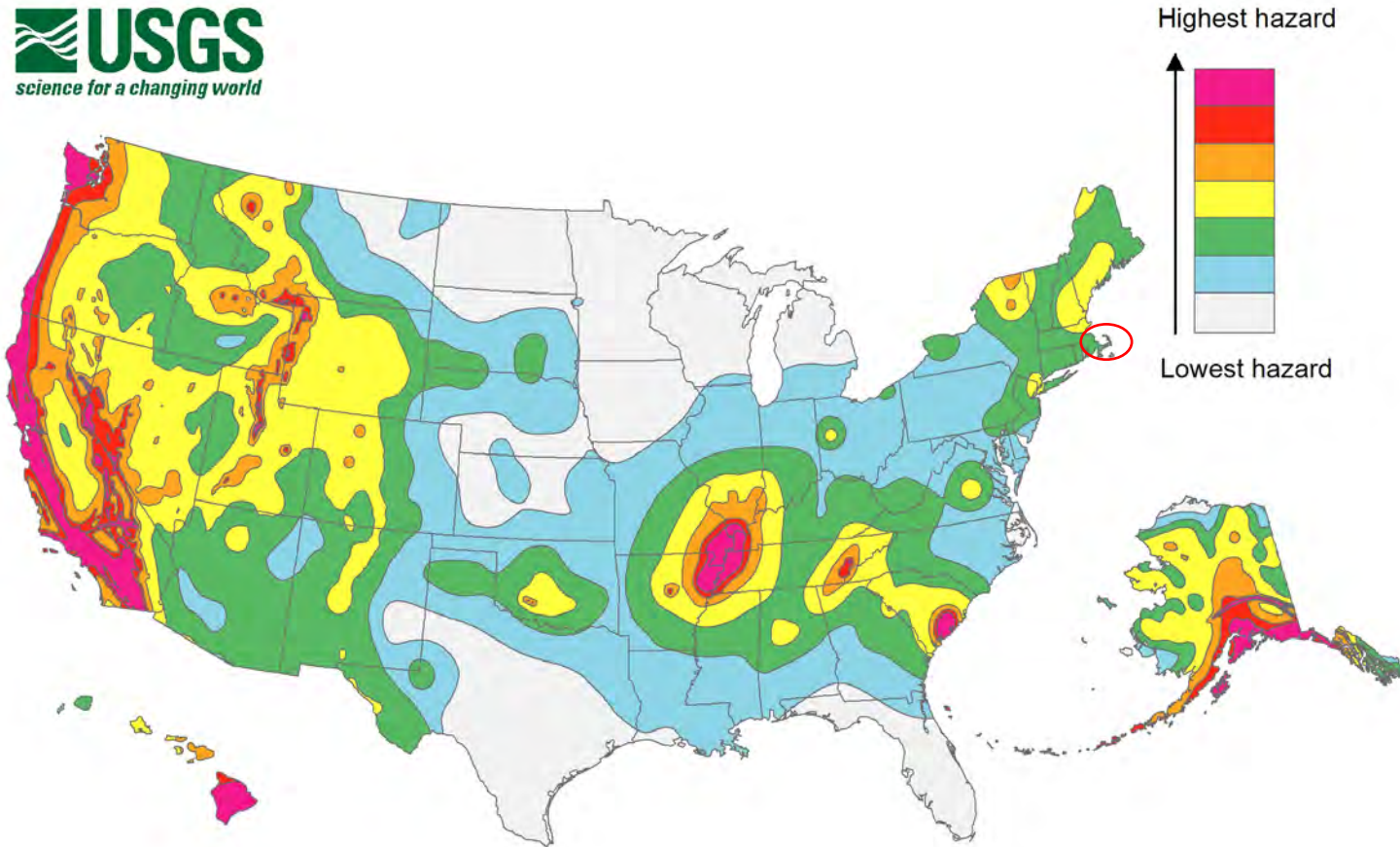


Figure 2.4 | 2014 simplified earthquake hazard risk map for the United States. A circle was used to identify the planning area on the map.

Hazard Profiles

B2c

Below is a list of earthquakes that affected eastern Massachusetts¹⁵:

- **August 8, 1847:** no data available on extent of hazard
- **November 27, 1852:** no data available on extent of hazard
- **December 10, 1854:** no data available on extent of hazard
- **September 21, 1876:** no data available on extent of hazard
- **May 12, 1880:** no data available on extent of hazard
- **January 21, 1903:** no data available on extent of hazard
- **April 24, 1903:** no data available on extent of hazard
- **October 15, 1907:** no data available on extent of hazard
- **January 7, 1925:** earthquake occurred off of Cape Ann and the reported felt area extended from Providence, RI to Kennebunk, ME
- **April 24, 1925:** no data available on extent of hazard
- **January 28, 1940:** no data available on extent of hazard

- **October 16, 1963:** intensity VI, caused plaster to fall in a house, a wall cracked, stones fell from a building foundation, dishes were broken, windows cracked
- **October 30, 1963:** no data available on extent of hazard
- **October 24, 1965:** slight damage to homes on Nantucket, house timbers creaked, doors, windows, and dishes rattled
- **December 30, 2012:** magnitude 1.2 earthquake about 7 miles south of Gardner, MA; no extent data available
- **April 2012:** a swarm of 12 or more earthquakes occurred off of the New England coast about 250 miles east of Boston. The largest of these earthquakes measured a magnitude of 4.4 on the Richter Scale. This swarm of earthquakes was of particular concern because of the major earthquake on the continental shelf further north in 1929 that produced a deadly and damaging tsunami in Nova Scotia.

There have been no earthquake declared disasters for Massachusetts. No data is available on the history of earthquakes in Mashpee.

Impact

Earthquakes can affect hundreds of thousands of square miles, cause damage to property, result in loss of life and injury, and disrupt the social and economic functioning

B3a

¹⁵ Massachusetts State Hazard Mitigation Plan, 2013

Hazard Profiles

of the affected area. Most property damage and earthquake related deaths are caused by the failure and collapse of structures during ground shaking. See **Table 2.2** for a list of possible damages from earthquakes.

Earthquakes can also cause large and sometimes disastrous landslides. Sand dunes, like the ones located along Route 6 in Mashpee, are vulnerable to slope failure during an earthquake. This process, called sand liquefaction, occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and move freely, turning the ground into a liquid.¹⁶

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Probability

Earthquakes cannot be predicted and may occur at any time of the day and any time of the year.¹⁷ The Planning Team determined that it is **UNLIKELY** that an earthquake will impact Mashpee. Probabilities were defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years

- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used data collected from the 2013 Massachusetts State Hazard Plan and historical earthquake data in Massachusetts to make this probability determination.

¹⁶ Massachusetts State Hazard Mitigation Plan, 2013

¹⁷ Massachusetts State Hazard Mitigation Plan, 2013

Fire: Urban and Wildland

Overview

This portion of the Mashpee Hazard Mitigation Plan assesses two types of fire events: urban fires and wildfires.

Urban fires occur when buildings and structures catch fire and there is potential for the fire to spread to adjoining structures. Urban fires are more common in areas where single family homes, multi-family homes, and businesses are clustered closely together, thereby increasing the possibility of rapid spread to nearby structures. Urban fires occur more frequently than wildfires and often result from everyday activities like cooking, smoking, and appliance malfunction.

Wildfires are defined as any non-structural fire that occurs in a vegetative wildland including grass, shrub, leaf litter, or forested area.¹⁸ Wildfires often begin undetected and spread quickly when brush, trees, and homes are ignited. In Massachusetts, wildfires are typically caused by lightning, human activity (i.e., smoking, unattended camp fires), or prescribed burns (intentional, controlled burns that are started under the supervision of experienced fire personnel).¹⁹

In 2012, the Cape Cod Cooperative Extension and many other regional partners developed the Barnstable County Wildfire Preparedness Plan. As stated in this document, Cape Cod is vulnerable to wildfires for several reasons:

- The Cape Cod region has a long history of wildfires. As a result, most of Cape Cod has fire-adapted ecosystems and therefore they are prone to burning. Also, pitch pine barrens are the dominant vegetative community on Cape Cod. These ecosystems contain several highly flammable plant species that are adapted to survive or regenerate post fire.
- Many residents of Barnstable County live in the Wildland Urban Interface (WUI). This zone is defined as the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuel. Development in the WUI is dangerous because wildfires can move to surrounding developments and place homes and other buildings at risk for ignition.

Hazard Location

A team of fire professionals developed the Barnstable County Wildfire Preparedness Plan and conducted a town-wide risk assessment for wildfire in Mashpee. This team identified ten sites in Mashpee that are areas of suggested mitigation focus based on this risk assessment (**Figure 2.5**). Additionally, Town Hall, the Town Archives Building, Rainbows and Rhymes Nursery

B1c

18 Massachusetts State Hazard Mitigation Plan, 2013

19 Massachusetts State Hazard Mitigation Plan, 2013

Hazard Profiles

TOWN OF MASHPEE WILDFIRE RISK MAP

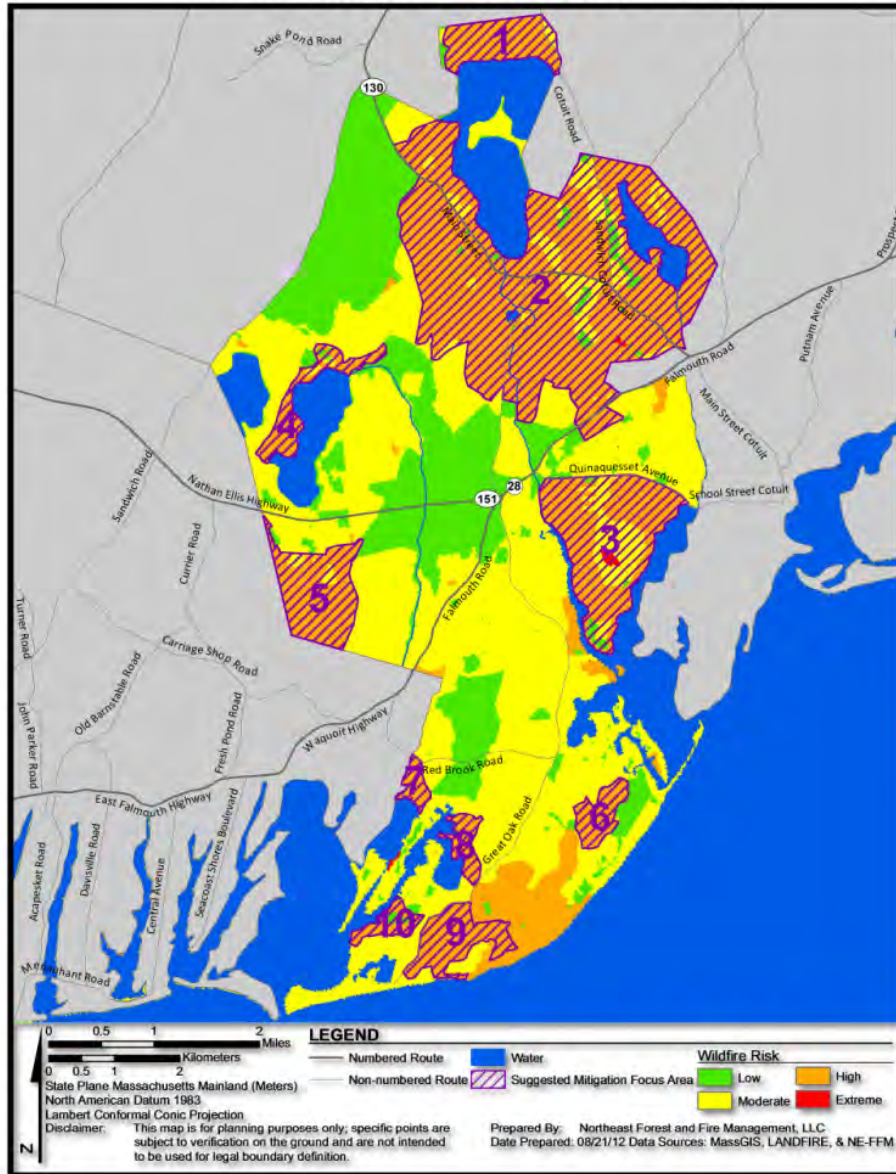


Figure 2.5 | Town of Mashpee Wildfire Risk map from the Barnstable County Wildfire Preparedness Plan

School, Mashpee Center for Optimum Care (Harborside), the Stratford Ponds Wastewater Treatment Plant, the Willowbend Wastewater Treatment Plant, Mashpee Vet, Christ the King Church, Mashpee Commons Wastewater Treatment Plan, the Windchime Point Wastewater Treatment Plant, and the New Seabury Wastewater Treatment Plant were identified as being in high risk areas from wildfires.

B1c,
B2a,c

Previous Occurrences and Extent

The following is a list of notable wildland fires that occurred in Barnstable County since 1887:

- **1887:** A large forest fire burned over 25,000 acres from the Pocasset section of Bourne to Sandwich. This fire destroyed approximately 600 cords of stacked wood at the Sandwich Glass Company as well as several stands of oak and pine. The Sandwich Glass Company was forced to purchase and burn coal in its furnaces at a substantial financial cost. This, along with a labor union strike, ultimately contributed to the demise of the Sandwich Glass Company, one of the Cape's largest industrial businesses between 1825 and 1894. (www.capecodfd.com)
- **May 30, 1923:** A fire began in the woods of Pocasset village and burned through the day. It was under control by nightfall, only to flare up again and again for 7 days. An area of approximately 25,000 acres, between Pocasset village, Sagamore, Sandwich, East Sandwich, and South Sandwich was left blackened. (www.capecodfd.com)
- **April 19, 20, 21, 1927:** 2,500 acres burned in Truro. (Barnstable Patriot, April 28, 1927)
- **1938:** A 5,000-acre wildfire killed three Sandwich firefighters on Route 130. (<http://www.mashpeeema.gov/sites/mashpeeema/files/uploads/mashpeewildlife.pdf>)
- **April 1946:** Slash piles started by German prisoners of war at Camp Edwards blazed out of control and consumed 50,000 acres. (<http://www.mashpeeema.gov/sites/mashpeeema/files/uploads/mashpeewildlife.pdf>)
- **June 1949:** 75 acres or more of brush and woodland burned after a fire started at the Truro Town Dump. Firefighters from Truro, Wellfleet, Brewster, and Orleans helped bring it under control. (Provincetown Banner, June 16, 1949)
- **1982 - 1997:** Approximately 7,500 acres burned at Camp Edwards from six fires. (<http://www.mashpeeema.gov/sites/mashpeeema/files/uploads/mashpeewildlife.pdf>)
- **2000:** Several wildfires burned in Mashpee. (<http://www.mashpeeema.gov/sites/mashpeeema/files/uploads/mashpeewildlife.pdf>)

Hazard Profiles

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Impact

Destruction caused by urban fires and wildfires depends on the following factors:

- Size of the fire
- Landscape
- Amount of fuel (i.e., vegetation and structures) in the path of the fire
- Direction and intensity of the wind
- Response time of fire personnel
- Number of firefighters able to respond to the fire
- Access to the fire once it starts

Below is a list of possible damages from urban and wildland fires.

- **People:** death or injury to people and animals, smoke can cause health issues for people, even for those far away from the fire
- **Infrastructure:** gas, power, and communications may be disrupted, flying embers can set fire to buildings more than one mile away from the initial fire
- **Buildings:** structures can be damaged or destroyed, a large number of buildings can be burned
- **Economy:** indirect economic losses in reduced tourism; as communication and infrastructure systems are damaged and disrupted, economic

activities come to a standstill, often resulting in dislocation and dysfunction of normal business activities; when roadways are disrupted, it impacts the customer base for small businesses and leads to slow recovery times for these businesses; the high cost of relief and recovery may adversely affect investment in infrastructure or other development activities

- **Natural Systems:** extensive acreage can be burned, damaging watersheds and critical natural areas; flash flooding and landslides can result from fire damage to the surrounding landscape; wildfires strip slopes of vegetation exposing them to greater runoff and erosion, which can weaken soils and cause failure on slopes; wildfires can impact the land for many years, including causing changes to the soil and therefore increasing the risk of future flooding and contamination of reservoirs, and change the permeability of the ground. When fires burn hot and for long periods of time, the soil will bake and become impermeable, increasing the risk of flooding.
- **Transportation:** transportation may be temporarily disrupted

Probability

The Planning Team determined that it is **HIGHLY LIKELY** that an urban fire will impact Mashpee and **HIGHLY**

B2b

LIKELY that a wildfire will impact the planning area. Probabilities were defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used data collected from the 2013 Massachusetts State Hazard Plan, the 2012 Barnstable County Wildfire Preparedness Plan, and local knowledge of the town to make this probability determination.

Flood

Overview

There are several types of flood hazards that frequently impact Mashpee:

- **Flash flooding** occurs when a severe storm like a nor'easter or tropical storm causes a large amount of rain in a short period of time.²⁰

²⁰ National Flood Insurance Program, Floodplain Management Requirements, FEMA 480

- **Coastal flooding** occurs when persistent high wind and changes in air pressure during a hurricane or nor'easter push water towards the shore. This action causes storm surge which raises the level of the water by several feet. Waves can be highly destructive as they move inland, battering structures in its path. The magnitude of a flood varies with the tides; storm surge that occurs during high tide will flood larger areas than if the same surge occurred at low tide.²¹
- **Urban drainage** occurs in flat areas where runoff or rain collects and cannot drain out. Drainage systems are made up of ditches, storm sewers, retention ponds, and other infrastructure that stores runoff and carries it into a receiving stream, lake, or ocean. When most of these systems were built, they were designed to handle the amount of water expected during a 10-year storm event. Larger storms overload the system and result in back-ups. When this system is blocked, water forms temporary ponds. This water will remain in an area until it infiltrates into the soil, evaporates, the blockage is cleared, or the water is actively pumped out.²²

²¹ National Hurricane Center Outreach and Education, <http://www.nhc.noaa.gov/climo/>

²² National Hurricane Center Outreach and Education, <http://www.nhc.noaa.gov/climo/>

Hazard Profiles

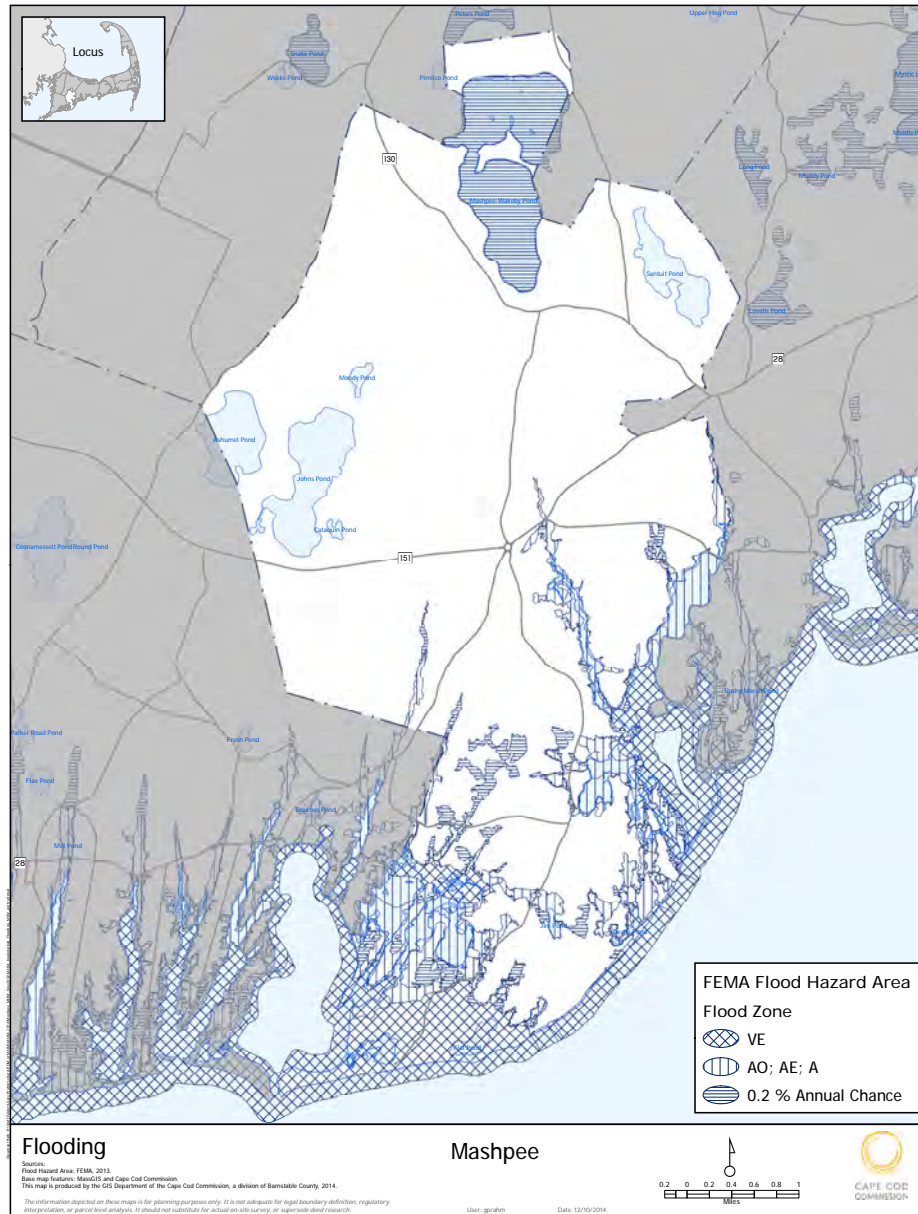


Figure 2.6 | 2014 FEMA Flood Hazard Area map for Mashpee

B1c

Hazard Location

Flooding in Mashpee is also the direct result of coastal storms, nor'easters, heavy rains, tropical storms, and hurricanes. **Figure 2.6** shows the 2014 FEMA Flood Insurance Rate Map (FIRM) for Mashpee. This map depicts areas of Mashpee in V and A zones and the 0.2% annual chance flood areas.

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B2a,c

Previous Occurrences and Extent

Below is a list of rain, flooding, and coastal flooding events experienced in Barnstable County from 1950 - 2015. Data was collected from NOAA's National Climatic Data Center and the 2004 Mashpee Pre-Disaster Mitigation Plan.

- **August-September, 1954:** Hurricane Carol caused flooding along Shore Drive.
- **February 1, 1970:** Thousands of cellars and roads flooded throughout Massachusetts. Traffic hampered by flooded streets; trees downed.
- **August 19, 1991:** Hurricane Bob caused flooding of the causeway near Amy Brown Road.
- **January 24, 2005:** Blizzard conditions caused major power outages for an extended amount of time. Vulnerable populations were evacuated to local shelters. Snow fall totals of up to 3 feet in some areas. Wind gusts of up to 65 MPH at times. Power

lines and trees downed all over roads and travel was extremely dangerous. Coastal flooding caused major damages to homes along vulnerable areas.

- **June 7, 2006:** A late season coastal storm brought heavy rainfall to much of eastern Massachusetts resulting in widespread flooding of roads and small streams. Significant flooding took place in Mashpee, where a child care center was flooded and forced evacuations to take place.
- **September 12, 2009:** Low pressure moved out of Pennsylvania, south of Long Island and past the Cape and Islands sending warm, moist air into Southern New England. This resulted in very heavy rainfall, particularly across Cape Cod. Six inches of rain fell in less than three hours over portions of Cape Cod and southern Plymouth County. Bourne and southern Plymouth were most affected by this with numerous roadways flooded. Two feet of water inundated Pleasantwood Road in Sandwich.
- **September 3, 2013:** A cold front moved through an unstable atmosphere across southern New England, triggering showers and thunderstorms across much of Massachusetts and Rhode Island. In Mashpee, the Mashpee Rotary, Route 28, and Route 151 were flooded.

Hazard Profiles

B3a

Impact

Below is a list of the possible impacts for a flooding event in Mashpee:

- **People:** people can be knocked down or washed off their feet while walking in floodwaters; injury and death for people who become trapped in their cars during a flood event; often people place themselves in harm's way by ignoring warning signs of water depth on roadways; people can be displaced from their homes because of post-flood safety and health hazards; mold, mildew, and bacteria can cause health issues; flooding can cause drinking water to become contaminated
- **Infrastructure:** flooding can leave a large amount of debris and sediment on and around town infrastructure; floods can damage gas lines, utility poles, water infrastructure, wastewater treatment plants; can cause sewage spills
- **Buildings:** moving water can damage the walls of buildings; mold and mildew can develop on walls, behind walls, and on insulation; building foundations on the beach can be undermined by the velocity of floodwaters; floodwaters pick up anything that floats, including logs, lumber, propane tanks, and vehicles and then these objects can act as battering rams and cause damage to buildings; buildings can float off of their foundations if not anchored properly

- **Economy:** as communication and infrastructure systems are damaged and disrupted, economic activities come to a standstill, often resulting in dislocation and dysfunction of normal business activities; roadway disruptions affect the customer base and slow recovery times for small businesses; the high cost of relief and recovery may adversely affect investment in infrastructure or other development activities; there can be losses associated with decreased land value in floodplains
- **Natural Systems:** during flood events, storm water systems cannot handle the high water volume and oftentimes untreated sewage can enter into the environment; floods can transfer sediment and debris into parks, beaches, estuaries, rivers, etc.
- **Transportation:** floods can wash out bridges and culverts, debris in floodwaters can occlude culverts so much that the culvert acts like a dam; roadways can be washed away in a flood event; there can be major disruptions to transit, train, or ferry services

Probability

The Planning Team determined that it is **HIGHLY LIKELY** that coastal flooding will impact the planning area, and **LIKELY** that urban drainage flooding will impact the planning area. Probability was defined based on the frequency of occurrence:

B2b

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used the history of hurricanes, tropical storms, and nor'easters in Mashpee to make this probability designation.

Hurricanes and Tropical Storms

Overview

A tropical cyclone is a rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters.²³ In the Atlantic Basin, the hurricane season “officially” runs from June 1 to November 30; peak activity is in early to mid-September.²⁴

There are four types of tropical cyclones that can occur in the Atlantic Basin:

- **Tropical Depression:** a tropical cyclone with maximum sustained winds of 38 mph or less
- **Tropical Storm:** a tropical cyclone with maximum sustained winds of 39 to 73 mph
- **Hurricane:** a tropical cyclone with maximum sustained winds of 74 mph or higher
- **Major Hurricane:** a tropical cyclone with maximum sustained winds of 111 mph winds or higher, corresponding to a Category 3, 4, or 5 on the Saffir-Simpson Hurricane Wind Scale

There are two data sets used to classify tropical cyclones:

1. **Saffir-Simpson Hurricane Wind Scale** is a 1 to 5 rating based on a hurricane’s sustained wind speed.²⁵ This scale estimates potential property damage (**Table 2.3**). Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous, however, and require preventative measures.
2. **Amount and location of storm surge** Storm surge is simply water that is pushed toward the shore by the force of the winds swirling around from

²³ National Hurricane Center Outreach and Education, <http://www.nhc.noaa.gov/climo/>

²⁴ National Hurricane Center Outreach and Education http://www.srh.noaa.gov/jetstream/tropics/tc_basins.htm

²⁵ <http://www.nhc.noaa.gov/aboutsshws.php>

Hazard Profiles

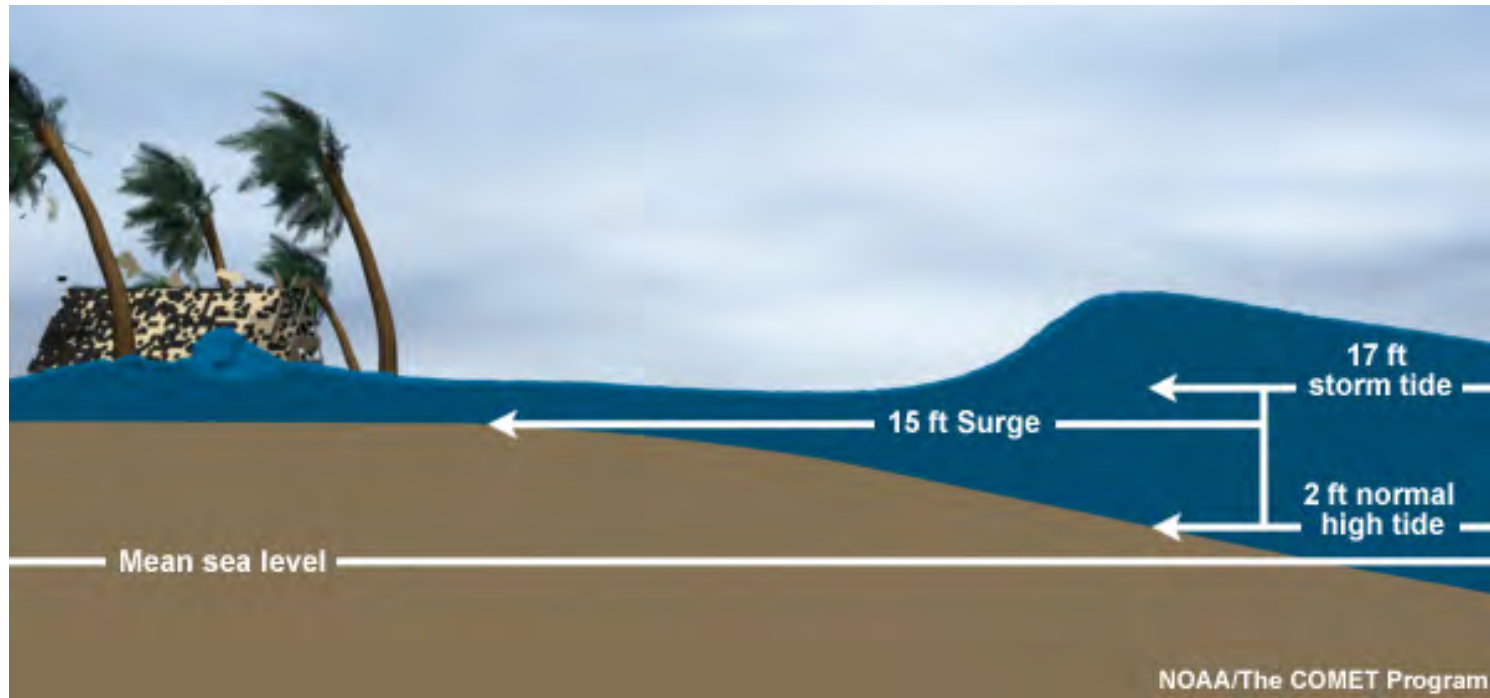


Figure 2.7 | Schematic of the generic differences between mean sea level, normal high tide, storm surge and storm tide. This graphic is for educational purposes only. The numbers shown (2, 15, 17 feet) are not specific to Mashpee.

Hazard Profiles

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	Catastrophic damage will occur: A high percentage of framed homes will be destroyed with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Table 2.3 | Saffir-Simpson hurricane wind scale (National Hurricane Center)

Hazard Profiles

the storm.²⁶ This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase average water levels 15 feet (4.5 m) or more. In addition, wind-driven waves are superimposed on the storm tide. This rise in water level can cause severe flooding in coastal areas, particularly when the storm tide coincides with the normal high tides (**Figure 2.7**).

The US Army Corps of Engineers New England Division, in cooperation with FEMA, prepared Sea, Lake and Overland Surge from Hurricanes (SLOSH) inundation maps.²⁷ SLOSH mapping represents potential flooding from worst-case combinations of hurricane direction, forward speed, landfall point, and high astronomical tide. It does not include riverine flooding caused by hurricane surge or inland freshwater flooding. The model, developed by the National Weather Service to forecast surges that occur from wind and pressure forces of hurricanes, considers only storm surge height and does not consider the effects of waves. The mapping was developed for New England coastal communities using the computer model, Long Island Sound bathymetry, and New England coastline topography. The resulting inundation areas are grouped into Category 1 and 2, Category 3, and Category 4. The hurricane category refers to the Saffir-Simpson Hurricane Intensity Scale.

²⁶ National Weather Service Jetstream – Online School for Weather, Tropical Weather, Tropical Hazards www.srh.noaa.gov/jetstream/tropics/tc_hazards.htm

²⁷ Massachusetts State Hazard Mitigation Plan, 2013

The Army Corps of Engineers considered the highest wind speed for each category, the highest surge level, combined with worst-case forward motion, and developed a model to depict areas that would be inundated under those combined conditions.

Hazard Location

The entire planning area is vulnerable to tropical cyclones. Coastal areas are extremely susceptible to damage because of wind and storm surge. Inland areas can also be affected by flooding, strong winds, and heavy rain associated with tropical cyclones. **Figure 2.8** shows the predicted storm surge in the planning area for the Category 1-4 storms.

Previous Occurrences and Extent

The National Hurricane Center created maps showing the tracks of all known North Atlantic hurricanes and major hurricanes between the years 1851 – 2013 (**Figure 2.9**). These maps indicate that there is a strong history of hurricanes affecting the Atlantic Coast of the United States, including Barnstable County.

The Moris tool and data from NOAA was used to plot hurricane tracks making landfall in New England between 1851 and 2008 (**Figure 2.10**).

Data collected from the FEMA disaster declaration website, the 2013 Massachusetts State Hazard Plan,

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Hazard Profiles

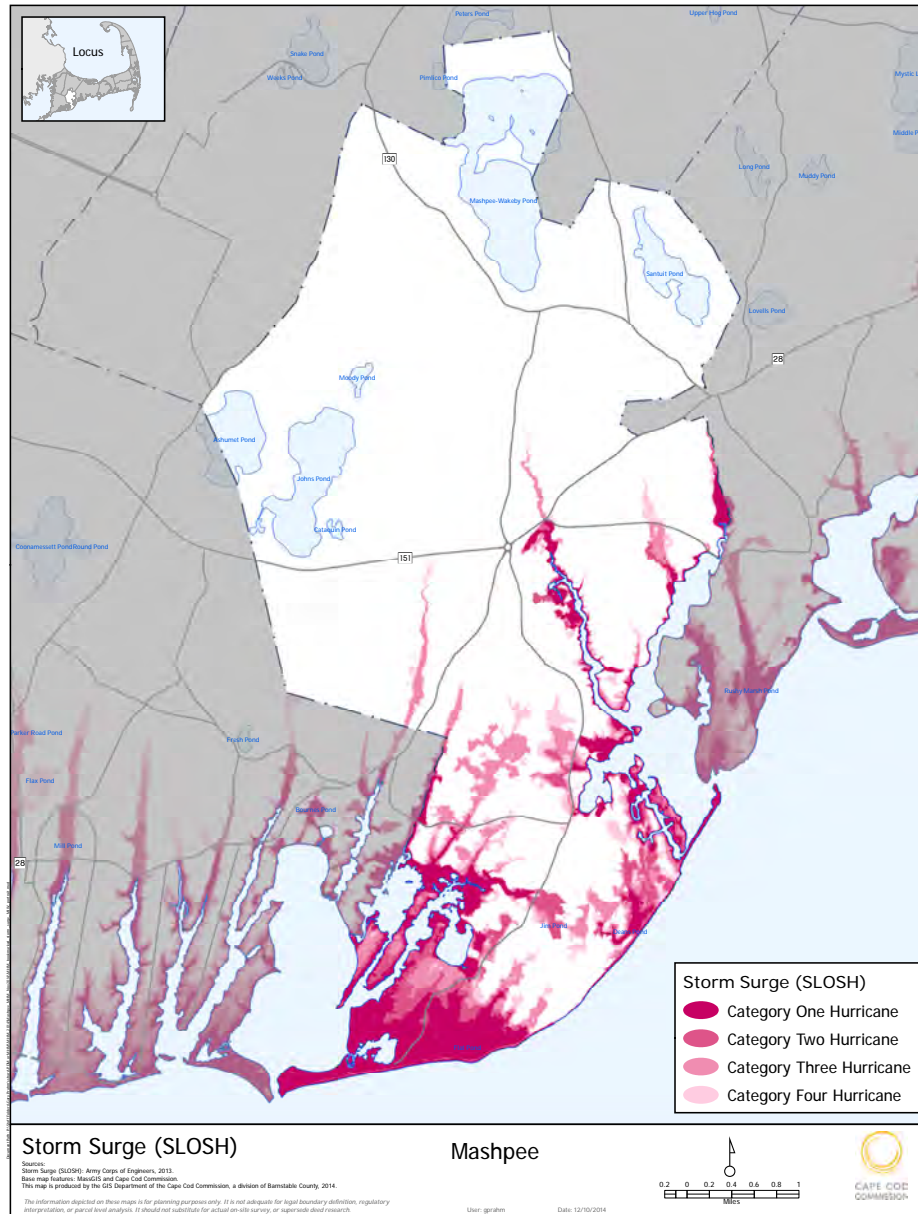


Figure 2.8 | SLOSH map for Mashpee

Hazard Profiles

Major Disaster Declarations and Most Memorable Tropical Cyclones for Barnstable County from 1954 - 2012							
Number	Storm Name	Saffir-Simpson Classification	Landfall	Incident period	Declaration Date	Comments	References
	Tropical Storm Arthur	TS		July 4, 2014			Barnstable County Regional Emergency Planning Committee
EM-3350	Tropical Storm Sandy	TS	Yes	October 27 to November 8, 2012	October 28, 2012	Barnstable County was designated for Category B Public Assistance	FEMA Disaster Declaration website
DR-4097	Tropical Storm Sandy	TS	Yes	October 27 to November 8, 2012	December 19, 2012	HMGP Assistance was provided for Barnstable County	FEMA Disaster Declaration website
EM-3330	Tropical Storm Irene	Category 2		August 26 to September 5, 2011	August 26, 2011	Barnstable County was designated for Category B Public Assistance	FEMA Disaster Declaration website
DR-4028	Tropical Storm Irene	Category 2		August 27 to August 29, 2011	September 3, 2011	HMGP Assistance was provided for Barnstable County	FEMA Disaster Declaration website
EM-3315	Hurricane Earl	Category 4		September 1 to September 4, 2010	September 2, 2010		FEMA Disaster Declaration website
DR-914	Hurricane Bob	Category 3	Yes	August 19, 1991	August 26, 1991		FEMA Disaster Declaration website
DR-751	Hurricane Gloria	Category 4		September 27, 1985	October 28, 1985		FEMA Disaster Declaration website
	Hurricane Donna	Category 5	Yes	September 12 to September 13, 1960	Not declared		FEMA Disaster Declaration website
	Hurricane Carol	Category 2-3		August 31, 1954	Not declared		Barnstable County Regional Emergency Planning Committee
	Hurricane Edna	Category 3	Yes	September 11, 1954	Not declared		Barnstable County Regional Emergency Planning Committee
	1938 Hurricane	Category 3	Yes	September 1938	Not declared		Barnstable County Regional Emergency Planning Committee
	1944 Hurricane	Category 4	Yes	September 1944	Not declared		Barnstable County Regional Emergency Planning Committee

Table 2.4 | History and extent of tropical storms and hurricanes for Barnstable County

and local experts (including the Planning Team and the Barnstable County Emergency Planning Committee) were also used to document the previous occurrences of tropical cyclones that affected Cape Cod. **Table 2.4** describes the major disaster declarations and most memorable cyclones to affect Barnstable County and thus, the planning area.

B3a

Impact

The National Hurricane Center describes the types of damages that a community could experience during a Category 1-5 storm.²⁸

CATEGORY 1: 74-95 mph 1 minute sustained winds

■ Impact to People, Pets, and Livestock:

- Could result in injury or death from flying or falling debris

■ Impact to Frame Homes:

- Some poorly constructed frame homes can experience major damage, involving loss of the roof covering, damage to gable ends, removal of porch coverings and awnings
- Unprotected windows may break if struck by flying debris

- Masonry chimneys can be toppled
- Well-constructed frame homes could have damage to roof shingles, vinyl siding, soffit panels, and gutters
- Failure of aluminum, screened-in, swimming pool enclosures can occur

■ Impact to Apartments, Shopping Centers, and Industrial Buildings

- Some apartment building and shopping center roof coverings could be partially removed
- Industrial buildings can lose roofing and siding especially from windward corners, rakes, and eaves
- Failures to overhead doors and unprotected windows will be common

■ Impacts to Signage, Fences, and Canopies:

- There will be occasional damage to commercial signage, fences and canopies

■ Impacts to Trees:

- Large branches will snap
- Shallow-rooted trees will be toppled

■ Impacts to Power and Water Infrastructure:

- Extensive damage to power lines and poles will likely result in power outages that could last up to several days

²⁸ National Hurricane Center Outreach and Education, Saffir-Simpson Hurricane Wind Scale Extended Table, <http://www.nhc.noaa.gov/aboutsshws.php>

Hazard Profiles

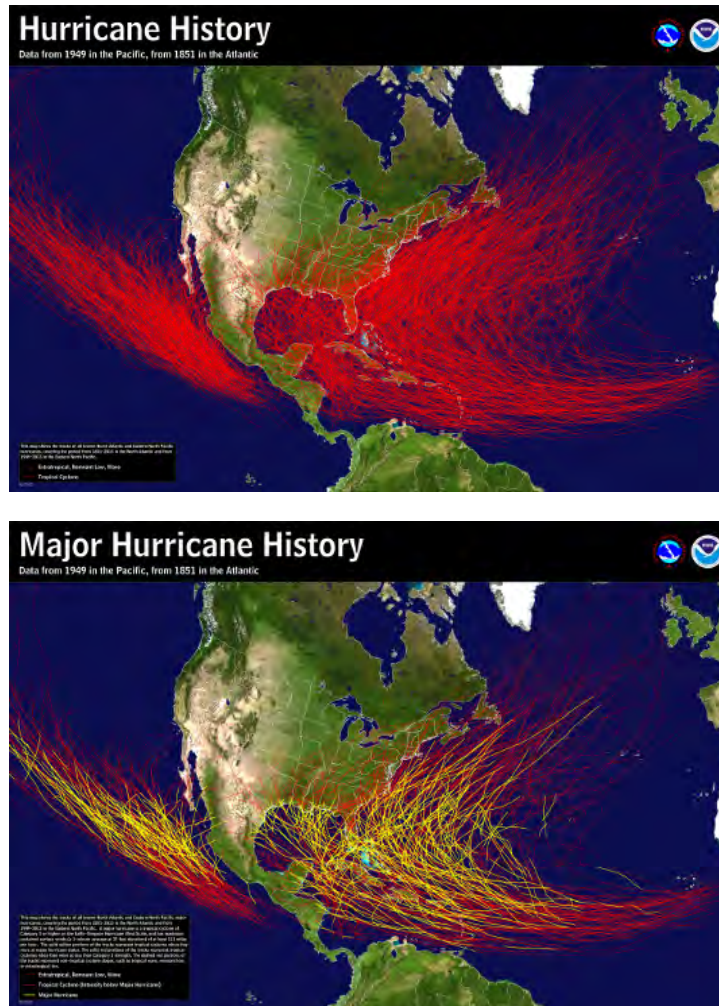


Figure 2.9 | Hurricanes and major hurricanes in the Atlantic Basin, National Hurricane Center (right).

CATEGORY 2: 96-110 mph 1 minute sustained wind

- **Impact to People, Pets, and Livestock:**
 - There is substantial risk of injury or death due to flying or falling debris
- **Impact to Frame Homes:**
 - Poorly constructed frame homes have a high chance of having their roof structures removed, especially if they are not anchored properly
 - Unprotected windows will have a high probability of being broken by flying debris
 - Well-constructed frame homes could sustain major roof and siding damage
 - Failure of aluminum, screened-in, swimming pool enclosures will be common
- **Impact to Apartments, Shopping Centers, and Industrial Buildings**
 - There will be a substantial percentage of roof and siding damage to apartment buildings and industrial buildings
 - Unreinforced masonry walls can collapse
- **Impacts to Signage, Fences, and Canopies:**
 - Commercial signage, fences, and canopies will be damaged and often destroyed

Hazard Profiles

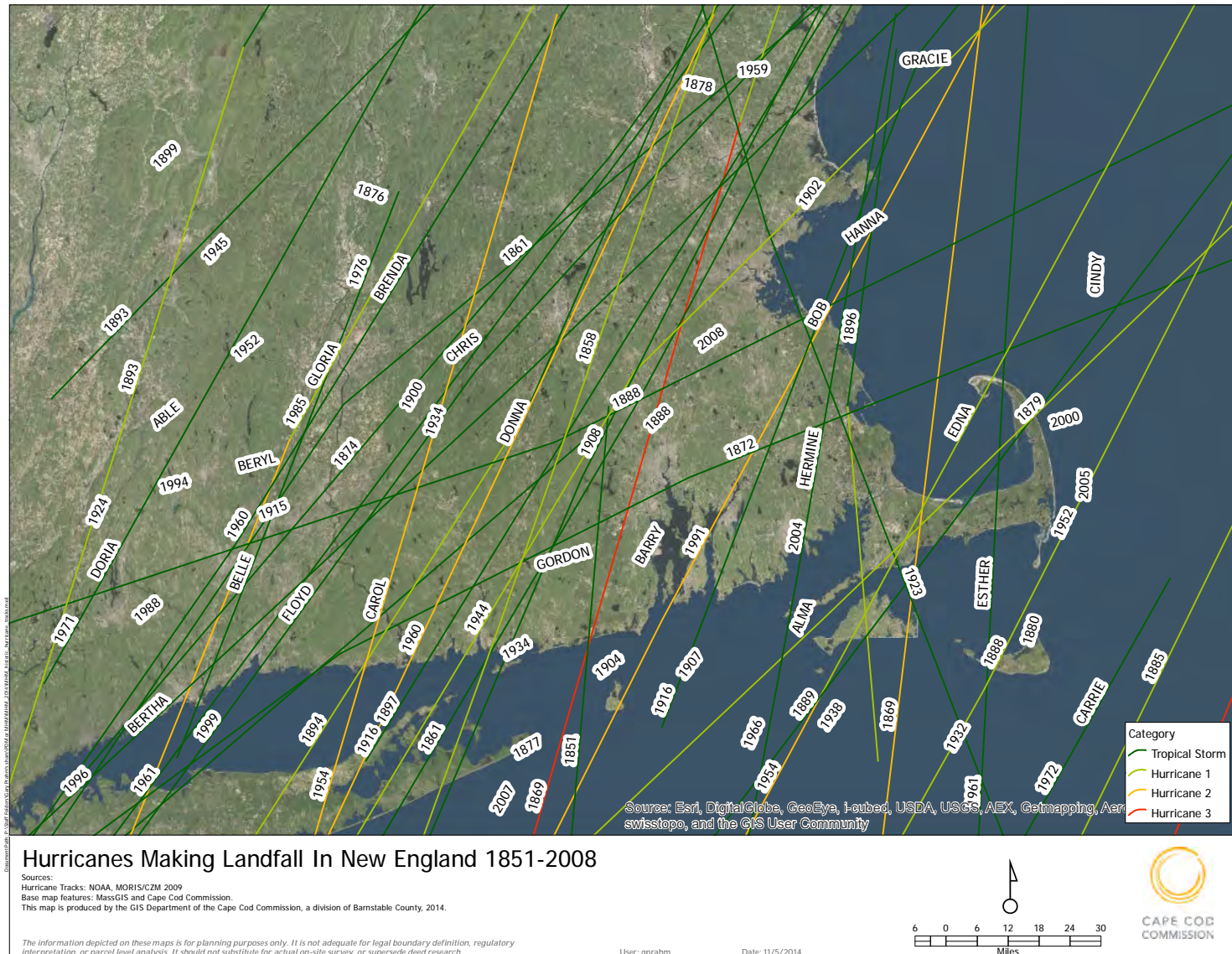


Figure 2.10 | Hurricanes making landfall in New England, 1851-2008

Hazard Profiles

■ Impacts to Trees:

- Many shallow-rooted trees will be snapped or uprooted
- Roads will be blocked by toppled trees

■ Impacts to Power and Water Infrastructure:

- Near total power loss is expected with outages that could last from several days to weeks
- Potable water could become scarce as filtration systems begin to fail

CATEGORY 3: 111-129 mph 1-minute sustained wind

■ Impact to People, Pets, and Livestock:

- There is high risk of injury or death due to flying and falling debris

■ Impact to Frame Homes:

- Poorly constructed frame homes can be destroyed by the removal of the roof and exterior walls
- Unprotected windows will be broken by flying debris
- Well-built frame homes can experience major damage involving the removal of roof decking and gable ends

■ Impact to Apartments, Shopping Centers, and Industrial Buildings

- There will be a high percentage of roof coverings and siding damage to apartment and industrial buildings
- Isolated structural damage to wood or steel framing can occur
- Complete failure of older metal buildings is possible
- Older unreinforced masonry buildings can collapse

■ Impacts to Signage, Fences, and Canopies:

- Most commercial signage, fences, and canopies will be destroyed

■ Impacts to Trees:

- Many trees will snap or become uprooted
- Numerous roads will be blocked

■ Impacts to Power and Water Infrastructure:

- Electricity and water will be unavailable for several days to a few weeks after the storm passes

CATEGORY 4: 130-156 mph 1-minute sustained wind

■ Impact to People, Pets, and Livestock:

- There is a very high risk of injury or death due to flying and falling debris

■ Impact to Frame Homes:

Hazard Profiles

- Poorly constructed homes can sustain complete collapse of all walls as well as the loss of the roof structure
 - Well-built homes also can sustain severe damage with loss of most of the roof structure and/or some exterior walls
 - Extensive damage to roof coverings, windows, and doors will occur. Large amounts of wind-borne debris will be lofted into the air
 - Wind-borne debris will break most unprotected windows and penetrate some protected windows
- **Impact to Apartments, Shopping Centers, and Industrial Buildings:**
- There will be a high percentage of structural damage to the top floors of apartment buildings
 - Steel frames in older industrial buildings can collapse
 - There will be a high percentage of collapse to older unreinforced masonry buildings
- **Impacts to Signage, Fences, and Canopies:**
- Nearly all commercial signage, fences, and canopies will be destroyed
- **Impacts to Trees:**
- Most trees will snap or become uprooted
 - Power poles will be downed
- Numerous roads will be blocked
 - Fallen trees and power poles will isolate residential areas
- **Impacts to Power and Water Infrastructure:**
- Power outages will last for weeks to possibly months
 - Long term shortages will increase human suffering
 - Most of the area will be uninhabitable for weeks to months
- CATEGORY 5: 157 mph or higher 1-minute sustained wind**
- **Impact to People, Pets, and Livestock:**
- There is a very high risk of injury or death due to flying and falling debris even if indoors in mobile or framed homes
- **Impact to Frame Homes:**
- A high percentage of frame homes will be destroyed, with total roof failure and wall collapse
 - Extensive damage to roof covers, windows, and doors will occur
 - Large amounts of wind-borne debris will be lofted into the air

Hazard Profiles

- Wind-borne debris damage will occur to nearly all unprotected windows and many protected windows
- **Impact to Apartments, Shopping Centers, and Industrial Buildings:**
 - Significant damage to wood roof commercial buildings will occur due to loss of roof sheathing
 - Complete collapse of many older metal buildings can occur
 - Most unreinforced masonry walls will fail, which can lead to building collapse
 - A high percentage of industrial buildings and low-rise apartment buildings will be destroyed
- **Impacts to Signage, Fences, and Canopies:**
 - Nearly all commercial signage, fences, and canopies will be destroyed
- **Impacts to Trees:**
 - All trees will snap or become uprooted
 - All power poles will be downed
 - Fallen trees and power poles will isolate residential areas
- **Impacts to Power and Water Infrastructure:**
 - Power outages will last for weeks to possibly months

- Long-term shortages will increase human suffering
- Most of the area will be uninhabitable for weeks to months

Probability

The Planning Team determined that it is **HIGHLY LIKELY** that a hurricane or tropical storm will impact the planning area. High probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used the history of tropical cyclones in Barnstable County and local knowledge to make this probability designation.

B2b

Landslides

Overview

A landslide is a general term used to describe the downslope movement of soil, rock, and organic materials under the effect of gravity.²⁹

Below is a list of the most common causes of landslides in Massachusetts³⁰:

- **Water saturation** on a slope occurs after intense rainfall, snow melt, changes in level of groundwater and water level changes along coasts and banks. Water from a rain event adds weight to the slope and reduces the strength of slope materials.
- **Undercutting of slopes by flooding and wave action** occurs when streams and waves erode the base of slopes, causing them to over-steepen and eventually collapse. Areas where this type of failure occurs includes Cape Cod, Nantucket, and Martha's Vineyard.³¹
- **Construction related failures** occur during construction activities such as cut and fill construction for highways and roads and when vegetation on a slope is removed during the

construction of buildings. These activities can increase slope angle and decrease lateral support which can sometimes lead to landslides.³²

Hazard Location

Landslides occur in every state in the U.S., but the majority of Massachusetts has a low incidence of landslides. In Mashpee, the risk of flooding and loose soils could result in a landslide in the planning area.

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Previous Occurrences and Extent

There have been no federally declared landslide disasters in Massachusetts from 1954 - 2012. To date, there have been no significant landslides in Mashpee.

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Based on reports from the USGS website, the extent of a landslide is quantified as the estimated amount of material in cubic yards that was deposited from a higher elevation. There is no history of a landslide in Mashpee, therefore there is no data on the worst conditions experienced in Mashpee from a landslide.

Impact

Below is a list of possible impacts that could result from a landslide.

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²⁹ The Landslide Handbook – A Guide to Understanding Landslides USGS Circular 1325, 2008

³⁰ Massachusetts State Hazard Mitigation Plan, 2013

³¹ Massachusetts State Hazard Mitigation Plan, 2013

³² Landslide Loss Reduction: A Guide for State and Local Government Planning, FEMA-182, 1989

Hazard Profiles

- **People:** people, cars, and homes can become buried; delays in emergency services; isolated residents
- **Infrastructure:** damaged power lines
- **Buildings:** unstable foundations of structures; damage and destruction to buildings because of the movement of sediment and flooding
- **Economy:** isolated businesses
- **Natural Systems:** downed trees, decreased water quality
- **Transportation:** road closures, damage to road segments and/or culverts, transportation delays because of blocked access to roadways

B2b

Probability

The Planning Team determined that it is **POSSIBLE** that a landslide will impact the planning area. Probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used the history of flooding and the presence of loose soils to make this probability determination.

Nor'easters

Overview

A nor'easter is a cyclonic storm that forms outside of the tropics and moves along the east coast of North America.³³ It is called a nor'easter because the winds over coastal areas blow from a northeasterly direction. These storms usually develop between Georgia and New Jersey within 100 miles of the coastline and then move north or northeastward. Once these storms reach New England, they usually become more intense. These storms can occur at any time of year but are most frequent between September and April. The years with the most nor'easters tend to coincide with El Niño events.³⁴

The east coast of North America provides an ideal breeding ground for nor'easters.³⁵ During the winter, the polar jet stream transports cold Arctic air southeast across Canada, the United States, and the Atlantic

³³ NOAA: Know the dangers of nor'easters, http://www.noaa.gov/features/O3_protecting/noreasters.html

³⁴ "Storm of the Century" by Susan Milton, Cape Cod Times, reported in the February 3, 2008 issue

³⁵ NOAA: Know the dangers of nor'easters, http://www.noaa.gov/features/O3_protecting/noreasters.html

Hazard Profiles

Ocean. In addition, warm air from the Gulf of Mexico and the Atlantic moves northward, keeping the coastal waters relatively mild during the winter. This difference in temperature between the warm air over the water and cold Arctic air over the land is the area where nor'easters are born.

Nor'easters bring heavy rain and snow, gale force winds, rough seas, coastal flooding, and can cause beach erosion. Sustained wind speeds of 20-40 mph are common during a nor'easter with short-term wind speeds gusting up to 50-60 mph.³⁶ Wind gusts associated with these storms can exceed hurricane force in intensity. Nor'easters are notorious for producing heavy snow, rain, and oversized waves that crash onto Atlantic beaches, often causing beach erosion and structural damage. Nor'easters may also sit stationary for several days, affecting multiple tide cycles and producing extended periods of heavy precipitation. The level of damage in a strong hurricane is often more severe than a nor'easter, but historically Massachusetts has suffered more damage from nor'easters because of the greater frequency of these coastal storms (one or two per year).

Traditionally, nor'easters are not given names like hurricanes and tropical storms. This changed recently as a result of The Weather Channel adopting a naming protocol in 2012 that gained popularity in defining storm systems. Nor'easters do not have their own

³⁶ Massachusetts State Hazard Mitigation Plan, 2013

categorization scheme; instead aspects of a nor'easter are categorized. For example, the Beaufort Scale is used to categorize the wind speed of a nor'easter (small craft advisory, gale warning, storm warning, hurricane force wind warning) and the Regional Snowfall Index is used to categorize snowfall during a nor'easter.

Hazard Location

Coastal areas of Mashpee are susceptible to damages from wind, snow, and surge during a nor'easter. However, it is important to note that nor'easters can also bring heavy snow and flooding to the entire planning area.

B1c

Previous Occurrences and Extent

Since nor'easters are not categorized like Hurricanes and Tropical Storms, it is difficult to track their history. Also, it is important to note that hurricanes and tropical storms can transform into nor'easters,³⁷ making it especially difficult to track the history of nor'easters in a particular area.

The following is a list of some of the nor'easters that affected Barnstable County, but it is not a complete list because of the reasons mentioned above³⁸:

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³⁷ "Storm of the Century" by Susan Milton, Cape Cod Times, reported in the February 3, 2008 issue

³⁸ Massachusetts State Hazard Mitigation Plan, 2013

Hazard Profiles

- **February 1978:** this blizzard/nor'easter produced 8-12 inches of snow as well as ice and flooding and 92 mph winds in Chatham. It damaged buildings and infrastructure across Barnstable County including battering the bathhouse and parking lot at Coast Guard Beach in Eastham; waves flooded and flattened dunes on barrier beaches in Chatham, Eastham, and; Monomoy Island off of Chatham split in several places; homes were destroyed; the Outer Cape was an island for a few hours when a 16-foot storm tide flooded Route 6 at Fort Hill with three feet of water; Bridge Road flooded in Eastham.³⁹ This event resulted in a federal disaster declaration (FEMA DR-546).
- **October-November 1991:** This large nor'easter was an unusual event because it moved south and strengthened when it joined with Hurricane Grace – producing what some would call the “Perfect Storm.” Winds measured over 80 mph with waves over 30 feet high in some parts of the coastline. This event resulted in a federal disaster declaration (FEMA DR-920).
- **December 1992:** A strong nor'easter affected the Commonwealth from December 11 to 13, 1992. Impacts included deep and intense snowfall, freezing rain, heavy rainfall near the coast, coastal flooding, and damaging winds. The weight of the snow taxed snow removal equipment in many communities and caused roof damage. Precipitation totals for this storm were extraordinary. Much of southern New England received up to 5 inches of liquid equivalent precipitation during a 2 to 3 day period, with locally close to 8 inches recorded in parts of southeast Massachusetts. Along coastal sections of Massachusetts, much of the precipitation fell as rain or rain/snow mix. This caused considerable ponding and localized flooding in poorly drained areas. The greatest damage from this storm was due to coastal flooding. Most east-facing shoreline communities from Chatham to Yarmouth and Plymouth to the North Shore, as well as Nantucket Island, experienced some level of coastal flood damage. As much as 20 feet of dune was lost in Sandwich. Many coastal roads closed and docks and cottages were damaged.
- **March 1994:** A strong nor'easter passed to the southeast of Cape Cod, resulting in heavy snow and drifting snow. Over southeast Massachusetts, between 3 and 6 inches of snow fell before it changed to rain. Wind gusts of up to 40 and 60 mph resulted from this event and created snow drifts of up to 3 feet. Buildings were damaged, businesses and schools were closed, and road travel was disrupted.
- **January 22-23, 2005:** A major winter storm brought heavy snow, high winds, and coastal flooding to southern New England. In Massachusetts, blizzard conditions were reported on Nantucket.

³⁹ “Storm of the Century” by Susan Milton, Cape Cod Times, reported in the February 3, 2008 issue

Hazard Profiles

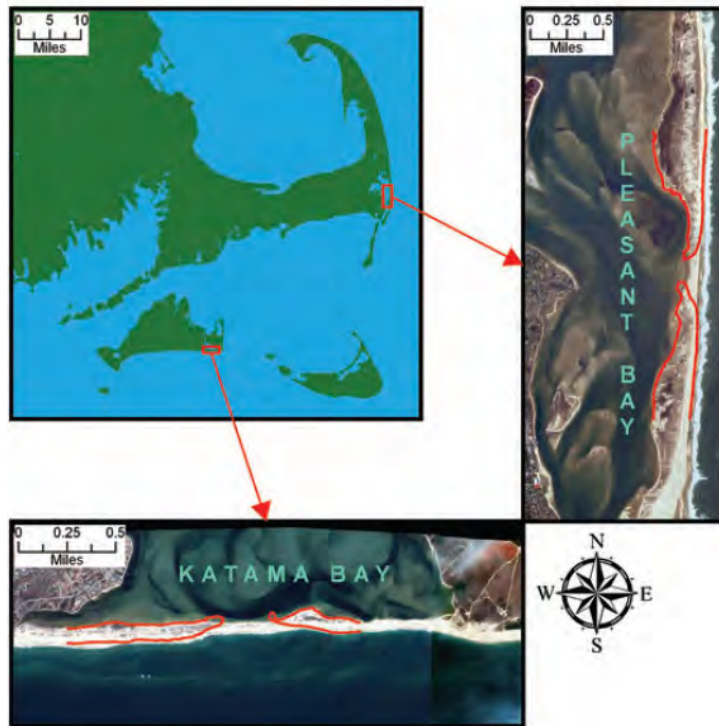


Figure 2.11 | Locations of barrier island breaches that occurred during the April 2007 storm. The Joint Airborne LiDAR Bathymetry Technical Center of Expertise (JALBTCX) collected the aerial photograph shortly before the storm and the red lines were extracted from JALBTCX LiDAR flown shortly after the storm (Berman and Nemunaitis-Monroe, 2012).

Near-blizzard conditions were reported in areas and brought between 1 and 3 feet of snow and produced wind gusts of up to 65 mph. The highest snowfall totals were reported in eastern Massachusetts (between 2 and 3 feet). Minor to moderate coastal flooding was observed around high tide in eastern Massachusetts coast. Roads were inundated and evacuations occurred.

- **April 2007:** An intense coastal storm brought rain and coastal/inland flooding to eastern Massachusetts. The storm was primarily a rain event due to warmer temperatures. For this Patriot's Day Storm, the surge peaked on a high tide on April 16, 2007 and the time period of one foot surge lasted more than four high tides (~47 hours). Major coastal flooding and storm damage resulted not only from the severity of the storm but also due to the timing of the Perigean spring tides. The 2007 nor'easter hit during the highest predicted tide of the month, which was also the top 0.2% of the year. This 2007 storm breached the barrier beaches at both Pleasant Bay on the Lower Cape and Katama Bay on Martha's Vineyard (**Figure 2.11**). While some breaches will close by themselves in a short amount of time, both of these 2007 breaches became new inlets for the bays.⁴⁰ This event

⁴⁰ <http://capeandislands.org/post/blizzard-2015-delivers-high-wind-more-snow-forecast>

Hazard Profiles

resulted in a federal disaster declaration (FEMA DR-1701). Counties included in this disaster received over \$8 million in public assistance from FEMA.

- **January 2015:** Winter storm Juno was a powerful nor'easter that impacted the northeast and New England.⁴¹ Governor Baker declared a state of Emergency and issued travel bans in preparation for this storm; all shelters in Barnstable County were opened; transit and ferry services were canceled; winds gusted to 75 mph; rain/snow mix transitioning to 15-18 inches of snow; 5,700 out of the 9,500 customers were without power on Cape Cod; thundersnow occurred in various regions across Cape Cod; storm surge and coastal flooding caused erosion in many areas on Cape Cod; Pilgrim Nuclear Power Station shutdown in response to degrading off-site electrical grid conditions; dune break at Ballston Beach in Truro; significant damage to coastal areas in Cape Cod National Seashore. This event resulted in a federal disaster declaration (FEMA DR-4214).

B3a

Impact

Below is a list of possible impacts that could occur in Mashpee during a nor'easter:

⁴¹ <http://capeandislands.org/post/blizzard-2015-delivers-high-wind-more-snow-forecast>

- **People:** longer response time for emergency personnel; see also impact on people in the Flood Hazard Profile
- **Infrastructure:** damages to water infrastructure; utility outages
- **Buildings:** wind damage to buildings; see also damages to buildings in the Flood Hazard Profile
- **Economy:** loss of business function; damage to inventory; relocation costs; wage loss
- **Natural Systems:** snow and ice accumulation can negatively impact vegetation and natural habitat; downed trees and fallen branches; coastal landscape can be reshaped by storm surge
- **Transportation:** roadways can become impassable from storm surge and debris; culverts damaged from storm surge

Probability

The Planning Team determined that it is **HIGHLY LIKELY** that a nor'easter will impact the planning area. High probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years

B2b

- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used the history of nor'easters impacting Mashpee to make this probability designation.

High Winds

Overview

Wind is air in motion relative to the ground surface.⁴² High winds can occur as an isolated event or can accompany other weather events such as:

- Before and after frontal systems
- Hurricanes and tropical storms
- Severe thunder and lightning storms
- Tornadoes
- Nor'easters

The National Weather Service issues warnings and advisories for high wind events as follows⁴³:

⁴² Massachusetts State Hazard Mitigation Plan, 2013

⁴³ Massachusetts State Hazard Mitigation Plan, 2013

- **Wind Advisory:** for non-tropical events over land, sustained winds of 31-39 mph for at least one hour or any gusts up to 46-57 mph
- **High Wind Warning:** for non-tropical events over land, sustained winds of 40-73 mph or any gusts 58+ mph
- **Small Craft Advisory:** for non-tropical events over water, sustained winds of 29-38 mph
- **Gale Warning:** for non-tropical events over water, sustained winds of 39-54 mph
- **Storm Warning:** for non-tropical events over water, sustained winds of 55-73 mph
- **Hurricane Force Wind Warning:** for non-tropical events over water, sustained winds of 74+ mph
- **Tropical Storm Warning:** for tropical systems, any inland or coastal area with expected sustained winds from 39-73 mph
- **Hurricane Warning:** for tropical systems, any inland or coastal area with expected sustained winds of 74+ mph

Hazard Location

FEMA compiled 40 years of tornado history and 100 years of hurricane history to generate a map of the frequency and strength of windstorms in the United States (*Figure 2.12*).

Hazard Profiles

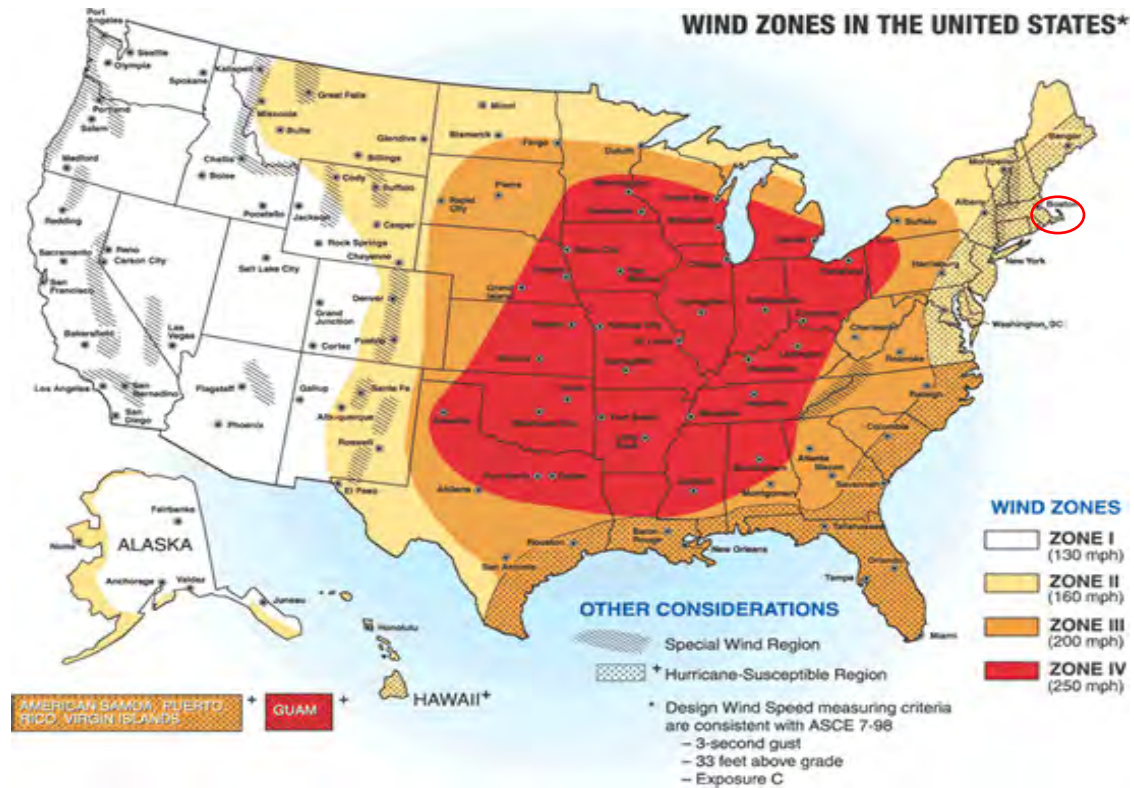


Figure 2.12 | Map of frequency and strength of windstorms in the United States. Planning area is highlighted with a red circle. Map is from the 2013 Massachusetts State Hazard Plan.

The map shows that Mashpee is located in Wind Zone II with maximum wind speeds of 160 mph. Since this map includes hurricane and tornado winds, it does not capture wind advisories, high wind warnings, small craft advisories, and gale warnings; it generalizes data at the local level.

The Planning Team decided that the entire planning area is vulnerable to high winds, especially the coastline of Mashpee.

B1c,
B2a,c

Previous Occurrences and Extent

According to the NOAA National Climatic Data Center (NCDC), Barnstable County experienced the following wind events between January 1, 1950 and July 21, 2015:

- **71 days of High Wind**
- **28 days of Thunderstorm Wind**

B2c

However, specific information on the extent of these NCDC wind events in Mashpee is not available.

B3a

Impact

Table 2.3 lists possible damages that can result from high wind events.

- **People:** power outages can affect vulnerable populations especially if outages occur during the winter months
- **Infrastructure:** downed power lines, power outages (wind gusts of only 40-45 mph have caused scattered power outages from downed trees and wires), high wind events can generate rough seas which can cause damage to coastal infrastructure
- **Buildings:** damage to roofs, windows; the roof on the Surfside Inn blew off in Hurricane Bob and damaged the houses across the street
- **Economy:** loss of power can cause businesses to close temporarily until power is restored
- **Natural Systems:** downed trees and branches

Probability

B2b

The Planning Team determined that it is **HIGHLY LIKELY** that a high wind event will impact the planning area. High probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years

Hazard Profiles

- **Highly Likely:** near 100% probability in the next year

The Planning Team used Mashpee’s history of high wind, hurricanes/tropical storms, and nor’easters as well as the town’s proximity to the ocean to make this probability determination.

Thunderstorms

Overview

A thunderstorm is a storm that produces lightning and thunder and is usually accompanied by gusty winds, heavy rain, and sometimes hail.⁴⁴ The National Weather Service considers a thunderstorm to be severe if it produces any of the following: hail at least one inch in diameter, winds of 58+ mph, or a tornado.

Three basic “ingredients” are required for the formation of a thunderstorm: moisture that forms clouds and rain, unstable air that rises rapidly, and lift caused by cold or warm fronts, sea breezes, or heat from the sun. The following is a description of the formation of thunderstorms.⁴⁵ The rising air in a thunderstorm cloud causes various types of frozen precipitation to form within the cloud (i.e., small ice crystals, snow

and ice pellets, and water pellets). The smaller ice crystals are carried upward toward the top of the clouds by the rising air while the denser ice pellets are either suspended by the rising air or start falling towards the ground. Collisions occur between the ice crystals and the pellets and these collisions serve as the charging mechanism for the thunderstorm. The small ice crystals become positively charged while the pellets become negatively charged. As a result, the top of the cloud becomes positively charged and the middle to lower part of the cloud becomes negatively charged. When the charge difference between the ground and the cloud becomes large, a charge starts moving toward the ground and a powerful discharge occurs between the cloud and the ground (**Figure 2.13**). This discharge is seen as a bright, visible flash of lightning. The channel of air through which lightening passes can be heated to 50,000°F. The rapid heating and cooling of the air near this lightning channel causes a shock wave that results in the sound of thunder. Compared to hurricanes and winter storms, thunderstorms affect a relatively small area. The typical thunderstorm is 15 miles in diameter and lasts on average for 30 minutes.⁴⁶

44 Massachusetts State Hazard Mitigation Plan, 2013

45 Thunderstorms, Tornadoes, Lightning: Nature’s Most Violent Storms, A Preparedness Guide, US Department of Commerce, NOAA, and the National Weather Service

46 Thunderstorms, Tornadoes, Lightning: Nature’s Most Violent Storms, A Preparedness Guide, US Department of Commerce, NOAA, and the National Weather Service



Figure 2.13 | Schematic of how lightning develops, from Thunderstorms, Tornadoes and Lightning: Nature's Most Violent Storms

B1c

Hazard Location

According to a map presented in the Massachusetts State Hazard Plan, Barnstable County experiences approximately 20 thunderstorm days per year (see *Figure 2.14*).

B1c,
B2a,c

Previous Occurrences and Extent

Using local knowledge, the Planning Team concluded that at least 1-2 thunderstorms occur every year in Mashpee. However, data on these storm events are not consistently recorded at the local level. The thunderstorm profile relies on data from the NOAA National Climatic Data Center (NCDC) but this website does not have searchable data at the town level.

The following is a list of historical thunderstorms that occurred in Mashpee, although it is not a complete list:

- **August 19, 2008:** A cold front moved through Southern New England producing showers and thunderstorms that became severe as they moved through the Commonwealth. Large hail and damaging winds affected Cape Cod. Trees were downed by thunderstorm winds.
- **August 4, 2015:** A line of thunderstorms developed across Long Island, NY and raced towards Rhode Island and southeastern Massachusetts. These storms caused significant wind damage knocking down a significant number of trees.

Hazard Profiles

B3a

Impact

Below is a list of impacts that could occur during a thunderstorm:

- **People:** power outages can affect vulnerable populations, especially if outages occur during the winter months; injury or death can occur because people are often caught outdoors during a thunderstorm and do not have enough time to run inside; people can become stuck if area flooding occurs
- **Infrastructure:** downed power lines and power outages; heavy rain associated with a thunderstorm can overwhelm drainage systems causing area flooding and property destruction
- **Buildings:** damage to roofs and windows; heavy rain associated with a thunderstorm can overwhelm drainage systems causing area flooding and property destruction; lightning strikes can cause buildings to catch on fire
- **Economy:** loss of power can cause businesses to close temporarily until power is restored; lightning strikes are possible during thunderstorm events which can cause economic loss to businesses
- **Natural Systems:** downed trees and branches

Probability

The Planning Team determined that it is **HIGHLY LIKELY** that thunderstorms will impact the planning area. High probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used Mashpee's history of thunderstorms and the town's proximity to the ocean to make this probability determination.

B2b

Hazard Profiles

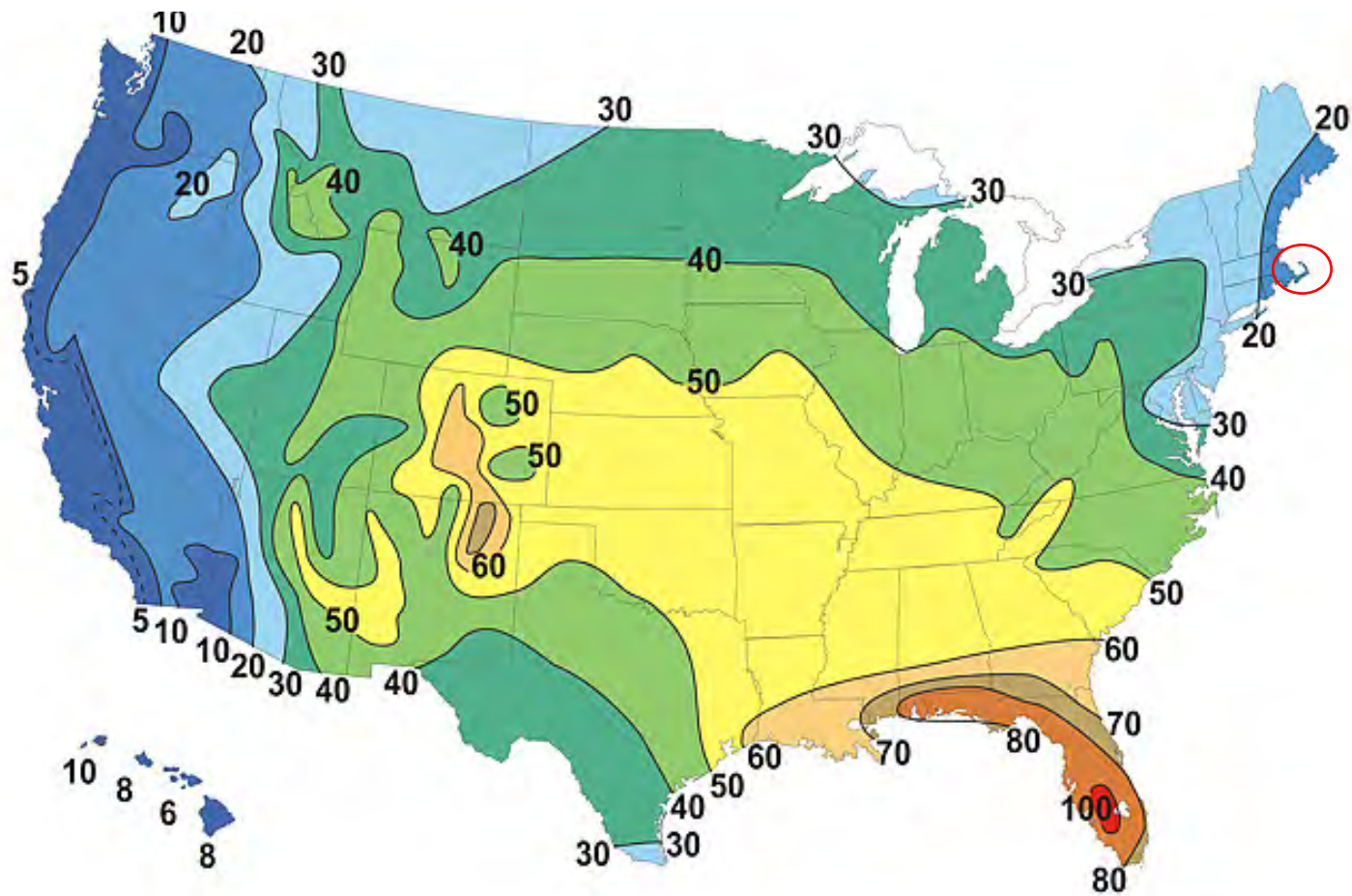


Figure 2.14 | Map of the average number of thunderstorms per year in the United States. Planning area is highlighted with a red circle. Map is from the 2013 Massachusetts State Hazard Plan

Hazard Profiles

Extreme Temperatures

Overview

Extreme temperatures are defined as temperatures that are far outside the normal ranges for the season in a specific area. Extreme cold events occur when temperatures drop well below normal in an area. Extreme cold temperatures are generally characterized in temperate zones by the ambient air temperature dropping to approximately 0°F or below. Excessive summer temperatures are often identified as the number of days with maximum temperatures greater than or equal to 90°F and greater than or equal to 100°F.

B1c

Hazard Location

The entire planning area is vulnerable to extreme temperatures.

B1c,
B2a,c

Previous Occurrences and Extent

According to NOAA's National Climatic Data Center (NCDC), the following extreme heat and extreme cold events were reported for Barnstable County between January 1, 1950 and July 31, 2015:

- **August 22, 2011:** Extreme heat event. A strong upper level ridge brought very hot temperatures to Southern New England and increased humidity levels such that heat index values rose above 105

degrees for a period of a few hours. The Automated Weather Observation System at Coast Guard Air Station Cape Cod (KFMH) near Falmouth, recorded heat indexes of 105 over a three hour period. The Automated Weather Observation System at Provincetown Municipal Airport (KPVC) also recorded heat indexes of 105 during this time frame.

Impact

Below is a list of possible impacts that could occur during extreme temperature events⁴⁷:

B3a

- **People:** children and elderly are particularly at risk to health problems associated with extreme temperature; heat-induced illness such as sunburn, heat cramps, heat exhaustion, and heat stroke; cold-induced illness such as frost bite and hypothermia; air quality can be affected during extreme heat events, which can cause health hazards; residents can be displaced if warming/cooling centers are opened during extreme temperature events
- **Infrastructure:** power failure; salt water freezes in bays/harbors and can damage coastal infrastructure; extreme temperatures can cause school closings

⁴⁷ Massachusetts State Hazard Mitigation Plan, 2013

- **Buildings:** in extreme cold temperature, urban fire risk increases as people often use space heaters, generators, and candles to stay warm
- **Economy:** extreme cold temperatures can inhibit fishing operations and the transport of goods and services
- **Natural Systems:** saltwater freezing can occur in coastal bays and harbors
- **Transportation:** icy roads make travel difficult

B2b

Probability

The Planning Team determined that it is **POSSIBLE** that extreme temperatures will impact the planning area. Probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used Mashpee's history of extreme temperatures in town to make this probability determination.

Tornadoes

Overview

A tornado is a violently rotating column of air extending from a thunderstorm cloud to the ground.⁴⁸ Tornadoes are not always visible as funnel clouds because they are nearly translucent until they pick up dust and debris. The average tornado moves from southwest to northeast, but they can move in any direction and can suddenly change direction. The average speed of a tornado is 30 mph, but they can be stationary or move as fast as 70 mph. The strongest tornadoes have rotating winds of more than 200 mph.

Tornadoes can form from a variety of sources:

- Accompanying tropical storms and hurricanes as they move onto land
- From individual cells within severe thunderstorms squall lines
- From an isolated super-cell thunderstorm
- From tropical cyclones or even their remnants that are passing through
- Form when air converges and spins upward

⁴⁸ NOAA's National Weather Service, Storm Prediction Center: <http://www.spc.noaa.gov/faq/tornado/f-scale.html>

Hazard Profiles

B1c

Hazard Location

The entire planning area is vulnerable to tornadoes, especially the coastline. Compared to the rest of Massachusetts, Barnstable County has a very low tornado density, defined as the number of tornadoes per 20 square miles (*Figure 2.15*).⁴⁹

B1c,
B2a,c

Previous Occurrences and Extent

According to the NOAA National Climatic Data Center, Barnstable County experienced the following tornado and waterspouts events between January 1, 1950 and July 21, 2015:

- **August 9, 1968:** F1 tornado was reported for Barnstable County. Many trees felled, destructive wind and hail, fruit and vegetable crops damaged, utility lines damaged, power outages, roof was lifted from a fruit stand (account taken from NCDC Storm data for August 1968)
- **August 22, 1977:** F1 tornado was reported for Barnstable County. A small tornado touched down in Yarmouth and destroyed an art gallery and signs on the street. It also picked up two buildings and two people were inside the building. Also, it spawned very large thunderstorm across Cape Cod.
- **August 20, 1997:** Showers developed during the afternoon in southeastern Massachusetts and these

went on to produce three waterspouts, at least one confirmed weak tornado (F0), and numerous funnel clouds. The first waterspout occurred just east of the Sagamore Bridge, over Cape Cod Bay, at 1:30 p.m. Another waterspout was reported just west of Bourne, over Buzzards Bay, at 3:20 p.m. Throughout the afternoon, there were numerous reports of funnel clouds, some of which appeared in newspaper photos and documented via amateur radio operators' videos. Many of the funnels came as far as half-way down before retreating up into the cloud. There were no reports of damage or injury as a result of these events.

According to the NOAA National Climatic Data Center (NCDC), there were no specific reports of tornadoes in Mashpee from 1950 to July 31, 2015.

Impact

Below is the Fujita Tornado Damage Scale developed in 1971 by T. Theodore Fujita⁵⁰:

- **Scale F0, <73 mph winds, light damage:** some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged

B3a

⁴⁹ Massachusetts State Hazard Mitigation Plan, 2013

⁵⁰ NOAA's National Weather Service, Storm Prediction Center: <http://www.spc.noaa.gov/faq/tornado/f-scale.html>

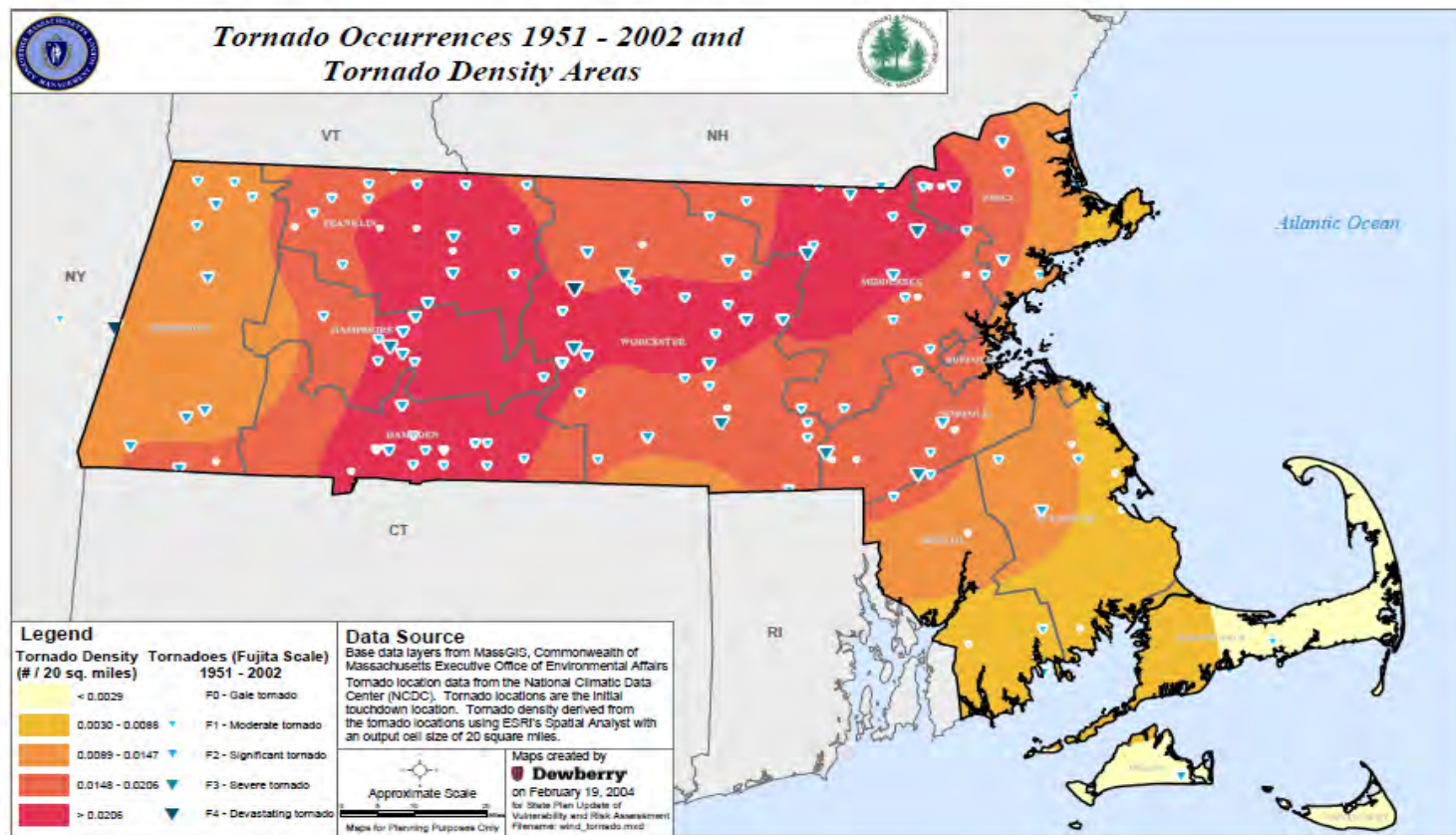


Figure 2.15 | Tornado occurrence and density for Massachusetts. Map is from the 2013 Massachusetts State Hazard Plan

Hazard Profiles

- **Scale F1, 73- 112 mph winds, moderate damage:** surface peeled off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads
- **Scale F2, 113- 157 mph winds, considerable damage:** roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground
- **Scale F3, 158- 206 mph winds, severe damage:** roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown
- **Scale F4, 207-260 mph winds, devastating damage:** well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated
- **Scale F5, 261-318 mph winds, incredible damage:** strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; incredible phenomena will occur

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used Mashpee's propensity for tropical weather and Cape Cod's history of tornadoes to make this probability determination.

Drought

Overview

Drought is a period characterized by long durations of below normal precipitation.⁵¹ Drought conditions occur in virtually all climatic zones yet its characteristics vary significantly from one region to another, since it is relative to the normal precipitation in that region.

B2b

Probability

The Planning Team determined that it is **POSSIBLE** that a tornado will impact the planning area. Probability was defined based on the frequency of occurrence:

⁵¹ Massachusetts State Hazard Mitigation Plan, 2013

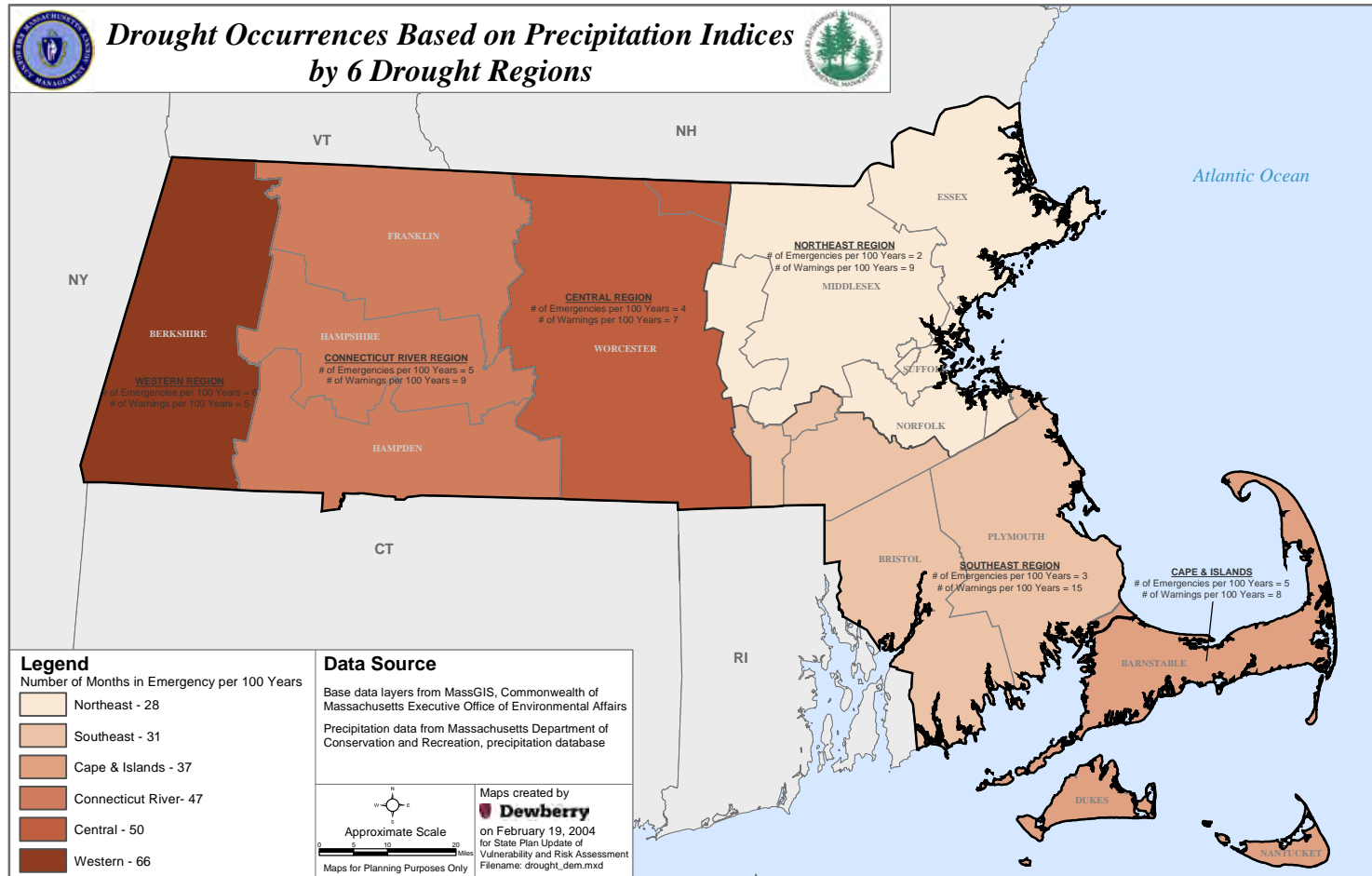


Figure 2.16 | Number of drought emergencies per 100 years for Massachusetts. Map is from the 2013 Massachusetts State Hazard Plan

Hazard Profiles

B1c

Hazard Location

The entire planning area could be affected by drought. *Figure 2.16* shows how Barnstable County compares to the rest of the Commonwealth of Massachusetts for the number of months in a drought emergency per 100 years.

B1c,
B2a,c

Previous Occurrences and Extent

According to the Massachusetts Drought Management Plan, a determination of drought level is based on seven indices:

- **Standardized Precipitation Index (SPI)** reflects soil moisture and precipitation conditions and is calculated monthly using Massachusetts Rainfall Database at DCR, Office of Water Resources. SPI values are calculated for “look-back” periods of 1 month, 3 months, 6 months, and 12 months.
- **Crop Moisture Index (CMI)** reflects short-term soil moisture conditions as used for agriculture and is available from the National Climate Data Center.
- **Keetch-Byram Drought Index (KBDI)** is designed specifically for fire potential assessment. The KBDI attempts to measure the amount of precipitation necessary to return the soil to full field capacity.
- **Precipitation Index** is a comparison of measured precipitation amounts (in inches) to historic normal

precipitation. Cumulative amounts for 3-, 6-, and 12-month periods are factored into the drought determination.

- **Groundwater Level Index** is based on the number of consecutive months groundwater levels are below normal (lowest 25% of period of record for the respective months). The U.S. Geological Survey (USGS) monitors groundwater levels in a network of monitoring wells throughout Massachusetts.
- **Streamflows Index** is based on the number of consecutive months that streamflow levels are below normal (lowest 25% of period of record for the respective months). The USGS monitors streamflow in a network of gages throughout Massachusetts.
- **Reservoir Index** is based on the water levels of small, medium, and large index reservoirs across the state. The reservoir level relative to normal conditions for each month of the year will be considered. As part of its monthly conditions report, DCR, Office of Water Resources maintains a list of index water supply reservoirs and the percentage at which they are at capacity as well as non-water supply index reservoir levels, as available.

Using these indices, the Massachusetts Drought Management Plan uses five levels to characterize drought severity. (See *Table 2.5*)

Hazard Profiles

Drought Level	Standardized Precipitation Index	Crop Moisture Index*	Keetch-Byram Drought Index*	Precipitation	Groundwater	Streamflow	Reservoir***
Normal	3-month > -1.5 <u>or</u> 6-month > -1.0 <u>or</u> 12-month > -1.0	0.0 to -1.0 slightly dry	< 200	1 month below normal	2 consecutive months below normal**	1 month below normal**	Reservoir levels at or near normal for the time of year
Advisory	3-month = -1.5 to -2.0 <u>or</u> 6-month = -1.0 to -1.5 <u>or</u> 12-month = -1.0 to -1.5	-1.0 to -1.9 abnormally dry	200-400	2 month cumulative below 65% of normal	3 consecutive months below normal**	At least 2 out of 3 consecutive months below normal**	Small index Reservoirs below normal
Watch	3-month < -2.0 <u>or</u> 6-month = -1.5 to -3.0 <u>or</u> 12-month = -1.5 to -2.0	-2.0 to -2.9 excessively dry	400-600	1 of the following criteria met: 3 month cum. < 65% <u>or</u> 6 month cum. < 70% <u>or</u> 12 month cum. < 70%	4-5 consecutive months below normal**	At least 4 out of 5 consecutive months below normal**	Medium index Reservoirs below normal
Warning	6-month < -3.0 <u>or</u> 12-month = -2.0 to -2.5	< -2.9 severely dry	600-800	1 of the following criteria met: 3 month cum. < 65% and 6 month cum. < 65%, <u>or</u> 6 month cum. < 65% and 12 month cum. < 65%, <u>or</u> 3 month cum. < 65% and 12 month cum. < 65%	6-7 consecutive months below normal**	At least 6 out of 7 consecutive months below normal**	Large index reservoirs below normal
Emergency	12-month < -2.5	< -2.9 severely dry	600-800	Same criteria as Warning and previous month was Warning or Emergency	>8 months below normal**	>7 months below normal**	Continuation of previous month's conditions

* The Crop Moisture Index is subject to frequent change. The drought level for this indicator is determined based on the repeated or extended occurrence at a given level.

** Below normal for groundwater and streamflow are defined as being within the lowest 25th percentile of the period of record.

*** Water suppliers should be consulted to determine if below normal reservoir conditions are due to operational issues.

Table 2.5 | Drought Indices as defined in the 2013 Massachusetts Drought Management Plan

Hazard Profiles

These drought levels are intended to provide information on the current status of water resources in distinct regions of Massachusetts (Western, Central, Connecticut River Valley, Northeast, Southeast, and Cape and Islands). The levels provide a basic framework from which to take actions to assess, communicate, and respond to drought conditions. They begin with a normal situation where data are routinely collected and distributed, move to heightened vigilance with increased data collection during an advisory, and increased assessment and proactive education during a watch.

The following list of dates and drought levels and descriptions for Barnstable County was compiled from data from the Massachusetts State Hazard Mitigation Plan, US Drought Monitor website, and the Department of Conservation and Recreation Drought Management website:

- **1991:** Drought conditions in Barnstable County but no data is available on the drought level as described above. The observation well located in the vicinity of the Barnstable Airport set a record monthly low for two months. Local and state officials were concerned with water table levels primarily because of the impacts of low pond levels (i.e., Mary Dunn Pond) on wildlife and vegetation.
- **2001:** Drought Advisory in December
- **2002:** Drought Advisories and Watches from February to December

- **2012:** January to May of 2012 was the driest start to any year on record for the Commonwealth of Massachusetts, with only 6 inches of total precipitation. Most areas in southern New England were running 6-8 inches below normal. In April 2012, most of the Commonwealth was again under drought conditions that lasted until May 2012. Rivers and streams were most affected as most ran at record low levels during the spring run-off season. The main impact of the meteorological drought was periods of very high fire danger. In addition, small pond levels were reduced. While soil moisture was well below normal, this drought occurred prior to the beginning of the growing season so no agricultural impacts were realized.
- **2014:** Drought Advisory in October
- **2016:** Drought Advisories and Watches from July to December
- **2017:** Drought Advisory January to March

Impact

The following is a list of impacts that are possible with drought⁵²:

- **People:** migration from a community, increased conflicts between water users, reduction in drinking water, food shortages

B3a

⁵² Massachusetts State Hazard Mitigation Plan, 2013

- **Infrastructure:** reduced water levels, soil erosion
- **Buildings:** soil erosion could cause damage to foundations and buildings
- **Economy:** reduced crop yield, increased prices for food
- **Natural Systems:** increased fire hazard, damage to water quality, damage to wildlife and fish habitat, degradation of landscape quality, loss of biodiversity, soil erosion, loss of wetlands

B2b

Probability

The Planning Team determined that it is **HIGHLY LIKELY** that a drought will impact the planning area. Probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used Barnstable County's history of drought to make this probability designation.

Severe Winter Weather: Snow, Blizzards and Ice Storms

Overview

A winter storm occurs when there is significant precipitation during periods of low temperatures.⁵³ Winter storms typically occur from early autumn to late spring and can include any of the following events^{54,55}:

- **Blizzards:** defined as winter storms with sustained or frequent wind gusts to 35 miles per hour or more, accompanied by falling or blowing snow that reduces visibility to or below one-quarter mile. Severe blizzards are defined as winter storms with temperatures near or below 10°F, winds exceeding 45 miles per hour and visibility near zero miles.⁵⁶
- **Blowing snow:** wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground that is picked up by the wind.
- **Snow squalls:** brief, intense snow showers accompanied by strong gusty winds. Snow accumulation may be significant.

⁵³ How to Prepare for a Winter Storm, www.ready.gov/prepare

⁵⁴ Massachusetts State Hazard Mitigation Plan, 2013

⁵⁵ Winter Storms, The Deceptive Killers, A Preparedness Guide, U.S. Department of Commerce, NOAA, National Weather Service, American Red Cross, June 2008

⁵⁶ Massachusetts State Hazard Mitigation Plan, 2013

Hazard Profiles

- **Snow showers:** snow falling at varying intensities for brief periods of time, some accumulation is possible
- **Snow flurries:** light snow falling for short durations with little to no accumulation
- **Ice pellets and sleet:** composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground or other hard surfaces. A Winter Storm Warning is issued for sleet or a combination of sleet and snow based on total accumulation, which is locally defined by area.
- **Icing:** occurs when liquid rain falls and freezes on contact with structures and objects on the ground, causing a coating of ice on a solid object or surface.
- **Coastal flooding:** winds generated from intense winter storms can cause widespread tidal flooding and severe beach erosion along coastal areas.
- **Ice jams and floes:** long cold spells can cause rivers and lakes to freeze. A rise in the water level or a thaw breaks the ice into large chunks which become jammed at man-made and natural obstructions. Ice jams act as a dam, resulting in severe flooding.
- **Snow melt:** sudden thaw of a heavy snow pack, often leads to flooding.

Winter storms form when cold air, moisture, and lift are present (*Figure 2.17*).

There are many ways for winter storms to form; however, all three have key components.

COLD AIR: For snow and ice to form, the temperature must be below freezing in the clouds and near the ground.

MOISTURE: Water evaporating from bodies of water, such as a large lake or the ocean, is an excellent source of moisture.

LIFT: Lift causes moisture to rise and form clouds and precipitation. An example of lift is warm air colliding with cold air and being forced to rise. Another example of lift is air flowing up a mountainside.

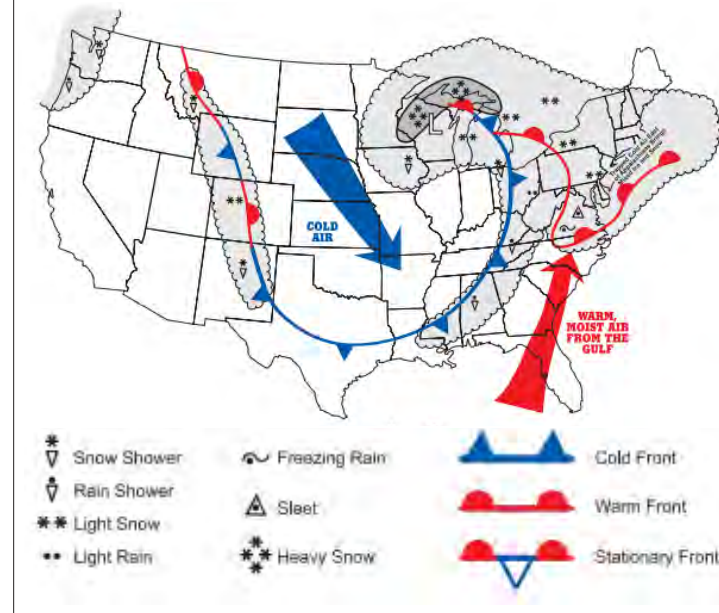


Figure 2.17 | How winter storms form. Graphic from Winter Storms, The Deceptive Killers, A Preparedness Guide, U.S. Department of Commerce, NOAA, National Weather Service, American Red Cross, June 2008.

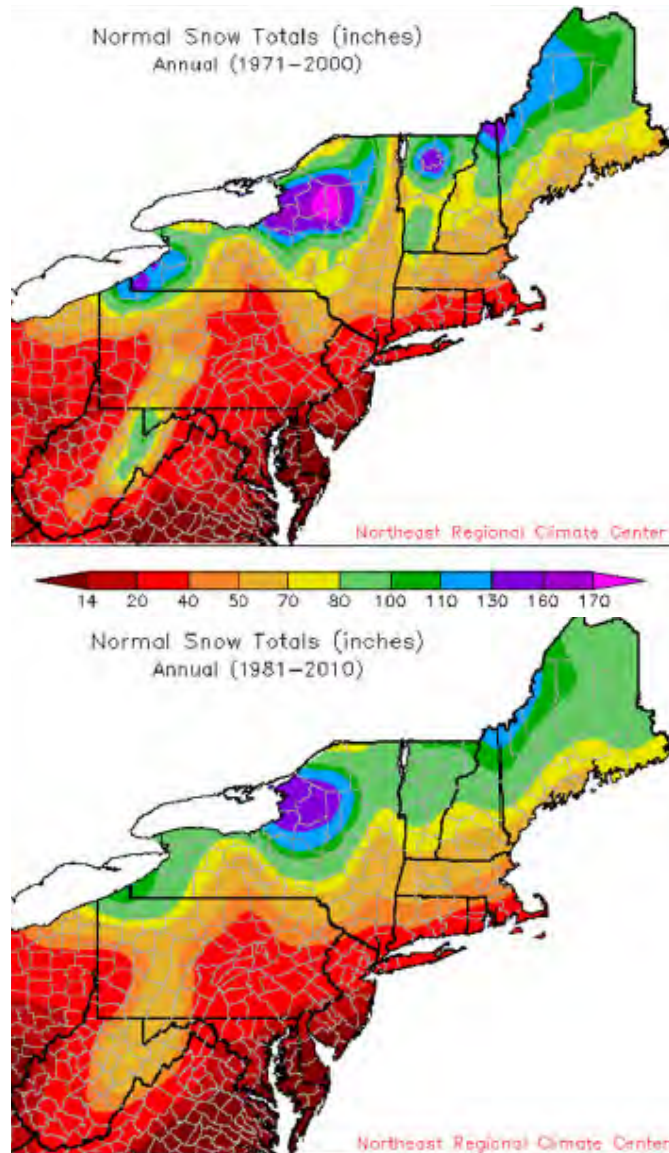


Figure 2.18 | Annual snow totals in inches from 1971-2000 (top) and 1981-2010 (bottom). Maps are from the 2013 Massachusetts State Hazard Plan

Hazard Location

B1c

The entire planning area is at risk for snow, blizzards, and ice storms. During these events, the coastline of Mashpee experiences higher snow accumulations and higher winds than other areas of town.

Previous Occurrences and Extent

B1c,
B2a,c

Snow and other forms of winter precipitation occur frequently in Mashpee. The Northeast Regional Climate Center compiled normal 30-year average annual snow totals in New England and in the eastern U.S. (**Figure 2.18**). These maps show normal snow totals for Mashpee to be within 14-40 inches per year from 1971-2000 and from 1981-2010.⁵⁷

Table 2.6 is a list of federally-declared disasters from winter storm events in Barnstable County. The Blizzard of 1978 crippled most of the Commonwealth of Massachusetts, including Barnstable County. This event included blizzard conditions, extreme snowfall, high winds and devastating coastal flooding. As stated in the Massachusetts Hazard Mitigation Plan, the worst conditions in this storm event were:

- Snowfall rates of at least 3 inches per hour, 1-3 feet of snowfall, zero visibility
- Wind peaked at 93 mph in Chatham

⁵⁷ Massachusetts State Hazard Mitigation Plan, 2013

Hazard Profiles

Major Disaster Declarations for Winter Storms in Barnstable County from 1954 - 2015

Number	Disaster Type	Incident period	Declaration Date
DR-546	Coastal storms, flood, ice, snow	February 6 - 8, 1978	February 10, 1978
DR-975	Winter coastal storm	December 11 - 13, 1992	December 21, 1992
EM-3103	Blizzards, high winds and record snowfall	March 13-17, 1993	March 16, 1993
DR-1090	Blizzard	January 7-13, 1996	January 24, 1996
EM-3175	Snowstorm	February 17 - 18, 2003	February 11, 2003
EM-3191	Snow	December 6 - 7, 2003	January 15, 2004
EM-3201	Snow	January 22-23, 2005	February 17, 2005
DR-1701	Severe storms, inland and coastal flooding	April 15 - 25, 2007	May 16, 2007
DR-4110	Severe winter storm, snowstorm, flooding	February 8-10, 2013	April 19, 2013
DR-4214	Severe winter storm, snowstorm, flooding	January 26 - 29, 2015	April 13, 2015

Table 2.6 | Major disaster declarations for Barnstable County for winter storms. Data is from the FEMA Disaster Declaration website and from the 2013 Massachusetts State Hazard Plan

- Major coastal flooding occurred over multiple high tide cycles

B3a

Impact

Below is a list of impacts likely to occur during a winter storm event^{58,59}:

- **People:** walking and driving can become extremely hazardous due to icy conditions, snow accumulation, low visibility, and extreme cold which causes people to shelter in place without utilities or other services until driving is safe or utilities are restored; injury from slipping and falling, overexertion during shoveling, frostbite; death from hypothermia, carbon monoxide poisoning (when gas powered furnaces and alternative heating sources are used inappropriately indoors during power outages); people become isolated in their homes
- **Infrastructure:** ice and heavy snowfall can knock out heating, power, and communication services for several hours or days; pipes and water mains may break due to extremely cold temperatures; large sections of ice can cause damage to floating docks
- **Buildings and Property:** structural failure of buildings due to heavy snow loads; roof failure; structural damage to buildings because of high wind; damage to fishing vessels, recreational boats and kayaks because of ice floes and coastal flooding
- **Economy:** as people are immobilized by the storm, they are unable to go to work, leading to economic losses; excessive costs to the town and residents because of increased plowing, snow removal, salting and sanding
- **Transportation:** roadways can become extremely hazardous due to icy conditions, snow accumulation, low visibility and extreme cold; car accidents can occur if people attempt to travel in unsafe conditions; transit and airport facilities will close temporarily because of severe winter weather; snow storms halt the transport of supplies, goods and services because of unsafe roadways

It is important to note that not all winter storms affecting Mashpee were declared federal disasters. Therefore, Mashpee likely experienced more severe winter weather than that documented in *Table 2.6*.

⁵⁸ Massachusetts State Hazard Mitigation Plan, 2013

⁵⁹ Winter Storms, The Deceptive Killers, A Preparedness Guide, U.S.

Department of Commerce, NOAA, National Weather Service, American Red Cross, June 2008

Hazard Profiles

B2b

Probability

The Planning Team determined that it is **HIGHLY LIKELY** that a winter storm (snow and blizzard) will impact the planning area. High probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used Mashpee's history of snow storms and blizzards to make this probability designation.

Tsunami

Overview

A tsunami is a series of traveling ocean waves of extremely long wavelength usually caused by displacement of the ocean floor, seismic or volcanic activity, or underwater landslides. Tsunamis generate a devastating onshore surge of water.⁶⁰ The waves

⁶⁰ Massachusetts State Hazard Mitigation Plan, 2013

associated with a tsunami move hundreds of miles per hour in the open ocean and can come ashore with wave heights of 100 feet or more.

Hazard Location

All of the coastal communities of Massachusetts are exposed to the threat of tsunamis, but at the present time, it is unknown what the probability is of a damaging tsunami along the Massachusetts coast.⁶¹

Previous Occurrences and Extent

According to the NOAA National Climatic Data Center, Barnstable County did not experience any tsunamis between January 1, 1950 and July 31, 2015.

Only a total of six tsunamis have been reported in the US Atlantic coast and Gulf coast states in the last 200 years⁶²:

- Three tsunamis were generated in the Caribbean. Tsunamis are more likely to occur at convergent margins and there is a convergent plate in the Caribbean Sea. Thus, this area has a higher probability of generating earthquakes that could produce a tsunami.

⁶¹ Massachusetts State Hazard Mitigation Plan, 2013

⁶² Massachusetts State Hazard Mitigation Plan, 2013

B1c

B1c,
B2a,c

Hazard Profiles

- Two tsunamis were related to a magnitude 7+ earthquake along the Atlantic coast.
- One tsunami was reported off the mid-Atlantic states and may be associated with an underwater landslide.
- There is no data on the extent of these tsunamis for Barnstable County or Mashpee.

B3a

Impact

Below is a list of potential impacts of a tsunami:

- **People:** hydraulic forces of the tsunami injure people or lead to death; floating debris can endanger human lives; people and businesses will be without fuel, food, or employment
- **Infrastructure:** floating debris can batter infrastructure; breakwaters and piers collapse; scouring actions sweep away infrastructure; oil fires often result because the waves carry away oil tanks therefore damaging infrastructure
- **Buildings:** hydraulic forces of the tsunami will destroy buildings; floating debris can batter inland structures; scouring actions sweep away buildings; oil fires often result because the waves carry away oil tanks therefore damaging buildings
- **Economy:** public utilities will be damaged and therefore the economy will suffer; disruption of coastal systems will have far-reaching economic effects, especially for the fishing industry

- **Natural Systems:** trees and plants are uprooted; animal habitats such as nesting sites for birds are destroyed; land animals are killed by drowning and sea animals are killed by pollution if dangerous chemicals are washed away into the sea, poisoning marine life
- **Transportation:** roads, bridges, and culverts buckle or are swept away

Probability

The Planning Team determined that it is **POSSIBLE** that a tsunami will impact the planning area. Probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used the low frequency of tsunamis in Barnstable County to make this probability designation.

B2b

Hazard Profiles

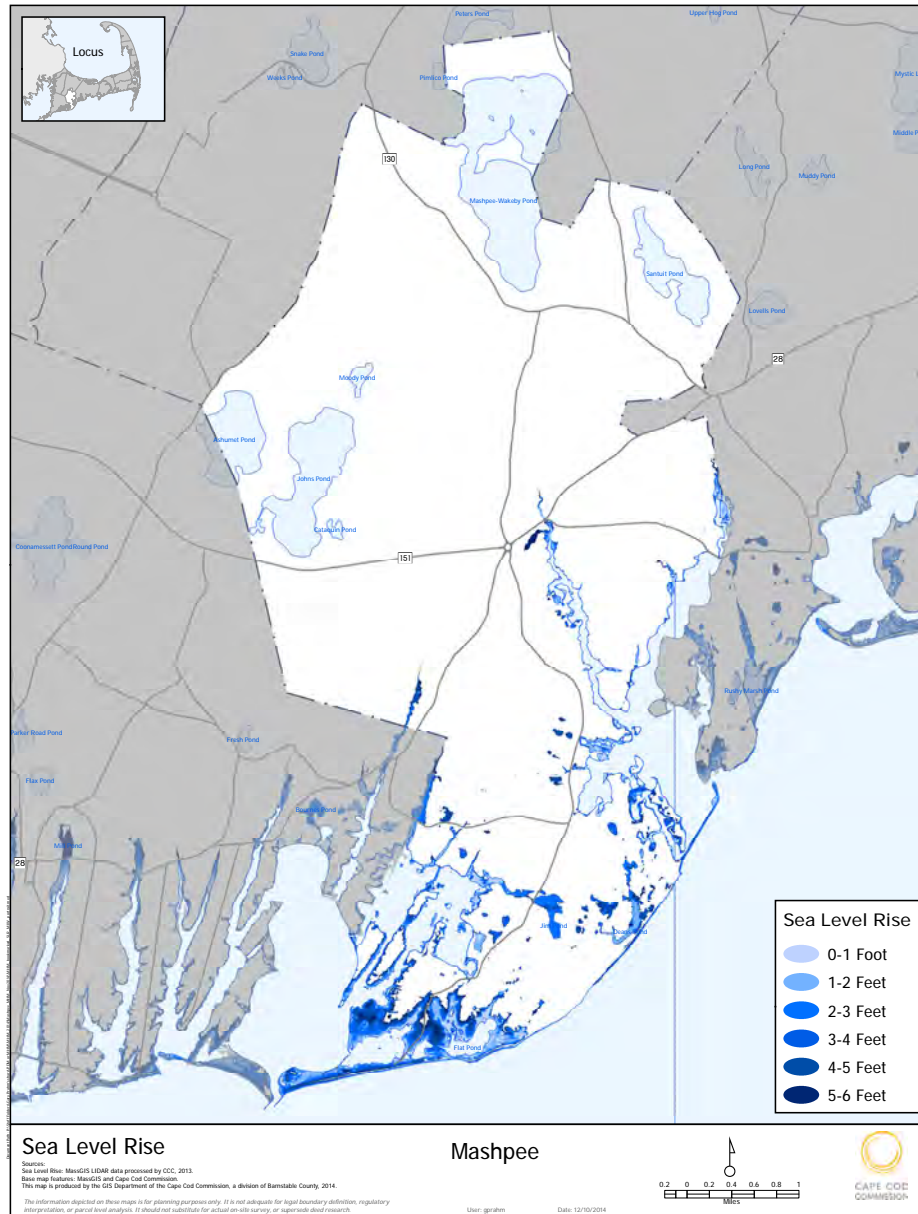


Figure 2.19 | Sea level rise map for Mashpee

Sea Level Rise

Overview

Sea level rise refers to the increase in mean sea level over time.⁶³ Relative sea level rise is a combination of eustatic and isostatic contributions:

- **Eustatic contributions to sea level rise** are global-scale changes and include thermal expansion of seawater as it warms and the addition of water volume from melting land-based glacial ice sheets.
- **Isostatic contributions to sea level rise** are more localized changes in land surface elevations such as subsidence or sinking.

Sea level has been rising around the globe for thousands of years since the end of the last Ice Age. For a little over a century, tidal gages and satellites have been measuring changes in sea level. Tide gauge stations measure the height of water referenced to a horizontal control point, or benchmark, and gages are used to track and predict tide levels and longer term sea level. Long-term data sets from tide stations have been used to understand local and global sea level trends. The National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services

⁶³ Sea level rise: understanding and applying trends and future scenarios for analysis and planning, Massachusetts Office of Coastal Zone Management, December 2013

maintains several tide gauge stations across coastal Massachusetts, including long-term stations at Boston, Woods Hole, and Nantucket. The sea level data recorded by NOAA and other tide gauges produce trends in relation to fixed reference levels on land, and therefore the data from these stations includes variation in local land elevations.

There is high confidence that the warming atmosphere associated with global climate change is expected to accelerate both the thermal expansion of seawater and the melting of glaciers and ice sheets and will lead to increasing rates of sea level rise.⁶⁴

Hazard Location

The entire coast of Mashpee is vulnerable to sea level rise (*Figure 2.19*).

In 2014, the Cape Cod Commission developed a bathtub model to visualize Cape Cod's vulnerability to sea level rise (see Sea Level Rise Viewer at www.capecodcommission.org/blackbox). The Sea Level Rise data was derived from classified Digital Elevation Model (DEM) data collected through Light Detection and Ranging (LiDAR) in 2011 by the USGS. The elevation data is accurate to 18 cm at a 95% confidence level with a 1 meter resolution. This elevation data was adjusted to Mean Higher High Water (MHHW) using the

⁶⁴ United States Environmental Protection Agency, 2006

Hazard Profiles

NOAA VDatum Software. The Sea Level Rise is shown as a simple representation of a change in elevation, commonly referred to as a “bathtub” model. No account has been made for the effects of velocity and resulting erosion caused by wave action.

B1c,
B2a,c

Previous Occurrences and Extent

Mean sea level trends from the Boston, Woods Hole, and Nantucket long-term stations are listed below⁶⁵:

- **Boston, MA tide gauge station:**
 - 0.11 ± 0.007 inches per year, measured over the period of 1921-2012
 - Century rate at the Boston tide gauge: 0.92 feet per 100 years
- **Woods Hole, MA tide gauge station:**
 - 0.11 ± 0.007 inches per year, measured over the period of 1932-2012
 - Century rate at the Woods Hole tide gauge: 0.92 feet 100 years
- **Nantucket, MA tide gauge station:**
 - 0.14 ± 0.017 inches per year, measured over the period of 1965-2012

⁶⁵ Sea level rise: understanding and applying trends and future scenarios for analysis and planning, Massachusetts Office of Coastal Zone Management, December 2013

- Century rate at the Nantucket tide gauge: 1.15 feet per 100 years

Impact

As relative sea level rises, high water elevations will move landward, areas of coastal shorelines will retreat, and low-lying areas will be increasingly exposed to erosion, tidal inundation, and coastal storm flooding. Developed parts of the coast are especially vulnerable because of the presence of infrastructure, homes, and businesses that can be damaged or destroyed by coastal storms. In addition, development often impedes the ability of natural coastal systems to buffer inland areas from storm damage, further exacerbating the problem. Many coastal habitats are also vulnerable to rising sea levels, including salt marshes, beaches and dune systems, and floodplains, because they are generally at or within a few feet of existing sea elevations. These areas provide significant environmental benefits, including habitat value, filtering of pollutants for improved water quality, protection of inland areas from flooding and storm surge, and extensive recreational opportunities.⁶⁶

B3a

⁶⁶ United States Environmental Protection Agency, 2006

B2b

Probability

The Planning Team determined that it is **HIGHLY LIKELY** that sea level rise will impact the planning area. Probability was defined based on the frequency of occurrence:

- **Unlikely:** less than a 1% probability over the next 100 years
- **Possible:** 1-10% probability in the next year or at least one chance in the next 100 years
- **Likely:** 10-100% probability in the next year or at least one chance in the next 10 years
- **Highly Likely:** near 100% probability in the next year

The Planning Team used the history of sea level rise in Massachusetts to make this probability designation.

Climate Change

Climate Change

Climate is defined as average temperature and precipitation and it also includes the type, frequency, and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as storms, including those which may bring precipitation, high winds, and tornado events. While predicting changes of storm events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society, and the environment.⁶⁷

The following changes in hazard frequency and intensity are expected to occur with changes in climate⁶⁸:

Coastal Erosion: Climatic trends can change a beach from naturally accreting to eroding due to increased episodic erosion events caused by waves from an above-average number of storms and high tides, or the long-term effects of fluctuations in sea or lake level. The coastal zone is being severely impacted by erosion and flooding due in part to climate change and sea-level rise. It is likely that the impact will increase in the future as sea levels continue to rise at the current rate or rises at an accelerated rate.

Earthquakes: The impacts of global climate change on earthquake probability are unknown. Some scientists feel that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska might be opening the way for future earthquakes.

Fire: Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Flooding: While it is not known if the number of storms will increase in the future as the result of climate change, it is anticipated that the intensity of tropical and extra-tropical storms may increase as the storm intensity is a function of sea surface temperature, which continues to rise. Thus, we may experience more intense storms with greater rainfall in the future.

⁶⁷ United States Environmental Protection Agency, 2006

⁶⁸ Massachusetts State Hazard Mitigation Plan, 2013

Tropical Cyclones: Although there is still some level of uncertainty, research indicates the warming climate may double the frequency of Category 4 and 5 hurricanes by the end of the century, and decrease the frequency of less severe hurricane events.

Nor'easters and Winter Storms: Weather extremes are likely to become more frequent and cause more damage under a changing climate. Although no specific storm is directly linked to climate change, an increasing number of events could become more common. New England is expected to experience changes in the amount, frequency, and timing of precipitation. Along with rising temperatures, it is expected that annual precipitation will increase by 14%, with a slight decrease in summer totals and a 30% increase in winter totals. Winter precipitation is predicted to be in the form of rain rather than snow. This change in precipitation will have significant effects on the amount of snow cover, winter recreation, spring snowmelt and peak stream flows, water supply, aquifer recharge, and water quality. Snow is also predicted to fall later in the winter and cease falling earlier in the spring.

Severe Weather (wind, extreme temperature, thunderstorms, tornadoes, drought): Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data show

that the probability for severe weather events increases in a warmer climate. With a warmer climate, droughts could become more frequent, more severe, and longer-lasting.

Hazards Selected for Risk Assessment

Hazards Selected for Risk Assessment

After profiling the hazards in the 2013 Massachusetts Hazard Mitigation Plan and assigning a probability to each hazard, the Planning Team reached out to members of the public and stakeholders through an online survey. In the survey, the public was asked if they had experienced any of the hazards identified in the 2013 Massachusetts State Hazard Plan (Question 2 and 3 of the online survey – see “Public Survey” in **Appendix 1**). Public and stakeholder input was then used to determine if specific hazards were significant to Mashpee (see Column 2 of **Table 2.7**)

Table 2.7 documents the evaluation process used for determining which of the 11 Massachusetts State hazards are considered significant enough to warrant further evaluation in the risk assessment. A hazard was further evaluated for a risk assessment if the following criteria were met:

- The Planning Team determined that the probability of the hazard was highly likely
- The public and stakeholders have experienced the hazard in the past (more than 1% of respondents)

Using the process described above, the following hazards were selected for risk assessment in Chapter 4:

- Coastal Erosion/Shoreline Change
- Urban Fire
- Wildfire
- Flood
- Hurricanes and Tropical Storms
- Nor'easters
- High Winds
- Thunderstorms
- Drought
- Severe Winter Weather
- Sea Level Rise

Hazards Selected for Risk Assessment

Type of Natural Hazard	What is the future probability of the hazard as determined by the Planning Team?	Did the public/stakeholders/ neighboring communities experience the hazard in the past?	Was the hazard further evaluated in the risk assessment in Chapter 4?
Coastal Erosion and Shoreline Change	HIGHLY LIKELY	Yes	Yes
Dam (Culvert) Failure	POSSIBLE	No	No
Earthquake	UNLIKELY	No (<1% said yes)	No
Urban Fire	HIGHLY LIKELY	Yes	Yes
Wildfire	HIGHLY LIKELY	Yes	Yes
Flood	HIGHLY LIKELY	Yes	Yes
Hurricane and Tropical Storms	HIGHLY LIKELY	Yes	Yes
Landslide	POSSIBLE	No (<1% said yes)	No
Nor'easters	HIGHLY LIKELY	Yes	Yes
High Winds	HIGHLY LIKELY	Yes	Yes
Thunderstorms	HIGHLY LIKELY	Yes	Yes
Extreme Temperatures	POSSIBLE	Yes	No
Tornadoes	POSSIBLE	Yes	No
Drought	HIGHLY LIKELY	Yes	Yes
Severe Winter Weather	HIGHLY LIKELY	Yes	Yes
Tsunami	POSSIBLE	No (<1% said yes)	No
Sea Level Rise	HIGHLY LIKELY	Yes	Yes

Table 2.7 | List of hazards selected for a risk assessment

Asset Inventory

CHAPTER THREE

Chapter 2 profiled natural hazards that have affected Mashpee in the past or could affect the town in the future. The next step in the hazard planning process is to determine the types of assets and people that are located in Mashpee. Once this asset inventory is complete, the Planning Team can determine which of these assets and populations are vulnerable to the impacts of natural hazards. **Chapter 3 is an inventory of the people and natural and built environments in Mashpee.**

People

People

Population: Year-round and Seasonal

There are approximately 14,000 year-round residents in Mashpee (14,027 according to the 2011-2015 U.S. Census American Community Survey estimate). The median household income for this population is \$70,313 and the average household income is \$84,888.

There is no one estimate of Mashpee's seasonal population because this statistic is difficult to determine. For the purposes of this plan, seasonal population seeks to address how many individuals may need to be accounted for within the Town of Mashpee, regardless of resident, visitor, or transient status.

However, an accounting of Mashpee's seasonally-used second homes can help provide an estimate of the seasonal population. Using an occupancy rate of 4.5 individuals for each unit as determined in the Cape Cod Commission Second Homeowner Survey (2008) and the Cape Cod Chamber's 80 percent occupancy rate, Mashpee's 3,624 seasonally-vacant homes¹ represent the possibility of another 13,307 individuals with overnight accommodations at peak times.

Lodging supply in Mashpee is very limited and so may provide relatively few additional visitors during peak season. Accommodations consist of two independent motels classified as economy level properties. One serves as more of a long-term, low income rental unit facility and one is an 18-room lodging facility, which closes January through March. Using an assumed two lodgers per room, and the Cape Cod Chamber of Commerce's peak occupancy estimate of 80%, this would add approximately 28 people to Mashpee's peak seasonal population.

Thus, during peak times, the total population or number of people present in Mashpee may be more than 27,360 people, which is almost twice as much as its year round population.

Base Map of Mashpee

Figure 3.1 is a base map for the Town of Mashpee. It is a map showing the geographic area of Mashpee and includes features such as roads, rivers, coastlines. The base map acts as a frame of reference for the reader and reviewer of the Mashpee Hazard Plan.

1 U.S. Census American Community Survey Estimate, 2009-2013

Base Map of Mashpee

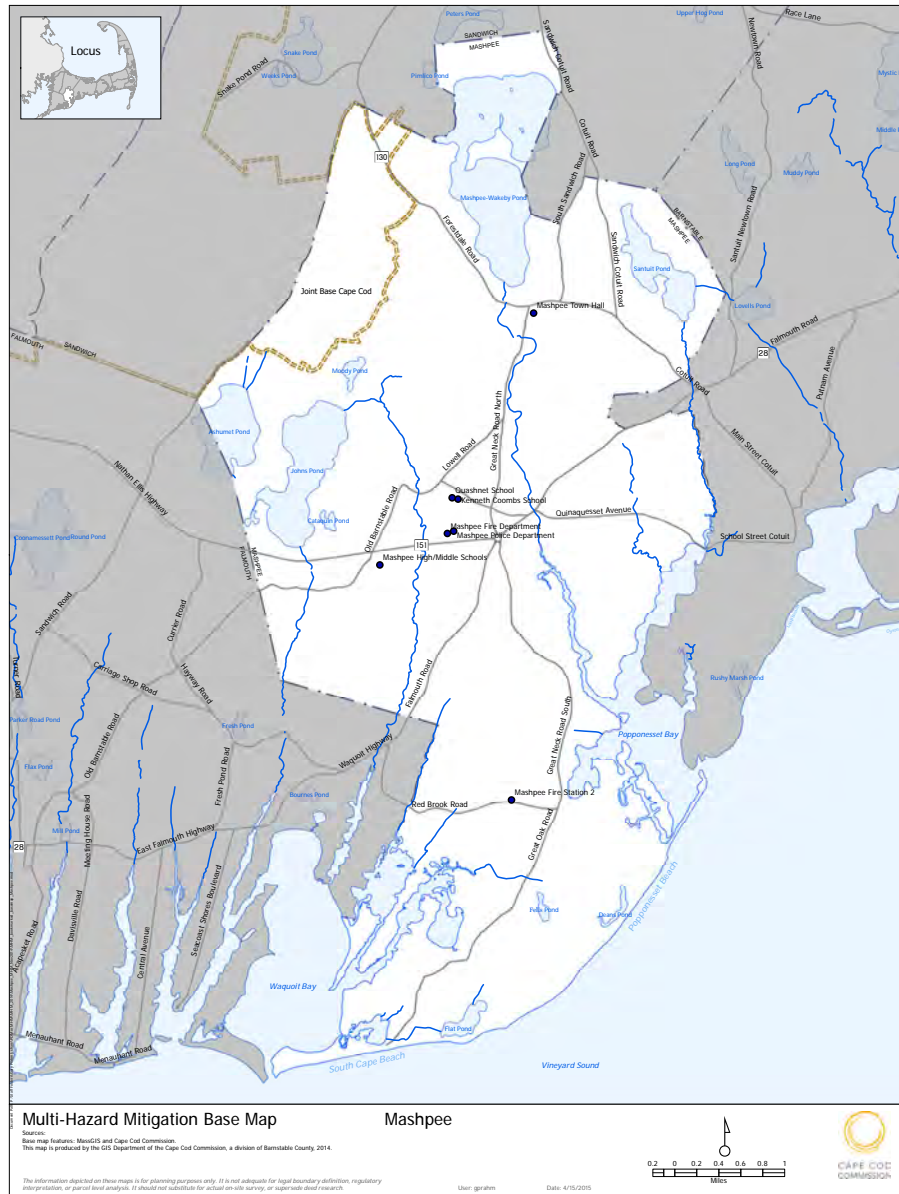


Figure 3.1 | Base map of Mashpee

Natural Environment

Natural Environment

The Town of Mashpee is located on Cape Cod, Massachusetts, surrounded by the Town of Sandwich to the north, the Town of Falmouth to the west, the Town of Barnstable to the east, and the Nantucket and Vineyard Sounds to the south.

Based on the Town Assessor's Maps and Geographic Information System (GIS), Mashpee has a total area of 18,469.66 acres, or 28.86 square miles, excluding the portion of Vineyard and Nantucket Sounds which lies within its legal boundaries. Of that area, approximately 1,513.5 acres lies in the Waquoit Bay estuarine system (Waquoit Bay proper, Jehu Pond, Sedge Lot Pond, Hamblin's Pond and Great and Little Rivers) and 558.9 acres is in the Popponesset Creek estuary (Popponesset Bay proper, Ockway Bay, Shoestring Bay, Popponesset Creek and the Mashpee River below Route 28) for a total of 2,072.4 salt water acres, or 11.22% of the town. An additional 1,503.3 acres of the Town's remaining 16,397.26 acres (25.62 square miles) is made up of fresh water bodies. Mashpee's two estuarine systems are shared with the bordering communities: to the west Waquoit Bay is shared with Falmouth while to the east Popponesset Bay is shared with Barnstable. The primary forest cover in Mashpee is Pitch Pine/Scrub Oak.

UNITS IN STRUCTURE	Estimate
1-unit, detached	7,586
1-unit, attached	734
2 units	29
3 or 4 units	621
5 to 9 units	521
10 to 19 units	84
20 or more units	155
Mobile home	77
Boat, RV, van, etc.	0
Total Housing Units	9,807

Table 3.1 | Number and type of housing units in Mashpee, U.S. Census American Community Survey (estimate), 2013

Built Environment

Homes

Mashpee has 4,586 total housing units. **Table 3.1** is a list of the type and number of housing units in Mashpee.

Mashpee has grown rapidly over the past couple of decades with more than 33 percent of the housing units built since 1990, and more than 95 percent of the town's housing units built after 1950.² The median number of rooms in Mashpee residences—5.6—is the same as the Cape-wide median number of rooms in residences.³

² U.S. Census American Community Survey 2011-2015

³ U.S. Census American Community Survey 2011-2015

Businesses and Employment

Mashpee's business landscape is dominated by tourism-supported service industries, primarily Retail and Accommodations/Food Service (*Table 3.2* and *Table 3.3*).

Industry	Number Employed
Wholesale trade	107
Retail trade	1097
Transportation and warehousing (104)	15
Information	32
Finance and insurance	57
Real estate and rental and leasing	b
Professional, scientific, and technical services	147
Administrative and support and waste management and remediation services	199
Educational services	a
Health care and social assistance	439
Arts, entertainment, and recreation	c
Accommodation and food services	596
Other services (except public administration)	263

Table 3.2 | Estimated number of Mashpee businesses' employees by industry, 2012 Economic Census of the United States
When data must be withheld due to disclosure concerns, the following ranges for employment are used:
a: 0-19 employees
b: 20-99 employees
c: 100-249 employees

Industry	Number	Values
Wholesale trade	16	36,667
Retail trade	91	241,033
Transportation and warehousing (104)	4	1,346
Information	6	N
Finance and insurance	13	N
Real estate and rental and leasing	17	D
Professional, scientific, and technical services	38	18,535
Administrative and support and waste management and remediation services	35	26,657
Educational services	2	D
Health care and social assistance	36	30,619
Arts, entertainment, and recreation	14	D
Accommodation and food services	38	36,616
Other services (except public administration)	33	21,534

Table 3.3 | Estimated number and value of Mashpee businesses by industry, 2012 Economic Census of the United States
D=Withheld to avoid disclosing data for individual companies
N=Data not available or not comparable

Built Environment

Critical Facilities

Table 3.4 is a list of the Critical Facilities in Mashpee.

Type of Critical Facility	Name of Critical Facility
Essential Facilities Assets that are essential to the health and welfare of the whole population and are especially important following hazard events. The potential consequence of losing these assets is so great that they were carefully inventoried. The building, contents and function/services provided to the community are significant. Source: FEMA How-to Guide 2/ FEMA 386-2	Mashpee Town Hall
	Mashpee Department of Public Works
	Mashpee Fire and Rescue Department Station 1
	Mashpee Fire and Rescue Department Station 2
	Mashpee Police Department
	Kenneth C. Coombs School
	Quashnet Elementary School
	Mashpee Middle-High School
	Mashpee Family Medicine (Rogers Outpatient Center)
	Community Health Center of Cape Cod
	Stop and Shop
Lifeline Utilities Includes wastewater, water, oil, natural gas, electric power, and communication systems	Mashpee Commons Sewer Treatment
	Radio Communications at Police Department
	Transfer Station
	Verizon Building
	Echo Road Cell Tower
	Industrial Road Cell Tower #1
	Industrial Road Cell Tower #2
	Power Transfer Station
	Water Tower #1
Water Tower #2	

Table 3.4 | List of critical facilities in Mashpee

Type of Critical Facility		Name of Critical Facility
Transportation Systems	Critical assets in all 5 modes of transportation (air, road, transit, rail, sea). Source: FEMA How-to Guide 2/ FEMA 386-2	Route 151
		Route 130
		Great Neck Road North
		Great Neck Road South
		Route 28 (east of rotary)
		Great Oak Road
		Route 28 (west of rotary)
		Culvert - Red Brook Road at Red Brook Reservoir
		Culvert - Route 151 at Quashnet River
		Culvert - Old Barnstable Road at Childs River
		Culvert - Old Barnstable Road at Quashnet River
		Culvert - Quinaquisset Avenue at Willowbend Bogs
		Culvert - Sampsons Mill Road at Santuit River
		Culvert - Great Neck Road North at Mashpee River
		Culvert - Route 130 at Besse Bog
		Culvert - Route 130 at Mashpee River
		Culvert - Route 28 at Mashpee River
Culvert - Monomoscoy Road Causeway		
Culvert - Great Oak Road at Abigail's Brook		
School Street Bridge		

Table 3.4 | List of critical facilities in Mashpee (continued)

Built Environment

B4a

Repetitive Loss Properties

Repetitive Loss Properties are those for which two or more losses of at least \$1,000 each have been paid under the National Flood Insurance Program (NFIP) within any ten year period since 1978.

The Town of Mashpee has three repetitive loss properties, all of which are residential, and three repetitive loss areas.

The three areas in Mashpee that are designated as repetitive loss are all subject to storm surge as waterfront properties. More detailed descriptions can be found below.

- **Frog Pond Close Area:** This area is on the Santuit River near the confluence with the Mashpee River and Popponesset Bay, and ultimately Nantucket Sound. It is near Simons Narrows, a narrow point in the river that likely acts like a funnel. There is also a significant fetch over the mouth of the River and the Bay, which could generate a localized surge if the wind is blowing from a direction that may not cause significant surge in Nantucket Sound.
- **Mariner Lane Area:** This area is on the eastern side of Monomoscoy Island on Great River near the confluence with Little River and Waquoit Bay. Waquoit Bay is connected to Nantucket Sound by a maintained navigational channel. Surge from Nantucket Bay can affect the area, and the river

can act as a funnel amplifying that surge near the property. There is enough of a fetch that waves can be generated near the property. The area includes a narrowing in the river, which may cause excess flood water to be channeled onto some properties during a surge.

- **Taffrail Way:** This area is on the western side of Popponesset Island. This side of the island is surrounded by a narrow waterway that could funnel storm surge from Popponesset Bay and is large enough to generate waves. A small inlet in this area could further funnel flood waters.

New Developments in Mashpee

Since Mashpee's previous Hazard Mitigation plan, dated November 2004, there have been new developments in the Town. These new developments have been included in the vulnerability assessment in the following chapter and identified significant developments are described below.

- New Seabury and Popponesset: construction of several residences in the New Seabury and Popponesset area
- Mashpee Commons: more than 300 residential units were approved for development and are under construction
- Regatta Drive Subdivision: 28 single family homes were built

D1

Built Environment

Name of New Development	Special Flood Hazard Area	SLOSH zone	Sea Level Rise
New Seabury and Popponneset Development	Yes (some parcels)	Yes (some parcels)	Yes (some parcels)
Mashpee Commons	No	No	No
Regatta Drive Subdivision	No	No	No
Mashpee Industrial Park	No	No	No
Mashpee Community Health Center	No	No	No
Bridges @ Mashpee	No	No	No
Northbridge Assisted Living Facility	No	No	No
South Cape Village	No	No	No

Table 3.5 | Exposure assessment of new developments in Mashpee

- Mashpee Industrial Park: four buildings were constructed in the Mashpee Industrial Park providing warehouse, industrial, and manufacturing space
- Mashpee Community Health Center: a new 32,000 square foot health services building
- Bridges @ Mashpee: a senior living facility
- Northbridge Assisted Living Facility: an assisted living facility
- South Cape Village: a large retail development, including a grocery store

The Planning Team mapped these new developments and determined if they are located in the floodplain according the most recent FIRMs, vulnerable to storm

surge using SLOSH models or vulnerable to sea level rise using the Cape Cod Commission's sea level rise viewer (*Table 3.5*).

The exposure assessment shows that the following new developments are vulnerable to flooding, storm surge or sea level rise:

- New Seabury and Popponneset Development

The Town of Mashpee and Save Popponneset Bay (a local nonprofit) are addressing the risk in the following ways:

- Conducted beach nourishment projects with dredged sand
- Replenished dune grass in the area to help stabilize the Popponneset Spit

Vulnerability Assessment

CHAPTER FOUR

Chapter 2 of the Mashpee Hazard Plan profiled natural hazards that could impact the town in the future or have impacted Mashpee in the past. Chapter 3 inventoried the assets that could be damaged during a hazard event, such as buildings, infrastructure, and critical facilities. Chapter 4 ties together the hazard profiles and asset inventories to estimate the potential losses that Mashpee could experience during a natural hazard event. **Essentially, Chapter 4 answers the question: How will assets in Mashpee be affected by hazard events?**

Methodology: Vulnerability Assessments

Methodology: Vulnerability Assessments

There are two assessments included in Chapter 4 of the 2017 Mashpee Hazard Plan:

- **Vulnerability Assessment of Parcels and Buildings:** this assessment was completed by the Town of Mashpee and the Cape Cod Commission (i.e., the Planning Team) using data from the Town Assessor's office.
- **Exposure Assessment of Critical Facilities:** the Planning Team used Geographic Information System (GIS) analysis to identify whether critical facilities could be exposed to flooding, surge, sea level rise and coastal erosion.

The methods of both assessments are provided in the remaining part of this section.

Methods of the Vulnerability Assessment of Parcels and Buildings:

1. To estimate the total number of parcels and value of buildings located in Mashpee, the Planning Team used Town Assessing data from 2015. This 2015 data set contains information about parcels such as use codes, building characteristics and assessed value. The 2015 parcel data is also linked to geometry data for specific parcels on the ground. The 2015 data was used because it is the most

current data set that contains both the parcel and the geometry data. This large data set was grouped into categories using Massachusetts Property Type Classification Codes. Parcel numbers and building values were totaled for each category.¹ It is important to note that the category titles were not selected by members of the Planning Team; instead category names are based on the State's Classification Code. Below is a list of examples of asset types in each category.

- **Agriculture:** agricultural land/farms, greenhouses, farm buildings
- **Banks:** bank buildings
- **Entertainment and Recreation:** includes eating and drinking establishments, indoor recreation, recreational land
- **General Services:** includes warehouses and distributional facilities, post offices, housing authorities, municipal property
- **Medical Office/Clinics:** includes medical office buildings
- **Multi-Family Dwelling:** includes condos, 2-3 family homes, multiple houses on a single property, 4-8 unit homes and 8+ units

¹ Property type classification codes, non-arm's length codes and sales report spreadsheet specifications, prepared by the Bureau of Local Assessment, revised March 2015, <http://www.mass.gov/dor/docs/dls/bla/classificationcodebook.pdf>

Methodology: Vulnerability Assessments

- **Non-Profit/Municipal:** government or town owned properties, public parking lots, libraries, museums, fraternal offices
 - **Parking:** commercial parking lots
 - **Personal/Repair Services:** buses and funeral homes
 - **Retail Trade:** hardware stores, shopping malls, supermarkets, small retail
 - **Single Family Dwelling:** single family homes
 - **Temporary Lodging:** motels, inns, resorts
 - **Theaters:** theaters and stadiums
 - **Vacant:** developable land, undevelopable land, residential open land, underwater land or marshes not under public ownership
 - **Wholesale Trade:** tanks holding fuel and oil products for retail distribution, bottled gas and propane tanks, lumber yards
2. Next, the Planning Team used GIS to overlay maps of hazard areas onto parcel and value data. Only a subset of natural hazards were identified for further vulnerability assessment (see *Table 2.7* for rationale). Below is a list of hazards selected for the vulnerability assessment and a description of the available data used for the assessment.
- **Flooding:** FEMA flood hazard maps, adopted by Mashpee in 2014
 - **Hurricanes and Tropical Storms:** The storm surge that occurs during tropical cyclones is assessed using the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model. Currently, there is no model available for the impact of wind from tropical cyclones. *Figure 2.8* in Chapter 2 shows a SLOSH map for the Town of Mashpee.
 - **Sea Level Rise:** Bathtub model developed by the Cape Cod Commission was used to model the impacts of sea level rise on Mashpee. *Figure 2.19* in Chapter 2 shows a Sea Level Rise map for the Town of Mashpee.
 - **Coastal Erosion/Shoreline Change:** The Planning Team used GIS to identify which properties had a physical connection to saltwater. Properties that share a boundary with saltwater was identified as “coastal property.” Parcel and building values were identified. The Planning Team recognizes that this method is not perfect.
 - **Nor’easters:** Data is not available. A detailed vulnerability assessment could not be completed at this time.
 - **High Winds:** Data is not available. A detailed vulnerability assessment could not be completed at this time.

Methodology: Vulnerability Assessments

- **Thunderstorms:** Data is not available. A detailed vulnerability assessment could not be completed at this time.
- **Severe Winter Weather:** Data is not available. A detailed vulnerability assessment could not be completed at this time.
- **Drought:** Data is not available. A detailed vulnerability assessment could not be completed at this time.
- **Urban Fire:** Data is not available. A detailed vulnerability assessment could not be completed at this time.
- **Wildfire:** A wildfire vulnerability assessment was already completed for Mashpee in 2012 by wildfire professionals. This assessment exists as part of the Barnstable County Wildfire Preparedness Plan. To view this assessment see: http://ne-ffm.com/Barn_Co._CWPP_Final.pdf.

It is important to note that SLOSH and Sea Level Rise models are coarse models to illustrate vulnerability to storm surge and sea level rise using the best available data. Both of these models have their strengths and their weaknesses:

- **Sea, Lake and Overland Surges from Hurricanes (SLOSH) model:** SLOSH is a computerized numerical model developed by the National Weather Service (NWS) to estimate storm surge heights resulting from historical, hypothetical, or predicted hurricanes by taking into account the atmospheric pressure, size, forward speed, and track data². These parameters are used to create a model of the wind field which drives the storm surge. The SLOSH model consists of a set of physics equations which are applied to a specific locale's shoreline, incorporating the unique bay and river configurations, water depths, bridges, roads, levees and other physical features. However, the SLOSH model does not explicitly model the impacts of waves on top of the surge, nor does it account for normal river flow or rain flooding. Future advancements in the SLOSH model will allow for the resolution of some of these limitations.²
- **Cape Cod Commission's Sea Level Rise model:** Sea Level Rise data was derived from classified Digital Elevation Model (DEM) data collected through Light Detection and Ranging (LiDAR) in 2011 by the United States Geological Society (USGS). The elevation data is accurate to 18 cm at a 95% confidence level with a 1 meter resolution. This elevation data was adjusted

² <http://www.nhc.noaa.gov/surge/slosh.php>

Methodology: Vulnerability Assessments

to Mean Higher High Water (MHHW) using the NOAA VDatum Software. The Sea Level Rise is shown as a simple representation of a change in elevation, commonly referred to as a “Bathtub” model. No account has been made for the effects of velocity and resulting erosion caused by wave action.

Methods of Exposure Assessment of Critical Facilities:

For this exposure assessment, the Team compiled a list of critical facilities list and mapped them in GIS. Sea level rise, flooding, and storm surge maps were overlaid on the map of critical facilities. If a critical facility was located in a hazard area, the Planning Team determined that it was exposed and therefore vulnerable. To assess exposure to coastal shoreline change, the Planning Team determined if the parcel boundary of the critical facility was adjacent to salt water. As mentioned in the previous section, maps for nor’easters, high winds, severe winter weather, thunderstorms, and urban fire are not available and therefore their impact on critical facilities was not determined.

Results: Vulnerability Assessment

Results: Vulnerability Assessment Parcels and Buildings in Hazard Areas

Parcels and Buildings Vulnerable to Flooding

Flooding (A Zone)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	11	14%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	26	26%	\$9,343,500	\$6,390,100	68%
General Services	32	1	3%	\$37,459,400	\$259,100	1%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	44	11%	\$811,961,500	\$156,557,300	19%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	1	25%	\$632,200	\$79,100	13%
Retail Trade	26	1	4%	\$27,404,500	\$168,500	1%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	1,426	21%	\$1,235,862,800	\$323,954,500	26%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1,786	316	18%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	1,830		\$2,251,509,500	\$488,388,600	

Table 4.1 | The proportion of buildings and value of buildings located in an A zone. Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

Flooding (V Zone)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	4	5%	\$13,250,600	\$0	0%
Emergency Response	5	0	0%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	25	25%	\$9,343,500	\$227,200	2%
General Services	32	0	0%	\$37,459,400	\$0	0%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	12	3%	\$811,961,500	\$125,124,400	15%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	0	0%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	0	0%	\$632,200	\$0	0%
Retail Trade	26	0	0%	\$27,404,500	\$0	0%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	320	5%	\$1,235,862,800	\$117,877,900	10%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1,786	73	4%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	0	0%
COLUMN TOTAL	9,440	435		\$2,251,509,500	\$244,209,500	

Table 4.2 | The proportion of buildings and value of buildings located in a V zone. Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

Parcels and Buildings Vulnerable to Sea Level Rise

Sea Level Rise (1 foot)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	10	13%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	28	28%	\$9,343,500	\$3,426,500	37%
General Services	32	0	0%	\$37,459,400	\$0	0%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	30	8%	\$811,961,500	\$182,928,800	23%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	0	0%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	0	0%	\$632,200	\$0	0%
Retail Trade	26	0	0%	\$27,404,500	\$0	0%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	583	8%	\$1,235,862,800	\$201,975,800	16%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1,786	166	9%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	819		\$2,251,509,500	\$389,311,100	

Table 4.3 | The proportion of buildings and value of buildings exposed to 1 foot of sea level rise.

Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

Sea Level Rise (2 feet)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	10	13%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	31	31%	\$9,343,500	\$3,646,600	39%
General Services	32	0	0%	\$37,459,400	\$0	0%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	33	8%	\$811,961,500	\$194,170,500	24%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	1	25%	\$632,200	\$79,100	13%
Retail Trade	26	0	0%	\$27,404,500	\$0	0%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	639	9%	\$1,235,862,800	\$219,744,600	18%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1,786	188	11%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	906		\$2,251,509,500	\$418,620,800	

Table 4.4 | The proportion of buildings and value of buildings exposed to 2 feet of sea level rise.
Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

Sea Level Rise (3 feet)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	12	15%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	36	36%	\$9,343,500	\$7,167,700	77%
General Services	32	0	0%	\$37,459,400	\$0	0%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	37	9%	\$811,961,500	\$226,654,600	28%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	1	25%	\$632,200	\$79,100	13%
Retail Trade	26	0	0%	\$27,404,500	\$0	0%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	727	11%	\$1,235,862,800	\$237,645,200	19%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1,786	215	12%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	1,032		\$2,251,509,500	\$472,526,600	

Table 4.5 | The proportion of buildings and value of buildings exposed to 3 feet of sea level rise.

Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

Sea Level Rise (4 feet)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	12	15%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	39	39%	\$9,343,500	\$7,167,700	77%
General Services	32	0	0%	\$37,459,400	\$0	0%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	37	9%	\$811,961,500	\$226,654,600	28%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	1	25%	\$632,200	\$79,100	13%
Retail Trade	26	0	0%	\$27,404,500	\$0	0%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	831	12%	\$1,235,862,800	\$259,944,000	21%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1786	236	13%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	1,160		\$2,251,509,500	\$494,825,400	

Table 4.6 | The proportion of buildings and value of buildings exposed to 4 feet of sea level rise. Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

Sea Level Rise (5 feet)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	0	0%
Church/Non-Profit Offices	79	12	15%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	46	46%	\$9,343,500	\$7,167,700	77%
General Services	32	0	0%	\$37,459,400	\$0	0%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	44	11%	\$811,961,500	\$237,071,700	29%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	1	25%	\$632,200	\$79,100	13%
Retail Trade	26	1	4%	\$27,404,500	\$168,500	1%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	1,076	16%	\$1,235,862,800	\$302,083,400	24%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1,786	305	17%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	1,489		\$2,251,509,500	\$547,550,400	

Table 4.7 | The proportion of buildings and value of buildings exposed to 5 feet of sea level rise.

Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

Sea Level Rise (6 feet)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	12	15%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	46	46%	\$9,343,500	\$7,167,700	77%
General Services	32	0	0%	\$37,459,400	\$0	0%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	44	11%	\$811,961,500	\$237,071,700	29%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	1	25%	\$632,200	\$79,100	13%
Retail Trade	26	1	4%	\$27,404,500	\$168,500	1%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	1,076	16%	\$1,235,862,800	\$302,083,400	24%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1,786	305	17%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	0	0%
COLUMN TOTAL	9,440	1,489		\$2,251,509,500	\$547,550,400	

Table 4.8 | The proportion of buildings and value of buildings exposed to 6 feet of sea level rise. Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

Parcels and Buildings Vulnerable to Storm Surge During Hurricane

SLOSH (Category 1 Storm)

Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	7	9%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	30	30%	\$9,343,500	\$3,426,500	37%
General Services	32	0	0%	\$37,459,400	\$0	0%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	37	9%	\$811,961,500	\$206,395,100	25%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	1	25%	\$632,200	\$79,100	13%
Retail Trade	26	1	4%	\$27,404,500	\$168,500	1%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	856	12%	\$1,235,862,800	\$264,540,000	21%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1,786	218	12%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	1,154		\$2,251,509,500	\$475,589,200	

Table 4.9 | The proportion of parcels and value of buildings located in Category 1 SLOSH zone.
Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

SLOSH (Category 2 Storm)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	4	5%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	34	34%	\$9,343,500	\$3,563,800	38%
General Services	32	0	0%	\$37,459,400	\$0	0%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	0	0%	\$258,900	\$0	0%
Multi-family Dwelling	390	43	11%	\$811,961,500	\$211,399,200	26%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	1	25%	\$632,200	\$79,100	13%
Retail Trade	26	1	4%	\$27,404,500	\$168,500	1%
Schools	2	0	0%	\$25,957,300	\$0	0%
Single Family Dwelling	6,921	1,419	21%	\$1,235,862,800	\$350,849,100	28%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1,786	288	16%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	1,794		\$2,251,509,500	\$567,039,700	

Table 4.10 | The proportion of parcels and value of buildings located in Category 2 SLOSH zone.
Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

SLOSH (Category 3 Storm)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	15	19%	\$13,250,600	\$0	0%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	47	47%	\$9,343,500	\$6,307,300	68%
General Services	32	1	3%	\$37,459,400	\$259,100	1%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	1	50%	\$258,900	\$156,600	60%
Multi-family Dwelling	390	53	14%	\$811,961,500	\$298,869,600	37%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5	0	0%	\$387,400	\$0	0%
Professional/Tech. Services	4	1	25%	\$632,200	\$79,100	13%
Retail Trade	26	2	8%	\$27,404,500	\$921,600	3%
Schools	2	1	50%	\$25,957,300	\$25,663,800	99%
Single Family Dwelling	6,921	1,499	22%	\$1,235,862,800	\$361,358,000	29%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1786	272	15%	\$16,419,300	\$0	0%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	1,896		\$2,251,509,500	\$694,595,100	

Table 4.11 | The proportion of parcels and value of buildings located in Category 3 SLOSH zone.

Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

SLOSH (Category 4 Storm)						
Type of Use	Number of Parcels			Value of Buildings		
	# in town	# in Hazard area	% in Hazard Area	\$ in town	\$ in Hazard area	% in Hazard Area
Agriculture	9	0	0%	\$0	\$0	0%
Banks	5	0	0%	\$2,217,200	\$0	0%
Church/Non-Profit Offices	79	17	22%	\$13,250,600	\$368,500	3%
Emergency Response	5	1	20%	\$5,503,800	\$0	0%
Entertainment and Recreation	101	47	47%	\$9,343,500	\$6,755,200	72%
General Services	32	1	3%	\$37,459,400	\$259,100	1%
Heavy Industrial	11	0	0%	\$547,200	\$0	0%
Light Industrial	16	0	0%	\$4,056,400	\$0	0%
Medical Office/Clinic	23	0	0%	\$42,766,700	\$0	0%
Metals/Minerals Processing	2	1	50%	\$258,900	\$156,600	60%
Multi-family Dwelling	390	51	13%	\$811,961,500	\$298,589,300	37%
Nursing Home	2	0	0%	\$2,432,000	\$0	0%
Parking	6	2	33%	\$0	\$0	0%
Personal/Repair Services	5		0%	\$387,400	\$0	0%
Professional/Tech. Services	4	2	50%	\$632,200	\$79,100	13%
Retail Trade	26	2	8%	\$27,404,500	\$921,600	3%
Schools	2	1	50%	\$25,957,300	\$25,663,800	99%
Single Family Dwelling	6,921	1,220	18%	\$1,235,862,800	\$297,039,300	24%
Temporary Lodging	5	1	20%	\$7,246,600	\$980,000	14%
Vacant	1786	256	14%	\$16,419,300	\$696,200	4%
Wholesale Trade	10	0	0%	\$7,802,200	\$0	0%
COLUMN TOTAL	9,440	1,602		\$2,251,509,500	\$631,508,700	

Table 4.12 | The proportion of parcels and value of buildings located in Category 4 SLOSH zone.
Table generated using 2015 Mashpee Assessing Data.

Results: Vulnerability Assessment

Parcels and Buildings Vulnerable to Shoreline Change

Coastal Properties		
	# of Parcels in Hazard area	\$ of Buildings in Hazard area
Coastal	799	\$382,353,000
Not Coastal	8659	\$1,751,806,800
Column TOTAL	9,458	\$2,134,159,800

Table 4.13 | The number of parcels and value of buildings on parcels that share a physical boundary with sea water. If a parcel shares a boundary with sea water, it is assumed to be vulnerable to coastal hazards such as shoreline change and erosion .

Results: Vulnerability Assessment

Exposure Assessment of Critical Facilities by the Planning Team

Name of Critical Facility	SLOSH Cat 1	SLOSH Cat 2	SLOSH Cat 3	SLOSH Cat 4	Sea Level Rise 1 foot	Sea Level Rise 2 feet	Sea Level Rise 3 feet	Sea Level Rise 4 feet	Sea Level Rise 5 feet	Sea Level Rise 6 feet	Special Flood Hazard Area (AE)	Special Flood Hazard Area (VE)	COASTAL (boundary with salt water)
Mashpee Town Hall	N	N	N	N	N	N	N	N	N	N	N	N	N
Mashpee Department of Public Works	N	N	N	N	N	N	N	N	N	N	N	N	N
Mashpee Fire and Rescue Department Station 1	N	N	N	N	N	N	N	N	N	N	N	N	N
Mashpee Fire and Rescue Department Station 2	N	N	N	N	N	N	N	N	N	N	N	N	N
Mashpee Police Department	N	N	N	N	N	N	N	N	N	N	N	N	N
Kenneth C. Coombs School	N	N	N	N	N	N	N	N	N	N	N	N	N
Quashnet Elementary School	N	N	N	N	N	N	N	N	N	N	N	N	N
Mashpee Middle-High School	N	N	N	N	N	N	N	N	N	N	N	N	N
Mashpee Family Medicine (Rogers Outpatient Center)	N	N	N	N	N	N	N	N	N	N	N	N	N
Community Health Center of Cape Cod	N	N	N	N	N	N	N	N	N	N	N	N	N
Stop and Shop	N	N	N	N	N	N	N	N	N	N	N	N	N
Mashpee Commons Sewer Treatment	N	N	N	N	N	N	N	N	N	N	N	N	N

Table 4.14 | Exposure assessment for critical facilities. In the Sea Level Rise section of the table, “Y coast” represents facilities that are inundated by water from the coast, “Y depression” represents facilities that are inundated because they are in low-lying areas.

Results: Vulnerability Assessment

Name of Critical Facility	SLOSH Cat 1	SLOSH Cat 2	SLOSH Cat 3	SLOSH Cat 4	Sea Level Rise 1 foot	Sea Level Rise 2 feet	Sea Level Rise 3 feet	Sea Level Rise 4 feet	Sea Level Rise 5 feet	Sea Level Rise 6 feet	Special Flood Hazard Area (AE)	Special Flood Hazard Area (VE)	COASTAL (boundary with salt water)
Radio Communications at Police Department	N	N	N	N	N	N	N	N	N	N	N	N	N
Transfer Station	N	N	N	N	N	N	N	N	N	N	N	N	N
Verizon Building	N	N	N	N	N	N	N	N	N	N	N	N	N
Echo Road Cell Tower	N	N	N	N	N	N	N	N	N	N	N	N	N
Industrial Road Cell Tower #1	N	N	N	N	N	N	N	N	N	N	N	N	N
Industrial Road Cell Tower #2	N	N	N	N	N	N	N	N	N	N	N	N	N
Power Transfer Station	N	N	N	N	N	N	N	N	N	N	N	N	N
Water Tower #1	N	N	N	N	N	N	N	N	N	N	N	N	N
Water Tower #2	N	N	N	N	N	N	N	N	N	N	N	N	N
Route 151	N	N	N	N	N	N	N	N	N	N	N	N	N
Route 130	N	N	N	N	N	N	N	N	N	N	N	N	N
Great Neck Road North	N	N	N	N	N	N	N	N	N	N	N	N	N
Great Neck Road South	Y, partial	Y, partial	Y, partial	Y, partial	N	N	N	N	N	N	Y, partial	N	Y, partial
Route 28 (east of rotary)	N	N	Y, partial	Y, partial	N	N	N	N	N	N	N	N	N
Great Oak Road	Y, partial	Y, partial	Y, partial	Y, partial	Y, partial	Y, partial	Y, partial	Y, partial	Y, partial	Y, partial	Y, partial	Y, partial	Y, partial
Route 28 (west of rotary)	N	N	N	N	N	N	N	N	N	N	N	N	N
Culvert - Red Brook Road at Red Brook Reservoir	Y	N	N	N	N	N	Y, depression	Y, coast	Y, coast	Y, coast	N	N	N

Table 4.14 | Exposure assessment for critical facilities (continued). In the Sea Level Rise section of the table, “Y coast” represents facilities that are inundated by water from the coast, “Y depression” represents facilities that are inundated because they are in low-lying areas.

Results: Vulnerability Assessment

Name of Critical Facility	SLOSH Cat 1	SLOSH Cat 2	SLOSH Cat 3	SLOSH Cat 4	Sea Level Rise 1 foot	Sea Level Rise 2 feet	Sea Level Rise 3 feet	Sea Level Rise 4 feet	Sea Level Rise 5 feet	Sea Level Rise 6 feet	Special Flood Hazard Area (AE)	Special Flood Hazard Area (VE)	COASTAL (boundary with salt water)
Culvert - Route 151 at Quashnet River	N	N	N	N	N	N	N	N	N	N	N	N	N
Culvert - Old Barnstable Road at Childs River	N	N	N	N	N	N	N	N	N	N	N	N	N
Culvert - Old Barnstable Road at Quashnet River	N	N	N	N	N	N	N	N	N	N	N	N	N
Culvert - Quinaquisset Avenue at Willowbend Bogs	N	N	N	N	N	N	N	N	N	N	N	N	N
Culvert - Sampsons Mill Road at Santuit River	N	Y	Y	N	N	N	N	N	N	N	Y	N	N
Culvert - Great Neck Road North at Mashpee River	N	N	N	N	N	N	N	N	N	N	N	N	N
Culvert - Route 130 at Besse Bog	N	N	N	N	N	N	N	N	N	N	N	N	N
Culvert - Route 130 at Mashpee River	N	N	N	N	N	N	N	N	N	N	N	N	N
Culvert - Route 28 at Mashpee River	N	N	N	Y	Y, depression	Y, depression	Y, depression	Y, depression	Y, coast	Y, coast	Y	N	N
Culvert - Monomoscoy Road Causeway	Y	N	N	N	N	N	Y, coast	Y, coast	Y, coast	Y, coast	N	Y	N
Culvert - Great Oak Road at Abigail's Brook	N	Y	Y	Y	N	N	N	N	N	Y, coast	Y	N	N
School Street Bridge	N	N	N	N	N	N	N	N	N	N	Y	N	N

Table 4.14 | Exposure assessment for critical facilities (continued). In the Sea Level Rise section of the table, “Y coast” represents facilities that are inundated by water from the coast, “Y depression” represents facilities that are inundated because they are in low-lying areas.

Vulnerable Populations

B3b

Vulnerable Populations

Below is a description of segments of the population who are vulnerable to the impacts of natural hazard events:

Coastal Erosion: Coastal erosion is not generally considered an imminent threat to public safety because shoreline changes are gradual over many years. However, drastic changes to the shoreline may occur in a single storm event, which can threaten homes and public safety.

Culvert Failure: All populations in a culvert failure inundation zone would be exposed to the risk of culvert failure. The potential for loss of life is affected by the capacity and number of evacuation routes available to populations living in areas of potential inundation.³

Earthquake: The entire population of Massachusetts is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of dwelling structures, soil types in which homes are constructed, proximity to fault locations, etc. Further, the time of day also exposes different sectors of the community to the hazard.⁴

Wildland and Urban Fire: As demonstrated by historical urban and wildfire events, potential losses include human health and life of residents and responders. The most vulnerable populations include the elderly, children, and disabled, as well as emergency responders and those within a short distance of the interface between the built environment and the wildland environment.⁵

Flooding: The impact of flooding on life, health, and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure includes the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by a hazard event (e.g., risk while traveling in flooded areas, or compromised access to emergency services during an event). The degree of such impacts will vary and is not strictly measurable.⁶ Of the population exposed, the most vulnerable include the economically disadvantaged and population over the age of 65. Those over the age of 65 are vulnerable because they are more likely to seek or need medical attention, which may not be available due to isolation during a flood event. They also may have more difficulty evacuating.⁷

³ Massachusetts State Hazard Mitigation Plan, 2013

⁴ Massachusetts State Hazard Mitigation Plan, 2013

⁵ Massachusetts State Hazard Mitigation Plan, 2013

⁶ Massachusetts State Hazard Mitigation Plan, 2013

⁷ Massachusetts State Hazard Mitigation Plan, 2013

Vulnerable Populations

Hurricanes and Tropical Storms: The impact of a hurricane or tropical storm on life, health, and safety is dependent upon several factors including the severity of the event and whether or not residents received adequate warning time. It is assumed that the entire population of Barnstable County is exposed to this hazard. Residents may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings, and debris carried by high winds can lead to injury or loss of life. Socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard, and the location and construction quality of their housing.⁸ Of the population exposed, the most vulnerable include the economically disadvantaged and population over the age of 65. Those over the age of 65 are vulnerable because they are more likely to seek or need medical attention, which may not be available due to isolation during a flood event. They also may have more difficulty evacuating.⁹

Landslides: It is difficult to determine demographics of populations vulnerable to landslides.¹⁰

Nor'easters: The impact of a nor'easter on life, health and safety is dependent upon several factors including the severity of the event and whether or not residents

received adequate warning time. It is assumed that the entire Commonwealth's population is exposed to this hazard (wind and rain/snow). Of the population exposed, the most vulnerable include the economically disadvantaged and population over the age of 65. Those over the age of 65 are vulnerable because they are more likely to seek or need medical attention, which may not be available due to isolation during a flood event. They also may have more difficulty evacuating.¹¹

Severe Weather (wind, thunderstorms, tornadoes, extreme temperatures, drought): For the purposes of this plan, the entire population of Mashpee is exposed to severe weather events. Residents may be displaced or require temporary to long-term sheltering due to severe weather events. In addition, downed trees, damaged buildings and debris carried by high winds can lead to injury or loss of life. Socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. In general, vulnerable populations include the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These

⁸ Massachusetts State Hazard Mitigation Plan, 2013

⁹ Massachusetts State Hazard Mitigation Plan, 2013

¹⁰ Massachusetts State Hazard Mitigation Plan, 2013

¹¹ Massachusetts State Hazard Mitigation Plan, 2013

Vulnerable Populations

populations face isolation and exposure during severe weather events and could suffer more secondary effects of the hazard.¹²

Severe Winter Weather (snow, blizzards and ice):

According to NOAA's National Severe Storms Laboratory, winter weather indirectly and deceptively kills hundreds of people in the U.S. every year, primarily from automobile accidents, overexertion, and exposure. Winter storms are often accompanied by strong winds, creating blizzard conditions with blinding wind-driven snow, drifting snow, and extreme cold temperatures with dangerous wind chills. These storms are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. Injuries and fatalities may occur due to traffic accidents on icy roads, heart attacks while shoveling snow or hypothermia from prolonged exposure to cold.¹³

Heavy snow can immobilize a region and paralyze a town, shutting down its transportation network, stopping the flow of supplies, and disrupting medical and emergency services. The elderly are considered most susceptible due to their increased risk of injury and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice, or related to power failures. In addition, severe winter weather events can reduce the ability of these populations to access emergency services. Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply).¹⁴

Tsunami: It is difficult to determine demographics of populations vulnerable to tsunamis.¹⁵

12 Massachusetts State Hazard Mitigation Plan, 2013

13 Massachusetts State Hazard Mitigation Plan, 2013

14 Massachusetts State Hazard Mitigation Plan, 2013

15 Massachusetts State Hazard Mitigation Plan, 2013

Summary of Vulnerable Infrastructure

B3b

Summary of Vulnerable Infrastructure

Below is a description of Mashpee infrastructure that is vulnerable to the impacts of natural hazard events:

- Overhead power lines are vulnerable to high winds.
- Several culverts are located within the floodplain or are vulnerable to storms (located in SLOSH categories) or sea level rise.
- Parts of Great Neck Road South and Great Oak Road, as well as parts of Route 28 east of the rotary, are vulnerable to flooding (located in SLOSH categories) and some sea level rise levels.
- School Street Bridge is located within the floodplain.

Mitigation Strategy

CHAPTER FIVE

Chapter 2 profiled specific hazards that could affect Mashpee and Chapter 4 assessed the losses that could result from those hazard events. The next step in the hazard planning process is to identify actions to reduce risk and loss of life and to develop ways to implement these actions. This so-called “Mitigation Strategy” determines broad goals and outlines specific actions for the next five years. **Chapter 5 outlines a mitigation strategy for the Town of Mashpee for the next five years.**

Mitigation Goals

Mitigation Goals

Mitigation goals are broad guidelines that articulate Mashpee's desire to protect people and structures, reduce the cost of disaster response and recovery, and minimize disruption to the community following a disaster.¹

C3a,b

Mitigation Goals

The Planning Team reviewed the Goals in the 2004 Hazard Mitigation Plan and decided to keep the existing goals as well as add a few new goals. Mitigation Goals for the 2017 Mashpee Hazard Plan are:

1. Reduce the potential for loss of life, property, infrastructure, and environmental, cultural and economic resources in Mashpee from natural hazards
2. Reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities
3. Communicate and coordinate local hazard mitigation planning activities with those of our neighboring

towns, the Massachusetts Military Reserve, and Barnstable County, as well as the appropriate state and federal agencies

4. Competitively position the town to seek and apply for funding opportunities to implement the actions identified in the Mashpee hazard plan
5. Ensure that mitigation measures are sensitive to the natural features, historic resources, and community character of Mashpee
6. Increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process

Mitigation Actions

Mitigation actions are any action, process, or project designed to reduce or eliminate long term risk from natural hazards. These mitigation actions are developed by the Planning Team and they must be consistent with the vulnerability and risk assessment performed in Chapter 4 and with the priorities of the Town of Mashpee.

Below is a description of how the Planning Team developed the Mitigation Action section of the 2017 Mashpee Hazard Mitigation Plan Update:

- 1. Progress Determinations on Mitigation Actions in 2004:** the Team assigned a status to each mitigation action identified in the 2004 Hazard Mitigation Plan

¹ FEMA How-to Guide 3: Developing the Mitigation Plan: Identifying mitigation actions and implementation strategies, FEMA 386-3, April 2003

Progress Determination on Mitigation Actions since 2004

and explained why the action was completed, an existing capability, in progress, deferred, or deleted (See *Table 5.1*).

2. Mitigation Actions for the 2017 Hazard Mitigation Plan Update: the list contains:

- New mitigation actions based on the Vulnerability and Risk Assessment in Chapter 4
- “In Progress” and “Existing Capability” actions in *Table 5.1* identified as continuing by the Planning Team

3. Capability Assessment: the Team developed an existing capabilities assessment. Any action designated as an “existing capability” in *Table 5.1* was carried over to the Capability Assessment (*Table 5.2*).

- **Existing Capability:** The project was implemented and completed in 2004 – 2017, and it will continue to be implemented on an annual basis in the future. These action items are also identified in the capability assessment (*Table 5.2*).
- **In Progress:** The project was started in the 2004 – 2017 timeframe and it is still in progress.
- **Deferred:** The project is important, but it was deferred because there was no funding available or it is not feasible to complete the project.
- **Deleted:** The project is no longer relevant to the community.

In 2004 the Planning Team identified 24 Mitigation Actions. During the plan update, the Planning Team assessed the Town’s progress on these actions (*Table 5.1*).

D2a

Progress Determination on Mitigation Actions since 2004

Before identifying new Mitigation Actions for the 2017 Hazard Plan, the Planning Team discussed the status of the mitigation actions identified in the 2004 Hazard Mitigation Plan. One of the following status determinations was given to each mitigation action identified from the 2004 plan:

- **Complete:** The project was implemented and completed in 2004 – 2017.

Progress Determination on Mitigation Actions since 2004

Hazard(s) to Mitigate	Action Item Number and Description	Responsible Department	Status	Explanation of Status
All Hazards	Action Item #1: Seek funding under the FEMA Hazard Mitigation Grant Program to implement the structural and capital measures in this Plan.	Various	Existing Capability	Both the Department of Public Works and the Conservation Commission applied for grants from Coastal Zone Management but were unsuccessful.
Flood	Action Item #2: Become a participant in the NFIPs Community Rating System program by the year 2006 through enhanced floodplain management activities. Explore opportunities to join with Barnstable County as a whole.	Planning and Building Departments	Complete	Work has been ongoing to get Mashpee as a participant in the Community Rating System and all documentation has been submitted. The Town is awaiting any further instructions.
Flood	Action Item #3: Work with FEMA to update the Town's Flood Insurance Rate Maps (FIRM) to correct inaccuracies identified by the Town's Local Hazard Mitigation Planning Team and to take advantage of improvements in mapping technology.	Planning and Building Departments, Waterways Commission	Complete	The updated 2014 FIRM Maps and planning maps were adopted at Town Meeting in May 2014.
Flood, Wind	Action Item #4: Develop an emergency evacuation plan that includes specific procedures for evacuation areas where evacuation routes may be inaccessible due to flooding or wave action.	Public Works, Fire and Police	In Progress	This has been done by Barnstable County but needs to be updated for the Town.
All	Action Item #5: Conduct a detailed geologic study of the Popponeset Spit to determine the action necessary to prevent further deterioration or erosion.	Conservation Commission	Complete	Completed by Save Popponeset Bay (non-profit); worked with the Town on where to put dredging spoils.

Table 5.1 | Progress determination on 2004 Mitigation Actions (continued)

Progress Determination on Mitigation Actions since 2004

Hazard(s) to Mitigate	Action Item Number and Description	Responsible Department	Status	Explanation of Status
Wildfire	Action #6: Engage in the National Fire Prevention Association's (NFPA) planning process to minimize wildfire hazards.	Fire and Planning Departments	Existing Capability	Town will continue to hold two meetings per year, conduct controlled burns, and partner with Tribe, State, and Federal agencies on implementation.
Wildfire	Action Item #7: Develop a plan, in conjunction with the Mashpee National Wildlife Refuge Management Committee, for the maintenance of the unpaved roads within the Mashpee National Wildlife Refuge (MWNR) to ensure adequate access for response to wildfires or other disasters and so that these roads can also function as fire breaks.	Fire, Public Works, Police and Conservation with MWNR Management Committee	Existing Capability	Wildlife Refuge Partnership Group meets twice each year to ensure adequate access for response to wildfires or other disasters, and so that these roads can also function as fire breaks.
Flood	Action Item #8: Develop a Stormwater Runoff Management Plan, which identifies and prioritizes in the Town of Mashpee needed stormwater runoff projects.	Public Works	Existing Capability	Done on a road-by-road basis as road maintenance is done; the Town does not have significant flooding issues and so prioritization is also done on a road-by-road basis.
Flood	Action Item #9: Establish and Implement the Town's Wastewater Facilities Plan	Planning, Public Works	In progress	The Plan has been completed and the Town continues to work on its implementation.
Wind	Action Item #10: Evaluate feasibility of burying utilities in identified hazardous areas.	Planning, Public Works; NSTAR (Eversource)	Complete	The feasibility of burying utilities was examined and deemed cost prohibitive.

Table 5.1 | Progress determination on 2004 Mitigation Actions (continued)

Progress Determination on Mitigation Actions since 2004

Hazard(s) to Mitigate	Action Item Number and Description	Responsible Department	Status	Explanation of Status
Flood, Wind, Fire, Snow/Ice	Action Item #11: Study the appropriate placement for Fire, Police and DPW facilities.	Local ERC; Town Manager, Fire, Police and DPW, Planning	Existing Capability	The town went through this process and the fire substation was constructed; the Town will review future needs to keep up with development through the Board of Selectmen and Fire and Police Chiefs.
All	Action Item #12: Coordinate the Town's mitigation planning efforts with the Mashpee Water District.	Mashpee Water District; Board of Health, Public Works and Fire Department, other Town Departments as designated by the Town Manager	Existing Capability	This has been done through emergency planning; the Mashpee Water District releases the plan to the Town.
Wildfire	Action Item #13: Complete application and submit to Barnstable County Cooperative Extension's Wildfire Assessment & Preparedness Program for the six (6) identified Town-owned parcels.	Fire and Conservation Commission	In Progress	This program no longer exists; the Town now seeks funding from federal programs.
All	Action Item #14: Insure that identified hazard mitigation programs and measures are adequately addressed in updates of the Town's Comprehensive Emergency Management Plan (CEMP).	Police, Fire, Town Manager, Local ERC	Existing Capability	The Comprehensive Emergency Management Plan is now electronic.

Table 5.1 | Progress determination on 2004 Mitigation Actions (continued)

Progress Determination on Mitigation Actions since 2004

Hazard(s) to Mitigate	Action Item Number and Description	Responsible Department	Status	Explanation of Status
All	Action Item #15: Investigate the possibility of tax credits for property owners who voluntarily implement mitigation measures.	Town Manager to designate	Deleted	This action was deemed impractical.
Flood	Action Item #16: Increase protection of the floodplain by enhancing floodplain management activities (zoning, building) within the Town of Mashpee.	Planning and Building Departments	Existing Capability	Getting ready for 9th edition of building code; the local wetland bylaw has standards for flood zones
Flood	Action Item #17: Incorporate Part 44 of the Code of Federal Regulations, Section 60.3, regarding the placement of utility structures, into the Town's General Bylaws (versus zoning to avoid grandfathering)	Planning and Building Departments	In Progress	Utility structures must be built to state code.

Table 5.1 | Progress determination on 2004 Mitigation Actions (continued)

Progress Determination on Mitigation Actions since 2004

Hazard(s) to Mitigate	Action Item Number and Description	Responsible Department	Status	Explanation of Status
All Hazards	<p>Work with Barnstable County to develop a multifaceted hazard mitigation education program to:</p> <ul style="list-style-type: none"> ▪ Raise public awareness and support for mitigation. ▪ Assist the Town in implementation of community based hazard mitigation through education of Town officials and employees, residents, visitors, and businesses (including resorts and seasonal residents); on-going risk assessment and vulnerability analysis; floodplain management, land use and community planning; and through participation in other state and federal programs intended to reduce risk. ▪ Reduce duplication of effort of Countywide work. <p>Elements of the educational program may include the following as well as additional action items/elements that will be developed or specified as additional needs are identified:</p> <ul style="list-style-type: none"> ▪ Production and distribution of hazard mitigation materials targeted specifically to diverse sectors of the Cape's population (i.e. seniors, visitors, realtors, homeowners, second home owners, contractors and builders, realtors, children, Chambers of Commerce, business owners, boat owners, marina managers, etc.). ▪ Educate town officials to the available, proper mitigation techniques. ▪ Develop education programs to inform Town residents about prevention techniques to minimize storm damage to their own property. ▪ Develop seasonal visitor evacuation education (specifically hurricanes or other disaster that may require evacuation or sheltering in place). ▪ Encourage participation in the National Fire Protection Association's National Firewise Communities Program. 	To be determined	Existing Capability	<p>The Cape Cod Emergency Preparedness Handbook has been updated and made available to homeowners, at senior centers, and at the library; there have been lectures on the subject and brochures distributed; the website has been updated with emergency information and a call back system.</p>

Table 5.1 | Progress determination on 2004 Mitigation Actions (continued)

Progress Determination on Mitigation Actions since 2004

Hazard(s) to Mitigate	Action Item Number and Description	Responsible Department	Status	Explanation of Status
All Hazards	<p>(Action Item #18 Continued)</p> <ul style="list-style-type: none"> Assist in annual updates to the Cape Cod Emergency Preparedness Handbook: A Guide to Natural Disasters, which was produced by the Cape Cod Commission in 2004, by providing updated Town of Mashpee information and distribute at various locations within the Town. Work with the Commission in providing the relevant Mashpee information for inclusion in all Cape Cod phone books a section on hazard mitigation, emergency preparedness, and hazardous event response (contact, shelter and evacuation information) intended as a quick reference guide for the public. Coordinate with the Commission on utilization and adoption to Cape Cod and Mashpee of the State's public information, materials, workshops, and videos, and the utilization of the State Hazard Mitigation Training Program to train Mashpee officials. Get local officials and permitting board to participate in an annual hazard mitigation training program that the Commission has proposed to organize as part of its Regional Hazard Mitigation Plan. Have links from the Town's redesigned web page to the County and State's hazard mitigation web information in order to provide local officials and the general public the latest information on hazard mitigation measures, programs and funding in Massachusetts. 	To be determined	Existing Capability	The Cape Cod Emergency Preparedness Handbook has been updated and made available to homeowners, at senior centers, and at the library; there have been lectures on the subject and brochures distributed; the website has been updated with emergency information and a call back system.
Flood, Wind	Action Item #19: Conduct a feasibility study of the roadways within the Town of Mashpee subject to flooding or wave action, as identified in the Hazard Identification and Ranking Matrix, to determine the ability and cost to elevate or relocate the identified roads and/or the utilities located within these road right-of-ways to above the applicable 100-year flood level or to mitigate flooding impacts by other means.	Public Works	In Progress	The Town wants to continue to pursue this, but it has not been completed.

Table 5.1 | Progress determination on 2004 Mitigation Actions (continued)

Progress Determination on Mitigation Actions since 2004

Hazard(s) to Mitigate	Action Item Number and Description	Responsible Department	Status	Explanation of Status
Flood	Action Item #20: Prepare an engineering assessment of the various dam/flume structures controlled by the Town, including those at Santuit Pond, Mill Pond (Mashpee River), Quashnet River, in order to develop a long-term plan for the improvement and/or replacement of these structures as necessary.	Conservation Commission	Existing Capability	State office of dam safety conducted phase 1 inspections of all dams and water impoundments in the Town, and all of the impoundments passed. Santuit Pond dam has been replaced; some structures have been improved; inspections will continue every 5-10 years as determined by risk.
Flood	Action Item #21: Prepare design plans for the improvement of the culvert situation for the Child's River at John's Pond.	Conservation Commission	In Progress	The Town wants to complete an assessment of all culverts, but has not completed this yet.
All	Action Item #22: Implement and operate a fully functional Emergency Operations Center.	Police, Fire, Town Manager, Local ERC	Existing Capability	The Town has purchased the equipment necessary to make the Fire Station an Emergency Operations Center and will continue pursuing making it fully functional.
Flood	Action Item #23: Assess the condition of the culvert between Hamblin and Jehu Ponds under Monomoscoy Road (ideally raise the roadway).	Public Works	Existing Capability	Monitoring of this culvert will continue.
Flood	Action Item #24: Assist in the development and provision of Town water for areas subject to flooding that are not hooked up to Town water.	Mashpee Water District, Board of Health	Deleted	Homes that are on wells are not in the flood zones.

Table 5.1 | Progress determination on 2004 Mitigation Actions (continued)

Mitigation Actions for the 2017 Hazard Plan

Mitigation Actions for the 2017 Hazard Plan

This section of the plan is the most dynamic because it is heavily influenced by factors such as grant funding and staff capability. The Mitigation Actions section will be routinely updated to ensure that it remains consistent with current Town priorities.

The Planning Team carried over the 2004 Mitigation Actions that were identified as “In Progress” and some continuing “Existing Capability” actions, and developed new Mitigation Actions based on the Vulnerability and Risk Assessments in Chapter 4. The mitigation actions are described in no particular order.

C4a,b,c
C5b,c
C6a

C5a

The Planning Team ranked the Mitigation Actions based on their priority for the Town. Several variables factored into the team ranking:

Life Safety/Social:

- How effective is the action at protecting lives and preventing injuries?
- If the action is to improve structures/infrastructure, will it also protect lives and prevent injury?
- Will the action affect one segment of the population more than another?

- Will the action disrupt the community in any way? (i.e., impact emergency service routes, break up neighborhoods)

Property Protection:

- Will the action eliminate or reduce damage to structures and infrastructure? If so, how?
- What are the secondary impacts of the mitigation action?
- Does it solve a problem or a symptom of the problem?

Technical/Legal/Environmental/Administrative:

- Is the mitigation action technically feasible based on Mashpee's current capabilities?
- Is the action a long or short-term solution?
- What are the benefits of the project? What are the costs?
- Does the action support Mashpee's Mitigation Goals?
- Does Mashpee have the authority to implement the action? If not, who does?
- Is the action consistent with town values and other planning projects?
- What are the environmental impacts of the action?
- Does it comply with environmental regulations?

Mitigation Actions for the 2017 Hazard Plan

Political/Local Champion:

- Is there political support to implement and maintain the action?
- Does the public support the mitigation action?
- Is there a strong advocate for the action?

C5a

The priority designations for the 2017 Mitigation Actions are as follows:

- High Priority; town will begin or complete these projects within three years.
- Medium Priority; town will begin or complete these projects within four years.
- Low Priority; town will begin or complete these projects within five years.

The Mitigation Actions include 28 projects recommended by the Planning Team. The list identifies Responsibility, Funding, and a Timeframe for the recommended mitigation projects. The actions will begin as soon as the plan is approved and the community is eligible for funding, unless otherwise stated, and will be completed in the amount of time as noted in the “Timeframe” section.

Mitigation Actions for the 2017 Hazard Plan

All Hazards

Mitigation Action #1

NEW AND FROM 2004

Seek funding from agencies such as FEMA and Massachusetts Coastal Zone Management to implement the structural and capital measures in this Plan.

Project Type:

Structure and Infrastructure

Responsible Dept:

Department of Public Works,
Conservation Commission,
Others as Appropriate

Funding Sources:

Town Operating Budget,
<\$50,000

Timeframe:

Within 1 year/ongoing

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: High

All Hazards

Mitigation Action #2

FROM 2004

Develop an emergency evacuation plan that includes specific procedures for evacuation areas where evacuation routes may be inaccessible due to flooding or wave action.

Project Type:

Planning and Development

Responsible Dept:

Department of Public Works,
Fire Department, Police
Department

Funding Sources:

Town Operating Budget,
<\$50,000

Timeframe:

Within 2 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Medium

Mitigation Actions for the 2017 Hazard Plan

Wildfire

Mitigation Action #3

FROM 2004

Engage in the National Fire Prevention Association's (NFPA) planning process to minimize wildfire hazards.

Project Type:

Planning and Development

Responsible Dept:

Fire Department, Planning Department

Funding Sources:

Town Operating Budget, <\$50,000

Timeframe:

Within 1 year/ongoing

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: High

Wildfire

Mitigation Action #4

FROM 2004

In conjunction with the Mashpee National Wildlife Refuge Management Committee, continue planning for the maintenance of the unpaved roads within the Mashpee National Wildlife Refuge (MWNR) to ensure adequate access for response to wildfires or other disasters and so that these roads can also function as fire breaks.

Project Type:

Planning and Development

Responsible Dept:

Fire Department, Department of Public Works, Police Department, and Conservation Commission, with MWNR Management Committee

Funding Sources:

Town Operating Budget, <\$50,000

Timeframe:

Within 1 year/twice annually

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: High

Mitigation Actions for the 2017 Hazard Plan

Flooding

Mitigation Action #5

FROM 2004

Develop a Stormwater Runoff Management Plan, which identifies and prioritizes needed stormwater runoff projects in the Town of Mashpee.

Project Type:

Planning and Development

Responsible Dept:

Department of Public Works

Funding Sources:

Town Operating Budget,
<\$50,000

Timeframe:

Ongoing/within 4 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Medium

Flooding

Mitigation Action #6

FROM 2004

Continue working on implementing the Town's Wastewater Facilities Plan.

Project Type:

Planning and Development;
Structure and Infrastructure

Responsible Dept:

Department of Public Works,
Planning Department

Funding Sources:

Town Operating Budget;
State Revolving Fund

Timeframe:

Ongoing/annually

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Mitigation Actions for the 2017 Hazard Plan

Flooding, Wind, Fire, Snow/Ice

Mitigation Action #7

FROM 2004

Study the appropriate placement for Fire, Police, and Department of Public Works facilities to mitigate damages caused by natural hazards.

Project Type:

Planning and Development

Responsible Dept:

Local Emergency Response Committee; Town Manager, Fire Department, Police Department, Department of Public Works, Planning Department

Funding Sources:

Town Operating Budget; FEMA grants

Timeframe:

Ongoing/annually

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

All Hazards

Mitigation Action #8

FROM 2004

Coordinate the Town's mitigation planning efforts with the Mashpee Water District.

Project Type:

Planning and Development

Responsible Dept:

Local Emergency Response Mashpee Water District; Board of Health, Public Works and Fire Department, other Town Departments as designated by the Town Manager

Funding Sources:

Town Operating Budget; FEMA grants; Water District

Timeframe:

Ongoing/annually

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Mitigation Actions for the 2017 Hazard Plan

All Hazards

Mitigation Action #9

FROM 2004

Ensure that identified hazard mitigation programs and measures are adequately addressed in updates of the Town's Comprehensive Emergency Management Plan (CEMP).

Project Type:

Planning and Development

Responsible Dept:

Local Emergency Response Committee, Fire Department, Police Department, Town Manager

Funding Sources:

Town Operating Budget; FEMA or MEMA grants

Timeframe:

Ongoing/within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: High

Flooding

Mitigation Action #10

FROM 2004

Increase protection of the floodplain by enhancing floodplain management activities (zoning, building) within the Town of Mashpee.

Project Type:

Planning and Development

Responsible Dept:

Planning Department, Building Department

Funding Sources:

Town Operating Budget; FEMA grants

Timeframe:

Ongoing/annually

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Medium

Mitigation Actions for the 2017 Hazard Plan

Flooding

Mitigation Action #11

FROM 2004

Incorporate Part 44 of the Code of Federal Regulations, Section 60.3, regarding the placement of utility structures, into the Town's General Bylaws (versus zoning to avoid grandfathering)

Project Type:

Planning and Development

Responsible Dept:

Planning Department,
Building Department

Funding Sources:

Town Operating Budget;
FEMA grants

Timeframe:

Ongoing/within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

All Hazards

Mitigation Action #12

FROM 2004

Work with Barnstable County to develop a multifaceted hazard mitigation education program to raise public awareness and support for mitigation; conduct on-going risk assessment and vulnerability analysis, floodplain management, land use and community planning; and through participation in other state and federal programs intended to reduce risk; and to reduce duplication of effort of countywide work

Project Type:

Outreach

Responsible Dept:

To be determined

Funding Sources:

Grant funding

Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities; communicate and coordinate local hazard mitigation planning activities with those of our neighboring towns, the Massachusetts Military Reserve, and Barnstable County, as well as the appropriate state and federal agencies; increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Mitigation Actions for the 2017 Hazard Plan

All Hazards

Mitigation Action #13

NEW AND FROM 2004

Work with Barnstable County to produce and distribute hazard mitigation materials targeted specifically to diverse sectors of the Cape's population (i.e., seniors, visitors, realtors, homeowners, second home owners, contractors and builders, realtors, children, Chambers of Commerce, business owners, boat owners, marina managers, etc.)

Project Type:

Outreach

Responsible Dept:

To be determined

Funding Sources:

Grant funding

Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Communicate and coordinate local hazard mitigation planning activities with those of our neighboring towns, the Massachusetts Military Reserve, and Barnstable County, as well as the appropriate state and federal agencies; increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

All Hazards

Mitigation Action #14

NEW AND FROM 2004

Work with Barnstable County to develop education programs to inform Town residents and employees about prevention techniques to minimize storm damage to private and public property

Project Type:

Outreach

Responsible Dept:

To be determined

Funding Sources:

Grant funding

Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; communicate and coordinate local hazard mitigation planning activities with those of our neighboring towns, the Massachusetts Military Reserve, and Barnstable County, as well as the appropriate state and federal agencies; increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Mitigation Actions for the 2017 Hazard Plan

All Hazards

Mitigation Action #15

FROM 2004

Develop seasonal visitor evacuation education, specifically for hurricanes or other disasters that may require evacuation or sheltering in place

Project Type:

Outreach

Responsible Dept:

To be determined

Funding Sources:

Town Operating Budget;
FEMA grants

Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; communicate and coordinate local hazard mitigation planning activities with those of our neighboring towns, the Massachusetts Military Reserve, and Barnstable County, as well as the appropriate state and federal agencies; increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Wildfire

Mitigation Action #16

FROM 2004

Encourage participation in the National Fire Protection Association's National Firewise Communities Program

Project Type:

Outreach

Responsible Dept:

To be determined

Funding Sources:

Town Operating Budget;
FEMA grants

Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Mitigation Actions for the 2017 Hazard Plan

All Hazards

Mitigation Action #17

FROM 2004

Assist in updates to the handbooks on emergency preparedness for Cape Cod by providing updated Town of Mashpee information and distribute at various locations within the Town

Project Type:

Outreach

Responsible Dept:

To be determined

Funding Sources:

Town Operating Budget

Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; communicate and coordinate local hazard mitigation planning activities with those of our neighboring towns, the Massachusetts Military Reserve, and Barnstable County, as well as the appropriate state and federal agencies; increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

All Hazards

Mitigation Action #18

NEW AND FROM 2004

Encourage local officials such as the permitting board to utilize state and other agency hazard mitigation training programs

Project Type:

Outreach

Responsible Dept:

To be determined

Funding Sources:

Town Operating Budget

Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; communicate and coordinate local hazard mitigation planning activities with those of our neighboring towns, the Massachusetts Military Reserve, and Barnstable County, as well as the appropriate state and federal agencies; increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Mitigation Actions for the 2017 Hazard Plan

All Hazards

Mitigation Action #19

FROM 2004

Have links from the Town's web page to the County and State's online hazard mitigation information in order to provide local officials and the general public the latest information on hazard mitigation measures, programs, and funding in Massachusetts

Project Type:

Outreach

Responsible Dept:

To be determined

Funding Sources:

Town Operating Budget

Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Communicate and coordinate local hazard mitigation planning activities with those of our neighboring towns, the Massachusetts Military Reserve, and Barnstable County, as well as the appropriate state and federal agencies; increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Flooding, High Winds

Mitigation Action #20

FROM 2004

Conduct a feasibility study of the roadways within the Town of Mashpee subject to flooding or wave action, as identified in the Hazard Identification and Ranking Matrix from the 2004 Hazard Mitigation Plan, to determine the ability and cost to elevate or relocate the identified roads and/or the utilities located within these road right-of-ways to above the applicable 100-year flood level or to mitigate flooding impacts by other means

Project Type:

Planning and Development

Responsible Dept:

Department of Public Works

Funding Sources:

Town Operating Budget;
FEMA grants

Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Mitigation Actions for the 2017 Hazard Plan

Flooding

Mitigation Action #21

FROM 2004

Prepare an engineering assessment of the various dam/flume structures controlled by the Town, including those at Santuit Pond, Mill Pond (Mashpee River), Quashnet River, in order to develop a long-term plan for the improvement and/or replacement of these structures as necessary

Project Type:

Structure and Infrastructure

Responsible Dept:

Conservation Commission

Funding Sources:
Town Operating Budget;
FEMA grants
Timeframe:

Every 5-10 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Flooding

Mitigation Action #22

NEW AND FROM 2004

Prepare design plans for the improvement of the culvert situation for the Child's River at John's Pond, assess the condition of the culvert between Hamblin and Jehu Ponds under Monomoscoy Road (ideally raise the roadway), and conduct an assessment of all Town culverts

Project Type:

Structure and Infrastructure

Responsible Dept:

Conservation Commission

Funding Sources:
Town Operating Budget;
FEMA grants
Timeframe:

Within 5 years

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Low

Mitigation Actions for the 2017 Hazard Plan

All Hazards

Mitigation Action #23

FROM 2004

Implement and operate a fully functional Emergency Operations Center

Project Type:

Planning and Development

Responsible Dept:

Police Department, Fire Department, Town Manager, Local Emergency Response Committee

Funding Sources:

Town Operating Budget; FEMA grants

Timeframe:

Within 1 year

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: High

Flooding

Mitigation Action #24

NEW

Make a dredging plan that helps with combining all permits into a single comprehensive permit

Project Type:

Planning and Development

Responsible Dept:

Waterways Commission, Board of Selectmen

Funding Sources:

Town Operating Budget; FEMA grants

Timeframe:

Within 1 year

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: High

Mitigation Actions for the 2017 Hazard Plan

All Hazards

Mitigation Action #25

NEW

Provide generators for the elderly housing complex at 1 Carleton Drive

Project Type:

Planning and Development

Responsible Dept:

Mashpee Housing Authority

Funding Sources:

Town Operating Budget

Timeframe:

Within 1 year

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: Medium

All Hazards

Mitigation Action #26

NEW

Develop a better understanding of regional shelters, their resources, and how the Town can utilize them

Project Type:

Planning and Development

Responsible Dept:

Fire Department, Board of Health

Funding Sources:

Town Operating Budget

Timeframe:

Within 1 year

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: High

Mitigation Actions for the 2017 Hazard Plan

All Hazards

Mitigation Action #27

NEW

Acquire field computers, kits, and communication devices to improve hazard mitigation and response operations

Project Type:

Planning and Development

Responsible Dept:

Board of Selectmen, IT Department

Funding Sources:

Town Operating Budget;
FEMA grants

Timeframe:

Within 1 year

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: High

All Hazards

Mitigation Action #28

NEW

Coordinate debris management with Barnstable County Regional Emergency Planning Committee

Project Type:

Structure and Infrastructure

Responsible Dept:

Fire Department, Board of Health, Police Department, Department of Public Works, Building Commissioner,

Funding Sources:

Town Operating Budget

Timeframe:

Within 1 year

Consistency with Mitigation Goals:

Reduce the potential for loss of life, property, infrastructure, and environmental, cultural, and economic resources in Mashpee from natural hazards; reduce the damage to public infrastructure resulting from natural hazards including but not limited to critical facilities, roadways and culverts, and water facilities.

Consistency with Other Town Plans:

Mashpee Local Comprehensive Plan

Priority: High

Participation in NFIP

A6c

Participation in NFIP

B4a

Repetitive Loss Properties

Repetitive Loss Properties are those for which two or more losses of at least \$1,000 each have been paid under the National Flood Insurance Program (NFIP) within any ten year period since 1978.

The Town of Mashpee has three repetitive loss properties, all of which are residential, and three repetitive loss areas.

The three areas in Mashpee that are designated as repetitive loss areas are all subject to storm surge as waterfront properties. More detailed descriptions can be found below.

- **Frog Pond Close Area:** This area is on the Santuit River near the confluence with the Mashpee River and Popponesset Bay, and ultimately Nantucket Sound. It is near Simons Narrows, a narrow point in the river that likely acts like a funnel. There is also a significant fetch over the mouth of the River and the Bay, which could generate a localized surge if the wind is blowing from a direction that may not cause significant surge in Nantucket Sound.
- **Mariner Lane Area:** This area is on the eastern side of Monomoscoy Island on Great River near the confluence with Little River and Waquoit Bay. Waquoit Bay is connected to Nantucket Sound

by a maintained navigational channel. Surge from Nantucket Bay can affect the area, and the river can act as a funnel amplifying that surge near the property. There is enough of a fetch that waves can be generated near the property. The area includes a narrowing in the river, which may cause excess flood water to be channeled onto some properties during a surge.

- **Taffrail Way:** This area is on the western side of Popponesset Island. This side of the island is surrounded by a narrow waterway that could funnel storm surge from Popponesset Bay and is large enough to generate waves. A small inlet in this area could further funnel flood waters.

The Town has verified the location of each repetitive loss property and corrected any mistakes, submitting AW-501 forms to FEMA. To help mitigate flooding hazards, the Town of Mashpee focused on planning for evacuating vulnerable areas, continuing the Town's floodplain management activities, improving education and awareness about flooding hazards and prevention, and acquiring both training and equipment to improve the Town's response to hazards. While there are several other possible mitigation actions that could be taken for the repetitive loss properties, the chosen mitigation actions were the most feasible for the Town, both in terms of existing capability and expense. Additionally, the mitigation actions chosen for the Hazard Mitigation Plan may benefit a more widespread population than

An Assessment of the Changes in Priorities from 2004 to 2017

mitigation actions focused solely on the three repetitive loss properties in the Town, such as working to acquire the properties.

C2a

Continued compliance with NFIP

To be approved by the Federal Emergency Management Agency (FEMA), the Mashpee Hazard Plan must describe the Town's participation in the National Flood Insurance Program (NFIP). The NFIP is based on a mutual agreement between the Federal government and the Town of Mashpee.¹ Federally backed flood insurance is available in Mashpee as long as the Town agrees to regulate development in their mapped floodplain.² To remain compliant with the NFIP, Mashpee is committed to the following activities:

- Issue or deny floodplain development/building permits
- Inspect all developments to ensure compliance with local ordinance
- Maintain records of floodplain development

¹ National Flood Insurance Program (NFIP) Floodplain Management Requirements: A study guide and desk reference for local officials, FEMA 480, February 2005

² National Flood Insurance Program (NFIP) Floodplain Management Requirements: A study guide and desk reference for local officials, FEMA 480, February 2005

- Assist with floodplain identification and mapping as well as any revision of floodplain maps, including local requests for map updates
- Help residents obtain information on flood hazards, floodplain map data, flood insurance and proper construction practices

An Assessment of the Changes in Priorities from 2004 to 2017

D3

The Mitigation Actions described in the 2004 Mashpee Hazard Mitigation Plan were prioritized based on their feasibility using the STAPLEE method. The Mitigation Actions in the 2017 Hazard Mitigation Plan were prioritized by the Planning Team as high, medium, or low.

Below is a list of activities that remain a priority for the Town of Mashpee in 2017:

- Mashpee remains dedicated to reducing the potential for life, property, infrastructure, and environmental, cultural, and economic resources in the Town from natural hazards.
- Mashpee remains committed to assessing local infrastructure for damage to coastal hazards such as storm surge, flooding and shoreline change
- Mashpee remains committed to their participation in the National Flood Insurance Program and the Community Rating System

Existing Capabilities Assessment

Below is a list of goals that are slightly different from the 2004 Hazard Mitigation Plan:

- The Town seeks to ensure that mitigation measures are sensitive to the natural features, historic resources, and community character of the town.
- The Town looks to increase public awareness of existing hazards and encourage hazard mitigation planning as part of the overall municipal planning process.

Existing Capabilities Assessment

c1

During the development of the 2017 Mashpee Hazard Mitigation plan, members of the Planning Team reviewed the capabilities of the town departments (see **Table 5.2**) These are the Town's current capabilities, which cannot be expanded at this time. During the evaluation and maintenance period of the Plan, the Town will discuss whether it can then expand and improve upon existing capabilities.

Existing Capabilities Assessment

Natural Hazard	Explanation of Capability	Responsible Department
All Hazards	Educational Materials: The town distributes educational materials from local, county, and state level organizations such as the Barnstable County Regional Emergency Planning Committee (BCREPC) and the Cape Cod Cooperative Extension (CCCE). Materials include but are not limited to: CCCE's "Questions and Answers on Purchasing Coastal Real Estate in MA" and "Homeowner's Handbook to Prepare for Coastal Hazards."	Fire and Police Departments, Planning
All Hazards	Emergency Communication: The town owns a large variable message board which displays 3-4 lines of text. The board is usually placed on Route 6 to notify residents of hazards, lane closures, and parking instructions.	Police and Fire Departments, DPW, Town Administrator
All Hazards	Emergency Planning: Continuous review and practice of the Comprehensive Emergency Management Plan. Town staff determine supplies, equipment and communications needs and prioritize purchases so that the town is prepared for any needed emergency response to any natural hazard event. The Fire or Police Chief attends the monthly Barnstable County Regional Emergency Planning Committee meetings.	Police and Fire Departments, DPW, Town Administrator
All Hazards	Eversource: In 2012, an Act Relative to Emergency Response of Public Utility Companies was signed into law, requiring a more robust response to emergencies from power companies. Additionally, Eversource has MOUs with private companies to provide accommodations during all but the summer seasons. The Town has supplied Eversource with a list of critical facilities to prioritize power restoration.	Police and Fire Departments, DPW, Town Administrator
All Hazards	Generators: An inventory of Town-owned generators is continually reviewed and monitored by town staff.	Police and Fire Departments, DPW, Town Administrator
All Hazards	Shelter: Equipment inventories and needs for the regional shelter are assessed during monthly meetings of the Barnstable County Regional Emergency Planning Committee.	Police and Fire Departments, DPW, Town Administrator

Table 5.2 | Existing capabilities assessment

Existing Capabilities Assessment

Natural Hazard	Explanation of Capability	Responsible Department
All Hazards	The Town has purchased the equipment necessary to make the Fire Station an Emergency Operations Center and will continue to pursue making it fully functional.	Police Department, Fire Department, Town Manager, Local ERC
All Hazards	Grant Funding: The DPW and Conservation Commission have proactively applied for grants over the last 5-6 years.	DPW, Conservation Commission
Fire	Fire Code: Town observes State, Federal, and local fire codes. New sprinkler system laws are continually enforced. The Building Commissioner seeks input from the Fire Department on where to place sprinkler systems in new developments and redevelopment projects.	Fire Department, Building Commissioner
Fire	Fire Prevention: Camp fires are not allowed in conservation areas and only by permit on Town Beaches for a special event. The Town combats the threat of uncontrolled wildland fires through the implementation of a land management and Prescribed Burn Programs, dependent upon grant funding.	Fire Department, Building Commissioner
Fire	Fire Prevention: The Town holds controlled burns and meets twice annually with the Wildlife Refuge Partnership Group and Tribe, State, and Federal agencies to minimize wildfire hazards and ensure adequate access for wildfire response.	Fire Department, Conservation Commission, Department of Public Works, Police Department
Fire	Suppression Systems: Hydrants and sprinkler systems are connected to the municipal water system located throughout Town.	Water, Building, Fire
All Hazards	Notifications: The Police Department collaborates with other Police Departments to send out press releases about the locations of regional shelter and natural hazards.	Police Department
Flooding	Coastal Infrastructure: Department of Public Works assesses infrastructure that is vulnerable to flooding and storm surge in collaboration with the Cape Cod Commission and Federal Highway Administration.	Town Administrator, DPW

Table 5.2 | Existing capabilities assessment (continued)

Existing Capabilities Assessment

Natural Hazard	Explanation of Capability	Responsible Department
Flooding	State Building Code: Substantial monitoring and compliance activities are performed under administration of the State Building Code. Inspection and certification of lowest floor elevation is required by State Building Code. Elevation certificates are required by State Building Code. Applicants are required to submit plans that include the Special Flood Hazard Area and proposed elevations of the proposed structures.	Town Administrator, Building Commissioner, Conservation Commission, Planning
Flooding	Flood Insurance Rate Map (FIRM): Voters amended the Mashpee Zoning Bylaw to be consistent with updated FEMA FIRM maps for Barnstable County.	Town Administrator, Planning
Flooding	Conservation Commission: The Conservation Commission reviews and enforces the MA Wetlands Protection Act as well as local regulations and regulates development within and adjacent to wetland resource areas including floodplains and stormwater management.	Conservation Commission
Flooding	Planning: The Open Space and Recreation Plan, along with the Local Comprehensive Plan, include goals for identifying land within the floodplain for purchase and preservation.	Planning
Flooding	The Town works with the State to inspect dams and water impoundments owned by the Town; inspections will continue every 5-10 years as determined by risk.	Conservation Commission
Flooding, Sea Level Rise, Severe Winter Storms, Nor'easters, Hurricanes/Tropical Storms	Essential Records: Town electronic files are backed up and stored in a building outside of the Special Flood Hazard Area.	Board of Selectmen, Town Administrator, IT, Town Clerk
Flooding, Sea Level Rise, Severe Winter Storms, Nor'easters, Shoreline Change, Hurricanes/Tropical Storms	Stormwater: The Department of Public Works regularly cleans municipal catch basins, storm drains, and infiltration structures. The Town will be meeting the new MS4 Permit requirements which will result in more inspection, cleaning, and monitoring requirements for municipal drainage systems. The Town continually identifies and prioritizes needed stormwater runoff projects.	Department of Public Works

Table 5.2 | Existing capabilities assessment (continued)

Existing Capabilities Assessment

Natural Hazard	Explanation of Capability	Responsible Department
Wind	State Building Code: State Building Code regulates construction for specific wind loads.	Building Commissioner
Flood, Wind, Fire, Snow/Ice	Planning: The Town reviews future needs and studied the appropriate placement for Fire, Police, and Department of Public Works facilities.	Local ERC, Town Manager, Fire Department, Police Department, Department of Public Works, Planning Department

Table 5.2 | Existing capabilities assessment (continued)

Plan Evaluation and Maintenance

CHAPTER SIX

Once the 2017 Mashpee Hazard Plan is adopted by the Board of Selectmen, the plan enters into a five-year “maintenance” phase. **Chapter 6 describes how the Mashpee Hazard Plan will be evaluated, updated, and enhanced over the next five years.**

Plan Maintenance

A6d

Who is involved?

Each department identified in the Mashpee Hazard Mitigation Plan is responsible for implementing specific mitigation actions as prescribed in the Mitigation Action section of the plan (Chapter 5). Every proposed action listed in the Mitigation Action section is assigned to a specific “lead” department as a way to assign responsibility and accountability and increase the likelihood of subsequent implementation.

The Mashpee Town Planner will be responsible for ensuring that the plan is monitored, evaluated, and updated throughout the next five years.

How will the plan be maintained?

Below is a list of the activities describing how the plan will be maintained and updated over the next five years:

A6a

■ Plan Monitoring:

- Members of the Planning Team will meet annually to discuss the implementation status of each Mitigation Action identified in Chapter 5. During these meetings, the Planning Team will also describe and document any new hazard data that can be incorporated in the Hazard Profile section of the plan; specifically new hazard locations, extent and impacts.

- After the annual meeting, members of the Planning Team will present to the Board of Selectman on the implementation status of the Mitigation Actions identified in Chapter 5. This presentation will occur once per year and will include an evaluation of the appropriateness of Mitigation Actions. If an amendment, change or update is needed, the Board of Selectman can vote to adopt the change and amend the Mashpee Hazard Plan.

■ Plan Evaluation:

- Members of the Planning Team will meet annually to evaluate the stated purpose and goals of the Mashpee Hazard Plan. During this annual meeting, the Team will ensure that the plan continues to serve its purpose through the following activities:
 - Review the Mitigation Goals in the 2017 Mashpee Hazard Plan
 - Discuss any recent activities to reduce the loss of life and property in Mashpee such as grants received/applied for and any completed Mitigation Actions
 - Distribute an online survey to gauge the public’s awareness of the risks posed by natural hazards

A6b

- Discuss ongoing or recent planning efforts that are consistent with the Mitigation Goals and Actions of the 2017 Mashpee Hazard Mitigation Plan.

A6c

■ Plan Update:

- The Mashpee Hazard Plan will be reviewed and updated every five years to ensure that there is no lapse in plan coverage. The Hazard Plan update process must begin one to one and one-half years before the plan is set to expire.

When will the plan be maintained?

A start date and time period were assigned to each Mitigation Action in Chapter 5 to assess whether actions are being implemented in a timely fashion. Also, the Planning Team will reconvene annually to discuss progress on the Mitigation Actions.

Following a disaster declaration, the Mashpee Hazard Plan will be revised as necessary to reflect lessons learned or to address specific issues and circumstances arising from the event. It will be the responsibility of the Planning Team to reconvene the Local Emergency Planning Committee and to ensure the appropriate stakeholders are invited to participate in the plan revision and update process following declared disaster events.

Plan Adoption

CHAPTER SEVEN

Once the draft of the Mashpee Hazard Mitigation Plan is reviewed by the Planning Team, stakeholders, and the general public, the plan is reviewed by the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA). If approved by MEMA and FEMA, the Mashpee Board of Selectmen can officially adopt the plan. If and when the plan is approved, it enters into the five year “maintenance” phase. **Chapter 7 describes the timeline for plan adoption and includes documentation for plan adoption by the Mashpee Board of Selectmen.**

Timeline for Plan Adoption

Timeline for Plan Adoption

The timeline for Plan Adoption is as follows:

- **August 2017:** After approval by the Board of Selectmen, the Planning Team submitted the Mashpee Hazard Plan to the Massachusetts Emergency Management Agency (MEMA) in August 2017. MEMA reviewed the plan and returned it to the Town of Mashpee with required edits. The updated Mashpee Hazard Plan was then submitted to the Federal Emergency Management Agency (FEMA) for final review.
- **October 2017:** FEMA issued an Approved Pending Adoption status and the Mashpee Board of Selectmen officially adopted the Mashpee Hazard Mitigation Plan during its meeting on October 30, 2017.

E1a

Plan Adoption

The Certificate of Adoption signed by the Mashpee Board of Selectmen is shown in *Figure 7.1*.



Figure 7.1 | Certificate of Adoption signed by the Mashpee Board of Selectmen

Appendix

Introduction: Local Mitigation Plan Review Guide, FEMA



Local Mitigation Plan Review Guide

October 1, 2011



Introduction: Local Mitigation Plan Review Guide, FEMA

4.1 ELEMENT A: PLANNING PROCESS

Requirement §201.6(b)	An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:
§201.6(b)(1)	(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
§201.6(b)(2)	(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
§201.6(b)(3)	(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.
§201.6(c)(1)	[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.
§201.6(c)(4)(i)	[The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
§201.6(c)(4)(iii)	[The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

Overall Intent. The planning process is as important as the plan itself. Any successful planning activity, such as developing a comprehensive plan or local land use plan, involves a cross-section of stakeholders and the public to reach consensus on desired outcomes or to resolve a community problem. The result is a common set of community values and widespread support for directing financial, technical, and human resources to an agreed upon course of action, usually identified in a plan. The same is true for mitigation planning. An effective and open planning process helps ensure that citizens understand risks and vulnerability, and they can work with the jurisdiction to support policies, actions, and tools that over the long-term will lead to a reduction in future losses.

Leadership, staffing, and in-house knowledge in local government may fluctuate over time. Therefore, the description of the planning process serves as a permanent record that explains how decisions were reached and who involved. FEMA will accept the planning process as defined by the community, as long as the mitigation plan includes a narrative

description of the process used to develop the mitigation plan—a systematic account about how the mitigation plan evolved from the formation of a planning team, to how the public participated, to how each section of the plan was developed, to what plans or studies were incorporated into the plan, to how it will be implemented. Documentation of a current planning process is required for both new and updated plans.

ELEMENT	REQUIREMENTS
<p>A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? 44 CFR 201.6(c)(1)</p> <p><i>Intent:</i> To inform the public and other readers about the overall approach to the plan’s development and serve as a permanent record of how decisions were made and who was involved. This record also is useful for the next plan update.</p>	<p>a. Documentation of how the plan was prepared must include the schedule or timeframe and activities that made up the plan’s development as well as who was involved. Documentation typically is met with a narrative description, but may also include, for example, other documentation such as copies of meeting minutes, sign-in sheets, or newspaper articles.</p> <p><i>Document</i> means provide the factual evidence for how the jurisdictions developed the plan.</p> <p>b. The plan must list the jurisdiction(s) participating in the plan that seek approval.</p> <p>c. The plan must identify who represented each jurisdiction. The Plan must provide, at a minimum, the jurisdiction represented and the person’s position or title and agency within the jurisdiction.</p> <p>d. For each jurisdiction seeking plan approval, the plan must document how they were involved in the planning process. For example, the plan may document meetings attended, data provided, or stakeholder and public involvement activities offered. Jurisdictions that adopt the plan without documenting how they participated in the planning process will not be approved.</p> <p><i>Involved in the process</i> means engaged as participants and given the chance to provide input to affect the plan’s content. This is more than simply being invited (See “<i>opportunity to be involved in the planning process</i>” in A2 below) or only adopting the plan.</p> <p>e. Plan updates must include documentation of the current planning process undertaken to update the plan.</p>
<p>A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? 44 CFR 201.6(b)(2)</p>	<p>a. The plan must identify all stakeholders involved or given an opportunity to be involved in the planning process. At a minimum, stakeholders must include:</p> <ol style="list-style-type: none"> 1) Local and regional agencies involved in hazard mitigation activities; 2) Agencies that have the authority to regulate development; and 3) Neighboring communities. <p><i>An opportunity to be involved in the planning process</i> means that the stakeholders are engaged or invited as participants and given the chance to provide input to affect the plan’s content.</p>

Introduction: Local Mitigation Plan Review Guide, FEMA

ELEMENT	REQUIREMENTS
<p>Intent: To demonstrate a deliberative planning process that involves stakeholders with the data and expertise needed to develop the plan, with responsibility or authority to implement hazard mitigation activities, and who will be most affected by the plan's outcomes.</p>	<p>b. The Plan must provide the agency or organization represented and the person's position or title within the agency.</p> <p>c. The plan must identify how the stakeholders were invited to participate in the process.</p> <p>Examples of stakeholders include, but are not limited to:</p> <ul style="list-style-type: none"> Local and regional agencies involved in hazard mitigation include public works, zoning, emergency management, local floodplain administrators, special districts, and GIS departments. Agencies that have the authority to regulate development include planning and community development departments, building officials, planning commissions, or other elected officials. Neighboring communities include adjacent counties and municipalities, such as those that are affected by similar hazard events or may be partners in hazard mitigation and response activities. Other interests may be defined by each jurisdiction and will vary with each one. These include, but are not limited to, business, academia, and other private and non-profit interests depending on the unique characteristics of the community.
<p>A3. Does the Plan document how the public was involved in the planning process during the drafting stage? 44 CFR 201.6(b)(1) and 201.6(c)(1)</p> <p>Intent: To ensure citizens understand what the community is doing on their behalf, and to provide a chance for input on community vulnerabilities and mitigation activities that will inform the plan's content. Public involvement is also an opportunity to educate the public about hazards and risks in the community, types of activities to mitigate those risks, and how these impact them.</p>	<p>a. The plan must document how the public was given the opportunity to be involved in the planning process and how their feedback was incorporated into the plan. Examples include, but are not limited to, sign-in sheets from open meetings, interactive websites with drafts for public review and comment, questionnaires or surveys, or booths at popular community events.</p> <p>b. The opportunity for participation must occur during the plan development, which is prior to the comment period on the final plan and prior to the plan approval / adoption.</p>

The Mitigation Planning regulation includes several “optional” requirements for the vulnerability assessment. These are easily recognizable with the use of the term “should” in the requirement (See §201.6(c)(2)(ii)(A-C)). Although not required, these are strongly recommended to be included in the plan. However, their absence will not cause FEMA to disapprove the plan. These “optional” requirements were originally intended to meet the overall vulnerability assessment, and this analysis can assist with identifying mitigation actions.

ELEMENT	REQUIREMENTS
<p>B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction? 44 CFR 201.6(c)(2)(i) and 44 CFR 201.6(c)(2)(iii)</p> <p>Intent: To understand the potential and chronic hazards affecting the planning area in order to identify which hazard risks are most significant and which jurisdictions or locations are most adversely affected.</p>	<p>a. The plan must include a description of the natural hazards that can affect the jurisdiction(s) in the planning area.</p> <p><i>A natural hazard is a source of harm or difficulty created by a meteorological, environmental, or geological event³. The plan must address natural hazards. Manmade or human-caused hazards may be included in the document, but these are not required and will not be reviewed to meet the requirements for natural hazards. In addition, FEMA will not require the removal of this extra information prior to plan approval.</i></p> <p>b. The plan must provide the rationale for the omission of any natural hazards that are commonly recognized to affect the jurisdiction(s) in the planning area.</p> <p>c. The description, or profile, must include information on location, extent, previous occurrences, and future probability for each hazard. Previous occurrences and future probability are addressed in sub-element B2.</p> <p>The information does not necessarily need to be described or presented separately for location, extent, previous occurrences, and future probability. For example, for some hazards, one map with explanatory text could provide information on location, extent, and future probability.</p> <p>Location means the geographic areas in the planning area that are affected by the hazard. For many hazards, maps are the best way to illustrate location. However, location may be described in other formats. For example, if a geographically-specific location cannot be identified for a hazard, such as tornados, the plan may state that the entire planning area is equally at risk to that hazard.</p> <p>Extent means the strength or magnitude of the hazard. For example, extent could be described in terms of the specific measurement of an occurrence on a scientific scale (for example, Enhanced Fujita Scale, Saffir-Simpson Hurricane Scale, Richter Scale, flood depth grids) and/or other hazard factors, such as duration and speed of onset. Extent is not the same as impacts, which are described in sub-element B3.</p>

³ DHS Risk Lexicon, 2010 Edition. <http://www.dhs.gov/xlibrary/assets/dhs-risk-lexicon-2010.pdf>

Introduction: Local Mitigation Plan Review Guide, FEMA

ELEMENT	REQUIREMENTS
	<p>d. For participating jurisdictions in a multi-jurisdictional plan, the plan must describe any hazards that are unique and/or varied from those affecting the overall planning area.</p>
<p>B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? 44 CFR 201.6(c)(2)(i)</p> <p><i>Intent:</i> To understand potential impacts to the community based on information on the hazard events that have occurred in the past and the likelihood they will occur in the future.</p>	<p>a. The plan must include the history of previous hazard events for each of the identified hazards.</p> <p>b. The plan must include the probability of future events for each identified hazard.</p> <p><i>Probability</i> means the likelihood of the hazard occurring and may be defined in terms of general descriptors (for example, unlikely, likely, highly likely), historical frequencies, statistical probabilities (for example: 1% chance of occurrence in any given year), and/or hazard probability maps. If general descriptors are used, then they must be defined in the plan. For example, “highly likely” could be defined as equals near 100% chance of occurrence next year or happens every year.</p> <p>c. Plan updates must include hazard events that have occurred since the last plan was developed.</p>
<p>B3. Is there a description of each identified hazard’s impact on the community as well as an overall summary of the community’s vulnerability for each jurisdiction? 44 CFR 201.6(c)(2)(ii)</p> <p><i>Intent:</i> For each jurisdiction to consider their community as a whole and analyze the potential impacts of future hazard events and the vulnerabilities that could be reduced through hazard mitigation actions.</p>	<p>a. For each participating jurisdiction, the plan must describe the potential impacts of each of the identified hazards on the community.</p> <p><i>Impact</i> means the consequence or effect of the hazard on the community and its assets. Assets are determined by the community and include, for example, people, structures, facilities, systems, capabilities, and/or activities that have value to the community. For example, impacts could be described by referencing historical disaster impacts and/or an estimate of potential future losses (such as percent damage of total exposure).</p> <p>b. The plan must provide an overall summary of each jurisdiction’s vulnerability to the identified hazards. The overall summary of vulnerability identifies structures, systems, populations or other community assets as defined by the community that are susceptible to damage and loss from hazard events. A plan will meet this sub-element by addressing the requirements described in §201.6(c)(2)(ii)(A-C).</p> <p>Vulnerable assets and potential losses is more than a list of the total exposure of population, structures, and critical facilities in the planning area. An example of an overall summary is a list of key issues or problem statements that clearly describes the community’s greatest vulnerabilities and that will be addressed in the mitigation strategy.</p>

ELEMENT	REQUIREMENTS
<p>B4. Does the Plan address NFIP insured structures within each jurisdiction that have been repetitively damaged by floods? 44 CFR 201.6(c)(2)(ii)</p> <p><i>Intent:</i> To inform hazard mitigation actions for properties that have suffered repetitive damage due to flooding, particularly problem areas that may not be apparent on floodplain maps. Information on repetitive loss properties helps inform FEMA hazard mitigation assistance programs under the National Flood Insurance Act.</p>	<p>a. The plan must describe the types (residential, commercial, institutional, etc.) and estimate the numbers of repetitive loss properties located in identified flood hazard areas.</p> <p><i>Repetitive loss properties</i> are those for which two or more losses of at least \$1,000 each have been paid under the National Flood Insurance Program (NFIP) within any 10-year period since 1978.</p> <p><i>Severe repetitive loss properties</i> are residential properties that have at least four NFIP payments over \$5,000 each and the cumulative amount of such claims exceeds \$20,000, or at least two separate claims payments with the cumulative amount exceeding the market value of the building.</p> <p>Use of flood insurance claim and disaster assistance information is subject to The Privacy Act of 1974, as amended, which prohibits public release of the names of policy holders or recipients of financial assistance and the amount of the claim payment or assistance. However, maps showing general areas where claims have been paid can be made public. If a plan includes the names of policy holders or recipients of financial assistance and the amount of the claim payment or assistance, the plan cannot be approved until this Privacy Act covered information is removed from the plan.</p>

Introduction: Local Mitigation Plan Review Guide, FEMA

4.3 ELEMENT C. MITIGATION STRATEGY

Requirement §201.6(c)(3)	[The plan shall include the following:] A <i>mitigation strategy</i> that provides the jurisdiction’s blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs, and resources, and its ability to expand on and improve these existing tools.
§201.6(c)(3)(i)	[The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.
§201.6(c)(3)(ii)	[The hazard mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. All plans approved by FEMA after October 1, 2008, must also address the jurisdiction’s participation in the NFIP, and continued compliance with NFIP requirements, as appropriate.
§201.6(c)(3)(iii)	[The hazard mitigation strategy shall include an] action plan, describing how the action identified in paragraph (c)(3)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.
§201.6(c)(3)(iv)	For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.
§201.6(c)(4)(ii)	[The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvements, when appropriate.

Overall Intent. The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The Stafford Act directs Local Mitigation Plans to describe hazard mitigation actions and establish a strategy to implement those actions.⁴ Therefore, all other requirements for a Local Mitigation Plan lead to and support the mitigation strategy.

⁴ Section 322(b), Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended, 42 U.S.C. 5165.

The mitigation strategy includes the development of goals and prioritized hazard mitigation actions. Goals are long-term policy statements and global visions that support the mitigation strategy. A critical step in the development of specific hazard mitigation actions and projects is assessing the community’s existing authorities, policies, programs, and resources and its capability to use or modify local tools to reduce losses and vulnerability from profiled hazards.

In the plan update, goals and actions are either reaffirmed or updated based on current conditions, including the completion of hazard mitigation initiatives, an updated or new risk assessment, or changes in State or local priorities.

ELEMENT	REQUIREMENTS
<p>C1. Does the plan document each jurisdiction’s existing authorities, policies, programs and resources, and its ability to expand on and improve these existing policies and programs? 44 CFR 201.6(c)(3)</p> <p><i>Intent:</i> To ensure that each jurisdiction evaluates its capabilities to accomplish hazard mitigation actions, through existing mechanisms. This is especially useful for multi-jurisdictional plans where local capability varies widely.</p>	<p>a. The plan must describe each jurisdiction’s existing authorities, policies, programs and resources available to accomplish hazard mitigation.</p> <p>Examples include, but are not limited to: staff involved in local planning activities, public works, and emergency management; funding through taxing authority, and annual budgets; or regulatory authorities for comprehensive planning, building codes, and ordinances.</p>
<p>C2. Does the Plan address each jurisdiction’s participation in the NFIP and continued compliance with NFIP requirements, as appropriate? 44 CFR 201.6(c)(3)(ii)</p> <p><i>Intent:</i> To demonstrate flood hazard mitigation efforts by the community through NFIP activities. Where FEMA is the official administering Federal agency of the NFIP, participation in the program is a basic community capability and resource for flood hazard mitigation activities.</p>	<p>a. The plan must describe each jurisdiction’s participation in the NFIP and describe their floodplain management program for continued compliance. Simply stating “The community will continue to comply with NFIP,” will <u>not</u> meet this requirement. The description could include, but is not limited to:</p> <ul style="list-style-type: none"> • Adoption and enforcement of floodplain management requirements, including regulating new construction in Special Flood Hazard Areas (SFHAs); • Floodplain identification and mapping, including any local requests for map updates; or • Description of community assistance and monitoring activities. <p>Jurisdictions that are currently not participating in the NFIP and where an FHBM or FIRM has been issued may meet this requirement by describing the reasons why the community does not participate.</p>

Introduction: Local Mitigation Plan Review Guide, FEMA

ELEMENT	REQUIREMENTS
<p>C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? 44 CFR 201.6(c)(3)(i)</p> <p><i>Intent: To guide the development and implementation of hazard mitigation actions for the community(ies). Goals are statements of the community's visions for the future.</i></p>	<p>a. The plan must include general hazard mitigation goals that represent what the jurisdiction(s) seeks to accomplish through mitigation plan implementation.</p> <p><i>Goals are broad policy statements that explain what is to be achieved.</i></p> <p>b. The goals must be consistent with the hazards identified in the plan.</p>
<p>C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? 44 CFR 201.6(c)(3)(ii) and 44 CFR 201.6(c)(3)(iv)</p> <p><i>Intent: To ensure the hazard mitigation actions are based on the identified hazard vulnerabilities, are within the capability of each jurisdiction, and reduce or avoid future losses. This is the heart of the mitigation plan, and is essential to leading communities to reduce their risk. Communities, not FEMA, "own" the hazard mitigation actions in the strategy.</i></p>	<p>a. The plan must include a mitigation strategy that 1) analyzes actions and/or projects that the jurisdiction considered to reduce the impacts of hazards identified in the risk assessment, and 2) identifies the actions and/or projects that the jurisdiction intends to implement.</p> <p><i>Mitigation actions and projects means a hazard mitigation action, activity or process (for example, adopting a building code) or it can be a physical project (for example, elevating structures or retrofitting critical infrastructure) designed to reduce or eliminate the long term risks from hazards. This sub-element can be met with either actions or projects, or a combination of actions and projects.</i></p> <p>The mitigation plan may include non-mitigation actions, such as actions that are emergency response or operational preparedness in nature. These will not be accepted as hazard mitigation actions, but neither will FEMA require these to be removed from the plan prior to approval.</p> <p>A comprehensive range consists of different hazard mitigation alternatives that address the vulnerabilities to the hazards that the jurisdiction(s) determine are most important.</p> <p>b. Each jurisdiction participating in the plan must have mitigation actions specific to that jurisdiction that are based on the community's risk and vulnerabilities, as well as community priorities.</p> <p>c. The action plan must reduce risk to existing buildings and infrastructure as well as limit any risk to new development and redevelopment. With emphasis on new and existing building and infrastructure means that the action plan includes a consideration of actions that address the built environment.</p>

ELEMENT	REQUIREMENTS
<p>C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? 44 CFR 201.6(c)(3)(iii) and 44 CFR (c)(3)(iv)</p> <p><i>Intent: To identify how the plan will directly lead to implementation of the hazard mitigation actions. As opportunities arise for actions or projects to be implemented, the responsible entity will be able to take action towards completion of the activities.</i></p>	<p>a. The plan must describe the criteria used for prioritizing implementation of the actions.</p> <p>b. The plan must demonstrate when prioritizing hazard mitigation actions that the local jurisdictions considered the benefits that would result from the hazard mitigation actions versus the cost of those actions. The requirement is met as long as the economic considerations are summarized in the plan as part of the community's analysis. A complete benefit-cost analysis is not required. Qualitative benefits (for example, quality of life, natural and beneficial values, or other "benefits") can also be included in how actions will be prioritized.</p> <p>c. The plan must identify the position, office, department, or agency responsible for implementing and administering the action (for each jurisdiction), and identify potential funding sources and expected timeframes for completion.</p>
<p>C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? 44 CFR 201.6(c)(4)(ii)</p> <p><i>Intent: To assist communities in capitalizing on all available mechanisms that they have at their disposal to accomplish hazard mitigation and reduce risk.</i></p>	<p>a. The plan must describe the community's process to integrate the data, information, and hazard mitigation goals and actions into other planning mechanisms.</p> <p>b. The plan must identify the local planning mechanisms where hazard mitigation information and/or actions may be incorporated.</p> <p><i>Planning mechanisms means governance structures that are used to manage local land use development and community decision-making, such as comprehensive plans, capital improvement plans, or other long-range plans.</i></p> <p>c. A multi-jurisdictional plan must describe each participating jurisdiction's individual process for integrating hazard mitigation actions applicable to their community into other planning mechanisms.</p> <p>d. The updated plan must explain how the jurisdiction(s) incorporated the mitigation plan, when appropriate, into other planning mechanisms as a demonstration of progress in local hazard mitigation efforts.</p> <p>e. The updated plan must continue to describe how the mitigation strategy, including the goals and hazard mitigation actions will be incorporated into other planning mechanisms.</p>

Introduction: Local Mitigation Plan Review Guide, FEMA

Requirement §201.6(d)(3) A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit if for approval within 5 years in order to continue to be eligible for mitigation project grant funding.

Overall Intent. In order to continue to be an effective representation of the jurisdiction’s overall strategy for reducing its risks from natural hazards, the mitigation plan must reflect current conditions. This will require an assessment of the current development patterns and development pressures as well as an evaluation of any new hazard or risk information. The plan update is an opportunity for the jurisdiction to assess its previous goals and action plan, evaluate progress in implementing hazard mitigation actions, and adjust its actions to address the current realities.

Where conditions of growth and revisions in priorities may have changed very little in a community, much of the text in the updated plan may be unchanged. This is acceptable as long as it still fits the priorities of their community, and it reflects current conditions. The key for plan readers to recognize a good plan update is documentation of the community’s progress or changes in their hazard mitigation program, along with the community’s continued engagement in the mitigation planning process.

ELEMENT	REQUIREMENTS
<p>D1. Was the plan revised to reflect changes in development? 44 CFR 201.6(d)(3)</p> <p><i>Intent: To ensure that the mitigation strategy continues to address the risk and vulnerabilities to existing and potential development, and takes into consideration possible future conditions that can impact the vulnerability of the community.</i></p>	<p>a. The plan must describe changes in development that have occurred in hazard prone areas and increased or decreased the vulnerability of each jurisdiction since the last plan was approved. If no changes in development impacted the jurisdiction’s overall vulnerability, plan updates may validate the information in the previously approved plan.</p> <p>Changes in development means recent development (<i>for example</i>, construction completed since the last plan was approved), potential development (<i>for example</i>, development planned or under consideration by the jurisdiction), or conditions that may affect the risks and vulnerabilities of the jurisdictions (<i>for example</i>, climate variability, declining populations or projected increases in population, or foreclosures). Not all development will affect a jurisdiction’s vulnerability.</p>

ELEMENT	REQUIREMENTS
<p>D2. Was the plan revised to reflect progress in local mitigation efforts? 44 CFR 201.6(d)(3)</p> <p><i>Intent: To evaluate and demonstrate progress made in the past five years in achieving goals and implementing actions outlined in their mitigation strategy.</i></p>	<p>a. The plan must describe the status of hazard mitigation actions in the previous plan by identifying those that have been completed or not completed. For actions that have not been completed, the plan must either describe whether the action is no longer relevant or be included as part of the updated action plan.</p>
<p>D3. Was the plan revised to reflect changes in priorities? 44 CFR 201.6(d)(3)</p> <p><i>Intent: To ensure the plan reflects current conditions, including financial, legal, and political realities as well as post-disaster conditions.</i></p>	<p>a. The plan must describe if and how any priorities changed since the plan was previously approved.</p> <p>If no changes in priorities are necessary, plan updates may validate the information in the previously approved plan.</p>

Introduction: Local Mitigation Plan Review Guide, FEMA

4.5 ELEMENT E. PLAN ADOPTION

Requirement §201.6(c)(5) [The plan shall include...] Documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County commissioner, Tribal Council). For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

Overall Intent. Adoption by the local governing body demonstrates the jurisdiction’s commitment to fulfilling the hazard mitigation goals and actions outlined in the plan. Adoption legitimizes the plan and authorizes responsible agencies to execute their responsibilities. Updated plans also are adopted anew to demonstrate community recognition of the current planning process, changes that have occurred within the previous five years, and validate community priorities for hazard mitigation actions.

ELEMENT	REQUIREMENTS
<p>E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? 44 CFR 201.6(c)(5)</p> <p><i>Intent:</i> To demonstrate the jurisdiction’s commitment to fulfilling the hazard mitigation goals outlined in the plan, and to authorize responsible agencies to execute their responsibilities.</p>	<p>a. Each jurisdiction that is included in the plan must have its governing body adopt the plan prior to FEMA approval, even when a regional agency has the authority to prepare such plans.</p> <p>As with single jurisdictional plans, in order for FEMA to give approval to a multi-jurisdictional plan, at least one participating jurisdiction must formally adopt the plan within one calendar year of FEMA’s designation of the plan as “Approvable Pending Adoption.” See Section 5, <i>Plan Review Procedure</i> for more information on “Approvable Pending Adoption.”</p>

ELEMENT	REQUIREMENTS
<p>E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? 44 CFR 201.6(c)(5)</p> <p><i>Intent:</i> To demonstrate the jurisdiction’s commitment to fulfilling the hazard mitigation goals outlined in the plan, and to authorize responsible agencies to execute their responsibilities.</p>	<p>a. The plan must include documentation of plan adoption, usually a resolution by the governing body or other authority.</p> <p>If the local jurisdiction has not passed a formal resolution, or used some other documentation of adoption, the clerk or city attorney must provide written confirmation that the action meets their community’s legal requirements for official adoption and/or the highest elected official or their designee must submit written proof of the adoption. The signature of one of these officials is required with the explanation or other proof of adoption.</p> <p>Minutes of a council or other meeting during which the plan is adopted will be sufficient if local law allows meeting records to be submitted as documentation of adoption. The clerk of the governing body, or city attorney, must provide a copy of the law and a brief, written explanation such as, “in accordance with section ___ of the city code/ordinance, this constitutes formal adoption of the measure,” with an official signature.</p> <p>If adopted after FEMA review, adoption must take place within one calendar year of receipt of FEMA’s “Approval Pending Adoption.” See Section 5, <i>Plan Review Procedure</i> for more information on “Approvable Pending Adoption.”</p>

Chapter 1: Planning Team Meeting Attendance

Sign in Aug 2, 2016

Rodney Collins - Town Mgr.
 John Phelan - Deputy Fire Chief
 Michael Mendoza - BLDG Commissioner
 ✓ Glen Harrington - Board of Health
 ✓ Jean Richards - Recording Sec'y
 CATHERINE LAURENT - DPW DIRECTOR
 Scott Carline - Chief of Police
 TOM FUDALA - TOWN PLANNER

October 4, 2016 → Mashpee Hazard Planning Meeting #2

Thomas C. Rullo - Fire Chief (+EMD)
 Michael Mendoza - BLDG Commissioner
 Glen E. Harrington - Health Agent Bldg
 TOM FUDALA - PLANNING
 Dan McManus - Conservation Dept

Chloe Schaefer

From: Jean Giliberti <jeangiliberti@comcast.net>
Sent: Thursday, April 20, 2017 3:40 PM
To: Chloe Schaefer
Cc: Mendoza, Michael; Jean Giliberti
Subject: List of Meeting Attendees Request by Chloe Schaefer

Thurs - April 20, 2017

TO: CHLOE SCHAEFER, COMMUNITY DESIGN PLANNER

cc: Michael Mendoza

Chloe, at yesterday's meeting with Plan Review Committee you asked for a list of Plan Review attendees who attended past Hazard Mitigation planning meetings. The 2016 meetings were with Cally Harper and you, of course, attended April 18, 2017.

Below are the formal meetings. In addition, supposedly there was perhaps going to be an informal meeting in November, 2016--I don't know whether that was ever scheduled or not. I only have the formal meetings recorded.

8/2/2016 Meeting

Michael Mendoza, Building Commissioner
 Tom Fudala, Town Planner
 Glen Harrington, Health Agent
 Rodney Collins, Town Manager
 John Phelan, Deputy Fire Chief
 Catherine Laurent, DPW Director
 Scott Carline, Police Chief

10/4/2016

Michael Mendoza, Building Commissioner
 Tom Fudala, Town Planner
 Andrew McManus, Conservation Agent
 Glen Harrington, Health Agent
 Thomas Rullo, Fire Chief

11/1/2016

Michael Mendoza, Building Commissioner
 Wayne Taylor, Assistant Town Manager
 Tom Fudala, Town Planner
 Andrew McManus, Conservation Agent
 Glen Harrington, Health Agent
 Thomas Rullo, Fire Chief
 Catherine Laurent, DPW Director

4/18/2017

Michael Mendoza, Building Commissioner
 Andrew McManus, Conservation Agent
 John Phelan, Deputy Fire Chief
 Catherine Laurent, DPW Director
 Scott Carline, Police Chief
 Glen Harrington, Health Agent

Jean Giliberti
 Plan Review Recording Secretary
jeangiliberti@comcast.net

Public Survey for the Mashpee Hazard Mitigation Plan

Mashpee Hazard Plan

The Town of Mashpee, along with the Cape Cod Commission and other partners, are working to update the Mashpee Hazard Mitigation Plan. The Plan will identify and assess our community's natural hazard risks and determine how to best minimize and manage those risks.


Please take this survey – it is an opportunity for you to share your opinions and participate in the hazard planning process. The information you provide will help us better understand your hazard concerns and can lead to mitigation activities that could lessen the impacts of future hazard events. The survey is only **9 questions** and it will take just a few minutes to complete. Thank you so much for participating!

If you have any questions regarding this survey, please contact Wayne Taylor at wtaylor@marshpeema.gov or Chloe Schaefer at chloe.schaefer@capecodcommission.org.

To begin, click the "NEXT" button at the bottom of the screen. Questions labeled with an * are required.

Next

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Chapter 1: Public Survey

* 1. Have you experienced a weather-related event or disaster while living, working or visiting Mashpee?

- Yes
 No

* 2. Which of the following events have you experienced while in Mashpee? You can select more than 1 answer. The hazard types listed below were taken directly from the State Hazard Plan for the Commonwealth of Massachusetts drafted in 2013.

- Coastal Erosion and Shoreline Change
 Dam Failure
 Drought
 Earthquake
 Fire (structural or wildfires)
 Floods
 Hurricanes and Tropical Storms
 Landslides
 Nor'easter
 High Wind
 Lightning/Thunderstorms
 Tornado
 Extreme Cold or Heat
 Winter Storms (snow storms, blizzards, ice storms)
 Tsunami
 Sea Level Rise
 Other (please specify)

Chapter 1: Public Survey

*** 3. In your opinion, which of the following hazard events are you most concerned about? Choose up to 3 answers.**

- Coastal Erosion and Shoreline Change
- Dam Failure
- Drought
- Earthquake
- Fire (Urban and Wildfire)
- Floods
- Hurricanes and Tropical Storms
- Landslides
- Nor'easter
- High Wind
- Lightning/Thunderstorms
- Tornado
- Extreme Cold or Heat
- Winter Storms (snow storms, blizzards, ice storms)
- Tsunami
- Sea Level Rise
- Other (please specify)

*** 4. How concerned are you about the possibility of a natural disaster impacting Mashpee?**

- Extremely Concerned
- Somewhat Concerned
- Not Concerned

Chapter 1: Public Survey

*** 5. Which of the following actions have you taken to be more hazard resistant? Answer yes or no to the following activities:**

	Yes	No
Signed up for an Emergency Notification System hosted by Barnstable County	<input type="radio"/>	<input type="radio"/>
Purchased flood insurance	<input type="radio"/>	<input type="radio"/>
Participated in educational activities and trainings about hazard and emergency preparedness	<input type="radio"/>	<input type="radio"/>
Obtained information pamphlets about natural hazards at Town Hall	<input type="radio"/>	<input type="radio"/>
Removed debris and hazardous materials from my property	<input type="radio"/>	<input type="radio"/>
Pruned trees on or near my property	<input type="radio"/>	<input type="radio"/>
Obtained an emergency response kit	<input type="radio"/>	<input type="radio"/>

Other (please specify)

*** 6. What is the most effective way to engage you in hazard planning and emergency preparedness activities? You can select more than 1 answer.**

- Local newspaper (Cape Cod Times and Mashpee Enterprise)
- Public Television
- Radio Advertising
- Internet (Town website and Facebook)
- Email
- Mail
- Public workshops and/or meetings
- Other (please specify)

Chapter 1: Public Survey

*** 7. What steps can your local government take to reduce risk from natural hazards and protect the buildings and people of Mashpee? Please select more than 1 answer.**

- Improve the alert/warning/notification systems
- Develop climate change adaptation plans and implement them
- Continue to improve regional shelters
- Remove debris and hazardous materials as well as prune trees on town property
- Improve drainage on area roads
- Educate the public on evacuation methods
- Apply for funding to reduce Mashpee's risk to natural hazards
- Perform detailed risk assessments
- Work to reduce flood insurance for residents through the Community Rating System
- Educate the public on the science of natural hazards and emergency preparedness
- Improve the communication system during hazard events (i.e. radio towers, cellular services)
- Continue to work with regional partners to prepare for and recover from natural disasters
- Improve water control structures (i.e. culverts)
- Assess the vulnerability of low lying critical roads to flooding

Other (please specify)

*** 8. Please tell us about yourself. Select all that apply to you.**

- Year-round resident
- Part-time resident
- I own a home in Mashpee
- I rent a home in Mashpee
- I am not a resident of Mashpee, but I am employed in Mashpee
- I am a business owner in Mashpee

Other (please specify)

9. If you are interested in the hazard planning process, please provide your name, email and/or alternate contact information.

Name

Email

Alternate Contact
Information

Chapter 1: Public Survey Notices: Mashpee Town Website

The screenshot displays the official website of the Town of Mashpee, Massachusetts. The header features the town's name and logo, a search bar, and a home icon. A navigation menu includes links for 'Discover Mashpee', 'Departments', 'Boards & Committees', 'Open for Business', and 'Visitors', along with a 'FIND IT FAST' button. The main content area is titled 'Public Survey for the Mashpee Hazard Mitigation Plan' and includes the following text:

Home

Public Survey for the Mashpee Hazard Mitigation Plan

POSTED ON: JANUARY 13, 2017 - 10:20AM

The Town of Mashpee, along with the Cape Cod Commission and other partners, are working to update the Mashpee Hazard Mitigation Plan. The Plan will identify and assess our community's natural hazard risks and determine how to best minimize and manage those risks.

Please take this survey – it is an opportunity for you to share your opinions and participate in the hazard planning process. The information you provide will help us better understand your hazard concerns and can lead to mitigation activities that could lessen the impacts of future hazard events. The survey is only 9 questions and it will take just a few minutes to complete. Thank you so much for participating!

If you have any questions regarding this survey, please contact Wayne Taylor at wtaylor@mashpeema.gov or Cally Harper at cally.harper@capecodcommission.org
Please access the Survey Here

The footer contains the Seal of the Town of Mashpee, contact information for the Town of Mashpee Massachusetts (16 Great Neck Road North, Mashpee, MA 02649 | (508) 539-1400), a 'Login' link, a 'Select Language' dropdown menu, and a 'Translate' button.

Chapter 1: Public Survey Notices: Mashpee Town Website

The screenshot shows the official website of the Town of Mashpee, Massachusetts. The header features the town's name and logo, a search bar, and a home icon. A navigation menu includes links for 'Discover Mashpee', 'Departments', 'Boards & Committoes', 'Open for Business', and 'Visitors', along with a 'FIND IT FAST' button. The main content area displays a 'Home' link and a large heading for the 'Public Survey for the Mashpee Hazard Mitigation Plan', dated March 10, 2017. The text explains that the survey is open through April 3, 2017, and provides details about the survey's purpose and contact information for Wayne Taylor and Cally Harper. The footer contains the town's seal, address (16 Great Neck Road North, Mashpee, MA 02649), phone number (508) 539-1400, and links for 'Website Disclaimer', 'Virtual Towns & Schools Website', and 'Login'. There is also a 'Select Language' dropdown menu and a 'Translate' button.

Chapter 1: Public Survey Notices: Cape Cod Commission Website

The screenshot shows the Cape Cod Commission website with a navigation bar at the top containing links for About CCC, Departments, Calendar, Quick Links, Regional Plans, Resource Center, and Initiatives. The main content area features the Cape Cod Commission logo and three large circular graphics: '208 WATER QUALITY PLAN', 'REGIONAL POLICY PLAN', and 'INITIATIVES'. Below this is a section titled 'Keeping a Special Place Special' with a 'Text - | Text +' toggle. The 'QUICK LINKS' section includes: Section 208 Plan, Regional Policy Plan Update, BART, Public Records Access, DRI Project Files, and STATScapcod Data Site. The 'Announcements' section contains two items: 'PUBLIC INVOLVEMENT: Planning for the Future Transportation Needs of Cape Cod' and 'Mashpee Hazard Mitigation Plan Survey closes April 3'. The 'Mashpee Hazard Mitigation Plan Survey closes April 3' article text reads: 'The opportunity for Mashpee residents to provide input during the drafting of the 2017 Hazard Mitigation Plan update is coming to a close. The Town of...'. Below the article is a large image of a rocky coastline. The footer includes the County of Barnstable logo, navigation links (home, site search, contact), a language selector, a Table VI and Nondiscrimination Statement link, and contact information for the Cape Cod Commission: P.O. Box 226 - 3225 Main Street - Barnstable, MA 02630 - p: (508) 362-3828 - f: (508) 362-3136 - frontdesk@ccc.com. Copyright information for 1990-2015 Cape Cod Commission and Blue LAN Group's KNOWare™ CMS is also present.

Mashpee Hazard Mitigation Plan Survey closes April 3

The opportunity for Mashpee residents to provide input during the drafting of the 2017 Hazard Mitigation Plan update is coming to a close.

The Town of Mashpee is updating its previous plan with the assistance of the Cape Cod Commission. The Commission is facilitating the process, data collection and drafting of the plan update.

Hazard mitigation plans identify critical town infrastructure, vulnerabilities to natural hazards and actions for the town to take to protect facilities and residents. Approved plans also help maintain eligibility for state and federal pre- and post-disaster funding.

The survey is aimed at collecting information from residents about hazards they have experienced, their top concerns and actions they've taken to prepare. The information will inform the town's consideration of specific hazard types and possible mitigation for inclusion in the plan.

A draft plan is expected to be presented to the Mashpee Board of Selectmen around June 1. It needs to be submitted to the Massachusetts Emergency Management Agency prior to June 30

Log on and take the nine-question survey at capecodcommission.org/mashpeesurvey. It will remain open through April 3.

Item Last Updated **March 15, 2017**

Chapter 1: Public Survey Notices: Mashpee Police Department Facebook Page

facebook [Sign Up](#) [Log In](#)
[Forgot account?](#)

MASHPEE POLICE
 CAPE COD
 MASSACHUSETTS

Mashpee Police Department
 @mashpeepd

Home
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Mashpee Police Department
 2 mins · 🌐

Take the Public Survey for the Mashpee Hazard Mitigation Plan! The Town of Mashpee, along with the Cape Cod Commission and other partners, are working to update the Mashpee Hazard Mitigation Plan. The Plan will identify and assess our community's natural hazard risks and determine how to best minimize and manage those risks. The survey is an opportunity for you to share your opinions and participate in the hazard planning process. It is only 9 questions and it will take just a few minutes to complete. The survey will remain open through April 3 2017.
<https://www.surveymonkey.com/r/Mashpeehazardplan>

👍 Like 💬 Comment

Mashpee Police Department shared Massachusetts State Police's post.
 18 hrs · 🌐

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Chapter 1: Public Survey Notices: Local News Outlets

NEWS LIFESTYLE ENTERTAINMENT EVENTS PHOTOS CAPE WIDE NEWS ABOUT THE CAPE

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Mashpee Residents Encouraged to Provide Opinion for Hazard Mitigation Plan Drafting

March 14, 2017

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More

MASHPEE – The opportunity for Mashpee residents to provide input during the drafting of the 2017 Hazard Mitigation Plan is coming to a close.

The Town of Mashpee is working on an update to the previous plan with the Cape Cod Commission.

The Commission is accepting public comments regarding town infrastructure and vulnerable resources.

A 9-question survey aimed at identifying that information is available at capecodcommission.org/mashpeesurvey and will remain open until April 3rd.

The town is expected to submit their latest draft to the Massachusetts Emergency Management Agency in June.



CAPECOD.COM POLL

As we head toward spring, what are you looking forward to most? *

- More Daylight
- Something Else
- My Favorite Restaurants Re-Opening
- Getting Outdoors More
- Warmer Weather

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Chapter 1: Public Survey Notices: Local News Outlets



Mashpee Hazard Mitigation Survey Closing April 3

posted by Walt Perkins - 6 days ago

share



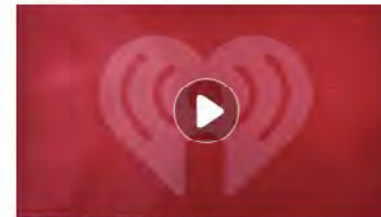
Residents of Mashpee have until April 3 to provide input into the drafting of the Hazard Mitigation Plan which identifies critical town infrastructure, vulnerabilities to natural hazards, and actions the town will take to protect residents and facilities.

Mashpee is updating its plan with the help of the Cape Cod Commission. Approved plans help maintain eligibility for state and federal pre-and post-disaster funding.

A draft plan is expected to be presented to the Mashpee Board of Selectmen around June 1 and must then be submitted to MEMA, the Massachusetts Emergency Management Agency, prior to June 30.

Mashpee residents can provide input by answering a nine question survey at capecodcommission.org/mashpeesurvey through April 3.

#ThisWeekinHistory




The Week of March 13th in history

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Chapter 1: Public Survey Notices: Local News Outlets

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Hazard Mitigation Plan Survey Closes April 3

Mar 17, 2017 0

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[f](#) [t](#) [e](#) [p](#) [h](#)

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A draft plan is expected to be presented to the Mashpee Board of Selectmen around June 1. It needs to be submitted to the Massachusetts Emergency Management Agency prior to June 30.

Residents are encouraged take the nine-question survey at capecodcommission.org/mashpeesurvey; it will remain open through April 3.

Letters, Editorials, Guest Commentaries

- [Taking The Woody Allen Approach - Editorial](#)
- [An Ounce Of Prevention](#)
- [Lessons From Tragedy For Tomorrow's Mariners - Editorial](#)
- [Cape Tech Benefits Students - Letter](#)
- [Where Would Prohibition Stop? - Guest Commentary](#)
- [The Free Press: A Friend, Not An Enemy - Editorial](#)
- [Don't Play Politics With Water - Letter](#)
- [Cape Tech Is Worth Mashpee's Investment - Letter](#)
- [Presidents Day Meditation-Letter](#)
- [Getting Here From There - Editorial](#)

Mashpee Police & Fire News

- [Federal Judge Sentences Mashpee Trafficker To Prison](#)
- [Kitchen Fire Damages Mashpee Home](#)

Chapter 1: Public Survey Notices: Local News Outlets

March 20, 2017 11:14 AM ● 41°F Fair
CapeCodTravel.com WeddingsonCapeCod.com

capecodtoday

cape cod community news

BarnstableBourneBrewsterChathamDennisEasthamFalmouthHarwichHyannis
MashpeeOrleansPlymouthProvincetownSandwichTruroWarehamWellfleetYarmouth

HOME NEWS POLICE & FIRE POLITICS CALENDAR COMMUNITY THINGS TO DO MARKETPLACE

Mashpee Hazard Mitigation Plan Survey Closes April 3rd

CC Commission seeks input from Mashpee residents...

ARTICLE | **NEWS** | MARCH 13, 2017 01:14 PM | BY CAPECODTODAY STAFF

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Alarm New England

Jason's Tavern

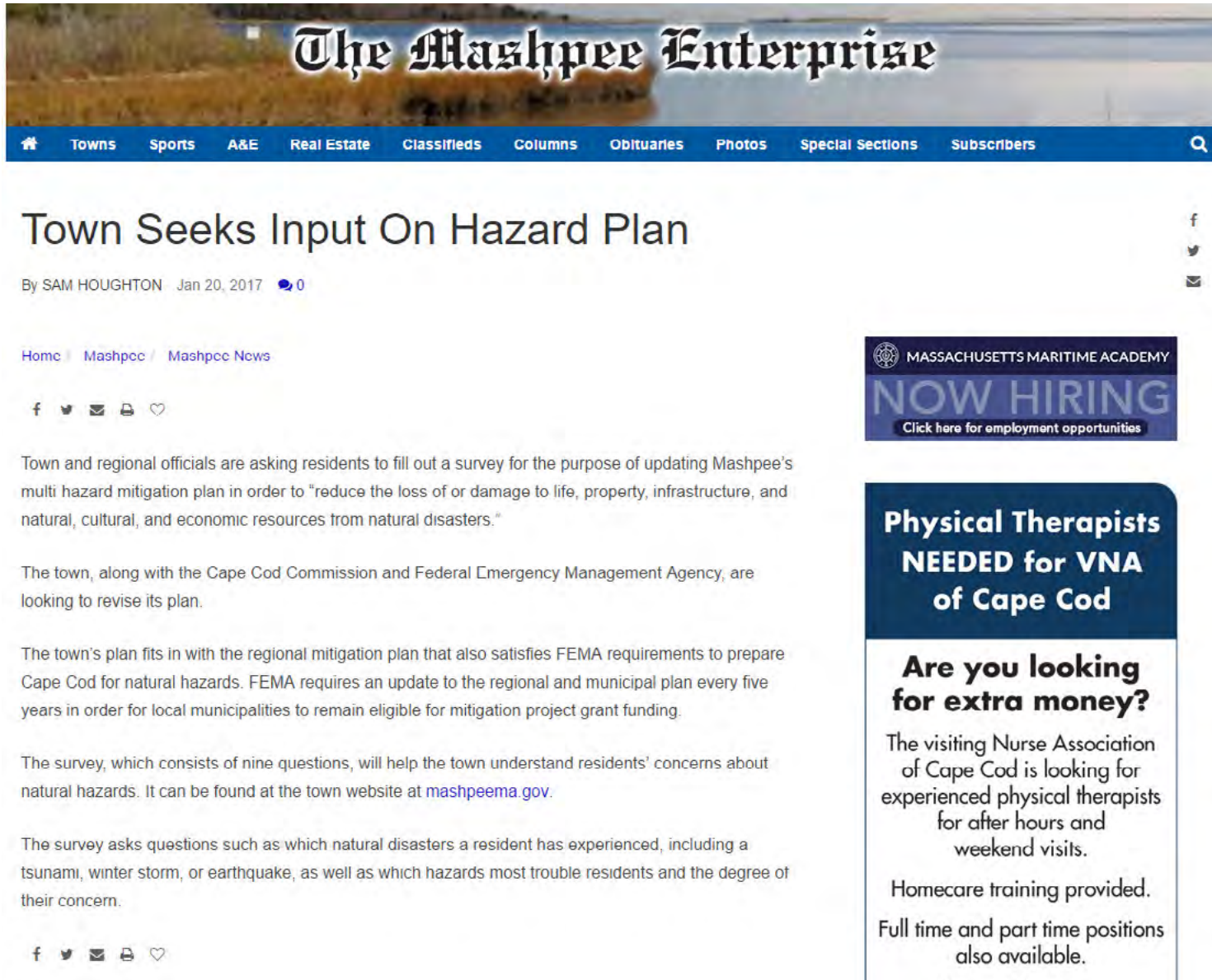
Poll

How do you read books?

Hard copy	58% (32 votes)
On an e-reader (Kindle, Nook..etc.)	7% (4 votes)
On my tablet	5% (3 votes)
On my laptop or desktop	4% (2 votes)
I don't read books	25% (14 votes)
Total votes: 55	

[Past Polls](#) | [Results](#)

Chapter 1: Public Survey Notices: Local News Outlets



The screenshot shows a news article on the website 'The Mashpee Enterprise'. The article title is 'Town Seeks Input On Hazard Plan' by SAM HOUGHTON, dated Jan 20, 2017. The article text discusses a survey for updating the town's multi-hazard mitigation plan. There are two advertisements on the right side of the page: one for the Massachusetts Maritime Academy 'NOW HIRING' and another for the Visiting Nurse Association of Cape Cod seeking physical therapists.

The Mashpee Enterprise

Home Towns Sports A&E Real Estate Classifieds Columns Obituaries Photos Special Sections Subscribers

Town Seeks Input On Hazard Plan

By SAM HOUGHTON Jan 20, 2017 0

Home Mashpee Mashpee News

f t e p h

Town and regional officials are asking residents to fill out a survey for the purpose of updating Mashpee's multi hazard mitigation plan in order to "reduce the loss of or damage to life, property, infrastructure, and natural, cultural, and economic resources from natural disasters."

The town, along with the Cape Cod Commission and Federal Emergency Management Agency, are looking to revise its plan.

The town's plan fits in with the regional mitigation plan that also satisfies FEMA requirements to prepare Cape Cod for natural hazards. FEMA requires an update to the regional and municipal plan every five years in order for local municipalities to remain eligible for mitigation project grant funding.

The survey, which consists of nine questions, will help the town understand residents' concerns about natural hazards. It can be found at the town website at mashpeema.gov.

The survey asks questions such as which natural disasters a resident has experienced, including a tsunami, winter storm, or earthquake, as well as which hazards most trouble residents and the degree of their concern.

f t e p h

MASSACHUSETTS MARITIME ACADEMY
NOW HIRING
Click here for employment opportunities

**Physical Therapists
NEEDED for VNA
of Cape Cod**

**Are you looking
for extra money?**

The visiting Nurse Association of Cape Cod is looking for experienced physical therapists for after hours and weekend visits.

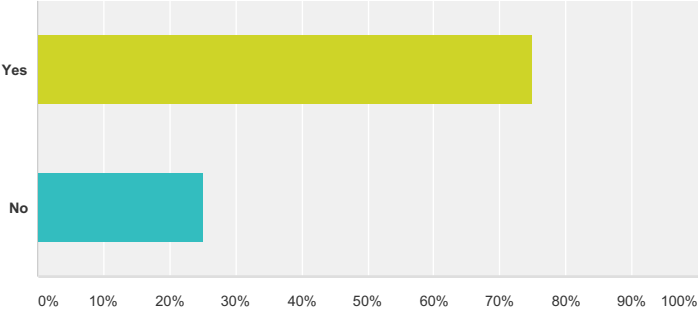
Homecare training provided.

Full time and part time positions also available.

Chapter 1: Public Survey Results

Q1 Have you experienced a weather-related event or disaster while living, working or visiting Mashpee?

Answered: 112 Skipped: 0

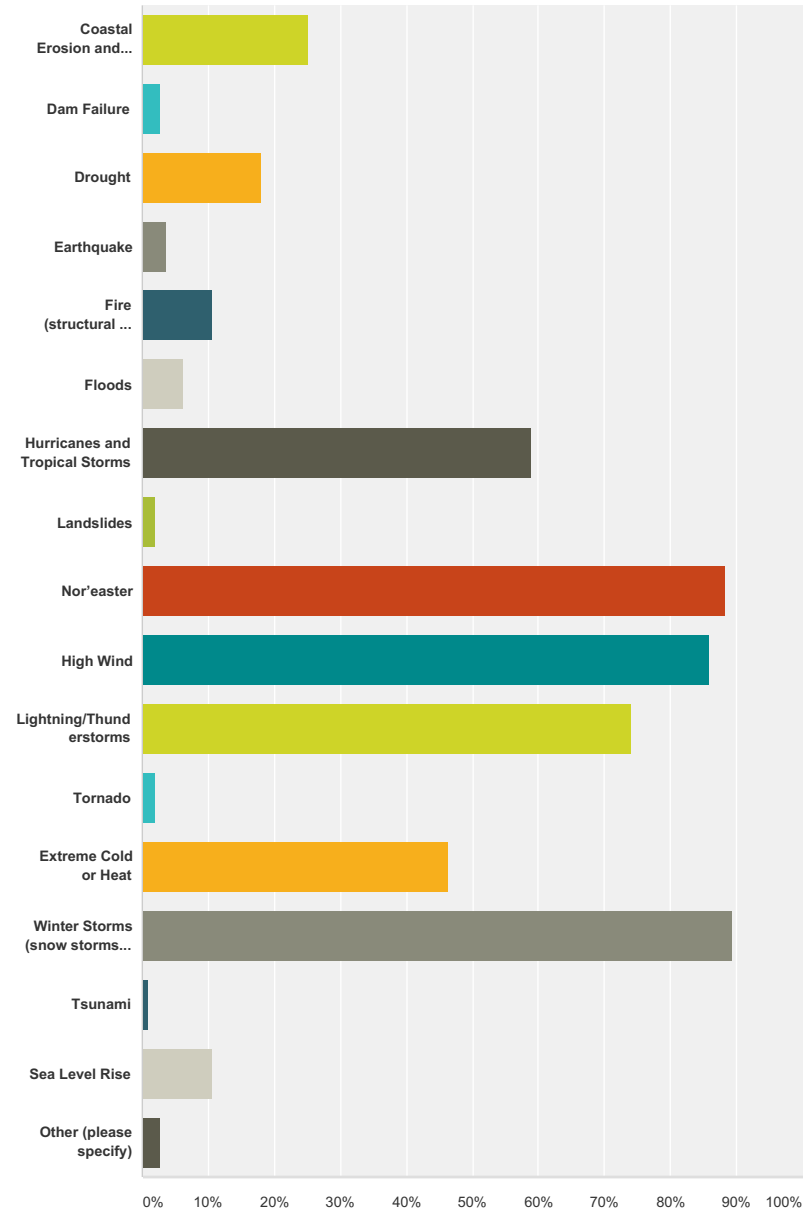


Chapter 1: Public Survey Results

Q2 Which of the following events have you experienced while in Mashpee? You can select more than 1 answer. The hazard types listed below were taken directly from the State Hazard Plan for the Commonwealth of Massachusetts drafted in 2013.

Answered: 112 Skipped: 0

#	Other (please specify)
1	none
2	THE SKY IS FALLING
3	Trees falling in road way

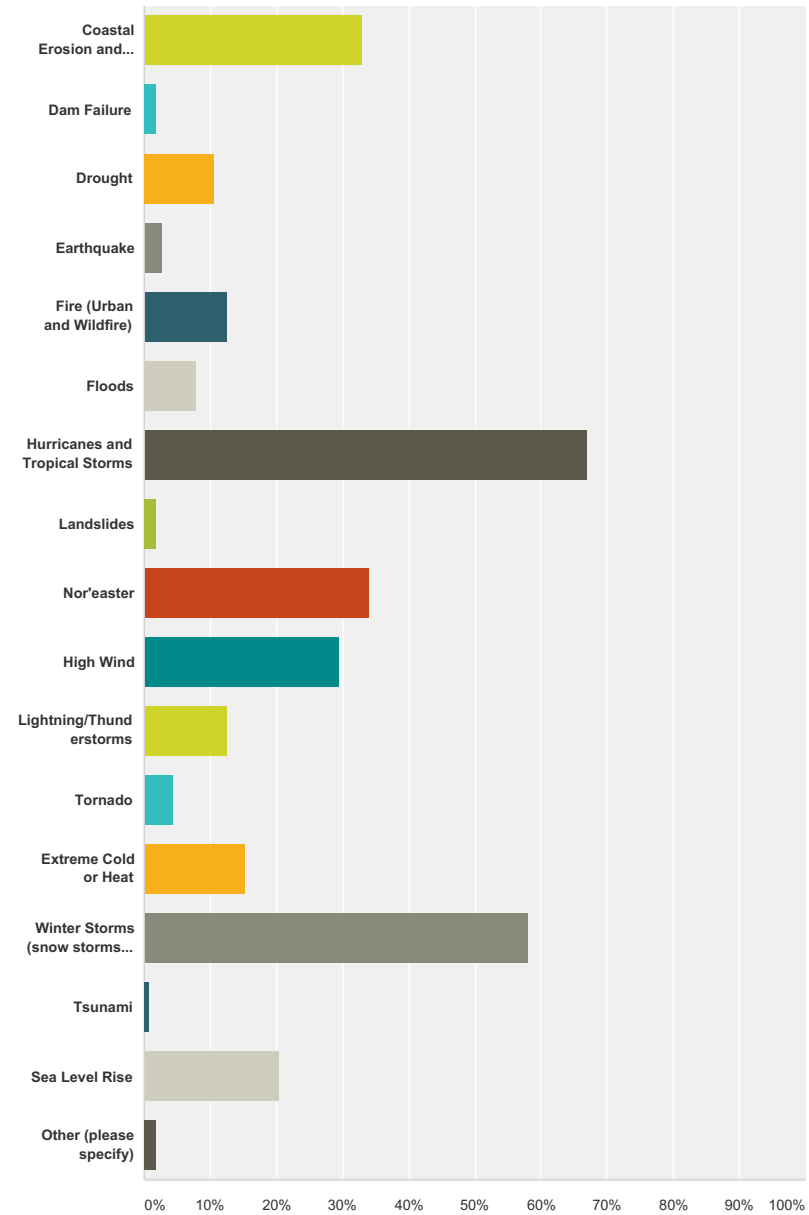


Chapter 1: Public Survey Results

Q3 In your opinion, which of the following hazard events are you most concerned about? Choose up to 3 answers.

Answered: 112 Skipped: 0

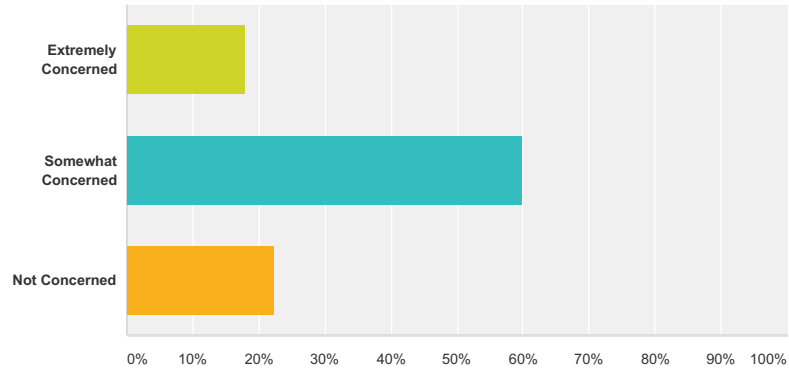
#	Other (please specify)
1	BIBLICAL FLOODS
2	Our waterways



Chapter 1: Public Survey Results

Q4 How concerned are you about the possibility of a natural disaster impacting Mashpee?

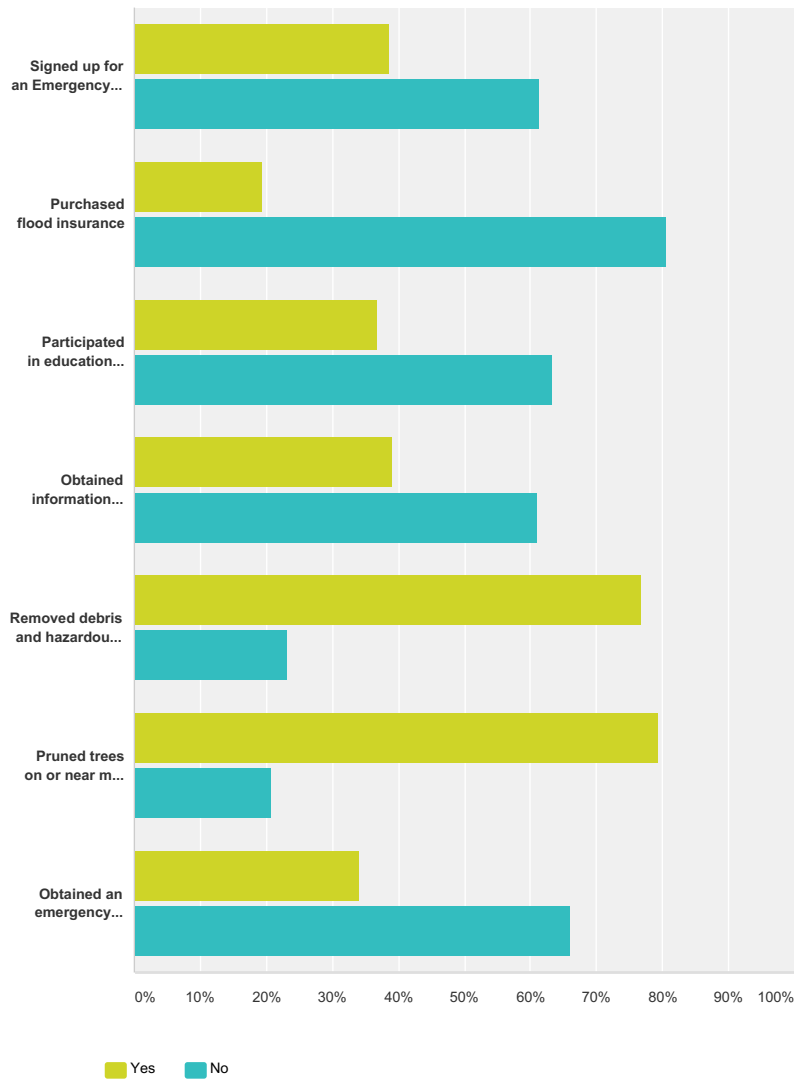
Answered: 112 Skipped: 0



Chapter 1: Public Survey Results

Q5 Which of the following actions have you taken to be more hazard resistant? Answer yes or no to the following activities:

Answered: 104 Skipped: 8

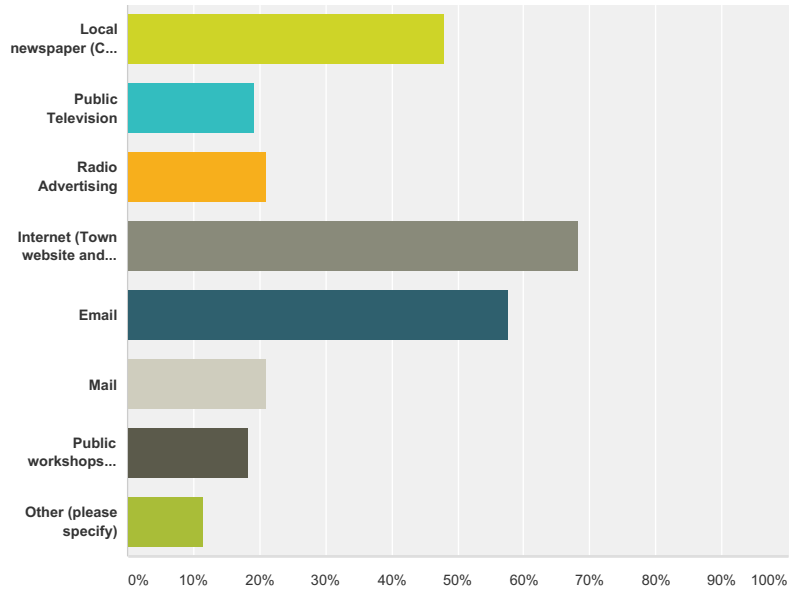


#	Other (please specify)
1	Not being a Mashpee resident or employed in Mashpee, many of these do not apply
2	you need a N/A column
3	CUREL UP IN BED
4	Installed a generator
5	Purchased natural gas generator
6	Stand-by generator
7	I'm very concerned with Plymouth's nuclear power plant at this time.. and a very poor evacuation plan/route for those of us on Cape
8	Have been a Red Cross volunteer nurse, and have a fair amount of disaster training from my career in various states and cities.
9	Know location of emergency shelters, evacuation route, planned meeting spot for family member at an off-Cape location.
10	I have my own emergency materials. If a serious event is forecast, my plan is to simply leave the Cape prior to the forecast event.
11	purchased generator
12	I have the FEMA app and the MEMA app
13	downloaded the FEMA App to my phone.
14	Signed up for an Emergency Notification System hosted by the State, and by the Town of Mashpee.

Chapter 1: Public Survey Results

Q6 What is the most effective way to engage you in hazard planning and emergency preparedness activities? You can select more than 1 answer.

Answered: 104 Skipped: 8

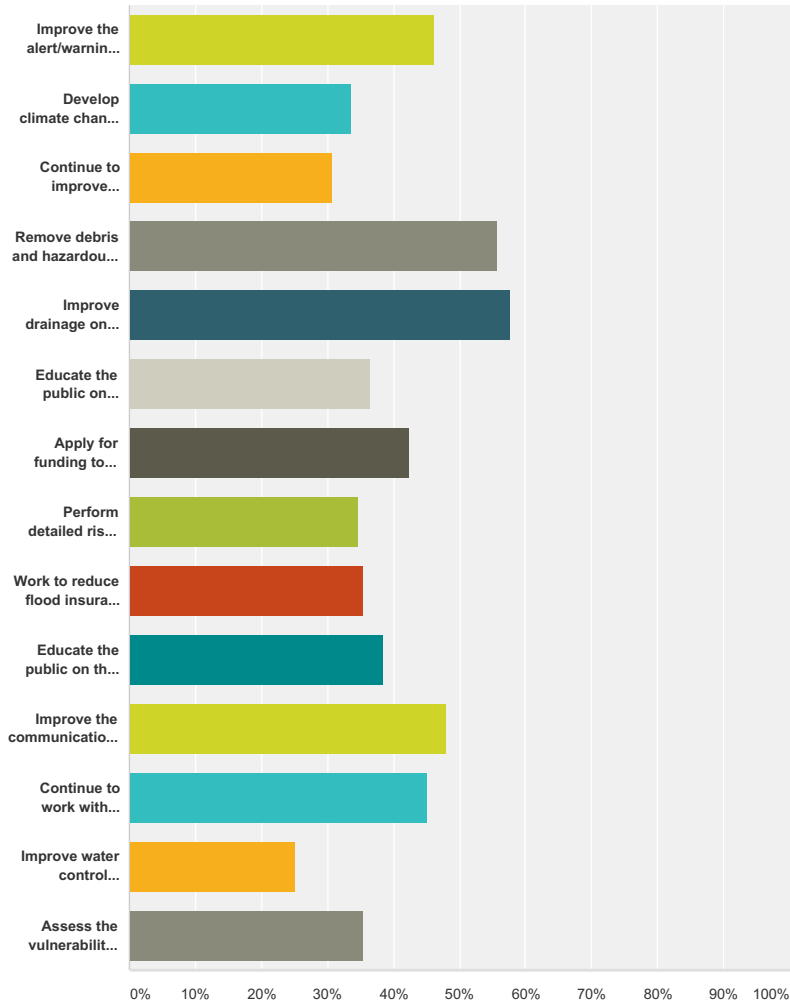


#	Other (please specify)
1	Information signage in high risk areas (in the field)
2	Text
3	ALIENS
4	via text
5	Text alerts
6	Preparing should be a regular or quarterly program and not just event specific.
7	Text/phone
8	Facebook.. like the Mashpee Police use
9	text
10	Internet in general, text with family members
11	Mail for some elderly that do not use internet
12	Expand internet to Twitter and Instagram like surrounding towns have. This will in tease awareness in the younger population in town.

Chapter 1: Public Survey Results

Q7 What steps can your local government take to reduce risk from natural hazards and protect the buildings and people of Mashpee? Please select more than 1 answer.

Answered: 104 Skipped: 8

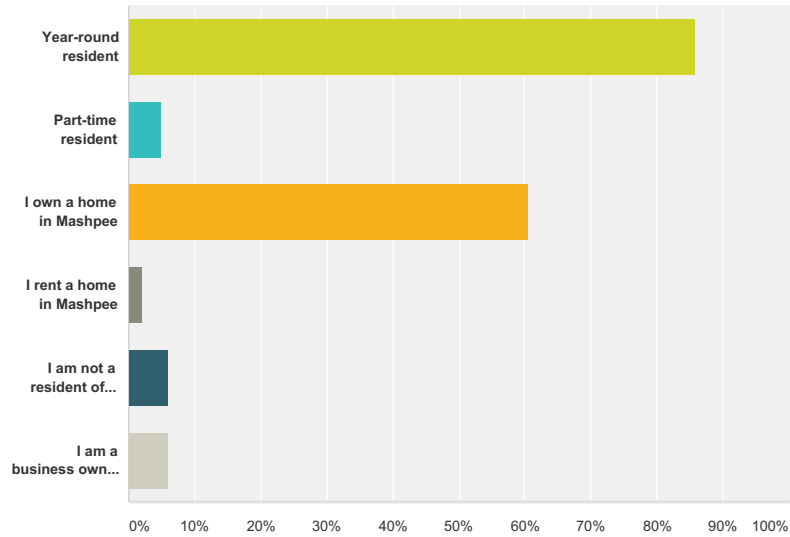


#	Other (please specify)
1	I wish the town would be an example for the rest of the county in diverting water AWAY from drainage sewers and adopt phytoremediation protocols.
2	Educate property owners about ways to reduce risk of flooding on their property
3	PRAY
4	I believe that the town of Mashpee had done a great job in alerting its residents to storm, weather related warnings, as well as to air quality issues, i.e., controlled brush burning.
5	Local government should be regularly involved in assisting town members, not just imposing rules....there are a lot of elderly who need help with staying safe and protecting their homes. Can you develop a fund to keep the elderly and less ambled safe during crises?
6	The town's "robot calls" are helpful and appreciated.
7	Curtail all near coastal building. Promote coastal plantings. Require all utilities to be underground on any new or remodel construction building permits.
8	Give information about how to plan, remove hazardous stuff, get training.
9	prune trees near power lines

Chapter 1: Public Survey Results

Q8 Please tell us about yourself. Select all that apply to you.

Answered: 99 Skipped: 13



#	Other (please specify)
1	I assist the town but am not based in Mashpee
2	I have done work in Mashpee, but am not employed by mashpee
3	County Employee
4	HOMELESS
5	I am a retired senior on my own.
6	former resident
7	Visitor to Mashpee

Q9 If you are interested in the hazard planning process, please provide your name, email and/or alternate contact information.


Answered: 28 Skipped: 84

Answer Choices	Responses
Name	100.00% 28
Email	100.00% 28
Alternate Contact Information	28.57% 8

Chapter 1: Draft Plan Comment Website

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 [Multi-Hazard Mitigation Planning](#) »
 Mashpee Hazard Mitigation Plan



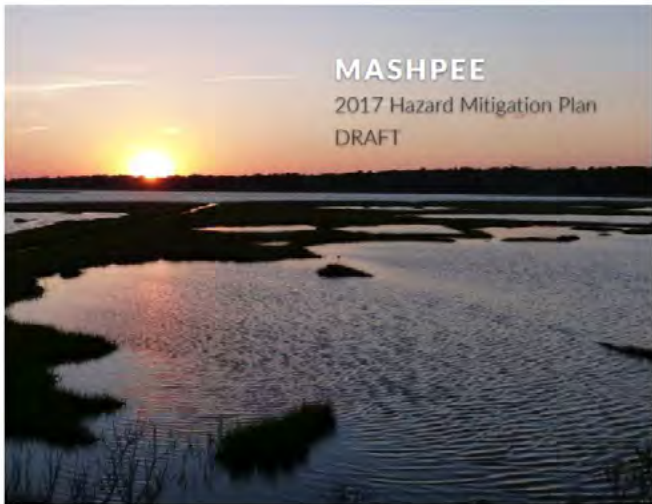
CAPE COD COMMISSION

[Mashpee Hazard Mitigation Plan](#)

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Mashpee Hazard Mitigation Plan

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MASHPEE

2017 Hazard Mitigation Plan

DRAFT

DOWNLOAD PLAN

Comments open through Sunday, July 9, 2017


The Town of Mashpee and the Cape Cod Commission have been working together to update the Mashpee Hazard Mitigation Plan. The Hazard Mitigation Plan looks at the vulnerabilities in the Town and outlines actions the Town can take to help protect critical facilities and residents from natural hazards.

An approved hazard mitigation plan also makes the Town eligible for state and federal pre- and post-disaster funding. The Planning Team has completed a draft of the Hazard Mitigation Plan and now seeks public comment on it.

Comments will be accepted through Sunday, July 9.

Please email any comments on the draft Mashpee Hazard Mitigation Plan to Chloe Schaefer at chloe.schaefer@capecodcommission.org.

The Planning Team will review and incorporate public comments into the plan, which will then be presented at an upcoming Board of Selectmen meeting. Following approval from the Board of Selectmen, the plan will be submitted to the Massachusetts Emergency Management Agency for review. Thank you for your input!



Higher Resolution Maps

List of Files

- Figure2.1 Mashpee MHM BaseMap.pdf

SIZE: 1.3mb
UPLOADED: Wed, March 22, 2017
- Figure2.8 Mashpee MHM StormSurge.pdf

SIZE: 1.2mb
UPLOADED: Wed, December 29, 2014
- Figure2.6 Mashpee MHM FEMA FHAs.pdf

SIZE: 3.2mb
UPLOADED: Wed, December 30, 2014
- Figure2.J Mashpee MHM Culverts.pdf

SIZE: 462.0kb
UPLOADED: Thu, June 15, 2017
- Figure2.2 Mashpee MHM Dams.pdf

Chapter 1: Draft Plan Comment Notices

Chloe Schaefer

From: Chloe Schaefer
Sent: Friday, June 16, 2017 2:02 PM
Subject: Draft Mashpee Hazard Mitigation Plan

Hello,

First of all, thank you for your input during the updating of the Hazard Mitigation Plan for Mashpee through the online survey. I am reaching out because you expressed an interest in staying informed about the Mashpee Hazard Mitigation Plan. The Planning Team has completed a draft of the Hazard Mitigation Plan and is seeking public comment. The public comment period for the plan will be open through Sunday, July 9.

Please go to www.capecodcommission.org/mashpeehazardplan to review the plan. Send any comments to me, Chloe Schaefer, at chloe.schaefer@capecodcommission.org.

Following the public comment period, the Planning Team will incorporate comments into the plan and prepare it for presentation and approval for submittal to the Massachusetts Emergency Management Agency at an upcoming Board of Selectmen meeting. Thank you for your feedback!

Sincerely,

Chloe Schaefer
Community Design Planner
CAPE COD COMMISSION
chloe.schaefer@capecodcommission.org
508.744.1219

Chapter 1: Draft Plan Comment Notices



Chapter 1: Draft Plan Comment Notices

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MASHPEE POLICE
 CAPE COD MASSACHUSETTS

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Mashpee Police Department
 2 mins · 🌐

This is a followup to a post we made in March, on behalf of the Cape Cod Commission. Provide your comments on the draft Mashpee Hazard Mitigation Plan. The Town of Mashpee and the Cape Cod Commission have been working together to update the Mashpee Hazard Mitigation Plan. The Planning Team has completed a draft of the updated plan and is now seeking public comment on it. Click on the below link to review the plan and for more information. Comments will be accepted through Sunday July 9. <http://www.capecodcommission.org/mashpeehazardplan>

👍 Like 🗨 Comment

Mashpee Police Department
 June 22 at 5:31pm · 🌐

Great job to the current police academy recruits attending the MSP academy including our very own Recruit Officer Derochea. Good luck tomorrow at graduation Officers!!

Encouragement
 Recently, members of the State Police Academy staff received a "Thank You" card from the students and teachers at the Royalston Community School Kindergarten...

👍 Like 🗨 Comment ➦ Share


Sean Joseph, Lisa Mangelson, Linda Mini and 37 others like this.

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Chapter 1: BCREPC Meeting Attendees (March 2, 2016)



**BARNSTABLE COUNTY
REGIONAL EMERGENCY PLANNING
COMMITTEE**
SUPERIOR COURT HOUSE
POST OFFICE BOX 427
BARNSTABLE, MA 02630

Phone: (508) 375-6618
FAX: (508) 362-2603
Email: bcrepc@barnstablecounty.org

MEETING NOTES
The Barnstable County Regional Emergency Planning Committee
Held a meeting on Wednesday, March 2, 2016 at 2:00 p.m. in the
Innovation Room in the OpenCape Building at the Barnstable County Complex
3195 Main Street, Barnstable, MA 02630

I. Welcome/Introductions

The meeting was called to order at 1405 by co-chair Chief Ron Fisette. Introductions were made around the room:

Tim Lynch, Massachusetts Maritime Academy, Cally Harper, Cape Cod Commission, Lance Lambros, Office of Senator Vinny deMacedo, Hilary Greene, American Red Cross, Kent Farrenkopf, Eastham Fire Department, Jerry McDermott, Eversource, Philip Simonian, Yarmouth Fire Department, Kevin Morley, PIO BCREPC, Sean O'Brien, BCREPC, Debra Rogers, Falmouth Community Television, Dan Howard, ARES, Jeff Tavares, Falmouth Fire Department, Michael Walker, Incident Management Team, Diana Gaumond, Cape Cod Medical Reserve Corps, Roy Jones, Cape Cod Regional Transit Authority, Chrystal LaPine Health and Medical Coordinating Coalition, Bill Crocca, National Grid, Dee Yeater, Visiting Nurse Association, Amy Henderson, AmeriCorps Cape Cod, Chloe Schaefer, Cape Cod Commission, Deirdre Arvidson, Barnstable County Department of Health and Environment, Amy Alati, Barnstable County Department of Health and Environment, Brian Dale, Cape Cod Regional Transit Authority, Ed Kulhawik, Eastham Police Department, Jeff Rossi, AmeriCorps Cape Cod, Paul Hoy, American Red Cross, Jake Garringer, AmeriCorps Cape Cod, Michael Clark, Barnstable Police Department, Brian Gallant, Sandwich Office of Emergency Management, Ron Fisette, Wellfleet Police Department, Chad Absten, Falmouth Fire Department, Laura Marin, Provincetown Health Department, Rachel Potts, Massachusetts Emergency Management Agency, Joseph Gordon, Barnstable County Sheriff's Office, Phil Burt, BCREPC, Eric Trudeau, National Park Service, Charles Noyes, Bourne Emergency Management Director.

II. Minutes: February 3, 2016

A motion was made by Brian Gallant to accept the minutes; the motion was seconded by Roy Jones and approved unanimously.

1

III. Status Reports from REPC Subcommittees and Programs:

- **Executive Committee**
Sean O'Brien said there would be a meeting on March 14 to discuss expansion of the executive committee from 5 to 9 members
- **HAZMAT/Tier 2 Update**
Amy Alati reported it was the best year ever but most complicated. She praised the filers using the Tier 2 Manager software. 418 facilities reported in Barnstable County this year. BCREPC covers Nantucket County as well – 27 facilities reported on the island.

There were 67 office visits from public and private facility representatives in the month of February. Compliance protects the facilities by ensuring fire departments on Cape Cod and Nantucket receive the HAZMAT database and the facility emergency response plans.

Oyster Harbor Marine and Cape Cod Oil were exemplary said Amy. They were assiduous in their willingness to do the right thing.
- **Health Agents Coalition**
No report but Amy mentioned a program around opioid abuse. She has copies of the presentation
- **Incident Management Team**
Mike Walker reported on the MACC standup and the call-out for a search operation in Harwich. The team continues to seek more training opportunities.
- **Sheltering Task Group**
Phil Burt said there were no shelter operations this winter. The committee is looking for grant funding for equipment and supplies and scheduling walk-throughs during the summer months.
- **American Red Cross**
Paul Hoy introduced himself as the Disaster Program Manager on an interim basis. He reported the ARC is looking for a full-time replacement

2

Chapter 1: BCREPC Meeting Attendees (March 2, 2016)

for Ellen Rossano who left the ARC due to health reasons. In terms of volunteers the ARC is trying to increase shelter manager capacity by 25%. The ARC is also adding supplies, in addition to shelter equipment and is also working on a mobile capacity, each of which would shelter 100 people. ARC is also increasing by 100 % the capacity of the Nantucket shelter with material for 100 people. Hilary Greene updated to committee on the Heroes Breakfast.

- **MEMA**

Rachel Potts reported there were no updates

- **OpenCape Liaison Task Group**

Sean O'Brien said the Task Group would be looking at dash/body cams and 700 MHz He would have a report at the next meeting.

- **Citizens Corps Council**

Amy Alati reported that the final edits were being made to the senior emergency reference magnetic card, which is to be printed by the Barnstable County Sheriff's Office. It will educate the senior population about planning for emergencies. Public seminars and education events will be held as well.

- **ARES**

Dan Howard reported that issues with antennas are being addressed at the Old Jail.

- **Barnstable County Sheriff's Office**

Joe Gordon reported that the S39 vehicle responded to Harwich for a search and rescue operation. He said that agencies shouldn't hesitate to ask for that vehicle as a command post. He reported that a new CERT class was starting at the Massachusetts Maritime Academy.

- **Public Information Officer**

Kevin Morley reported the shelter video project is making good progress. He reported that he is engaging Cape Cod Community Access TV stations in the production of Regional Shelter System videos

IV. **Introduction: Verizon Government Affairs**
Ellen Cummings, Regional Director

3

Sean introduced Ellen. She has been working with Cape for six years wireline and wireless. She is very happy to make connection with public safety. She will stay around after meeting to meet with public municipal officials to hand out information sheet on reporting on problems.

Sean praised Ellen and Verizon for their responsiveness.

V. **Presentation: Engaging Neighboring Communities in Hazard Planning**

Cally Harper, PhD, Planner II
Cape Cod Commission

Cally Harper reported her primary role is helping towns update hazard mitigation plans. She reviewed elements of hazard mitigation plan. She presented a status update on hazard mitigation plans for Cape towns. She reported that the majority of towns do not have an active plan. She reviewed the process of developing a hazard profile. She also sought input from the BCREPC for Town Hazard Mitigation Plans. She sought discussion of the relevant hazards on Cape Cod. She asked the meeting members to fill out a survey on Survey Monkey.
www.surveymonkey.com/r/bcrepc

VI. **News - Open Announcements - Information**

Hillary Greene announced a fundraiser for Frank O'Laughlin on March 11.

VII. **Public Comments**

None

VIII. **Adjourn**

A motion for adjournment was made by Joe Gordon; seconded by Brian Gallant. The meeting was adjourned at 1445

4

Chapter 1: BCREPC Presentation (March 2, 2016)

Engaging Neighboring Communities
in Hazard Planning

Cally Harper, PhD
Cape Cod Commission
March 2, 2016

Today:

- Review elements of Hazard Mitigation Plans
- Status update on Hazard Mitigation Plans on Cape Cod
- Process for developing a Hazard Profile
- Ask you to comment on elements of the Hazard Profile

Three Fundamental Parts of a Town Hazard Plan

Data Action + Accountability Public Engagement

Data

- Identify relevant hazards
- Collect data on historical storm events
- Determine the impact and probability of storms
- Conduct a Vulnerability and Risk Assessment

Action + Accountability

- Accountability for past Mitigation Actions
- Town Capability Assessment
- Develop new Mitigation Actions for the next 5 years


Public Engagement

- Engagement occurs during the planning process and once a draft plan is developed
- Who is engaged? Public, Stakeholders, Neighboring Towns

Chapter 1: BCREPC Presentation (March 2, 2016)

Why is hazard planning important?

1. Protects people and property
2. Eligibility for Hazard Mitigation Assistance
3. Community Rating System




Chapter 1: BCREPC Presentation (March 2, 2016)

FEMA Requirement 201.6(b)(2):
Give neighboring communities the opportunity to be involved in hazard mitigation activities



- A lot of towns are working on their plans!
- BCREPC meeting is a great opportunity to fulfill this requirement!
- Specifically, the towns would like to engage the BCREPC in the development of their hazard profiles



Town reviews the natural hazards in the MA State Hazard Plan



- Erosion + Shoreline Change
- Dam/Culvert Failure
- Earthquake
- Fire: Wildland and Urban
- Flood
- Hurricanes + Tropical Storms
- Landslide
- Nor'easters
- High Winds
- Thunderstorms
- Extreme Temperatures
- Tornadoes
- Drought
- Severe Winter Weather
- Tsunami
- Sea Level Rise

Town reviews the natural hazards in the MA State Hazard Plan

Town looks at the data and determines which hazards are relevant to their town



Example from the 2016 Provincetown Hazard Mitigation Plan

Town engages the public and stakeholders to comment on relevant natural hazards



Seek the public input on:

- History and impact of storms in town
- Level of concern that a storm will occur again



Town engages the public and stakeholders to comment on relevant natural hazards



Public input is used to determine which hazards undergo a Vulnerability and Risk Assessment

An example from the Provincetown Hazard Mitigation Plan

Chapter 1: BCREPC Presentation (March 2, 2016)

Seeking input from the BCREPC for Town Hazard Mitigation Plans

Nearly all towns will benefit from your input!



Activity #1: Discuss which hazards are relevant to Cape Cod

Activity #2: Fill out a survey on Survey Monkey

Activity #1: Discuss hazard relevance using local knowledge


- Erosion + Shoreline Change
- Dam/Culvert Failure
- Earthquake
- Fire: Wildland and Urban
- Flood
- Hurricane + Tropical Storms
- Landslide
- Nor'easters
- High Winds
- Thunderstorms
- Extreme Temperatures
- Tornadoes
- Drought
- Severe Winter Weather
- Tsunami
- Sea Level Rise

Are all of these hazards relevant to Cape Cod?

Are any missing?

Which ones affect only a few towns?

Activity #2: Survey on Impact + Probability of Natural Hazards



www.surveymonkey.com/r/BCREPC

You can fill it out now or it will be emailed to you this week.

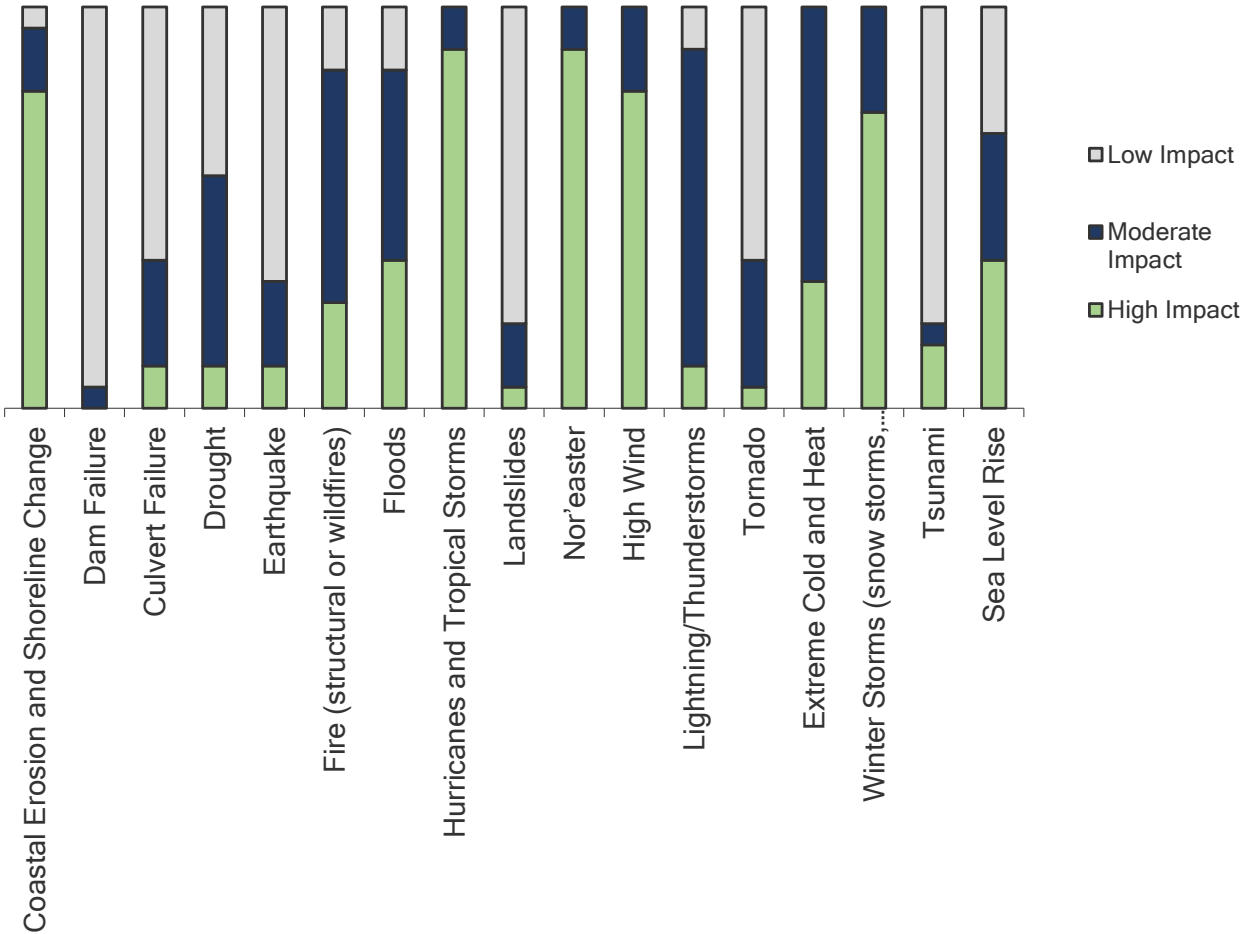
P.S. Its only 3 questions!



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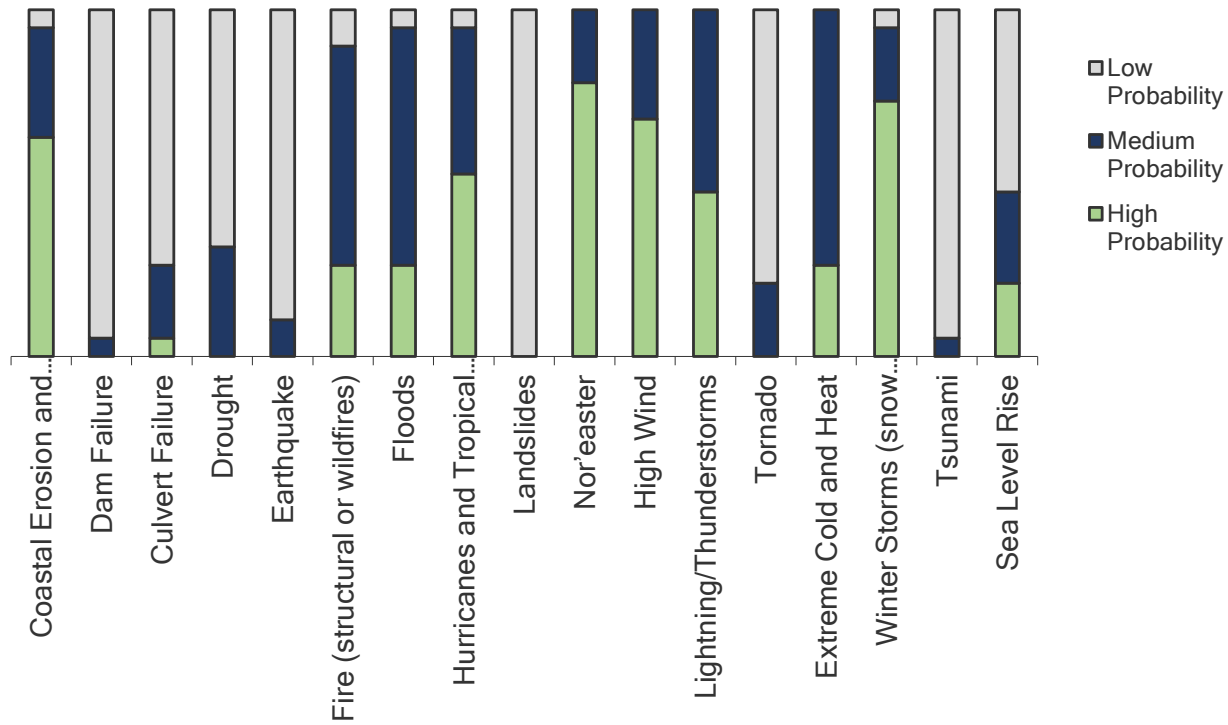
Chapter 1: BCREPC Survey Results

Question 1: For each hazard listed below, please identify if it will have a "low," "moderate" or "high" impact on Cape Cod. The towns would like you to use your local knowledge of Cape Cod. According to FEMA, impact is defined as the damage or consequence



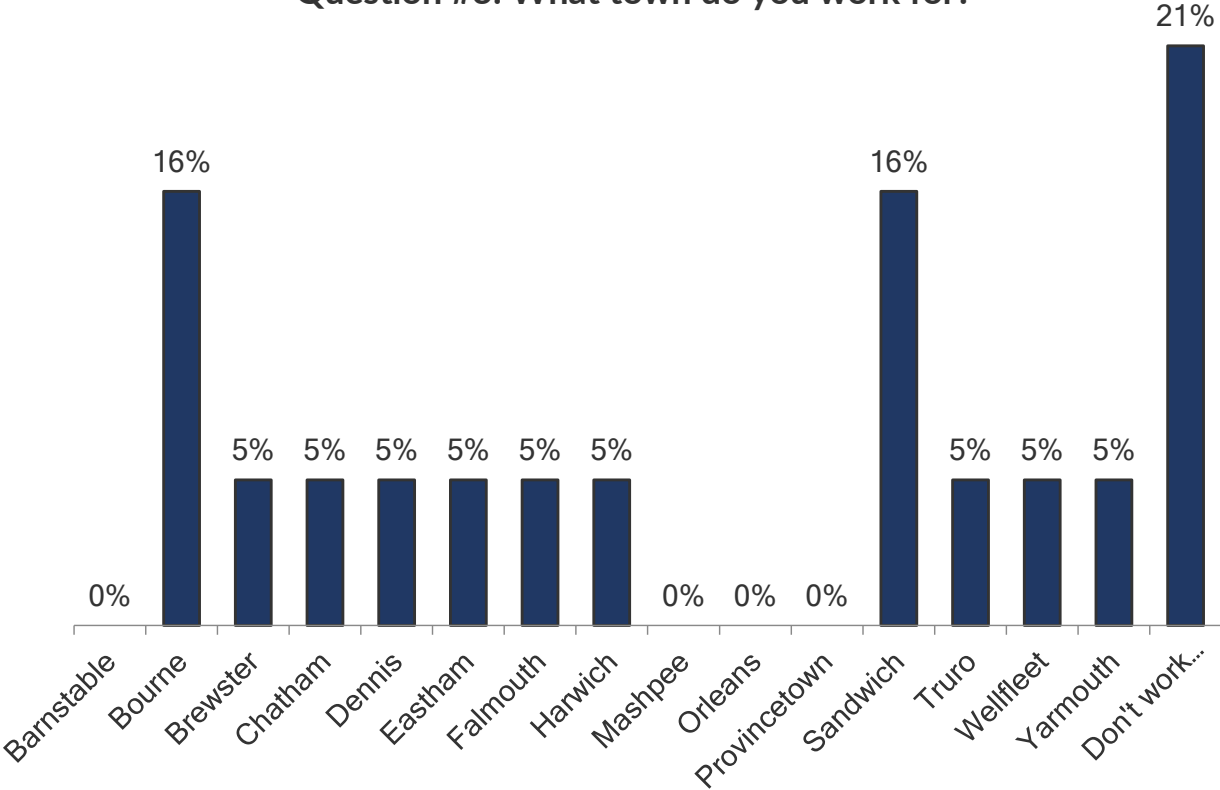
Chapter 1: BCREPC Survey Results

Question #2: For each hazard listed below, please assign a probability score of "low," "medium" or "high". According to FEMA, probability measures how often an event is likely to occur. Low probability means the event will occur at least once in the next

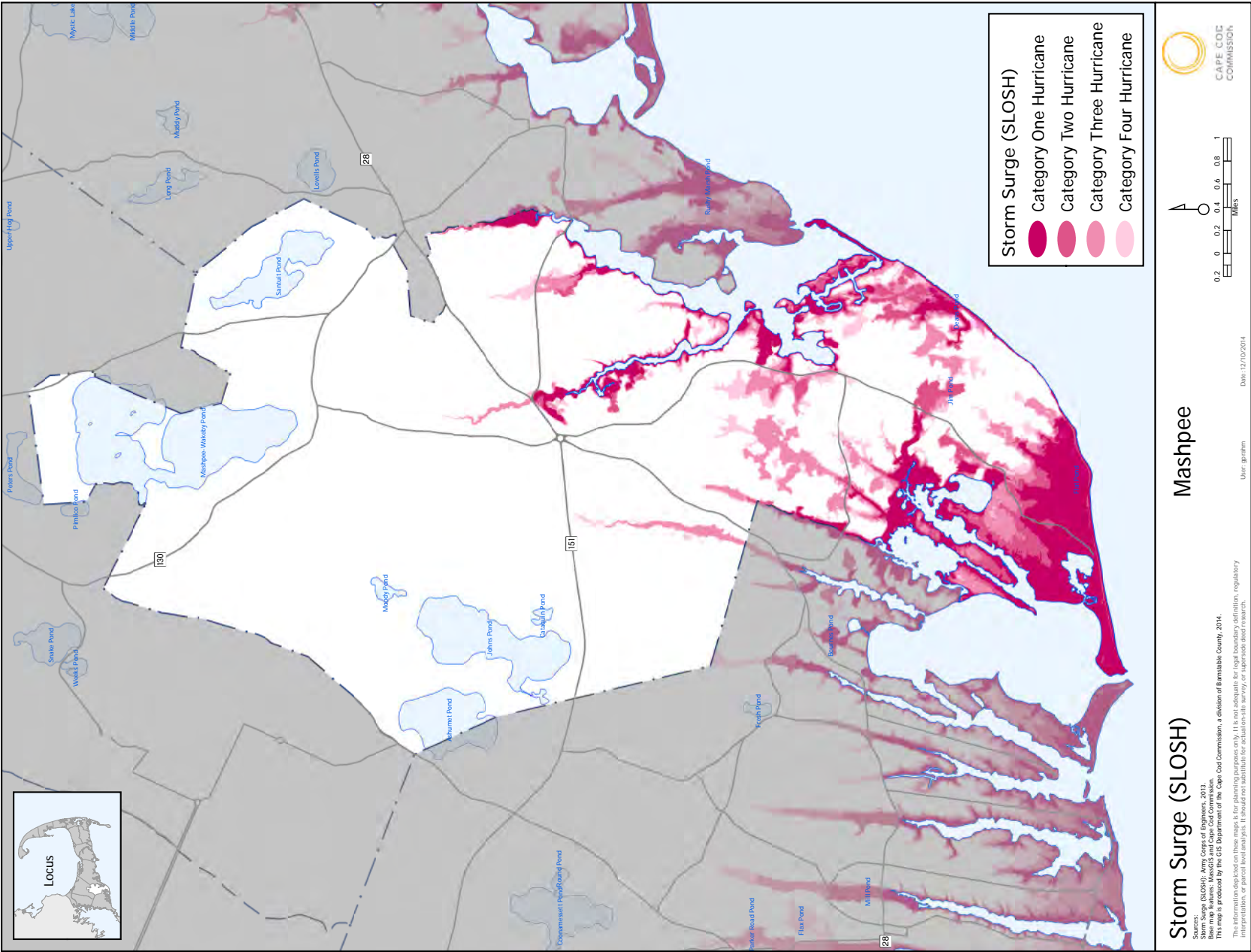


Chapter 1: BCREPC Survey Results

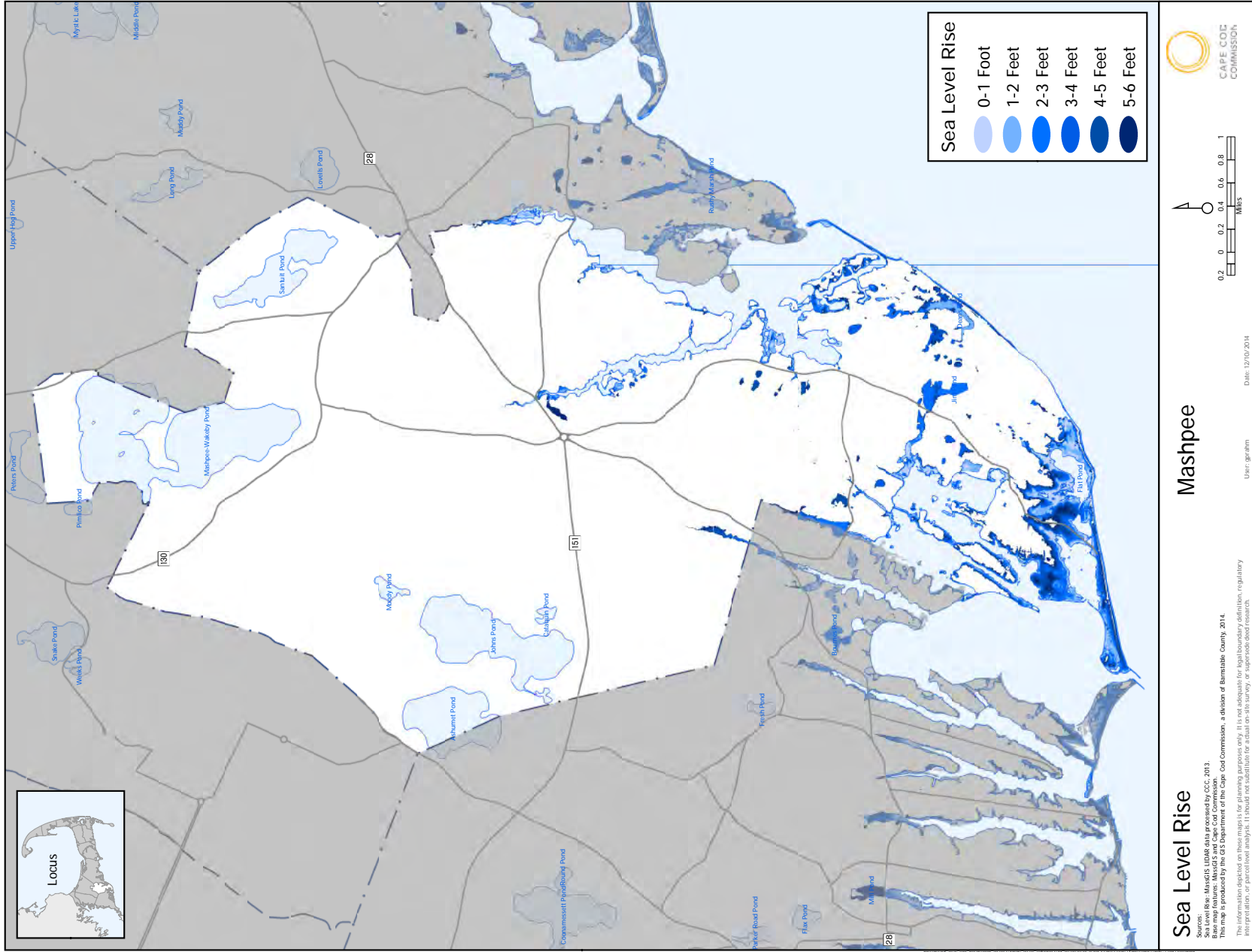
Question #3: What town do you work for?



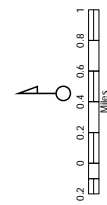
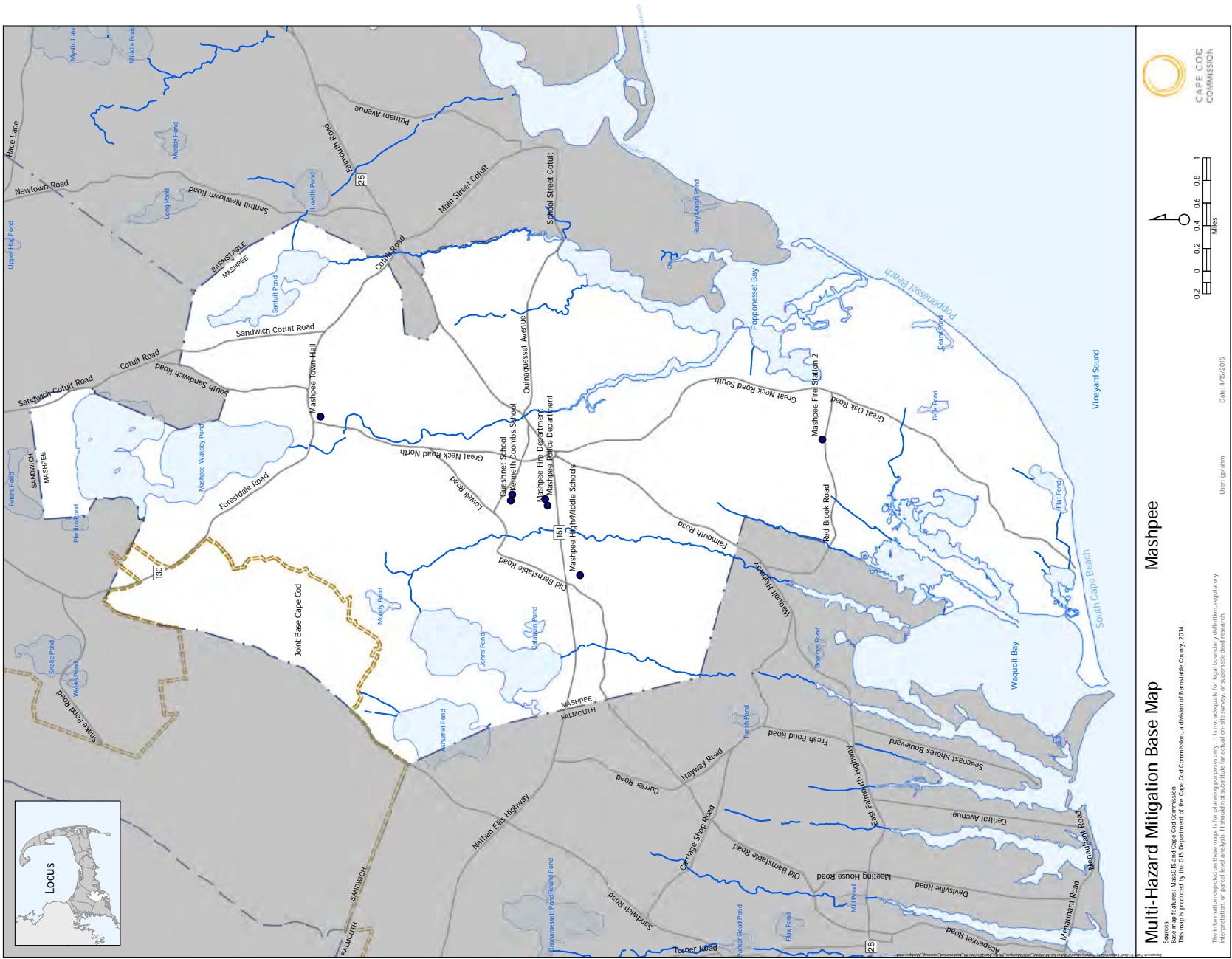
Larger Maps: Storm Surge (Figure 2.8)



Larger Maps: Sea Level Rise (Figure 2.19)



Larger Maps: Base Map (Figure 3.1)



Multi-Hazard Mitigation Base Map Mashpee

This information depiction on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory file preparation, or parcel level analysis. It should not substitute for actual on-site survey, or as-prepared deed research.

Source: Features: MxGIS and Cape Cod Commission.
 This map is produced by the GIS Department of the Cape Cod Commission, a division of Barnstable County, 2014.

Date: 4/22/2015
 User: graham



Mashpee Hazard Mitigation Plan, 2017



CAPE COD
COMMISSION

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