



DRAFT
Falmouth Multi-Hazard Mitigation Plan

July 2022

Prepared for:

Town of Falmouth
59 Town Hall Square
Falmouth, MA 02540

Prepared by:

Woods Hole Group
A CLS Company
107 Waterhouse Road
Bourne, MA 02532 USA
(508) 540-8080



Table of Contents

CHAPTER 1 – INTRODUCTION	1-1
1.1 PURPOSE OF PLAN	1-2
1.2 THE PLANNING PROCESS	1-2
1.3 PLAN DESCRIPTION	1-7
1.4 PREVIOUS FEDERAL/STATE DISASTERS	1-7
1.5 CLIMATE CHANGE	1-8
CHAPTER 2 - LOCAL PROFILE	2-1
2.1 OVERVIEW	2-2
2.2 GEOGRAPHY	2-2
2.3 CLIMATE	2-2
2.4 NATURAL ENVIRONMENT.....	2-2
2.5 LAND USE.....	2-3
2.6 TRANSPORTATION	2-5
2.7 CRITICAL FACILITIES.....	2-5
2.8 HISTORICAL PROPERTIES	2-7
2.9 REPETITIVE LOSS PROPERTIES.....	2-8
CHAPTER 3 - HAZARD IDENTIFICATION.....	3-1
3.1 FLOODING (COASTAL & INLAND)	3-3
3.2 COASTAL EROSION	3-14
3.3 HURRICANES & TROPICAL STORMS	3-19
3.4 SEVERE WINTER WEATHER (SNOW/BLIZZARD/ICE STORM/NOR'EASTER).....	3-26
3.5 WILDFIRE	3-31
3.6 TORNADO	3-36
3.7 DROUGHT	3-39
3.8 EXTREME TEMPERATURE	3-43
3.9 EARTHQUAKE.....	3-46
3.10 INVASIVE SPECIES	3-49
3.11 OTHER SEVERE WEATHER.....	3-51



3.12	LANDSLIDE	3-59
3.13	TSUNAMI	3-63
3.14	DAM AND CULVERT FAILURE	3-65
3.15	FRESHWATER QUALITY.....	3-69
3.16	SUMMARY OF HAZARDS	3-74
CHAPTER 4 - VULNERABILITY ASSESSMENT		4-1
4.1	METHODOLOGY	4-2
4.2	RESULTS.....	4-4
4.3	VULNERABLE PROPERTIES AND CRITICAL FACILITIES	4-27
4.4	VULNERABLE POPULATIONS.....	4-28
CHAPTER 5 - MITIGATION MEASURES		5-1
5.1	MITIGATION GOALS AND OBJECTIVES	5-2
5.2	EXISTING CAPABILITIES.....	5-2
5.3	PROGRESS ON MITIGATION ACTIONS SINCE 2004	5-7
5.4	PROPOSED MITIGATION.....	5-13
CHAPTER 6 - PLAN MAINTENANCE PROCESS		6-1
6.1	PLAN MONITORING, EVALUATION AND UPDATES	6-2
6.2	INCORPORATION OF MITIGATION STRATEGIES.....	6-2
6.3	CONTINUED PUBLIC INVOLVEMENT.....	6-3
6.4	PLAN ADOPTION	6-3
REFERENCES:		R-1
APPENDIX A: LOCAL MITIGATION PLAN REVIEW GUIDE.....		A-1
APPENDIX B: PLANNING PROCESS AND PUBLIC OUTREACH		B-1
APPENDIX C: CRITICAL FACILITIES AND VULNERABILITY.....		C-1



Acronym List

APCC	Association for Preservation of Cape Cod
BFE	Base Flood Elevation
CCC	Cape Cod Commission
CEC	Coastal Erosion Commission
CZM	Coastal Zone Management
CERT	Community Emergency Response Team
CFR	Code of Federal Regulations
CPA	Community Preservation Act
DCR	Department of Conservation and Recreation
EEA	Executive Office of Energy and Environmental Affairs
EF-Scale	Enhanced Fujita Scale
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
FIRM	Flood Insurance Rate Map
LiMWA	Limit of Moderate Wave Action
LEPC	Local Emergency Planning Committee
LPT	Local Planning Team
MassCZM	Massachusetts Office of Coastal Zone Management
MassDOT	Massachusetts Department of Transportation
MC-FRM	Massachusetts Coast Flood Risk Model
MEMA	Massachusetts Emergency Management Agency
MHMP	Multi-Hazard Mitigation Plan
MIPAG	Massachusetts Invasive Plant Advisory Group
MORIS	Massachusetts Ocean Resource Information System
MRC	Medical Reserve Corps
MSL	Mean Sea Level
MVP	Municipal Vulnerability Preparedness
NCDC	National Climatic Data Center
NESIS	Northeast Snowfall Impact Scale
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
SFHA	Special Flood Hazard Areas
SHMCAP	State Hazard Mitigation and Climate Adaptation Plan
SHMO	State Hazard Mitigation Officer
SLOSH	Sea, Lake and Overland Surge from Hurricanes
SLR	Sea-Level Rise
SRL	Severe Repetitive Loss
TSI	Trophic State Index
USACE	US Army Corps of Engineers
USGS	US Geological Survey



Virtually every type of weather has been and will be experienced within a coastal Massachusetts town. From freezing temperatures and blizzard conditions in the winter to heat and humidity in the summer, Falmouth must plan for the worst. The old adage of “if you don’t like the weather, wait a minute” certainly applies.

In addition to potentially severe weather, Falmouth’s unique coastal geography and its position between Buzzards Bay and the Vineyard Sound exposes the Town to potential wave energy and storm surges capable of causing coastal erosion, flooding, and property damage to multiple sections of Town. In total, Falmouth has over 68 miles of marine shoreline.

Natural hazards of all kinds can result in injury, loss of life, and damage to buildings and infrastructure, which can have significant adverse impacts on the Town’s economic, social, and environmental resources. Through the development and implementation of this Multi-Hazard Mitigation Plan, the Town of Falmouth is proactively trying to prepare for and mitigate potential impacts from the various natural hazards.



1.1 PURPOSE OF PLAN

To facilitate review of this plan against FEMA's *Local Mitigation Review Guide*, when the text addresses an element of the *Guide*, it is identified in a colored bullet in the margin.

The Federal Emergency Management Agency (FEMA) defines hazard mitigation as “any sustained action taken to reduce or eliminate the long-term risk to human life and property from (natural) hazards”, such as floods, hurricanes, winter storms, tornadoes, earthquakes, etc. Hazard mitigation may include both structural measures, such as flood control structures, and nonstructural measures, such as regulations and bylaws, to prevent flooding. Local planning and mitigation efforts allow communities to reduce or eliminate the loss of life and property damage resulting from natural hazards. The Town of Falmouth produced this updated Multi-Hazard Mitigation Plan for the entire Town with the goal of providing sustained actions to reduce or eliminate risk to human life and property damage from a natural hazard event. Objectives of this plan are as follows:

- Describe the planning process;
- Identify and update relevant background information about the Town, including geography, climate, land use, and infrastructure;
- Identify natural hazard risks and areas in town most likely to be impacted;
- Complete a risk assessment to profile hazard events, inventory assets, and estimate potential losses;
- Identify existing disaster mitigation measures already in place;
- Develop proposed mitigation measures and a mitigation strategy based on the risk assessment; and
- Design a mechanism to keep the plan updated to reflect current conditions and establish a schedule for monitoring and evaluating the plan.

What is a Hazard Mitigation Plan?

Natural hazard mitigation planning is the process of reducing or eliminating the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes through long-term strategies, including planning, policy changes, programs, projects, and other activities.

Preparation and updating of this Multi-Hazard Mitigation Plan (MHMP) before a major disaster occurs will help the community prevent property damage and loss of life associated with natural hazards, save money by instituting mitigation measures to protect against natural hazards, allow funding through FEMA for pre-disaster remediation, and expedite disaster recovery. The Plan will also help to reduce or eliminate repetitive flood losses.

1.2 THE PLANNING PROCESS

Public participation is a central component of this planning process, providing critical information about the local occurrence of hazards while also serving as a means to build a base of support for hazard mitigation activities. Additionally, the most successful mitigation plans are developed after participation by a wide range of stakeholders who play a role in identifying and

A1.a
A1.e



implementing mitigation actions. During the update of this MHMP, the planning process included the following:

- An opportunity for the public to attend two informational presentations
- An opportunity for the public to comment on the plan during draft stages and prior to final approval;
- An opportunity for local and regional agencies and organizations, neighboring communities and private industries to be involved in the planning process; and
- A review and incorporation of existing plans, studies, reports, and data.

A1.b

This MHMP is an update of the previous plan, developed by the Town of Falmouth in 2017. It was developed through substantial input from the Local Planning Team (LPT), which consisted of various Town officials who were able to provide critical local knowledge about the community to facilitate the development of an updated MHMP that reflects changes in the Town since 2017.

A1.a
A1.c
A1.d

The LPT was formed by the Conservation Administrator, and included the Town Manager, Assistant Town Manager, Assistant Town Planner, GIS Coordinator, Public Works Department, Town Engineer, Police Chief, Police Captain, Fire Chief, Harbormaster, and several Administrative Assistants. For a full list of LPT members and their departmental affiliations, see Appendix B. The LPT met for 1 kick-off meeting and 5 working meetings during the Plan development process; agendas for each are provided in Appendix B. The 2022 MHMP was funded through a Town Meeting Article for funding of improved coastal resiliency. In addition to the LPT input, public participation in the hazard mitigation planning process is also important, both for plan development and for implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historic and potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding about the hazard mitigation process and potentially creates support for future mitigation actions. Public presentations were held on March 24, 2022 at the Local Emergency Planning Committee (LEPC) meeting and on July 25, 2022 at a Board of Selectmen meeting. These presentations were advertised on the Town of Falmouth website and via LEPC social media posts. Both meetings were held in-person; the Board of Selectmen meeting was also available for live viewing on Falmouth Community TV. Video recordings of the meetings are available on the FCTV web site for residents to view when they are able.

A1.c
A2.a-c
A3.a-b

Copies of the announcements for the public presentations, as well as a master list of LPT members, are provided in Appendix B. These materials provide a foundation for understanding the planning process and major decisions made along the way and can help provide crucial background information the next time the LPT meets to review and update the MHMP.

The following steps were taken during the planning process:

- 1) Develop an LPT responsible for updating this Plan;
- 2) Define the potential natural hazards that could affect Falmouth;
- 3) Determine hazard locations and critical infrastructure potentially affected;



- 4) Conduct a vulnerability assessment of buildings and infrastructure;
- 5) Outline existing hazard mitigation measures and progress on the 2017 Plan's actions;
- 6) Determine gaps in hazard mitigation preparedness;
- 7) Define proposed hazard mitigation measures to fill these gaps; and
- 8) Evaluate the feasibility of and prioritize mitigation measures.

The above steps will allow implementation of proposed mitigation measures with a goal of reducing damage and improving public safety during a natural disaster. To solicit public comment, the draft Plan was posted on the Town of Falmouth's website and directions for how to submit questions or comments was provided. A screenshot documenting the website posting is provided in Appendix B. The draft Plan was also presented at the July 25, 2022 Board of Selectmen meeting to gather additional public input. Comments received during the meeting are included in Appendix B. Advertising for the public hearing included posting an announcement on the Town website and in the local paper, copies of which are included in Appendix B. The draft plan was posted on the website for 2 weeks prior to finalization. Comments and responses are provided in the comment response document in Appendix B.

A2.a
A2.b

The draft Plan was also sent to Town Planners in Bourne, Sandwich, and Mashpee, as well as the Cape Cod Commission (CCC) for review and comment. A copy of the email sent to these neighboring towns and regional planning body soliciting their feedback on the Plan is also provided in Appendix B.

A4.a
A4.b

During the preparation of this Plan, several existing studies and documents related to Falmouth and the surrounding area were reviewed. Preparation of this Plan borrowed from the following plans and documents where appropriate:

- Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018);
- Barnstable County Hazard Mitigation Plan (2010);
- Cape Cod Emergency Traffic Plan (2008);
- Falmouth Capital Improvement Plan (2021);
- Falmouth 5-Year Strategic Plan (2017-2021);
- Falmouth Community Preservation Plan (2020);
- Falmouth Comprehensive Emergency Management Plan (2020);
- Falmouth Climate Change Vulnerability Assessment and Adaptation Planning (2020);
- Municipal Vulnerability Preparedness (MVP) Workshop Summary of Findings (2018);
- Coastal Resiliency Planning for the Surf Drive Area (2020);
- Report on Coastal Resiliency Falmouth Massachusetts (2021);
- Falmouth Local Comprehensive Plan (2016);
- Falmouth Open Space and Recreation Plan (2014);
- Falmouth Historic Preservation Plan (2014); and
- Local bylaws and regulations.



The 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) was developed through a collaborative process that involved numerous state agencies, a large cross-section of stakeholders, members of the public, working groups, and a consulting team. This was the SHMCAP's eighth revision from its initial preparation in 1986, but this version is unique in that it is the first-of-its-kind statewide plan that fully integrates a traditional hazard mitigation plan with a climate change adaptation plan.

In 2010, the Cape Cod Commission drafted a Multi-Hazard Mitigation Plan for Barnstable County. The Commission worked with all 15 communities, including Falmouth, to assess hazards, evaluate vulnerable areas, and recommend planning and infrastructure improvements. Although this 2010 Barnstable County Plan was never approved by FEMA, it does provide a great deal of background information about local hazards and assessing vulnerability.

The 2018 Cape Cod Emergency Traffic Plan was developed by federal, state, and local agencies to manage traffic operations during hazardous weather that results in an exodus from areas of Cape Cod. The document defines procedures, details the concept of operations, and assigns responsibilities for implementation.

The 2021 Falmouth Capital Improvement Plan is a ten-year planning schedule identifying capital projects and equipment purchases for the Town as well as project goals and performance measurements.

The Falmouth 5-Year Strategic Plan for Fiscal 2017-2021 was developed in July of 2016 by the Falmouth Board of Selectmen. The plan establishes policy objectives for the Departments, Boards, Committees and Commission of the Town. The Board voted to affirm five Strategic Priority areas which include producing a long-term strategic vision plan, financial and economic stability and community development, coastal resources, resource conservation and management water and wastewater management, and health and public safety.

The Falmouth Community Preservation Plan was created in 2020 to outline community preservation goals, which include acquisition and preservation of open space and land for recreational use, creating and preserving community housing, and protecting historical buildings and landscapes. In addition, the document also details requirements given in the Community Preservation Act (CPA) Massachusetts Law (Chapter 44B) and guidelines for project submission.

The Falmouth Comprehensive Emergency Management Plan from 2020 provides a framework for effective preparedness, mitigation, response, and recovery to preserve public welfare and safety. The plan lists responsibilities of each department in an emergency scenario, the most likely threats and hazards facing the Town, and protocols for regional and state communication during and after a disaster.

The Falmouth Climate Change Vulnerability Assessment and Adaptation Plan prepared in 2020 utilized results from modeling of coastal inundation and wetland migration to assess the vulnerability of critical public assets to flooding, both now and through the year 2070. Adaptation



strategies were developed for municipal infrastructure and natural resources. Regional strategies and recommendations for policy and regulation changes were also made.

The Municipal Vulnerability Preparedness (MVP) Workshop Summary of Findings document (workshop conducted in March of 2018) provides an overview of the MVP workshop process including participation of attendees, top hazards identified, vulnerable areas of the town discussed, and natural hazard planning. In addition, participants developed recommendations to improve community resilience within small discussion groups.

The 2020 Coastal Resiliency Planning Study for Surf Drive utilized MVP grant funding to complete a detailed coastal resiliency planning study for the Surf Drive area, identified in an earlier study as one of the most vulnerable areas of Town. The study utilized a conceptual phased management approach to improve coastal resiliency by identifying key time frames and sea level thresholds for action. Resilience actions were grouped into the following themes, natural resources, connection, protection, and managed retreat.

The Report on Coastal Resiliency Falmouth Massachusetts was prepared in 2021 by the Coastal Resiliency Action Committee. The purpose of the report is to prepare action plans to help the town better understand and address the risks and hazards to coastal infrastructure and coastal properties that may be caused by coastal erosion, storms, and sea level rise. The report contains data and recommendations for near-, mid- and long-term actions to improve resiliency to coastal hazards within the Town of Falmouth.

The Falmouth Local Comprehensive Plan was prepared by the Local planning Committee as a tool to communicate community goals to Town boards, departments, committees, commissions, and other interested parties. The document outlines goals and policies on eight elements from Land Use to Coastal Resiliency and was last updated by the Planning Board in 2016.

The Falmouth Open Space and Recreation Plan provides a guide as to how to maintain and expand resources available for the public's enjoyment. Updates to the Plan in 2014 included increasing open and recreational spaces as well as the amount of green infrastructure within the community.

The Falmouth Historic Preservation Plan outlines recommendations to implement historic preservation with the Town. In 2014, the two Chairmen of Falmouth's Historical Commission and Historic District Commission with support of the Town's Planning Department the Cape Cod Commission, and various stakeholders for the Town, determined actions that should be taken to support historic preservation in Falmouth over the next three to ten years.

Various town departments and boards have implemented and updated bylaws and regulations as necessary to control development and ensure safe construction methods that adhere to current best management practices. The Falmouth Planning Board, Conservation Commission, and Building Department are the primary town agencies responsible for regulating development in the town. More specifically, these boards regulate development through the Zoning Bylaw and



the Falmouth Wetlands Protection Bylaw. Feedback to these boards was ensured through the participation of their Town staff liaisons (i.e., Town Planner, Conservation Administrator, etc.) on the LPT.

Technical information from the plans, regulations, and bylaws described above was incorporated into this Falmouth Multi-Hazard Mitigation Plan in a number of ways, including by:

- 1) Guiding the planning process;
- 2) Helping develop mitigation actions;
- 3) Providing recent data on various hazards and their impacts; and
- 4) Ensuring that mitigation actions in this plan were consistent with current state and local activities and plans.

1.3 PLAN DESCRIPTION

A1.d

FEMA developed a “Local Mitigation Review Guide” (Guide) to ensure Local Hazard Mitigation Plans meet the requirements of the Stafford Act and Title 44 Code of Federal Regulations (CFR) 201.6. This Guide was used as a tool in developing this Plan. For ease of assessment, when the text addresses an element of the Guide, it is identified in a colored bullet in the margin.

1.4 PREVIOUS FEDERAL/STATE DISASTERS

The Town of Falmouth has experienced 5 natural hazards that triggered federal or state disaster declarations since 2010 (FEMA 2021a). These are listed in Table 1-1 below. The vast majority of these events involved flooding. Only one of these events has occurred since the previous Falmouth MHMP in 2017, which was a Severe Winter Storm Disaster from March 2-3, 2018.

Table 1-1. Disaster Declarations for the Town of Falmouth Since 2011.

Disaster Name	Type of Assistance	Declared Areas
Tropical Storm Irene (August 27-29, 2011)	FEMA Public Assistance and Hazard Mitigation Grant Program	Counties of Plymouth, Barnstable, Berkshire, Bristol, Dukes, Franklin, Hampden, Hampshire, & Norfolk
Hurricane Sandy (Oct 27 – Nov 8, 2012)	FEMA Public Assistance and Hazard Mitigation Grant Program	Counties of Plymouth, Barnstable, Bristol, Dukes, Nantucket, & Suffolk
Severe Winter Storm (February 8-10, 2013)	FEMA Public Assistance and Hazard Mitigation Grant Program	All 14 MA Counties
Severe Winter Storm (January 26-28, 2015)	FEMA Public Assistance and Hazard Mitigation Grant Program	Counties of Plymouth, Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Suffolk & Worcester
Severe Winter Storm (March 2-3, 2018)	FEMA Public & Individual Assistance	Counties of Plymouth, Barnstable, Bristol, Nantucket, Norfolk & Essex



1.5 CLIMATE CHANGE

Although this plan is focused on specific natural hazards (e.g., flooding, hurricanes, wind, extreme precipitation, etc.), it is important to consider how each of these hazards will be affected by climate change in the future, and how, in some cases, the effects of climate change are already being felt. Climate change is already intensifying natural hazards, resulting in changes to precipitation patterns, sea level rise, increased temperatures, and more extreme weather. Climate change will continue to alter these natural hazards, in most cases increasing their severity, duration, or frequency. In the face of climate change, it is critical for the Town to build long-term resilience by leveraging historical risk data, integrating data on project future climate conditions, and developing and implementing actions that will reduce the Town's overall risk.



One of the first steps in hazard mitigation planning is to identify and define the Town's assets. Without a detailed and accurate understanding of the infrastructural, societal, and environmental resources present within the Town, it is impossible to develop a plan to protect them. The goal of this chapter is to provide a local profile, detailing the community's assets, the Town's geography and climate, an overview of the Town's environmental resources, the Town's land use and demographic patterns, the locations of major infrastructure and critical facilities, and historical locations throughout Town.

Although all community assets may be affected by natural hazards at times, some assets and infrastructure are more vulnerable because of their physical characteristics, location, or socioeconomic uses. This asset inventory will help support the vulnerability analysis conducted in Chapter 4, which will identify specific vulnerable assets within the Town of Falmouth.



2.1 OVERVIEW

The Town of Falmouth is a coastal community located in Barnstable County, Massachusetts. It was incorporated in 1686. As of the 2020 census, the population of Falmouth was 32,517. This number increases during the summer months with seasonal residents and visitors. The Town has a traditional New England government structure with a five-member Select Board, a Town Manager, and Town Meeting attended by elected members from each voting precinct. Among the basic services provided to the residents are public safety, schools, water, sewer, garbage collection, recreational facilities, and public libraries. Falmouth operates its own Wastewater Treatment Plant, which provides sewage treatment services to approximately 11% of the Town's developed properties. Fire protection is provided exclusively by the Falmouth Fire Department, led by a Fire Chief.

The Town maintains a website at: <https://www.falmouthma.gov/>

2.2 GEOGRAPHY

Falmouth is located in Cape Cod, Massachusetts and is bordered by Buzzards Bay and the Vineyard Sound. Both shorelines experience a dynamic environment, resulting in erosion. Marsh systems are present throughout the Town, including Little and Great Sippewissett Marsh along the Buzzards Bay shoreline. The shoreline along the Vineyard Sound includes a number of salt ponds. With numerous estuaries and coves, waterways are one of the Town's greatest assets, which not only spurred early maritime industries, but provides multiple coastal outlets and harbors protecting commercial and recreational boaters and beaches to draw summer vacationers.

Falmouth is approximately 54 square miles in area. The Town is located approximately 3 miles northeast of Martha's Vineyard and 77 miles southeast of Boston. Falmouth is bordered by Bourne and Sandwich to the North and Mashpee to the east.

2.3 CLIMATE

Falmouth averages 49 inches of precipitation per year. Average temperatures range from highs in the 70's (Fahrenheit) during the summer months to lows in the low 20's during winter months. Falmouth's location along Buzzards Bay and the Vineyard Sound generally keeps temperatures cooler in the summer and warmer in the winter relative to other nearby inland communities at the same latitude.

2.4 NATURAL ENVIRONMENT

Falmouth's natural environment and natural resources are important to the Town's identity and quality of life. In fact, one of the most important factors in why people move to and visit Falmouth is its natural environment and coastal features. The Town has a varied landscape, with large stretches of open space, forested land, and upland, as well as coastal salt marshes, sandy beaches, and protected harbors. These natural resources support the economy through tourism and recreation, in addition to a variety of other ecosystem services, such as clean air and water.



The natural environment also increases resiliency and reduces hazard impacts, through flood attenuation as wetland areas absorb flood waters, through stormwater management as rainwater drains through the soil, and through erosion control as vegetation secures soil along coastal banks and dunes. Salt marshes are an important first line of defense against storms and provide invaluable ecosystem services to the Town. However, the long-term health of salt marshes is threatened by sea level rise. Without suitable landward areas (e.g., of an appropriate slope and elevation, undeveloped, etc.) for salt marshes to migrate into, there will likely be an overall reduction in total salt marsh area over time. The Town supports efforts to promote or enhance the health of existing salt marshes and recognizes the long-term challenge of sea level rise's impact on salt marsh habitat.

2.5 LAND USE

D1.a

During the colonial period, Falmouth relied upon agricultural and maritime industries to support the local economy. Early industries including raising sheep and farming. Like many coastal Massachusetts towns, Falmouth also relied on marine industries such as commercial fishing, the coastal trade, whaling, salt production, and building ships. By the late 1800s, the Town was also farming cranberries and strawberries for local markets including in Boston. Today, the Town of Falmouth still depends on maritime industries, as well as summer tourism as the many beaches provide recreational opportunities.

Figure 2-1 and Table 2-1 depict the 2021 assessor's parcel dataset categorized by land use. The largest category by area is residential (single family) for a total of 35% of Falmouth's total area. The next largest categories by area are open space, public services, vacant, residential (multi-family), and recreation making up 20%, 19%, 12%, 4%, and 4% of Falmouth's area, respectively. This categorization reflects the classifications used in the 2017 Falmouth Multi Hazard Mitigation Plan. There has not been any major development or land use changes since the 2017 Multi Hazard Mitigation Plan that impacts risk level or vulnerability to hazards. In addition, there is no planned development in Falmouth that would affect the Town's vulnerability.



**Table 2-1. Number of Parcels in Each Land Use Classification.**

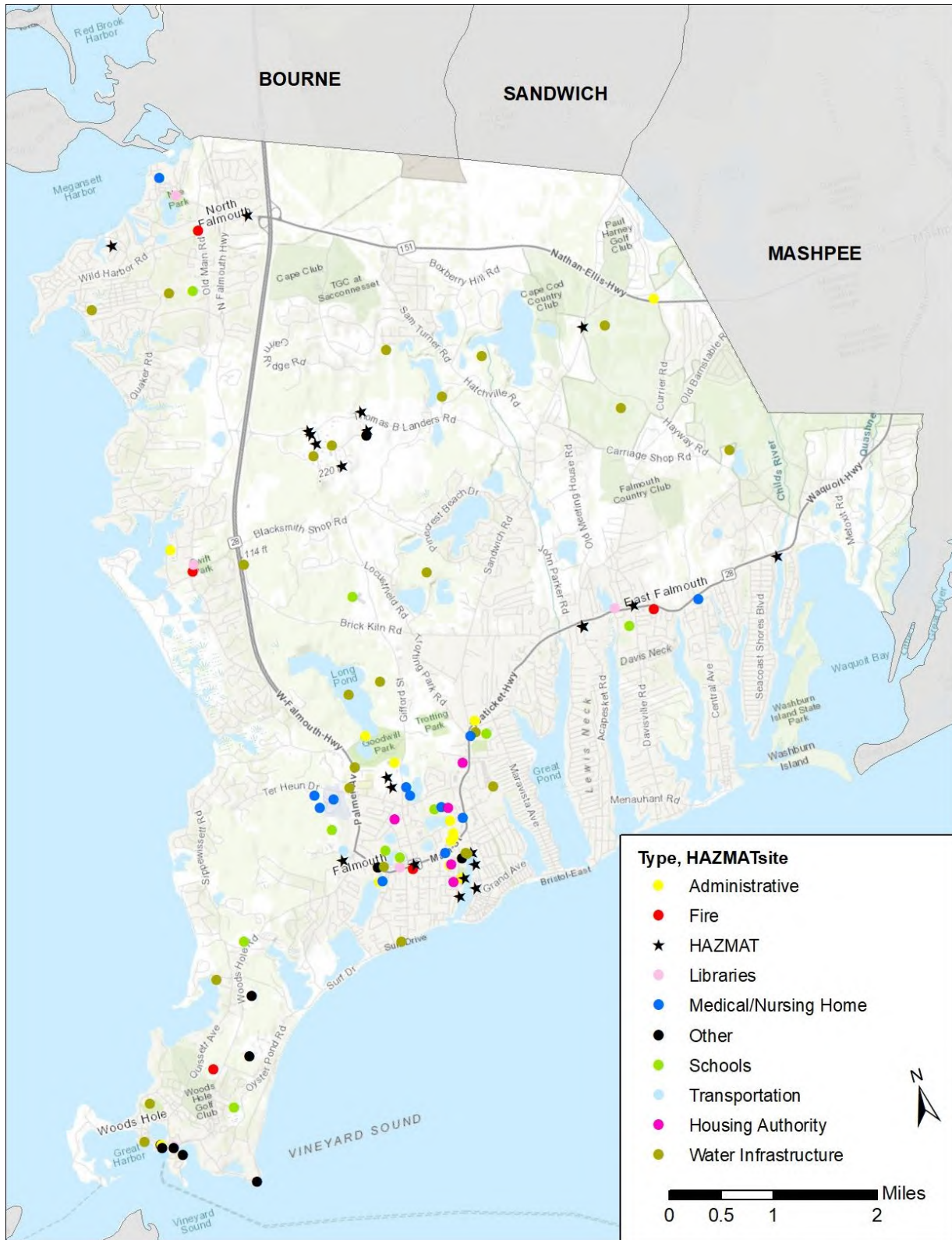
Land Use Type	Number of Parcels
Residential (Single Family)	18,636
Residential (Multi-Family)	882
Temporary Lodging	44
Commercial (Retail/Offices/Services)	385
Commercial (Manufacturing/Distribution)	86
Public Services	421
Agriculture	28
Open Space	821
Recreation	91
Vacant	2,015

2.6 TRANSPORTATION

The Town of Falmouth includes several major transportation corridors including Route 28 and Route 151. The Woods Hole, Martha's Vineyard, and Nantucket Steamship Authority is also located in Woods Hole, Falmouth and provides daily service to the islands. Falmouth contains a private airfield, while the nearest regional airport is located in Hyannis and the nearest international airport being Boston Logan Airport. Bus services are provided by Cape Cod Regional Transit Authority, Peter Pan, and Plymouth Brockton bus companies.

2.7 CRITICAL FACILITIES

Critical facilities are those that are essential to the health and welfare of the Town and those that are especially important for response and recovery following hazard events. Critical facilities include buildings and infrastructure such as emergency operations centers, critical municipal buildings, water and wastewater facilities, schools, churches, marinas, etc. The LPT developed a list of critical facilities, which is provided in Appendix C. The critical facilities in Falmouth are shown in Figure 2-2; the numbers correspond to the list in Appendix C. A portion of these critical facilities are located within high hazard areas, such as floodplains. However, due to the importance of these facilities, special care must be taken to ensure continued operation even during disaster events.





2.8 HISTORICAL PROPERTIES

The Town of Falmouth has many areas and landmarks of historical significance, including seven historic districts, four of which are on the National Register of Historic Places. Falmouth also has ten additional historic sites listed on the National Register. Historic districts and sites are described below.

- 1) **Falmouth Village Green** – Listed on the National Register of Historic Places, Falmouth Village Green has been the Town center since 1756 and includes late Colonial and Federal period architecture.
- 2) **North Falmouth Village** - Listed on the National Register of Historic Places, North Falmouth Village was primarily developed over the 19th century to support maritime activities on Buzzards Bay.
- 3) **Waquoit** - Listed on the National Register of Historic Places, Waquoit Village is located at the head of Waquoit Bay and includes primarily residential properties.
- 4) **West Falmouth Village** - Listed on the National Register of Historic Places, West Falmouth Village is located south of Bourne Farm and was settled in 1673. Historic buildings located within West Falmouth include the Quaker Meeting House, Quaker Carriage Sheds, and the Emerson House.
- 5) **Woods Hole** – Woods Hole village is located at the extreme southwest corner of Cape Cod, near Martha's Vineyard. This village is home to several premier scientific institutions including Woods Hole Oceanographic Institute, the Marine Biological Laboratory, the Woodwell Climate Research Center, NOAA Northeast Fisheries Science Center, USGS Coastal and Marine Science Center, and the Sea Education Association.
- 6) **Davisville** – Davisville is located along the Vineyard Sound shoreline of Falmouth, between Green Pond and Bourne's Pond. The area contains marinas, beaches, and residential developments.
- 7) **Quissett** – Historic Quissett is located north of Woods Hole and contains Quissett Harbor and several marine based facilities such as the Quissett Yacht Club as well as residential development.
- 8) **Central Fire Station** – Located at 399 Main Street, the two-story brick fire station was built in 1929, renovated in 2021, and is still operational today.
- 9) **Crowell-Bourne Farm** – This property includes 49 acres of fields and woods as well as a historic farmhouse built in 1775.
- 10) **Elnathan Nye House** – Built in 1735 and located at 33 Old Main Road in North Falmouth, this structure was built by Elnathan Nye, a prominent citizen of Falmouth.
- 11) **Falmouth Pumping Station** – The pumping station complex was built in 1898 in the Queen Anne style and was designed by Ernest Boyden.
- 12) **Josiah Tobey House** – This structure was built in 1854 in the Greek Revival style for Josiah Tobey.



- 13) Lawrence Academy** – Located to 20 Academy Lane, this structure was historically used as a school building. Also built in the Greek Revival style, the building serves as a private academy before being used for veteran’s organizations, and currently as the Falmouth Chamber of Commerce.
- 14) Nobska Light** – This lighthouse is located near the intersection of Buzzards Bay and the Vineyard Sound within Woods Hole. The lighthouse was originally built in 1826.
- 15) Poor House and Methodist Cemetery** – Located on 744 Main Street, this structure was built in 1809 and served the mentally ill and poor until 1963. Adjacent to the building is a cemetery where residents were buried. After 1963, the building was used by the Historical Commission and by the Falmouth Artists Guild but is presently vacant.
- 16) Teaticket School** – This school building was built in 1927 in the Colonial Revival style. After 1967, the building has served as the Administration Building for Falmouth Public Schools.
- 17) Woods Hole School** – Located at 24 School Street in Woods Hole, this structure was built in 1870. Currently, the building houses the Children’s School of Science in the summer and the Woods Hole Daycare Cooperative in the winter.

B4.a

2.9 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. In 2017 FEMA reported a total of 26 residential properties in Falmouth with repetitive losses. Data current to 2022 was not released by FEMA in time for preparation of this plan update.



Falmouth is vulnerable to a wide range of natural hazards that can threaten the people, economy, infrastructure, and natural resources of the Town. As suggested under FEMA planning guidance, the Town of Falmouth reviewed the full range of natural hazards identified in the most recent Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018), which included:

- | | |
|--|--|
| 1) Inland Flooding | 8) Drought |
| 2) Coastal Flooding | 9) Average/Extreme Temperature |
| 3) Coastal Erosion | 10) Earthquake |
| 4) Hurricanes and Tropical Storms | 11) Invasive Species |
| 5) Severe Winter Storms (snow, blizzards, ice storms, Nor'easters) | 12) Other Severe Weather (heavy precipitation, high wind, thunder/lightning) |
| 6) Wildfire | 13) Landslide |
| 7) Tornadoes | 14) Tsunami |

In addition to the hazards above, the Town of Falmouth also included Dam/Culvert Failure and Freshwater Quality as additional hazards. This chapter provides a description of each hazard, the location(s) within Falmouth that are impacted by each hazard, previous occurrences of each hazard, the possible magnitude of each hazard, the probability of each hazard occurring in a given year, and some of the impacts that can happen in the event that hazard occurs.



B1.a

FEMA defines a hazard as an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing. All natural disasters pose hazards to property, loss of human life, and have the ability to limit access to power, communication services, water, wastewater collection/treatment, and transportation. Downed trees and limbs also limit emergency access and complicate cleanup efforts. Through the development of this Plan, Falmouth is taking steps to protect its infrastructure from natural disasters as much as possible, such that essential utilities and services continue when most needed. Hazards associated with natural disasters typically encountered in Falmouth include coastal flooding, winter weather, and other severe weather. Natural disasters occurring less frequently, such as tornadoes, earthquakes, or landslides, pose less frequent but unique challenges.

The 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan identifies 14 natural hazards that could have an impact on communities in the Commonwealth of Massachusetts. These hazards are:

- | | |
|-----------------------------------|--------------------------------|
| 1) Inland Flooding | 8) Drought |
| 2) Coastal Flooding | 9) Average/Extreme Temperature |
| 3) Coastal Erosion | 10) Earthquake |
| 4) Hurricanes and Tropical Storms | 11) Invasive Species |
| 5) Severe Winter Storms | 12) Other Severe Weather |
| 6) Wildfire | 13) Landslide |
| 7) Tornadoes | 14) Tsunami |

B1.b

As suggested under FEMA planning guidance (FEMA, 2011), the Town of Falmouth reviewed the full range of natural hazards identified in the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan. Also, given some particularly problematic culverts and issues with the water quality of inlands ponds, the Town also evaluated dam/culvert failure and water quality. The full list of hazards addressed in this plan is provided in the call out box below. In addition to the 2018 State Plan, other resources consulted during the drafting of this plan included news articles and other media sources, as well as local knowledge from LPT members. All resources are referenced in the text of each hazard profile.

Hazards Addressed in Detail in the Falmouth Multi-Hazard Mitigation Plan

- | | | |
|--------------------------------|--------------------|--------------------------|
| 1. Flooding (Coastal & Inland) | 6. Tornado | 10. Invasive Species |
| 2. Coastal Erosion | 7. Drought | 11. Other Severe Weather |
| 3. Hurricane/Tropical Storm | 8. Average/Extreme | 12. Landslide |
| 4. Severe Winter Storm | Temperature | 13. Tsunami |
| 5. Wildfire | 9. Earthquake | 14. Dam/Culvert Failure |
| | | 15. Freshwater Quality |



3.1 FLOODING (COASTAL & INLAND)

Overview

Flooding was identified as one of the top hazards in Falmouth according to the LPT and the MVP Workshop. Flooding can be caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Sea-level rise also has the potential to exacerbate these flooding issues in the future.

The Town of Falmouth is subject to two kinds of flooding: coastal flooding where wind, tides, waves, and storm surge lead to flooding low lying coastal areas, and inland flooding where heavy precipitation overwhelms the capacity of natural and structured drainage systems to convey water away from roads and other areas of concern, causing it to overflow the system. Although the Town of Falmouth experiences the majority of its flooding from coastal storm events, these two types of flooding are often related as inland flooding is prevented from draining by wind and tide driven coastal water. Both types of flooding can be caused by major storms, such as nor'easters and hurricanes. Nor'easters can occur at any time of the year, but they are most common in winter. Hurricanes are most common in the summer and early fall. Due to Falmouth's geographic position along Buzzards Bay and the Vineyard Sound, the Town is somewhat protected from significant flooding impacts due to nor'easters but is extremely vulnerable to the high storm surges that would result if a hurricane were to track directly towards the Town. Despite some geographical protection from nor'easters, these storms tend to cover a larger area than hurricanes and tend to last longer, resulting in storm conditions coinciding with at least one high tide – a combination that results in the most severe flooding. Large rainstorms or snowfalls can also lead to inland flooding. See later sections for more specific details on those natural hazards.

Many of the Town's ponds and waterways remain tidally influenced despite being located somewhat inland, meaning inland flooding is closely tied to coastal flooding conditions. Much of this type of flooding is contained within existing wetland areas, reinforcing the need to protect and maintain these areas as a mitigation measure. High tides and coastal flooding can prevent water from draining out of the streams and stormwater conveyance systems. This can result in flooding that occurs well away from coastal areas.

Flooding due to storm run-off that overwhelms the carrying capacity of storm water infrastructure can be exacerbated by poor design or poor maintenance. Flooding from blocked drainage occurs in flat or depressional areas where runoff or rain collects but cannot drain out. Drainage systems are made up of ditches, storm drains, retention ponds, and other infrastructure designed to transport storm water away from roadways and parking lots, to receiving streams, bays, and/or the ocean. Large storms can overwhelm these systems and blocked or clogged drainage ditches and culverts can inhibit the flow of water, resulting in back-ups and ponding. Water will remain in an area until it infiltrates into the soil, evaporates, the blockage is cleared, or the water is actively pumped out.



Coastal flooding results from storm surge, which occurs when water is pushed onshore during powerful storms, such as hurricanes and nor'easters, and can raise the water level by several feet (Figure 3-1). Storm surges are easily capable of inundating low-lying areas, and waves associated with coastal storms can be highly destructive as they move inland, battering buildings, structures, and infrastructure in their path. However, the magnitude of flooding is strongly influenced by the tides; storm surge that occurs during a high tide will inundate a larger area than if the same surge occurs at low tide. A storm surge coinciding with a high tide event can devastate coastal features such as piers, floats, docks, and boats.



Figure 3-1. Storm surge during Winter Storm Riley from March 2nd to 4th, 2018.

Hazard Location

B1.c
B2.a

Figure 3-2 shows the Effective 2021 FEMA Flood Insurance Rate Map (FIRM) for Falmouth. These areas represent the risk of flooding from a 100-year storm. This map depicts the areas of Falmouth in AE, AO, and VE zones and within the 0.2% flood area (an area expected to be inundated during a 500-year storm event). The different FEMA flood zones are defined as follows:

- AE Zones, also within the 100-year flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet.
- AO Zones, representing coastal hazard areas that are mapped with flood depths instead of base flood elevations. Depths are mapped from 1 to 3 feet, in whole-foot increments.



These areas are generally located in areas of sheet flow and runoff from coastal flooding where a BFE cannot be established.

- VE Zones, also known as the coastal high hazard areas, are defined by the 1% annual chance flood limits and wave effects 3 feet or greater. The hazard zone is mapped with base flood elevations (BFEs) that reflect the combined influence of stillwater flood elevations, primary frontal dunes, and wave effects 3 feet or greater.

Recent post-storm field visits and laboratory tests throughout coastal flood hazard areas in the U.S. have consistently confirmed that wave heights as low as 1.5 feet can cause significant damage to structures that are constructed without considering coastal hazards. To address this, FEMA has added a line of the FIRMs called the Limit of Moderate Wave Action (LiMWA). The LiMWA marks the inland limit of the Coastal A Zone, which is the part of the coastal Special Flood Hazard Area where wave heights can be between 1.5 and 3.0 feet during the base flood event. This area is subject to flood hazards associated with floating debris and high-velocity flow associated with waves and debris that can erode and scour building foundations and, in extreme cases, cause foundation failure. The LiMWA is shown in Figure 3-2. FEMA, MEMA, and Massachusetts Coastal Zone Management (CZM) recommend building to V Zone standards in the Coastal A Zone, but currently the regulations do not require it.

Localized flooding as a result of blocked or undersized drainage infrastructure occurs in specific areas of town such as at the culvert at Maravista Avenue near the entrance to the Falmouth Mall, and at the intersection of Main Street and Falmouth Heights Road, which floods even during minor events.

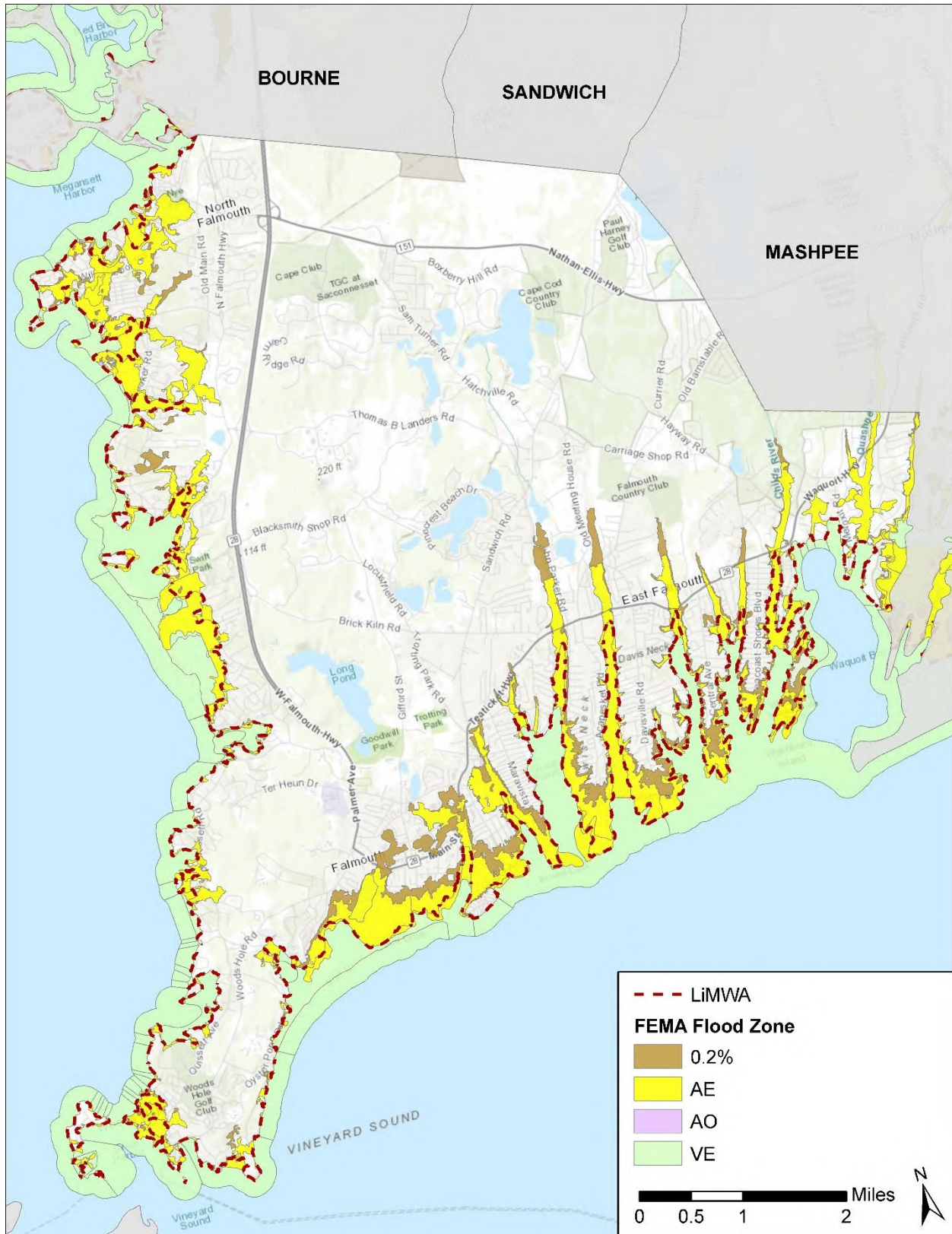


Figure 3-2. FEMA Special Flood Hazard Areas in Falmouth (Effective 2021).

***Previous Occurrences & Extent*****B1.c
B2.a,c**

Below is a list of major flooding events that have occurred in Falmouth from between 2017 and January 2022, from NOAA's NCEI Storm Events Database (NOAA, 2022), which lists a number of specific flooding incidents for Falmouth:

July 7, 2017: A low pressure system south of new England brought heavy down pour of 1 to 5 inches and thunderstorms. In Falmouth, Main Street and Palmer Avenue were closed due to impassable conditions. Approximately 3.75 inches of rain was reported in East Falmouth.

October 27, 2018: A low pressure system originating in the Gulf of Mexico traveled north to Central and Eastern Massachusetts resulting minor coastal flooding. In Falmouth, Surf Drive near Oyster Pond was closed due to impassable coastal flooding.

October 29, 2018: Localized flooding and waterspouts developed off the southern coast of Massachusetts and one waterspout briefly moved onshore in Woods Hole Village within the Town of Falmouth.

November 12, 2021: A strong southerly wind flow out ahead of an advancing cold front produced strong to damaging wind gusts and some heavy rain that caused street and basement flooding. In Falmouth, extensive flooding occurred on Gifford Street.

January 17, 2022: A strong low pressure system brought damaging winds along the south coast of Barnstable County with moderate coastal flooding. In Falmouth, coastal flooding was reported on Menauhant Road and Surf Drive near Oyster Pond Road.

The extent of flooding in the future, however, will impact a larger area of Falmouth. Sea-level rise refers to the increase in mean sea level over time. Global mean sea level (MSL) has been rising since the end of the last ice age approximately 11,000 years ago. Recently, sea-level rise (SLR) rates have accelerated, with unprecedented rates along the northeastern U.S. since the late 19th century (Kemp et al., 2011). Global sea-level rise is driven by several factors, including thermal expansion of ocean water and freshwater inputs from melting glaciers. Because sea level sets a baseline for storm surge, sea-level rise will exacerbate already existing coastal flood issues. As local sea level rises, it allows coastal storm surge to extend farther inland. With the higher sea levels predicted in 2030, 2050 and 2070, areas much farther inland will be at risk of being flooded. Although sea-level rise plays a substantial role, local flooding also depends on tides, natural and artificial barriers, and the contours of the land along the coast (Figure 3-3).

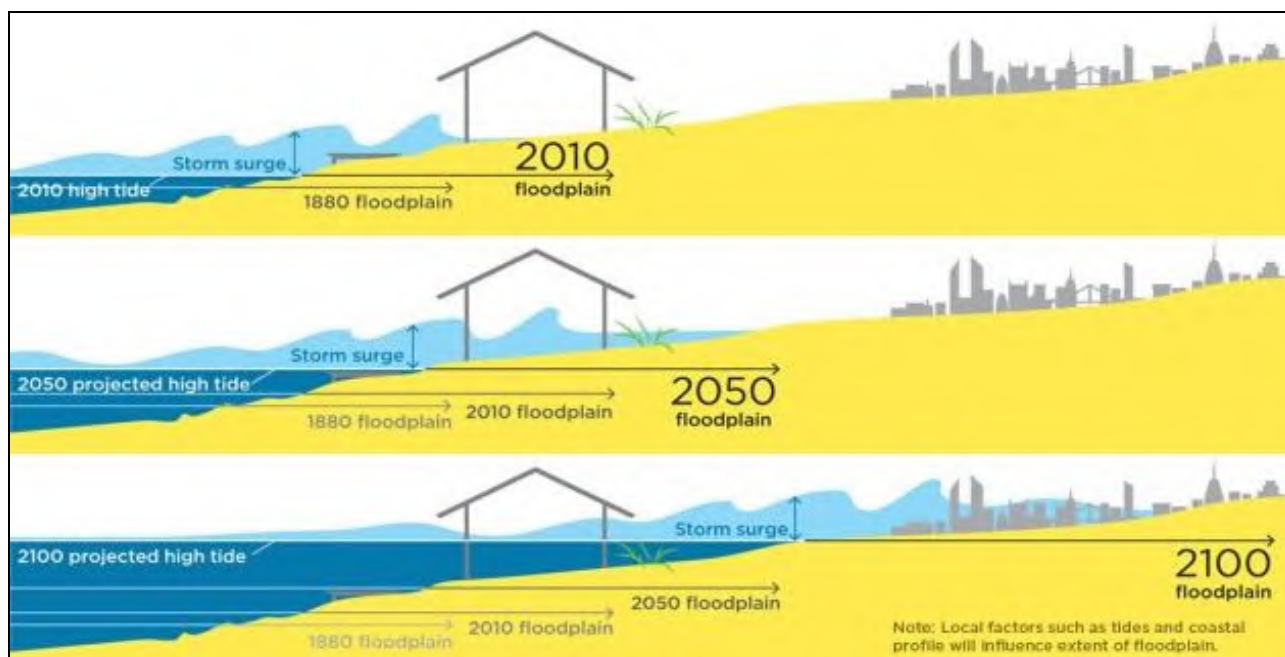


Figure 3-3. Sea-level rise magnifies the risks of storm surge and high tides (UCS, 2015).

The National Oceanic and Atmospheric Administration's (NOAA) Center for Operational Oceanographic Products and Services maintains a series of tide gages along the coast of Massachusetts. Records from NOAA's Woods Hole tide gage (station ID 8447930), indicate that our relative sea level has risen at a rate of 2.98 mm (+/- 0.17 mm) annually based on the monthly mean sea level between 1932 and 2021, resulting in a change of 0.98 feet (11.76 inches) in 100 years (Figure 3-4).

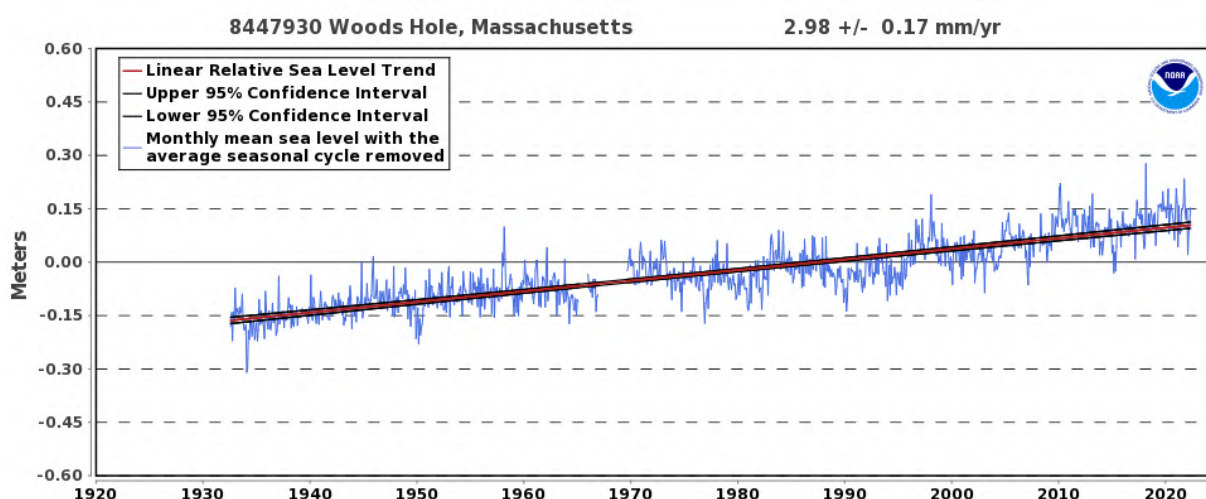


Figure 3-4. Sea-level rise trend from Woods Hole, Massachusetts (NOAA, 2022a).



Although the historical sea-level rise trend presented in Figure 3-4 is linear, this is not expected to continue. Global sea-level rise projections range from an additional 4.3 ft (under an intermediate sea level rise scenario) to 10.5 ft (under an extreme sea level rise scenario) by 2100.

The probability of inundation in present day, as well as in future out years, along the entire Massachusetts coastline has been calculated through the Massachusetts Coast Flood Risk Model (MC-FRM), which was developed for the Massachusetts Department of Transportation (MassDOT) (Bosma et al., 2019). The MC-FRM incorporates a full suite of processes that affect coastal water levels, including tides, waves, winds, storm surge, sea level rise, and wave set-up at a fine enough resolution to identify site-specific locations that may require adaptation alternatives. The MC-FRM provides fine-resolution data and is also superior to a more rudimentary “bathtub” approach, since the latter does not account for critical physical processes that occur during a storm event, including waves and winds, nor can it determine the limited volume of water that may be able to enter certain areas, particularly those with narrow entry points.

The data in Table 3-1 summarize the expected relative mean sea level elevations (relative to NAVD88) for various out-years under various sea-level rise scenarios. MassDOT chose to utilize the high sea level rise values as inputs to the MC-FRM; these values also correspond with the Massachusetts EEA recommendations for assessing sea-level rise (EEA, 2018). Note that the values in Table 3-1 are *elevations* of the projected mean sea level at various times relative to a vertical datum of NAVD88, not the *magnitude of change* in elevation. For comparison, the baseline (i.e., year 2000) mean sea level elevation, is -0.30 feet (NAVD88).

Table 3-1. Relative Mean Sea Level (feet, NAVD88).

	2030	2050	2070	2100
Intermediate	0.7	1.4	2.3	4.0
Intermediate-High	0.8	1.7	2.9	5.0
High	1.2	2.5	4.3	7.8
Extreme	1.4	3.1	5.4	10.2

Probabilistic flood risk maps for 2030, 2050, and 2070 are presented in Figures 3-5 through 3-7. The color-coded results represent the percent chance of flooding in any given year due to the combined impact of sea-level rise and storm surge. For example, areas shaded light purple have a 5-10% chance of flooding. In other words, these areas will flood in a 10 to 20-year storm event. Similarly, areas shaded in yellow have a 0.2-0.5% chance of flooding (i.e., will flood in a 200 to 500-year storm event).

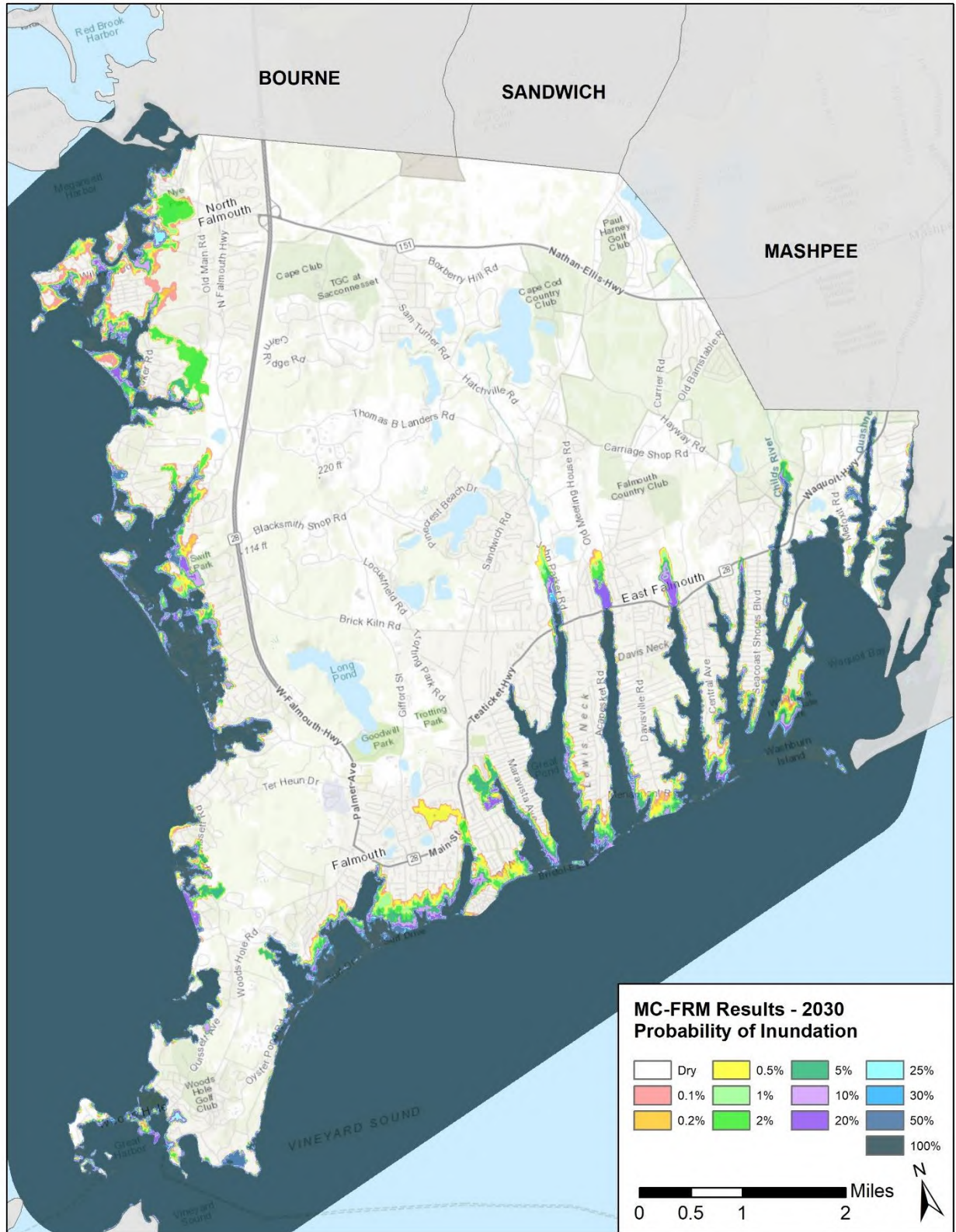


Figure 3-5. Probability of inundation in 2030 given assuming a high sea-level rise scenario (data from MC-FRM).

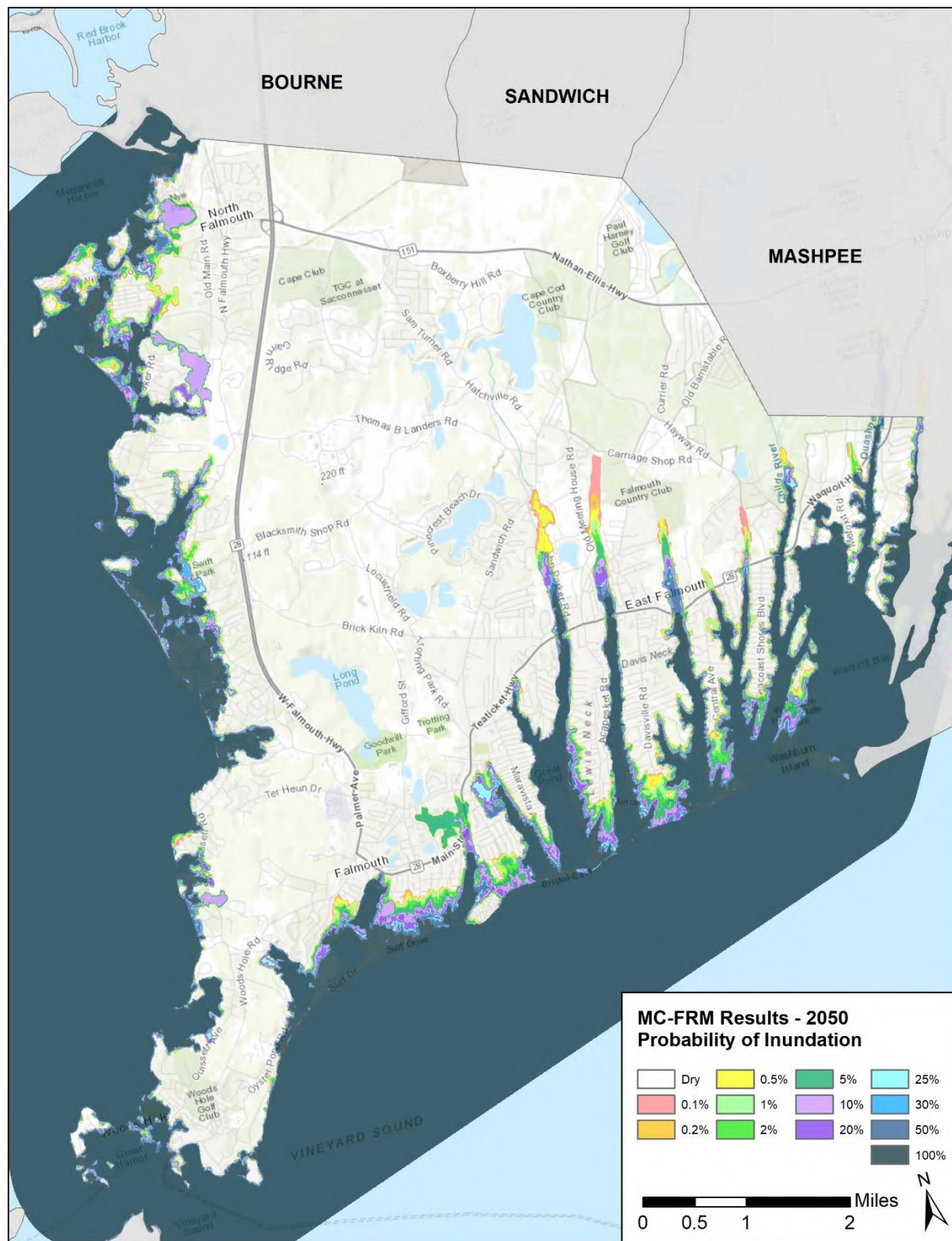


Figure 3-6. Probability of inundation in 2050 given assuming a high sea-level rise scenario (data from MC-FRM).

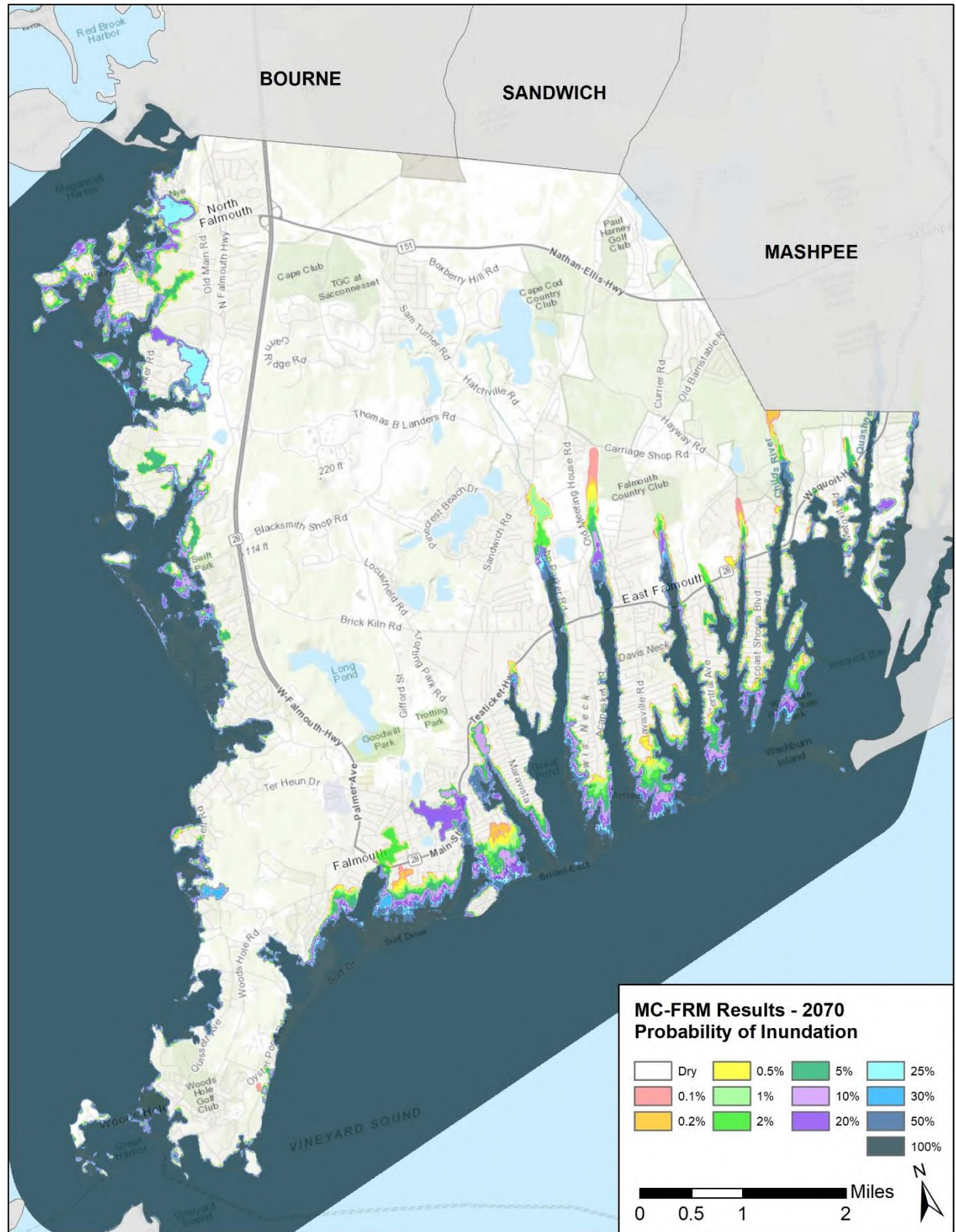


Figure 3-7. Probability of inundation in 2070 given assuming a high sea-level rise scenario (data from MC-FRM).



B2.b

Probability

Based on the frequency of past flooding occurrences described above, it is highly likely (near 100% probability in the next year) that flooding of some type will occur in Falmouth. However, climate change is projected to increase the frequency and intensity of severe weather events that can lead to major flooding events, such as heavy precipitation events, thunderstorms, or hurricanes. Considering projections of increased storm intensity as well as sea level rise, it is likely that in the future Falmouth will experience more severe and/or more frequent flooding.

B3.a

Impact

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

- **People:** People can be knocked down or washed off their feet while walking in floodwaters. Injury or death can result from people being trapped in their vehicles during a flood event. People can be displaced from their homes due to post-flood safety and health hazards. Also, intrusion of water into households can lead to health and respiratory issues caused by the development of mold and mildew.
- **Emergency Response:** Flooded roadways can inhibit response access and emergency evacuation.
- **Infrastructure:** Flooding causes debris and sediment deposits on Town infrastructure and roads. Storm surges and associated waves can damage utility poles, roadways, water mains, sewer pipes and other Town infrastructure. Potential loss of potable drinking water in flooded areas due to the need to shut valves to protect the Town's drinking water supply.
- **Buildings:** Moving water associated with floods can damage buildings and other structures. Building foundations on or near the beach can be undermined by the velocity of floodwaters. Debris carried by flood waters can act as battering rams and damage buildings. Buildings can float off their foundations if not anchored properly. Basements can flood or can collapse due to external water pressure.
- **Economy:** Communication and infrastructure systems damaged during floods can disrupt economic activities and close businesses. Roadway disruptions due to flooding can reduce customer base. There can be economic losses associated with reduced value on coastal properties damaged by flooding.
- **Natural Systems:** Floods can deposit sediment and debris onto parks, beaches, marshes, and estuaries.
- **Transportation:** Floods can wash out bridges and culverts. Debris lodged in culverts can inhibit flow, causing additional flooding on the upstream side. There can be major disruptions to transit services.



3.2 COASTAL EROSION

Overview

Coastal shorelines—especially beaches, dunes, and banks—change constantly in response to winds, waves, tides, and other factors including seasonal variations, sea level rise and human alterations to the shoreline system. Every day, winds, waves, and currents move sand, pebbles and other materials along the shore or out to sea. This dynamic and continuous process of erosion, sediment transport, and accretion shapes 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 and currents, such as those generated by nor'easters.

B1.c
B2.a

Hazard Location

The Massachusetts Office of CZM has documented the rate of change of all ocean-facing shorelines of Massachusetts through their Shoreline Change Project (Thieler et al., 2013). Shorelines were delineated and evaluated to demonstrate trends from the mid-1800s to 2009. These data were then incorporated into MORIS, the Massachusetts Ocean Resource Information System (now referred to as MassMapper), to provide better access to the shoreline change data and to allow the public to view the data using the online tool.

Figure 3-8 displays the long-term shoreline change data in Falmouth from CZM's Shoreline Change Project. Long-term data ranges from 1895 to 2013 in Falmouth. Rates shown in Figure 3-8 are in feet per year, where negative values indicate erosion and positive values indicate accretion. Areas of more significant long-term erosion along the western shoreline include Chappaquoit Beach and Black Beach, north of Woodneck Beach, south of Gunning Point, and east of Gansett Point. Along the western shoreline of Falmouth, areas experiencing moderate to severe erosion include around Falmouth Heights, Fay Beach, and Surf Drive, near the Falmouth Yacht Club, and then most significantly from Little Pond to Washburn Island. There are very few accretional trends in the long term, limited to the northeast corner of Chappaquoit Point, sporadic locations along the southern shoreline, and at the eastern end of Washburn Island.

The more recent rates of shoreline change, between 1978 and 2013, are shown in Figure 3-9. Overall, short-term erosion rates indicate that the majority of the Falmouth shoreline is relatively stable. However, these rates may reflect more recent, proactive shoreline management efforts such as beach nourishment or other shoreline stabilization projects. Compared to the long-term erosion rates, in the short term, erosion has decreased in severity almost everywhere, with the exception of east of Gansett Point, western Menauhant Beach, and Washburn Island. In contrast to the long-term rates, short-term erosion rates do not indicate any areas are accreting substantially.

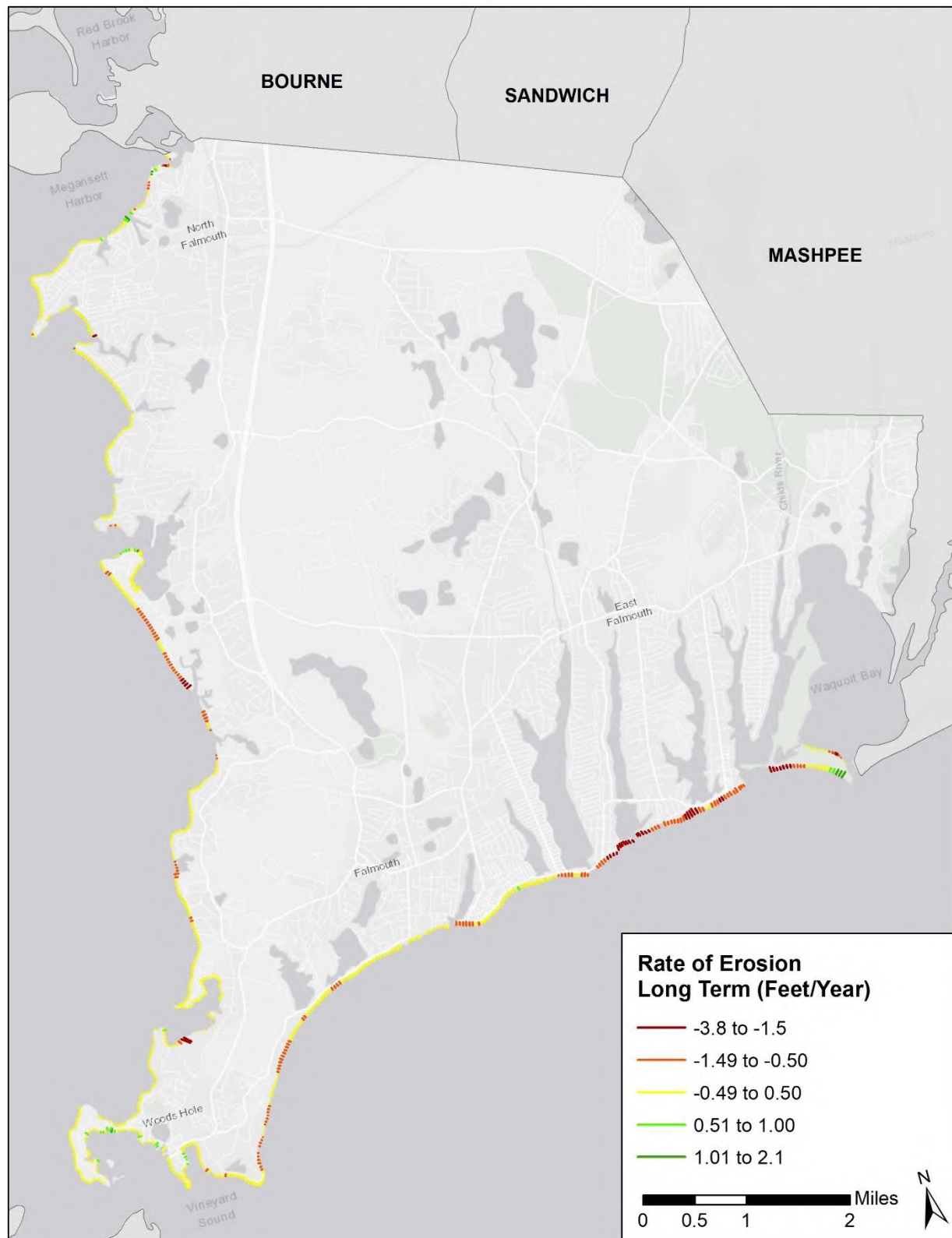


Figure 3-8. Long-term (1895 to 2013) rates of shoreline change (feet/year).



Figure 3-9. Short term (1978 to 2013) rates of shoreline change (feet/year).

The Report of the Massachusetts Coastal Erosion Commission tabulated the average shoreline change rate, in feet/year, for all coastal communities (CEC, 2015). The Coastal Erosion Commission (CEC) calculated both short- and long-term average rates of change: the average short-term rate of change for the entire Falmouth shoreline is -0.5 ft/yr, indicating erosion. The average long-term rate of change is -0.3 ft/yr, also indicating erosion. Average short- and long-term rates of change were also calculated for just the Nantucket Sound portion of shoreline (-1.1 ft/yr and -0.7 ft/yr, respectively) and for just the Buzzards Bay portion of shoreline (-0.3 ft/yr and -0.1 ft/yr, respectively). These results are consistent with the data from CZM's Shoreline Change Project.

B1.c
B2.a,c

Previous Occurrences & Extent

As shown in Figures 3-8 and 3-9, moderate to severe coastal erosion has occurred in Falmouth. Most notably, of the barrier beaches along the eastern shoreline of the Town separating salt ponds from the Nantucket Sound.



Figure 3-10. Severe weather events, such as a storm on October 17, 2019, can cause erosion.



B2.b

Probability

Based on the coastal erosion rates documented in the Massachusetts CZM Shoreline Change Project, it is highly likely (near 100% probability in the next year) that coastal erosion will occur in Falmouth; although the magnitude of these events may vary. As sea level rises and storms become more severe and frequent as a result of climate change, coastal and marine areas in Falmouth will likely experience increased rates of erosion.

B3.a

Impact

Below is a list of possible impacts that could result from coastal erosion:

- **People:** Public safety is jeopardized when buildings and structures collapse.
- **Emergency Response:** Erosion can collapse or damage roadways, which would impede emergency vehicles.
- **Infrastructure:** Erosion can expose septic systems, as well as break sewer pipes and water mains. Accreting sand can block outfall pipes, causing drainage issues and exacerbating flooding.
- **Buildings:** Erosion can undermine the foundations of buildings, making them more susceptible to settlement, lateral movement, or overturning. Debris from buildings that are damaged due to coastal erosion can be swept out to sea. Seawalls and other hard structures installed to reduce the effect of coastal erosion in one location can cause sediment losses at a downdrift area, affecting additional properties.
- **Economy:** Coastal erosion can adversely impact businesses by damaging a business's building. Relocation costs would be an additional economic burden to anyone forced to move to avoid coastal erosion impacts.
- **Natural Systems:** If engineered structures are used to stabilize shorelines, the natural process of erosion is altered, changing the amount of sediment available and the erosion rates at adjacent areas. The Town's natural ecosystem attractions (i.e. beaches, dunes, salt marshes, and estuaries) would also be threatened as sand sources that supply and sustain them are eliminated.
- **Transportation:** Roadways can become damaged through erosion.



3.3 HURRICANES & TROPICAL STORMS

Overview

A tropical cyclone is a rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters. The hurricane season for the Atlantic Ocean extends from June 1st to November 30th, with the peak from mid-August to late October. However, deadly hurricanes can occur anytime during the hurricane season. Tropical cyclones are classified as follows (NHC, 2016a), depending on their intensity:

- **Tropical Depression:** A tropical cyclone with maximum sustained winds of 38 mph (33 knots) or less.
- **Tropical Storm:** A tropical cyclone with maximum sustained winds of 39 to 73 mph (34 to 63 knots).
- **Hurricane:** A tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher. In the western North Pacific, hurricanes are called typhoons; similar storms in the Indian Ocean and South Pacific Ocean are called cyclones.
- **Major Hurricane:** A tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.

Hurricanes are typically fast-moving storms (typically lasting 6 to 12 hours) with high winds in excess of 74 miles per hour and torrential rains averaging 6 to 8 inches, but possibly dropping as much as 15 to 20 inches of rainfall during a single event.

Hazard Location

The entire Town of Falmouth is vulnerable to hurricanes and tropical storms. Coastal areas are extremely susceptible to damage due to a combination of wind and storm surge. However, even inland areas can be affected by the flooding, strong winds and heavy rains associated with these events. Storm surge occurs when water is pushed towards shore by storm generated winds. Storm surge combines with the water elevation, which can substantially increase water levels. In addition, wind generated waves are superimposed on the storm surge. This rise in water level can cause severe flooding in coastal areas, especially when a storm surge coincides with a high tide. Figure 3-11 depicts the components of storm surge.

The US Army Corps of Engineers (USACE) New England Division, in cooperation with FEMA, prepared Sea, Lake and Overland Surge from Hurricanes (SLOSH) inundation maps. SLOSH maps show the extent of potential flooding from worst-case combinations of hurricane direction, forward speed, landfall point, and high astronomical tide. However, the model considers only storm surge height and does not consider the effects of waves. When selecting model parameters, the USACE considered the highest wind speed for each category, the highest surge level, and the worst-case forward motion of the storm to develop a “worst case” scenario. The resulting inundation areas are grouped in Category 1, Category 2, Category 3, and Category 4. Figure 3-12 shows the SLOSH results for Falmouth.

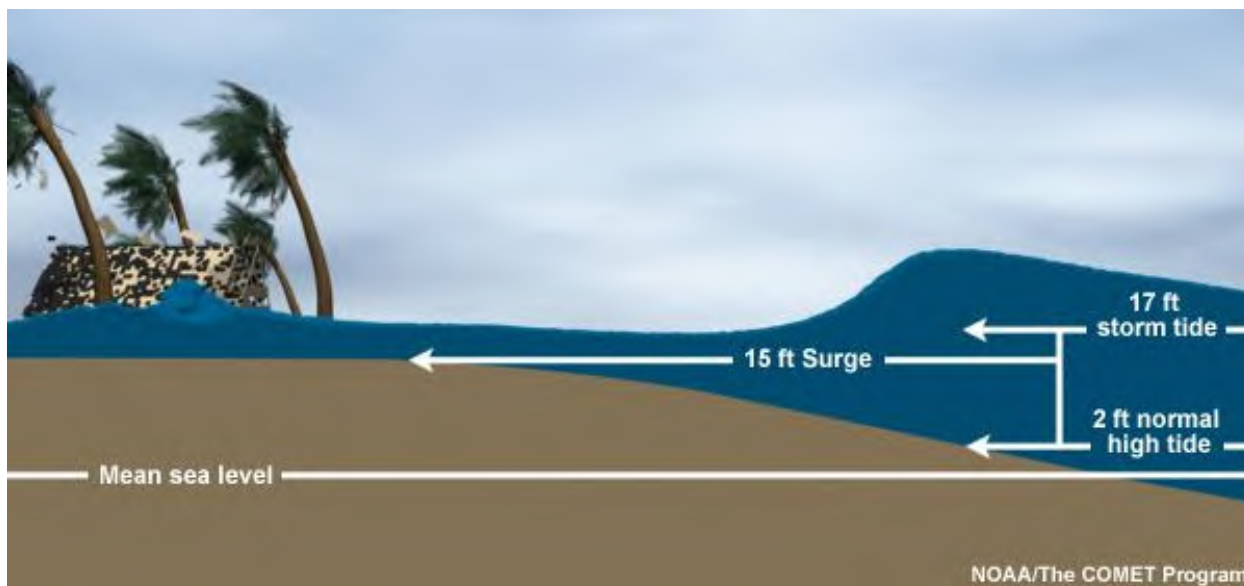


Figure 3-11. Schematic image of a storm surge and storm tide affecting a shoreline (NHC, 2016c).

Previous Occurrences & Extent

A hurricane has not made landfall in Massachusetts for almost 30 years (Hurricane Bob in 1991), and it has been more than 60 years since a major hurricane (Category 3 or higher) has occurred. The most treacherous storm in the last 50 years was Hurricane Bob, which caused severe storm surge and flooding. In a future storm of similar magnitude, a forced evacuation of the Town would be met with automobile congestion and difficulty for some residents in getting out of harm's way, particularly in neighborhoods with a single point of entry and exit.

Smaller tropical storms and depressions have affected the area, generally inflicting minor damage, such as downed tree limbs, power outages, and limited damage to boating-related infrastructure (Figure 3-13). Table 3-2 provides a summary of historic hurricanes that have impacted Massachusetts. However, due to the large diameter of many hurricanes and tropical storms, and the far-reaching effects of storm surge, even storms that don't make landfall in New England can have significant hazard impacts on Massachusetts, and on Falmouth. To illustrate the frequency of these storms, Figure 3-14 shows all hurricanes and tropical storms that have passed within 100 miles of Falmouth between 1972 and 2022. Note that although major hurricanes (Category 1, Category 2, etc.) occur approximately once every ten or twenty years in Massachusetts (Table 3-2), tropical storms and tropical depressions (represented by the green and blue lines in Figure 3-14) are relatively common, occurring every few years.

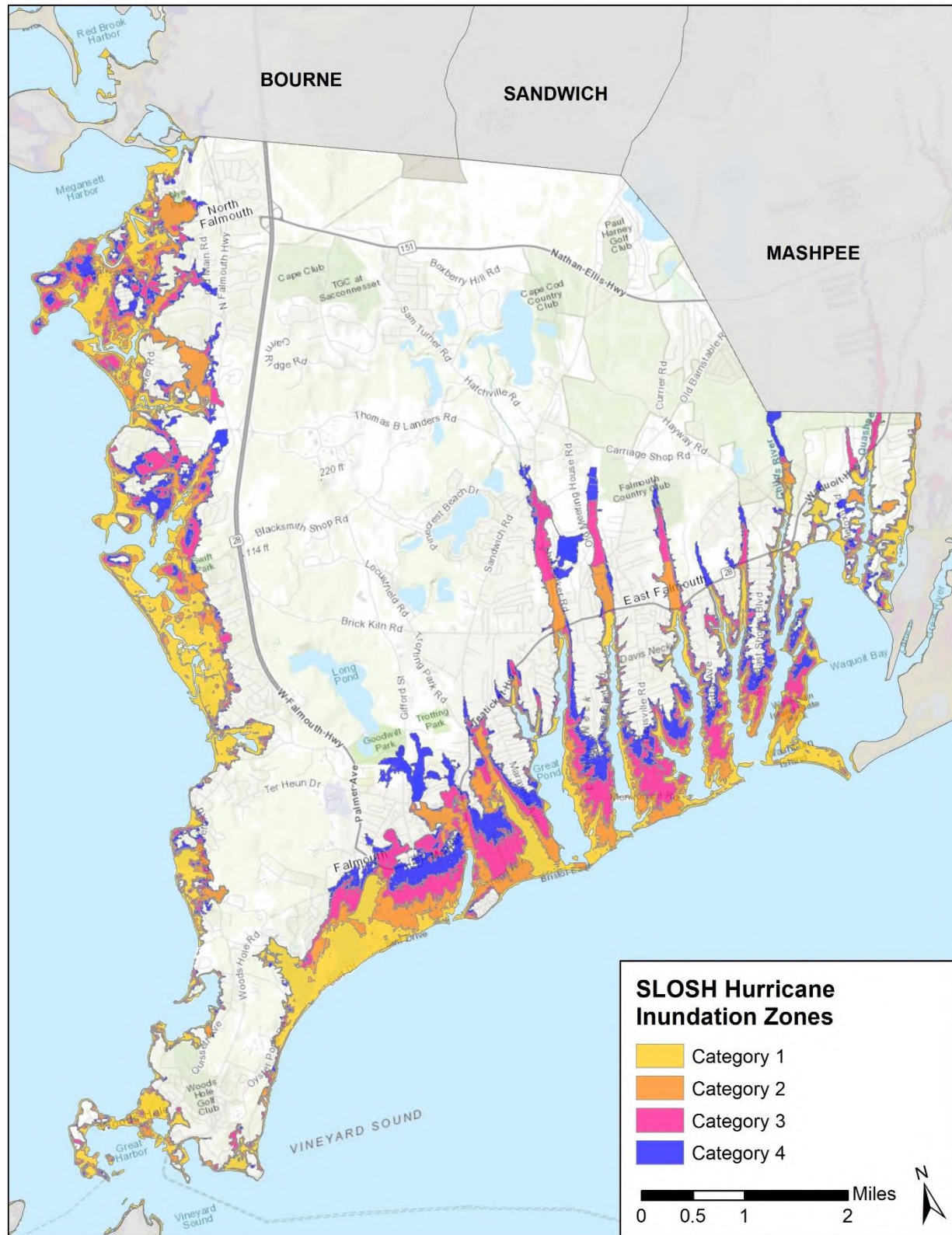


Figure 3-12. SLOSH Categories for Falmouth. Note: The SLOSH model considers only storm surge height and does not consider the added effects of wave height.



Figure 3-13. Large waves overtopping the seawall along Menauhant Road during Tropical Storm Henri on August 22, 2021.

Table 3-2. Massachusetts Hurricanes Since 1938.

Date	Name	Intensity (in MA)
August 19, 1991	Hurricane Bob	Category 2
September 27, 1985	Hurricane Gloria	Category 1
September 12, 1960	Hurricane Donna	Category 2
September 11, 1954	Hurricane Edna	Category 1
August 31, 1954	Hurricane Carol	Category 3
September 15, 1944	Great Atlantic Hurricane	Category 3
September 21, 1938	Great New England Hurricane	Category 3



Figure 3-14. Hurricane and tropical storm tracks in the within 100 miles of Falmouth between 1951 and 2021 (NOAA, 2020b).

The Saffir-Simpson Hurricane Wind Scale is often used to classify tropical cyclones. The Saffir-Simpson Scale, described in Table 3-3, outlines a rating system from 1 to 5 based on the hurricane's sustained wind speed. This scale is then used to estimate potential property damage. Hurricanes classified as a Category 3 or higher are considered major hurricanes due to their potential for devastating or catastrophic damage and loss of life.



Table 3-3. Saffir-Simpson Hurricane Wind Scale (NHC, 2016b).

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	75-95 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.

B2.b

Probability

Based on the hurricane and tropical storm frequency documented in this section, it is likely (between 10 and 100% probability) that a hurricane or tropical storm will impact Falmouth in the next year. In the future, higher category storms are predicted to increase as a result of climate change, meaning Falmouth may experience more of the severe weather associated with hurricanes and tropical storms.



B3.a

Impact

Below is a list of possible impacts that could result from a hurricane or tropical storm:

- **People:** Public safety is jeopardized when buildings and structures collapse, downed trees land on buildings or cars, or emergency response is blocked by flooded roadways. Danger of downed live electrical wires.
- **Emergency Response:** Heavy rains and flooding associated with hurricanes and tropical storms, as well as downed trees and branches caused by the high winds, can reduce the response time of emergency vehicles, or block access entirely.
- **Infrastructure:** High winds, heavy rains and coastal storm surge can cause widespread power outages, limit access to other utilities such as drinking water and communications, and limit transportation. A significant hurricane could also damage wellfields and wells, disrupting drinking water supply.
- **Buildings:** High coastal winds and storm surge can cause substantial damage to homes and businesses and devastate coastal infrastructure such as marinas.
- **Economy:** Hurricanes and/or tropical storms can adversely impact businesses if a business's building is damaged by the storm, or if utilities or road access are affected.
- **Natural Systems:** The high winds and heavy precipitation often associated with hurricanes and tropical storms can cause damage to the environment including uprooting vegetation, potentially harming the Town's natural ecosystems.
- **Transportation:** Roadways can become impassible due to flooding and/or downed trees.



3.4 SEVERE WINTER WEATHER (SNOW/BLIZZARD/ICE STORM/NOR'EASTER)

Overview

Snowstorms and blizzards are common events in New England. These storms are often high duration events with significant winds and heavy snowfall. The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. Sleet and ice storms result when temperatures are appropriate for precipitation to fall as frozen or mostly frozen raindrops, or liquid rain that freezes upon contact with structures and objects on the ground. Travel is often limited and disruptions to power and other utility delivery are a high potential. Coastal flooding can occur during these events, especially with westerly winds. However, periodically, a storm will occur that is a true disaster, and necessitates intense large-scale emergency response. On average Falmouth receives 27 inches of snow per year.

In addition to many of the same hazards posed by other natural disasters, winter storms have the added hazard associated with cold weather for prolonged periods of time. Unlike disasters occurring during the summer months such as hurricanes, power outages may result in extended periods of no heat. Prolonged contact with low temperatures can cause pipes to freeze and burst, damaging homes and businesses. Winter storms pose additional health problems with the added strain of exposure to freezing temperatures, especially for the elderly.

A nor'easter is a particular kind of cyclonic winter storm that moves along the east coast of North America, from south to north; once these storms reach New England, they often intensify. It is called a nor'easter because the winds associated with the storm blow from a northeasterly direction. Sustained wind speeds of 20 to 40 mph are common during a nor'easter, with gusting often reaching 50 to 60 mph. In some cases, the wind speed may actually meet or exceed hurricane force. The storm radius of a nor'easter can be as much as 1,000 miles, and the storm is often accompanied with heavy rain and/or snow, depending on temperature. Most nor'easters bring both storm surge and high winds to the coast of Massachusetts, making the coastline particularly vulnerable to erosion and flooding.

B1.c
B2.a

Hazard Location

The entire Town of Falmouth is at risk from severe winter weather. The Northeast Regional Climate Center has compiled 30-year annual snow totals in New England and the eastern United States. Based on this data, between 1981 and 2010, the Falmouth area averaged 20 to 40 inches of snowfall annually between 1981 and 2010 (Figure 3-15). Barnstable County has had 8 FEMA Winter Storm Declared Disasters between 1953 and 2017 (Figure 3-16).

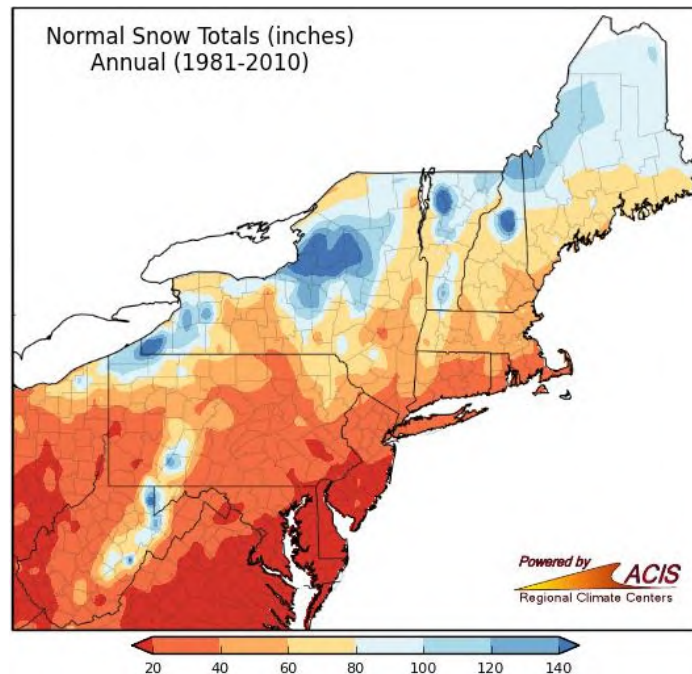


Figure 3-15. Annual average snow totals for New England between 1981 and 2010.

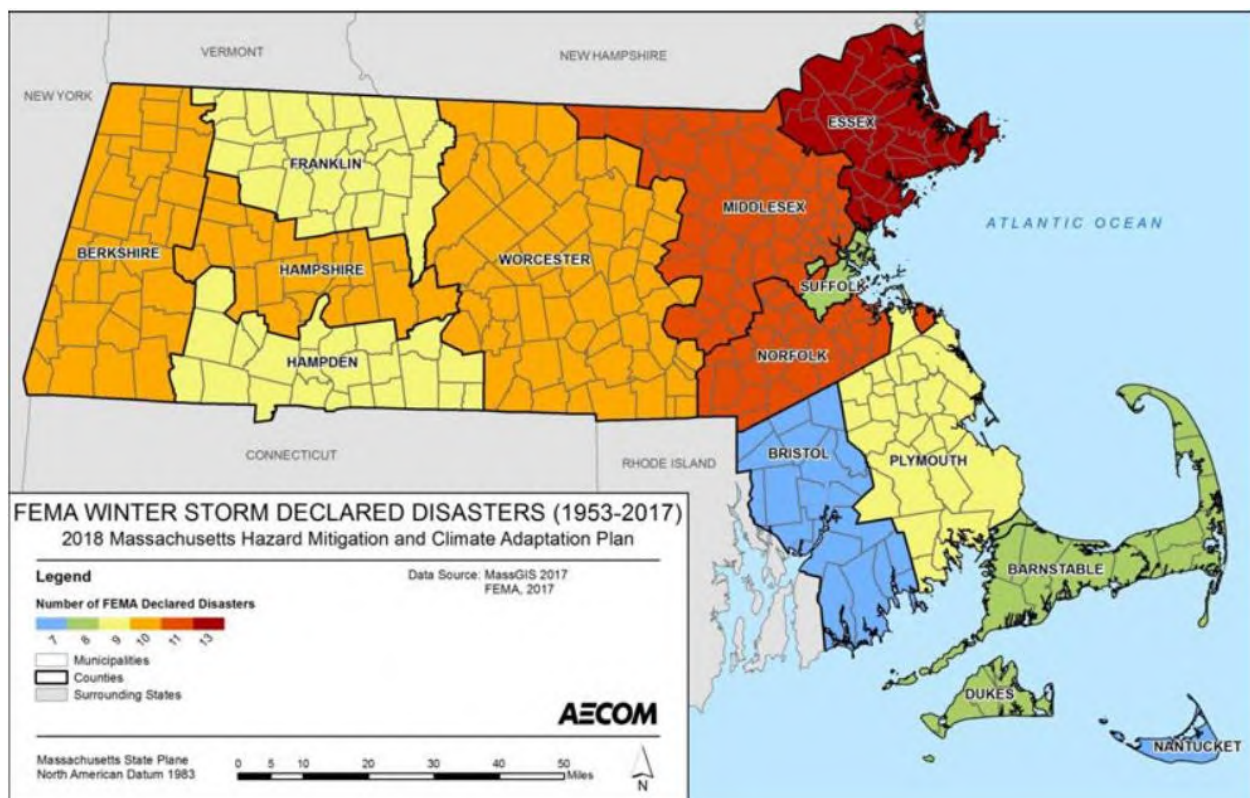


Figure 3-16. FEMA winter storm-related disasters by county (1953-2017) (from 2018 State Hazard Plan).

B1.c
B2.a,c***Previous Occurrences & Extent***

Winter storms occur quite frequently, but due to preparation by the Town and its residents, typically amount to no more than a minor inconvenience. School delays and slow travel occur but crippling winter storms are a rarity. However, they do occur. The most severe winter storm to ever hit New England was the Blizzard of 1888, which occurred in March of that year. Snow accumulations reached 30 to 50 inches where precipitation was entirely snow. Boston received a mix of snow and rain creating up to nine inches of slush. The Blizzard of 1978 resulted in 24 to 38 inches of snow across New England, immobilizing the infrastructure and blocking major highways, and causing thousands of motorists to abandon their cars on the road. Two weeks were required to remove the snow. The Blizzard of 1978 resulted in a federal disaster declaration for many counties in Massachusetts. More recent blizzards and snowstorms occurred in March 1993, February 1996, March 2001, January 2005, February 2013 (Winter Storm Nemo) and January 2015 (Winter Storm Juno).

Winter Storm Juno, in January 2015 was a powerful nor'easter that impacted the northeast. A state of Emergency was declared in Massachusetts and travel bans were issued in preparation for the storm. The storm produced winds that gusted to 75 mph, a rain/snow mix that resulted in 15 to 18 inches of snowfall, coastal flooding that caused erosion in many areas across the state, and multi-day loss of electricity for many properties. This nor'easter resulted in a federal disaster declaration for many counties in Massachusetts, including Barnstable County. Table 3-4 below provides a list of major winter storms in New England from 2013 to 2022.

The Northeast Snowfall Impact Scale (NESIS) was developed by the National Weather Service to characterize and rank high-impact Northeast snowstorms. A "High-impact" snowstorm is one that produces large areas of 10-inch snowfall accumulations or greater. The NESIS has five categories: Notable, Significant, Major, Crippling, and Extreme (Table 3-5). This index differs from other meteorological indices, however, because it uses population information in addition to meteorological measurements; the NESIS gives a ranking to the societal impacts of a storm. NESIS values are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. The largest NESIS values result from storms producing heavy snowfall over large areas that include metropolitan centers. These values are then converted into one of the five NESIS categories (NOAA, 2019b).



Figure 3-17. Winter storm Skylar from March 13-15, 2018. This was the third major Nor'easter in 11 days, resulting in widespread power outages across Cape Cod.

Table 3-4. Major Winter Storms in New England (2013 to 2022).

Date	NESIS	Cat	Description
Feb 7-10, 2013	4.35	3	Major
Mar 4-9, 2013	3.05	2	Significant
Dec 13-16, 2013	2.95	2	Significant
Dec 30, 2013 - Jan 3, 2014	3.31	2	Significant
Jan 20-24, 2014	1.26	1	Notable
Jan 29-Feb 4, 2014	4.08	3	Major
Feb 11-14, 2014	5.28	3	Major
Nov 26-28, 2014	1.56	1	Notable
Dec 9-14, 2014	1.49	1	Notable
Jan 25-28, 2015	2.62	2	Significant
Jan 29-Feb 3, 2015	5.42	3	Major
Feb 8-10, 2015	1.32	1	Notable
Jan 22-24, 2016	7.66	4	Crippling
Mar 12-15, 2017	5.03	3	Major
Jan 3-5, 2018	1.71	1	Notable
Mar 2-8, 2018	3.45	2	Significant
Mar 11-15, 2018	3.16	2	Significant
Mar 20-22, 2018	1.63	1	Notable
Dec 14-18, 2020	3.21	2	Significant
Jan 30-Feb 3, 2021	4.93	3	Major
Jan 30- Feb 3, 2022	4.93	3	Major



Table 3-5. NOAA's Northeast Snowfall Impact Scale (NESIS).

Category	NESIS Value	Description
1	1 – 2.499	Notable
2	2.5 – 3.99	Significant
3	4 – 5.99	Major
4	6 – 9.99	Crippling
5	10+	Extreme

B2.b

Probability

Based on the snow frequency of occurrence recorded from past events, it is likely (between 10 and 100% probability in the next year) that snow will occur in Falmouth. Climate change is predicted to increase moisture within the air, leading to an increase in the intensity and severity of winter storms in places that experience cold winter temperatures. Therefore, future storms that impact Falmouth may result in heavier snowfall.

B3.a

Impact

Below is a list of possible impacts that could result from severe winter weather:

- **People:** Walking and driving can become extremely dangerous due to icy roads and sidewalks, snow accumulation, and low visibility. Poor driving conditions often require people to shelter in place, and loss of utility function can result in dangerous conditions during extreme cold temperatures associated with snow events. Injury is also possible from slipping on ice, overexertion from shoveling, and frostbite.
- **Emergency Response:** Snow, icy roads, and trees felled by storm conditions can reduce emergency vehicle response time.
- **Infrastructure:** Culverts and roads can be washed out during a heavy flow after a snowmelt. Ice and heavy snowfall can impact and cut off utilities, such as heating, power, and communication services, for several hours or days. Water pipes can burst due to extreme cold temperatures. Utility outages can result from nor'easters.
- **Buildings:** Buildings and roofs can experience structural failure as a result of heavy snow loads.
- **Economy:** Poor driving conditions and closed roads prohibit businesses from opening and people from going to work. Heavy snowfalls result in increased cost to the Town for plowing, snow removal, and treatment of roads. Utility outages and damaged buildings can result in loss of business function.
- **Natural Systems:** Snow and ice accumulation can negatively impact vegetation and natural habitat. Trees and tree limbs can be knocked down by the weight of accumulated snow, by high winds, or both. Beaches, coastlines, and inlets can be reshaped by waves and storm surge associated with nor'easters.
- **Transportation:** Roadways can become extremely dangerous due to icy conditions, snow accumulation, and low visibility. Public transportation is also occasionally shutdown as a result of heavy snowfall.



3.5 WILDFIRE

Overview

Fire events can be broken into two major categories: urban fires and wildfires. Urban fires are the result of buildings and structures catching fire, with the potential for the fire to spread to neighboring properties. These events have a higher chance of spreading more rapidly in areas where residential and commercial buildings are clustered closely together. Urban fires tend to occur more frequently than wildfires, and often result from everyday activities such as cooking, smoking, or appliance malfunction.

A wildfire is an unplanned, unwanted fire burning in a natural area, such as a forest, scrubland, or grassy area. Wildfires and forest fires are naturally occurring events, and part of a normal, healthy ecosystem. Naturally occurring fires help keep forest floors free of excessive debris buildup, thin crowded trees, encourage growth of new vegetation, and recycle nutrients into the soil. Forest fires may occur at any time of year, however typically during hot, dry summer months, or during windy conditions during the spring and fall. Natural ignition most frequently occurs as the result of a lightning strike.

In Massachusetts, wildfires are typically caused by lightning or human activity (i.e. discarded cigarettes, unattended camp fires, downed power lines, etc.). The Bureau of Fire Control estimates that nearly 98% of fires in Massachusetts are started by human carelessness.

B1.c
B2.a

Hazard Location

Wildfire has played a role in shaping the northeast landscape for thousands of years. As a result, there are an abundance of fire-adapted ecosystems in the region. Falmouth's forests are primarily composed of pitch pine and oak, which are considered by the State fire officials to be high risk for wildfires. Figure 3-18 illustrates where the most heavily forested areas are within Falmouth, and therefore the areas with the highest risk of wildfire. Within Falmouth, densely forested areas are primarily located within the central part of town and are generally lowest along the waterfront, where residential and commercial development is highest.

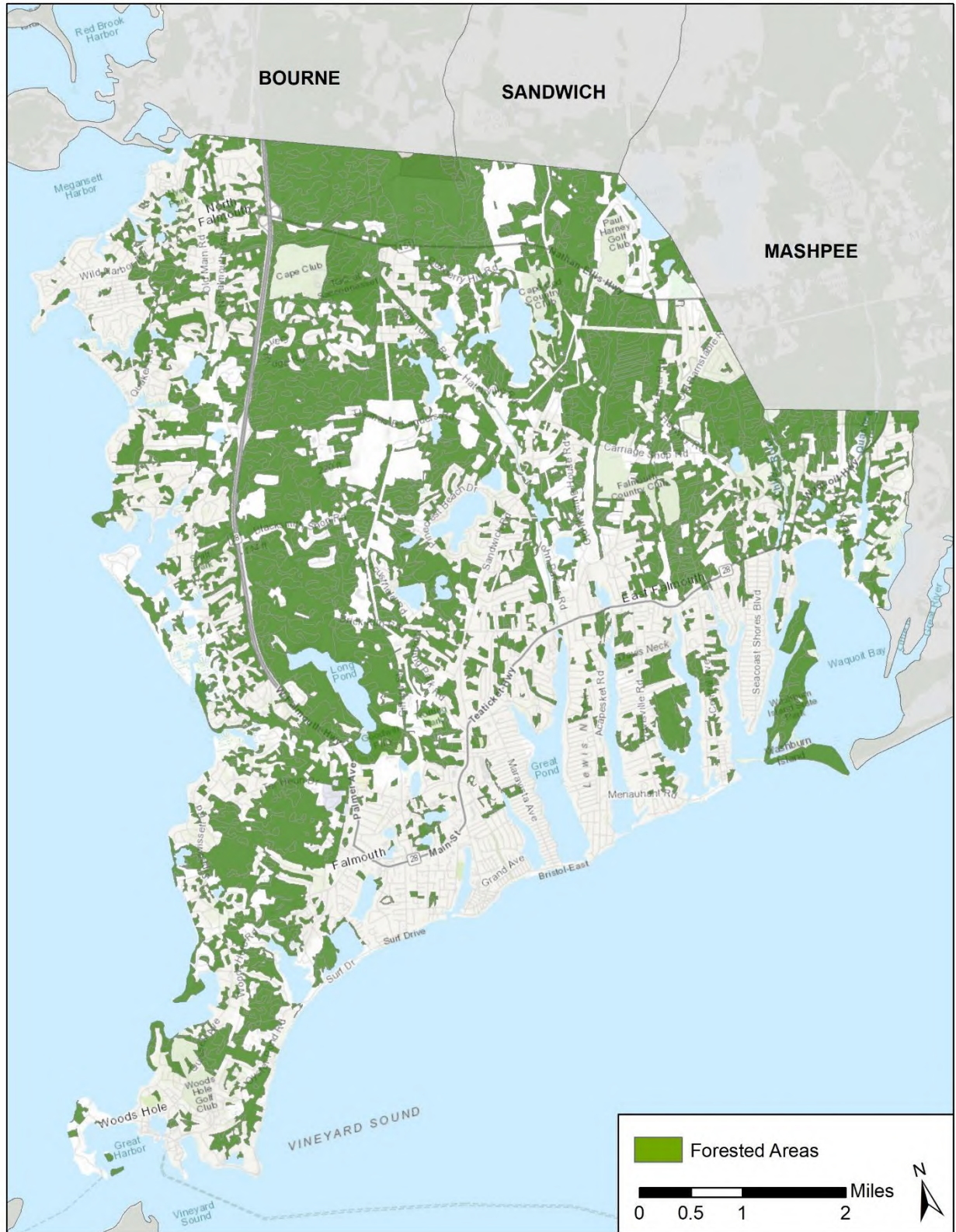


Figure 3-18. Heavily forested areas within the Town of Falmouth.

B1.c
B2.a,c***Previous Occurrences & Extent***

Forest fires vary in size, however thanks to modern detection and firefighting equipment methods, fires are typically kept to a reasonably small area. The Bureau of Fire Control estimates that the average fire 100 years ago consumed approximately 34 acres, while today the average fire burns only 1.2 acres. However, large fires have occurred nearby in the past, such as the 1957 fire in Myles Standish State Forest which burned over 18,000 acres, stopping only when it reached the ocean. Fortunately, most fires are quickly identified and suppressed, or extinguish themselves naturally due to wet weather conditions. The majority of wildfires occur in the spring, before “green-up”, or in late summer, following periods of drought.

Smaller fires are more common and are generally addressed quickly by the Falmouth Fire Department. Between 2018 and 2021, the Falmouth Fire Department responded to 60 wildfire incidents. Figure 3-19 below illustrates the number of fires that occurred within each year from 2018 to 2021.

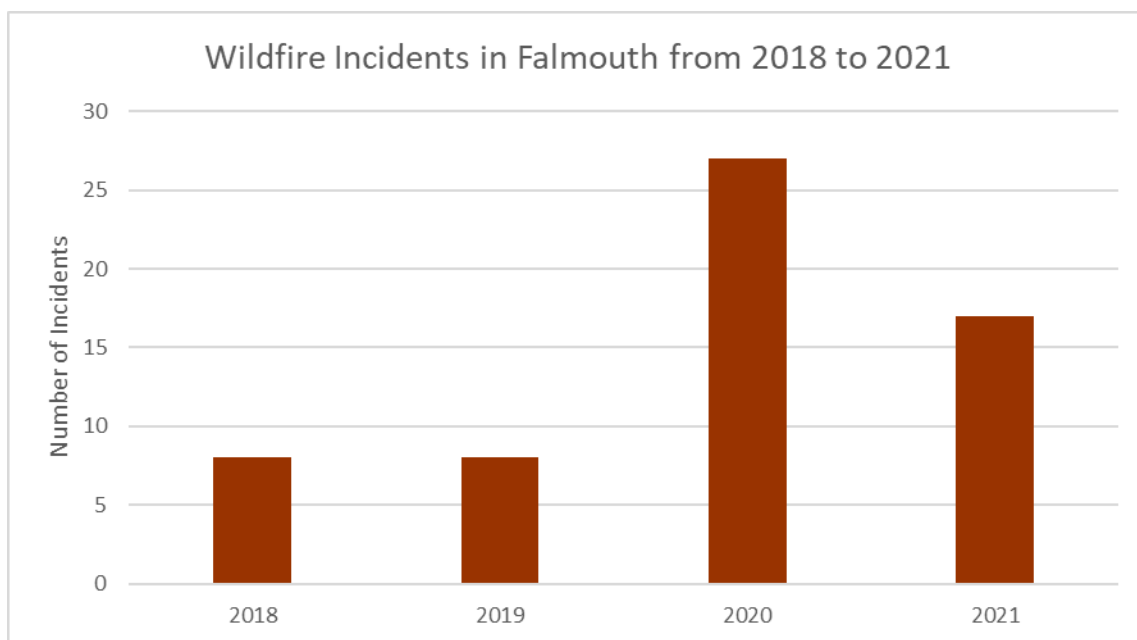


Figure 3-19. Number of wildfire incidents in Falmouth from 2018 to 2021.



Figure 3-20. Brush fire in Falmouth on March 12, 2020 off Brick Kiln Road. No injuries were reported but a total of 9 acres were burned.

Once a fire starts, location of the fire and the type of fuel consumed determines how severe the fire will be. There are four types of wildfires (Table 3-6). These fire types range from ground fires, which tend to travel relatively slowly and are easier to control, to canopy fires, in which flames can jump from tree to tree through the canopy relatively quickly. These are the most difficult to control and extinguish.

Table 3-6. Wildfire Types.

Type	Location	Typical Fuel
Ground	At or below ground surface	Underground roots, buried leaves or other organic matter
Surface	Ground surface	Surface leaves, grass, low lying vegetation, underbrush
Ladder	Between the surface and canopy	Underbrush, downed logs, vines and small trees
Canopy	In the tree canopy	Tall trees, vines and branches



B2.b

Probability

B3.a

The Town of Falmouth is somewhat susceptible to wildfires due to the availability of fuel, impacts from offshore winds, and increasing development within wooded areas. Therefore, it is possible (1 – 10% probability in the next year) that a wildfire will occur in Falmouth. Increasing temperatures caused by climate change leads to dryer soil within forests and a higher flammability of vegetation. In addition, snow may melt earlier, meaning wooded areas will experience drier conditions for a longer period of time. All of these factors contribute to a higher risk of wildfire within the Town of Falmouth in the future as a result of climate change.

Impact

Below is a list of possible impacts that could result from wildfire:

- **People:** Death or injury can result if people are trapped by urban or wildfires. Smoke inhalation can cause health issues.
- **Infrastructure:** Utility services may be disrupted; a large fire in the wellfield could negatively impact the wellfield itself, while a large enough fire could adversely impact well water quality. Roads may become impassible, and transportation may be disrupted.
- **Buildings:** Buildings and structures can be damaged or destroyed, either by the fire directly, or through ignition from flying sparks and embers.
- **Economy:** Indirect economic losses can result from lost tourism due to a major fire. Disrupted utilities may halt businesses and other economic activities.
- **Natural Systems:** Extensive areas of forests and other natural areas can be burned. Wildfires can strip slopes of vegetation, increasing the potential for runoff and erosion.



3.6 TORNADO

Overview

Tornadoes are a vortex of rapidly rotating air moving along the ground. Tornadoes typically occur during the spring, summer and fall months, usually during the afternoon. Tornadoes may occur in unusually severe thunderstorms, bringing hazards such as very high wind speeds (typically anywhere from 100 to 300 miles per hour) along a localized area, localized heavy rainfall and flooding, frequent lightning, and damaging hail.

Tornadoes may be anywhere from less than 250 feet to over two miles in diameter. Typically, tornadoes dissipate after no more than a couple miles on the ground; however they have been known to stay on the ground for dozens of miles, causing substantial damage along the way. Although not common in the northeast, tornadoes have occurred in every state of the U.S. In Massachusetts, tornadoes occur most frequently in and around Worcester County, however they may occur wherever conditions are right. According to NOAA, Barnstable County is located in an area of very low probability of occurrence, with less than one tornado expected to occur every five years.

B1.c
B2.a

Hazard Location

NOAA's National Weather Service maintains a database of tornado information in the United States (updated through February 2021). The data include information on date, start and end location, number of injuries and fatalities, and categories of property loss values from each storm. There have been 184 tornadoes documented in Massachusetts from 1951 to 2021 (Figure 3-21). From 1951 to 2022, only three (3) tornadoes have impacted Falmouth and were relatively minor with a scale from EF0 to F1 (Table 3-7).

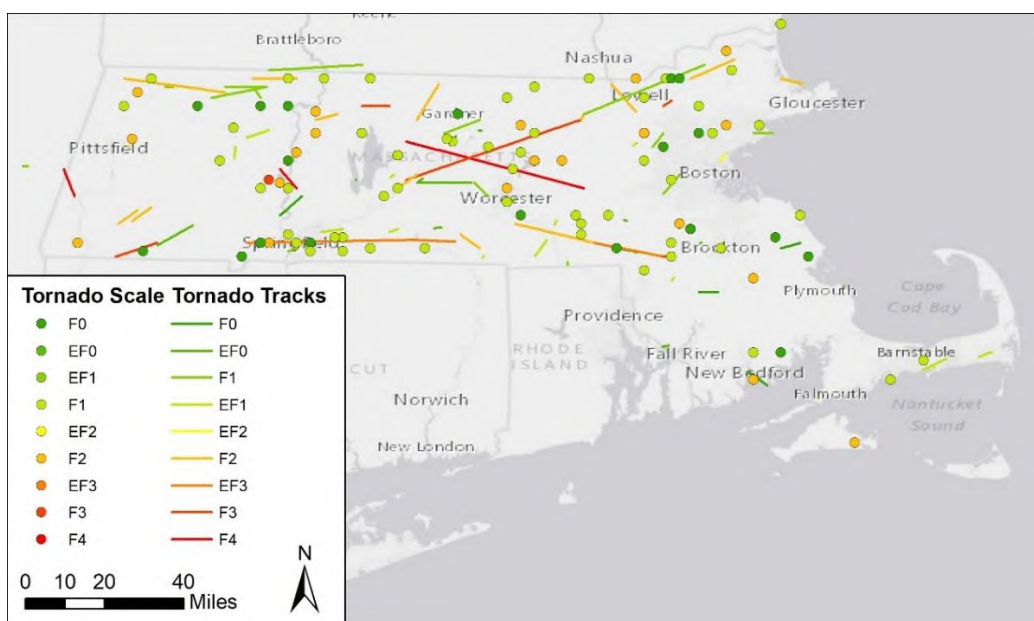


Figure 3-21. Massachusetts tornadoes between 1951 and 2021 (refer to Tables 3-8 and 3-9 for F and EF Scale descriptions).

**Table 3-7. Barnstable County Tornadoes Between 1951 and 2022.**

Date	Scale	Town	Death/Injury	Length/Width
9/2/2021	EF0	Dennis	0/0	0.1 mi / 15 yds
7/23/2019	EF1	Harwich	0/0	2.77 mi / 250 yds
7/23/2019	EF1	West Yarmouth	0/0	0.25 mi / 50 yds
7/23/2019	EF1	Hyannis Port	0/0	5.52 mi / 250 yds
10/29/2018	EF0	Woods Hole	0/0	0.1 mi / 10 yds
8/22/1977	F1	Barnstable Co.	0/2	0.1 mi / 10 yds
8/9/1968	F1	Barnstable Co.	0/0	0.1 mi / 33 yds

B1.c
B2.a,c

Previous Occurrences & Extent

Although only three tornadoes have impacted Falmouth since 1951, as noted above, five tornadoes have occurred within Barnstable County during the same time period. Table 3-7 documents the characteristics of these tornadoes; this table documents the F-scale (see description of the Fujita Tornado Damage Scale below) or EF-scale (see description of the Enhanced Fujita Scale below), number of injuries and fatalities, and the size of each tornado, as measured by the length and width of its track. Table 3-8 describes the Fujita Tornado Damage Scale developed by Dr. T. Theodore Fujita for winds, including tornadoes, which relates the degree of damage to the intensity of the wind, as well as the number of injuries and fatalities, and the value of any property loss associated with the event.

Recently, the National Weather Service has switched to using a revised rating system for tornadoes. The Enhanced Fujita Scale (EF-Scale) became operational in February 2007 and is similarly used to assign a tornado's rating based on estimated wind speeds and related damage. The EF-Scale was revised from the original Fujita Scale to better reflect the results of tornado damage surveys to align wind speeds more closely with associated storm damage. The new scale has to do with how most structures are currently designed. A summary of the EF-Scale ratings is provided in Table 3-9.

B2.b

Probability

Considering relatively small scale tornadoes do occur throughout Massachusetts on a regular basis, and have directly impacted the Town, it is possible (between 1 and 10% probability in the next year) that a tornado will occur in Falmouth. The effect of climate change on tornados is less clear than in the case of other hazards. Climate change is predicted to increase moisture within the air, an essential ingredient for tornadoes, however, another essential ingredient, wind shear, may decrease. As a result, the exact effect of climate change on tornadoes is still being determined.

**Table 3-8. Fujita Tornado Damage Scale.**

Scale	Wind Estimate (mph)	Typical Damage
F0	< 73	Light damage: some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged
F1	73-112	Moderate damage: peels surface off roads; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	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
F3	158-206	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.
F4	207-260	Devastating damage: well-constructed houses level; structures with weak foundations moved; cars thrown; large missiles generated.
F5	261-318	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.

Table 3-9. Enhanced Fujita (EF) Scale.

Scale	3 Second Wind Gust (mph)
EF0	65-85
EF1	86-110
EF2	111-135
EF3	136-165
EF4	166-200
EF5	Over 200

B3.a**Impact**

Below is a list of possible impacts that could result from tornadoes:

- **People:** Airborne debris can cause injury or death. Hazardous driving conditions can result from blocked roadways. Tornadoes can cause water contamination, which can affect drinking water quality and human health.
- **Infrastructure:** Tornadoes can damage power lines, other utility infrastructure, and roads. Downed power lines can also cause electrical hazards.
- **Buildings:** Tornadoes that pass through highly developed areas can cause significant property damage, blowing off roofs, and in severe cases, leveling houses.
- **Economy:** Tornadoes can destroy farms and agricultural fields.
- **Natural Systems:** High winds associated with a tornado can break branches and snap or uproot trees. Wildlife can be killed or injured.



3.7 DROUGHT

Overview

Drought is an extended period of time where a region experiences a notable reduction in available water supply typically caused by a lack of precipitation. Drought can affect either surface water or groundwater sources. Though most droughts in Massachusetts last only a matter of months, it is possible for drought conditions to extend over a period of years due to reduced rainfall and snowfall accumulations contributing to lower groundwater and surface water levels.

B1.c
B2.a

Hazard Location

The entire Town of Falmouth is equally vulnerable to drought.

B1.c
B2.a,c

Previous Occurrences & Extent

Significant periods of drought have occurred in Barnstable County, and Falmouth specifically, in the past. The Massachusetts Department of Conservation and Recreation (DCR) compiles monthly water conditions reports, summarizing the rainfall and its departure from average conditions for each of the 6 regions in the state (Cape Cod and Islands, Central, Connecticut River, Northeast, Southeast, and Western). Data for Cape Cod from a recent eleven (11) month period (DCR, 2021) is summarized in Table 3-10.

Table 3-10. Summary of the Southeast Region Rainfall from DCR Hydrologic Conditions Reports (2020).

Month-Year	Total Rainfall (inches)	Departure from normal (inches)
Jan 2020	2.63	-1.31
Feb 2020	3.80	-0.19
Mar 2020	3.56	-1.09
Apr 2020	6.29	+2.14
May 2020	2.04	-1.62
Jun 2020	1.49	-1.86
Jul 2020	0.80	-2.25
Aug 2020	1.29	-2.17
Sep 2020	1.38	-2.45
Oct 2020	4.67	+0.22
Nov 2020	2.41	-1.52
Total	30.36	-12.10



Based on the total rainfall from the eleven (11) months in Table 3-10, which is 12.1 inches below the average, Falmouth is currently experiencing a drought and droughts are likely to occur again in the future.

There are five levels of drought that have been developed to characterize the severity of the event:

1. Normal
2. Mild Drought (formerly Advisory prior to 2019)
3. Significant Drought (formerly Watch prior to 2019)
4. Critical Drought (formerly Warning prior to 2019)
5. Emergency Drought

These levels are based on the regional conditions and are designed to provide information about the current status of water resources. A Mild Drought calls for a heightened level of vigilance and increased data collection as conditions begin to deviate from normal. During a Significant Drought, increased assessment would continue, in addition to proactive public education about water conservation. Water restrictions might become necessary during the watch or warning stage, depending on the capacity and condition of each water supply system. A Critical Drought designation is issued during a severe situation and the possibility of a drought emergency may be issued. Finally, a Drought Emergency often requires mandatory water restrictions and/or the use of emergency water supplies (EEA, 2019). These categories and their associated characteristics are summarized in Table 3-11.

Based on the categories outlined in Table 3-11, the Massachusetts Executive Office of Energy and Environmental Affairs has compiled information about past drought declarations at a regional level. Drought declarations from 2016 to 2022 for Cape Cod are detailed in Table 3-12. Most recently, there was a drought from April 1, 2021 to August 31, 2021 with a severity level of Mild (Table 3-12).



Table 3-11. Drought Indices from the Massachusetts Drought Management Plan (EEA 2019).

Drought Level	Precipitation	Groundwater	Streamflow	Reservoir
Normal (0)	1 month below normal	2 consecutive months below normal	1 month below normal	Reservoir levels at or near normal for time of year
Mild (1) <i>(formerly Advisory)</i>	2 month cumulative total below 65% of normal	3 consecutive months below normal	At least 2 out of 3 consecutive months below normal	Small index reservoirs below normal
Significant (2) <i>(formerly Watch)</i>	1 of the following: 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
Critical (3) <i>(formerly Warning)</i>	1 of the following: 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 (4)	Same Warning <u>and</u> previous month was Warning or Emergency	>8 months below normal	>7 months below normal	Continuation of previous month's conditions



Table 3-12. Drought Dates and Levels from Massachusetts DCR for the Cape Cod Region Between 2016 and 2022.

Year	Begin Date	End Date	Southeast Status
2016	8/1/2016	8/31/2016	Advisory
2016	9/1/2016	10/31/2016	Watch
2016-2017	11/1/2016	4/30/2017	Advisory
2020	6/1/2020	6/30/2020	Mild
2020	7/1/2020	10/31/2020	Significant
2020	11/1/2020	11/30/2020	Mild
2021	4/1/2021	8/31/2021	Mild

B2.b

Probability

Based on the data summarized above about past drought conditions in Falmouth, the probability that a drought will occur in Falmouth in the future is likely (between 10% and 100% probability in the next year). Although climate change is predicted to increase precipitation in the Northeast, such as through snowfall, more frequent and severe droughts are still predicted to occur as a result of increased temperature and evaporation.

B3.a

Impact

Below is a list of possible impacts that could result from drought:

- **People:** Drought conditions can increase conflicts between water users. Water conservation actions may impact users' activities. Reduction in drinking water supply. Health related issues may arise due to dust inhalation.
- **Infrastructure:** Droughts can result in lower water levels in reservoirs. Drought can cause well water quality, and potentially quantity, to worsen. Drought can cause sanitary issues in the water distribution system, as well as increase water demand. Drought can also result in private residential wells to dry up, increasing requests to be connected to the municipal water supply system.
- **Economy:** Farmers experience financial losses if a drought destroys their crops. Finances may need to be diverted to provide additional irrigation or drill new wells. Businesses that depend on farming may lose business. Food costs may increase.
- **Natural Systems:** Loss of fish habitat such as streams, rivers, and ponds dry up. Lack of food and drinking water for wildlife. Wildlife may be forced to migrate to find adequate resources. Wildfires may become more common.



3.8 EXTREME TEMPERATURE

Overview

There is no defined cut-off for what defines extreme temperatures. Instead, extreme temperatures are considered relative to the usual weather in a region based on long-term climatic averages. According to the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018), extreme heat for this region is usually defined as a period of three or more consecutive days with temperatures above 90°F. However, more generally it can be thought of as a prolonged period of excessively hot weather, which is often accompanied by high humidity. Similarly, extreme cold is also relative to normal climatic lows in the region. Temperatures that drop well below normal, especially when accompanied by high winds can produce dangerous wind-chill factors. The wind-chill is the perceived decrease in air temperature felt by the body on exposed skin due to the flow of air.

Since extreme temperatures are defined relative to normal conditions, it is important to know the average temperatures for the region for a particular season. The average low winter temperature (January) for Massachusetts is 22°F, while the average high summer temperature (July) is 81°F.

B1.c
B2.a

Hazard Location

The entire Town of Falmouth is equally vulnerable to extreme temperature hazards.

B1.c
B2.a,c

Previous Occurrences & Extent

NOAA's National Centers for Environmental Information houses a Storm Events Database (NOAA, 2021), which includes accounts of Cold/Wind Chill, Extreme Cold/Wind Chill, Heat, and Excessive Heat. Querying the data for these types of events for the past 20 years returned three occurrences of extreme temperature:

- 1) February 14, 2016: An arctic high-pressure system brought strong northwest winds and extremely cold wind chills to southern New England. Wind chills as low as -32°F were reported in Plymouth.
- 2) July 22, 2011: High temperatures and high humidity levels brought the heat index above 105 for several hours. Heat index values at the Coast Guard Air Station Cape up to 105.
- 3) Jul 6, 2010: Similar to July of 2011, high temperatures and severe humidity resulted in a heat index of 100 to 102 across Cape Cod.

NOAA's National Weather Service (NWS) has developed a Heat Index (NWS, 2016a), which measures how hot it feels when relative humidity is considered along with the actual air temperature (Figure 3-22). Relative humidity is the amount of atmospheric moisture present relative to the amount that would be present if the air were fully saturated. For example, a 90°F day with 80% humidity would have a heat index of 113°F, and there is a dangerous likelihood of heat disorders with prolonged exposure or strenuous activity. The NWS issues alerts when the Heat Index is expected to exceed 105-110°F (depending on local climate) for at least 2



consecutive days. Wind chill temperature indicates how cold it feels outside, based on the rate of heat loss from exposed skin caused by the combination of wind and cold. Because wind draws heat from the body, reducing skin temperature, as well as internal body temperature, the wind actually makes it feel colder than the absolute temperature would indicate. Frostbite is the result of body tissue (i.e. skin) freezing. The most vulnerable parts of the body are the fingers, toes, ears and nose. The National Weather Service's Wind Chill Temperature Index (NWS, 2016b) provides a useful method for calculating the dangers from extreme cold temperatures and winter winds, and the amount of time exposed skin will take to get frostbite (Figure 3-23). According to the chart in Figure 3-23, if it is 0°F with a 15 mph, the wind chill temperature would be -19°F and it would take exposed skin 30 minutes to get frostbite. The index calculates wind speed at an average height of 5 feet above the ground's surface, the typical height of a person's face, from the measured wind data collected from standard 33-foot high anemometers.

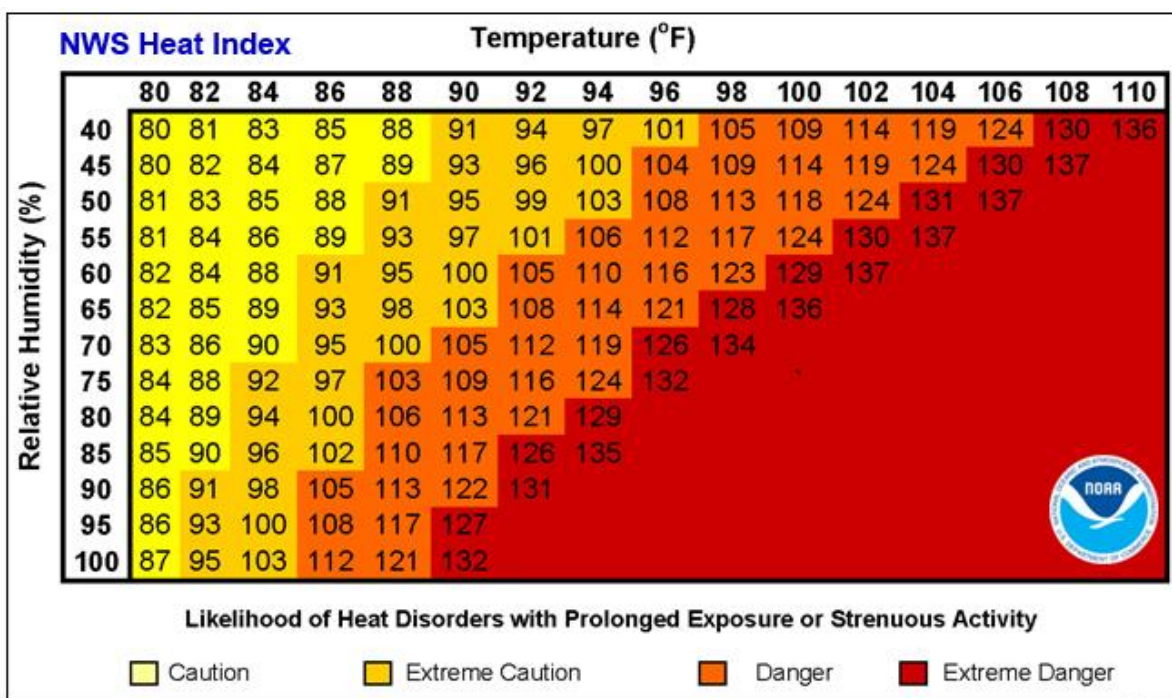


Figure 3-22. NWS's heat index.

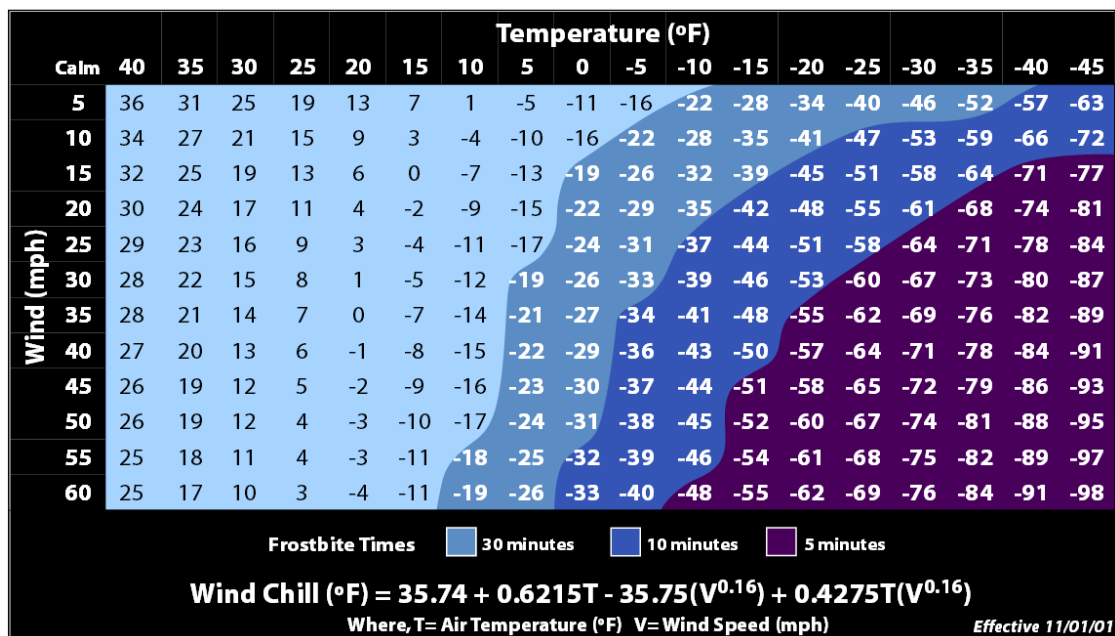


Figure 3-23. NOAA's wind chill chart.

B2.b

Probability

Based on the data summarized above about past extreme temperature conditions in Barnstable County, the probability that extreme temperatures will occur in Falmouth in the future is likely (between 10% and 100% probability in the next year). Overall, Massachusetts has been experiencing an increase in temperature as a result of climate change, meaning extreme summer temperatures are becoming more intense, while winter temperatures are becoming less severe.

B3.a

Impact

Below is a list of possible impacts that could result from extreme hot or cold temperatures:

- **People:** Excessive heat and severe cold poses serious health risks, including death.
- **Emergency Response:** Stress will be placed on the cooling systems of emergency vehicles in extreme heat.
- **Infrastructure:** Highways and roads can be damaged by excessive heat as asphalt softens. Both extreme heat and extreme cold can put significant strain on power utilities, as users' energy needs increase to run air conditioners or heaters. Extreme heat can cause well water quality, and potentially quantity, to worsen. Extreme heat can cause sanitary issues in the water distribution system as the water in tanks and the groundwater heat up, as well as increase water demand.
- **Economy:** Transported refrigerated goods experience a higher degree of spoilage during excessive heat conditions. Agriculture and livestock can be adversely impacted by extreme heat.
- **Natural Systems:** Extreme heat can reduce water levels in natural ponds and reservoirs, as well as increase surface water temperatures to dangerous levels. Both can have an adverse impact on fish and wildlife.



3.9 EARTHQUAKE

Overview

An earthquake is a sudden, intense shaking of the Earth's surface caused by the movement of large portions of the Earth's crust. These movements tend to occur along faults, which are fractures in the Earth's crust along which two plates of crust can move against each other. Earthquakes can occur suddenly at any time, with virtually no warning.

The depth at which an earthquake occurs is called a focal depth. A focal depth of less than 43.5 miles is considered to be a shallow earthquake; the majority of earthquakes fall into this category. Earthquakes originating at focal depths of 43.5 to 186 miles are considered intermediate. However, focal depths of earthquakes can reach depths of more than 435 miles. The epicenter of an earthquake is the location on the Earth's surface directly above the focal point of an earthquake.

New England is located in the middle of the North American tectonic plate; the western edge of this plate is along the west coast where it is pushing up against the Pacific Ocean Plate, and the eastern edge is in the middle of the Atlantic Ocean where it is spreading away from the European and African plates. Because New England is located a considerable distance from either edge of the North American plate, most earthquakes that occur here are due to the cracking of crustal rocks due to compression as the plate is slowly squeezed by the global movement of other plates.

B1.c
B2.a

Hazard Location

Due to the configuration of the tectonic plates, the greatest threat from earthquakes in the United States occurs along the fault lines on the west coast. While earthquakes do occur in the eastern United States, they tend to be less frequent and less intense. Figure 3-24 shows earthquakes since the 1970s as reported by US Geological Survey (USGS); this includes 156 earthquakes ranging in magnitude from 0 to 3.8 within 100 miles of the Town of Falmouth.

B1.c
B2.a,c

Previous Occurrences & Extent

There has only been one recorded earthquake within Falmouth since 1970. The earthquake occurred in 1981 and had a magnitude of 2.1. There have been an additional 155 occurrences of earthquakes since 1970 within 100 miles of Falmouth. The epicenter locations of these earthquakes are shown in Figure 3-24; the range in magnitude of each event is indicated by color. The Richter magnitude of these 45 events ranged from 0 to 3.8, which as described below, can often be felt, but only cause minor damage.

The Richter Scale (Table 3-13) is frequently used to measure the magnitude of earthquakes. It measures the maximum recorded amplitude of a seismic wave, which quantifies the ground motion and the energy released at the source of an earthquake.

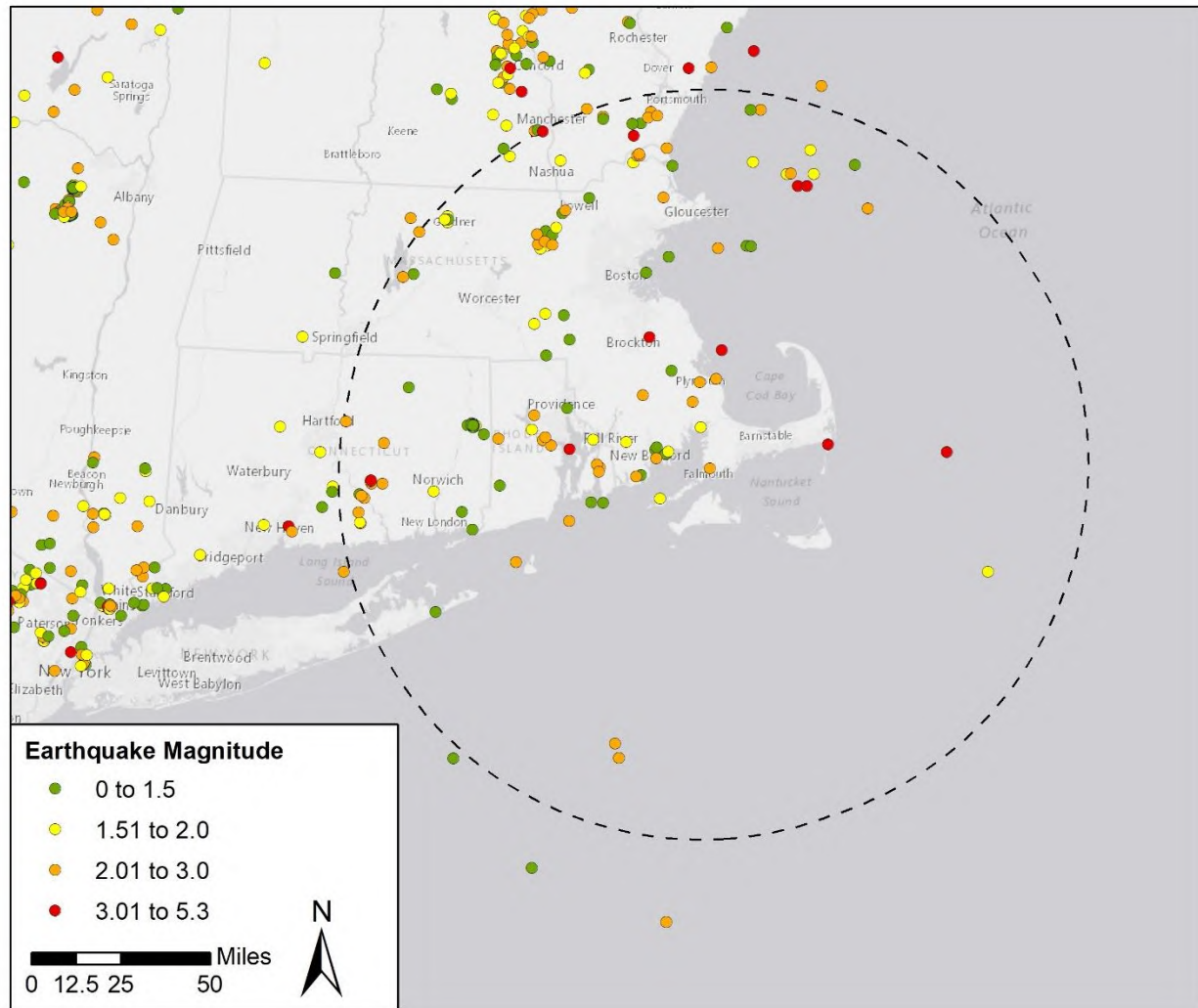


Figure 3-24. Earthquakes that have occurred within 100 miles of Falmouth since 1970.

Table 3-13. Richter Scale.

Richter Magnitude	Earthquake Effects
2.5 or less	Not felt or felt mildly near the epicenter; can be recorded by seismographs
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter



B2.b

Probability

Given that earthquakes have occurred in Massachusetts and in Barnstable County specifically in recent years, it is possible (1-10% probability in the next year) that an earthquake could occur in Falmouth. Any possible effects of climate change on earthquakes are still being determined.

B3.a

Impact

Below is a list of possible impacts that could result from an earthquake:

- **People:** Damage caused to buildings and other structures during an earthquake can lead to injury or loss of life.
- **Emergency Response:** Downed trees and power lines, as well as damaged roads caused by an earthquake can impede emergency vehicles.
- **Infrastructure:** Earthquakes can cause utility poles to fall and live wires to become exposed or to start fires. The shaking caused by an earthquake can also rupture gas lines causing the release of flammable substances and can break or separate sewer collection and water distribution pipes, resulting in loss of service.
- **Economy:** Earthquakes can damage foundations and buildings; most property damage is caused by the failure and collapse of structures during ground shaking. Concrete and masonry structures are brittle and thus more susceptible to damage and collapse.
- **Natural Systems:** Earthquakes can cause landslides and slope failure; this could have hazardous impacts on areas with steep slopes, such as coastal banks.



3.10 INVASIVE SPECIES

Overview

Invasive species are defined as non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health. Although invasive species can be any type of organism, including marine organisms, insects, and birds, the 2018 Massachusetts State Hazard and Climate Adaptation Plan focuses specifically on invasive terrestrial plants, as these are the most studied and managed type of invasive species. However, other categories of invasive species, such as insects and fungi, can cause significant damage to native flora, increasingly the likelihood for downed trees and limbs during many other natural hazard events.

B1.c
B2.a

Hazard Location

Although the entire Town of Falmouth is potentially vulnerable to the introduction and establishment of invasive species, they pose the biggest threat to native or minimally managed ecosystems. In addition, the ability of invasive species to travel far distances (either via natural means or accidental human interference) allows these species to propagate rapidly over large geographic areas.

B1.c
B2.a,c

Previous Occurrences & Extent

The Massachusetts Invasive Plant Advisory Group (MIPAG) recognizes 69 plant species as “Invasive”, “Likely Invasive”, or “Potentially Invasive.” In addition, the 2018 State Plan also lists a number of other invasive species, including gypsy moths (*Lymantria dispar*), the Dutch elm disease fungus (*Ophiostoma sp.*), European green crabs (*Carcinus maenas*), and Asian shore crab (*Hemigrapsis sanguineus*).

Within the Town of Falmouth, invasive species are present within the Coonamessett Reservation, Mares Pond, Spectacle Pond Conservation Area, and Sea Farms Conservation Area. The Falmouth Open Space and Recreation Plan (2014) suggests control and/or removal of these species. Similar to most coastal Massachusetts towns, Falmouth struggles to control common reed (*Phragmites australis*) stands, bittersweet (*Solanum dulcamara*), and Japanese knotweed (*Reynoutria japonica*). These species are found in many areas throughout town. The Town has been using DPW staff to control these species. Local not for profit groups like the 300 Committee and the Oyster Pond Environmental Trust have also been working to control invasive species.

B2.b

Probability

There are known invasive species within the Town of Falmouth, so it is 100% likely that invasive species occur in Town. However, the likelihood that a significant negative impact would occur due to the presence of these species is possible, but not as high. In the future, the Town of Falmouth may become more susceptible to additional invasive species as climate change facilitates the spread and establishment of invasive species.



B3.a

Impact

Below is a list of possible impacts that could result from invasive species:

- **People:** Those who rely on natural systems for their livelihood or well-being are more likely to experience negative repercussions from the expansion of invasive species.
- **Economy:** The agricultural sector is vulnerable to increased invasive species associated with increased temperatures. More pest pressure from insects, diseases, and weeds may harm crops and cause farms to increase pesticide use.
- **Natural Systems:** Biodiversity and ecosystem health may be impacted by invasive species. Aquatic invasive species pose a particular threat to water bodies. Impacts of aquatic invasive species include impairment of recreational uses, such as swimming, boating and fishing, degradation of water quality and wildlife habitat, declines in finfish and shellfish habitat, and diminished property values.



3.11 OTHER SEVERE WEATHER (HEAVY PRECIPITATION, HIGH WIND, THUNDER/LIGHTNING)

Overview

Heavy Precipitation: The Massachusetts State Hazard Mitigation and Climate Adaptation Plan notes that the Fourth National Climate Assessment published by the U.S. Global Change Research Program shows that heavy precipitation events have increased in both intensity and frequency over the past century across much of the country, with the largest increases occurring in the Northeast. Annual precipitation in Massachusetts is projected to increase by as much as 7.3 inches by the end of this century. Furthermore, increased precipitation will likely occur during more intense periods of precipitation coupled with more frequent episodic drought, causing more stormwater runoff, and higher surface water levels.

High Wind: Major wind events in coastal Massachusetts are hurricanes and nor'easters. Tornadoes are extremely rare, although they do occur. Waterspouts have been seen in Cape Cod Bay, in the Cape Cod Canal, and in Buzzards Bay. Thunderstorms, especially in the summer months, do occur and can bring localized damage due to wind, especially to summer cottages of poorer construction and old or rotted tree limbs.

Thunder and Lightning: A thunderstorm is a storm that produces lightning and thunder and is usually accompanied by gusty winds, heavy rain, and sometimes hail. The National Weather Service defines a severe thunderstorm as one that produces a tornado, winds of at least 58 mph (50 knots or ~93 km/h), and/or hail at least 1 inch in diameter. Structural wind damage may imply the occurrence of a severe thunderstorm. A thunderstorm wind equal to or greater than 40 mph (35 knots or ~64 km/h) and/or hail of at least ½ inch is defined as approaching severe. Lightning is one of the most dangerous aspects of a thunderstorm, and it can strike up to 10 miles away from the main thunderstorm location; however, because lightning occurs during every thunderstorm, its presence does not indicate a “severe” thunderstorm.

Three basic ingredients required for a thunderstorm to form are moisture, rising unstable air (air that keeps rising when given a nudge), and a lifting mechanism. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise—by hills or mountains, or areas where warm/cold or wet/dry air bump together—it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool, releasing the heat; and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice, and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder.

B1.c
B2.a

Hazard Location

Heavy Precipitation: Heavy precipitation can affect all portions of the Town of Falmouth. Based on recent studies, New England has already experienced an increase in heavy precipitation events in the last 50 years. This is due to increased sea surface temperatures in the Atlantic Ocean that cause air moving north over the water to hold more moisture. As a result, when these warm fronts meet cold air systems from the north, an even greater amount of precipitation than normal can be anticipated to fall on Massachusetts. As shown in Figure 3-25, the percent change in the precipitation amount occurring as very heavy precipitation has increased by 38% in the northeast. This data compares a reference period from 1901-1960 with a more recent period: 1986-2016. The threshold used to define a heavy precipitation event is the top 1 percent of all days with precipitation.

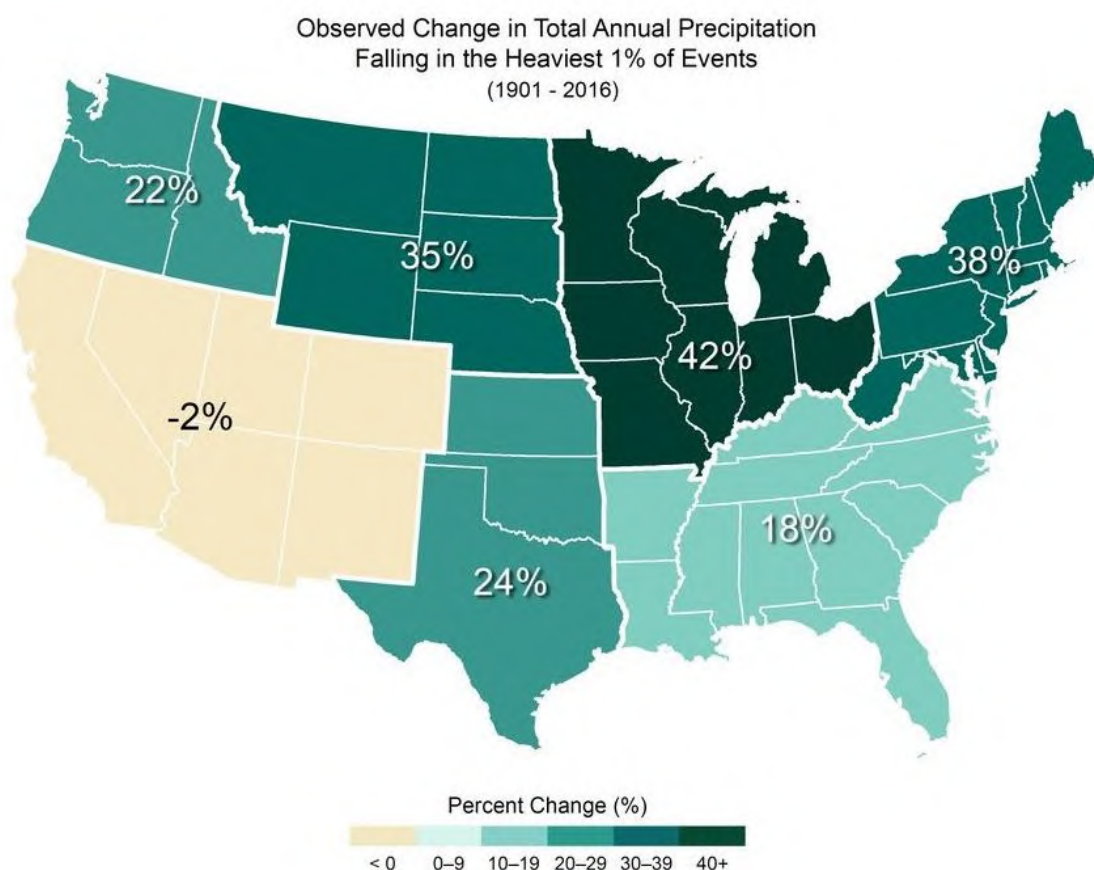


Figure 3-25. Observed changes in heavy precipitation (GlobalChange.gov, 2020).

High Wind: In their effort to research potential sites for wind energy facilities, the Executive Office of Energy and Environmental Affairs (EEA) put considerable effort into measuring wind velocities in Massachusetts. These efforts produced four sets of data, representing mean wind speed at different elevations above the land's surface: 30, 50, 70 and 100 meters. The mean wind speed, in miles per hour, at 30 meters above the land's surface is shown for Falmouth in Figure 3-26.

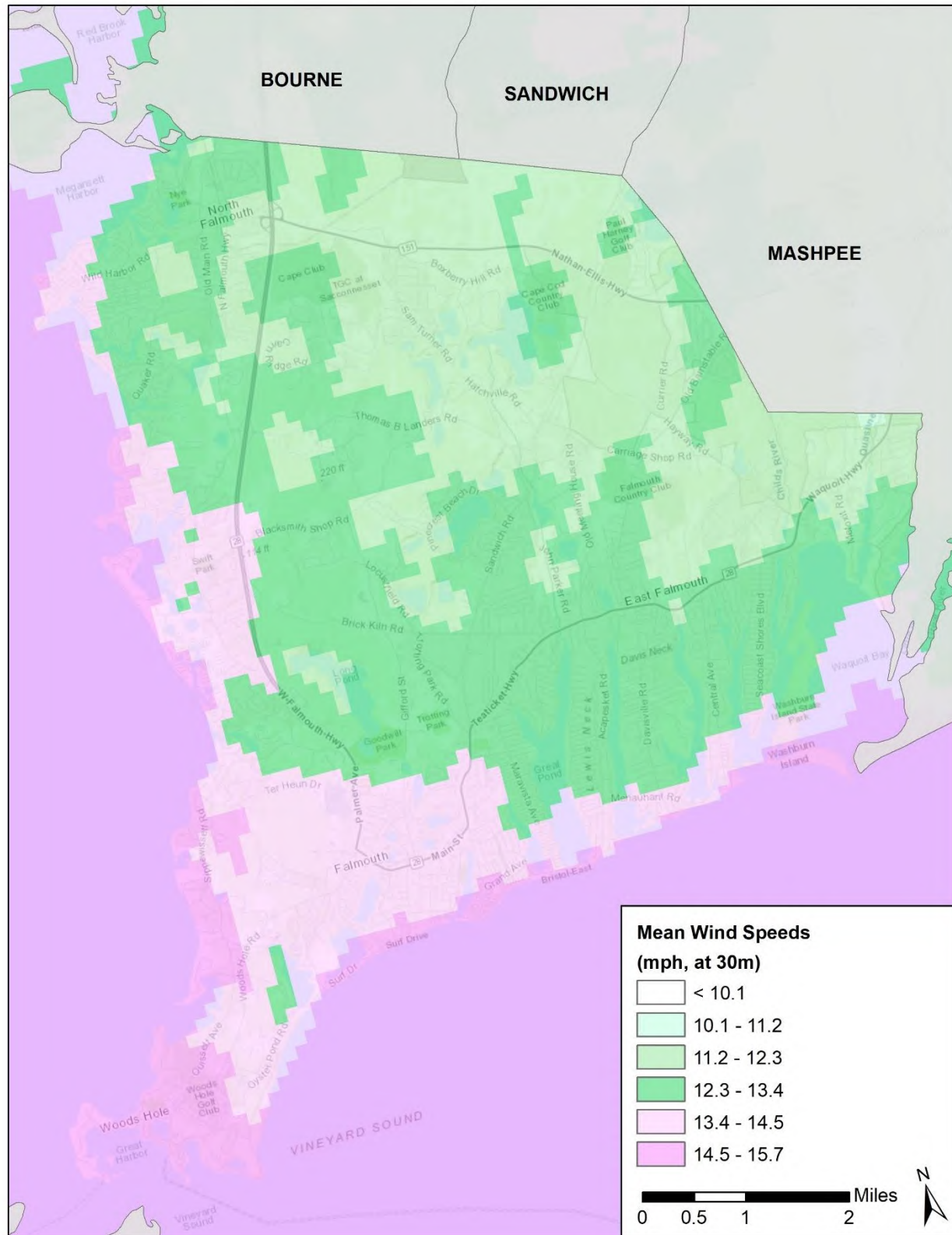


Figure 3-26. Mean wind speed (mph) at 30 meters above the surface.



Thunder and Lightning: The entire Town of Falmouth is at risk from thunderstorms. NOAA has compiled data about the annual number of thunderstorms across the United States. Figure 3-27 shows the annual number of thunderstorms in the northeastern United States. The arrow shows that all of eastern Massachusetts, including Falmouth, falls in the darker blue area, which receives, on average, 10-20 thunderstorms per year.

B1.c
B2.a,c

Previous Occurrences & Extent

Heavy Precipitation: Because heavy rain is often associated with other major weather events (e.g., tropical storms, nor'easters, etc.) the list of heavy rain events from the NOAA NCDC Storm Events (NOAA, 2021) does not have many entries from the past 20 years, none of which occurred prior to 2008):

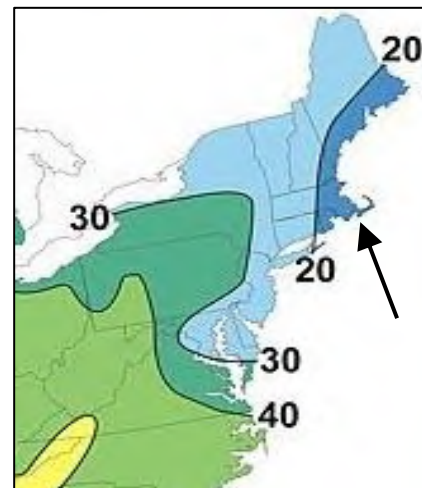


Figure 3-27. Annual number of thunderstorms.

- 1) March 8, 2008: A low pressure system moved from New York spreading heavy rain and strong winds, which coincided with snowmelt. Coastal areas such as Falmouth also experienced heavy surf.
- 2) April 11, 2003: A slow moving pressure system tracked over southern New England resulting in 1 to 3 inches of precipitation. No reports of major flooding.
- 3) March 29, 2003: Rainfall between 2 to 4 inches fell on Cape Cod when a low-pressure system tracked north from the mid-Atlantic. No serious flooding was reported.
- 4) September 22, 2002: Central and eastern Massachusetts experienced heavy rainfall when a slow-moving cold front passed over the state. The highest precipitation totals were reported on Cape Cod and were as high as 3 inches.

Although not recorded in the NOAA Storm Events Database, the Town also experienced heavy precipitation on February 4, 2022, which combined with snowmelt from a blizzard on January 29, 2022 and resulted in flooding along Surf Drive, Menauhant Road, Millfield Street, and Gardner Road. Given the tendency for heavy precipitation to occur during other weather events, it is likely that the frequency of these events is underestimated by this database. Average precipitation data within Falmouth for 2021 is displayed in Figure 3-28 below.

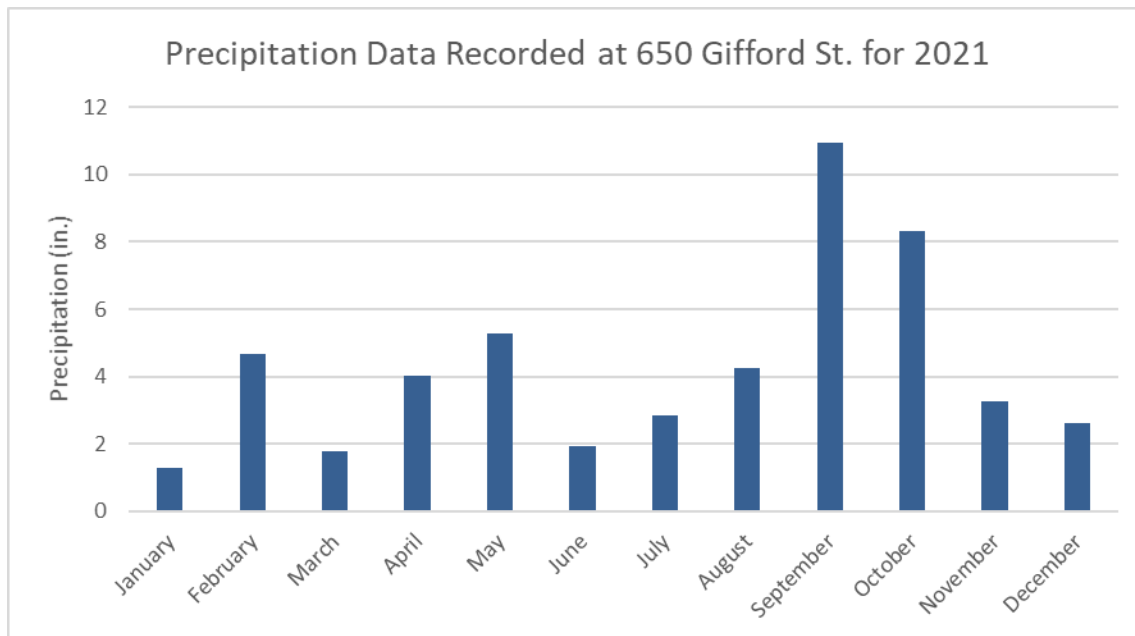


Figure 3-28. Precipitation data from 650 Gifford St. for 2021.

High Wind: A summary of the high wind events from the NOAA NCDC Storm Events database (NOAA, 2021) for the most recent 15 high wind events that included information specific to Falmouth are listed below and indicate high wind events are very common in Falmouth (multiple times per year):

- 1) October 26-27, 2021: A low pressure nor'easter resulted in wind gusts of 60 to over 90 mph. Over 495,000 people lost power in Massachusetts. Falmouth recorded wind gusts of 79 mph.
- 2) March 2-3, 2021: An arctic cold front moved into new England bringing damaging west-northwest winds. Gusts of 56 mph were reported in Falmouth and a downed tree on North Falmouth Highway was reported.
- 3) December 25, 2020: A strong frontal system moved north from the southern US over Massachusetts. Wind gusts of 60 mph were recorded in Woods Hole.
- 4) September 30, 2020: A cold front moved across the northeast region causing damaging winds. Gusts over 50 mph were reported in Falmouth.
- 5) April 13, 2020: A pressure system originating the great Lakes area caused sustained winds of over 50 mph in Falmouth.
- 6) April 3, 2020: An intense ocean storm brought wind gusts of up to 55 mph in Falmouth.
- 7) March 6-7, 2020: A bomb cycle caused winds of 59 mph in Woods Hole and a downed tree at the intersection of John Parker Road and Harris Hill Road.
- 8) February 27, 2020: A cold front across New England caused strong southwest to west winds of up to 61 mph in Falmouth and downed a tree on Ashumet Road.
- 9) February 7, 2020: A powerful low-pressure system moved across Massachusetts downing trees on English Street and Davisville Road in Falmouth.



- 10) October 17, 2019: A coastal storm developed off New Jersey then brought wind gusts of over 65 mph to Falmouth.
- 11) October 10-11, 2019: An ocean storm combined with a high-pressure system causing high winds. In Falmouth, a large branch was downed on Woods Hole Road by the Golf course and there were downed trees on Brick Kiln Road, Jamie Lane, Katy Hatches Road, Madeline Road, and Maravista Avenue.
- 12) January 30, 2019: A low pressure system moved across the New England region. The strongest wind gust was recorded in West Falmouth and was 62 mph.
- 13) November 13, 2018: A low pressure system moved across Massachusetts bringing winds over 50 mph to Falmouth and downed a tree on Union Street.
- 14) November 3, 2018: A low pressure system originating in New York brought high winds to Cape Cod. In Falmouth, two oak trees were downed on Vidal Avenue.
- 15) March 2-3, 2018: A low pressure system out of Ohio Valley brought strong winds to New England and East Falmouth experienced wind gusts of over 60 mph.

The National Weather Service issues a variety of warnings related to wind hazards. They are:

- High Wind Watch: Issued when the following conditions are possible – sustained winds of 40 mph or higher for one hour or more, or wind gusts of 58 mph for one hour or more.
- High Wind Warning: Issued when the following conditions are occurring or imminent – sustained winds of 40 mph or higher for one hour or more, or wind gusts of 58 mph for one hour or more.
- Hurricane Watch: Issued when a tropical cyclone containing winds of 74 mph or higher poses a possible threat, generally within 48 hours.
- Hurricane Warning: Issued when sustained winds of 74 mph or higher associated with a tropical cyclone are expected in 36 hours or less.
- Wind Advisory: Issued when the following conditions are expected for 3 hours or longer – sustained winds of 31 to 39 mph and/or wind gusts of 46 to 57 mph.
- Extreme Wind Warning: Issued for surface winds of 115 mph or greater associated with non-convective, downslope, derecho (not associated with tornado), or sustained hurricane winds are expected to occur within one hour.
- Small Craft Advisory: Issued when one or all of the following conditions are expected to occur within 36 hours – sustained winds of 18 to 33 knots or frequent gusts (with a duration of 2 hours or more) between 18 to 33 knots or waves of 4 feet or higher.
- Gale Warning: Issued when one or both of the following conditions are expected to occur within 36 hours and is not directly associated with a tropical cyclone – sustained winds of 34 to 47 knots or frequent gusts (with a duration of 2 hours or more) between 34 to 47 knots.
- Storm Warning: Issued when one or both of the following conditions are expected to occur within 36 hours and is not directly associated with a tropical cyclone – sustained winds of 48 to 63 knots or frequent gusts (with a duration of 2 hours or more) between 48 to 63 knots.



- **Hurricane Force Wind Warning:** Issued when one or both of the following conditions are expected to occur within 36 hours and is not directly associated with a tropical cyclone – sustained winds of 64 knots or greater or frequent gusts (with a duration of 2 hours or more) between 64 knots or greater.



Figure 3-29. Downed wires on Quissett Avenue (left) and downed trees on Jones Road (right) caused by wind gusts of up to 92 miles per hour during Winter Storm Riley from March 2 to 4, 2018.

Thunder and Lightning: The NOAA NCDC Storm Events database lists 18 lightning and/or thunderstorm wind events were reported for Barnstable County within the last 10 years (NOAA, 2021). Only two (2) of the recorded events were specific to Falmouth:

- 1) August 22, 2020: A short wave trough led to a connective complex that triggered severe thunderstorms in eastern Massachusetts. In North Falmouth, multiple trees were reported down on Quaker Road and on Old Main Road.
- 2) April 9, 2020: A strong cold front joined with an upper-level disturbance to create thunderstorm winds across southeastern Massachusetts. In East Falmouth, thunderstorms produced wind gusts of up to 60 mph.

There are a variety of types of thunderstorms:

- Single-cell thunderstorms, which are small, brief, weak storms that can develop and then dissipate within an hour. They are typically produced by heating on a summer afternoon. Single-cell storms produce brief, heavy rain and lightning.
- Multi-cell storms form along the leading edge of rain-cooled air. Although individual cells that comprise the multi-cell storm can only last 30-60 minutes, the entire multi-cell storm system can persist for many hours. Multi-cell storms may produce hail, strong winds, brief tornadoes and flooding.



- A squall line is a group of storms arranged in line, often associated with “squalls” of heavy wind and rain. These storms tend to pass quickly and are less likely to produce tornadoes than supercells. A squall line can be hundreds of miles long but tend to only be 10-20 miles wide.
- A supercell is a highly organized, long-lived storm fueled by an updraft that is tilting and rotating. These tilting and rotating updrafts can produce severe tornadoes.

B2.b

Probability

Based on the data presented above, it is highly likely (near 100% probability in the next year) that other severe weather (heavy precipitation, high wind, and thunder/lightning) will occur in Falmouth. As mentioned with prior hazards, climate change is predicted to increase the frequency and intensity of storms and severe weather events, which includes heavy precipitation, high winds, and thunder/lightning storms.

B3.a

Impact

Below is a list of possible impacts that could result from other severe weather:

- **People:** Thunderstorms and high winds can result in power outages, leaving people without heat or other utilities. Lightning may cause injury or death to people who are outdoors during the onset of a thunderstorm if they are unable to seek shelter. Flooding in and around residential structures due to heavy precipitation can result in mold, which can cause serious health concerns, ranging from itching eyes, sneezing and coughing to serious allergic reactions, asthma attacks, and even permanent lung damage.
- **Emergency Response:** Trees and power lines felled by high winds and/or lightning can impede emergency vehicles.
- **Infrastructure:** Lightning and high winds can result in downed power lines. High wind events can generate significant waves which can damage coastal infrastructure and moored/docked vessels. Heavy rains associated with thunderstorms can result in flooded roads and overwhelm drainage systems.
- **Buildings:** Wind and wind-born debris can damage roofs, windows, and other portions of houses and buildings. Heavy rains and flooding can damage properties; the resulting water damage and mold may require removal and replacement of wall boards, insulation, etc. Lightning strikes can start fires, which can threaten buildings and structures.
- **Economy:** Power outages can force businesses to close temporarily.
- **Natural Systems:** Heavy winds can bring down trees and branches.



3.12 LANDSLIDE

Overview

Landslides are a form of mass wasting in which there is a mass movement of rock, debris, or earth down a slope under the direct influence of gravity. There are five different types of slope movement that are considered landslides including falls, topples, slides, spreads, and flows. These categories can be further divided up by the type of material composing the landslide including bedrock, debris, or earth. The most common types of landslides are mudflows or mudslides, otherwise known as debris flows. Depending on the severity of the event, landslides can be a threat to human life, buildings, infrastructure, and the natural environment.

Landslides occur when down-slope forces exceed the strength of the earthen material on the slope. Landslides are often the result of a combination of factors increasing down-slope forces and decreasing strength of material. These factors can be brought on by heavy precipitation, snowmelt, stream erosion, earthquakes, and/or human disturbance. Landslides can travel as slow as millimeters per year, or in the case of severe debris flows, as fast as 200 mph, but more commonly 30 to 50 mph. Landslide speed is dependent on steepness of the slope, water composition, and debris volume and type. Generally, landslides are not common in Massachusetts. The coastal and mountainous areas of the west coast, as well as the Appalachian Mountains, Rocky Mountains, Alaska, and Hawaii all have more severe and frequent landslide events.

B1.c
B2.a

Hazard Location

In 2013, the Massachusetts Geologic Survey mapped potential landslide hazards for the entire state of Massachusetts. Maps were specifically produced for use in the upcoming 2018 Massachusetts Statewide Hazard Mitigation Plan and shows where past slope movement has occurred and/or may occur in the future under heavy precipitation events. Figure 3-30 shows the slope stability map for Falmouth. Overall, the topography of Falmouth is relatively flat and stable. Areas with low stability or moderate instability are limited but include around Coonamessett Pond, seaward of Oyster Pond Road, south of Old Silver Beach at the Falmouth Cliffs, south of Research Road, and south of Goodwill Park.

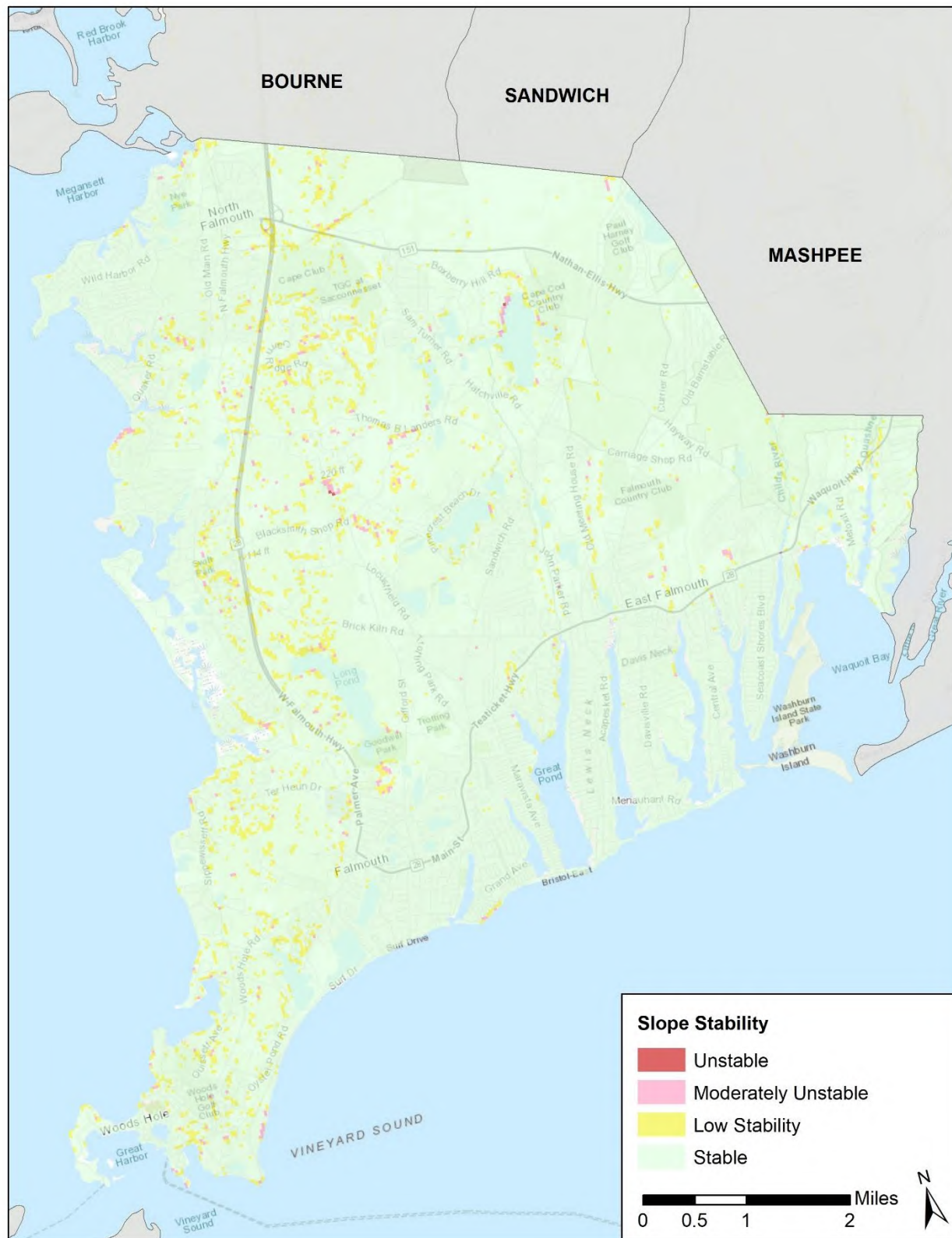


Figure 3-30. Slope stability of Falmouth (Massachusetts Geological Survey, 2013).

B1.c
B2.a,c**Previous Occurrences & Extent**

Although there have been no reported landslides within the Town of Falmouth since 1900, there have been seven (7) reported landslides within 100 miles of Falmouth. These events are shown in Figure 3-31 and listed in Table 3-14. The U.S. Geological Survey, in cooperation with NASA, maintains a database of landslides across the U.S. from 1900 through 2019. The database includes landslides from a variety of sources, and thus, each landslide is reported with a confidence in the ground failure event and location. Landslide confidence categories and the number of landslides within 100 miles of Falmouth in each category are listed below:

- High confidence in extent or nature of the landslide (0);
- Confident consequential landslide at this location (1);
- Likely landslide at or near this location (4);
- Probable landslide in the area (2); and
- Possible landslide in the area (0).

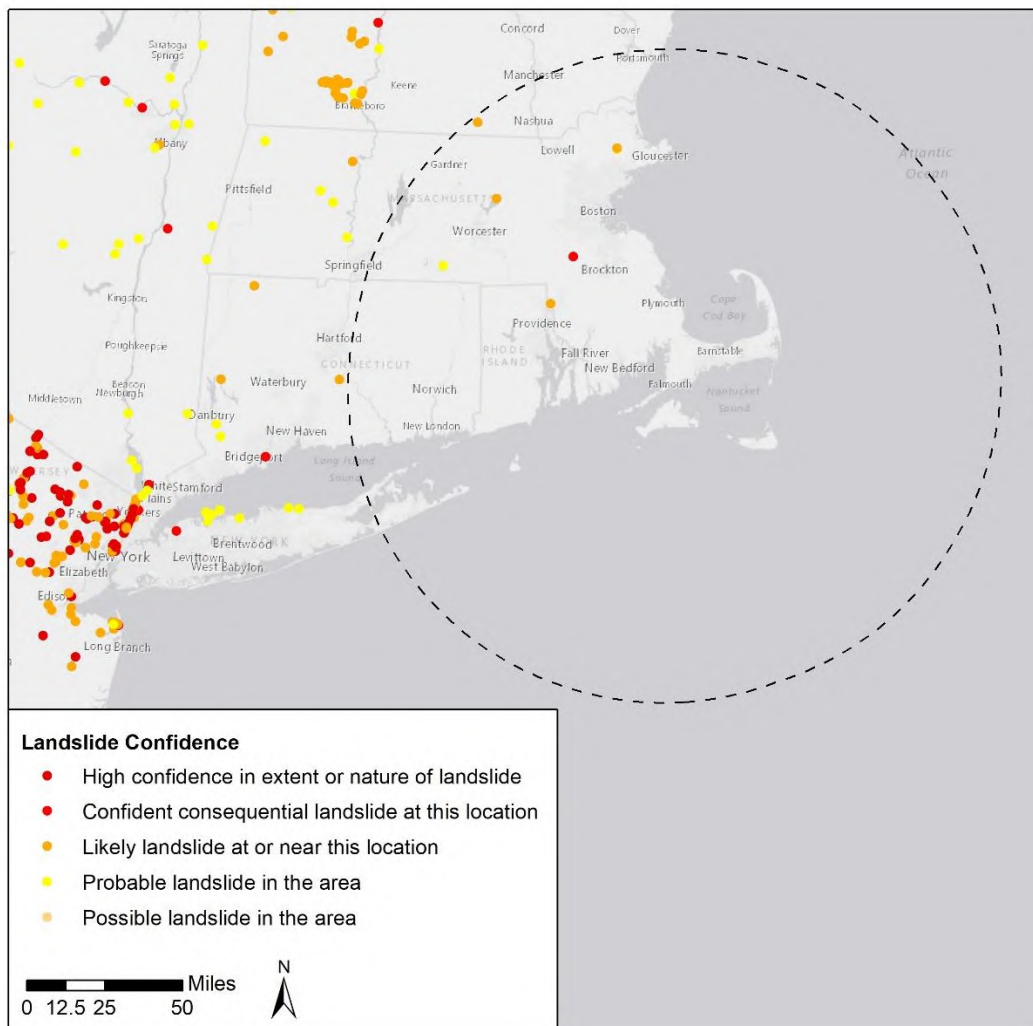


Figure 3-31. Landslides that have occurred within 100 miles of Falmouth from 1900 to 2019 (USGS, 2019).

**Table 3-14. Landslide Inventory from 1900 to 2019 Within 100 Miles of Falmouth.**

Date	Location	Confidence
12/9/2014	Topsfield, MA	Likely landslide at or near this location
11/4/2014	Attleboro, MA	Likely landslide at or near this location
9/30/2013	Southbridge, MA	Probable landslide in the area
3/31/2010	Greenville, NH	Likely landslide at or near this location
3/15/2010	Walpole, MA	Confident consequential landslide at this location
3/15/2010	Clinton, MA	Likely landslide at or near this location
3/14/2010	Topsfield, MA	Probable landslide in the area

B2.b

Probability

Considering the low occurrence of landslides within the vicinity of the Town of Falmouth, as well as the flat topography and lack of major hills, the likelihood of a landslide occurring within Falmouth is unlikely (less than 1% probability in the next year). Similar to hazards previously discussed, climate change is predicted to increase heavy precipitation events, which may result in destabilization of slopes and a higher frequency of landslides in some areas.

B3.a

Impact

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

- **People:** Could become trapped or blocked by obstructed roads resulting from displaced sediment, vegetation, tree limbs, etc. In severe cases, landslide events can also lead to injury or death.
- **Infrastructure:** Could be damaged leading to an interruption in utilities such as electricity or water, due to damaged pipes or power lines near landslide.
- **Buildings:** Major landslides could lead to property and/or building damage.
- **Economy:** Businesses could experience economic losses due to obstructed roads prohibiting employees and/or customers from accessing certain areas of Town.
- **Natural Systems:** Landslides can result in the loss of habitat areas and vegetation. Debris and sediment can also accumulate in rivers or streams negatively affecting fish habitat and water quality.



3.13 TSUNAMI

Overview

A tsunami is a series of ocean waves generated by earthquakes, a sudden displacement of the ocean floor, underwater landslides, or volcanic activity. In the deep ocean, a tsunami wave may only be a few inches high. However, as the wave nears shore, tsunamis generate a devastating onshore surge of water. Major tsunamis are produced by large (greater than 7 on the Richter scale), shallow focal depth (<30 km) earthquakes associated with continental plate movement. The waves 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. However, even waves that are 10 to 20 feet high can be extremely destructive.

B1.c
B2.a

Hazard Location

Although tsunamis most commonly occur in the Pacific Ocean, where dense oceanic plates slide under lighter continental plates, they can occur in the Atlantic Ocean as well.

B1.c
B2.a,c

Previous Occurrences & Extent

Although there are no records of a tsunami occurring in Falmouth, there are three (3) reported tsunamis within 100 miles of Falmouth since the mid-1500s (Figure 3-32), the most recent of which occurred in 1879.

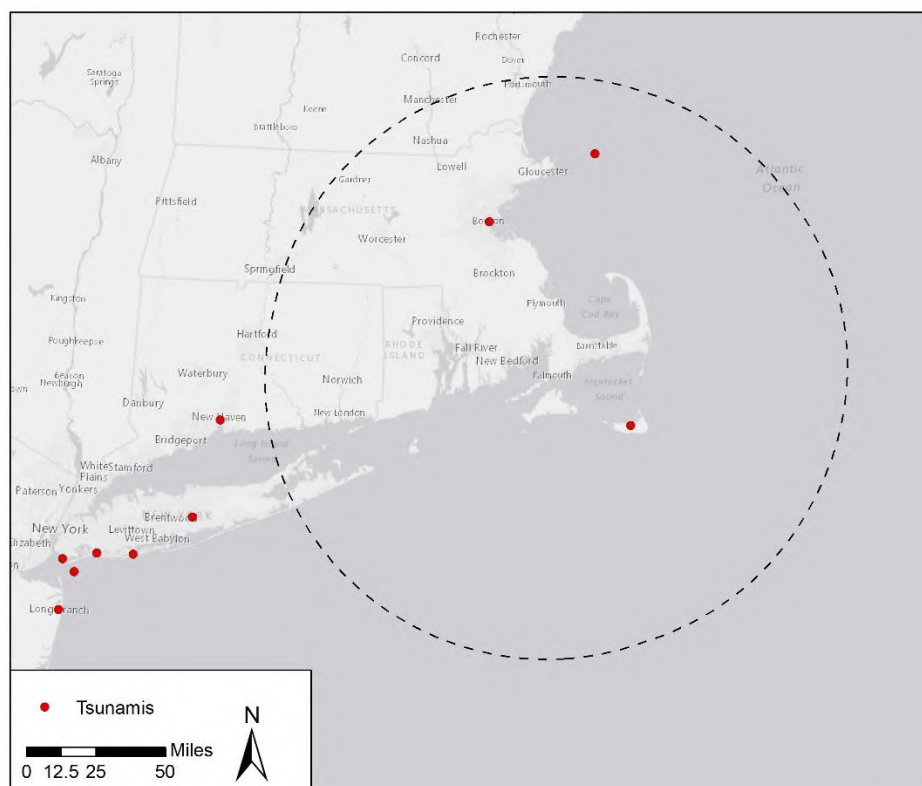


Figure 3-32. Tsunamis that have occurred within 100 miles of Falmouth from the mid 1500s to 2022 (NOAA NCEI, 2021).



B2.b

Probability

There is no record of tsunamis ever occurring in Falmouth, and only three occurrences within 100 miles since the mid-1500s. Therefore, it is unlikely (less than a 1% probability over the next 100 years) that a tsunami will occur in Falmouth. As sea level rises, the extent of inland flooding resulting from a tsunami will likely increase, however, the overall risk to Falmouth will still likely be very low.

B3.a

Impact

Below is a list of possible impacts that could result from a tsunami:

- **People:** The forces of a tsunami wave itself can injure people or lead to death. Floating debris can endanger human lives, and the effects of a tsunami may leave people within food or fuel.
- **Emergency Response:** Flooded roads and deposited debris may block emergency response.
- **Infrastructure:** Tsunami waves and floating debris can damage coastal infrastructure and piers. Ruptured utility pipes and storage containers can release oil and gas, resulting in fire hazards.
- **Buildings:** The force of the tsunami wave can destroy buildings, and floating debris can damage structures. Also, the scouring action of moving water can sweep away buildings.
- **Economy:** Utilities can be damaged and roadways blocked, which can adversely impact economic activities. Coastal systems impacted by tsunamis can also adversely impact the fishing and tourism industries.
- **Natural Systems:** Tsunamis can uproot trees and plants. Land animals can be killed by drowning and marine life can be killed by pollution if toxic chemicals are washed into the ocean.



3.14 DAM AND CULVERT FAILURE

Overview

A dam is any artificial barrier and/or any controlling structure that can or does impound or divert water. There are 2,903 public and privately owned dams in Massachusetts, eight (8) of which are located in Falmouth (Figure 3-33).

Dam failure is any sudden, uncontrolled release of impounded water due to structural deficiencies in a dam. Dams can fail for a variety of reasons, including the dam being overtopped by floods that exceed its capacity, structural failure of the dam construction materials or the foundation supporting the dam, and inadequate maintenance and repair.

The hazards associated with a failing dam can also occur from culverts that act like dams during flooding events. A culvert is a structural opening under a roadway that allows water to pass from one side of the road to the other. They are typically made of concrete, steel or aluminum, and their size is calculated based on the location-specific volume of water expected to pass through that location. The primary function of a culvert is to prevent flooding during normal and extreme weather conditions and to provide proper road drainage. Culverts can fail due to the pipe becoming occluded by debris or improper maintenance, the pipe caving in due to structural deficiencies, or from a buildup of flood waters exceeding the capacity of the culvert. The Town of Falmouth's Municipal Maintenance Department has identified 127 culverts within the Town, 3 of which are in a concerning condition (Figure 3-33).

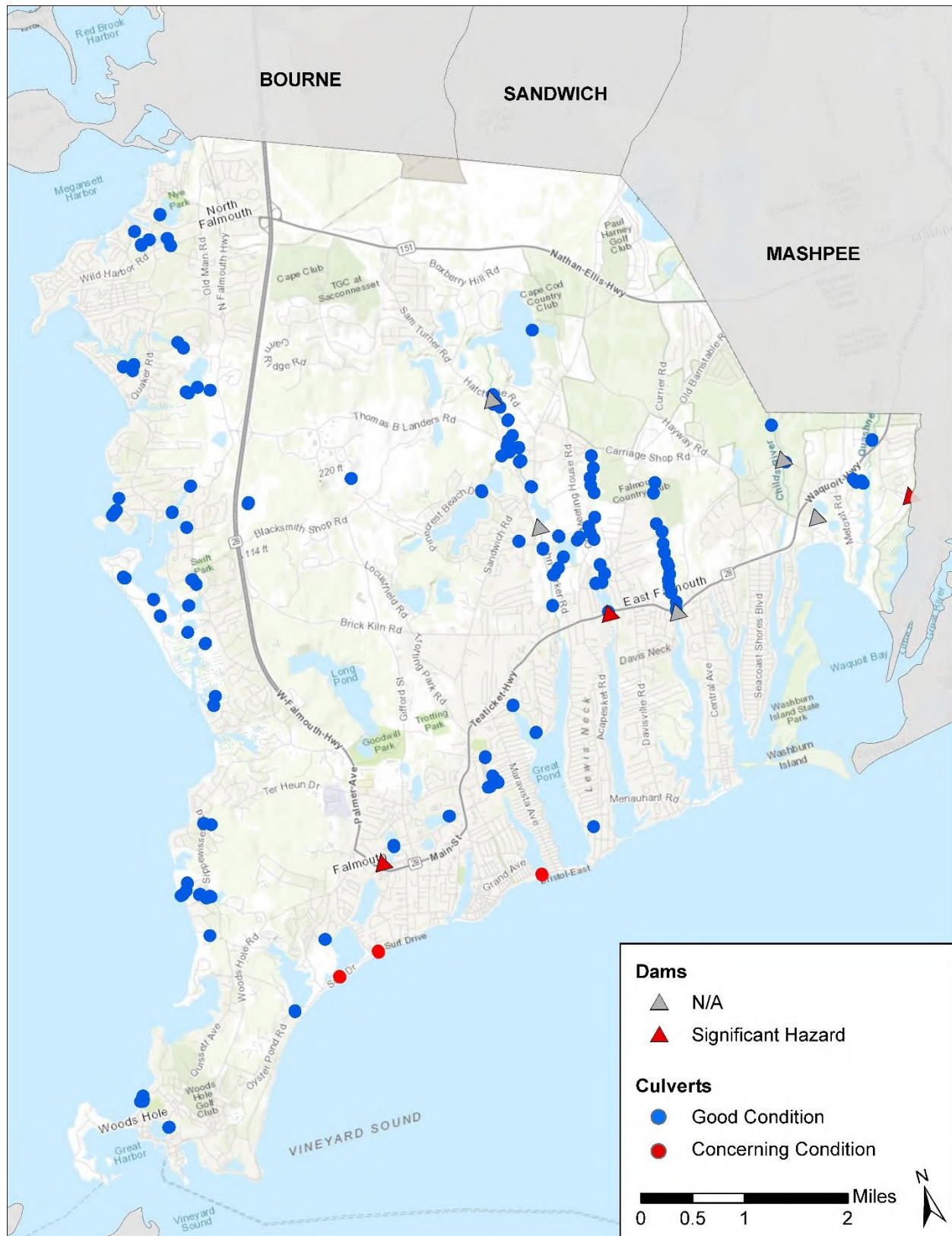


Figure 3-33. Locations of dams and culverts within Falmouth.

B1.c
B2.a**Hazard Location**

The Massachusetts Office of Dam Safety, within the Department of Conservation and Recreation, maintains a database of all the dams in Massachusetts, classified by their hazard potential. This database divides dams into three categories:

- 1) High Hazard Potential Dam: A dam location where failure will likely cause loss of life and serious damage to homes, industrial or commercial facilities, important public utilities, main highways or railroads.
- 2) Significant Hazard Potential Dam: A dam located where failure may cause loss of life and damage to homes, industrial or commercial facilities, secondary highways, or railroads, or cause interruption of use or service of relatively important facilities.
- 3) Low Hazard Potential Dam: A dam located where failure may cause minimal property damage to other, and loss of life is not expected.

Hazards associated with dam failure are confined to the areas around existing dams. Of the eight (8) dams located in Falmouth, three (3) are classified as a significant hazard by the Office of Dam Safety (Figure 3-33). The remaining dams have not been classified. This is likely because the remaining five (5) are very small dams located on cranberry bogs and are generally not considered to be a hazard in the event of failure. There are no Emergency Action Plans for any of the dams in Falmouth.

B1.c
B2.a,c**Previous Occurrences & Extent**

There have been no previous occurrences of dam or culvert failure in the Town of Falmouth. However, aging infrastructure, as well as increased storm intensity and rising sea levels associated with climate change, may produce such incidents in the future.

B2.b

Probability

Even though a dam or culvert failure has never occurred in the Town of Falmouth, the probability of it occurring is moderate, especially for those sites recognized as being a significant hazard or a concern (10-100% probability in the next year). The 2018 Massachusetts Hazard Mitigation and Climate Adaptation Plan describes two primary types of dam failure: catastrophic failure, characterized by the sudden, rapid, and uncontrolled release of impounded water, and design failure, which occurs as a result of minor overflow events. Dam overtopping is caused by floods that exceed the capacity of the dam, and it can occur as a result of inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors. Overtopping accounts for 34 percent of all dam failures in the U.S. More extreme precipitation events could increase the frequency of overtopping events. So, although climate change will not increase the probability of catastrophic failure, it may increase the probability of design failure.



B3.a

Impact

Below is a list of possible impacts that could result from dam or culvert failure:

- **People:** Could become trapped or blocked by flooded roads resulting from overtopped dams or culverts.
- **Infrastructure:** Utilities may be disrupted due to damaged pipes or power lines near the dam or culvert.
- **Buildings:** May be damaged by flooding caused by a failed dam or blocked culvert.
- **Economy:** Businesses could experience economic losses due to flooded or blocked roads prohibiting employees and/or customers from accessing certain areas of Town.
- **Natural Systems:** Dam and culvert failures can result in bank erosion. Debris and other materials can be deposited in natural systems.



3.15 FRESHWATER QUALITY

Overview

Clean freshwater resources, such as ponds and rivers, are essential for a healthy ecosystem. Freshwater ponds provide habitat for a variety of flora and fauna. In addition, ponds on Cape Cod support agricultural activities, such as cranberry bogs, which also have a historical and cultural significance. However, nutrient pollution from poorly maintained septic systems and lawn fertilizers, among other sources, can fuel the growth of algae: tiny plants that can bloom rapidly in a body of water. This process of over-supplying nutrients (i.e., nitrogen and phosphorus) to an aquatic system is called eutrophication. An algal bloom is a rapid increase in the amount of algae. When this occurs, it affects the whole ecosystem. Its impacts range from benign (e.g., providing additional food for herbivorous organisms) to harmful (e.g., blocking sunlight from other photosynthetic organisms, depleting dissolved oxygen levels, or secreting toxins into the water). Poor water quality in rivers that flow downstream to the ocean or in salt ponds can also lead a negative effect on marine water quality.

Since clean drinking water in Falmouth is provided via a sole source aquifer, the Town regulates development density, land use, and wastewater discharges for the protection of freshwater quality. Without continued protection, there is the potential for aquifer contamination from stormwater runoff, non-point source pollution, and nitrification in areas where the groundwater is presented as surface water. Saltwater intrusion may also be a concern in the future as sea levels continue to rise and the potential for contamination increases.

B1.c
B2.a

Hazard Location

There are 38 major freshwater ponds in Falmouth ranging in size from 152 acres (Coonamessett Pond) to 1.7 acres (unnamed pond) (Figure 3-34). Due to the factors causing algal blooms and eutrophication, freshwater ponds are some of the most likely areas to be adversely affected. Falmouth also has two rivers, Coonamessett River and Quashnet River. Eutrophication can also affect nearshore estuaries and shallow bays. Long Pond is a protected surface water reservoir and the major source of drinking water for Falmouth, supplying up to 80% of daily water needs on a summer day. Other sources of drinking water are from the Coonamessett Pond and Crooked Pond wells which draw from groundwater sources.



Figure 3-34. Major freshwater ponds and rivers in Falmouth.

B1.c
B2.a,c**Previous Occurrences & Extent**

In order to minimize the risk of illness from water contaminated with bacteria, public beaches have to be tested for E. coli or Enterococci. Towns are then required to report testing results to the Massachusetts state government/Board of Health. Below in Table 3-15 are E. coli testing records for freshwater beaches in Falmouth from 2020. Ponds that did exceed E. coli benchmarks include the Cape Cod Camp Resort pond (Round Pond), Jenkin's Pond, and the Lochstead Association pond.

Table 3-15. E. Coli Testing Data for Falmouth Freshwater Beaches in 2020.

Beach	Testing Frequency	Tests	Single Sample Exceedances	Minimum Exceedance (cfu/1000mL)	Maximum Exceedance (cfu/1000mL)
Ashumet Valley Holly Sands	Weekly	14	0	-	-
Cape Cod Camp Resort	Weekly	15	2	274.4	2239.8
Coonamessett Pond	Weekly	14	0	-	-
Grew's Pond	Weekly	14	0	-	-
Jenkins Pond (Pinecrest)	Weekly	15	1	1046.2	1046.2
Lochstead Association	Weekly	15	1	866.4	866.4
Mares Pond Association	Weekly	14	0	-	-
Sand Pointe Shores: Rock Hollow	Weekly	13	0	-	-
Sand Pointe Shores: White Cap	Weekly	13	0	-	-
Shady Lane Homeowners: Crooked Pond	Weekly	12	0	-	-
Water-by-Estates Association (Flax Pond)	Weekly	14	0	-	-

The Association for the Preservation of Cape Cod (APCC), recently published a State of the Waters Report in 2021 in which freshwater ponds on Cape Cod were graded using the Carlson Trophic State Index (TSI) and cyanobacteria data to form a combined pond grading system. An “acceptable; ongoing protection required” grade was given if CTI grade was acceptable and/ or cyanobacteria was low. An “unacceptable; immediate restoration required” grade was given if the CTI was unacceptable and/or cyanobacteria was high. Within Falmouth, ponds that received an unacceptable grade include Ashumet Pond (partially within Mashpee), Deep Pond, Crooked

Pond, Mares Pond, and Jenkins Pond (red in Figure 3-35). Ponds that received an acceptable grade include Cedar Lake and Fresh Pond (blue in Figure 3-35).

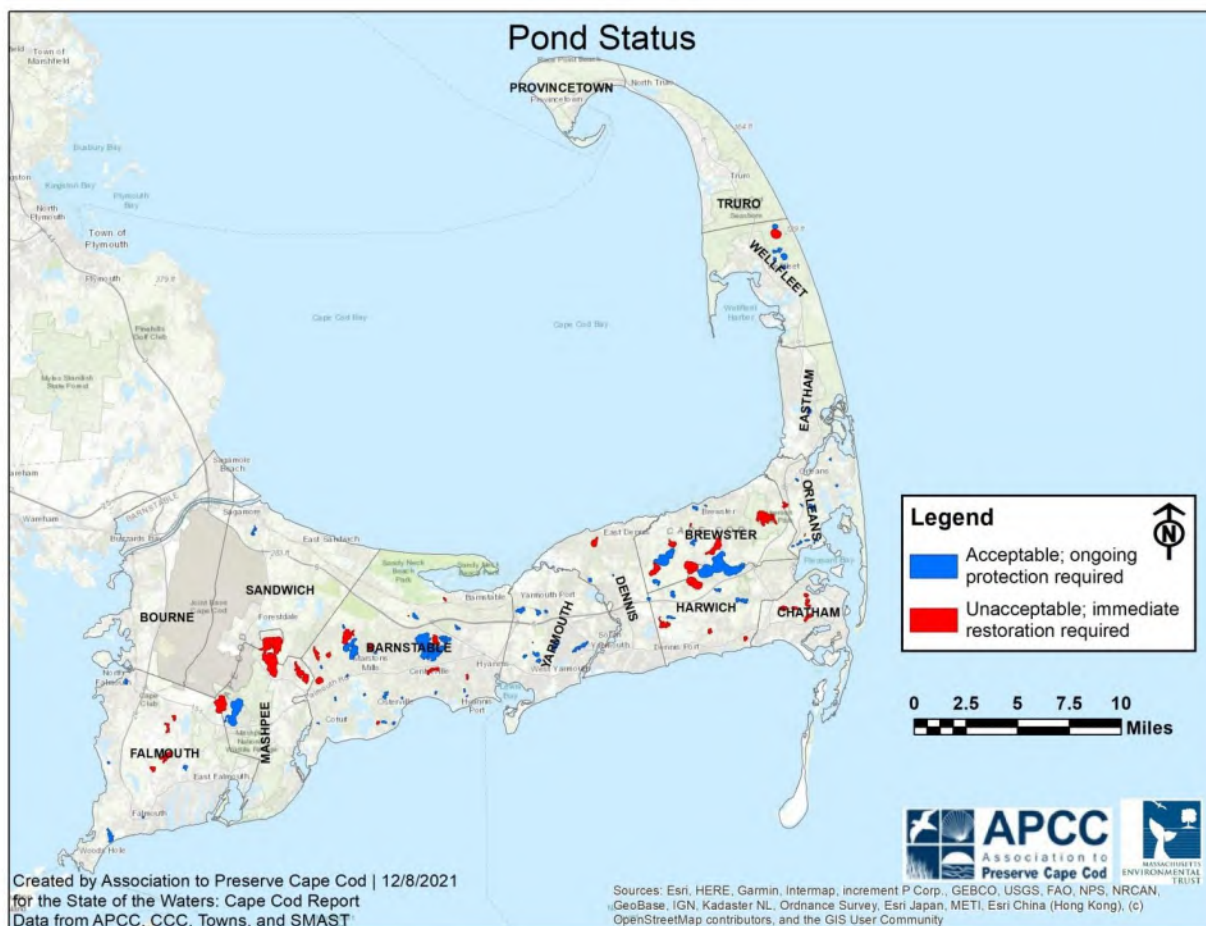


Figure 3-35. Pond Status on Cape Cod (created by the APCC, 2021).

The APCC also evaluated drinking water sources on Cape Cod (Figure 3-36). Within Falmouth, drinking water supply was scored as “excellent”. The Long Pond Reservoir was outfitted with a new state-of-the-art drinking water filtration plant in 2017 and water filtration systems are also active on the Coonamessett Pond and Crooked Pond wellhead sites.

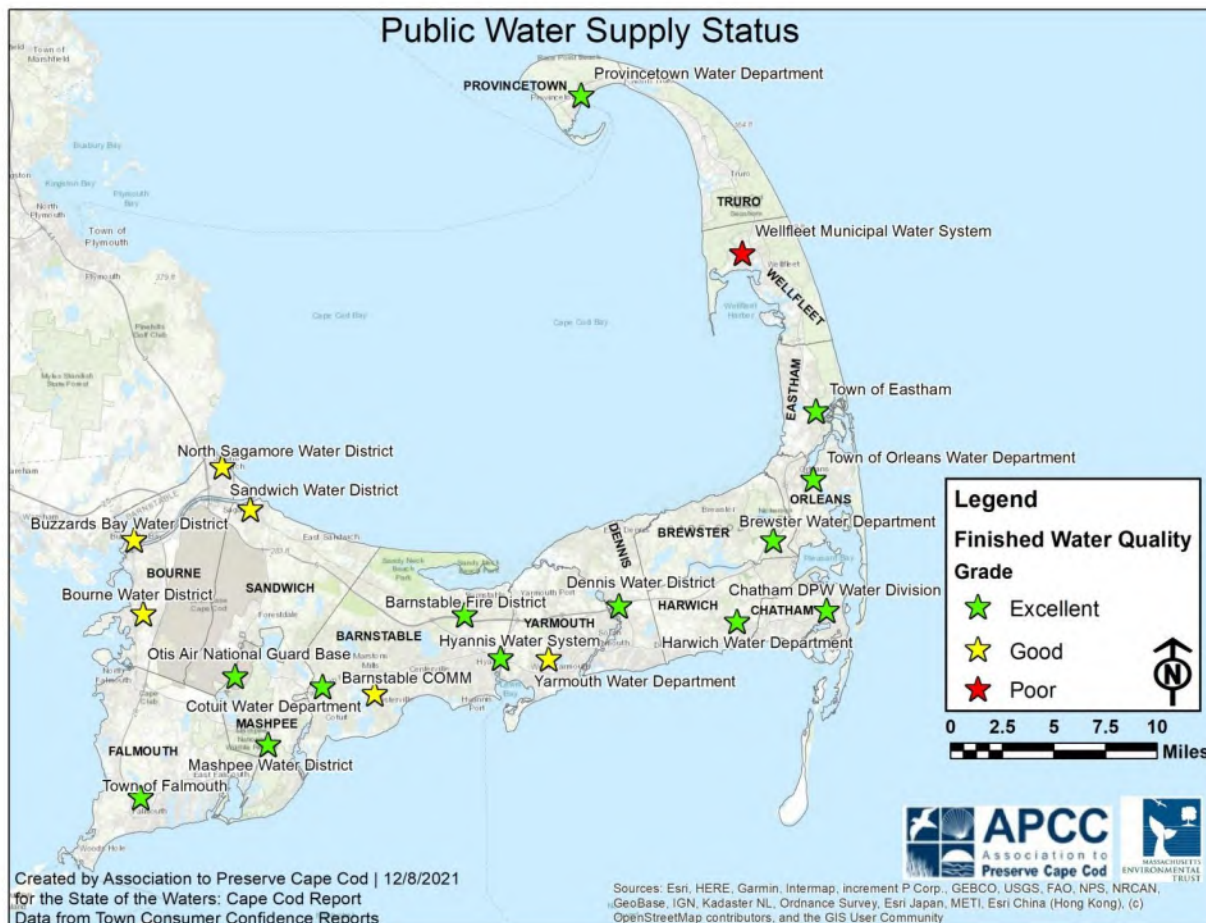


Figure 3-36. Public water supply status on Cape Cod (created by the APCC, 2021).

B2.b

Probability

Based on past records, the likelihood of poor water quality in the Town's freshwater ponds is somewhat likely (1 to 10% probability in the next year).

B3.a

Impact

Below is a list of possible impacts that could result from water quality problems:

- **People:** Serious illness can result if people consume fish contaminated with toxins. Drinking water sources can be impacted if drinking water reservoirs are impacted by algal blooms.
- **Economy:** Businesses relying on freshwater recreation can be negatively impacted by unhealthy levels of bacteria when ponds are closed for swimming.
- **Natural Systems:** Freshwater systems can be severely degraded due to algal blooms: algal blooms can shade out other photosynthetic organisms and oxygen depletion can result in fish kills.



3.16 SUMMARY OF HAZARDS

As suggested by the FEMA planning guidance, the Local Planning Team (LPT) reviewed the full range of natural hazards identified in the 2018 Massachusetts State Hazards and Climate Adaptation Plan and identified natural hazards that could impact Falmouth in the future, or that have impacted the Town in the past (Chapter 3). The 15 individual hazards discussed in Chapter 3 are evaluated below in Table 3-16 based on the likelihood of occurrence, severity, and area. Likelihoods for each hazard, as described in Chapter 3, are scored from 1 (unlikely) to 4 (highly likely). The severity of the hazard was scored on a scale of 1 to 4, with 1 being minor and 4 being catastrophic. Finally, whether the hazard was likely to have isolated impacts, or a town-wide effect was scored as 1 or 2 respectively. For both severity and area, an “X” was used in Table 3-16 to indicate the most likely severity, while a “P” indicates the anticipated severity of a worst-case scenario (i.e., a “potential” scenario). The value associated with the “X”, rather than the “P”, was used to calculate the estimated cumulative risk from that hazard. These determinations were made using local expertise from LPT members, data from the 2018 Massachusetts State Hazard and Climate Mitigation Plan and other resources.

The LPT selected only a subset of hazards from Table 3-16 to consider during the vulnerability analysis in Chapter 4. This selection was based on:

- Lack of data: If spatial information about the likelihood of a hazard is not available, conducting a site-specific vulnerability assessment is not possible. Examples of this include thunderstorm, tornado, and invasive species.
- Low estimated cumulative risk: If the estimated cumulative risk from a particular hazard is low, fully developing a vulnerability assessment to address it may be unnecessary. An example of this is tsunami.

However, a discussion-based qualitative vulnerability assessment was conducted for high-risk hazards that could not be analyzed quantitatively, such as severe winter weather and other severe weather (heavy precipitation, high wind, thunderstorm). The hazards that were selected for a quantitative or qualitative vulnerability assessment are indicated in Table 3-16 in bold font. Additional detail as to what data was used to evaluate these selected hazards in the vulnerability assessment is provided in Section 4.1. Finally, it is important to acknowledge that the cumulative risk associated with each hazard may change in the future due to climate change (e.g., flooding frequency and extent will likely increase due to sea level rise, there will be an increased likelihood of extreme temperatures, etc.). These factors will be considered in future updates of this plan (i.e., every 5 years) and the cumulative risk score adjusted accordingly.



Table 3-16. Relative Risk of Hazards in Falmouth.

	Likelihood				Severity				Area		Estimated Cumulative Risk†
	Unlikely	Possible	Likely	Highly Likely	Minor	Serious	Extensive	Catastrophic	Isolated	Town Wide	
Score	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	
Severe Winter Weather			X			X		P		X	12
Hurricane & Tropical Storm			X			X		P		X	12
Flooding (Inland & Coastal)				X			X		X		12
Other Severe Weather				X			X	P	X	P	12
Coastal Erosion				X		X	P		X		8
Water Quality		X				X	P			X	8
Extreme Temperature			X		X					X	6
Drought			X		X					X	6
Dam/Culvert Failure			X			X			X		6
Tornado		X				X		P	X		4
Wildfire		X				X	P		X		4
Earthquake		X			X		P			X	4
Invasive Species				X	X				X	P	4
Landslide	X				X	P			X		1
Tsunami	X				X			P	X		1

X indicates the believed value, while P indicates an extreme potential.

*These **bolded** hazards were selected for specific vulnerability analyses in Chapter 4.

† This value is based on the formula Likelihood*Severity*Area. The Likelihood of the hazard is based on a scale of 1 to 4, with 1 being unlikely and 4 being highly likely. The Severity of the hazard was based on a scale from 1 to 4, with 1 being minor and 4 being catastrophic. Area was given a value of 1 for isolated and 2 for town-wide. The “P”s were not incorporated into the Estimated Cumulative Risk value.



Source: Falmouth Enterprise

A risk analysis involves identifying a potential hazard event, determining the likelihood of its occurrence, and evaluating the consequence of it happening. Chapter 2 of the Falmouth Multi-Hazard Mitigation Plan profiled the local assets, natural resources, demographics, infrastructure and critical facilities, to document assets within the Town. Chapter 3 detailed the various natural hazards that have impacted or could impact the Town in the future. Chapter 4 combines the hazard descriptions and asset inventories to conduct an exposure analysis, that quantifies the number, type, and value of properties and critical facilities located in identified hazard areas.

This vulnerability assessment provides a foundation for the rest of the mitigation planning process, which is focused on identifying and prioritizing actions to reduce risks to hazards. In addition to informing the mitigation strategy, the vulnerability assessment also facilitates the establishment of emergency preparedness and response priorities, land use and comprehensive planning, and decision making by elected officials, city and county departments, businesses, and organizations in the community.



4.1 METHODOLOGY

This report includes two separate quantitative vulnerability assessments:

- 1) Vulnerability assessment of parcels and buildings; and
- 2) Exposure assessment of critical facilities

To estimate the total number of parcels, as well as both the value of the buildings on the property and the total property value (total property value is the sum of the value of the buildings, other structures, and the land itself within a given parcel), the planning team utilized the most current Assessor's Parcel dataset for the Town of Falmouth (2021). The dataset provides information about parcel size, land use type, assessed value, and building characteristics.

This parcel dataset was first classified into various land use types based on the Massachusetts Property Type Classification Codes according to the Land Use classifications presented in Figure 2-1. The outcome of this classification was presented in Table 2-1 where the number of parcels within each land use category were quantified. Table 4-1 details the parcels Land Use Codes that are encompassed by each land use type used in this report.

Table 4-1. Falmouth Land Use Classifications Based on Property Land Use Codes.

Land Use Type	Land Use Codes
Residential - Single Family	101, 106
Residential - Multi-Family	013, 102, 104, 105, 109, 111, 112, 121, 123, 125, 959, 970, 996
Temporary Lodging	301, 302, 303, 304
Commercial - Retail/Offices/Services	031, 318, 321, 323, 325, 326, 327, 330, 331, 332, 337, 340, 343, 356, 423, 900, 929
Commercial - Manufacturing/Distribution	310, 311, 313, 316, 333, 334, 400, 401, 402, 403, 404, 405, 410
Public Services	140, 341, 342, 349, 350, 352, 354, 355, 384, 388, 424, 431, 433, 903, 906, 914, 931, 934, 935, 941, 943, 951, 952, 955, 956, 957, 960, 961, 962, 985
Agricultural	014, 016, 017, 018, 710, 712, 714, 717, 719
Open Space	201, 210, 383, 385, 601, 720, 9035, 910, 911, 916, 919, 920, 928, 932, 950, 982
Recreation	038, 083, 805, 353, 369, 370, 375, 380, 381, 802, 804, 805, 9036, 905, 924, 954, 958
Vacant	130, 131, 132, 390, 392, 393, 440, 442, 930, 933, 936, 946, 980, 997



To determine each parcel's vulnerability, a GIS analysis was conducted by overlaying extent maps for a subset of the hazards shown in Chapter 3 with the parcel data. Below is a list of the hazard types selected for this vulnerability analysis, and a description of the data used for the evaluation:

1. **Flooding:** FEMA Hazard Maps (effective 2021) (see Figure 3-2).
2. **Sea-Level Rise:** MC-FRM Results produced by Woods Hole Group for MassDOT (see Figures 3-5 through 3-7)
3. **Hurricanes and Tropical Storms:** The extent of storm surge and flooding during a hurricane was estimated using the SLOSH model (Figure 3-12).

Once the parcels affected by each hazard type were identified, the number of parcels in each land use category was totaled, as well as the value of the buildings and total property value associated with each parcel. In this way, the percent of the Town's parcels and the percent of the Town's property value potentially affected by each hazard type was quantified. These parcel totals and property values also represent the potential impact from secondary issues associated with each hazard (e.g., mold, mildew and other water damage impacts associated with flood hazard events). These results are summarized in Tables 4-3 to 4-15. To convert the potential value losses from flooding to potential revenue loss for the Town with respect to property taxes, the current tax rate can be applied to any of the values in Tables 4-3 to 4-15. The Town of Falmouth tax rate for fiscal year 2022 is \$8.05 per thousand.

To assess the vulnerabilities of Falmouth's critical facilities, as discussed in Chapter 2, the planning team first developed a list of the critical facilities and structures. Each location was mapped in GIS (Figure 2-2). The same hazards that were mapped and applied to the parcel vulnerability assessment were again overlaid on the map of critical infrastructure (i.e., flooding, sea-level rise, and hurricanes). If a critical facility was located in a hazard area, that particular facility was considered to be exposed, and therefore vulnerable, to that particular hazard. For the same reasons listed above in the description of the parcel vulnerability analysis, potential impacts from other hazards, such as earthquakes and tsunamis were not quantitatively evaluated for critical facilities. Results from the quantitative vulnerability analysis for critical facilities are summarized in Table 4-2.



4.2 RESULTS

Table 4-2. Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
1	Town Archives	Admin					
2	Falmouth Housing Authority			4			
3	Falmouth School Administration						
4	Town Hall		AE	3	3%	9%	22%
5	Falmouth Harbor Master Building		AE	2	0.2%	2%	9%
6	Mass Highway Dept						
7	Falmouth Police Dept						
8	Falmouth Recreation Department			2		2%	8%
9	Human Services Dept			3	0.1%	1%	4%
10	Falmouth Senior Center						
11	Veterans Service Center		AE	2	0.3%	5%	18%
12	Harbor Master Shack		VE	1	94%	94%	95%
13	Drawbridge Hut		VE	1	99%	100%	100%
14	Department of Public Works	Admin/HAZMAT		4			
15	West Falmouth Fire Station	Fire		4			
16	North Falmouth Fire Station						
17	Emergency Operations Center (Headquarters)						
18	East Falmouth Fire Station						
19	Woods Hole Fire Station						



Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
20	North Marine	HAZMAT	AE	1	56%	74%	80%
21	Accurate Plastics						
22	Associates of Cape Cod						
23	Cape Cod Aggregates						
24	East Marine		AE	1	71%	76%	100%
25	Falmouth Ice Arena						
26	Falmouth Ready Mix			4			
27	Lawrence Ready Mix Concrete						
28	Eversource Station 967						
29	Eversource Station 933						
30	Eversource Station 936						
31	The Fuel Co. Inc 1						
32	The Fuel Co. Inc 2						
33	Verizon 1						
34	Verizon 2						
35	Falmouth Coal Co. / Falmouth Energy						
36	Wynne Fuel Oil Co.						
37	Safe Harbor Fiddler's Cove Marina	HAZMAT/ Wastewater	AE	2	2%	7%	20%
38	Falmouth Marine		AE	1	24%	53%	72%
39	MacDougall's Cape Cod Marine		AE	2	9%	37%	67%
40	Bosun's Marina		AE	1	75%	98%	100%
41	Town Marina Dock		AE	1	96%	96%	97%



Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
42	Falmouth Public Library	Library		4			
43	North Falmouth Public Library						
44	East Falmouth Public Library						
45	West Falmouth Public Library						
46	Woods Hole Library						
47	Coastal Medical Transportation Services LLC	Medical					
48	ConvenientMD Urgent Care			3		2%	7%
49	Cape Cod Healthcare Urgent Care			3			
50	Overlook - Visiting Nurse						
51	Cape Cod Free Clinic & Community Health Center			3	0.1%	1%	4%
52	Atria Woodbriar Park (Assisted Living)	Medical/Nursing					
53	Atria Woodbriar Place (Independent Living)						
54	Heritage At Falmouth						
55	JML Care Center, Inc.						
56	Royal Megansett Nursing and Retirement Home						
57	Royal Falmouth Nursing & Rehabilitation Center						



Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
58	Falmouth Hospital	Medical/HAZMAT					
59	Post Office	Other		3			0.25%
60	Cape & Islands NPR Radio						
61	Woods Hole Community Center		AE	1	84.29%	90.28%	95.03%
62	Falmouth Landfill						
63	Town Fuel Dock/Pier 37			4			
64	Nobska Lighthouse						
65	WHOI 1		VE	1	86.99%	92.95%	93.84%
66	WHOI 2						
67	WHOI 3						
68	Coast Guard Station	Other/HAZMAT	VE	1	72%	79%	100%
69	Falmouth Airpark	Transportation					
70	Falmouth Bus Terminal						
71	Island Queen Ferry Terminal	Transportation/Wastewater	AE	1	100%	100%	100%
72	Steamship Authority Ferry Terminal	Transportation/HAZMAT	AE	1	61%	75%	87%



Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
73	East Falmouth Elementary School	Schools					
74	Falmouth Academy						
75	Lawrence Jr. High School						
76	Morse Pond Middle School						
77	North Falmouth Elementary School						
78	Teaticket Elementary School			3			0.33%
79	Falmouth High School						
80	Mullen Hall School			3			0.68%
81	Sea Education Association Inc						
82	MBL/WHOI Dorms						
83	Former Water Plant Pumping Station	Water/Wastewater					
84	Long Pond Water Treatment Plant						
85	Town Marine Pumpout Boat		AE	1	97%	98%	99%
86	Coonamessett Well						
87	Ashument Well						
88	Crooked Pond Well						
89	Long Pond Reservoir						



Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
90	Water Tower 1	Water/Wastewater					
91	Hayway Water Tower						
92	Water Tower 2						
93	Water Street Pump Station		AE	2	21%	36%	66%
94	Park Road Pump Station		AE	1	75%	95%	100%
95	Shivericks Pond Pump Station			3			2%
96	Surf Beach Pump Station		VE	1	51%	73%	76%
97	Inner Harbor Pump Station		AE	1	46%	71%	81%
98	Spring Bars Road Pump Station		AE	2	3%	20%	46%
99	Alphonse Street Pump Station			3			1%
100	Silver Beach Avenue Pump Station		AE	1	72%	75%	76%
101	Quissett Harbor Boat Yard		VE	2	50%	53%	58%
102	Service Road Wastewater Treatment Plant	Water/Wastewater/HAZMAT					
103	Crooked Pond Treatment Plant						
104	NS Treatment Plant			2	0.1%	1%	3%
105	Mares Pond Well						

**Table 4-2 (cont.). Critical Facility Vulnerability Assessment.**

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
106	Fresh Pond Well	Water/Wastewater/HAZMAT					
107	Sewer Pumping Station						
108	Harborview Housing	Vulnerable Populations - Housing Authority		4			
109	Tataket Apartments						
110	Salt Sea Apartments			3			
111	Mayflower Housing						
112	Rose Morin Apartments			3			

In the case a critical facility does not have any flood information listed, it is not vulnerable.



Table 4-3. Parcels and Buildings Vulnerable to Flooding in the AE Zone.

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	3,729	20%	\$6,021,861,900	\$1,336,314,800	22%	\$11,738,149,300	\$2,814,629,400	24%
Residential - Multi-Family	882	183	21%	\$387,789,450	\$68,025,600	18%	\$748,562,150	\$141,419,300	19%
Temporary Lodging	44	14	32%	\$63,805,400	\$21,199,800	33%	\$125,633,000	\$38,759,600	31%
Commercial - Retail/Offices/Services	385	76	20%	\$187,746,795	\$48,437,400	26%	\$426,350,095	\$120,607,800	28%
Commercial - Manufacturing/Distribution	86	9	10%	\$45,925,400	\$6,264,600	14%	\$110,878,700	\$11,969,800	11%
Public Services	421	104	25%	\$593,189,700	\$165,764,700	28%	\$879,352,300	\$243,503,300	28%
Agricultural	28	13	46%	\$4,792,200	\$1,170,200	24%	\$9,017,574	\$2,449,643	27%
Open Space	821	151	18%	\$1,800,100	\$35,500	2%	\$221,462,542	\$59,921,771	27%
Recreation	91	8	9%	\$32,721,400	\$1,897,900	6%	\$85,932,495	\$5,188,200	6%
Vacant	2,015	392	19%	\$694,000	\$212,900	31%	\$406,286,300	\$85,040,900	21%
Total	23,409	4,679	20%	\$7,340,326,345	\$1,649,323,400	22%	\$14,751,624,456	\$3,523,489,714	24%



Table 4-4. Parcels and Buildings Vulnerable to Flooding in the AO Zone.

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	2	0.01%	\$6,021,861,900	\$1,034,700	0.02%	\$11,738,149,300	\$2,280,100	0.02%
Residential - Multi-Family	882	0	0%	\$387,789,450	\$-	0%	\$748,562,150	\$-	0%
Temporary Lodging	44	0	0%	\$63,805,400	\$-	0%	\$125,633,000	\$-	0%
Commercial - Retail/Offices/Services	385	0	0%	\$187,746,795	\$-	0%	\$426,350,095	\$-	0%
Commercial - Manufacturing/Distribution	86	0	0%	\$45,925,400	\$-	0%	\$110,878,700	\$-	0%
Public Services	421	0	0%	\$593,189,700	\$-	0%	\$879,352,300	\$-	0%
Agricultural	28	0	0%	\$4,792,200	\$-	0%	\$9,017,574	\$-	0%
Open Space	821	0	0%	\$1,800,100	\$-	0%	\$221,462,542	\$-	0%
Recreation	91	0	0%	\$32,721,400	\$-	0%	\$85,932,495	\$-	0%
Vacant	2,015	0	0%	\$694,000	\$-	0%	\$406,286,300	\$-	0%
Total	23,409	2	0.01%	\$7,340,326,345	\$1,034,700	0.02%	\$14,751,624,456	\$2,280,100	0.02%



Table 4-5. Parcels and Buildings Vulnerable to Flooding in the VE Zone.

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	1,307	7%	\$6,021,861,900	\$798,642,200	13%	\$11,738,149,300	\$2,387,104,600	20%
Residential - Multi-Family	882	79	9%	\$387,789,450	\$76,799,100	20%	\$748,562,150	\$222,533,000	30%
Temporary Lodging	44	7	16%	\$63,805,400	\$19,686,100	31%	\$125,633,000	\$43,497,100	35%
Commercial - Retail/Offices/Services	385	19	5%	\$187,746,795	\$14,198,800	8%	\$426,350,095	\$53,769,000	13%
Commercial - Manufacturing/Distribution	86	2	2%	\$45,925,400	\$831,900	2%	\$110,878,700	\$1,960,800	2%
Public Services	421	55	13%	\$593,189,700	\$33,991,200	6%	\$879,352,300	\$98,244,500	11%
Agricultural	28	0	0%	\$4,792,200	\$-	0%	\$9,017,574	\$-	0%
Open Space	821	228	28%	\$1,800,100	\$1,420,900	79%	\$221,462,542	\$61,888,566	28%
Recreation	91	12	13%	\$32,721,400	\$5,672,400	17%	\$85,932,495	\$13,488,625	16%
Vacant	2,015	350	17%	\$694,000	\$-	0%	\$406,286,300	\$76,095,600	19%
Total	23,409	2,059	9%	\$7,340,326,345	\$951,242,600	13%	\$14,751,624,456	\$2,958,581,791	20%



Table 4-6. Parcels and Buildings Vulnerable to a Category 1 Hurricane (SLOSH 1).

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	2,943	16%	\$6,021,861,900	\$1,411,860,000	23%	\$11,738,149,300	\$3,748,880,300	32%
Residential - Multi-Family	882	150	17%	\$387,789,450	\$107,519,400	28%	\$748,562,150	\$290,897,400	39%
Temporary Lodging	44	11	25%	\$63,805,400	\$23,888,800	37%	\$125,633,000	\$52,863,200	42%
Commercial - Retail/Offices/Services	385	42	11%	\$187,746,795	\$21,333,100	11%	\$426,350,095	\$81,828,200	19%
Commercial - Manufacturing/Distribution	86	6	7%	\$45,925,400	\$4,242,100	9%	\$110,878,700	\$8,588,200	8%
Public Services	421	119	28%	\$593,189,700	\$127,164,900	21%	\$879,352,300	\$239,175,600	27%
Agricultural	28	4	14%	\$4,792,200	\$798,000	17%	\$9,017,574	\$1,413,368	16%
Open Space	821	333	41%	\$1,800,100	\$1,456,400	81%	\$221,462,542	\$75,971,328	34%
Recreation	91	17	19%	\$32,721,400	\$7,570,300	23%	\$85,932,495	\$18,242,625	21%
Vacant	2,015	590	29%	\$694,000	\$212,900	31%	\$406,286,300	\$121,552,700	30%
Total	23,409	4,215	18%	\$7,340,326,345	\$1,706,045,900	23%	\$14,751,624,456	\$4,639,412,921	31%



Table 4-7. Parcels and Buildings Vulnerable to a Category 2 Hurricane (SLOSH 2).

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	1,821	10%	\$6,021,861,900	\$623,909,900	10%	\$11,738,149,300	\$1,262,655,700	11%
Residential - Multi-Family	882	91	10%	\$387,789,450	\$30,192,400	8%	\$748,562,150	\$61,069,900	8%
Temporary Lodging	44	9	20%	\$63,805,400	\$16,097,100	25%	\$125,633,000	\$27,990,300	22%
Commercial - Retail/Offices/Services	385	49	13%	\$187,746,795	\$43,943,500	23%	\$426,350,095	\$96,580,900	23%
Commercial - Manufacturing/Distribution	86	6	7%	\$45,925,400	\$3,339,800	7%	\$110,878,700	\$6,231,000	6%
Public Services	421	38	9%	\$593,189,700	\$87,979,900	15%	\$879,352,300	\$120,033,700	14%
Agricultural	28	7	25%	\$4,792,200	\$0	0%	\$9,017,574	\$127,436	1%
Open Space	821	32	4%	\$1,800,100	\$0	0%	\$221,462,542	\$44,831,611	20%
Recreation	91	3	3%	\$32,721,400	\$0	0%	\$85,932,495	\$434,200	1%
Vacant	2,015	124	6%	\$694,000	\$0	0%	\$406,286,300	\$34,267,900	8%
Total	23,409	2,180	9%	\$7,340,326,345	\$805,462,600	11%	\$14,751,624,456	\$1,654,222,647	11%



Table 4-8. Parcels and Buildings Vulnerable to a Category 3 Hurricane (SLOSH 3).

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	2,044	11%	\$6,021,861,900	\$611,130,000	10%	\$11,738,149,300	\$1,153,291,000	10%
Residential - Multi-Family	882	96	11%	\$387,789,450	\$37,572,700	10%	\$748,562,150	\$64,914,800	9%
Temporary Lodging	44	4	9%	\$63,805,400	\$4,418,400	7%	\$125,633,000	\$7,627,800	6%
Commercial - Retail/Offices/Services	385	60	16%	\$187,746,795	\$28,652,400	15%	\$426,350,095	\$56,882,400	13%
Commercial - Manufacturing/Distribution	86	3	3%	\$45,925,400	\$998,400	2%	\$110,878,700	\$2,908,100	3%
Public Services	421	36	9%	\$593,189,700	\$102,921,800	17%	\$879,352,300	\$116,121,900	13%
Agricultural	28	3	11%	\$4,792,200	\$567,900	12%	\$9,017,574	\$1,350,414	15%
Open Space	821	42	5%	\$1,800,100	\$0	0%	\$221,462,542	\$4,164,698	2%
Recreation	91	2	2%	\$32,721,400	\$394,700	1%	\$85,932,495	\$773,700	1%
Vacant	2,015	128	6%	\$694,000	\$71,800	10%	\$406,286,300	\$27,885,500	7%
Total	23,409	2,418	10%	\$7,340,326,345	\$786,728,100	11%	\$14,751,624,456	\$1,435,920,312	10%



Table 4-9. Parcels and Buildings Vulnerable to a Category 4 Hurricane (SLOSH 4).

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	1,618	9%	\$6,021,861,900	\$461,919,000	8%	\$11,738,149,300	\$822,342,300	7%
Residential - Multi-Family	882	104	12%	\$387,789,450	\$56,697,200	15%	\$748,562,150	\$89,030,600	12%
Temporary Lodging	44	9	20%	\$63,805,400	\$7,181,500	11%	\$125,633,000	\$13,380,200	11%
Commercial - Retail/Offices/Services	385	61	16%	\$187,746,795	\$33,812,100	18%	\$426,350,095	\$64,033,700	15%
Commercial - Manufacturing/Distribution	86	6	7%	\$45,925,400	\$3,286,400	7%	\$110,878,700	\$8,297,300	7%
Public Services	421	34	8%	\$593,189,700	\$16,263,100	3%	\$879,352,300	\$35,550,400	4%
Agricultural	28	1	4%	\$4,792,200	\$218,300	5%	\$9,017,574	\$506,465	6%
Open Space	821	35	4%	\$1,800,100	\$0	0%	\$221,462,542	\$2,341,400	1%
Recreation	91	6	7%	\$32,721,400	\$836,800	3%	\$85,932,495	\$4,677,927	5%
Vacant	2,015	114	6%	\$694,000	\$0	0%	\$406,286,300	\$21,382,400	5%
Total	23,409	1,988	8%	\$7,340,326,345	\$580,214,400	8%	\$14,751,624,456	\$1,061,542,692	7%



Table 4-10. Parcels and Buildings Vulnerable to Flooding During a Major Storm Event (1% to less than 20% chance of inundation) in 2030.

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	1,289	7%	\$6,021,861,900	\$474,076,400	8%	\$11,738,149,300	\$982,111,100	8%
Residential - Multi-Family	882	60	7%	\$387,789,450	\$22,604,800	6%	\$748,562,150	\$45,937,000	6%
Temporary Lodging	44	8	18%	\$63,805,400	\$10,720,200	17%	\$125,633,000	\$19,439,700	15%
Commercial - Retail/Offices/Services	385	34	9%	\$187,746,795	\$28,791,300	15%	\$426,350,095	\$60,256,700	14%
Commercial - Manufacturing/Distribution	86	3	3%	\$45,925,400	\$986,500	2%	\$110,878,700	\$2,149,300	2%
Public Services	421	29	7%	\$593,189,700	\$45,738,700	8%	\$879,352,300	\$60,130,700	7%
Agricultural	28	8	29%	\$4,792,200	\$0	0%	\$9,017,574	\$135,454	2%
Open Space	821	40	5%	\$1,800,100	\$0	0%	\$221,462,542	\$44,858,074	20%
Recreation	91	3	3%	\$32,721,400	\$390,400	1%	\$85,932,495	\$1,174,200	1%
Vacant	2,015	113	6%	\$694,000	\$0	0%	\$406,286,300	\$26,585,000	7%
Total	23,409	1,587	7%	\$7,340,326,345	\$583,308,300	8%	\$14,751,624,456	\$1,242,777,228	8%



Table 4-11. Parcels and Buildings Vulnerable to Flooding During a Minor Storm Event (20% or greater chance of inundation) in 2030.

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	2,761	15%	\$6,021,861,900	\$1,342,012,500	22%	\$11,738,149,300	\$3,603,322,200	31%
Residential - Multi-Family	882	146	17%	\$387,789,450	\$103,803,800	27%	\$748,562,150	\$284,522,900	38%
Temporary Lodging	44	10	23%	\$63,805,400	\$23,588,900	37%	\$125,633,000	\$52,098,700	41%
Commercial - Retail/Offices/Services	385	36	9%	\$187,746,795	\$19,805,000	11%	\$426,350,095	\$80,861,100	19%
Commercial - Manufacturing/Distribution	86	6	7%	\$45,925,400	\$4,242,100	9%	\$110,878,700	\$8,588,200	8%
Public Services	421	119	28%	\$593,189,700	\$93,550,400	16%	\$879,352,300	\$205,761,000	23%
Agricultural	28	3	11%	\$4,792,200	\$798,000	17%	\$9,017,574	\$1,405,350	16%
Open Space	821	326	40%	\$1,800,100	\$1,456,400	81%	\$221,462,542	\$75,772,828	34%
Recreation	91	16	18%	\$32,721,400	\$7,179,900	22%	\$85,932,495	\$17,294,125	20%
Vacant	2,015	553	27%	\$694,000	\$212,900	31%	\$406,286,300	\$116,602,600	29%
Total	23,409	3,976	17%	\$7,340,326,345	\$1,596,649,900	22%	\$14,751,624,456	\$4,446,229,003	30%



Table 4-12. Parcels and Buildings Vulnerable to Flooding During a Major Storm Event (1% to less than 20% chance of inundation) in 2050.

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	1,888	10%	\$6,021,861,900	\$634,141,200	11%	\$11,738,149,300	\$1,246,874,600	11%
Residential - Multi-Family	882	88	10%	\$387,789,450	\$30,024,100	8%	\$748,562,150	\$58,757,000	8%
Temporary Lodging	44	6	14%	\$63,805,400	\$13,697,100	21%	\$125,633,000	\$21,446,600	17%
Commercial - Retail/Offices/Services	385	43	11%	\$187,746,795	\$25,989,400	14%	\$426,350,095	\$53,856,600	13%
Commercial - Manufacturing/Distribution	86	5	6%	\$45,925,400	\$2,450,900	5%	\$110,878,700	\$4,853,700	4%
Public Services	421	36	9%	\$593,189,700	\$56,629,200	10%	\$879,352,300	\$77,280,000	9%
Agricultural	28	6	21%	\$4,792,200	\$195,700	4%	\$9,017,574	\$498,105	6%
Open Space	821	26	3%	\$1,800,100	\$0	0%	\$221,462,542	\$43,605,911	20%
Recreation	91	1	1%	\$32,721,400	\$0	0%	\$85,932,495	\$38,300	0%
Vacant	2,015	128	6%	\$694,000	\$0	0%	\$406,286,300	\$28,537,400	7%
Total	23,409	2,227	10%	\$7,340,326,345	\$763,127,600	10%	\$14,751,624,456	\$1,535,748,216	10%



Table 4-13. Parcels and Buildings Vulnerable to Flooding During a Minor Storm Event (20% or greater chance of inundation) in 2050.

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	3,350	18%	\$6,021,861,900	\$1,559,056,400	26%	\$11,738,149,300	\$4,067,060,900	35%
Residential - Multi-Family	882	176	20%	\$387,789,450	\$115,095,800	30%	\$748,562,150	\$307,419,700	41%
Temporary Lodging	44	15	34%	\$63,805,400	\$27,188,800	43%	\$125,633,000	\$60,810,100	48%
Commercial - Retail/Offices/Services	385	58	15%	\$187,746,795	\$42,121,500	22%	\$426,350,095	\$128,135,600	30%
Commercial - Manufacturing/Distribution	86	8	9%	\$45,925,400	\$5,540,700	12%	\$110,878,700	\$10,700,400	10%
Public Services	421	113	27%	\$593,189,700	\$134,319,800	23%	\$879,352,300	\$253,305,400	29%
Agricultural	28	6	21%	\$4,792,200	\$798,000	17%	\$9,017,574	\$1,484,274	16%
Open Space	821	352	43%	\$1,800,100	\$1,456,400	81%	\$221,462,542	\$78,508,928	35%
Recreation	91	18	20%	\$32,721,400	\$7,570,300	23%	\$85,932,495	\$18,430,025	21%
Vacant	2,015	607	30%	\$694,000	\$212,900	31%	\$406,286,300	\$127,793,900	31%
Total	23,409	4,703	20%	\$7,340,326,345	\$1,893,360,600	26%	\$14,751,624,456	\$5,053,649,227	34%



Table 4-14. Parcels and Buildings Vulnerable to Flooding During a Major Storm Event (1% to less than 20% chance of inundation) in 2070.

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	1,893	10%	\$6,021,861,900	\$604,198,900	10%	\$11,738,149,300	\$1,152,531,700	10%
Residential - Multi-Family	882	90	10%	\$387,789,450	\$31,455,900	8%	\$748,562,150	\$56,727,600	8%
Temporary Lodging	44	3	7%	\$63,805,400	\$6,576,800	10%	\$125,633,000	\$10,718,300	9%
Commercial - Retail/Offices/Services	385	59	15%	\$187,746,795	\$33,634,700	18%	\$426,350,095	\$65,150,200	15%
Commercial - Manufacturing/Distribution	86	2	2%	\$45,925,400	\$1,451,800	3%	\$110,878,700	\$2,721,300	2%
Public Services	421	43	10%	\$593,189,700	\$163,703,500	28%	\$879,352,300	\$200,313,800	23%
Agricultural	28	4	14%	\$4,792,200	\$372,200	8%	\$9,017,574	\$911,059	10%
Open Space	821	24	3%	\$1,800,100	\$0	0%	\$221,462,542	\$2,840,237	1%
Recreation	91	2	2%	\$32,721,400	\$394,700	1%	\$85,932,495	\$773,700	1%
Vacant	2,015	148	7%	\$694,000	\$71,800	10%	\$406,286,300	\$33,299,600	8%
Total	23,409	2,268	10%	\$7,340,326,345	\$841,860,300	11%	\$14,751,624,456	\$1,525,987,496	10%



Table 4-15. Parcels and Buildings Vulnerable to Flooding During a Minor Storm Event (20% or greater chance of inundation) in 2070.

Land Use	Number of Parcels			Value of Buildings			Value of Total Property		
	Total	Total in Hazard	% in Hazard	Total Value	Total Value in Hazard	% Value in Hazard	Total Value	Total Value in Hazard	% Value in Hazard
Residential - Single Family	18,636	4,157	22%	\$6,021,861,900	\$1,831,933,100	30%	\$11,738,149,300	\$4,620,573,800	39%
Residential - Multi-Family	882	212	24%	\$387,789,450	\$127,121,600	33%	\$748,562,150	\$332,204,100	44%
Temporary Lodging	44	18	41%	\$63,805,400	\$34,309,100	54%	\$125,633,000	\$71,538,400	57%
Commercial - Retail/Offices/Services	385	73	19%	\$187,746,795	\$50,166,300	27%	\$426,350,095	\$144,383,600	34%
Commercial - Manufacturing/Distribution	86	11	13%	\$45,925,400	\$6,539,800	14%	\$110,878,700	\$12,832,800	12%
Public Services	421	144	34%	\$593,189,700	\$136,764,700	23%	\$879,352,300	\$259,211,600	29%
Agricultural	28	10	36%	\$4,792,200	\$993,700	21%	\$9,017,574	\$1,980,159	22%
Open Space	821	366	45%	\$1,800,100	\$1,456,400	81%	\$221,462,542	\$120,902,802	55%
Recreation	91	19	21%	\$32,721,400	\$7,570,300	23%	\$85,932,495	\$18,468,325	21%
Vacant	2,015	673	33%	\$694,000	\$212,900	31%	\$406,286,300	\$144,196,700	35%
Total	23,409	5,683	24%	\$7,340,326,345	\$2,197,067,900	30%	\$14,751,624,456	\$5,726,292,286	39%



The Local Planning Team (LPT) decided not to quantitatively evaluate the vulnerability from the remaining natural hazards listed in Table 3-16, for the following reasons:

1. **Coastal Erosion:** Although rates of erosion are available from MassCZM, a detailed vulnerability assessment for this hazard was not performed since it is assumed that any waterfront parcel has a risk of erosion.
2. **Severe Winter Weather, Other Severe Weather, Drought, Extreme Temperature, Tornado, Wildfire, Earthquake, Invasive Species, and Tsunami:** Location specific data within Falmouth is not available meaning a detailed vulnerability assessment could not be completed.
3. **Landslide:** This hazard is unlikely to occur (i.e. less than 1% chance), meaning a vulnerability assessment for this hazard would not have a high value to the Town.
4. **Dam and Culvert Failure:** Although the locations of potentially problematic dams are known, location specific data for areas that would be impacted by a failure of any of these structures is not available. Therefore, a detailed vulnerability assessment could not be completed.
5. **Water Quality:** Although the locations of freshwater lakes and ponds are known, a detailed vulnerability assessment for this hazard was not performed since the water quality is expected to fluctuate by season.

However, the impacts from hazards ranked in Table 3-16, including Severe Winter Weather, Hurricane/Tropical Storm, Other Severe Weather, Drought, and Wildfire on critical facilities were qualitatively discussed with the LPT and are summarized below in Table 4-16.

Table 4-16. Results of the Qualitative Vulnerability Assessment of Critical Facilities.

Vulnerability	Applicable Critical Facilities
Severe Winter Weather (roof vulnerable to heavy snowfall, and/or access impacted by heavy snowfall)	Falmouth Housing Authority Harborview Housing Eversource Stations 967, 933, & 936 Falmouth Hospital East Falmouth Elementary School Falmouth Academy Lawrence Jr. High School Morse Pond Middle School North Falmouth Elementary School Teaticket Elementary School Falmouth High School Mullen Hall School Pump Stations (Water Street, Park Road, Shivericks Pond, Surf Drive Beach, Inner Harbor, Spring Bars Road, Alphonse Street, Silver Beach Avenue,



	Treatment Plants (Service Road Wastewater, Crooked Pond, New Silver) Wells (Mares Pond, Fresh Pond)
Hurricane/Tropical Storm/High Wind (waterfront areas vulnerable to high winds and waves)	Town Hall Harbor Master Shack Drawbridge Hut North Marine East Marine Safe Harbor Fiddler's Cove Marina Falmouth Marine MacDougall's Cape Cod Marine Bosun's Marina Town Marina Dock Royal Megansett Nursing & Retirement Home Woods Hole Community Center WHOI 1 Coast Guard Station Island Queen Ferry Terminal Steamship Authority Ferry Terminal Town Marine Pumpout Facility Pump Stations (Water Street, Park Road, Surf Drive Beach, Inner Harbor, Spring Bars Road, Silver Beach Avenue) Quissett Harbor Boat Yard Harborview Housing Salt Sea Apartments
Heavy Precipitation (heavy rains cause localized street flooding)	Falmouth Police Department Falmouth Recreation Department Falmouth Senior Center Veterans Service Center Alphonse Street Pump Station
High Wind (critical facility where downed trees could cause loss of power would impair ability to provide necessary services)	Falmouth Housing Authority Falmouth Harbor Master Building Drawbridge Hut Department of Public Works West Falmouth Fire Station North Falmouth Fire Station Emergency Operations Center (HQ) East Falmouth Fire Station Woods Hole Fire Station Eversource Stations 967, 933, 936 Verizon 1 and 2 Coastal Medical Transportation Services LLC



	ConvenientMD Urgent Care Cape Cod Healthcare Urgent Care Overlook – Visiting Nurse Cape Cod Free Clinic & Community Health Center Atria Woodbriar Park Atria Woodbriar Place Heritage at Falmouth JML Care Center, Inc. Royal Megansett Nursing and Retirement Home Royal Falmouth Nursing & Rehabilitation Center Falmouth Hospital WHOI 1 Coast Guard Station Island Queen Ferry Terminal Steamship Authority Ferry Terminal Schools (East Falmouth, Falmouth Academy, Lawrence Jr. High, Morse Pond, North Falmouth, Teaticket, Falmouth High, Mullen Hall) Long Pond Water Treatment Plant Wells (Coonamessett, Ashument, Crooked Pond) Water Towers (Tower 1, Tower 2, Hayway Tower) Treatment Plants (Service Road, Crooked Pond, New Silver, Mares Pond, Fresh Pond) Housing Authority Facilities (Harborview, Tataket, Salt Sea, Mayflower, Rose Morin)
Lightning	Water Tower 1 Water Tower 2 Hayway Water Tower
Wildfire	Falmouth Hospital Falmouth Academy Coonamessett Well Ashumet Well Crooked Pond Well Long Pond Reservoir Crooked Pond Treatment Plant Mares Pond Well Fresh Pond Well



B3.b

4.3 VULNERABLE PROPERTIES AND CRITICAL FACILITIES

Although the tables in Section 4.2 provide a detailed summary of the potential impacts from each type and magnitude of risk analyzed, this section will summarize the main risks identified from this analysis. The discussion below will focus on hazards that have the potential to harm the most properties or cost the most economic damage, critical facilities that are impacted by the most hazards, and vulnerabilities of the highest concern to the Town. This summary was also used to guide the development of mitigation actions.

Tables 4-3 through 4-5 summarize the number of parcels that overlap with a FEMA flood zone. Although individual parcels may overlap with more than one flood zone, because the risk to each parcel was noted as the highest hazard flood type, the values in Tables 4-3 through 4-5 are additive. For example, a single property can contain both a VE and an AE zone but would only be listed in the VE zone risk table. Therefore, by summing the total values from those three tables, the total value of all structures and property at risk from flooding is approximately \$6.5 billion. Additionally, because flooding often causes more permanent damage to structures than to the land itself, it is worth noting that the total value of buildings within the SFHA in Falmouth is approximately \$2.6 million. Surge inundation (i.e., flooding) from hurricanes would also result in substantial financial impact on properties. For instance, a Category 2 hurricane would impact properties significantly, valuing approximately \$1.7 billion, with the structures and buildings on those properties valuing \$805 million (Table 4-7). Finally, although based on the mapping criteria alone, it appears that flooding will cause similar damage to hurricanes, this does not account for the Town-wide impacts that hurricanes can produce from heavy rains and high winds; these additional forces would likely make the financial impacts of a Category 2 hurricane much more substantial than would be expected with flooding alone.

Most of the critical facilities likely to be impacted by flooding are sewer pump stations, marinas, and marine based facilities (Table 4-2), located within VE and AE zones. Other critical facilities within both AE and VE flood zones include the Town Hall, Veterans Service Center, Woods Hole Community Center, Drawbridge Hut, WHOI 1, Coast Guard Station, Island Queen Ferry Terminal, and the Steamship Authority Ferry Terminal.

It is also worth acknowledging the breakdown of land use types impacted by these hazards. The inundation projected within the AE and VE flood zones will impact primarily single-family residential properties (3,726 and 1,307 parcels, respectively, out of a total of 18,636 single family residential parcels), which cumulatively represents 27% of the single-family residential land use category. The inundation projected from a Category 2 hurricane will also impact primarily single-family residential properties (1,821 parcels out of a total of 18,636 parcels), which represents 10% of that land use category.

The MC-FRM results (see Section 3.1) were utilized to evaluate how climate change and sea level rise could affect the Town's vulnerability to flooding in the future. For the vulnerability assessment, two categories of vulnerability to flooding were selected: a probability of inundation from 1% to less than 20% (representing larger storm events) and a probability of inundation of



20% or greater (representing smaller, more frequent storm events). These results are based on a high sea level rise projection for 2030 and 2070. In 2030, 1,587 parcels have between a 1% and 20% chance of inundation in a given year of experiencing some level of coastal flooding (Table 4-10), while an additional 3,976 parcels have a 20% chance or greater in any given year (Table 4-11). This means that during a 100-year flood event (i.e., the 1% chance event) in 2030, a total of 5,563 parcels are at risk of coastal inundation. These numbers increase to 2,268 and 5,683 parcels with between a 1% and 20% chance of inundation (Table 4-14) and a greater than 20% chance of inundation (Table 4-15), respectively, in 2070. This means that during a 100-year flood event (i.e., the 1% chance event) in 2070, a total of 7,951 parcels are at risk of coastal inundation.

B3.b

4.4 VULNERABLE POPULATIONS

Falmouth has several vulnerable populations, including areas with a high concentration of elderly residents, childcare facilities, healthcare facilities, and environmental justice populations.

Concentrations of Elderly People

Falmouth Housing Authority has five (5) facilities that house many elderly and disadvantaged people. These include Harborview Housing, Tatakot Apartments, Salt Sea Apartments, Mayflower Housing and Rose Moring Apartments. In addition, there are six (6) medical nursing facilities in Town that provide independent, assisted, and nursing care services. These include Atria Woodbriar Park, Atria Woodbriar Place, Heritage at Falmouth, JML Care Center, Royal Megansett Nursing and Retirement Home, and Royal Falmouth Nursing and Rehabilitation Center. These locations will need special attention during emergencies or if evacuations become necessary, as residents may need additional help to exit buildings during an emergency. The locations of these communities are shown in Figure 4-1 in green and listed in Table 4-17.

Concentrations of Children

The Town of Falmouth has multiple areas with a high concentration of young children including Sandpiper Nursery School, Falmouth Preschool, Tender Years Preschool, VNA Child Care Center, Friendship Garden Nursery School, Little Milestones, Little Kids, Woods Hole Child Center, Magic Years Nursery School and Day Care, Montessori Academy of Cape Cod, Cape Cod Child Development, and YMCA Cape Cod – North Falmouth Early Learning Center. Falmouth also has concentrations of children at public and private schools including, North Falmouth, Teaticket, East Falmouth, Mullen Hall, Morse Pond, Lawrence, Falmouth High, and Falmouth Academy. During a natural hazard emergency, these locations may need additional assistance evacuating children and coordinating a safe pick-up system for parents. The locations of these facilities are shown in Figure 4-1 in purple and listed in Table 4-17.

Health Care Facilities

Within the Town of Falmouth there are several health care centers including Falmouth Hospital, Coastal Medical Transportation Services, ConvenientMD urgent Care, Cape Cod Healthcare Urgent Care, Overlook – Visiting Nurse, and Cape Cod Free Clinic & Community Health Center. During a natural hazard emergency, these locations may need increased support in order to safely evacuate patients in a variety of conditions. The locations of these facilities are shown in Figure 4-1 in orange and listed in Table 4-17.

***Environmental Justice Populations***

Falmouth has six (6) areas of environmental justice populations based on income and/or minority status. The populations may need extra assistance during a natural hazard emergency to safely prepare and to evacuate, if necessary. The locations of these facilities are shown in Figure 4-1 and summarized in Table 4-18.

Table 4-17. List of Vulnerable Populations in Falmouth.

#	Name	Address
Concentrations of Elderly People		
1	Atria Woodbriar Park (Assisted Living)	339 Gifford Street
2	Atria Woodbriar Park (Independent Living)	389 Gifford Street
3	Heritage At Falmouth	140 Ter Heun Drive
4	JML Care Center, Inc.	184 Ter Heun Drive
5	Royal Megansett Nursing and Retirement Home	209 County Road
6	Royal Falmouth Nursing and Rehabilitation Center	359 Jones Road
7	Harborview Housing	115 Scranton Avenue
8	Tataket Apartments	138 Teaticket Highway
9	Salt Sea Apartments	211 Scranton Avenue
10	Mayflower Housing	238 Lakeview Avenue
11	Rose Morin Apartments	58 Rose Morin Lane
Concentrations of Children		
12	Little Kids Inc.	381 Front Street
13	YMCA CC North Falmouth Early Learning Center	155 Old Main Road
14	Montessori Academy	81 Chester Street
15	VNA Child Care Center	67 Ter Heun Drive
16	Sandpiper Nursery School	184 Jones Road
17	Falmouth Pre School	704 Main Street
18	Tender Years Pre School	545 Main Street
19	Woods Hole Child Center	93 Harbor Hill Road
20	Little Milestones	805 Teaticket Highway
21	Cape Cod Child Development	439 East Falmouth Highway
22	Magic Years Nursery and Day School	222 Trotting Park Road
23	Friendship Garden Nursery School	460 Locustfield Road
24	East Falmouth Elementary School	33 Davisville Road
25	Falmouth Academy	7 Highfield Drive
26	Lawrence Jr. High School	113 Lakeview Avenue
27	Morse Pond Middle School	323 Jones Road
28	North Falmouth Elementary School	62 Old Main Road
29	Teaticket Elementary School	45 Maravista Avenue
30	Falmouth High School	847 Gifford Street
31	Mullen Hall School	140 Katharine Lee Bates



32	Sea Education Association Inc.	171 Woods Hole Road
33	MBL & WHOI Dorms	Devil's Lane
Health Care Facilities		
34	Falmouth Hospital	15 Mill Street
35	Coastal Medical Transportation Services LLC	668 Main Street
36	Overlook – Visiting Nurse	East Falmouth Highway
37	Cape Cod Free Clinic & Community Health Center	65C Town Hall Square
38	ConvenientMD Urgent Care	40 Davis Straits
39	Cape Cod Healthcare Urgent care	273 Teaticket Highway

Table 4-18. List of Environmental Justice Populations in Falmouth.

Block Group	Census Tract No.	EJ Criteria
2	144.02	Minority
3	149	Income
1	148	Income
3	148	Income
2	146	Minority and Income
3	145	Income

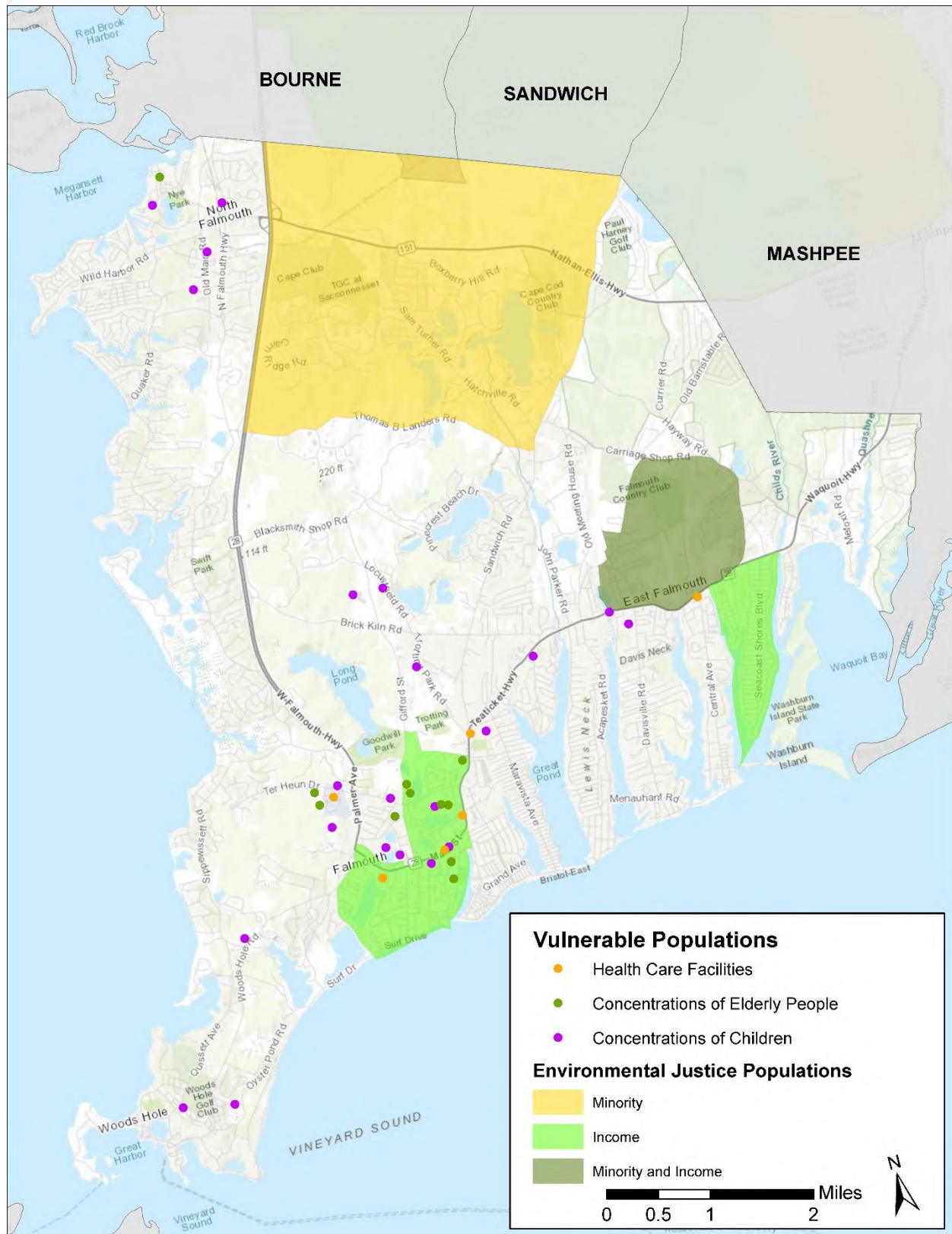


Figure 4-1. Locations of vulnerable populations in Falmouth.



The first sections of this plan discuss the potential hazards that could occur in Falmouth and some of the potential losses and vulnerabilities associated with each of these hazards. An important next step in hazard mitigation planning is to develop specific strategies and actions that will help mitigate or minimize the risk to these natural hazards. A mitigation action is a specific action, project, activity, or process taken to reduce or eliminate short- or long-term risks to people and property from hazards and their impacts. Implementing mitigation actions helps achieve the plan's mission and goals. These mitigation strategies are the heart of the mitigation plan. They describe how Falmouth will accomplish their mitigation goals.

This chapter documents Falmouth's mitigation goals and existing and ongoing mitigation actions, as well as its proposed mitigation actions. The purpose, responsibility, priority, and timeline are detailed for each of the proposed mitigation actions.



The central component of a hazard mitigation plan is the strategy for reducing the community's vulnerability to natural hazard events. Responding to the analysis of risk, vulnerabilities, potential impacts, and anticipated future development, the process for developing this strategy is one of setting goals, understanding what actions the community is already taking that contribute to mitigating the effects of natural hazards and assessing where more action is needed to complement or modify existing measures. The following sections include descriptions of the Town's mitigation goals, existing capabilities and ongoing mitigation actions, a status update on mitigation measures identified in previous plans, and descriptions of proposed new mitigation measures. All mitigation measures are evaluated by their benefits and potential costs to arrive at a prioritized list of action items.

5.1 MITIGATION GOALS AND OBJECTIVES

C3.a
C3.b
D3.a

During planning team meetings for this update of the plan, the LPT developed a series of hazard mitigation goals. These goals are meant to prevent and mitigate injury, loss of life, and damage to property, critical infrastructure, and cultural resources from the impacts of natural hazards. The following eight (8) goals were endorsed by the LPT for this Multi-Hazard Mitigation Plan:

1. Provide residents with adequate access to emergency shelters equipped with sufficient provisions, climate control and emergency electricity during natural disaster events.
2. Improve communications between private citizens, businesses, utility companies, and town, regional, state, and federal agencies before, during and after a natural disaster.
3. Maintain adequate access to public utilities such as electricity, drinking water, and communications during and after a natural disaster.
4. Maintain an adequate Level of Service (LOS) on all roadways during and after natural disasters, particularly on major roadways.
5. Investigate, design, and implement projects that will reduce and minimize the risks and impacts from natural hazards to critical municipal facilities and resources.
6. Develop public education outlets and materials to inform residents about what to expect during natural disasters and to promote pre-disaster planning by the public, particularly regarding natural disasters such as hurricanes.
7. Make improvements to existing practices based on experience gained during disaster response and recovery.
8. Encourage future development that minimizes risks to natural hazards, such as flooding and high winds.

5.2 EXISTING CAPABILITIES

Falmouth has a unique set of capabilities, including Town plans, policies, staff, funding, and other resources available to accomplish mitigation actions and reduce short- and long-term vulnerability. These capabilities are summarized in this section. Opportunities for how these capabilities could be expanded or improved upon are also described.



Town Plans and Policies

Falmouth has a series of planning documents that address natural hazards. These documents include measures associated with the Town's mitigation strategy and could be useful when implementing mitigation actions. Through the implementation of these plans, Falmouth can guide and manage growth and development within the Town, with the goal of reducing hazard vulnerability. These plans include:

1. Local Comprehensive Plan (2016): Addresses topics such as land use, economic development, services and facilities, transportation, housing, resilience to climate change, open space and recreation, and natural and cultural resources. The Plan includes a chapter on coastal resiliency.
2. Falmouth Climate Change Vulnerability Assessment & Adaptation Plan (2020):
3. Coastal Resiliency Planning for the Surf Drive Area (2020)
4. Coastal Resiliency Action Committee Final Report (2021)
5. Falmouth Community Resiliency Building Workshop Summary of Findings (2018): Contains recommendations for
6. Stormwater Management Rules and Regulations (2021)

These plans provide important background for hazard planning, particularly with respect to flooding and climate change, and affirm municipal goals to improve hazard resilience and response. In the future, the Town's capacities, with respect to planning documents, could be improved by developing more departmental-, sector-, and asset-specific hazard reduction recommendations. Many of the proposed mitigation actions in Section 5.3 provide actionable, specific recommendations, which will help the Town move towards a more inter-departmental and inter-sector approach to hazard mitigation.

Many of the existing Town policies and ordinances also provide an effective means of mitigating hazards. Falmouth relies on the Massachusetts state building code (780 CMR) to ensure that new buildings and structures are built safely and to the state-standards for hazard preparedness. Falmouth also has Town-specific Zoning and Floodplain ordinances. The local Falmouth Wetlands Regulations have floodplain specific regulations designed to minimize flooding damages and build resiliency to future flooding.

Town Staff

The Town of Falmouth has a very capable staff that includes a Building Commissioner (who also serves as the Floodplain Administrator), Emergency Manager and Fire Chief, Community Planner, Conservation Commission Administrator, GIS Coordinator, and Professional Engineers within the Department of Public Works. Together these staff allow the Town to effectively plan for and implement specific mitigation actions. The capacity of the existing staff and committee members could be further improved through continuing education and trainings, and/or additional staff with specialized skills could be hired, such as a designated Sustainability Director.



Financial Capabilities

Financial capabilities are the resources that a Town has to fund mitigation actions. The costs to implement mitigation activities vary from relatively low-cost to relatively high-cost activities. Low-cost actions include building assessments or outreach efforts, which require little to no costs other than staff time and existing operating budgets. Alternatively, higher cost actions, such as major infrastructure redesigns, could require a substantial monetary commitment from local, state, and federal funding sources.

The Town of Falmouth has the following potential sources of funding to implement hazard mitigation activities:

1. Capital improvements funding;
2. Authority to levy taxes for specific purposes;
3. Fees from water and sewer services;
4. Fees from new development; and
5. Incurring debt through general obligation bonds and/or special tax bonds.

The Town's annual revenue from taxes and from specific town meeting articles can be used to fund some mitigation actions, but other larger actions may need additional outside funding, such as from state and federal grant programs. Grant funding that has been used in the past includes MVP and CZM Coastal Resilience grants. Funding from the Community Preservation Act has also been used by the Town to implement mitigation actions. Additional financial assistance in the form of grant funding will likely be required to implement some of the larger proposed mitigation actions in Section 5.3.

C1.a

Existing Mitigation Measures

The following are existing and ongoing mitigation measures performed by the Town of Falmouth:

1. **Emergency Response Plan:** Falmouth maintains a Comprehensive Emergency Management Plan to document mitigation, preparedness, and response and recovery actions to be taken by the Town in the event of an emergency. The plan evaluates natural hazards, and addresses coordination between multiple departments and agencies within the area to provide for the safety and welfare of Falmouth citizens. The plan is periodically updated to reflect the most up-to-date information available.
2. **Emergency Operations Center:** Falmouth maintains an Emergency Operations Center (EOC) at the Fire Department Headquarters Building at 399 Main Street. The EOC is activated in the event of a natural or other disaster and provides emergency services such as providing auxiliary communications, lighting, and transportation as needed. The EOC operates under the general direction of the Chief of the Fire Department.
3. **Emergency Shelters & Mutual Aid:** Falmouth has established the following emergency shelters for use in the event of a natural disaster:
 - Primary – Falmouth High School, Gifford Street
 - Secondary – Otis Air Force Base Regional Shelter



Typically, the High School building is opened first, with the Air Base available should the capacity of the High School be exceeded. Both shelters are equipped with emergency generators in the event of a power outage, as well as other vital supplies such as food, water, blankets, etc.

4. **Communications System:** The Town has an array of communications systems in place to assist public safety efforts during a natural hazard event. Falmouth recently established the FalmouthAlert system, which sends emergency alerts and notifications via phone call, text message, email, and social media. To take advantage of this system, residents need to sign up either via text message to the Town or by completing an online form. Many residents are unaware of the need to actively sign up for this service. The Town also utilizes the Plymouth County Sheriff's Department's CodeRED emergency alert system, which can reach residents via phone call, text message, or email. The Town is part of the Fire and Police Mutual Aid Plan and communicate frequently with neighboring communities when they need assistance, specifically with Mashpee, Bourne, and Sandwich.
5. **Emergency Power Generators:** Much of Falmouth's critical drinking water, wastewater collection, pumping, and treatment infrastructure is equipped with onsite backup power sources. Falmouth's wastewater treatment plant has backup generators for emergency use, while all sewer pump stations are equipped with emergency generators. Water treatment facilities and many drinking water supply wells also have backup generators. The water storage tanks function automatically by gravity to maintain flows and pressures throughout the water system, with backup power only required for instrumentation purposes (i.e. communicate tank water levels). Generators are powered by onsite fuel sources such as above ground diesel tanks or propane tanks and may be refueled as needed by conventional methods. The Town routinely tests backup generators, either utilizing automatic test methods such as on DPW's water and sewer pump station generators or manual weekly tests such as on those located at schools and the police station.
6. **Massachusetts State Building Code:** The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads.
7. **Public Information and Outreach:** Falmouth has implemented several programs as a means of reaching out to the public prior to and during an emergency. The town routinely distributes information via the local cable channels managed by Falmouth Community Television (FCTV) and via FalmouthAlert. FCTV operates three channels, 14, 15 and 16 on the Comcast Cable System and live streams channels 14 and 15 on their website at www.fctv.org. FalmouthAlert sends emergency notices via phone call, email, text, and social media outlets. These communication resources are used to convey information to the public before, during and after natural disasters. Information typically includes closed roadways, power company response information, contact information for local, regional and state resources and preparedness information. Should power and cable television be down, FCTV has the ability to go live from the LEPC for all three channels simultaneously.



Falmouth uses the town website as a means of conveying information to the public. The website also provides links to applicable emergency agencies, such as Falmouth Police, Fire and Emergency operations Center. The website also provides emergency management maps such as flood insurance and hurricane maps, and a number of emergency preparedness brochures.

8. **Tree Committee:** Town staff are responsible for the care and planting of trees along Town streets and parks. This committee works in cooperation with the Tree Warden, the Department of Public Works, and Eversource to maintain and trim trees that may interfere with power lines.
9. **Snow Disposal:** The Town conducts general snow removal operations and has adequate space for snow storage as needed.
10. **Water Restrictions:** Even/odd numbered homes have outside watering restrictions in effect from June 15th through September 15th to alleviate water shortages during periods of drought.
11. **Wetland Protection Standards:** The purpose of the Falmouth Wetland Protection Standards is to protect the wetlands, water resources and adjoining land areas.

C2.a

Participation in the National Flood Insurance Program (NFIP)

Falmouth currently participates in FEMA's National Flood Insurance Program (NFIP). Per FEMA's Local Multi-Hazard Mitigation Planning Guidance document, the NFIP has three basic aspects:

1. Floodplain identification and mapping – adopt flood maps depicting hazards;
2. Floodplain management – adopt and enforce floodplain management regulations; and
3. Flood insurance – require property owners to purchase insurance in exchange for floodplain management regulations that reduce future flood damages.

Flood Hazard Boundary Maps (FHBMs) were first established in 1979, with flood insurance rate maps (FIRMs) following in 1981. The most recent FEMA Flood Insurance Study became effective on July 6, 2021.

Loss statistics as of April 30, 2022 for the Town of Falmouth include a total of 181 closed cases, of which the total payments amounted to \$2,896,862 (FEMA 2021b). There are currently 417 active policies in effect.

As part of ongoing NFIP requirements, Falmouth regulates new development within the Special Flood Hazard Area (SFHA). The Town follows NFIP regulations and guidelines for all new construction, as well as substantial improvements to existing structures, within the flood plain.



D2.a

5.3 PROGRESS ON MITIGATION ACTIONS SINCE 2004

Before identifying new mitigation actions for the 2022 Falmouth Multi-Hazard Mitigation Plan, the LPT discussed the status of the mitigation actions identified in the 2017 SPREDD Regional Natural Hazard Disaster 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 2017-2022.
- **Existing Capability:** The project was implemented and completed in 2017-2022, and it will continue to be implemented on an annual basis.
- **In Progress:** The project was started in the 2017-2022 timeframe and is still in progress.
- **Deferred:** The project is important, but it was deferred because there was no funding available, or it was not feasible to complete the project in this timeframe.
- **Deleted:** The project is no longer relevant to the community.

Table 5-1. Status of 2017 Proposed Mitigation Actions.

Action Category 1: Prevention and Resource Protection – Regulatory Modifications to Bylaws and Regulations to Prevent Damage and Preserve or Restore Natural Resources.

Action	Current Status
1a. Create a comprehensive wetlands restoration plan and begin reconstruction in the most vulnerable areas.	In Progress – Coonamessett River restoration project completed in Fall 2021. Restoration projects are ongoing at Oyster Pond, Red Brook, and Childs River culverts. Future restoration planned for Wild Harbor culvert and other sites identified in the Association to Preserve Cape Cod restoration atlas.
1b. Study the range of options and ideas found in the winning proposals of the “Rebuild By Design” competition and identify how they may be modified and implemented in Falmouth.	Deleted – Recommendations in the “Rebuild by Design” studies are not relevant to Falmouth.
1c. Maintain a list of municipal construction projects, bylaw/code revisions, and properties to acquire to reduce risk from natural hazards; develop priority ranking.	In Progress – Falmouth CCVA (WHG, 2020) prioritized municipal infrastructure based on flood vulnerability and identified bylaw/code revisions needed to reduce vulnerability to flooding. A list of municipal projects and properties to acquire will be developed using recommendations from the CCVA.
1d. Integrate municipal mitigation and adaptation projects into the Town’s operating and capital budgets.	Existing Capability - Town routinely includes funding for adaptation and resiliency projects in the operating and capital budgets. The money is applied to projects on a case-by-case basis.
1e. Review and revise local codes and bylaws as necessary to increase the resiliency of construction projects, and lobby for changes in the state building code.	Deferred – Currently, the Town building code follows the state building code. The Building Department will consider future revisions to local codes and bylaws, as necessary.
1f. Revise Conservation Commission Wetlands Regulations to be consistent with the Coastal Resiliency goals and policies.	Deferred – The Conservation Commission plans to review the Wetlands Regulations in the future to ensure consistency with coastal resiliency goals and policies.
1g. Train fire department staff and other emergency responders in wildland fire training.	Complete – Wildland fire training was completed in the spring of 2022.

1h. Conduct fuel management activities in Fire Hazard Mitigation Focus Areas as identified in the Barnstable County Wildfire Preparedness Plan	Existing Capability – These activities are conducted routinely by state and federal agencies.
1i. Conduct a thorough evaluation of the Town’s most at-risk critical facilities identified in the Vulnerability Analysis, and evaluate potential mitigation techniques for protecting each location to the maximum extent possible	Existing Capability - Town has begun to build resiliency for their at-risk critical facilities. The drawbridge hut in Woods Hole and the Park Street sewer pump station were recently floodproofed. The Town is currently working to flood protect the remaining vulnerable pump stations through a MVP grant.

Action Category 2: Public Safety – Improvements to Protect Residents During a Disaster.

Action	Current Status
2a. Establish evacuation procedures	Complete - Evacuation routes were established as part of the 2018 Cape Cod Emergency Traffic Plan and signage was placed on the roadways.
2b. Incorporate evacuation procedures into the Emergency Response Plan	Complete - The LEPC developed online and in print flyers that provide information on evacuation procedures.
2c. Maintain an adequate supply of sand, salt, and other road treatment materials	Existing Capability - The Town maintains a supply of sand and salt at the DPW facility for both municipal operations and private use. Materials are restocked regularly.

Action Category 3: Property Protection – Modifications or Removal of Infrastructure to Protect from a Hazard.

Action	Current Status
3a. Design and reconstruction of the Falmouth Heights Bluff shore protection located on the seaward side of Grand Avenue between Vernon Avenue and Gertrude Avenue. Approx. length = 1,300’	In Progress - The Town is working with a consultant to design shore protection and identify construction funding for the Falmouth Heights Bluff shoreline.
3b. Design and reconstruction of shore protection along the Chapoquoit Road causeway from Chapoquoit Beach to end at stone pillars. Approx. length = 900’	In Progress - The Town has completed reconstruction of three (3) sections of shore protection along Chapoquoit Road. The last 250 ft section is scheduled for completion during the winter 2022-2023.
3c. Consider the feasibility of beach nourishment along Chapoquoit Beach	Deferred - The Town plans to take this project up in the future as they evaluate

	impacts of the project on navigation and tidal hydrodynamics at the entrance to West Falmouth Harbor.
3d. Begin talks with private organizations and businesses in Woods Hole (i.e., Steamship Authority, WHOI, MBL, etc.) about hazard mitigation, flood prevention, and traffic control	In Progress - The LEPC is composed of a broad spectrum of community representatives that work together on coordinating emergency response training. They completed a tabletop exercise on emergency response in the spring 2022. Many of the LEPC representatives have emergency response plans of their own. The Town is also working with ResilientWoodsHole.org to identify at risk facilities in Woods Hole and to plan for implementation of hazard mitigation actions.
3e. Work with local land trusts to identify repetitive loss properties that these entities would be willing to buy out in the event of substantial damage, with the intent that these properties would be restored to their natural state and managed by the non-profit	Deferred - The local land trust (300 Committee) has prioritized other land acquisitions for wetland restoration and greenways. The Town will reach out to the 300 Committee about acquisition of repetitive loss properties.
3f. Develop pre- and post-storm response plans for Falmouth public beaches, as described in Beach Management Plan	Existing Capability - Pre- and post-storm response plans for the Town of Falmouth beaches are included in the Beach Management Plan (BMP). The Town periodically updates the BMP, including the pre- and post-storm response plans.
3g. Evaluate alternatives for protecting, relocating, or abandoning vulnerable sections of Surf Drive	Complete - The Town completed a Coastal Resiliency Plan for the Surf Drive Area in 2020.
3h. Evaluate alternatives to minimize flooding and sand overwash on Menauhant Road during a storm, particularly in the vicinity of Bristol Beach, Inn Season Resorts, Surfside, and Menauhant Beach	In Progress - The Town funded engineering design and permitting for an inlet widening and beach nourishment project at Menauhant Beach. Construction for this project is expected in the fall of 2023. Flood resiliency measures at the other Menauhant Rd sites are still being evaluated.

Action Category 4: Structural Projects – Construction Projects to Reduce Hazard Impacts.

Action	Current Status
4a. Reconstruction of the Fresh River Outlet on Surf Drive, including a roadway culvert and outlet groin	Deferred - The Town has deferred this project due to lack of funding. A study for an evaluation of alternatives is being considered.
4b. Reconstruction of the Salt Pond Outlet on Surf Drive including the roadway culvert and outlet groin	In Progress - The Town funded engineering design and permitting for a new culvert at the Salt Pond Outlet. Construction of this project is expected in the next 2-3 years.
4c. Reconstruction of the Trunk River Outlet under the bike path	Completed - A new culvert was installed at the Trunk River Outlet in the spring of 2020.
4d. Reconstruct high school gymnasium glass roof with solid surface roof and install storm shutters on cafeteria windows	Deferred - This project has not been completed due to lack of funding. The Town plans to pursue Federal grants for the work once the MHMP is complete.
4e. When bridges require maintenance, assess the vulnerability of water mains and other utility infrastructure, and potentially upgrade or reinforce infrastructure during bridge repair	Existing Capability - Work to reduce vulnerability to existing water mains and utility infrastructure is completed as bridges undergo routine maintenance. For example, new water and gas mains were installed at the John Parker Rd. culvert in 2021 during replacement of the culvert.
4f. Explore stormwater best management practices (BMPs) to address sections of roadway that regularly flood after heavy rains (i.e., east end of Thomas Landers Road; Route 28 near Friendly's, etc.)	Existing Capability - The Town is currently working with the Commonwealth on a redesign plan for Rt 28 that includes drainage improvements. Other stormwater issues around town will continue to be reviewed on a case-by-case basis.
4g. Verify the location of each repetitive loss property. If it cannot be located, is located in another jurisdiction, or has been mitigated, notify FEMA to get the property removed from the town's repetitive loss list	Deferred – The Town has not had staff time available for this in the past but plans to allocate the necessary resources for verifying the locations of repetitive loss properties and notifying FEMA of properties that have been mitigated.
4h. Contact all owners of repetitive loss properties annually, and inform them of financial assistance available for structural mitigation such as elevation and acquisition	Existing Capability - The LEPC holds periodic emergency preparedness fairs where information is disseminated to property owners on financial assistance

	available for structural mitigation. The Town has plans in the future to reach out specifically to repetitive loss property owners.
--	---

Action Category 5: Public Information and Communications – Actions to Better Provide Information During a Disaster and Procedures to Facilitate Better Communication.

Action	Current Status
5a. Expand use of social media and other public outreach channels, such as Facebook, Twitter, YouTube, and an updated website to provide information about hazard preparedness, as well as a method to provide real-time updates during and following a major natural hazard.	Existing Capability - The Town established a program of emergency alerts via social media including Facebook, Twitter, and via regular web site updates. The FalmouthAlert system came online in 2021.
5b. Develop an informational brochure that highlights the key points of this plan for residents, which could be made available at Town Hall and on the Town website.	Existing Capability - The Town has created a number of informational brochures/web postings that highlight important emergency response procedures. These include: So, You're a Tourist during Hurricane Season, Emergency Supply Kit, What Should We Put in Our Emergency Supply Kit, and Winter Emergency Car Kit. The Town also provides access to MEMA and FEMA emergency preparedness literature on the Town web site, at Town Hall, at the Senior Center, Fire Department, and library. Access to this literature is updated on a regular basis.
5c. Improve interdepartmental and inter-agency communications.	Existing Capability - The Town holds interdepartmental meetings to discuss pre- and post-storm response and issues. Department heads from DPW, fire, and police also attend regular LEPC meetings to discuss emergency preparedness and response.
5d. Establish town-wide radio station per LEPC recommendation.	Deleted - Given more modern and effective forms of community outreach, the town-wide radio station was not pursued as an additional means of communication.

5e. Establish town-wide mass notification warning system (commercial program of sirens and loudspeakers) to notify residents.	Completed - The Town established the FalmouthAlert system in 2021 that allows residents and visitors to sign up for emergency alerts via voice call, text message, or email.
5f. Formalize mutual aid agreements	Completed - The Town formalized mutual aid agreements with fire and emergency service partners through the Barnstable County Sheriff's communications center. The partners are connected via radio with Barnstable County representative and resource availability is regularly updated.

5.4 PROPOSED MITIGATION

C4.a
C5.a
C5.b

Planning Process

To identify, evaluate, and prioritize specific mitigation actions and projects to reduce the effects of a natural disaster, the LPT used a prioritization method focusing on four key themes as follows:

- **Benefits:** Determine whether the proposed mitigation measure will improve property protection, natural resource protection, technical capacity, public awareness, or post-hazard emergency response;
- **Feasibility:** Determine whether the proposed mitigation measure is feasible in terms of Town staffing, public and Town support, and whether it is technically feasible;
- **Economic:** Evaluate each mitigation measure in terms of estimated cost and potential funding sources; and
- **Regulatory:** Evaluate each mitigation measure for consistency with local, state, and federal permitting/regulatory requirements and goals.

Each proposed mitigation action presented in this section was given a score based on 13 subcategories within these four larger categories documented above (i.e. Benefits, Feasibility, Economic, Regulatory). For each of these subcategories, the proposed action was given a score of 3 if the action was thought to be a “good” fit with a particular category (likely to provide the benefit under consideration, required little additional training or funding, feasible, etc.), 2 if it was “average”, or 1 if it was “poor” (did not provide the benefit under consideration, difficult to permit, costly, etc.). For a detailed overview of how each action was scored, see Appendix C.

When evaluating estimated costs for proposed mitigation actions, the following general cost categories were used:

- High:** Estimated costs greater than \$250,000
- Medium:** Estimated costs between \$50,000 and \$250,000
- Low:** Estimated costs less than \$50,000 and/or staff time only

C4.a
C4.b
C4.c
C5.c

Proposed Mitigation Actions

The final proposed mitigation actions developed during the planning process are summarized in this section. A total of thirty-three (33) actions were developed. These actions address risks due to flooding, severe weather, hurricanes and tropical storms, and wildfire, as well as more general public outreach and multi-hazard mitigation actions. Specific actions range from public education to increase awareness to actions that involve the modifications of existing buildings or infrastructure to protect them from a hazard.

Proposed mitigation actions are grouped according to their associated mitigation goal. For each action identified below, a brief description is provided, as well as the responsible department(s), potential funding sources, priority, and anticipated timeline.

Goal 1: Provide Residents with Adequate Access to Emergency Shelters Equipped with Sufficient Provisions, Climate Control, and Emergency Electricity During Natural Disaster Events.

Mitigation Action 1a: Reconstruct high school gymnasium glass roof with solid surface roof and install storm shutters on cafeteria windows.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storm, Other Severe Weather
PURPOSE	The Falmouth High School services as the Town's Emergency Shelter location but requires reinforcing of the structure to improve public safety.
RESPONSIBILITY	Falmouth School Department, Emergency Operations Center (Fire), and Dept. of Public Works
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Grant Funding (FEMA), Town Meeting Article
PRIORITY	High
TIMELINE	Within the next 3-5 years

Goal 2: Improve Communications Between Private Citizens, Businesses, Utility Companies, and Town, Regional, State, and Federal Agencies, Before, During, and After a Natural Disaster.

Mitigation Action 2a: Improve interdepartmental and inter-agency communications.	
HAZARD ADDRESSED	Multiple Hazards
PURPOSE	By having regular inter-departmental communication about hazard planning, the Town will be able to better coordinate its hazard mitigation efforts. Discussions could include how each department and committee could incorporate hazard mitigation planning and climate change resiliency into their respective mission statements and ongoing activities.
RESPONSIBILITY	All municipal departments and committees
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	Medium
TIMELINE	Annually starting in 2022

Mitigation Action 2b: Begin talks with private organizations and businesses in Woods Hole (i.e. Steamship Authority, WHOI, MBL, etc.) about hazard mitigation, flood prevention, and traffic control.	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Other Severe Weather
PURPOSE	A number of the Tier 1 and 2 Critical Facilities are owned by these entities and are at risk from a number of hazards including flooding, hurricanes, sea level rise, and coastal erosion. Hazard mitigation actions to protect these facilities will require a plan and financial investment from these entities, but the Town can facilitate and coordinate planning to lead an integrated mitigation effort in Woods Hole.
RESPONSIBILITY	Town Manager, Conservation Commission, Planning Dept., and Dept. of Public Works
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	Medium
TIMELINE	Ongoing, starting in 2021, and continuing for the next 2-3 years

Goal 3: Maintain Adequate Access to Public Utilities Such as Electricity, Drinking Water, and Communications During and After a Natural Disaster.

Mitigation Action 3a: When bridges require maintenance, assess the vulnerability of water mains and other utility infrastructure, and potentially upgrade or reinforce infrastructure during bridge repair.	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Other Severe Weather
PURPOSE	Falmouth's water mains carry the Town's drinking water. In areas where communities are separated by waterbodies, these water mains are located alongside bridges. In many coastal areas, these bridges get inundated during storms and are subject to wave actions and impacts from floating debris that could damage the water mains. Upgrades should be implemented when feasible.
RESPONSIBILITY	Dept. of Public Works
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, State Grants
PRIORITY	Low
TIMELINE	Ongoing and continuing for the next 5 years

Mitigation Action 3b: Ensure that all schools, housing authority facilities, and town-owned buildings that provide emergency support services are equipped with generators.	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Severe Winter Weather, and Other Severe Weather
PURPOSE	Falmouth schools and housing authority facilities contain concentrations of vulnerable people, and a number of town-owned buildings provide critical emergency support services during a natural hazard. The loss of power at these facilities caused by tree damage to overhead power lines places populations at risk and increases the likelihood that critical municipal services will be interrupted. The ability to maintain a power supply to these facilities is important.
RESPONSIBILITY	Dept. of Public Works, School Administration, Falmouth Housing Authority
ESTIMATED COST	Medium
POTENTIAL FUNDING SOURCES	Town Meeting Article, State and Federal Grants, Private Funding
PRIORITY	High
TIMELINE	Ongoing and continuing for the next 5 years

Mitigation Action 3c: Establish a regular program of trimming trees on municipal properties that have the potential to impact power supply during storms.	
HAZARD ADDRESSED	Severe Winter Weather and Other Severe Weather
PURPOSE	Trees in many areas of Town are close to or interfering with overhead electrical lines. During high wind and ice storm events, downed trees have the potential to damage power lines. By maintaining and trimming trees around existing power lines, the potential for interruptions to the power supply will be minimized.
RESPONSIBILITY	Dept. of Public Works
ESTIMATED COST	Medium
POTENTIAL FUNDING SOURCES	State Grants, Town Operating Budget
PRIORITY	Medium
TIMELINE	Ongoing and continuing for the next 5 years

Goal 4: Maintain an Adequate Level of Service (LOS) on all Roadways During and After Natural Disasters, Particularly on Major Roadways.

Mitigation Action 4a: Maintain an adequate supply of sand, salt and other road treatment materials.	
HAZARD ADDRESSED	Severe Winter Weather
PURPOSE	To ensure Town roads can be treated quickly and effectively to maintain safe transportation routes in the event of a snow event.
RESPONSIBILITY	Dept. of Public Works
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget, Snow & Ice Budget
PRIORITY	Medium
TIMELINE	Seasonal and ongoing

Mitigation Action 4b: Explore stormwater best management practices (BMPs) to address sections of roadway that regularly flood after heavy rains (i.e. east end of Thomas Landers Road; Route 28 near Friendly's, etc.).	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, and Other Severe Weather
PURPOSE	Some roadway areas routinely flood after heavy rains due to ponding water or backed up storm drains. Stormwater BMPs, such as regularly cleaning catch basins and directly treating storm-water runoff in vegetated swales, could reduce the ponding in the roads.
RESPONSIBILITY	Dept. of Public Works
ESTIMATED COST	Medium to High

POTENTIAL FUNDING SOURCES	Town Meeting Article, State Grants
PRIORITY	Medium
TIMELINE	Ongoing and continuing for the next 5 years

Mitigation Action 4c:

Evaluate alternatives to minimize flooding and sand overwash on Menauhant Road during a storm, particularly in the vicinity of Bristol Beach, Inn Season Resorts, and Menauhant Beach.

HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Severe Winter Weather, Coastal Erosion, and Other Severe Weather
PURPOSE	Sections of Menauhant Road are prone to storm overwash and flooding during coastal storm events. Since this road serves as a critical east-west transportation corridor, it is important to maintain safe passage for motorists for as long as possible during and after storms.
RESPONSIBILITY	Board of Selectmen, Dept. of Public Works, Planning Dept., Conservation Commission
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	MVP Action Grant, CZM Coastal Resilience Grant, Town Meeting Article
PRIORITY	Low
TIMELINE	Within the next 5 years

Mitigation Action 4d:

Design and reconstruction of the Falmouth Heights Bluff shore protection located on the seaward side of Grand Avenue between Vernon Avenue and Gertrude Avenue. Approx length = 1,300'.

HAZARD ADDRESSED	Hurricane & Tropical Storms, Severe Winter Weather, Coastal Erosion, and Other Severe Weather
PURPOSE	The bluff at Falmouth Heights continues to experience erosion, and the sea wall at the base is in need of repairs. Continued erosion of the bluff will threaten Falmouth Heights Road and the residential properties across the street.
RESPONSIBILITY	Dept. of Public Works
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	MVP Action Grant, CZM Coastal Resilience Grant, Town Meeting Article
PRIORITY	Low
TIMELINE	Within the next 5 years

Mitigation Action 4e: Design and reconstruction of shore protection along the Chapoquoit Road causeway from Chapoquoit Beach to end at stone pillars. Approx length = 900'.	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Severe Winter Weather, Coastal Erosion, and Other Severe Weather
PURPOSE	The existing revetment along Chapoquoit Road is failing. Part of the structure has already been repaired and reinforced, but additional work is necessary to provide protection for the roadway leading to Chapoquoit Island.
RESPONSIBILITY	Dept. of Public Works
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article
PRIORITY	Medium
TIMELINE	Complete within next 1-2 years

Mitigation Action 4f: Proceed with construction of the Bourne's Pond Bridge project and associated Menauhant Beach nourishment project.	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Coastal Erosion, and Other Severe Weather
PURPOSE	Accelerated rates of erosion at Menauhant Beach are threatening the adjacent public roadway and utilities, and negatively impacting the public beach. Engineering studies of the Bournes Pond Bridge and adjacent Menauhant Beach have shown that reconstruction of the bridge/culvert and nourishment of the beach will mitigate the ongoing erosion.
RESPONSIBILITY	Dept. of Public Works
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article
PRIORITY	Medium
TIMELINE	Complete within next 2-4 years

Mitigation Action 4g: Evaluate adaptation alternatives for low-lying roads and bridges throughout Town.	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Coastal Erosion, and Other Severe Weather
PURPOSE	A number of existing roadways in the Town of Falmouth are currently vulnerable to flooding during storms and will be increasingly vulnerable during high tide events in the future as sea levels rise. To address this problem, adaptation alternatives should

	be evaluated and roadways presenting the greatest risk to residents should be prioritized for added resiliency.
RESPONSIBILITY	Town Managers Office, Planning Dept., Conservation Commission, Dept. of Public Works
ESTIMATED COST	Low (for evaluation of alternatives), High (for implementation)
POTENTIAL FUNDING SOURCES	MVP Action Grant, CZM Coastal Resilience Grant
PRIORITY	Medium
TIMELINE	Within the next 1-2 years

Goal 5: Investigate, Design, and Implement Projects that will Reduce and Minimize the Risks and Impacts from Natural Hazards to Critical Municipal Facilities and Resources.

Mitigation Action 5a:

Create a comprehensive wetlands restoration plan and begin reconstruction in the most vulnerable areas.

HAZARD ADDRESSED	Flooding, Drought, Extreme Temperature, Water Quality, and Invasive Species
PURPOSE	This measure is one of the action items from the Local Comprehensive Plan Coastal Resiliency Goals voted at town meeting in November 2014. Implementation of this action would enhance flood protection and shoreline erosion control, among other benefits. Wetland restoration activities would provide additional trees, root mats and other wetland vegetation that would act to slow the speed of flood waters and distribute them more slowly over the floodplain throughout the coastal areas of Falmouth.
RESPONSIBILITY	Conservation Commission, Planning Dept., Dept. of Public Works
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, CZM Coastal Resilience Grant
PRIORITY	Medium
TIMELINE	Ongoing for the next 2-5 years

Mitigation Action 5b:

Conduct a thorough evaluation of the Town's most at-risk critical facilities identified in the CCVA (2020) and evaluate potential mitigation techniques for protecting each location to the maximum extent possible.

HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Coastal Erosion, and Other Severe Weather
PURPOSE	Now that the Town's vulnerable critical facilities have been identified, the next step is to identify and prioritize actions and projects that will provide additional protection to these structures.

RESPONSIBILITY	Town Manager, Board of Selectmen, Dept. of Public Works, Conservation Commission, Planning Dept.
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	CZM Coastal Resilience Grant, State & Federal Grants, Town Meeting Article
PRIORITY	Medium
TIMELINE	Within the next 2 to 5 years

**Mitigation Action 5c:
Reconstruction of the Fresh River Outlet on Surf Drive, including a roadway culvert and outlet groin.**

HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Water Quality, Dam/Culvert Failure
PURPOSE	Fresh River Outlet is a poorly flushed culvert, and is regularly damaged during storms, resulting in culvert collapse and damage to the road. Reconstruction of this outlet would minimize these events in the future.
RESPONSIBILITY	Dept. of Public Works, Conservation Commission
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, CZM Coastal Resilience Grant
PRIORITY	Medium
TIMELINE	Complete within the next 3 years

**Mitigation Action 5d:
Reconstruction of the Salt Pond Outlet on Surf Drive including the roadway culvert and outlet groin.**

HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Water Quality, Dam/Culvert Failure
PURPOSE	The Salt Pond Outlet is an undersized, poorly flushed culvert, and is often obstructed by sediment deposits during storms. To improve efficiency and reduce the risk of flooding and damage to the road, the outlet should be reconstructed.
RESPONSIBILITY	Dept. of Public Works, Conservation Commission
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, CZM Coastal Resilience Grant
PRIORITY	Medium
TIMELINE	Complete within the next 3 years

Mitigation Action 5e: Consider the feasibility of beach nourishment along Chapoquoit Beach.	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Coastal Erosion, and Other Severe Weather
PURPOSE	Chapoquoit Beach has a history of significant erosion, as well as repeated necessary repairs to the seawall and revetment. As a result, the remaining beach is very narrow, and in some cases no high tide beach is present. This leaves Chapoquoit beach, nearby wetland resources, and public infrastructure vulnerable to the impacts of storm surge, wave action, and flooding.
RESPONSIBILITY	Town Manager, Conservation Commission
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, CZM Coastal Resilience Grant
PRIORITY	Low
TIMELINE	Within the next 5 years

Mitigation Action 5f: Conduct fuel management activities in Fire Hazard Mitigation Focus Areas as identified in the Barnstable County Wildfire Preparedness Plan.	
HAZARD ADDRESSED	Wildfire
PURPOSE	Fuel management treatments can alter fuel loads to reduce wildfire hazard by changing fire behavior. These actions can increase public and firefighter safety while also reducing fire response and suppression costs. Focus areas should also include high risk areas in Beebe Woods around the hospital, and around water treatment facilities in heavily forested areas. The Town should coordinate with DCR on state-owned property.
RESPONSIBILITY	Fire Dept.
ESTIMATED COST	Low to Medium
POTENTIAL FUNDING SOURCES	Grants, Town Operating Budget
PRIORITY	High
TIMELINE	Ongoing and within the next 5 years

Mitigation Action 5g: Maintain a list of municipal construction projects, bylaw/code revisions, and properties to acquire to reduce risk from natural hazards; develop priority ranking.	
HAZARD ADDRESSED	Multiple Hazards
PURPOSE	A regularly updated list of important projects, regulatory updates, and potential property acquisitions, increases Falmouth's long-term resiliency by identifying and prioritizing the most effective next steps involved with hazard mitigation.

RESPONSIBILITY	Dept. of Public Works, Conservation Commission, Planning Dept., Town Manager, Board of Selectmen
ESTIMATED COST	Low (to maintain list & modify bylaws), High (to acquire properties)
POTENTIAL FUNDING SOURCES	Town Meeting Article
PRIORITY	Medium
TIMELINE	Ongoing and within the next 5 years

**Mitigation Action 5h:
Integrate municipal mitigation and adaptation projects into the Town's operating and capital budgets.**

HAZARD ADDRESSED	Multiple Hazards
PURPOSE	Vital mitigation and adaptation projects and actions will only be able to be implemented if they can be funded; integrating them into the Town's operating and capital budgets ensures there is a dedicated funding source for these projects.
RESPONSIBILITY	Finance Committee, Finance Director, Town Manager, Selectboard, Town Meeting
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Operating and Capital Budgets
PRIORITY	Medium
TIMELINE	Mid-term and ongoing within the next 5 years

**Mitigation Action 5i:
Update the Falmouth Open Space and Recreation Plan to include properties identified in the CCVA (2020) study as priorities for acquisition to allow salt marsh migration in response to sea level rise.**

HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Coastal Erosion, Other Severe Weather, and Water Quality
PURPOSE	The Falmouth CCVA (2020) identified properties that would be beneficial for allowing salt marsh migration in the future as sea levels rise. By allowing the marsh to migrate landward, there will be additional storage capacity for flood waters, enhanced wildlife habitat, and improved water quality.
RESPONSIBILITY	Planning Dept., Conservation Commission
ESTIMATED COST	Low (to update the Plan), High (to acquire the properties)
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant
PRIORITY	Medium
TIMELINE	Plan update within next 1 to 2 years; acquisition within the next 3 to 5 years

Mitigation Action 5j Evaluate alternatives for reducing vulnerability of Town Hall to flooding.	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, and Other Severe Weather
PURPOSE	Falmouth Town Hall was identified in the CCVA (2020) as being vulnerable to flooding from Siders Pond during future storm events as sea levels continue to rise. Conceptual alternatives for protecting Town Hall were developed, but additional work needs to be conducted so that a preferred alternative and schedule can be selected.
RESPONSIBILITY	Town Manager, Conservation Commission, Planning Dept., Dept. of Public Works
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, CZM Coastal Resilience Grant
PRIORITY	Medium
TIMELINE	Over the next 5 years

Goal 6: Develop Public Education Outlets and Materials to Inform Residents About What to Expect During Natural Disasters and to Promote Pre-Disaster Planning by the Public, Particularly Regarding Natural Disasters Such as Hurricanes.

Mitigation Action 6a: Continue use of social media and other public outreach channels, such as Facebook, Twitter, YouTube, and an updated website to provide information about hazard preparedness and encourage public to sign up for FalmouthAlert.	
HAZARD ADDRESSED	Multiple Hazards
PURPOSE	Large populations of residents and visitors can be reached through the internet and social media outlets at very little cost to the Town, so information can be disseminated widely. These communication methods also occur in real-time, which is crucial for updates during a natural hazard.
RESPONSIBILITY	Emergency Operations Center, Fire Dept.
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	High
TIMELINE	Ongoing and continue over the next 5 years

Mitigation Action 6b:**Develop informational brochures that highlight pre- and post-disaster preparedness and make them available through a broad range of outlets.**

HAZARD ADDRESSED	Multiple Hazards
PURPOSE	Easily accessible information in the form of educational brochures will inform both residents and visitors on the types of natural hazards possible in Falmouth, and the ways they can reduce their vulnerability.
RESPONSIBILITY	Emergency Operations Center, Fire Dept., Town Manager
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	High
TIMELINE	Ongoing and continue over the next 5 years

Mitigation Action 6c:**Develop public outreach materials, in concert with Eversource, on importance of allowing tree trimming around power lines.**

HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Other Severe Weather
PURPOSE	Recent high wind storm events have caused significant tree damage throughout Town. This has resulted in power supply interruptions and loss of electricity to many areas of town. Many homeowners are reluctant to allow tree trimming and would benefit from understanding the importance of this type of pre-disaster preparation.
RESPONSIBILITY	Dept. of Public Works
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	High
TIMELINE	Ongoing and continue over the next 5 years

Goal 7: Make Improvements to Existing Practices Based on Experience Gained During Disaster Response and Recovery.

Mitigation Action 7a: Work with local land trusts to identify repetitive loss properties that these entities would be willing to buy out in the event of substantial damage, with the intent that these properties would be restored to their natural state and managed by the non-profit.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
PURPOSE	By transitioning a repetitive loss property back to its natural state, the potential for future structural damage is removed and a restored natural system can improve coastal resilience and storm protection capacity of the property.
RESPONSIBILITY	Town Manager, Selectboard
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, State and Federal Grants
PRIORITY	Medium
TIMELINE	Withing the next 5 years

Mitigation Action 7b: Verify the location of each repetitive loss property. If it cannot be located, is located in another jurisdiction, or has been mitigated, notify FEMA to get the property removed from the town's repetitive loss list.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
PURPOSE	The number of repetitive loss properties influences the requirements of the Town in reference to hazard mitigation and CRS planning. If properties appear erroneously on this list, they should be removed to reflect the true repetitive loss status of the Town.
RESPONSIBILITY	GIS Services, Building Dept.
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	Low
TIMELINE	Within the next 1 year

Mitigation Action 7c: Develop pre- and post-storm response plans for Falmouth public beaches, as described in Beach Management Plan.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
PURPOSE	Falmouth has public beaches on the Buzzards Bay and Vineyard Sound coastlines. Pre- and post-storm response plans will help to minimize risks of storm damage to wetland resources and public/private infrastructure, and will help to avoid adverse impacts to resources during post-storm clean-up.
RESPONSIBILITY	Beach Dept., Dept. of Public Works, Fire Dept., Emergency Operations, Conservation Commission
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	Medium
TIMELINE	Within the next 3 years

Mitigation Action 7d: Revise Conservation Commission Wetlands Regulations to be consistent with the Coastal Resiliency goals and policies.	
HAZARD ADDRESSED	Multiple Hazards
PURPOSE	The Coastal Resiliency goals and policies focus on preserving, restoring, and enhancing coastal ecosystems to better absorb impacts from natural hazards, with an emphasis on resiliency and adaptability. Revising the Conservation Commission Wetland Regulations to reflect this will reinforce these goals and ensure consistency across planning and regulatory documents.
RESPONSIBILITY	Conservation Commission, Town Manager, Town Meeting
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget, Town Meeting Articles
PRIORITY	Medium
TIMELINE	Within the next 5 years

Goal 8: Encourage Future Development that Minimizes Risks to Natural Hazards, Such as Flooding and High Winds.

Mitigation Action 8a: Review and revise local codes and bylaws as necessary to increase the resiliency of construction projects, and lobby for changes in the state building code.	
HAZARD ADDRESSED	Multiple Hazards
PURPOSE	Revising local codes and bylaws to increase the resiliency of construction projects will ensure that future buildings and structures constructed in Falmouth will be more resilient, and less likely to experience damage in the event of a natural hazard.
RESPONSIBILITY	Planning Board, Zoning Board of Appeals, Town Meeting, Building Commissioner, Conservation Commission
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget, Town Meeting Article
PRIORITY	Medium
TIMELINE	Ongoing and continue over the next 5 years

Mitigation Action 8b: Contact all owners of repetitive loss properties annually and inform them of financial assistance available for structural mitigation such as elevation and acquisition.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
PURPOSE	If homeowners know about financial incentives for mitigating their flood risk, it is more likely they will perform the necessary work to remove their property from the repetitive loss list, while also avoiding future damage.
RESPONSIBILITY	Town Manager, Selectboard
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	State and Federal Grants
PRIORITY	Medium
TIMELINE	Within the next 2 to 5 years

Mitigation Action 8c: Develop a framework that addresses buy outs and incentives for relocation in low-lying neighborhoods.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
PURPOSE	With rising sea levels, more low-lying areas in the Town of Falmouth will become vulnerable to flooding. By developing a framework for identifying vulnerable properties, contacting the owners, and establishing financial resources for a buy out program, the Town will be able to mitigate the flooding impacts.
RESPONSIBILITY	Town Manager
ESTIMATED COST	Low (to develop framework), High (to buy out property owners)
POTENTIAL FUNDING SOURCES	Town Operating Budget, Town Meeting Article, State and Federal Grants
PRIORITY	Medium
TIMELINE	Within the next 5 years



The Falmouth Multi-Hazard Mitigation Plan is not meant to be a static document. As conditions change, new information becomes available, or mitigation actions progress or are completed over the life of the plan, adjustments and updates may be necessary to maintain its relevance. This chapter describes how the Plan will be tracked, updated, and enhanced in the coming years. The plan must be fully reviewed and revised as necessary at least once every five years. Keeping the plan up-to-date also means continuing to provide opportunities for public involvement and comment on the plan and its implementation.



As required by FEMA, this Plan must outline a maintenance process to ensure the Plan remains active and relevant to the current conditions of the Town. The process must identify the following items:

- Plan Monitoring, Evaluation and Updates – Method and schedule for monitoring, evaluating and updating the plan once every five years;
- Incorporation of Mitigation Strategies – Explanation of how local governments will incorporate mitigation strategies into existing mechanisms; and
- Continued Public Involvement – Requirements that public participation continue throughout the plan maintenance process.

This section details how Falmouth will meet these Plan maintenance requirements.

A6.a-d

6.1 PLAN MONITORING, EVALUATION AND UPDATES

As required by FEMA, the written plan will be evaluated and updated at least once every five years by relevant Town departments, boards, and agencies. In the interim, select members of the LPT will conduct annual reviews of the progress of mitigation actions and update as necessary. If a major disaster occurs in the interim, the plan may be evaluated or updated if Town personnel feel that the plan failed in some way, or imminent changes are required to better respond to future disasters. As necessary, LPT members and/or departments may be added or removed from the LPT to obtain the most accurate and applicable information possible.

Evaluations and updates will take place in much the same way this updated plan was developed. The process will include meetings of the LPT, review of goals and objectives, updating the community profile, review and modification of potential hazards and hazard related data, review of existing hazard-prone areas and the addition of any new areas, updating existing and planned hazard mitigation measures, and an evaluation as to the effectiveness of the plan to date. The next update will begin in year 4 of this plan, to ensure that the subsequent update is ready within the required 5-year window.

6.2 INCORPORATION OF MITIGATION STRATEGIES

Mitigation strategies outlined in this Plan will be incorporated into existing plans, bylaws, and regulations as feasible. During Plan updates, existing and proposed mitigation actions will be evaluated for effectiveness, level of completion, and continued appropriateness. Mitigation strategies will also need to be included in the annual budget process.

Upon approval of this plan, the LPT will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments and committees:

- Local Emergency Planning Committee
- Fire Department
- Police Department



- Department of Public Works
- Planning Board
- Conservation Commission
- Building Department

C6.e

After this plan has been approved by both FEMA and the local government, links to the final plan will be emailed to all Town staff, boards, and committees, with a reminder to review the plan periodically and work to incorporate its contents, especially the proposed mitigation actions presented in Chapter 5, into other planning processes, documents, and plans. In addition, during annual review meetings for the Multi-Hazard Mitigation Plan implementation process, the Local Planning Team (LPT) will review whether any of these plans are in the process of being updated. If so, the LPT will remind people working on these plans, policies, etc., of the Multi-Hazard Mitigation plan, and urge them to incorporate the Multi-Hazard Mitigation Plan data, findings, and actions into their respective efforts.

6.3 CONTINUED PUBLIC INVOLVEMENT

A5.a

During the periodic five-year update process, the LPT will hold at least one public workshop or similar meeting to solicit feedback from the general public on the progress made to date. Concerned citizens will also be invited to review the revised Plan and submit any additional comments or recommendations for improving the Plan. All events will be publicly advertised in the local newspaper and/or similar method. Copies of the Plan will be provided in public places such as Town Hall and the Emergency Operations Center. The Plan will also be made available to the general public via the Town's website.

6.4 PLAN ADOPTION

E1.a

At the conclusion of planning efforts conducted by the LPT, the draft of the Falmouth MHMP was reviewed by the Local Planning Team, stakeholders and the general public, and informally approved by all applicable Town departments, boards, and other agencies identified as members of the LPT. The plan was then submitted to the State Hazard Mitigation Officer (SHMO) of the Massachusetts Department of Resource Conservation, the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA) for review and approval. If approved by MEMA and FEMA, the plan will be brought before the Falmouth Selectboard for adoption, and the Plan will enter the five year "maintenance" phase. A draft of the certificate of adoption is provided on the following page. Proof of plan adoption will also be included at the front of this report.



DRAFT CERTIFICATE OF ADOPTION
Board of Selectmen

TOWN OF Falmouth, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF FALMOUTH MULTI-HAZARD MITIGATION PLAN (2022)

WHEREAS, the Town of Falmouth recognizes the threat that natural hazards pose to people and property within our community; and

WHEREAS, undertaking hazard mitigation actions will reduce the potential for harm to people and property from future hazard occurrences; and

WHEREAS, the Town of Falmouth established a Committee to prepare the *Town of Falmouth Multi-Hazard Mitigation Plan (2022)*; and

WHEREAS, the *Town of Falmouth Multi-Hazard Mitigation Plan (2022)* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Falmouth, and

WHEREAS, duly-noticed public meetings were held by the LOCAL PLANNING TEAM on March 24 and July 11, 2022, and

WHEREAS, the Town of Falmouth authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Town of Falmouth BOARD OF SELECTMEN adopts the *Town of Falmouth Multi-Hazard Mitigation Plan (2022)*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Falmouth.

ADOPTED AND SIGNED this Date. _____

Name(s)

Title(s)

Signature(s)



REFERENCES:

- AECOM. 2018. Massachusetts State Hazard Mitigation and Climate Adaptation Plan. Prepared by an AECOM consulting team for the State of Massachusetts. September 2018.
- BBNEP. 2020. Red Tide and PSP. Buzzards Bay National Estuary Program.
<https://buzzardsbay.org/living-resources/nuisance-algae-hab/red-tide-psp/>
- Bosma, K., E. Douglas, P. Kirshen, K. McArthur, S. Miller, and C. Watson, MassDOT Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the State of Massachusetts, 2019 (in publication).
- CDM Smith. 2019. Assessing the Threats from Climate Change to Falmouth's Vulnerable Wastewater Pumping Infrastructure. Prepared for the Town of Falmouth. June 26, 2019.
- DCR. 2021. Hydrologic Conditions Reports. <http://www.mass.gov/service-details/hydrologic-conditions-reports>
- EEA. 2019. Massachusetts Drought Management Plan. Massachusetts Executive Office of Energy and Environmental Affairs. September 2019.
- EEA. 2018. Massachusetts State Hazard Mitigation and Climate Adaptation Plan.
- EEA. 2018. Massachusetts Climate Change Projections - Statewide and for Major Drainage Basins. Produced by Northeast Climate Adaptation Science Center. Published by Massachusetts Executive Office of Energy and Environmental Affairs (EEA). March 2018.
<https://resilientma.org/resources/resource::2152/massachusetts-climate-change-projections-statewide-and-for-major-drainage-basins>.
- Falmouth Coastal Resiliency Action Committee. 2021. Report on Coastal Resiliency Falmouth Massachusetts.
- Falmouth, Town of. 2020. Town of Falmouth Website. <https://www.Falmouth.ma.us/>
- FEMA. 2011. Local Mitigation Plan Review Guide. October 1, 2011.
- FEMA. 2021a. Disaster Declarations. <https://www.fema.gov/disasters>
- FEMA. 2021b. FEMA Community Information System (CIS) database, accessed on April 27, 2021.
- FEMA. 2020. Loss Statistics. <https://bsa.nfipstat.fema.gov/reports/1040.htm>
- GlobalChange.gov. 2020. Heavy Precipitation.
<https://www.globalchange.gov/browse/indicators/heavy-precipitation>



- Kemp, A.C., B.P. Horton, J.P. Donnelly, M.E. Mann, M. Vermeer, and S. Rahmstorf. 2011. Climate related sea-level variations over the past two millennia. *Proceedings of the National Academy of Sciences*. 108 (27) 11017-11022.
- National Hurricane Center. 2016a. Tropical Cyclone Climatology. <http://www.nhc.noaa.gov/climo/>
- National Hurricane Center. 2016b. Saffir-Simpson Hurricane Wind Scale. <http://www.nhc.noaa.gov/aboutsshws.php>
- National Hurricane Center. 2016c. Storm Surge Overview. <http://www.nhc.noaa.gov/surge/>
- National Weather Service. 2016a. Heat Index. http://www.nws.noaa.gov/om/heat/heat_index.shtml
- National Weather Service. 2016b. Wind Chill/Temperature Index. <http://www.weather.gov/oun/safety-winter-windchill>
- NOAA. 2021. NOAA NCDC Storm Events Database. <https://www.ncdc.noaa.gov/stormevents/>
- NOAA NCEI. 2021. Global Historical Tsunami Database. <https://www.sciencebase.gov/catalog/item/5c7065b4e4b0fe48cb43fbd7>
- NOAA. 2020a. Mean Sea Level Trend 8447930 Woods Hole, Massachusetts. [NCEI Hazard Tsunami Search \(noaa.gov\)](#)
- NOAA. 2020b. Historical Hurricane Tracks. <https://coast.noaa.gov/hurricanes/>.
- Pare Corporation. 2016a. Emergency Action Plan: Route 25 Dam #1 MA02560/7-12-310-28. Prepared for Massachusetts Department of Transportation (MassDOT). Prepared by Pare Corporation. Pare Project Number 13048.03. October 2016.
- Pare Corporation. 2016b. Emergency Action Plan: Mill Pond (Route 28) Dam MA00027/7-12-310-3. Prepared for Massachusetts Department of Transportation (MassDOT). Prepared by Pare Corporation. Pare Project Number 13048.03. October 2016.
- Pare Corporation. 2013. Parker Mills Pond Dam Emergency Action Plan MA00150/7-12-310-2. Prepared for the Town of Falmouth. Prepared by Pare Corporation. Original: June 2007. Updated: June 2013.
- Thieler, E.R, T.L. Smith, J.M. Knisel, and D.W. Sampson. 2013. Massachusetts Shoreline Change Mapping and Analysis Project, 2013 Update. Open File Report 2002-1189.
- UCS. 2015. Causes of Sea Level Rise Fact Sheet. www.ucsusa.org/sealevelrisescience



USGS. 2019. Landslide Inventories Across the United States.

<https://www.sciencebase.gov/catalog/item/5c7065b4e4b0fe48cb43fbd7>

Woods Hole Group. 2020. Falmouth Climate Change Flood Vulnerability Assessment and Adaptation Planning.

Woods Hole Group. 2020. Coastal Resiliency Planning for the Surf Drive Area.



Appendix A: Local Mitigation Plan Review Guide

1. Local Mitigation Plan Review Guide
2. CRS Scoring Checklist

Local Mitigation Plan Review Guide

October 1, 2011



FEMA

SECTION 4:

REGULATION CHECKLIST

This section provides detailed guidance on how FEMA interprets the various requirements of the regulation for all Local Mitigation Plan reviews through a Regulatory Checklist. The guidance is limited only to the minimum requirements of *what* must be in a Local Mitigation Plan, and does not provide guidance on *how* the community should develop a plan. The Regulation Checklist includes the following Elements:

- 4.1 ELEMENT A: Planning Process
- 4.2 ELEMENT B: Hazard Identification and Risk Assessment
- 4.3 ELEMENT C: Mitigation Strategy
- 4.4 ELEMENT D: Plan Review, Evaluation, and Implementation
- 4.5 ELEMENT E: Plan Adoption
- 4.6 ELEMENT F: Additional State Requirements

Many requirements in the Checklist call for the plan to “document” or “describe” information. FEMA does not require specific formats for the plan or its content. Required information to “document” can be provided in the plan through a variety of formats, such as narrative, tables, lists, maps, etc. Examples provided in this *Guide* are samples of one or more approaches to meeting that particular requirement. Examples are not inclusive of all possible solutions to meet a requirement, and they are not necessarily considered “best practices” or exemplary. FEMA will recognize that there are many formats and types of documentation that may meet a particular requirement.

Terms from the regulation are defined in this *Guide*, where necessary. For example, many of the plan requirements ask for a “discussion” or “description.” FEMA considers the plan as the written record, or documentation, of the planning process. Therefore, many of these terms have the same meaning to document *what* was done. In addition, this *Guide* uses the terms “jurisdiction” and “community” interchangeably. For purposes of this *Guide*, these terms are equal to any local government developing a Local Mitigation Plan. This is defined at 44 CFR §201.2 as:

“any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.”

Finally, an important distinction must be made between the words “shall” and “should” in the Mitigation Planning regulation at 44 CFR Part 201. The Regulation Checklist only includes the requirements where the regulation uses the words “shall” and “must,” and does not include the “should.” When the word “should” is used, the item is strongly recommended to be included in the plan, but its absence will not cause FEMA to disapprove the plan.

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
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) <i>Intent: 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.</i>	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. <i>Document means provide the factual evidence for how the jurisdictions developed the plan.</i> b. The plan must list the jurisdiction(s) participating in the plan that seek approval. 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. 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. <i>Involved in the process 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 “opportunity to be involved in the planning process” in A2 below) or only adopting the plan.</i> e. Plan updates must include documentation of the current planning process undertaken to update the plan.
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)	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: 1) Local and regional agencies involved in hazard mitigation activities; 2) Agencies that have the authority to regulate development; and 3) Neighboring communities. <i>An opportunity to be involved in the planning process means that the stakeholders are engaged or invited as participants and given the chance to provide input to affect the plan’s content.</i>

ELEMENT	REQUIREMENTS
<i>Intent:</i> 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.	b. The Plan must provide the agency or organization represented and the person's position or title within the agency. c. The plan must identify how the stakeholders were invited to participate in the process. Examples of stakeholders include, but are not limited to: • 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.
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) <i>Intent:</i> 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.	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. 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.

ELEMENT	REQUIREMENTS
A4. Does the Plan document the review and incorporation of existing plans, studies, reports, and technical information? 44 CFR 201.6(b)(3) <i>Intent: To identify existing data and information, shared objectives, and past and ongoing activities that can help inform the mitigation plan. It also helps identify the existing capabilities and planning mechanisms to implement the mitigation strategy.</i>	a. The plan must document <i>what</i> existing plans, studies, reports, and technical information were reviewed. Examples of the types of existing sources reviewed include, but are not limited to, the state hazard mitigation plan, local comprehensive plans, hazard specific reports, and flood insurance studies. b. The plan must document <i>how</i> relevant information was incorporated into the mitigation plan. <i>Incorporate means to reference or include information from other existing sources to form the content of the mitigation plan.</i>
A5. Is there discussion on how the community(ies) will continue public participation in the plan maintenance process? 44 CFR 201.6(c)(4)(iii) <i>Intent: To identify how the public will continue to have an opportunity to participate in the plan's maintenance and implementation over time.</i>	a. The plan must describe how the jurisdiction(s) will continue to seek public participation after the plan has been approved and during the plan's implementation, monitoring and evaluation. <i>Participation means engaged and given the chance to provide feedback. Examples include, but are not limited to, periodic presentations on the plan's progress to elected officials, schools or other community groups, annual questionnaires or surveys, public meetings, postings on social media and interactive websites.</i>
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? 44 CFR 201.6(c)(4)(i) <i>Intent: To establish a process for jurisdictions to track the progress of the plan's implementation. This also serves as the basis of the next plan update.</i>	a. The plan must identify how, when, and by whom the plan will be monitored. <i>Monitoring means tracking the implementation of the plan over time. For example, monitoring may include a system for tracking the status of the identified hazard mitigation actions.</i> b. The plan must identify how, when, and by whom the plan will be evaluated. <i>Evaluating means assessing the effectiveness of the plan at achieving its stated purpose and goals.</i> c. The plan must identify how, when, and by whom the plan will be updated. <i>Updating means reviewing and revising the plan at least once every five years.</i> d. The plan must include the title of the individual or name of the department/ agency responsible for leading each of these efforts.

4.2 ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT

Requirement	
§201.6(c)(2)(i)	[The risk assessment shall include a] description of the type, location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
§201.6(c)(2)(ii)	[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:
§201.6(c)(2)(ii)(A)	(A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;
§201.6(c)(2)(ii)(B)	(B) An estimate of the potential dollar losses to vulnerable structures identified in ... this section and a description of the methodology used to prepare the estimate.
§201.6(c)(2)(ii)(C)	(C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.
§201.6(c)(2)(iii)	For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

Overall Intent. The risk assessment provides the factual basis for activities proposed in the strategy that will reduce losses from identified hazards. A quality risk assessments makes a clear connection between the community's vulnerability and the hazard mitigation actions. In other words, it provides sufficient information to enable the jurisdiction(s) to identify and prioritize appropriate hazard mitigation actions.

Local risk assessments do not need to be based on the most sophisticated technology, but do need to be accurate, current, and relevant. During a plan update, local jurisdictions assess current and expected future vulnerability to all hazards and integrate new hazard data such as recent hazard events and new flood studies. In the mitigation plan review, FEMA looks at the quality of the information in the risk assessment, not the quantity of information in the risk assessment.

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
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) <u>Intent:</u> <i>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.</i>	a. The plan must include a description of the natural hazards that can affect the jurisdiction(s) in the planning area. <i>A <u>natural hazard</u> 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> 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. 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. 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. <u>Location</u> 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. <u>Extent</u> 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 (<i>for example</i>, 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.

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

ELEMENT	REQUIREMENTS
	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.
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) <i>Intent: 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.</i>	a. The plan must include the history of previous hazard events for each of the identified hazards. b. The plan must include the probability of future events for each identified hazard. <i>Probability 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.</i> c. Plan updates must include hazard events that have occurred since the last plan was developed.
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) <i>Intent: 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.</i>	a. For each participating jurisdiction, the plan must describe the potential impacts of each of the identified hazards on the community. <i>Impact 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).</i> 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). 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.

ELEMENT	REQUIREMENTS
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) <i>Intent: 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.</i>	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. <i>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 10-year period since 1978.</i> <i>Severe repetitive loss properties 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.</i> 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.

4.3 ELEMENT C. MITIGATION STRATEGY

Requirement	[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)	
§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
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) <i>Intent: 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.</i>	a. The plan must describe each jurisdiction's existing authorities, policies, programs and resources available to accomplish hazard mitigation. 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.
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) <i>Intent: 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.</i>	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: • 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. 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.

ELEMENT	REQUIREMENTS
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? 44 CFR 201.6(c)(3)(i) <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>	a. The plan must include general hazard mitigation goals that represent what the jurisdiction(s) seeks to accomplish through mitigation plan implementation. <i>Goals are broad policy statements that explain what is to be achieved.</i> b. The goals must be consistent with the hazards identified in the plan.
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) <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>	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. <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> 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. <i>A comprehensive range consists of different hazard mitigation alternatives that address the vulnerabilities to the hazards that the jurisdiction(s) determine are most important.</i> 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. c. The action plan must reduce risk to existing buildings and infrastructure as well as limit any risk to new development and redevelopment. <i>With emphasis on new and existing building and infrastructure means that the action plan includes a consideration of actions that address the built environment.</i>

ELEMENT	REQUIREMENTS
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) <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>	a. The plan must describe the criteria used for prioritizing implementation of the actions. 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 benefic-cost analysis is not required. Qualitative benefits (<i>for example</i>, quality of life, natural and beneficial values, or other "benefits") can also be included in how actions will be prioritized. 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.
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) <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>	a. The plan must describe the community's process to integrate the data, information, and hazard mitigation goals and actions into other planning mechanisms. b. The plan must identify the local planning mechanisms where hazard mitigation information and/or actions may be incorporated. <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> 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. 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. 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.

4.4 ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (*Plan Updates Only*)

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.

<u>ELEMENT</u>	<u>REQUIREMENTS</u>
D1. Was the plan revised to reflect changes in development? 44 CFR 201.6(d)(3) <u>Intent:</u> <i>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>	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. <i>Changes in development</i> 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.

ELEMENT	REQUIREMENTS
D2. Was the plan revised to reflect progress in local mitigation efforts? 44 CFR 201.6(d)(3) <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>	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.
D3. Was the plan revised to reflect changes in priorities? 44 CFR 201.6(d)(3) <i>Intent: To ensure the plan reflects current conditions, including financial, legal, and political realities as well as post-disaster conditions.</i>	a. The plan must describe if and how any priorities changed since the plan was previously approved. If no changes in priorities are necessary, plan updates may validate the information in the previously approved plan.

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.

<u>ELEMENT</u>	<u>REQUIREMENTS</u>
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) Intent: 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.	a. The plan must include documentation of plan adoption, usually a resolution by the governing body or other authority. 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. 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. 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.”

ELEMENT	REQUIREMENTS
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? 44 CFR 201.6(c)(5) <i>Intent: 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.</i>	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. 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.”

APPENDIX A:

LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: Town of Falmouth, Massachusetts	Title of Plan: Falmouth Multi-Hazard Mitigation Plan	Date of Plan: July 2022
Local Point of Contact: Jennifer Lincoln	Address: Falmouth Town Hall 59 Town Hall Square Falmouth, MA 02540	
Title: Conservation Commission Administrator		
Agency: Conservation Commission		
Phone Number: (508) 495-7445	E-Mail: Jennifer.lincoln@falmouthma.gov	

State Reviewer:	Title:	Date:
------------------------	---------------	--------------

FEMA Reviewer:	Title:	Date:
Date Received in FEMA Region <i>(insert #)</i>		
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved		

SECTION 1: REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been ‘Met’ or ‘Not Met.’ The ‘Required Revisions’ summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is ‘Not Met.’ Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
Regulation (44 CFR 201.6 Local Mitigation Plans)				
ELEMENT A. PLANNING PROCESS				
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Section 1.2 (pages 1-2 to 1-7)			
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? (Requirement §201.6(b)(2))	Section 1.2 (page 1-4)			
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Section 1.2 (pages 1-2 to 1-7)			
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Section 1.2 (pages 1-4 to 1-7)			
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Section 6.3 (page 6-3)			
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Section 6.1 (page 6-2)			
ELEMENT A: REQUIRED REVISIONS				

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
Regulation (44 CFR 201.6 Local Mitigation Plans)				
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT				
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Section 3 (throughout)			
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Section 3 (throughout)			
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? (Requirement §201.6(c)(2)(ii))	Section 3 (throughout); Sections 4.3 & 4.4 (pages 4-27 to 4-31)			
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Section 2.9 (p2-8)			
<u>ELEMENT B: REQUIRED REVISIONS</u>				
ELEMENT C. MITIGATION STRATEGY				
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? (Requirement §201.6(c)(3))	Section 5.2 (pages 5-2 to 5-4)			
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Section 5.2 (page 5-6)			
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Section 5.1 (page 5-2)			
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? (Requirement §201.6(c)(3)(ii))	Section 5.4 (pages 5-13 to 5-29)			
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? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Section 5.4 (pages 5-13 to 5-29)			
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? (Requirement §201.6(c)(4)(ii))	Section 5.2 (page 5-2 to 5-4)			
<u>ELEMENT C: REQUIRED REVISIONS</u>				

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
Regulation (44 CFR 201.6 Local Mitigation Plans)				
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)				
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Section 5.4 (pages 5-13 to 5-29)			
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Section 5.3 (pages 5-7 to 5-13)			
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Section 5.1 (page 5-2)			
<u>ELEMENT D: REQUIRED REVISIONS</u>				
ELEMENT E. PLAN ADOPTION				
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Section 6.4 (page 6-3)			
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	N/A			
<u>ELEMENT E: REQUIRED REVISIONS</u>				
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)				
F1.				
F2.				
<u>ELEMENT F: REQUIRED REVISIONS</u>				

SECTION 2: PLAN ASSESSMENT

INSTRUCTIONS: The purpose of the Plan Assessment is to offer the local community more comprehensive feedback to the community on the quality and utility of the plan in a narrative format. The audience for the Plan Assessment is not only the plan developer/local community planner, but also elected officials, local departments and agencies, and others involved in implementing the Local Mitigation Plan. The Plan Assessment must be completed by FEMA. The Assessment is an opportunity for FEMA to provide feedback and information to the community on: 1) suggested improvements to the Plan; 2) specific sections in the Plan where the community has gone above and beyond minimum requirements; 3) recommendations for plan implementation; and 4) ongoing partnership(s) and information on other FEMA programs, specifically RiskMAP and Hazard Mitigation Assistance programs. The Plan Assessment is divided into two sections:

1. Plan Strengths and Opportunities for Improvement
2. Resources for Implementing Your Approved Plan

Plan Strengths and Opportunities for Improvement is organized according to the plan Elements listed in the Regulation Checklist. Each Element includes a series of italicized bulleted items that are suggested topics for consideration while evaluating plans, but it is not intended to be a comprehensive list. FEMA Mitigation Planners are not required to answer each bullet item, and should use them as a guide to paraphrase their own written assessment (2-3 sentences) of each Element.

The Plan Assessment must not reiterate the required revisions from the Regulation Checklist or be regulatory in nature, and should be open-ended and to provide the community with suggestions for improvements or recommended revisions. The recommended revisions are suggestions for improvement and are not required to be made for the Plan to meet Federal regulatory requirements. The italicized text should be deleted once FEMA has added comments regarding strengths of the plan and potential improvements for future plan revisions. It is recommended that the Plan Assessment be a short synopsis of the overall strengths and weaknesses of the Plan (no longer than two pages), rather than a complete recap section by section.

Resources for Implementing Your Approved Plan provides a place for FEMA to offer information, data sources and general suggestions on the overall plan implementation and maintenance process. Information on other possible sources of assistance including, but not limited to, existing publications, grant funding or training opportunities, can be provided. States may add state and local resources, if available.

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

How does the Plan go above and beyond minimum requirements to document the planning process with respect to:

- *Involvement of stakeholders (elected officials/decision makers, plan implementers, business owners, academic institutions, utility companies, water/sanitation districts, etc.);*
- *Involvement of Planning, Emergency Management, Public Works Departments or other planning agencies (i.e., regional planning councils);*
- *Diverse methods of participation (meetings, surveys, online, etc.); and*
- *Reflective of an open and inclusive public involvement process.*

Element B: Hazard Identification and Risk Assessment

In addition to the requirements listed in the Regulation Checklist, 44 CFR 201.6 Local Mitigation Plans identifies additional elements that should be included as part of a plan's risk assessment. The plan should describe vulnerability in terms of:

- 1) A general description of land uses and future development trends within the community so that mitigation options can be considered in future land use decisions;*
- 2) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; and*
- 3) A description of potential dollar losses to vulnerable structures, and a description of the methodology used to prepare the estimate.*

How does the Plan go above and beyond minimum requirements to document the Hazard Identification and Risk Assessment with respect to:

- *Use of best available data (flood maps, HAZUS, flood studies) to describe significant hazards;*
- *Communication of risk on people, property, and infrastructure to the public (through tables, charts, maps, photos, etc.);*
- *Incorporation of techniques and methodologies to estimate dollar losses to vulnerable structures;*
- *Incorporation of Risk MAP products (i.e., depth grids, Flood Risk Report, Changes Since Last FIRM, Areas of Mitigation Interest, etc.); and*
- *Identification of any data gaps that can be filled as new data became available.*

Element C: Mitigation Strategy

How does the Plan go above and beyond minimum requirements to document the Mitigation Strategy with respect to:

- *Key problems identified in, and linkages to, the vulnerability assessment;*
- *Serving as a blueprint for reducing potential losses identified in the Hazard Identification and Risk Assessment;*
- *Plan content flow from the risk assessment (problem identification) to goal setting to mitigation action development;*
- *An understanding of mitigation principles (diversity of actions that include structural projects, preventative measures, outreach activities, property protection measures, post-disaster actions, etc);*
- *Specific mitigation actions for each participating jurisdictions that reflects their unique risks and capabilities;*
- *Integration of mitigation actions with existing local authorities, policies, programs, and resources; and*
- *Discussion of existing programs (including the NFIP), plans, and policies that could be used to implement mitigation, as well as document past projects.*

Element D: Plan Update, Evaluation, and Implementation (*Plan Updates Only*)

How does the Plan go above and beyond minimum requirements to document the 5-year Evaluation and Implementation measures with respect to:

- *Status of previously recommended mitigation actions;*
- *Identification of barriers or obstacles to successful implementation or completion of mitigation actions, along with possible solutions for overcoming risk;*
- *Documentation of annual reviews and committee involvement;*
- *Identification of a lead person to take ownership of, and champion the Plan;*
- *Reducing risks from natural hazards and serving as a guide for decisions makers as they commit resources to reducing the effects of natural hazards;*
- *An approach to evaluating future conditions (i.e. socio-economic, environmental, demographic, change in built environment etc.);*
- *Discussion of how changing conditions and opportunities could impact community resilience in the long term; and*
- *Discussion of how the mitigation goals and actions support the long-term community vision for increased resilience.*

B. Resources for Implementing Your Approved Plan

Ideas may be offered on moving the mitigation plan forward and continuing the relationship with key mitigation stakeholders such as the following:

- *What FEMA assistance (funding) programs are available (for example, Hazard Mitigation Assistance (HMA)) to the jurisdiction(s) to assist with implementing the mitigation actions?*
- *What other Federal programs (National Flood Insurance Program (NFIP), Community Rating System (CRS), Risk MAP, etc.) may provide assistance for mitigation activities?*
- *What publications, technical guidance or other resources are available to the jurisdiction(s) relevant to the identified mitigation actions?*
- *Are there upcoming trainings/workshops (Benefit-Cost Analysis (BCA), HMA, etc.) to assist the jurisdictions(s)?*
- *What mitigation actions can be funded by other Federal agencies (for example, U.S. Forest Service, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA) Smart Growth, Housing and Urban Development (HUD) Sustainable Communities, etc.) and/or state and local agencies?*

SECTION 3:
MULTI-JURISDICTION SUMMARY SHEET (OPTIONAL)

INSTRUCTIONS: For multi-jurisdictional plans, a Multi-jurisdiction Summary Spreadsheet may be completed by listing each participating jurisdiction, which required Elements for each jurisdiction were ‘Met’ or ‘Not Met,’ and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it should be used as an optional worksheet to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET												
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Requirements
1												
2												
3												
4												
5												
6												
7												
8												
9												

MULTI-JURISDICTION SUMMARY SHEET												
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Requirements
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												



Appendix B: Planning Process and Public Outreach

1. Local Hazard Mitigation Planning Committee Member List
3. Meeting Agendas
4. Copy of Announcements for Public Presentations
5. Screenshot of Town Homepage with Link to Draft Report
6. Email Sent to Neighboring Towns and CCC
7. Comment Response Document

Local Planning Team Members:

Name	Title	Department
Jennifer Lincoln	Conservation Administrator	Conservation Commission
Timothy Smith	Fire Chief	Falmouth Fire Rescue
Peter Johnson-Staub	Assistant Town Manager	Town Manager
Peter McConarty	Director Public Works	Department of Public Works
Jed Cornock	Town Planner	Planning Department
Bob Shea	GIS Coordinator	Geographic Information System
Steven Cadorette	Deputy Directory Public Works	Department of Public Works
Jim McLoughlin	Town Engineer	Department of Public Works
Gregg Fraser	Director Natural Resources	Natural Resources
Kristin Nickerson	Assistant to Police Chief	Falmouth Police
Kim Strohm	Administrative Assistant to Fire Chief	Falmouth Fire Rescue
Paula Cushman	Administrative Assistant to Harbor Master	Natural Resources
Brian Reid	Police Captain	Falmouth Police Department

Town of Falmouth
Multi-Hazard Mitigation Plan Update
Kick-off Meeting

Time: 2:00PM

Date: January 26, 2022

Agenda Items:

1. Welcome and Introductions

2. Overview of the MHMP Update Process

- a. Falmouth last completed a Multi-Hazard Mitigation Plan (MHMP) in July 2017 (expires July 2022)
- b. Plans must be updated every 5 years to remain eligible for pre-disaster mitigation funds
 - Building Resilient Infrastructure and Communities (BRIC) program
- c. Woods Hole Group (WHG) will draw from the 2017 plan during the update process
 - What worked well for the Town when developing the 2017 plan?
 - Anything that the Town would like to do differently this time around?
- d. Review Scope of Work (email attachment)

3. Data Requirements

- a. Review State Hazard List and Falmouth MHMP 2017 Hazard List (email attachment)
 - Any additional hazards to include in the 2022 plan?
 - Review data sources (email attachment)
 - Any newly available hazard related data?
 - Recent photos (storms, flooding, wildfire incidents, etc.)?
- b. Selection of critical facilities
 - Start with the 2017 list of facilities (will review during the first working meeting)
- c. Town of Falmouth parcel database
 - Available in ArcGIS format from MassGIS (2020)
- d. Repetitive loss data
 - Town must request directly from FEMA
- e. Land use categories (from the 2017 MHMP, which utilized categories assigned by MassGIS):
 - Residential – Single Family
 - Residential – Multi-Family
 - Temporary Lodging (Hotels, Inns)
 - Commercial (Retail/Offices/Services)
 - Commercial (Manufacturing/Distribution)
 - Public Services
 - Agriculture

- Open Space
 - Recreation
 - Vacant
- f. Relevant Town plans/reports:
- Falmouth MHMP (2017)
 - Barnstable County HMP (2010)
 - Cape Cod Emergency Traffic Plan (2018)
 - 5-Year Strategic Plan (2017-2021)
 - Capital Improvement Plan (FY21)
 - Community Preservation Plan (2020)
 - Comprehensive Emergency Management Plan (2021)
 - Historic Preservation Plan (2014)
 - Housing Production Plan (2019)
 - Local Comprehensive Plan (2016)
 - MVP Workshop Summary of Findings (2018)
 - Open Space and Recreation Plan (2014)
 - Town Report (2020)
 - Vulnerability Assessment (2020)
 - Others?

4. Public Outreach Strategy

- a. Required by FEMA to provide opportunities for the public to be involved in the planning process
- b. Public outreach during the 2017 plan development included:
 - Two opportunities for the public to review and comment on draft plan
 - Public meeting held in January 2017
- c. Public engagement for more recent plans for neighboring towns has included:
 - A public survey available online and as a hardcopy
 - Two public presentations
 - One opportunity for public review and comment on plan draft
- d. What should be included or excluded for the 2022 planning process?

5. Timeline for Plan Completion

- a. Completed draft by July 20, 2022 (MEMA/FEMA approval by late August 2022)
 - Later than contract proposed date of completion in May 2022
 - Aggressive schedule requiring a high level of participation during meetings
 - Can submit a statement of interest to FEMA to receive BRIC funding between July 24 and approval of an updated plan (need to verify with FEMA)
- b. Alternative draft completion by September 7, 2022 (approval by October 2022)
 - Allows for more flexibility in scheduling and more time in between meetings

Town of Falmouth
Multi-Hazard Mitigation Plan Update
Working Meeting 1

Time: 2:00PM

Date: February 23, 2022

Agenda Items:

1. Outstanding Tasks (pg. 2)

2. Review Critical Facilities List (email attachment)

- a. Additional facilities to add? Any to be removed?

3. Review of Hazard Profiles

- a. Data gaps
 - More pictures: coastal/inland flooding, coastal erosion, severe winter weather
 - Local knowledge of flooding in town: *“Localized flooding as a result of blocked drainage occurs in specific areas of town such as at the culvert at Maravista Avenue near the entrance to the Falmouth Mall, and in front of Friendly’s at the corner of Falmouth Heights Road and Main Street, which flood even during minor events.”*
 - Local coastal erosion data (Jennifer)
 - Winter storms with the most significant impact on the town? Examples include Winter Storm Nemo, Winter Storm Juno, and the blizzard in January.
 - Wildfire data (Kim/Tim)
 - Local invasive species data (Jen/Peter): *“Similar to most coastal Massachusetts towns, Marion struggles to control common reed stands, such those as around Sprague Cove, where a stormwater remediation project is occurring.”*
 - Dams/Culverts:
 - Review list of dams and culverts (volunteer?)
 - Any history of dam or culvert failure? Are there EAPs?
- b. Review hazard maps (pgs. 3-13)
- c. Review hazard ranking process (pg. 14)

4. Town Capabilities Assessment (email attachment)

- a. FEMA’s Capabilities Assessment Questionnaire will help document Town capabilities

5. Schedule Next Working Meeting

- a. Discussed March 23 during our last meeting

Town of Falmouth
Multi-Hazard Mitigation Plan Update
Working Meeting 2

Time: 2:00PM

Date: March 9, 2022

Agenda Items:

- 1. Outstanding Tasks (pg. 2)**
- 2. Review Critical Facilities List (email attachment)**
 - a. Ready to finalize list?
- 3. Review of Hazard Profiles**
 - a. Review hazard maps (pgs. 3-13)
 - b. Review hazard ranking process (pg. 14)
- 4. Vulnerability Assessment**
 - a. Review results of flood vulnerability assessment for parcels (pgs. 15-18)
 - b. Vulnerable populations: Elderly populations, childcare centers/schools, healthcare/assisted living facilities, and/or low-income areas?
- 5. Schedule**
 - a. Next working meeting: April 6 at 2:00 pm?
 - b. First public presentation: Date/time?

**Town of Falmouth
Multi-Hazard Mitigation Plan Update
Working Meeting 3**

Time: 2:00PM

Date: April 20, 2022

Agenda Items:

- 1. Outstanding Tasks** (pgs. 2-3 of agenda)
- 2. Critical Facilities**
 - a. Finalize list (document attached)
- 3. Vulnerability Assessment**
 - a. Review results of flood vulnerability assessment for critical facilities (document attached)
 - b. Qualitative vulnerability assessment of critical facilities (document attached)
- 4. Develop Hazard Mitigation Plan Goals** (document attached)
- 5. Next working meeting: May 4, at 2:00 pm**

**Town of Falmouth
Multi-Hazard Mitigation Plan Update
Working Meeting 4**

Time: 2:00PM

Date: May 4, 2022

Agenda Items:

- 1. Outstanding Tasks (pg. 2)**
- 2. Review Qualitative Vulnerability Assessment (document attachment)**
- 3. Hazard Mitigation**
 - a. Review Hazard Mitigation Plan Goals (Draft document attached)
 - b. Review/update hazard mitigation actions from the 2017 plan (attached Excel file)
 - c. Develop additional hazard mitigation actions for the 2022 plan (attached Excel file)
- 4. Next working meeting: May 25 at 2:00 pm?**

**Town of Falmouth
Multi-Hazard Mitigation Plan Update
Working Meeting 5**

Time: 2:00PM

Date: May 25, 2022

Agenda Items:

- 1. Outstanding Tasks (pg. 2)**
- 2. Review Status of Hazard Mitigation Actions for 2017 (email attachment)**
- 3. Review Proposed Hazard Mitigation Actions for 2022 (email attachments)**
 - a. Fill in additional details (responsible party, estimated cost, potential funding sources, and timeline)
 - b. Assign priority to actions using ranking table
- 4. Final Steps**
 - a. Draft review
 - Draft MHMP will be ready for the working group by June 17, 2022. Two-week review period with comments back to WHG by July 1, 2022
 - Draft MHMP will then be distributed to/open for comments from neighboring towns, the regional agency, and the public from July 12 to July 26, 2022 (two-week review period)
 - b. Second public presentation (week of July 18)
 - Date/time? Platform (LEPC or BOS meeting)
 - c. Aiming for draft submission to MEMA/FEMA by August 9, 2022

<https://www.facebook.com/100067216429781/posts/pfbid02WMSW5H62CphGk2WC1fSP1mXkBUAN9BuCDzXD41XXLdEjSwT9CJhLkmVTLs2RsK6bl/?d=n>



Falmouth Emergency Preparedness

March 12 · 🌐



Falmouth Emergency Preparedness

March 12

In recent years, we have witnessed the enormous and devastating effects of hurricanes, floods, wildfires, earthquakes, and other disasters. The increasing number, duration, intensity, and severity of such disasters are alarming and highlight one of the most important challenges facing emergency management. Consequently, the effort to build resilience to natural hazards has shifted from a post-disaster discussion to one of the improved pre-disaster actions. The impacts of natural hazards on communities, families, individuals, and our economy makes it imperative to invest in creating infrastructure and communities that are more resilient to these hazards.

In response to these alarming impacts, The Town of Falmouth is working collaboratively with the Woods Hole Group to update the Town's Hazard Mitigation Plan, which enables the Town to be eligible for mitigation grants and non-emergency disaster assistance programs. The Woods Hole Group will be presenting information on what a Hazard Mitigation Plan is, what vulnerabilities, and what mitigation actions the Town can do to better prepare us for future natural and man-made hazards. Join the Local Emergency Planning Committee (LEPC) at its meeting on Thursday, March 24, at 2 pm, in the Emergency Operations Center, located on the 2nd floor at Falmouth Fire Rescue Headquarters, 399 Main Street, to learn more.

#BeReadyFalmouth

👍 2

➦ Share

English (US) · Español · Português (Brasil) · Français (France) · Deutsch

+

Privacy · Terms · Advertising · Ad Choices · Cookies · More

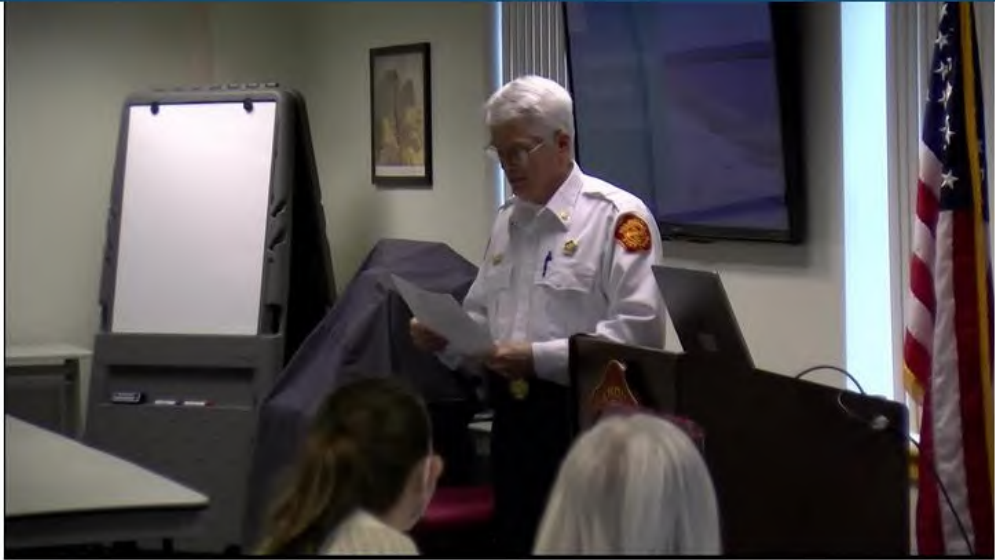
Meta © 2022

<http://www.fctv.org/v3/content/public-channel-programming-schedule>

Public Channel Programming Schedule

[Tweet](#)

[Search](#)[Watch](#)



Local Emergency Planning Committee 3/24/22

[Share](#)[Tweet](#)

SHOW DETAILS

Description
Local Emergency Planning Committee March 24, 2022

UPCOMING AIR TIMES

There are currently no upcoming air times.

Add .pdf of public notice for LEPC mtg and BOS meeting

Add link and screen capture from FCTV for BOS meeting

Fields Leslie

To: cnoyes@townofbourne.com
Subject: Falmouth Multi-Hazard Mitigation Plan

Hi Charles,

The Falmouth Local Planning Team (LPT) team, in partnership with the Woods Hole Group, has prepared the Falmouth Multi-Hazard Mitigation Plan (Plan), dated July 2022, for public review and comment. The Plan identifies impacts of climate change and natural hazards on residents, buildings, and infrastructure. Risks associated with the impacts are identified and evaluated. Mitigation actions that focus resources on the greatest risk areas are developed. Documenting the mitigation items and integrating the necessary actions into our future planning and budgeting will help protect our residents and infrastructure. The Plan demonstrates Falmouth's commitment to preparing for potential future disasters.

The Plan is attached to this email. Everyone is encouraged to review the Plan. Please submit any questions and/or comments relative to the Plan via email to Leslie Fields, Woods Hole Group Project Manager, lfields@woodsholegroup.com. The public comment period will end at August 1, 2022, at 3:00 PM. Public comments received after this date/time will not be considered.

In addition, the Falmouth Board of Selectmen will hold a public hearing on Monday, July 25, 2022, at 7:00 PM at Falmouth Town Hall. This is an opportunity for the public to learn about the Plan, participate, and offer comments and recommendations during the final draft stage and prior to submittal to MEMA and FEMA for final approval.

Please reply to this email to confirm receipt of the Plan. Woods Hole Group and the LPT looks forward to hearing from you.

Thank you!



M. Leslie Fields
Coastal Sciences & Planning Team Leader

 Tel: +1 508-495-6225  Mob: +1 508-274-8109

 107 Waterhouse Road
Bourne, MA 02562 - USA

 www.woodsholegroup.com



Fields Leslie

To: rvitacco@sandwichmass.org
Subject: Falmouth Multi-Hazard Mitigation Plan

Hi Ralph,

The Falmouth Local Planning Team (LPT) team, in partnership with the Woods Hole Group, has prepared the Falmouth Multi-Hazard Mitigation Plan (Plan), dated July 2022, for public review and comment. The Plan identifies impacts of climate change and natural hazards on residents, buildings, and infrastructure. Risks associated with the impacts are identified and evaluated. Mitigation actions that focus resources on the greatest risk areas are developed. Documenting the mitigation items and integrating the necessary actions into our future planning and budgeting will help protect our residents and infrastructure. The Plan demonstrates Falmouth's commitment to preparing for potential future disasters.

The Plan is attached to this email. Everyone is encouraged to review the Plan. Please submit any questions and/or comments relative to the Plan via email to Leslie Fields, Woods Hole Group Project Manager, lfields@woodsholegroup.com. The public comment period will end at August 1, 2022, at 3:00 PM. Public comments received after this date/time will not be considered.

In addition, the Falmouth Board of Selectmen will hold a public hearing on Monday, July 25, 2022, at 7:00 PM at Falmouth Town Hall. This is an opportunity for the public to learn about the Plan, participate, and offer comments and recommendations during the final draft stage and prior to submittal to MEMA and FEMA for final approval.

Please reply to this email to confirm receipt of the Plan. Woods Hole Group and the LPT looks forward to hearing from you.

Thank you!



M. Leslie Fields
Coastal Sciences & Planning Team Leader

 Tel: +1 508-495-6225  Mob: +1 508-274-8109

 107 Waterhouse Road
Bourne, MA 02562 - USA

 www.woodsholegroup.com



Fields Leslie

To: elehrer@marshpeema.gov
Subject: Falmouth Multi-Hazard Mitigation Plan

Hi Evan,

The Falmouth Local Planning Team (LPT) team, in partnership with the Woods Hole Group, has prepared the Falmouth Multi-Hazard Mitigation Plan (Plan), dated July 2022, for public review and comment. The Plan identifies impacts of climate change and natural hazards on residents, buildings, and infrastructure. Risks associated with the impacts are identified and evaluated. Mitigation actions that focus resources on the greatest risk areas are developed. Documenting the mitigation items and integrating the necessary actions into our future planning and budgeting will help protect our residents and infrastructure. The Plan demonstrates Falmouth's commitment to preparing for potential future disasters.

The Plan is attached to this email. Everyone is encouraged to review the Plan. Please submit any questions and/or comments relative to the Plan via email to Leslie Fields, Woods Hole Group Project Manager, lfields@woodsholegroup.com. The public comment period will end at August 1, 2022, at 3:00 PM. Public comments received after this date/time will not be considered.

In addition, the Falmouth Board of Selectmen will hold a public hearing on Monday, July 25, 2022, at 7:00 PM at Falmouth Town Hall. This is an opportunity for the public to learn about the Plan, participate, and offer comments and recommendations during the final draft stage and prior to submittal to MEMA and FEMA for final approval.

Please reply to this email to confirm receipt of the Plan. Woods Hole Group and the LPT looks forward to hearing from you.

Thank you!



M. Leslie Fields

Coastal Sciences & Planning Team Leader

Tel: +1 508-495-6225 Mob: +1 508-274-8109

107 Waterhouse Road
Bourne, MA 02562 - USA

www.woodsholegroup.com

Fields Leslie

To: hmcclroy@capecodcommission.org
Subject: Falmouth Multi-Hazard Mitigation Plan

Hi Heather,

The Falmouth Local Planning Team (LPT) team, in partnership with the Woods Hole Group, has prepared the Falmouth Multi-Hazard Mitigation Plan (Plan), dated July 2022, for public review and comment. The Plan identifies impacts of climate change and natural hazards on residents, buildings, and infrastructure. Risks associated with the impacts are identified and evaluated. Mitigation actions that focus resources on the greatest risk areas are developed. Documenting the mitigation items and integrating the necessary actions into our future planning and budgeting will help protect our residents and infrastructure. The Plan demonstrates Falmouth's commitment to preparing for potential future disasters.

The Plan is attached to this email. Everyone is encouraged to review the Plan. Please submit any questions and/or comments relative to the Plan via email to Leslie Fields, Woods Hole Group Project Manager, lfields@woodsholegroup.com. The public comment period will end at August 1, 2022, at 3:00 PM. Public comments received after this date/time will not be considered.

In addition, the Falmouth Board of Selectmen will hold a public hearing on Monday, July 25, 2022, at 7:00 PM at Falmouth Town Hall. This is an opportunity for the public to learn about the Plan, participate, and offer comments and recommendations during the final draft stage and prior to submittal to MEMA and FEMA for final approval.

Please reply to this email to confirm receipt of the Plan. Woods Hole Group and the LPT looks forward to hearing from you.

Thank you!



M. Leslie Fields
Coastal Sciences & Planning Team Leader

Tel: +1 508-495-6225 Mob: +1 508-274-8109

107 Waterhouse Road
Bourne, MA 02562 - USA

www.woodsholegroup.com





Appendix C: Critical Facilities and Vulnerability

1. Critical Facilities List
2. Mitigation Actions Prioritization

Critical Facilities List

Category	Facility #	Name	Address
Admin	1	Town Archives	65 Pumping Station Rd.
	2	Falmouth Housing Authority	115 Scranton Ave.
	3	Falmouth School Administration	340 Teaticket Hwy.
	4	Town Hall	59 Town Hall Sq.
	5	Falmouth Harbor Master Building	180 Scranton Ave.
	6	Mass Highway Dept	1132 Nathan B. Ellis Hwy.
	7	Falmouth Police Dept	750 Main St.
	8	Falmouth Recreation Department	790 East Main St.
	9	Human Services Dept	Town Hall Sqare
	10	Falmouth Senior Center	780 Main St.
	11	Veterans Service Center	300 Dillingham Ave.
	12	Harbor Master Shack	Old Dock Rd.
	13	Drawbridge Hut	Water St.
Admin/HAZMAT	14	Department of Public Works	416 Gifford St.
Fire	15	West Falmouth Fire Station	555 West Falmouth Hwy.
	16	North Falmouth Fire Station	204 Old Main Rd.
	17	Emergency Operations Center (Headquarters)	399 Main St.
	18	East Falmouth Fire Station	505 East Falmouth Hwy.
	19	Woods Hole Fire Station	419 Woods Hole Rd.
HAZMAT	20	North Marine	53 Falmouth Heights Rd.
	21	Accurate Plastics	33 Technology Park Dr.
	22	Associates of Cape Cod	124 Bernard E. Saint Jean Dr.
	23	Cape Cod Aggregates	486 Thomas Landers Rd.
	24	East Marine	89 Falmouth Heights Rd.
	25	Falmouth Ice Arena	9 Technology Park Dr.
	26	Falmouth Ready Mix	475 Thomas Landers Rd.
	27	Lawrence Ready Mix Concrete	396 Gifford St.
	28	Eversource Station 967	Old County Rd.
	29	Eversource Station 933	61 Stephens Ln.
	30	Eversource Station 936	1096 Sandwich Rd.

	31	The Fuel Co. Inc 1	11 Acapesket Rd.
	32	The Fuel Co. Inc 2	7 Acapesket Rd.
	33	Verizon 1	400 Main and Gifford St.
	34	Verizon 2	674 Thomas Landers Rd.
	35	Falmouth Coal Co. / Falmouth Energy	54 Depot Ave.
	36	Wynne Fuel Oil Co.	8 Old Meeting House Rd.
HAZMAT/Wastewater	37	Safe Harbor Fiddler's Cove Marina	42 Fiddlers Cove Rd.
	38	Falmouth Marine	278 Scranton Ave.
	39	MacDougall's Cape Cod Marine	145 Falmouth Heights Rd.
	40	Bosun's Marina	1209 East Falmouth Hwy.
	41	Town Marina Dock	180 Scranton Ave.
Library	42	Falmouth Public Library	300 Main St.
	43	North Falmouth Public Library	6 Chester St.
	44	East Falmouth Public Library	310 E Falmouth Hwy.
	45	West Falmouth Public Library	575 West Falmouth Hwy.
	46	Woods Hole Library	581 Woods Hole Rd.
Medical	47	Coastal Medical Transportation Services LLC	668 Main St. (Building A)
	48	ConvenientMD Urgent Care	40 Davis Straights
	49	Cape Cod Healthcare Urgent Care	273 Teaticket Hwy.
	50	Overlook - Visiting Nurse	East Falmouth Hwy.
	51	Cape Cod Free Clinic & Community Health Center	65C Town Hall Square
Medical/Nursing	52	Atria Woodbriar Park (Assisted Living)	339 Gifford St.
	53	Atria Woodbriar Place (Independent Living)	389 Gifford St.
	54	Heritage At Falmouth	140 Ter Heun Dr.
	55	JML Care Center, Inc.	184 Ter Heun Dr.
	56	Royal Megansett Nursing and Retirement Home	209 County Rd.
	57	Royal Falmouth Nursing & Rehabilitation Center	359 Jones Rd.
Medical/ HAZMAT	58	Falmouth Hospital	100 Ter Heun Dr.
Other	59	Post Office	120 Main St.
	60	Cape & Islands NPR Radio	3 Water St.
	61	Woods Hole Community Center	68 Water St.
	62	Falmouth Landfill	700 Thomas B Landers Rd.
	63	Town Fuel Dock/Pier 37	64 Scranton Ave.

	64	Nobska Lighthouse	233 Church St.
	65	WHOI 1	44 Water St.
	66	WHOI 2	266 Woods Hole Rd.
	67	WHOI 3	360 Woods Hole Rd.
Other/HAZMAT	68	Coast Guard Station	30 Little Harbor Rd.
Transportation	69	Falmouth Airpark	67 Airpark Dr.
	70	Falmouth Bus Terminal	59 Depot Ave.
Transportation/Wastewater	71	Island Queen Ferry Terminal	75 Falmouth Heights Rd.
Transportation/HAZMAT	72	Steamship Authority Ferry Terminal	0 Railroad Ave.
Schools	73	East Falmouth Elementary School	33 Davisville Rd.
	74	Falmouth Academy	7 Highfield Dr.
	75	Lawrence Jr. High School	113 Lakeview Ave.
	76	Morse Pond Middle School	323 Jones Rd.
	77	North Falmouth Elementary School	62 Old Main Rd.
	78	Teaticket Elementary School	45 Maravista Ave.
	79	Falmouth High School	847 Gifford St.
	80	Mullen Hall School	140 Katharine Lee Bates Rd.
	81	Sea Education Association Inc	171 Woods Hole Rd.
	82	MBL/WHOI Dorms	Devil's Ln.
	83	Former Water Plant Pumping Station	10 Pumping Station Rd.
Water/Wastewater	84	Long Pond Water Treatment Plant	650 Gifford St.
	85	Town Marine Pumpout Boat	0 Robbins Rd.
	86	Coonamessett Well	N/A
	87	Ashument Well	1095 Sandwich Rd.
	88	Crooked Pond Well	Geggatt Rd.
	89	Long Pond Reservoir	N/A
	90	Water Tower 1	64 Technology Park Dr.
	91	Hayway Water Tower	276 Hayway Rd.
	92	Water Tower 2	28 Bernard St Jean Dr.
	93	Water Street Pump Station	Water St.
	94	Park Road Pump Station	Park Rd.
	95	Shivericks Pond Pump Station	20 Academy Ln.
	96	Surf Beach Pump Station	Surf Dr.

	97	Inner Harbor Pump Station	Robbins Rd.
	98	Spring Bars Road Pump Station	110 Spring Bars Rd.
	99	Alphonse Street Pump Station	Alphonse St.
	100	Silver Beach Avenue Pump Station	127 Silver Beach Ave.
	101	Quissett Harbor Boat Yard	36 Quissett Harbor Rd.
Water/Wastewater/HAZMAT	102	Service Road Wastewater Treatment Plant	Service Rd.
	103	Crooked Pond Treatment Plant	50 Twin Oaks Dr.
	104	NS Treatment Plant	Williams Rd.
	105	Mares Pond Well	Pattee Rd.
	106	Fresh Pond Well	N/A
	107	Sewer Pumping Station	454 Palmer Ave.
Vulnerable Populations - Housing Authority	108	Harborview Housing	115 Scranton Ave.
	109	Tataket Apartments	138 Teaticket Hwy.
	110	Salt Sea Apartments	211 Scranton Ave.
	111	Mayflower Housing	238 Lakeview Ave.
	112	Rose Morin Apartments	58 Rose Morin Ln.

Mitigation Actions Prioritization

3=Best/Most Benefit/Least Cost/Easy or no permitting; 2=Some benefit/Moderate Cost/Some potential permitting complications; 1=Little to no benefit/Expensive/Complicated permitting required

		Benefits					Feasibility				Economic		Regulatory		Total Score
		Protects Properties and Structures	Protects Natural Resources	Technical/Capacity Improvement (Training, Evaluations, Regulations, etc)	Improves Public Awareness	Improves Emergency Response or Public Protection After an Emergency	Appropriate Staffing Available	Technically Feasible	Public Support	Town/Political Support	Cost	Funding Available / Attainable	Permitting/Regulatory Feasibility	Consistent with Local, State, & Federal Goals	
	Goals and Potential Mitigation Actions														
	Goal 1. Provide residents with adequate access to emergency shelters equipped with sufficient provisions, climate control and emergency electricity during natural disaster events.														
1	1a. Reconstruct high school gymnasium glass roof with solid surface roof and install storm shutters on cafeteria windows.	3	1	1	1	3	3	3	3	3	2	3	3	3	32
	Goal 2. Improve communications between private citizens, businesses, utility companies, and town, regional, state, and federal agencies before, during and after a natural disaster.														
2	2a. Improve interdepartmental and inter-agency communications.	1	1	1	1	3	3	3	2	3	3	3	3	3	30
3	2b. Begin talks with private organizations and businesses in Woods Hole (i.e. Steamship Authority, WHOI, MBL, etc.) about hazard mitigation, flood prevention, and traffic control.	2	2	1	2	2	2	3	3	3	3	1	3	3	30
	Goal 3. Maintain adequate access to public utilities such as electricity, drinking water, and communications during and after a natural disaster.														
4	3a. When bridges require maintenance, assess the vulnerability of water mains and other utility infrastructure, and potentially upgrade or reinforce infrastructure during bridge repair.	1	1	1	2	3	2	2	2	3	2	3	2	3	27
5	3b. Ensure that all schools, housing authority facilities, and town-owned buildings that provide emergency support services are equipped with generators.	3	1	1	2	3	3	3	3	3	2	3	3	3	33
6	3c. Establish a regular program of trimming trees on municipal properties that have the potential to impact power supply during storms.	2	1	1	2	3	2	3	2	3	2	2	2	3	28
	Goal 4. Maintain an adequate Level of Service (LOS) on all roadways during and after natural disasters, particularly on major roadways.														
6	4a. Maintain an adequate supply of sand, salt and other road treatment materials.	1	1	1	1	3	2	3	3	3	3	3	3	3	30
7	4b. Explore stormwater best management practices (BMPs) to address sections of roadway that regularly flood after heavy rains (i.e. east end of Thomas Landers Road; Route 28 near Friendly's, etc.).	2	2	1	2	3	2	2	2	3	2	3	2	3	29
8	4c. Evaluate alternatives to minimize flooding and sand overwash on Menauhant Road during a storm, particularly in the vicinity of Bristol Beach, Inn Season Resorts, Surfside, and Menauhant Beach.	2	2	1	2	3	1	2	2	3	1	3	1	2	25
9	4d. Design and reconstruction of the Falmouth Heights Bluff shore protection located on the seaward side of Grand Avenue between Vernon Avenue and Gertrude Avenue. Approx length = 1,300'.	2	1	1	2	3	1	3	2	3	1	2	1	2	24
10	4e. Design and reconstruction of shore protection along the Chapoquoit Road causeway from Chapoquoit Beach to end at stone pillars. Approx length = 900'.	3	3	1	2	3	1	3	2	3	2	2	2	2	29
11	4f. Proceed with construction of the Bourne's Pond Bridge project and associated Menauhant Beach nourishment project.	3	3	1	2	3	2	3	2	3	1	3	1	3	30
12	4g. Evaluate adaptation alternatives for low-lying roads and bridges throughtout Town.	3	3	1	2	3	2	3	2	1	1	2	3	3	29
	Goal 5. Investigate, design, and implement projects that will reduce and minimize the risks and impacts from natural hazards to critical municipal facilities and resources.														
13	5a. Create a comprehensive wetlands restoration plan and begin reconstruction in the most vulnerable areas.	1	3	2	2	1	2	3	2	3	2	3	1	3	28
14	5b. Conduct a thorough evaluation of the Town's most at-risk critical facilities identified in the CCVA (2020), and evaluate potential mitigation techniques for protecting each location to the maximum extent possible.	3	1	1	2	3	2	3	2	3	1	2	2	3	28
15	5c. Reconstruction of the Fresh River Outlet on Surf Drive, including a roadway culvert and outlet groin.	1	3	1	1	2	2	3	3	3	2	3	1	3	28
16	5d. Reconstruction of the Salt Pond Outlet on Surf Drive including the roadway culvert and outlet groin.	1	3	1	1	2	2	3	3	3	2	3	1	3	28
17	5e. Consider the feasibility of beach nourishment along Chapoquoit Beach.	3	3	1	2	3	1	3	2	2	1	2	1	3	27
18	5f. Conduct fuel management activities in Fire Hazard Mitigation Focus Areas as identified in the Barnstable County Wildfire Preparedness Plan.	3	3	3	2	1	2	3	2	2	3	2	3	3	32
19	5g. Maintain a list of municipal construction projects, bylaw/code revisions, and properties to acquire to reduce risk from natural hazards; develop priority ranking.	3	1	2	2	3	2	3	2	2	1	2	3	3	29
20	5h. Integrate municipal mitigation and adaptation projects into the Town's operating and capital budgets.	3	3	1	2	3	3	3	2	2	1	2	3	3	31
21	5i. Update the Falmouth Open Space and Recreation Plan to include properties identified in the CCVA (2020) study as priorities for acquisition to allow salt marsh migration in response to sea level rise.	1	3	1	2	2	3	3	2	2	1	2	3	3	28
22	5j. Evaluate alternatives for reducing vulnerability of Town Hall to flooding.	3	1	3	3	3	3	3	2	2	1	2	2	3	31
	Goal 6. Develop public education outlets and materials to inform residents about what to expect during natural disasters and to promote pre-disaster planning by the public, particularly regarding natural disasters such as hurricanes.														
23	6a. Continue use of social media and other public outreach channels, such as Facebook, Twitter, YouTube, and an updated website to provide information about hazard preparedness, and encourage public to sign up for FalmouthAlert.	3	1	3	3	3	3	3	3	3	3	3	3	3	37
24	6b. Develop informational brochures that highlight pre- and post-disaster preparedness and make them available through a broad range of outlets.	3	1	3	3	3	3	3	3	3	3	3	3	3	37
25	6c. Develop public outreach materials, in concert with Eversource, on importance of allowing tree trimming around power lines.	3	1	2	3	3	3	3	2	3	2	2	3	3	33
	Goal 7. Make improvements to existing practices based on experience gained during disaster response and recovery.														
26	7a. Work with local land trusts to identify repetitive loss properties that these entities would be willing to buy out in the event of substantial damage, with the intent that these properties would be restored to their natural state and managed by the non-profit.	3	2	1	2	2	2	3	2	2	1	3	2	3	28
27	7b. Verify the location of each repetitive loss property. If it cannot be located, is located in another jurisdiction, or has been mitigated, notify FEMA to get the property removed from the town's repetitive loss list.	3	1	1	1	1	2	3	2	2	3	2	3	3	27
28	7c. Develop pre- and post-storm response plans for Falmouth public beaches, as described in Beach Management Plan.	1	3	2	1	1	1	3	2	3	3	3	3	3	29
29	7d. Revise Conservation Commission Wetlands Regulations to be consistent with the Coastal Resiliency goals and policies.	2	3	3	2	2	2	3	2	2	3	2	2	3	31
	Goal 8. Encourage future development that minimizes risks to natural hazards, such as flooding and high winds.														
30	8a. Review and revise local codes and bylaws as necessary to increase the resiliency of construction projects, and lobby for changes in the state building code.	3	1	3	2	2	2	3	2	3	3	2	2	3	31
31	8b. Contact all owners of repetitive loss properties annually, and inform them of financial assistance available for structural mitigation such as elevation and acquisition.	3	1	2	3	2	1	3	2	2	3	2	3	3	30
32	8c. Develop a framework that addresses buy outs and incentives for relocation in low lying neighborhoods.	3	1	3	3	3	2	3	1	2	1	2	3	3	30

Low	<=27
Med	28-31
High	>=32