Marshfield Multi-Hazard Mitigation Plan
DRAFT

Brant Rock – March 5, 2018
High Tide Post Winter Storm Riley

March 2023

PREPARED FOR:
Town of Marshfield
870 Moraine Street
Marshfield, MA 02050

PREPARED BY:
Woods Hole Group, Inc.
A CLS Company
107 Waterhouse Rd
Bourne, MA 02532 USA

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Acronym List

APCC	Association for Preservation of Cape Cod
BFE	Base Flood Elevation
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
LHMPC	Local Hazard Mitigation Planning Committee
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

Sunrise Beach – May 2018

The Town of Marshfield was referred to by early English settlers as Green's Harbor, dubbed for the land and lush salt marshes woven between three rivers (Green Harbor River, South River, and the North River) near their confluence with Massachusetts Bay. With roughly five miles of its shoreline bordering the Atlantic Ocean, Marshfield's unique location along the Atlantic coast leaves the Town vulnerable to potentially severe weather, including increased exposure to natural hazards associated with ocean-based storm events, such as flooding and coastal erosion.

Natural hazards of all kinds can result in injury, loss of life, and damage to buildings and infrastructure, which can adversely impact the Town's economic, social, and environmental resources. The Town of Marshfield's Long-Term Coastal Resilience Plan commented recently that rising sea levels and increased storm intensity are projected to worsen coastal flooding in Marshfield. The report noted that average losses from coastal flooding are estimated to grow to $11 million per year in 2030 and $16 million per year in 2050.

Through developing and implementing this Multi-Hazard Mitigation Plan, the Town of Marshfield 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 Marshfield 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.

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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 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 Marshfield in 2018. It was developed through substantial input from the Local Hazard Mitigation Planning Committee (LHMPC), 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 2018.

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The LHMPC was formed by the Town Administrator and included the representatives from the Police and Fire Departments, Department of Public Works, Planning Department, Conservation Commission, Building Department, Zoning Board of Appeals, Board of Health, Veterans Services, the ADA Committee Chair, the Ventress Memorial Library Director, Beach Committee, and Council on Aging. Members of the Local Program for Public Information (PPI) also attended all LHMPC working meetings and actively participated in the hazard mitigation planning process. The LHMPC met for one kick-off meeting and five working meetings during the Plan development process; agendas for each are provided in Appendix B. In addition to the LHMPC input, public participation in the hazard mitigation planning process is also important, both for plan development and for later 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 an understanding of the concept of hazard mitigation, potentially creating support for mitigation actions taken in the future to implement the plan. To gather this information and educate residents on hazard mitigation, the Town hosted two public meetings:

- Meeting #1: December 14th, 2022
- Meeting #2: February 27th, 2023

The first public meeting was held in-person and the second public meeting was held in a hybrid mode. Video recordings of the meetings are available on the Town of Marshfield's website for residents to view when they are able. A public online survey was also administered to assess the community's experience with local natural hazards and their perception of the risk, and to reach a wider demographic that may not be available to attend public meetings in person. The results of this online public survey are including in Appendix B.

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Copies of the announcements and attendance lists from these two meetings, as well as a master list of LHMPC 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 LHMPC meets to review and update the Plan.

The following steps were taken during the planning process:

1) Develop an LHMPC responsible for updating this Plan;
2) Define the potential natural hazards that could affect Marshfield;
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 2018 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 Marshfield'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 February 27, 2023, 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.

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The Plan was also sent to Town Planners in Scituate, Norwell, Pembroke, and Duxbury, as well as the Metropolitan Area Planning Council (MAPC) and the Old Colony Planning Council (OCPC) for review and comment. A copy of the emails sent to these neighboring towns and regional planning bodies soliciting their feedback on the Plan is also provided in Appendix B.

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A4.b

During the preparation of this Plan, several existing studies and documents related to Marshfield 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);
- Marshfield Long-Term Coastal Resiliency Plan (2022);
- Municipal Vulnerability Preparedness (MVP) Workshop Summary of Findings (2020);
- Marshfield (Brant Rock) Rapid Recovery Plan (2021);
- Marshfield Beach Management Plan (2017);
- Town of Marshfield Open Space and Recreation Plan (2017);
- Green Harbor, Marshfield, MA River Tide Gate Study (2017);
- Feasibility Report and Environmental Assessment for the Brant Rock and Fieldston areas of Marshfield, Massachusetts (2016);
- Town of Marshfield's Master Plan (2015);
- Marshfield Harbor, Rivers, and Waterways Management Plan (2014);
- Sea Level Rise Study for Marshfield, Duxbury, and Scituate (2013);
- 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 was the first-of-its-kind statewide plan that fully integrated a traditional hazard mitigation plan with a climate change adaptation plan.

The goal of the 2022 Marshfield Long-Term Coastal Resiliency Plan was to develop recommended policies and zoning to proactively reduce future vulnerabilities and, if necessary, rebuild in a more resilient way after a future catastrophic event. This plan included damage and loss estimates for the Town, potential mitigation strategies, policy scenarios, and policy and zoning recommendations.

The Municipal Vulnerability Preparedness (MVP) Workshop Summary of Findings document (workshop conducted in February of 2020) provided 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 2021 Marshfield (Brant Rock) Rapid Recovery Plan was a result of the Massachusetts Local Rapid Recovery Planning (RRP) process which was established to assist communities as a result of the economic impacts brought on by COVID-19. The Brant Rock area was of particular concern since coastal flooding and storm surge events drastically impact development and make economic revitalization of the Esplanade challenging. The plan created a toolkit for the Town to utilize and included long-term recommendations and programs that address connectivity and access to the Esplanade, as well as programs that promote resilient development and encourage business diversity.

The goals of the Beach Management Plan in Marshfield were to preserve and enhance the natural and recreational functions of the Marshfield public beaches, and to guide future management decisions. The plan included recommendations for management and planning activities that intended to preserve and restore the natural functions of the various natural resources and provide a quality public beach resource for recreational purposes.

The Town of Marshfield Open Space and Recreation Plan developed goals to preserve Marshfield's open space from unmanaged growth and safeguard its natural resources. The plan examined the Town's ability to protect open space and develop recreational opportunities, including how the Town could make investments that have economic, environmental, and social benefits to the community.

The Green Harbor, Marshfield, MA River Tide Gate Study evaluated potential options for maximizing tidal exchange through the tide gates to increase and enhance the salt marsh and brackish habitat upstream, while minimizing and/or improving the on-going flood risks and freshwater runoff coming into the river during significant rainstorms. The study included the modeling of alternatives for various configurations of tide gate structures.

The Feasibility Report and Environmental Assessment for the Brant Rock and Fieldston areas of Marshfield, Massachusetts investigated the flooding and erosion problems along the shorefront of Brant Rock and Fieldston. The report included potential actions that could be taken to mitigate flooding and erosion in these areas. This report was the product of detailed investigations conducted by the New England District of the Corps of Engineers in cooperation with the Town of Marshfield and other state and Federal agencies.

The 2015 Marshfield Master Plan was prepared to codify planning goals for land use, housing, economic development, natural and open space, public service and facilities, and transportation. The plan included strategies to mitigate the impacts of climate change on the Town's most vulnerable populations and areas.

The Marshfield Harbor, Rivers, and Waterways Management Plan included recommend procedures, policies, and regulations concerning the safety, navigation, recreation, natural resources, planning and management of Marshfield's waterways. The plan included recommendations to prepare for impacts of sea-level rise and opportunities for collaboration with neighboring towns.

The Sea Level Rise Study for the Towns of Marshfield, Duxbury, and Scituate, MA was prepared in 2013, and provided a regional approach to identifying the effects of sea-level rise and possible ways to mitigate those impacts. The plan identified natural resources, infrastructure, transportation, and emergency access routes that could be impacted by sea-level rise.

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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 Marshfield 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 Marshfield 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 LHMPC.

Technical information from the plans, regulations, and bylaws described above was incorporated into this Marshfield 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

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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 left margin.

1.4 PREVIOUS FEDERAL/STATE DISASTERS

The Town of Marshfield has experienced 9 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 two of these events occurred since the previous Marshfield MHMP in 2018. They include two Severe Winter Storm Disasters, one from March 2-3, 2018, and another from January 28-29, 2022.

Table 1-1. Disaster Declarations for the Town of Marshfield Since 2010.

Disaster Name	Type of Assistance	Declared Areas
Flooding (Mar 12, 2010 - Apr 26, 2010)	FEMA Individual Assistance	Counties of Plymouth, Bristol, Essex, Middlesex, Norfolk, Suffolk, and Worcester
	FEMA Hazard Mitigation Grant Program	Statewide
Hurricane Earl (Sep 1, 2010 - Sep 4, 2010)	FEMA Public Assistance Grant Program	Counties of Plymouth, Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Suffolk, and Worcester
Severe Winter Storm (Jan 11, 2011 - Jan 12, 2011)	FEMA Hazard Mitigation Grant Program	Statewide
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, and Norfolk
	FEMA Hazard Mitigation Grant Program	Statewide
Hurricane Sandy (Oct 27 - Nov 8, 2012)	FEMA Public Assistance Grant Program	Counties of Plymouth, Barnstable, Bristol, Dukes, Nantucket, and Suffolk
	FEMA Hazard Mitigation Grant Program	Statewide
Severe Winter Storm (February 8 - 10, 2013)	FEMA Public Assistance and Hazard Mitigation Grant Program	Statewide
Severe Winter Storm (January 26 - 28, 2015)	FEMA Public Assistance Grant Program	Counties of Plymouth, Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Suffolk, and Worcester
	FEMA Hazard Mitigation Grant Program	Statewide
Severe Winter Storm (March 2 - 3, 2018)	FEMA Public Assistance Grant Program	Counties of Plymouth, Barnstable, Bristol, Nantucket, Norfolk & Essex
	FEMA Hazard Mitigation Grant Program	Statewide

Severe Winter Storm (January 28 - 29, 2022)	FEMA Public Assistance Grant Program	Counties of Plymouth, Bristol, Norfolk, and Suffolk
	FEMA Hazard Mitigation Grant Program	Statewide

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 projected future climate conditions, and developing and implementing actions that will reduce the Town's overall risk.

Brant Rock – January 2022
Severe Winter Storm

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, historical locations throughout Town and a description of Repetitive Loss Properties.

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 Marshfield.

2.1 OVERVIEW

The Town of Marshfield is located in southeastern Massachusetts, in Plymouth County. A coastal community located 30 miles south of Boston, Marshfield has a yearly population of about 25,000, growing to about 40,000 in the summer months. The Town has a traditional New England government structure with a three-member Board of Selectmen, a Town Administrator, and an open town meeting structure. Among the basic services provided to residents are public safety, schools, water and sewer, trash removal, recreation, public library, and senior center. The Town's water, sewer, and trash operations are managed through enterprise funds.

Active throughout the year with events such as the Marshfield Fair, the Town attracts visitors from all over the State. The community takes pride in its educational and sports programs and the Town's unique environmental beauty on the coast. The town maintains a website at: http://www.townofmarshfield.org

2.2 GEOGRAPHY

Marshfield is 32 square miles in area and contains 29 square miles of land and 3 square miles of water. The Atlantic Ocean borders the Town on the east, Duxbury on the south/southeast, Pembroke and Norwell on the west, and Scituate on the north. Situated in the South Shore Towns center, Marshfield is 29 miles southeast of Boston, 48 miles northeast of Providence, Rhode Island, and 225 miles from New York City.

The Town comprises ten distinct villages or areas: North Marshfield, Marshfield Hills, Seaview, West Marshfield (Plain Street), Downtown, Rexhame, Fieldston, Ocean Bluff, Brant Rock, and Green Harbor.

It is a coastal community with many beaches, marshes, and tidal waterways. Marshfield and the Town of Scituate share the waters of the South and North Rivers, a sensitive and vital natural resource area.

2.3 CLIMATE

Marshfield averages 48.8 inches of rain annually, with an average annual snowfall of 59 inches. Average temperatures range from highs in the upper 70s and low 80s (Fahrenheit) during the summer months to lows in the low to mid-20s during winter. Marshfield's location along the Atlantic Ocean generally keeps temperatures cooler in the summer and warmer in the winter relative to other nearby, inland Massachusetts communities.

2.4 NATURAL ENVIRONMENT

Marshfield's natural environment and natural resources are essential to the Town's identity and quality of life. One of the most critical factors in why people move to and visit Marshfield is its natural environment and coastal features such as its beaches.

The Town has a varied landscape, with large stretches of open space, forested land, upland, coastal salt marshes, sandy beaches, and protected harbors. These natural resources support the

economy through tourism and recreation and various 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, stormwater management as rainwater drains through the soil, and erosion control as vegetation secures soil along coastal banks and dunes. Salt marshes are an essential 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

The lands of the Town of Marshfield consist of coastal lowlands and river valleys with marshlands in the northern part of the Town along the South River and the southern village of Green Harbor. The land contains gravelly to sandy soils with an extensive network of waterways, including the North, South, and Green Harbor Rivers and several smaller creeks emptying into the rivers.

The land known as Marshfield today was inhabited by Native American tribes, including the Wampanoag Tribe, for thousands of years. The Wampanoag Tribe referred to the land as Missacautucket, and the tribes established roads still used by Marshfield residents today.

After the British colonization of the Americas, the land was established as Marshfield, and in 1640, belonged to the area known as the "New Colony of New Plymouth in New England." A small colony of settlers grew from cattle farming, salt marsh haying, shipbuilding, and commercial fishing, which continues to be an important economic and recreational activity in Marshfield today.

Four trends drove the broad land use patterns that shaped Marshfield:

1. Trails established by Native American Tribes such as the Wampanoag Tribe were improved and expanded upon during the colonial and subsequent 18th-century agricultural and early industrial development. This period established several villages, the winding road system, farms and fields, and the historic homes and civic buildings throughout Marshfield. This historic community development pattern lends to the Town's charm and character.

2. In the early 20th century, vacation subdivisions and associated vacation-oriented businesses were established along the beach in Marshfield. Occurring at sufficiently high densities along Ocean Street, there have been few changes in the overall character of that area. Many seasonal homes have been converted to year-round housing, but the primary land use pattern of single-family homes on small lots along beach areas remains.

3. The construction of Route 3 in the 1960s brought increasing suburbanization to Marshfield, establishing Marshfield as a Boston suburb, and spurring increased residential and commercial development.

4. Today, Marshfield is largely a seaside community with many residents commuting by car to jobs in Boston. Marshfield becomes a vibrant center of activity in the summer with a large influx of seasonal visitors, especially those renting summer homes near Marshfield's beaches.

Figure 2-1 shows significant land uses throughout Marshfield. The numbers of parcels and areas within each land use category are summarized in Table 2-1.

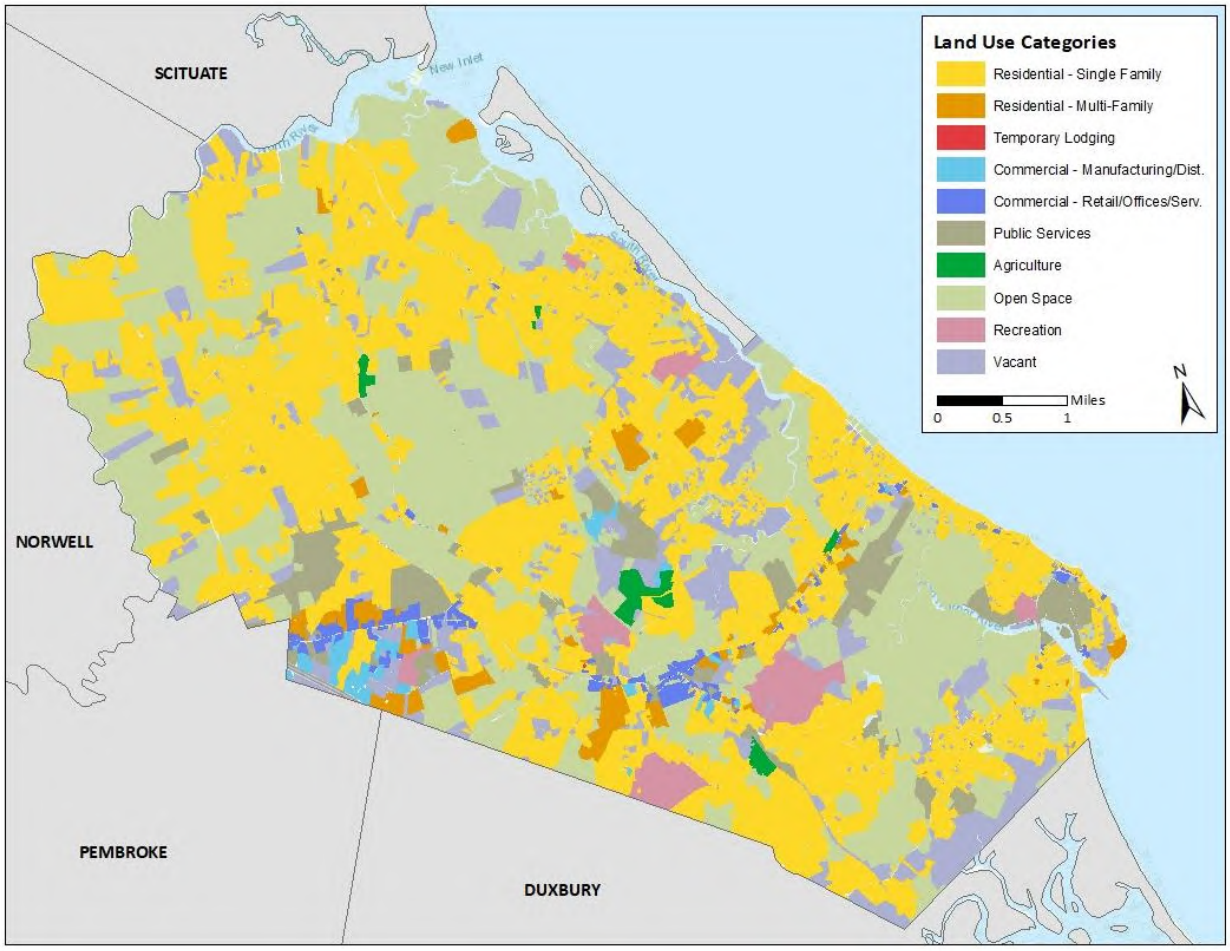

Figure 2-1. Town of Marshfield land use categories (Town of Marshfield, 2022).

Table 2-1. Land Use Summary for Marshfield (based on the 2022 Assessor's parcel dataset).

Land Use Category	Number of Parcels	Total (Acres)
Residential - Single Family	9,378	7231
Residential - Multi-Family	83	379
Temporary Lodging	1	0
Commercial - Retail/Offices/Services	195	209
Commercial - Manufacturing/Distribution	46	149
Public Services	117	877
Agricultural	6	103
Open Space	944	5950
Recreation	9	418
Vacant	935	1782

2.6 INFRASTRUCTURE

The Town of Marshfield has approximately 140 miles of roadway maintained by the Department of Public Works. Certain roadways (e.g. Route 3A and portions of Route 139) are maintained by the Massachusetts Highway Division. The road network operates satisfactorily during the off-season months; however, due to the large population increases in the summer months, there can be considerable congestion on some of the arterial roadways. Major roadways in Town also function as evacuation routes during an emergency. Figure 2-2 highlights the Town's current evacuation routes in red, based on the Pilgrim Nuclear Power Plant evacuation plan. The evacuation route follows Route 139 to Route 3. Residents are then directed to travel north to Exit 43B for Route I-93 south and continue on I-93 south to Exit 6 (Route 37 in Braintree) to get to the Braintree Emergency Reception Center located at Braintree High School. In addition to a number of major roadways, Marshfield is also serviced by the Greater Attleboro Taunton Regional Transit Authority (GATRA) service.

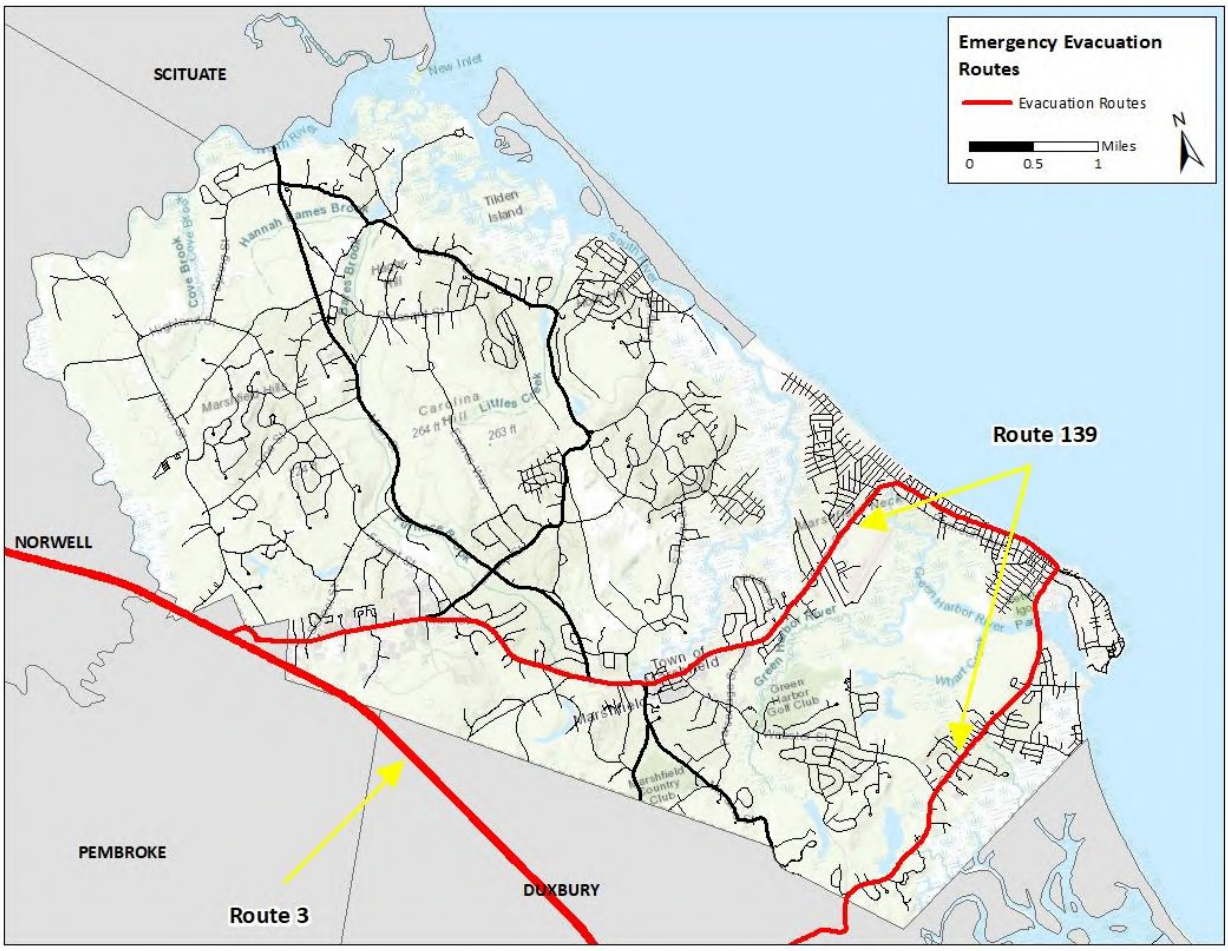

Figure 2-2. Emergency evacuation routes in Marshfield (MassGIS, 2022).

The Marshfield Department of Public Works – Water Division is responsible for providing an adequate supply of safe water for Marshfield's needs (domestic use and fire protection). This responsibility involves the installation, maintenance and repair of water mains and services lines, including fire hydrants on public ways, the maintenance and operation of wells, pumps and related infrastructure, water meter installation and reading, and water sampling. The Town's municipal drinking water supply consists of six aquifers and sixteen active gravel-packed wells. The Marshfield water supply is obtained entirely from underground sources within the Town's boundaries.

2.7 ECONOMY

Marshfield residents whose medium income is $109,841 provide a broad employment base for local and regional employers, including a civilian labor force that includes 69% of the population (16+) (U.S. Census Bureau 2021). Marshfield's residents include individuals with a high level of skills and educational attainment, which helps to support a diverse economy. Of Marshfield's residents (25+), 97% of residents have graduated from high school or higher, while 52% of

residents have a bachelor's degree or higher (U.S. Census Bureau 2021). The largest industries in Marshfield include education services, retail trade, and accommodation and food services.

Marshfield's five largest businesses include:

1. Road to Responsibility – Retail and Service
2. Roche Brothers – Supermarket
3. Star Market – Supermarket
4. Winslow Woods – Assisted Living Facility
5. Marshfield Country Club – Golf Course

2.8 DEVELOPMENT

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Marshfield's Master Plan identified the Downtown, Brant Rock and Enterprise Park areas as strategic areas for targeted development, redevelopment, or investment. These three areas confront varying uses, needs, and challenges. One area which is particularly vulnerable to natural hazards is the Brant Rock area. The Brant Rock commercial area includes an esplanade which is a draw for both residents and visitors due to unique restaurants and stores. This area faces challenges with storm events that cause frequent flooding of area businesses and has flood and storm related events that will influence redevelopment opportunities.

Since the last MHMP plan the most significant development in Brant Rock has been reconstruction of the Brant Rock seawall, which included elevating 1,200 feet of seawall by 3.5 feet. In this area, residential structures have rebuilt decks and moved away from the new seawall and several houses have been elevated on open piles and floodproofed foundations. The Town of Marshfield has been successfully enforcing the floodplain regulations for storage of materials and recreational vehicles on commercial properties in the esplanade and has updated a Town bylaw for the area to require that all new mixed-use construction provide residential parking above the Design Flood Elevation. To further address the needs of this area the Town has engaged in economic development and planning meetings to try to identify the needs in the esplanade and the proposed solutions. Additionally, Eversource is in the process of installing a new gas line and retrofitting new meters in the area. When this work is done the regulator valve will be elevated above Design Flood Elevation so that the meters in the area are not affected or inundated by flood waters during a storm event.

2.9 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, etc. The LHMPC developed a list of critical facilities, which is provided in Appendix C. The critical facilities in Marshfield are shown in Figure 2-3; the numbers correspond to the list in Appendix C. A portion of these critical facilities are located within high hazard areas, such as floodplains. Figure 2-4 shows critical facilities vulnerable

to flooding in the year 2070 with predicted sea level rise. Due to the importance of these facilities, special care must be taken to ensure continued operation even during disaster events.

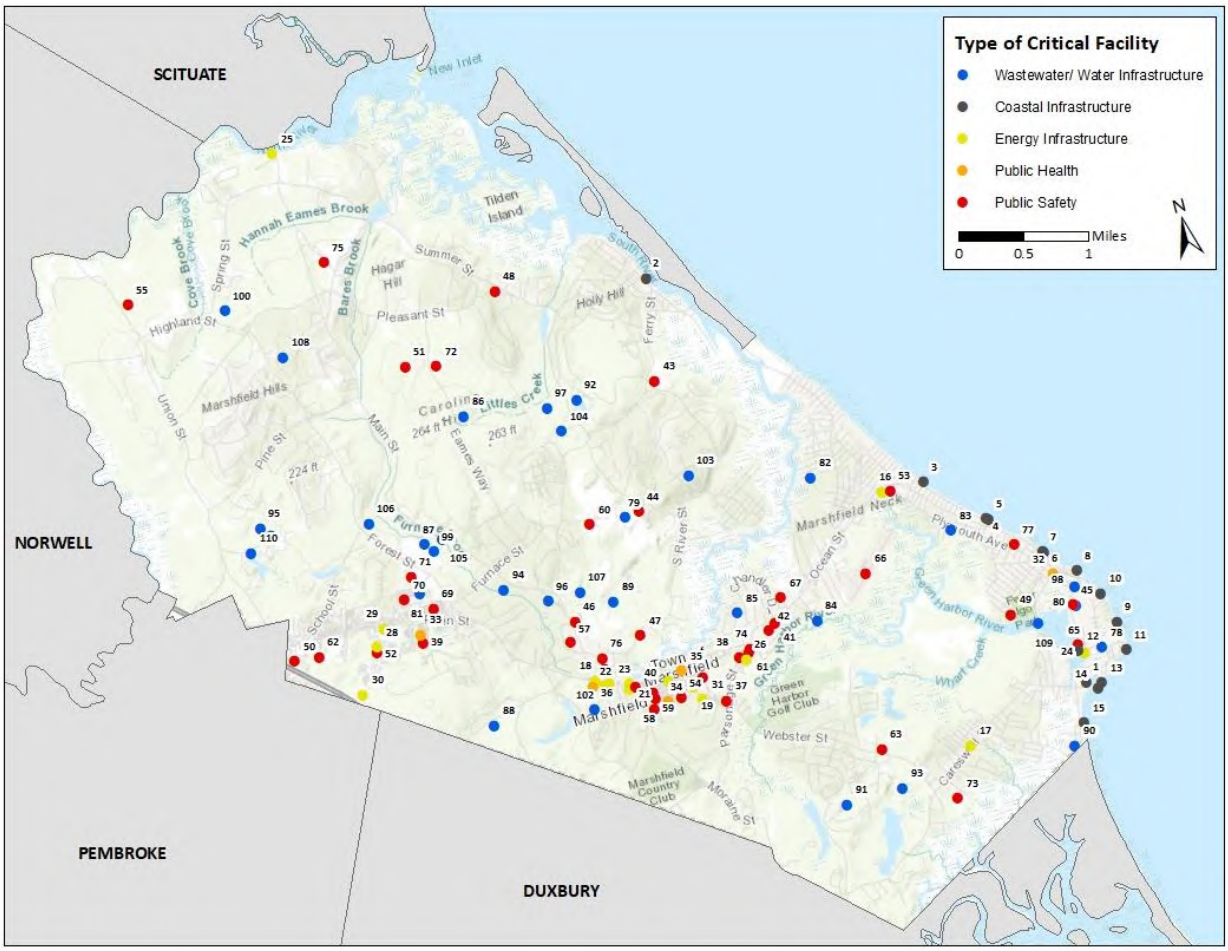


Figure 2-3. Marshfield critical facilities map.

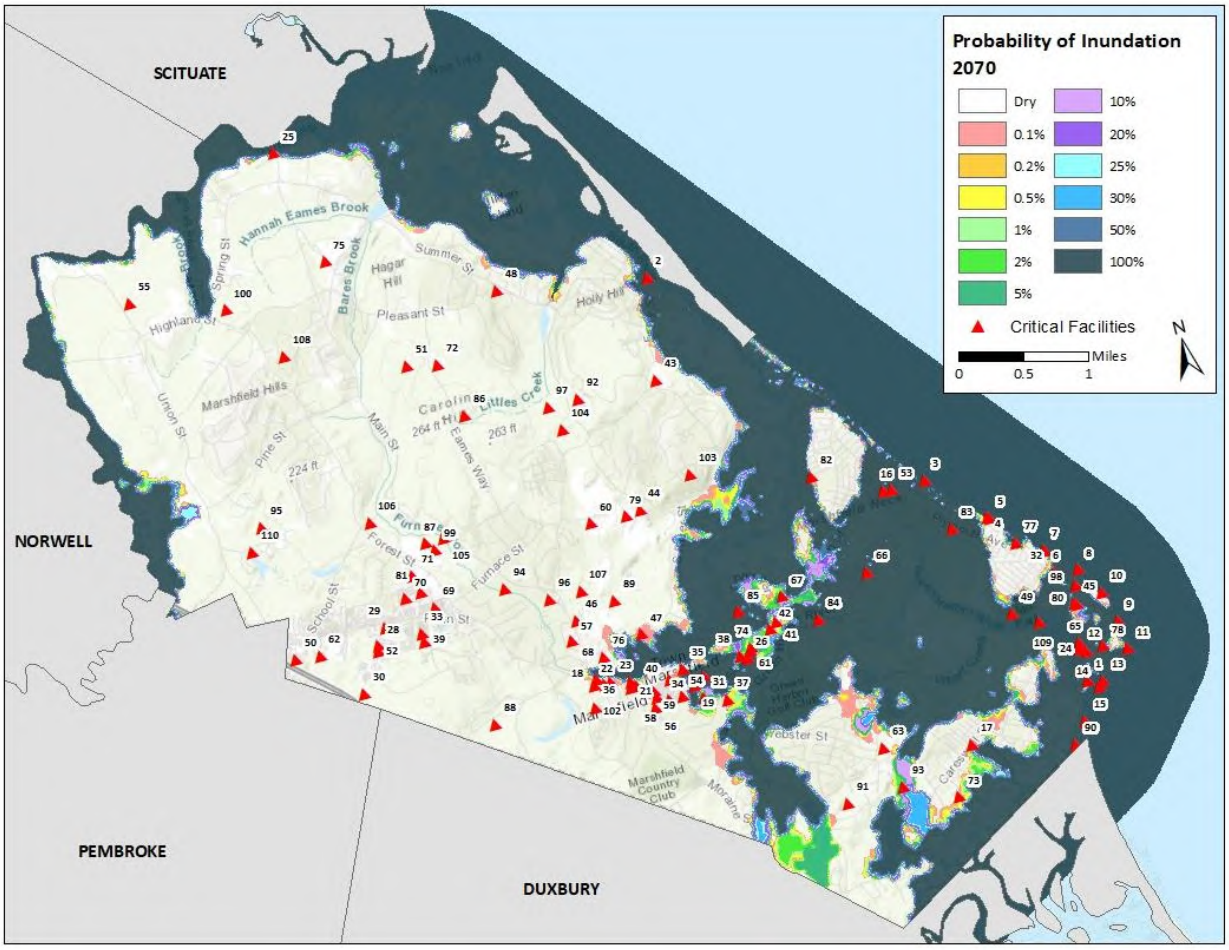


Figure 2-4. Marshfield critical facilities probability of inundation in 2070 (MassCZM, 2023).

2.10 HISTORICAL PROPERTIES

Marshfield has a rich history that is reflected in a wide range of historic and archaeological resources. Three historical groups exist in Marshfield: The Marshfield Historical Society, the Historic Winslow House Association, and the Marshfield Historic Commission.

Marshfield has 4 individual properties and one district on the National Register of Historic Places. They are:

1) Hatch Homestead and Mill Historic District (385 Union Street)
2) Marshfield Hills Historic District (Bow, Highland, Main, Old Main, Pleasant, Glen, and Prospect Streets)
3) Thomas-Webster Estate (238 Webster Street) (Figure 2-5).
4) Daniel Webster Law Office and Library (Careswell and Webster Streets)
5) Isaac Winslow House (634 Careswell Street)

Additional historic sites of cultural importance within Marshfield include the Marcia Thomas House and Seth Ventress Hall.

2.11 REPETITIVE LOSS PROPERTIES

B4.a

Repetitive Loss Properties are those for which two or more losses of at least $1,000 each have been paid under the National Flood Insurance Program (NFIP) within any ten-year period since 1978. The Town of Marshfield had 149 Repetitive Loss Properties in 2018, when the last Hazard Mitigation Plan was completed. In 2022 FEMA reported a total of 179 Repetitive Loss Properties.

All Repetitive Loss Properties in Marshfield are located on or near the coast, tidal waterways, or marsh areas. In most cases, past damages have been caused by storm surge flooding and/or wave overtopping. Storm surge is a temporary increase in the elevation of the water level caused by a storm, which can cause extreme flooding in coastal areas particularly when the storm surge coincides with a normal high tide. Many of these repetitive loss structures are located at low elevations and are within a FEMA velocity zone (VE), which makes them particularly susceptible to the hazards of storm surge and coastal flooding. Low-lying Repetitive Loss Areas in Marshfield within a VE Zone, that contain clusters of Repetitive Loss Properties, include the Rexhame Area, the Brant Rock Esplanade Area, the Brant Rock High Road Area, the Blue Fish Rock Area, and the Bay Avenue Area. Other Repetitive Loss Areas, such as the Barlett Island Area and the Ferry Street / Ridge Road Area are vulnerable to storm surge inundating low-lying properties adjacent to tidal rivers or marshes.

It is important to note the emphasis on Repetitive Loss “Areas”, as opposed to specific properties. While locating specific repetitive loss properties is important for some purposes, these properties only appear on FEMA’s list because the structure had flood insurance and received two or more claims of at least $1,000 during any ten-year period. Other nearby structures may have been uninsured during the floods, may have only had one flood insurance claim, or may have had multiple claims under different policies. The properties that are listed by FEMA as Repetitive Loss Properties simply represent a sampling of Marshfield’s repetitive flooding problem and are a good indication of the Town’s vulnerable and repetitively flooded areas. These Repetitive Loss Areas are shown in Figure 2-5.

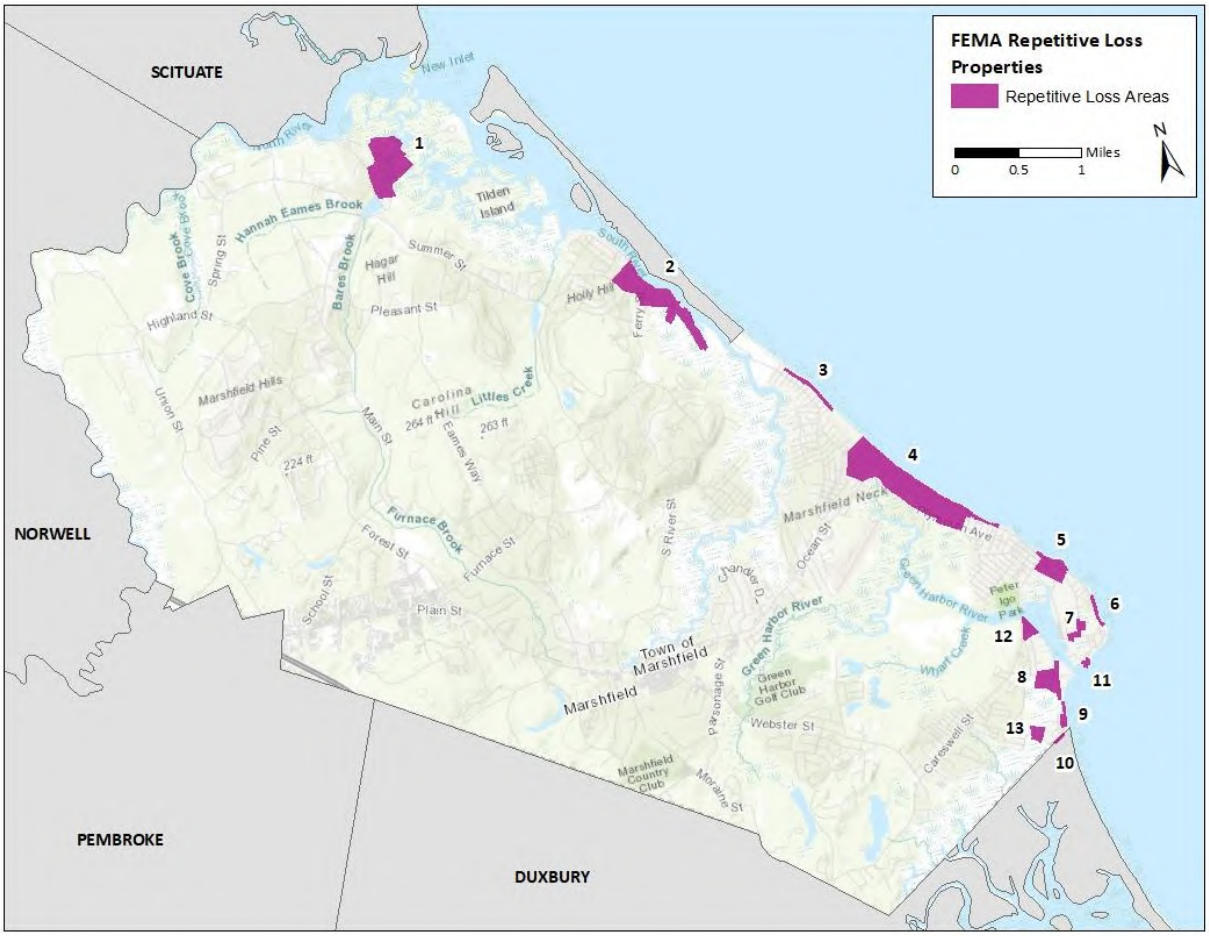


Figure 2-5. Repetitive Loss Areas in Marshfield.

Table 2-2. Repetitive Loss Areas

Number	Repetitive Loss Area
1	Bartlett Island Way Area
2	Ferry Street / Ridge Road Area
3	Rexhame Area
4	Fieldston Area
5	Brant Rock Esplanade Area
6	Brant Rock High Road Area
7	Island Street Area
8	Beach Street Area
9	Bay Avenue Area
10	Bay Street Area
11	Blue Fish Rock Area
12	Green Harbor Area
13	Canal Street Area

Anderson Drive – April 2022
Impacts of Brush Fire

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

In addition to the hazards above, the Town of Marshfield also included Dam/Culvert Failure as a hazard. This chapter provides a description of each hazard, the location(s) within Marshfield 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, Marshfield 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 Marshfield 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
2) Coastal Flooding
3) Coastal Erosion
4) Hurricanes and Tropical Storms
5) Severe Winter Storms
6) Wildfire
7) Tornadoes
8) Drought
9) Average/Extreme Temperature
10) Earthquake
11) Invasive Species
12) Other Severe Weather
13) Landslide
14) Tsunami

B1.b

As suggested under FEMA planning guidance (FEMA, 2011), the Town of Marshfield 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, the Town also evaluated dam/culvert failure. 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 LHMPC members. All resources are referenced in the text of each hazard profile.

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

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

3.1 FLOODING (COASTAL & INLAND)

Overview

Flooding was the most prevalent serious natural hazard identified by local officials in Marshfield. Flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Sea level rise has the potential to exacerbate these issues over time.

The Town of Marshfield 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 the rate of precipitation or amount of water 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 Marshfield 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, known 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. Marshfield, being north of Cape Cod, is particularly vulnerable to nor'easters because the area is not protected by the sheltering arm of Cape Cod. Nor'easters cover a larger area than hurricanes although the winds are generally not as high. They also generally last long enough to coincide with at least one high tide, resulting in the most severe flooding. Large rainstorms or snowfalls can also lead to inland flooding. See later sections for more specific details on these other natural hazards.

Most of the Town's rivers and waterways remain tidally influenced for their entire length such that 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, rivers, 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 sewers, retention ponds and other infrastructure designed to transport storm water away from roadways and parking lots, to receiving streams, lakes, and/or the ocean. When most of these systems were built, they were designed to withstand a 10-year storm event. Larger storms can overwhelm these systems and blocked or clogged drainage ditches and grates 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 surges, which occur when water is pushed onshore during powerful storms, such as hurricanes and nor'easters. These storms often cause a storm surge, which can raise the water level by several feet. 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 (Figure 3-1). 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. Flooding in the Esplanade area during the January 4, 2018, winter storm.

Hazard Location

B1.c
B2.a

Figure 3-2 shows the Effective July 2021 FEMA Flood Insurance Rate Map (FIRM) for Marshfield. These areas represent the risk of flooding from a 100-year storm. This map depicts the areas of Marshfield 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.

Although this is not a comprehensive list of the areas identified in Figure 3-2, specific problematic areas identified as frequently flooded within the Town of Marshfield include:

1. Brant Rock: Flooding in the Brant Rock area occurs primarily in the esplanade area, a low-lying area just inland from the sea wall where there is a collection of businesses and residences. Flooding is caused by sea splash over as waves overtop the sea wall and lack of drainage. The esplanade area floods two to three times a year to a depth of one to two feet. Specific areas of concern include Brant Rock Esplanade, South Street, Franklin Street, and the southern portion of Ocean Street to the Esplanade.
2. Bass Creek/Fieldston: The Fieldston area is subject to frequent flooding during rainfall events and overtopping of the sea wall during coastal storms. This flood water collects in the vicinity of Monitor and Mayflower Roads due to low elevations, high water table, and restrictions in the drainage ditch into Bass Creek. The upper reaches of Bass Creek are heavily impacted by sediment and overgrown with little elevation change further limiting drainage. The Town has begun work on improving drainage conditions in Bass Creek.
3. Overtopping: Most of Marshfield's Ocean coastline is protected by sea walls and along the entire length of these walls there is periodic overtopping where ocean waters top the sea wall. These waves carry debris, including cobble stones, and can bring enough water over the wall to cause flooding in adjacent low-lying streets and properties. Overtopping occurs during storm events and can also occur at times when storms pass further out at sea and drive waves towards the coast. Many of the locally identified flood areas in Marshfield that are along the coast, experience flooding due to overtopping events.
4. Rexhame: Specific areas of concern are the end of Rexhame Road, Standish Street from East Street to Parker Street.
5. Damon's Point.
6. Green Harbor: Bay Street, Bay Avenue, Avon Street, Brighton Street.
7. Ocean Bluff: Specific areas of concern are Brook Street and Foster Avenue.

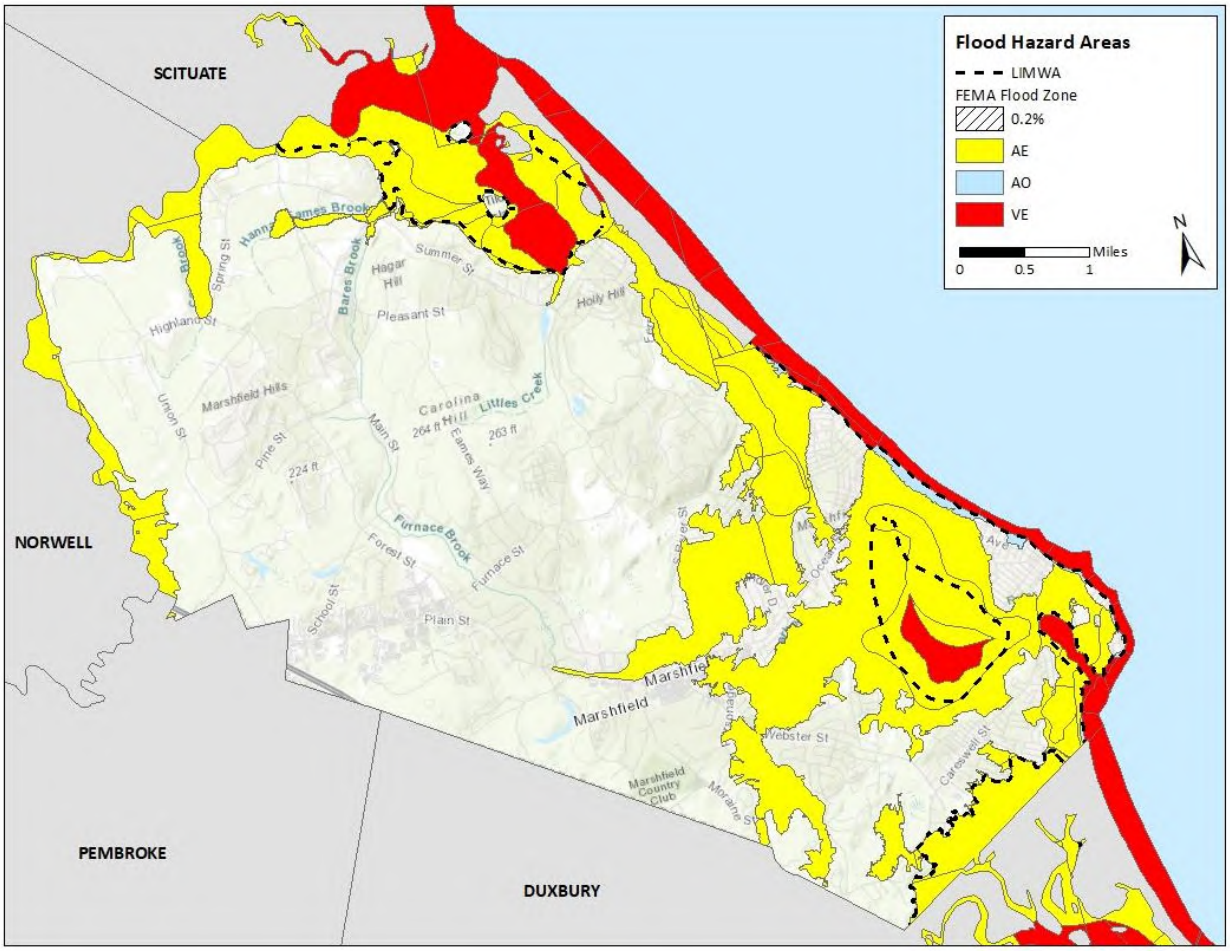


Figure 3-2. FEMA Special Flood Hazard Areas in Marshfield (FEMA, 2021).

Previous Occurrences & Extent

B1.c
B2.a
B2.c

Below is a list of major flooding events that have occurred in Marshfield from between 2018 and January 2023, from NOAA's NCEI Storm Events Database (NOAA, 2023), which lists a number of specific flooding incidents for Marshfield:

- January 4, 2018: Coastal flooding associated with a major winter storm. Still water levels reached elevations not seen since the Blizzard of 1978. Major roadways were flooded and impassible. Businesses in the Esplanade area flooded, with some areas reporting more than 3 feet of standing water (Figure 3-1). Frigid temperatures left some area roads encased in ice.

- 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 Marshfield overtopping was reported along the seawall on Ocean Street.

- April 3, 2020: An ocean storm east of New England included damaging winds and heavy rain during high tide resulting in coastal flooding. In Marshfield, coastal flooding was reported on Ocean Street.

- December 17, 2020: A winter storm system produced heavy snow, strong to damaging winds, and minor coastal flooding. The storm resulted in coastal flooding and a flash freeze. In Marshfield coastal flooding caused Plymouth Avenue to be impassable and Ocean Street was closed near the Esplanade area.

- February 2, 2021: A storm produced strong winds and coastal flooding causing ten inches of water to cover the Brant Rock Esplanade in Marshfield.

- October 27, 2021: A low pressure nor'easter underwent bombogenesis and included winds that gusted to 60-90+ mph. Marshfield experienced coastal flooding along low-lying roadways in the Brant Rock area, surrounding some homes and businesses.

- January 29, 2022: A strong winter storm brought blizzard conditions with snowfall and heavy winds. The storm resulted in coastal flooding along Ocean St/Route 139 in the Brant Rock area of Marshfield.

The extent of flooding in the future, however, will impact a larger area of Marshfield. 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 flooding. 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).

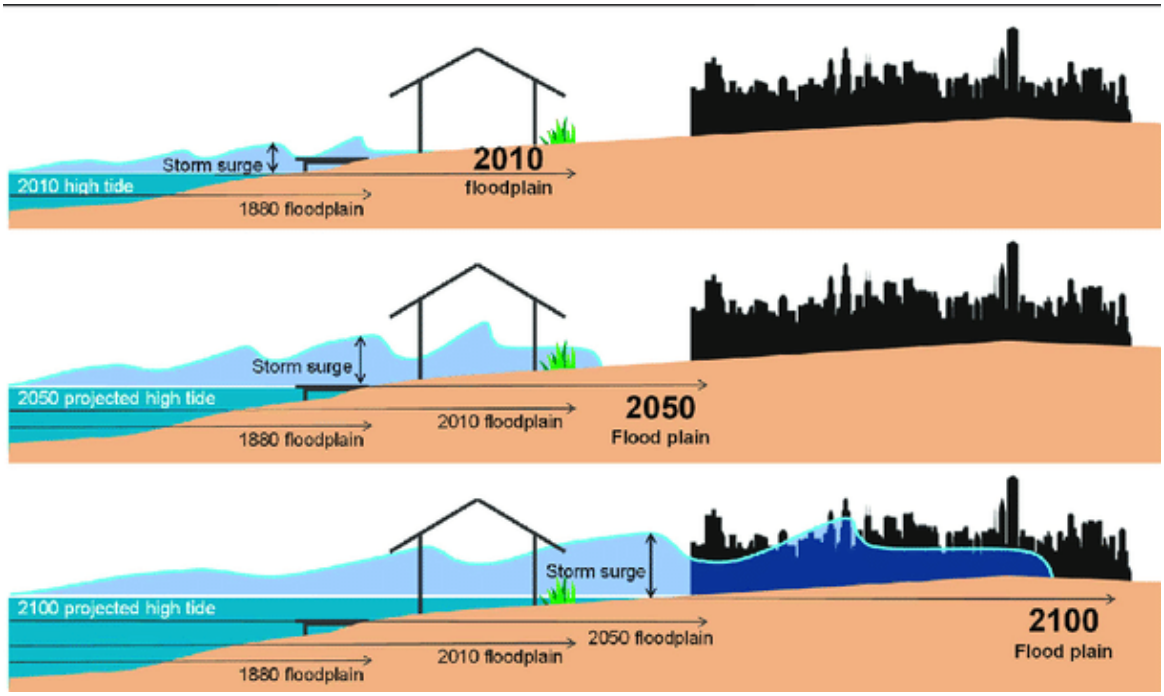


Figure 3-3. Sea-level rise magnifies the risks of storm surge and high tides (Zhang et al. 2021).

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 Boston tide gage (station ID 8443970) indicate that relative sea level has risen at a rate of 2.89 mm (+/- 0.15 mm) annually based on the monthly mean sea level between 1921 and 2021, resulting in a change of 0.95 feet (11.4 inches) in 100 years (Figure 3-4).

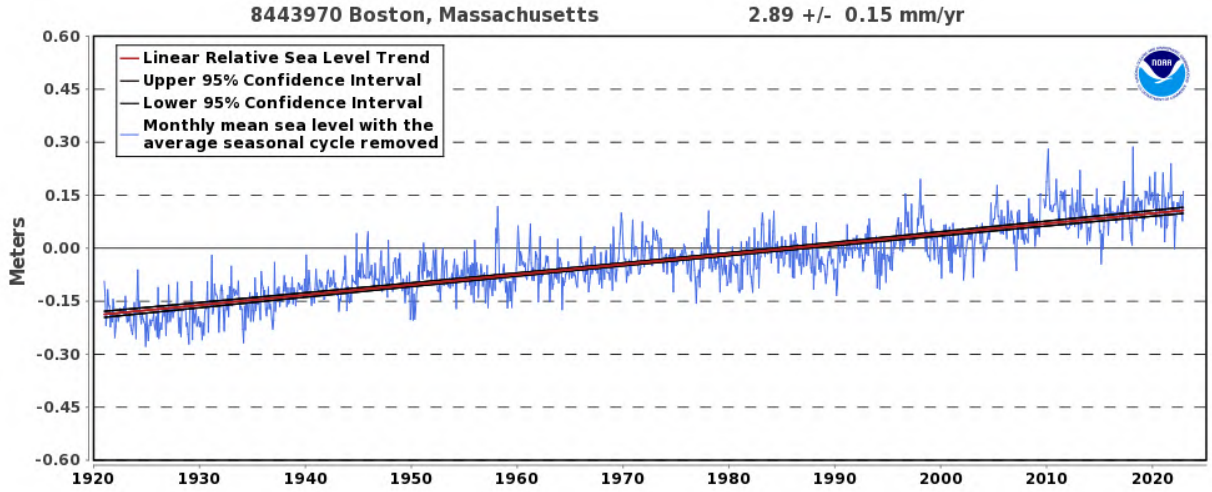


Figure 3-4. Sea-level rise trend from Boston, Massachusetts (NOAA, 2023).

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).

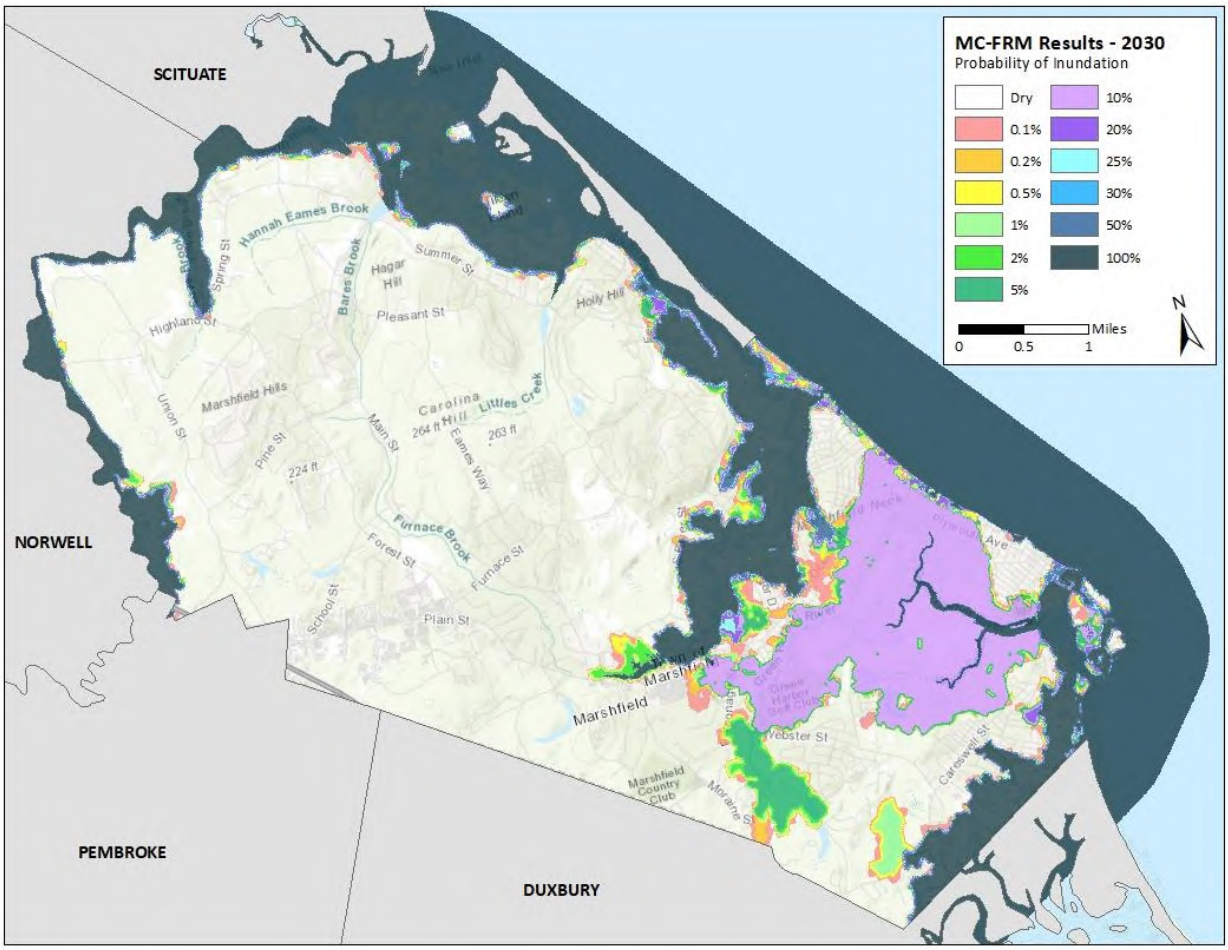


Figure 3-5. Probability of inundation in 2030 assuming a high sea-level rise scenario (MassCZM, 2023).

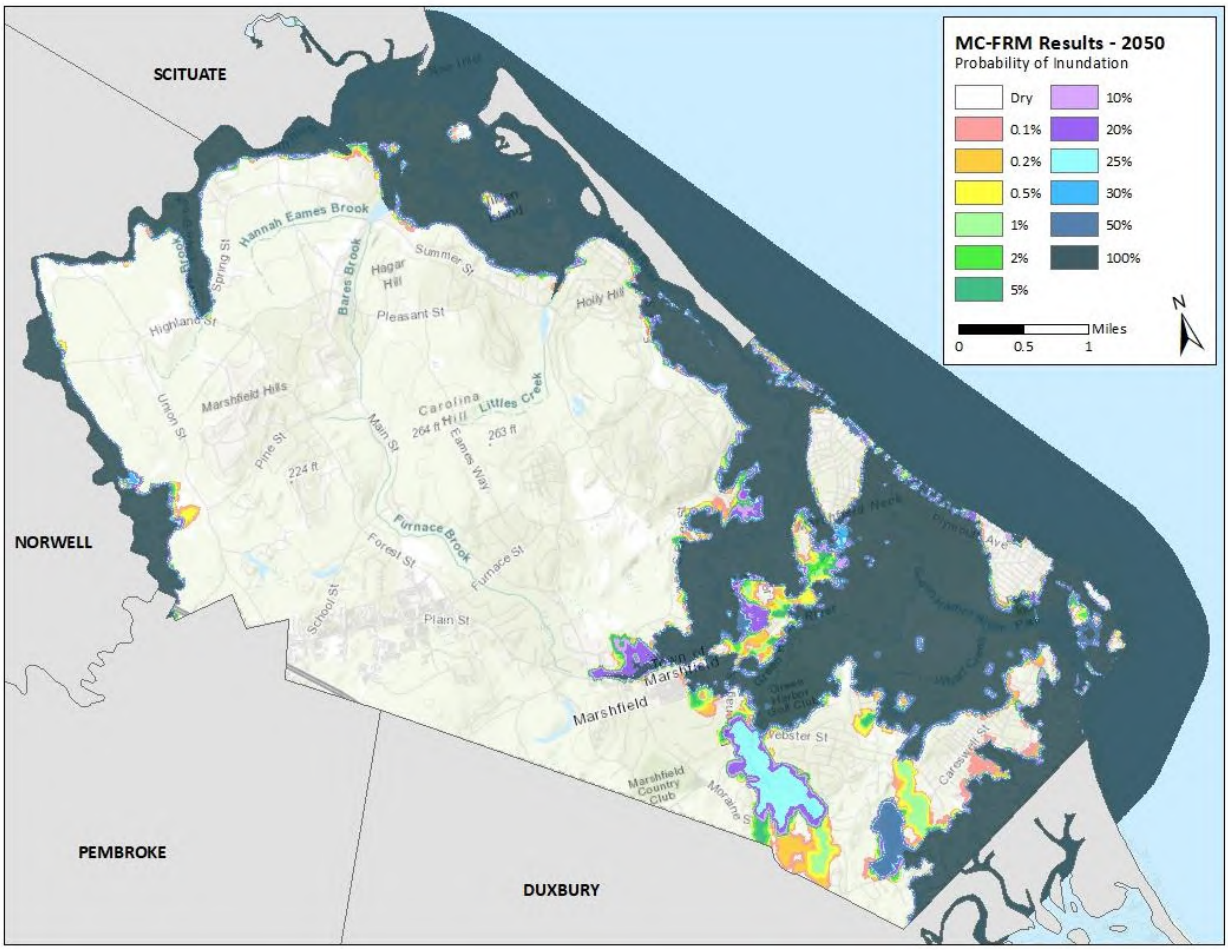


Figure 3-6. Probability of inundation in 2050 assuming a high sea-level rise scenario (MassCZM, 2023).

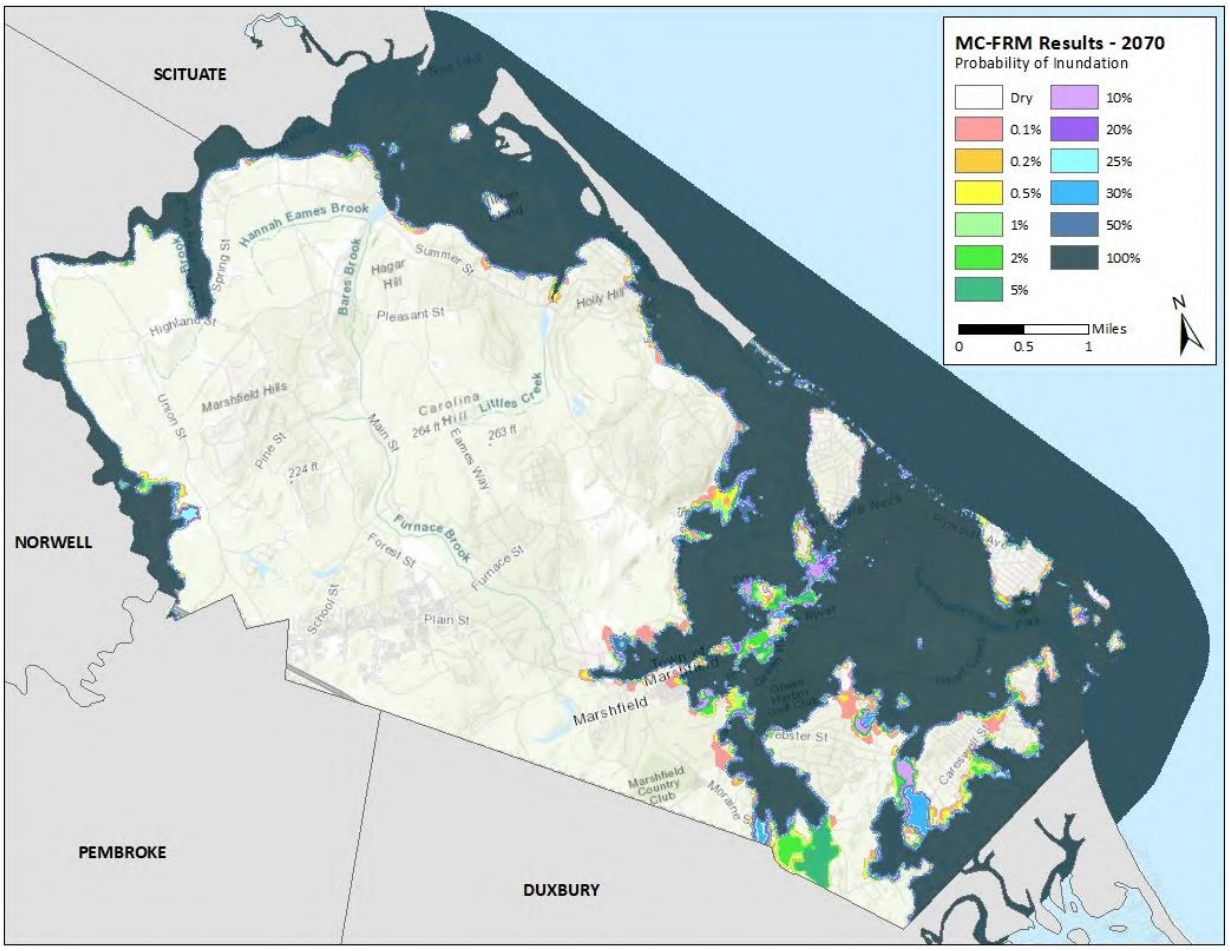


Figure 3-7. Probability of inundation in 2070 assuming a high sea-level rise scenario (MassCZM, 2023).

Probability

B2.b

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 Marshfield. 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 Marshfield will experience more severe and/or more frequent flooding.

A sea-level rise study was also completed for the Towns of Scituate, Marshfield, and Duxbury by Kleinfelder in 2013. This study evaluated areas of inundation for 2038, 2063, and 2088. The report summarized impacts from sea-level rise in Marshfield, including:

1. Marshes: Negative impacts to marshes if they cannot keep pace with sea-level rise through natural or assisted vertical growth; marshes that cannot keep up with sea-level rise will transition to intertidal mudflats or subtidal open water areas.

2. Beaches: If beaches are not nourished or raised, there could be partial or complete loss of some ocean front beaches.

3. Wildlife: Loss of tidal salt marsh areas will likely disrupt spawning grounds and wildlife habitat for numerous species.

4. Roadways and Bridges: A number of roads along the coast will be affected by higher tides and storm events. Roads that appear particularly vulnerable include: Sections of Gurnet Road and Bay Avenue; Dyke Road; Ocean Street, Island Street and Cove Street in the Brant Rock Area; Town Pier Road and the parking area at the Town Pier; Plymouth Avenue; numerous streets in the Rexhame area; Revere Street; Macombers Ridge and Macombers Way; and Bartletts Isle Way.

5. Coastal Stabilization Structures: Rising sea levels, combined with the effects of higher frequency and intensity of coastal storms, will result in more damage to coastal stabilization structures and more overtopping during major storms.

5. Wastewater Treatment Plant: Although Kleinfelder's projections did not show flooding at the Wastewater Treatment Plant facility on Joseph Driebeck Way during the 25- and 50-year projections, the 75-year sea-level rise projections did indicate that some minor flooding will occur on the access road after 5.16 feet of sea-level rise. Their results showed little to no flooding of the plant itself.

It is important to note, however, that although sea-level rise has been occurring for thousands of years, the changes that are likely to occur in the next five years (the lifespan of this document) are relatively small (14.4 mm – based on the Boston SLR trend). Although the true hazard from SLR is decades out, the time to start planning for it is now.

Impact

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

B3.a

- **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 or ferry 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. 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 coastline. 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.

The Town of Marshfield has approximately 4 miles of shoreline at least partially protected with shorefront coastal structures (e.g., seawalls, bulkheads, and jetties). Sea wall failure and coastal erosion are related issues increasingly impacting towns along the Massachusetts coast. Rising sea levels have led to increased rates of erosion along beaches and coastlines and the undermining of sea walls, some of which in Marshfield are many decades old. Sea walls protect the buildings behind them from storm damage and their failure can lead to increased property damage. Similarly, intact beaches with dunes dissipate wave energy, protecting buildings behind them. As the beaches erode away, this protection is lost. In some cases, sea walls can accelerate beach erosion. For example, in March of 2018, sections of the seawall along Bay Avenue collapsed due to undermining of its foundation from erosion. Many areas of the Marshfield coastline have no remaining high tide beach, leaving the seawalls exposed to larger waves during storms.

Hazard Location

B1.c
B2.a

The Massachusetts Office of CZM has documented the rate of change of all ocean facing shorelines in 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 Marshfield from CZM's Shoreline Change Project. Long-term data ranges from 1895 to 2013 in Marshfield. Rates shown in Figure 3-8 are in feet per year, where negative values indicate erosion and positive values indicate accretion. From these data, it is evident that the majority of the Town's coastline is experiencing some level of coastal erosion. Additionally, there is a localized area of greater erosion in the Rexhame area, where the long-term rates of erosion are significantly higher than the rest of Town (i.e., more than 1 feet per year). As shown in Figure 3-8, based on CZM's Shoreline Change Project data, coastal erosion has been occurring along much of the Marshfield coastline since at least the 1800s. However, this erosion is often episodic, as a result of significant storm flooding and wave impacts, rather than continuous erosion.

The rates of shoreline change between 1978 and 2013 are shown in Figure 3-9. It is notable that erosion in the last few decades has increased along much of Marshfield's coastline, despite the large percentage the coastline that is armored with sea walls. However, due to the presence of seawalls, these shoreline retreat rates will not continue indefinitely. Given that there is currently little to no dry high tide beach in many areas, it is likely that the seawalls will prevent any further horizontal retreat of the shoreline. Vertical erosion, which must be measured through targeted low-tide LiDAR data or through field topographic surveys, can and likely will continue to occur. If the beach profile is lowered enough, the stability of the seawalls will be threatened.

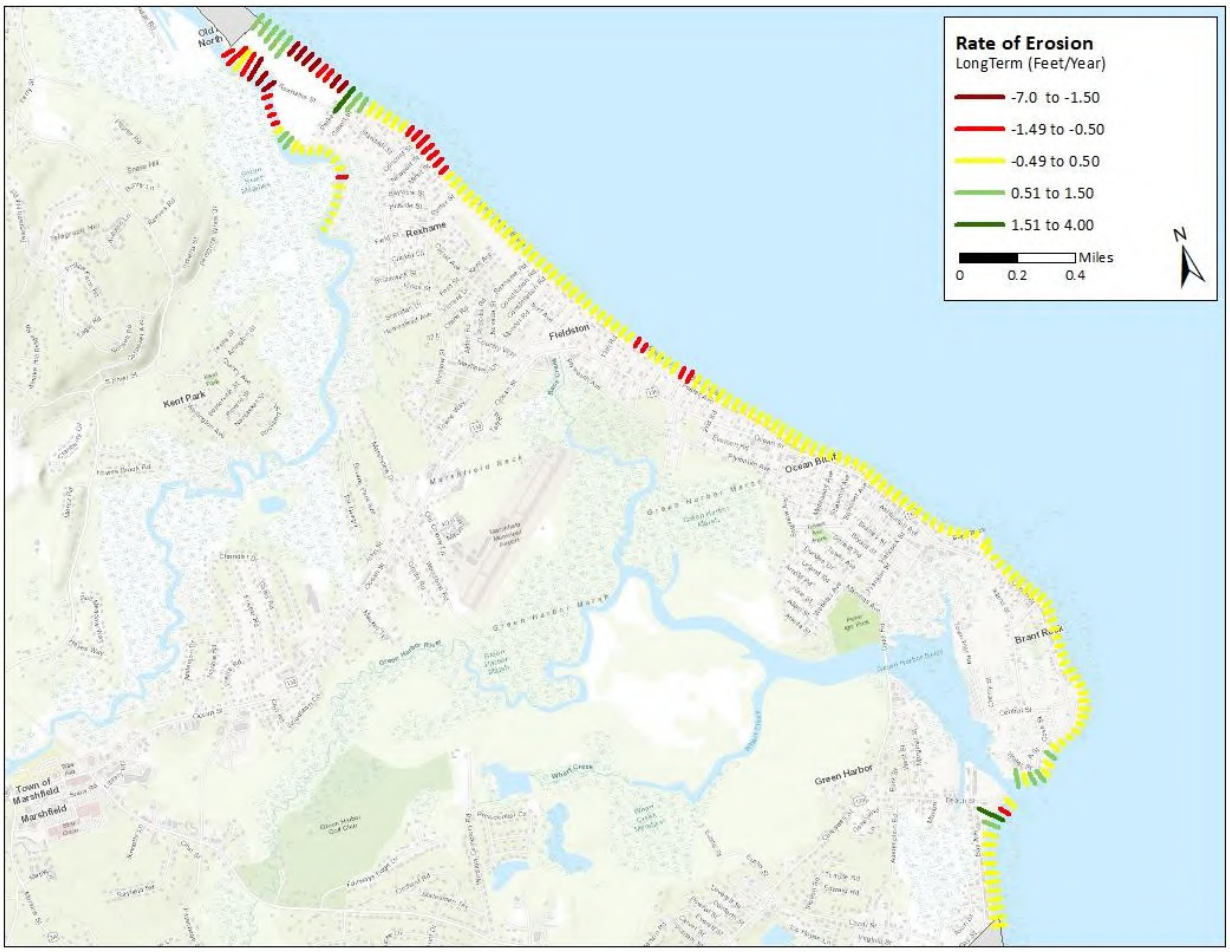


Figure 3-8. Long-term (1840 to 2014) rates of shoreline change (feet/year) (MassCZM, 2019).

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 calculated 0.1 ft/yr. as both the short- and long-term shoreline change rates for the Town of Marshfield. While this implies a stable or even slightly accretional shoreline, the standard deviation was 2.5 and 1.0 for the short- and long-term rates, respectively, indicating that some areas of town are in fact experiencing erosion. In fact, the area from Brant Rock to Fieldstone Beach and along Bay Avenue were considered to

be erosion "hot spot" areas. The CEC defines "hot spots" as known locations where the combination of erosion, storm surge, flooding, and waves have caused damage to buildings and/or infrastructure during coastal storm events over the past five years. He fact that the average rate from the CEC indicates essentially no change is likely a result of the large percentage of the Town's shoreline that is armored.

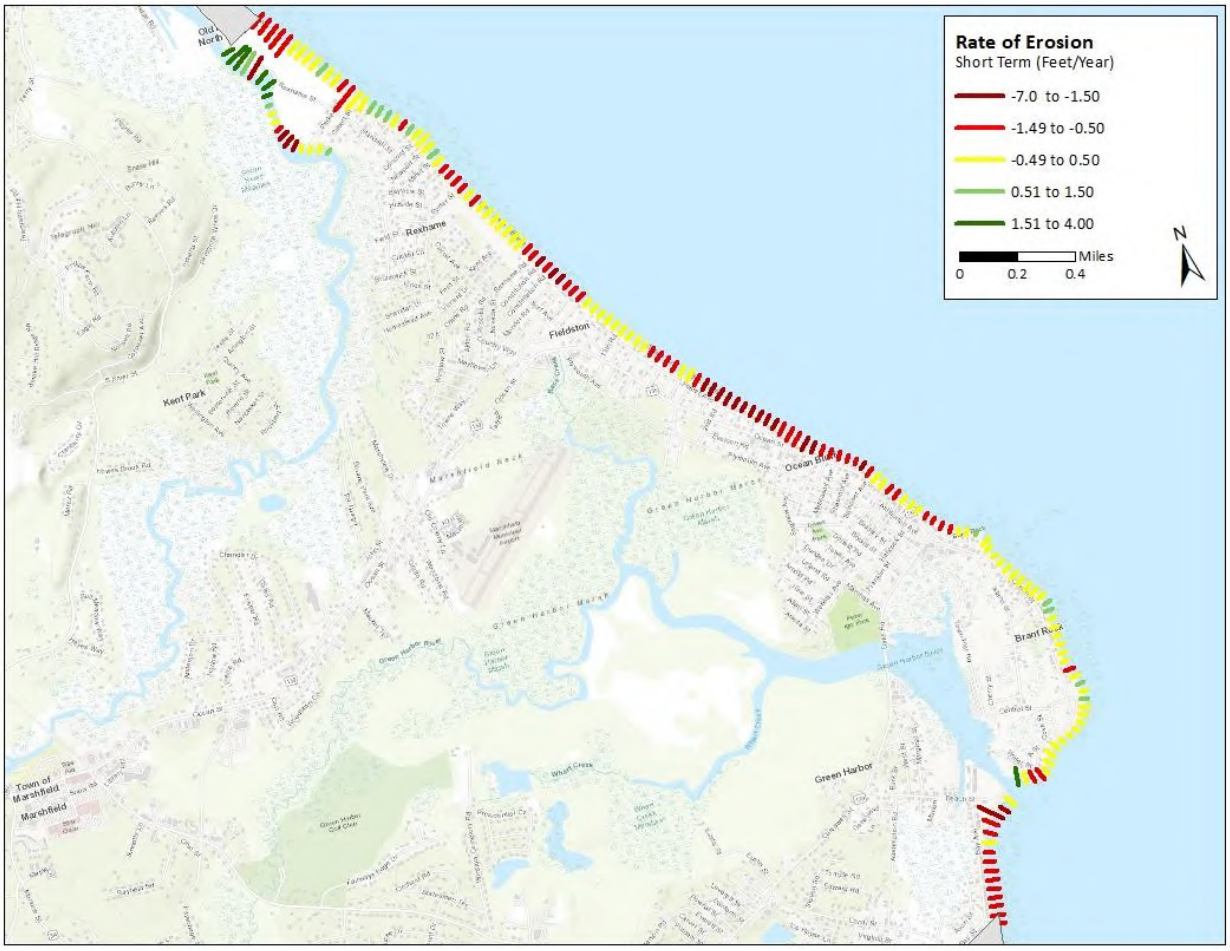


Figure 3-9. Short term (1970 to 2014) rates of shoreline change (feet/year) (MassCZM, 2019).

Previous Occurrences & Extent

B1.c
B2.a
B2.c

As shown in Figures 3-8 and 3-9, moderate to severe coastal erosion has occurred in Marshfield. 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 Marshfield.

Figure 3-10. Severe weather events, such as this Winter Storm on January 3, 2014, can cause erosion.

Probability

B2.b

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 Marshfield, 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 Marshfield will likely experience increased rates of erosion.

Impact

B3.a

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 buildings. 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

B1.c
B2.a

The entire Town of Marshfield 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 tropical cyclones. Storm surge happens when water is pushed towards shore by the force of storm generated winds. An advancing storm surge combines with the water elevation of the normal tides to create a hurricane storm tide, 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. A general schematic showing the components of storm surge is displayed in Figure 3-11.

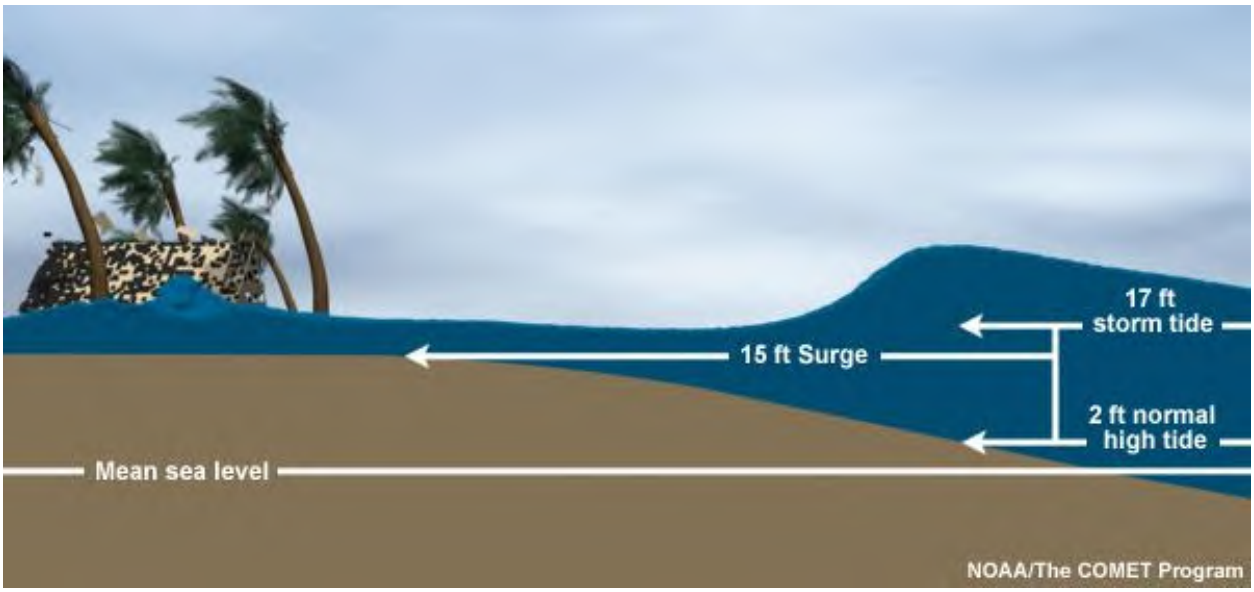


Figure 3-11. Schematic image of a storm surge and storm tide affecting a shoreline (NOAA, 2023).

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 Marshfield.

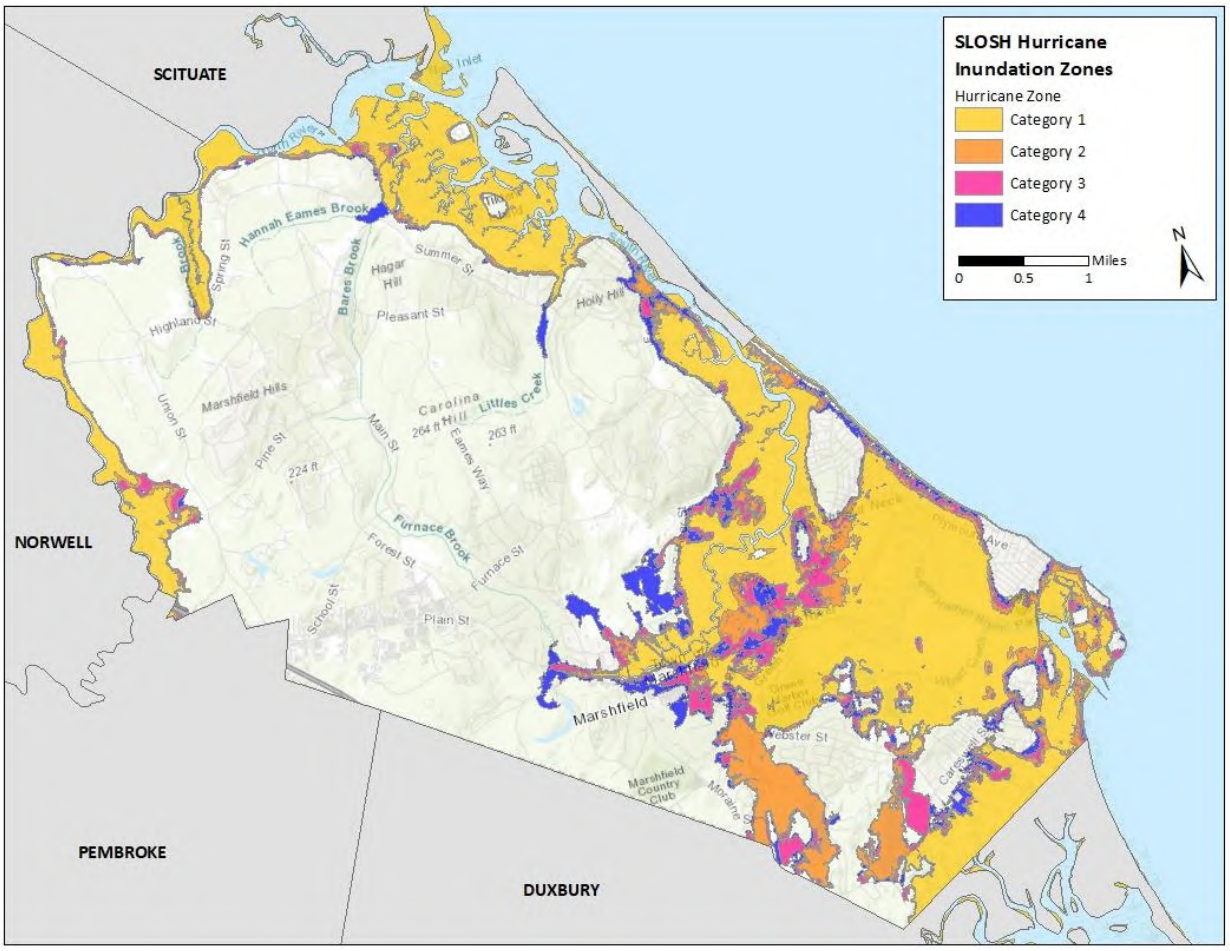


Figure 3-12. SLOSH Categories for Marshfield. Note: The SLOSH model considers only storm surge height and does not consider the added effects of wave height (MassGIS, 2013).

Previous Occurrences & Extent

B1.c
B2.a
B2.c

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 in Marshfield. The most damaging hurricane 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 Marshfield. To illustrate

the frequency of these storms, Figure 3-14 shows all hurricanes and tropical storms that have passed within 100 miles of Marshfield between 1950 and 2023. 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 3-13. High winds during Tropical Storm Sandy (October 2012) knocked over a tree onto a house on Spring Street.

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

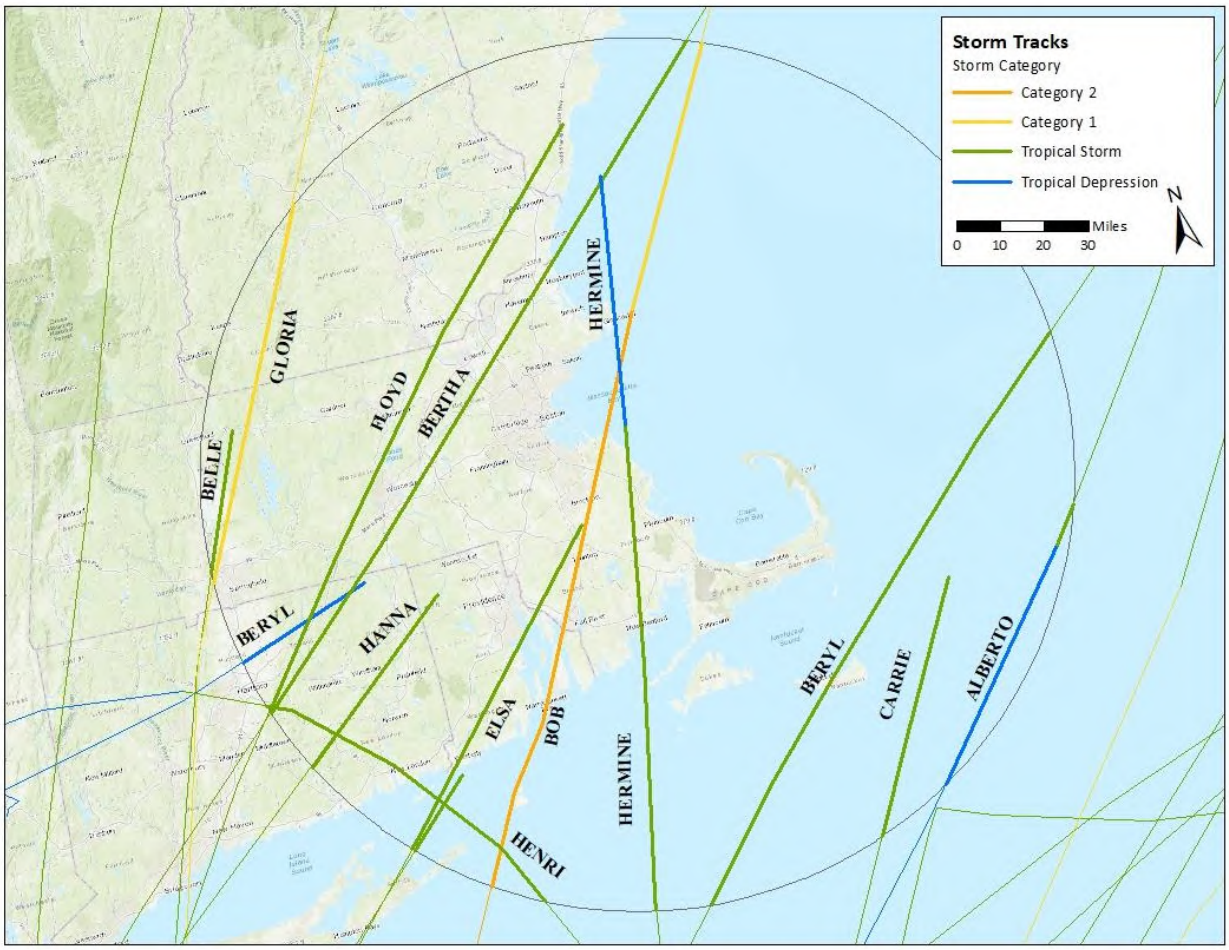


Figure 3-14. Hurricane and tropical storm tracks within 100 miles of Marshfield between 1951 and 2022 (NOAA, 2020).

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.

Probability

B2.b

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 Marshfield in the next year. In the future, higher category storms are predicted to increase as a result of climate change, meaning Marshfield may experience more of the severe weather associated with hurricanes and tropical storms.

Impact

B3.a

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 buildings are 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 Marshfield 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 gusts 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.

Hazard Location

B1.c
B2.a

The entire Town of Marshfield 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 these data from 1991 to 2020, the Marshfield area has averaged 20 to 40 inches of snowfall annually (Figure 3-15). Plymouth County has had 9 FEMA Winter Storm Declared Disasters between 1953 and 2017 (Figure 3-16).

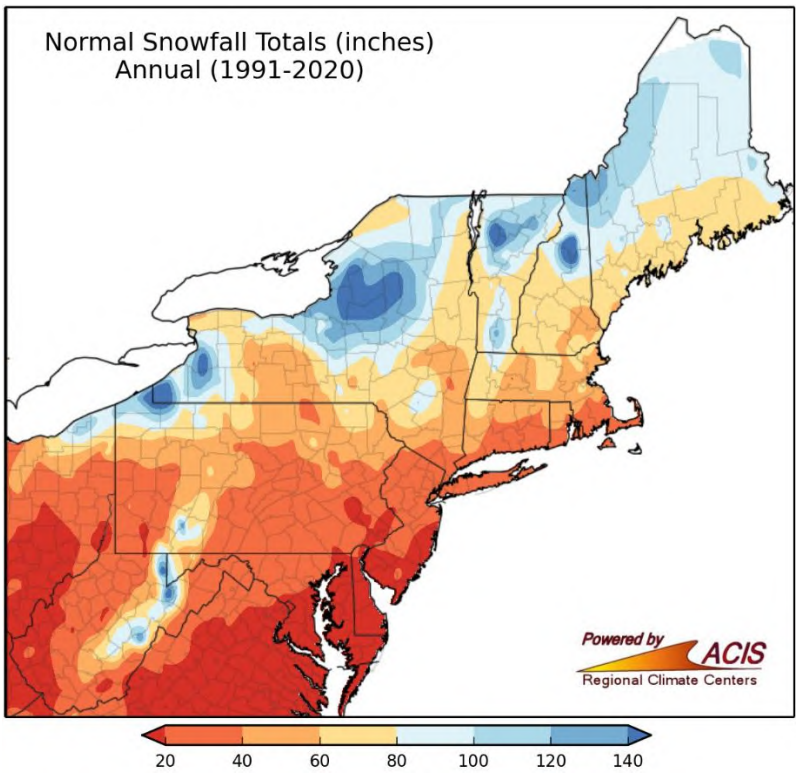


Figure 3-15. Annual average snow totals for New England between 1991 and 2020 (Northeast Regional Climate Center, 2023).

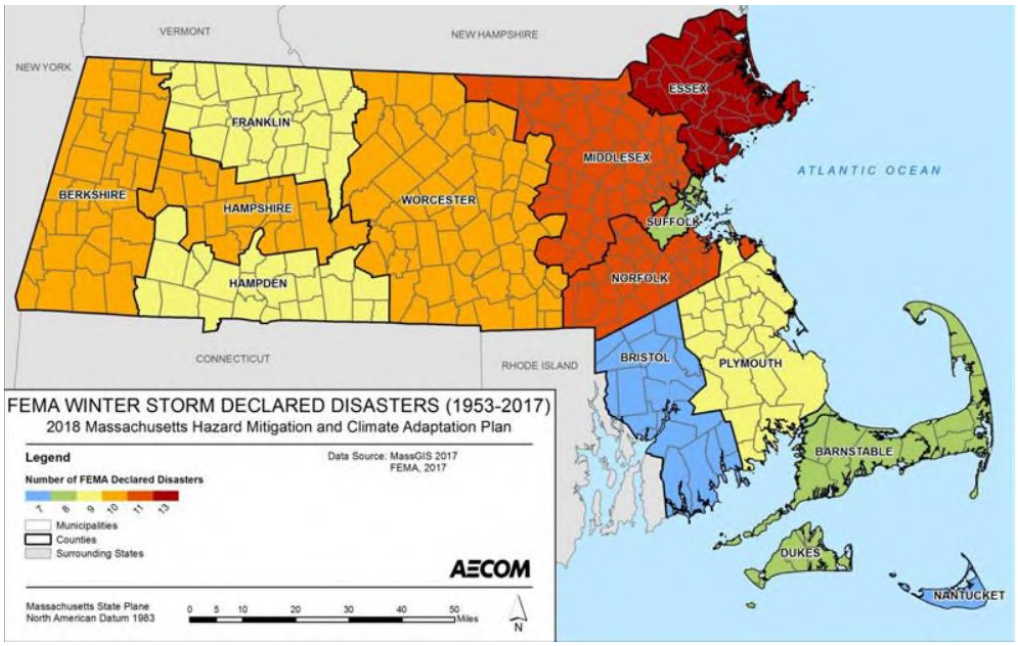


Figure 3-16. FEMA winter storm-related disasters by county (1953-2017) (Executive Office of Energy and Environmental Affairs, 2018).

Previous Occurrences & Extent

B1.c
B2.a
B2.c

Winter storms occur quite frequently, but due to preparation by the Town and its residents, these events 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), January 2015 (Winter Storm Juno), and January 2018 (Winter Storm Grayson; Figure 3-17).

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 Plymouth 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 additional 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 Greyson during January 2018.

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

Probability

B2.b

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 Marshfield. 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 Marshfield may result in heavier snowfall.

Impact

B3.a

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.

Hazard Location

B1.c
B2.a

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. Marshfield'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 Marshfield, and therefore the areas with the highest risk of wildfire. Within Marshfield, 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.

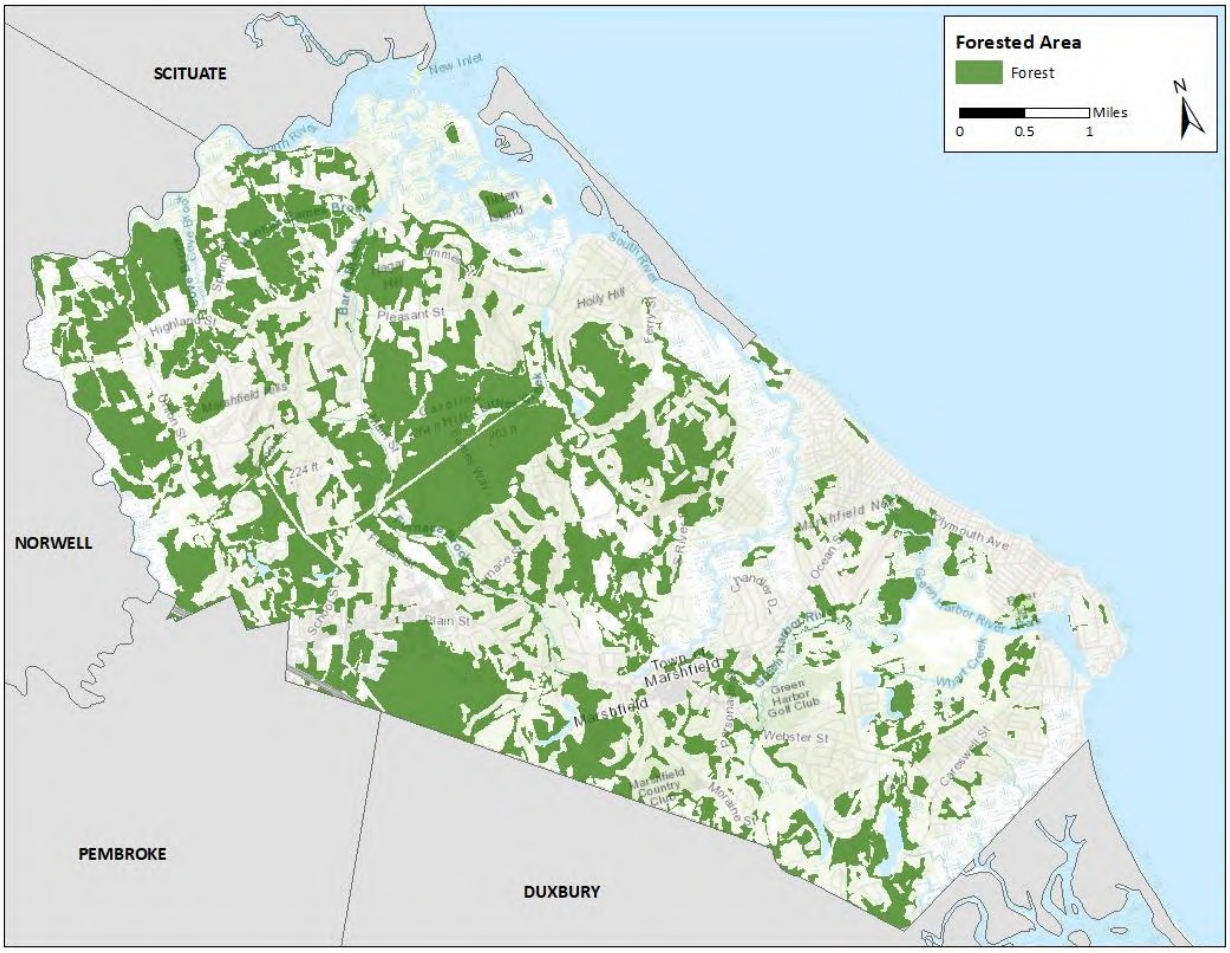


Figure 3-18. Heavily forested areas within the Town of Marshfield (MassGIS, 2013).

Previous Occurrences & Extent

B1.c
B2.a
B2.c

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. 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 Marshfield Fire Department. Between October 2017 and October 2022, the Marshfield Fire Department responded to a total of 138 Brush/Wildland/Vegetation Fires. Of those fires, the Marshfield Fire Department responded to 44 notable wildland/forest fire events which required personnel and several hundred gallons of water to extinguish. Figure 3-19 illustrates the number of wildfires

that occurred in Marshfield in each year from 2017 to 2021, and Figure 3-20 shows the impact from a marsh fire in 2022.

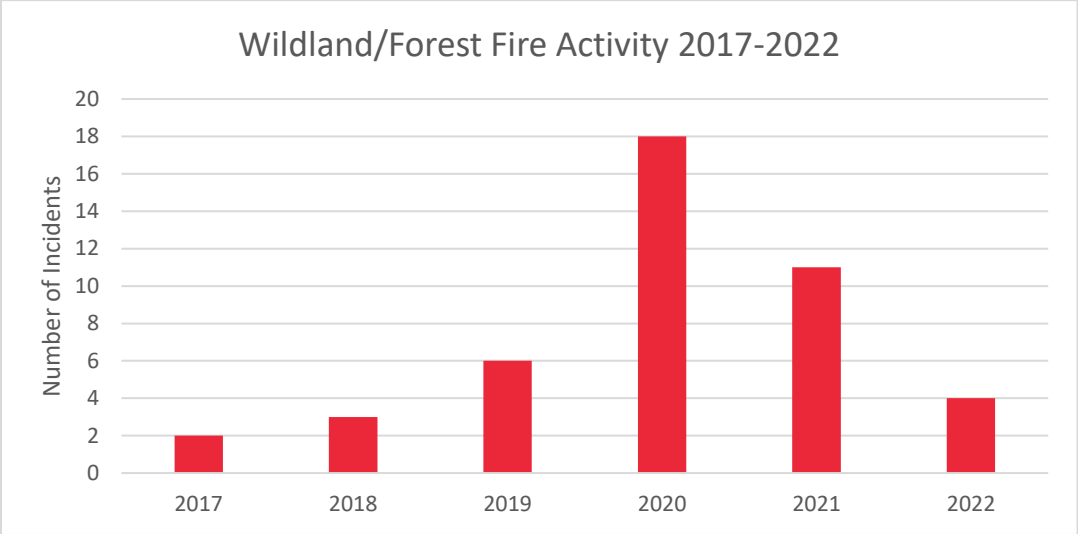


Figure 3-19. Notable Wildland/Forest Fire Activity 2017-2022 in Marshfield, Massachusetts.

The largest fire reported in Marshfield occurred in 1941. On April 24, 1941, a disastrous fire leveled the entire seaside community of Ocean Bluff, destroying approximately 500 buildings. The fire began in the marshland behind the beach and was carried to the nearby dwellings by high wind. The neighborhood was extremely congested, with many of the lots being less than 2,000 square feet, and cottages were generally of flimsy construction without substantial foundations or fire-resistant roofs. Changes were made in the zoning rules following the fire to prevent a repeat event.

Figure 3-20. The aftermath of illegal burning which resulted in a marsh fire during the spring of 2022 on Anderson Drive in Marshfield.

Once a fire starts, the 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

Probability

B2.b

The Town of Marshfield 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 Marshfield. Increasing temperatures caused by climate change leads to dryer soil within forests and a higher flamability of vegetation. In addition, snow may melt earlier, meaning wooded areas will experince drier conditions for a longer period of time. All of these factors contribute to a higher risk of wildfire within the Town of Marshfield in the future as a result of cliamte change.

Impact

B3.a

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, Plymouth County is located in an area of very low probability of occurrence, with less than one tornado expected to occur every five years.

Hazard Location

B1.c
B2.a

NOAA's National Weather Service maintains a database of tornado information in the United States (updated through December 2022). 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 190 tornadoes documented in Massachusetts from 1950 to 2021 (Figure 3-21). Although only one tornado has touched down within Marshfield itself, as noted above, a total of 9 tornadoes have occurred within Plymouth County since 1950.

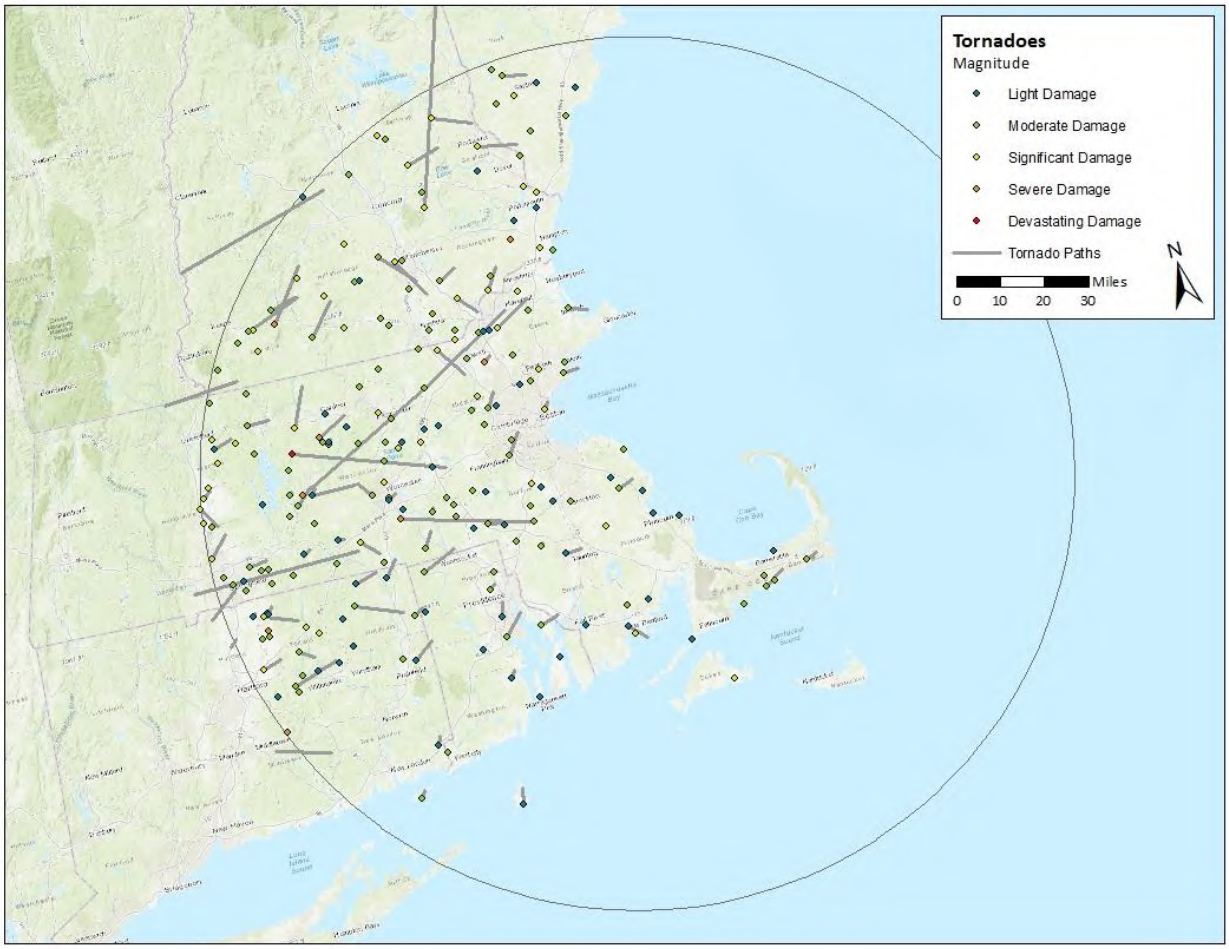


Figure 3-21. Massachusetts tornadoes between 1951 and 2021 (NOAA, 2022).

Previous Occurrences & Extent

B1.c
B2.a
B2.c

Although only one tornado has touched down within Marshfield itself, as noted above, a total of 9 tornadoes have occurred within Plymouth County since 1951. 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.

Table 3-7. Plymouth County Tornadoes Between 1951 and 2022.

Date	Town	F-scale	Injuries	Fatalities	Length (miles)	Width (yards)
9/7/1958	Duxbury	0	1	1	0.1	10
7/4/1964	Pembroke/ Marshfield	1	0	0	2.3	10
6/9/1965	Marion	0	0	0	0.1	10
11/18/1967	Halifax	2	0	0	0.1	17
9/16/1986	Scituate	1	0	0	0.1	50
7/10/1989	Brockton	1	1	0	0.1	23
7/10/1989	Hanover	0	0	0	0.1	23
8/20/2012	Plymouth	0	0	0	0.1	10
7/24/2012	Plymouth	0	0	0	0.03	15

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.

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.

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

Probability

B2.b

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 Marshfield. 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.

Impact

B3.a

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 when 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.

Hazard Location

B1.c
B2.a

The entire Town of Marshfield is equally vulnerable to drought.

Previous Occurrences & Extent

B1.c
B2.a
B2.c

Significant periods of drought have occurred in Plymouth County, and Marshfield 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 the Southeast region 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, Marshfield 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 the Southeast region are detailed in Table 3-12. Most recently, there was a drought from September 1, 2022, to September 30, 2022, with a severity level of Mild (Table 3-1).

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) (*Formerly Advisory*)	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) (*Formerly Watch*)	1 of the following: 3-month cum. <65%; **or** 6-month cum. <70%; **or** 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) (*Formerly Warning*)	1 of the following: 3-month cum. <65% and 6 month cum <65%; **or** 6-month cum. <65% and 12-month cum. <65%; **or** 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 **and** previous month were 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 Southeast Region Between 2016 and 2022.

Year	Begin Date	End Date	Southeast Status
2016	7/1/2016	7/31/2016	Advisory
2016	8/1/2016	8/31/2016	Watch
2016-2017	9/1/2016	2/28/2017	Warning
2017	3/1/2017	3/31/2017	Watch
2017	4/1/2017	4/30/2017	Advisory
2020	7/1/2020	8/31/2020	Significant
2020	9/1/2020	9/30/2020	Critical
2020	10/1/2020	10/31/2020	Significant
2020	11/1/2020	11/30/2020	Mild
2021	3/1/2021	3/31/2021	Significant
2021	5/1/2021	5/31/2021	Mild
2022	4/1/2022	4/30/2022	Mild
2022	5/1/2022	7/15/2022	Significant
2022	7/16/2022	8/15/2022	Critical
2022	8/16/2022	8/31/2022	Significant
2022	9/1/2022	9/30/2022	Mild

Probability

B2.b

Based on the data summarized above about past drought conditions in Marshfield, the probability that a drought will occur in Marshfield 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 frequnt and severe droughts are still predicted to occur as a result of increased temperature and evaporation.

Impact

B3.a

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. Reductions in drinking water supply may occur as well as health related issues 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**: Fish habitat such as streams, rivers, and ponds may dry up. Lack of food and drinking water for wildlife may occur and wildlife may be forced to migrate to find adequate resources. Wildfires may also 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.

Hazard Location

B1.c
B2.a

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

Previous Occurrences & Extent

B1.c
B2.a
B2.c

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 16, 2015: Near blizzard conditions brought large amounts of snow and frigid temperatures. The Automated Surface Observing Station at Plymouth Municipal Airport recorded wind chills as low as -28°F.
2) 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.
3) July 3, 2018: Hot and very humid air were brought to Southern New England where heat Index values of 105 to 109 occurred in parts of Eastern Massachusetts. The Marshfield Municipal Airport reported a Heat Index of 107 from 2:30 PM EST to 5:30 PM EST.

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.

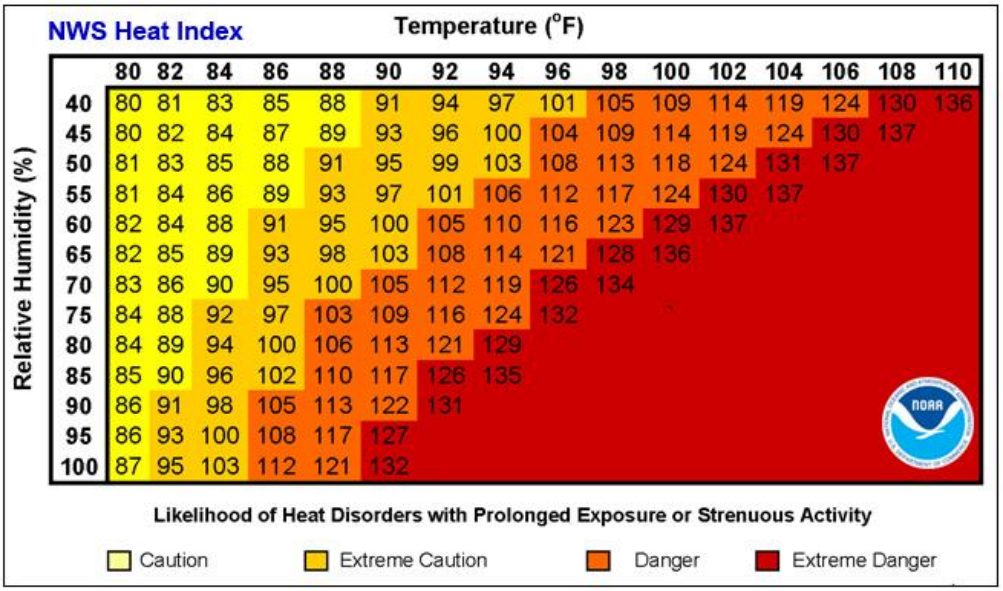
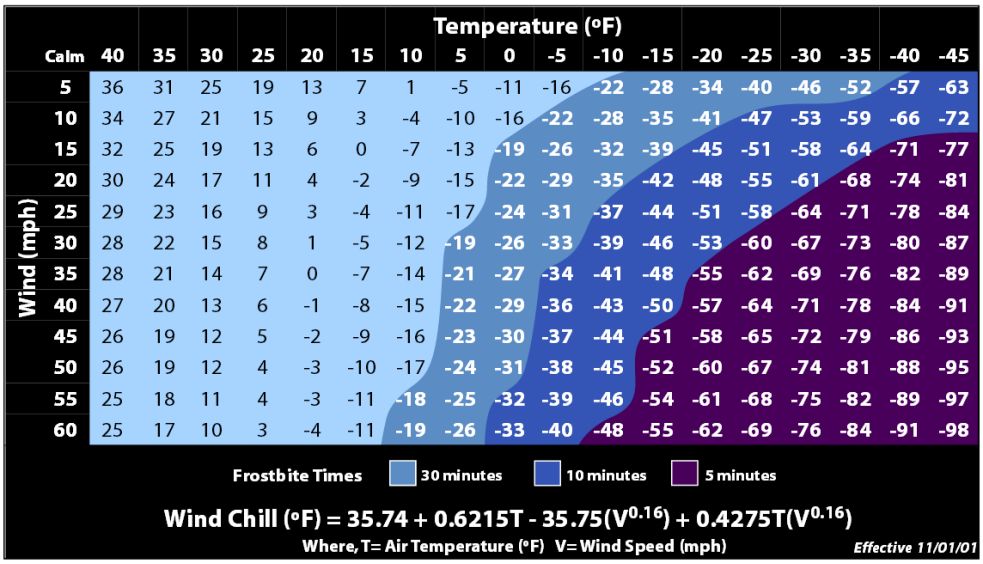


Figure 3-22. NWS's heat index (NOAA, 2017).



Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

Wind Chill (°F) = $35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$

Where, T= Air Temperature (°F) V= Wind Speed (mph) *Effective 11/01/01*

Figure 3-23. NOAA's wind chill chart (NOAA, 2001).

Probability

B2.b

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

Impact

B3.a

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 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.

Hazard Location

B1.c
B2.a

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 210 earthquakes ranging in magnitude from 0 to 3.8 within 100 miles of the Town of Marshfield.

Previous Occurrences & Extent

B1.c
B2.a
B2.c

Although there are no recorded earthquakes within Marshfield itself, there have been 210 occurrences of earthquakes since 1974 within 100 miles of Marshfield. 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 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.

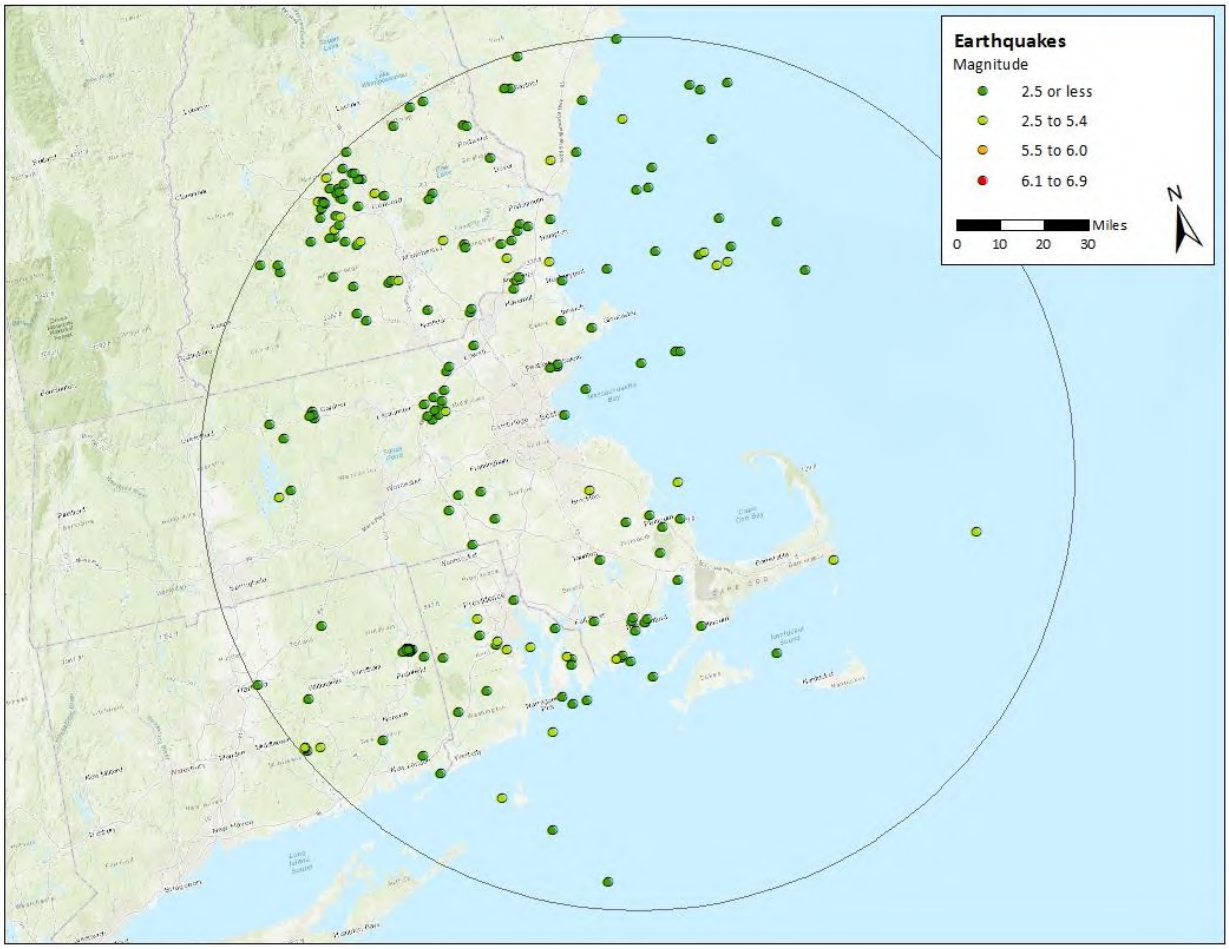


Figure 3-24. Earthquakes that have occurred within 100 miles of Marshfield since 1970 (USGS, 2019).

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

Probability

B2.b

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 Marshfield. Any possible effects of climate change on earthquakes are still being determined.

Impact

B3.a

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, increasing the likelihood for downed trees and limbs during many other natural hazard events.

Native flora and fauna may be adversely impacted by invasive species. Native flora and fauna in Marshfield, as detailed in Marshfield's BioMap2 include:

1. Endangered Species:
   a. Least Bittern *Ixobrychus exilis*
   b. Estuary Beggar-ticks *Bidens hyperborean*
   c. Long's Bitter-cress *Cardamine longii*
   d. Variable Sedge *Carex polymorpha*
   e. Parker's Pipewort *Eriocaulon parkeri*
2. Threatened Species:
   a. Piping Plover *Charadrius melodus*
   b. Seabeach Needlegrass *Aristida tuberculosa*
3. Species of Special Concern:
   a. Eastern Box Turtle *Terrapene Carolina*
   b. Common Moorhen *Gallinula chloropus*
   c. American Sea-blite *Suaeda calceoliformis*

The habitat of state-listed rare species in Massachusetts' Natural Heritage & Endangered Species Program (NHESP) are displayed in Figure 3-25.

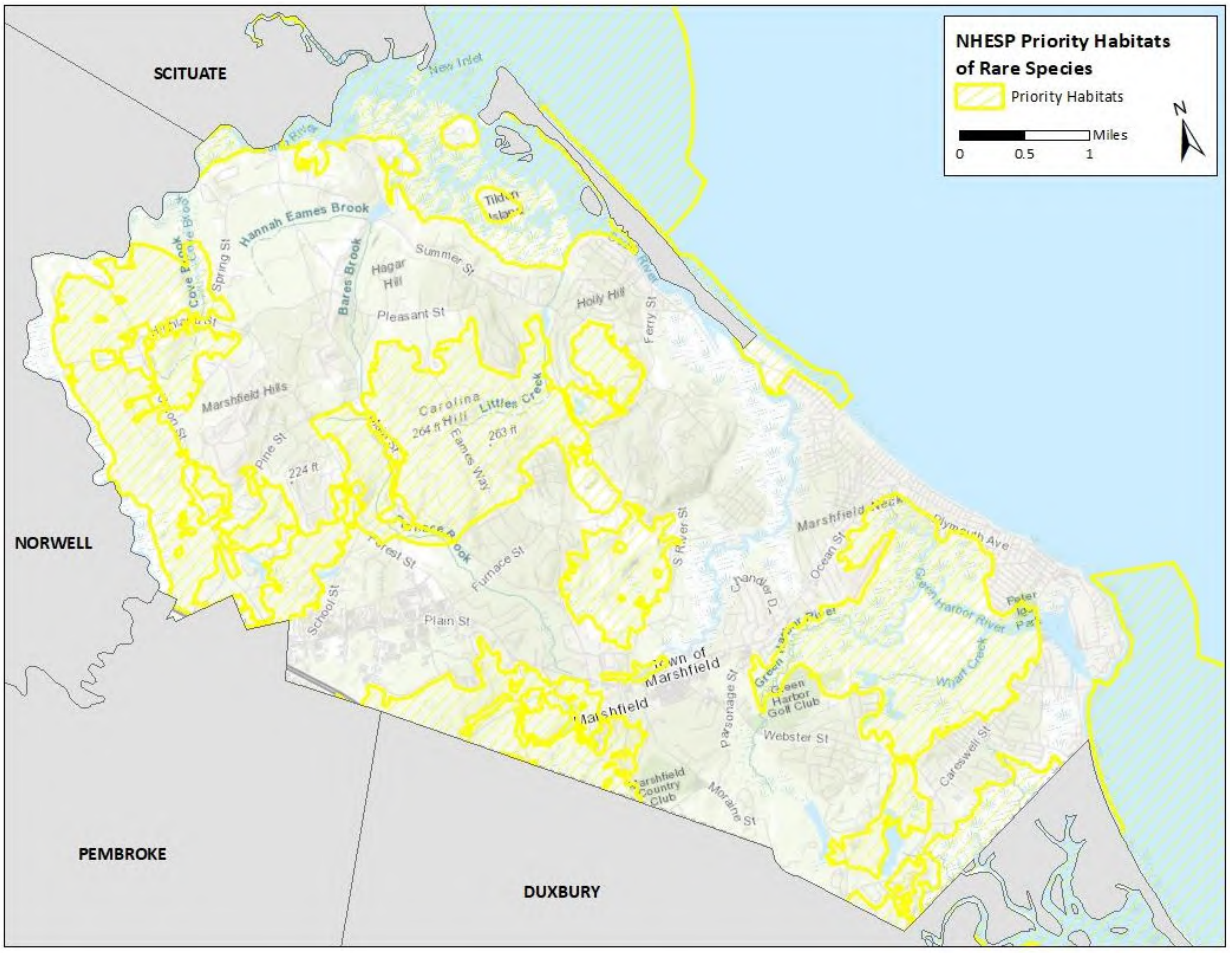


Figure 3-25. Priority Habitats of Rare Species within Marshfield (MassGIS, 2021).

Hazard Location

B1.c
B2.a

Although the entire Town of Marshfield 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.

Previous Occurrences & Extent

B1.c
B2.a
B2.c

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 maenus*), and Asian shore crab (*Hemigrapsis sanguineus*).

Within the Town of Marshfield, invasive species are present within large portions of town. Areas where they pose a significant problem are in areas along the inner shoreline of Green Harbor and the Bass Creek area.

The DPW has been known to manage Phragmites *Phragmites australis* (Common Reed) in the past. They have worked with Mosquito Control to remove this invasive species in areas of Bass Creek. At this time, the only organizations doing regular management of invasive species are the DPW and Mosquito Control.

Probability

B2.b

There are known invasive species within the Town of Marshfield, 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 Marshfield may become more susceptible to additional invasive species as climate change facilitates the spread and establishment of invasive species.

Impact

B3.a

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 equals 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 Marshfield. Based on recent studies, New England has 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. These data compare a reference period from 1901-1960 with the more recent period from 1986-2016. The threshold used to define a heavy precipitation event is the top 1 percent of all days with precipitation.

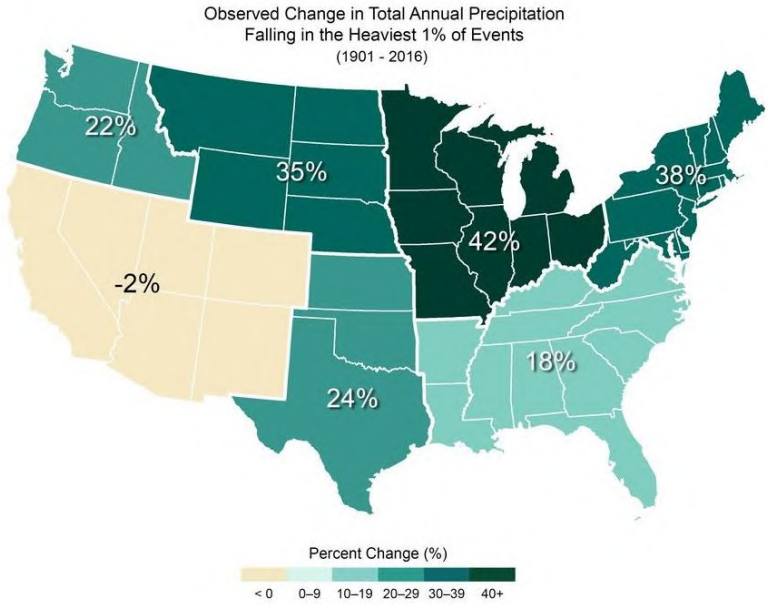


Figure 3-26. Observed changes in heavy precipitation (U.S. Global Change Research Program, 2023).

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 Marshfield in Figure 3-26.

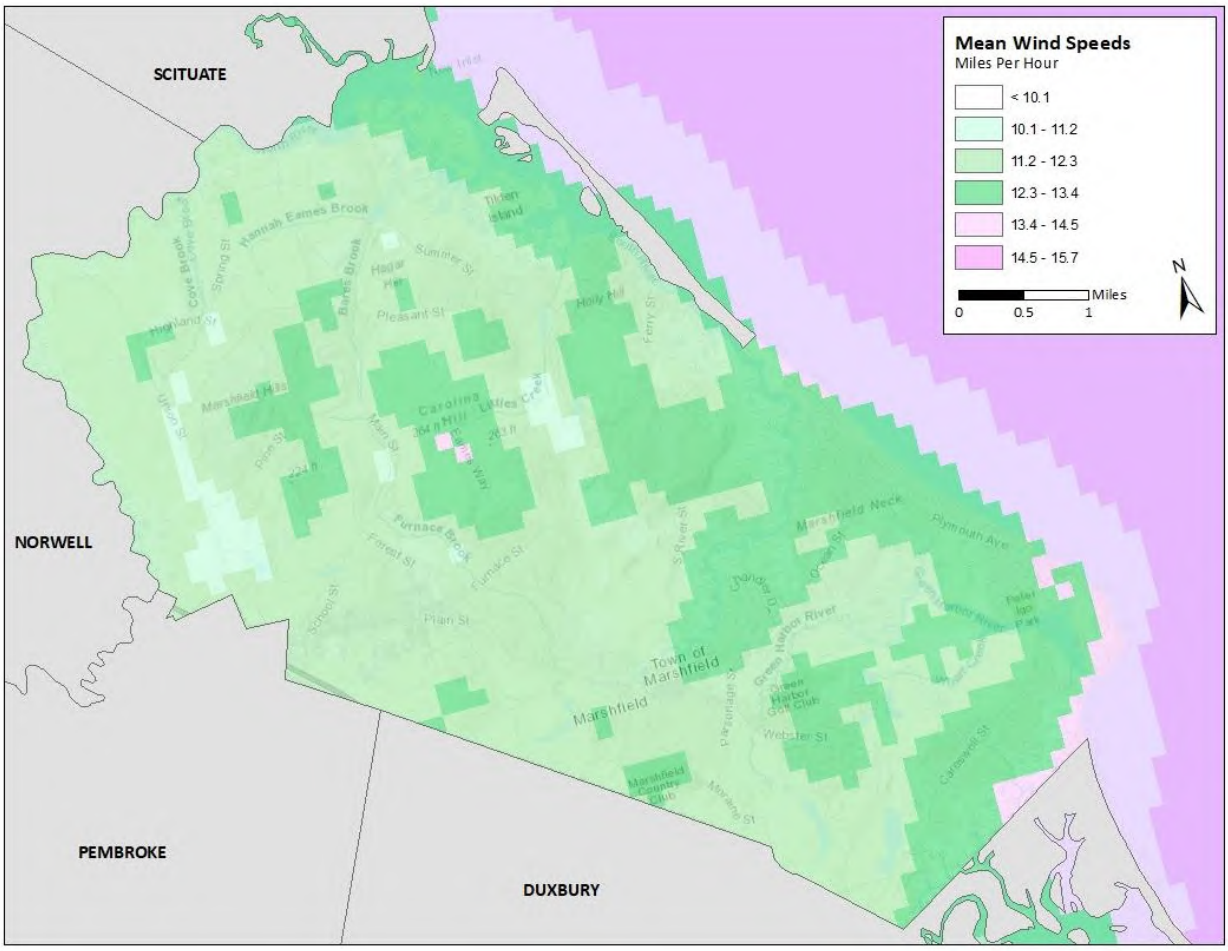


Figure 3-27. Mean wind speed (mph) at 30 meters above the surface (MassGIS, 2007)

Thunder and Lightning: The entire Town of Marshfield 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 Marshfield, falls in the darker blue area, which receives, on average, 10-20 thunderstorms per year.

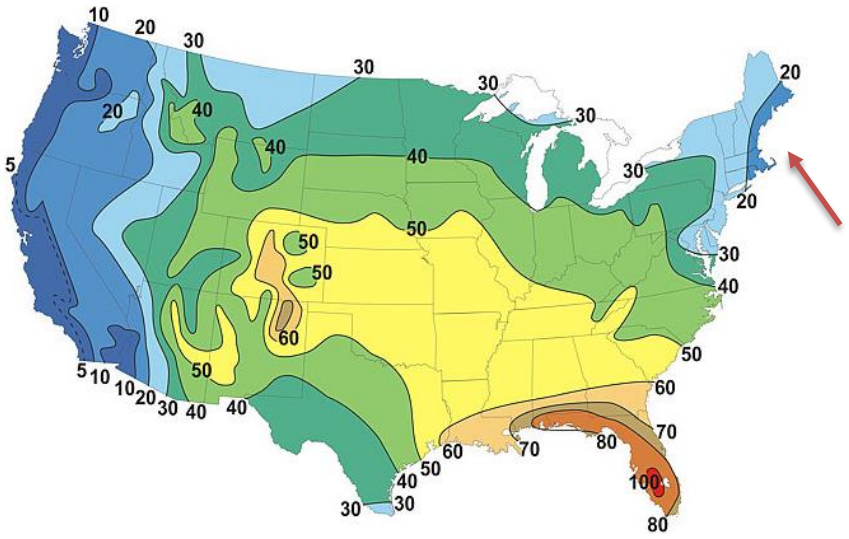


Figure 3-28. Annual number of thunderstorms (arrow added) (Department of Meteorology and Atmospheric Science, 2023)

Previous Occurrences & Extent

B1.c
B2.a
B2.c

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:

1) March 29, 2003: Rainfall between 2 to 4 inches fell on Eastern Massachusetts when a low-pressure system tracked north from the mid-Atlantic. No serious flooding was reported.

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. Marshfield reported 3.25 inches of rainfall.

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 monthly precipitation in Marshfield for the period 2017 to 2033 is summarized in Table 3-14.

Table 3-14. Average precipitation data for the Boston Region from 2017 to 2033.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	4.25	3.22	4.18	5.73	3.45	4.85	4.03	1.58	3.73	4.14	1.8	2.49	43.45
2018	4.92	3.77	5.07	4.62	1.9	2.96	4.55	4.65	5.12	3.78	9.26	2.72	53.32
2019	3.62	3.45	2.95	6.52	3.35	5.15	5.81	3.48	2.16	4.45	3.37	6.07	50.38
2020	1.39	3.3	3.6	4.33	2.21	2.66	1.95	2.28	0.97	4.98	4.2	5.67	37.54
2021	2.02	3.05	1.89	4.44	4.92	2.57	10.07	7	7.47	5.11	1.34	2.45	52.33
2022	2.33	4.61	2.93	2.32	1.32	2.33	0.62	1.47	2.6	4.28	2.69	3.75	31.25
Mean	3.09	3.57	3.44	4.66	2.86	3.42	4.51	3.41	3.68	4.46	3.78	3.86	44.71

High Wind: A summary of the high wind events from the NOAA NCDC Storm Events database (NOAA, 2022) for the most recent nine (9) events that are specific to Marshfield since the 2018 plan are listed below. These events indicate high wind events are very common in Marshfield (multiple times per year):

1) January 24, 2019: A low pressure system brought high south winds and heavy rain to Massachusetts. A utility pole was reported to be downed on Union Street in Marshfield.
2) February 25, 2019: A storm redeveloped along the Mid Atlantic coast moving to the Southern coast of New England. This coastal storm brought damaging west-northwest winds to Massachusetts. Two utility poles were down in Marshfield near the Fairgrounds on Main Street. A utility pole, transformer, and wires were down on Main Street and a large tree and wires were down on Colby Hewitt Lane.
3) February 7, 2020: Damaging winds occurred across much of eastern Massachusetts, which included widespread power outages and numerous trees down, some falling on homes and vehicles. The Marshfield Airport recorded a 56-mph gust.
4) April 13, 2020: A pressure system originating in the Great Lakes area caused sustained winds of over 64 mph in Marshfield.
5) September 30, 2020: A cold front moved across the northeast region causing damaging winds. Gusts over 54 mph were reported in Marshfield.
6) December 25, 2020: A strong frontal system moved north from the southern US over Massachusetts. In Marshfield a 4-foot diameter tree was down on Corn Hill Road.
7) October 26, 2021: A low pressure nor'easter resulted in wind gusts of 60 to over 90 mph. Over 495,000 people lost power in Massachusetts. Marshfield recorded wind gusts of 60 mph.
8) April 19, 2022: A coastal storm moved northward from the mid-Atlantic coast which included heavy rainfall, damaging wind gusts a storm system, and snow in some areas. Marshfield Airport recorded a gust to 48 mph.
9) December 23, 2022: The storm produced damaging southeast to south winds across much of southern New England and included minor to moderate coastal flooding and rainfall. The Marshfield Airport recorded a wind gust to 58 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.

Thunder and Lightning: The NOAA NCDC Storm Events database lists 79 lightning and/or thunderstorm wind events for Plymouth County within the last 10 years (NOAA, 2021). Only one (1) of the recorded events was specific to Marshfield:

1) February 25, 2016: A low pressure tracked through southern New England which developed showers and thunderstorms. The storms and heavy rain allowed the stronger winds to mix down to the surface. This resulted in a complicated combination of severe thunderstorm winds and high winds causing a downed tree on a house in Marshfield.

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.

Probability

B2.b

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 Marshfield. As mentioned with prior hazards, climate change is predicted to increase the frequncy and intensity of storms and severe weather events, which includes heavy precipitaiton, high winds, and thunder/lightning storms.

Impact

B3.a

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.

Hazard Location

B1.c
B2.a

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 show where past slope movement has occurred and/or may occur in the future under heavy precipitation events. Figure 3-28 shows the slope stability map for Marshfield. Overall, the topography of Marshfield is relatively flat and stable.

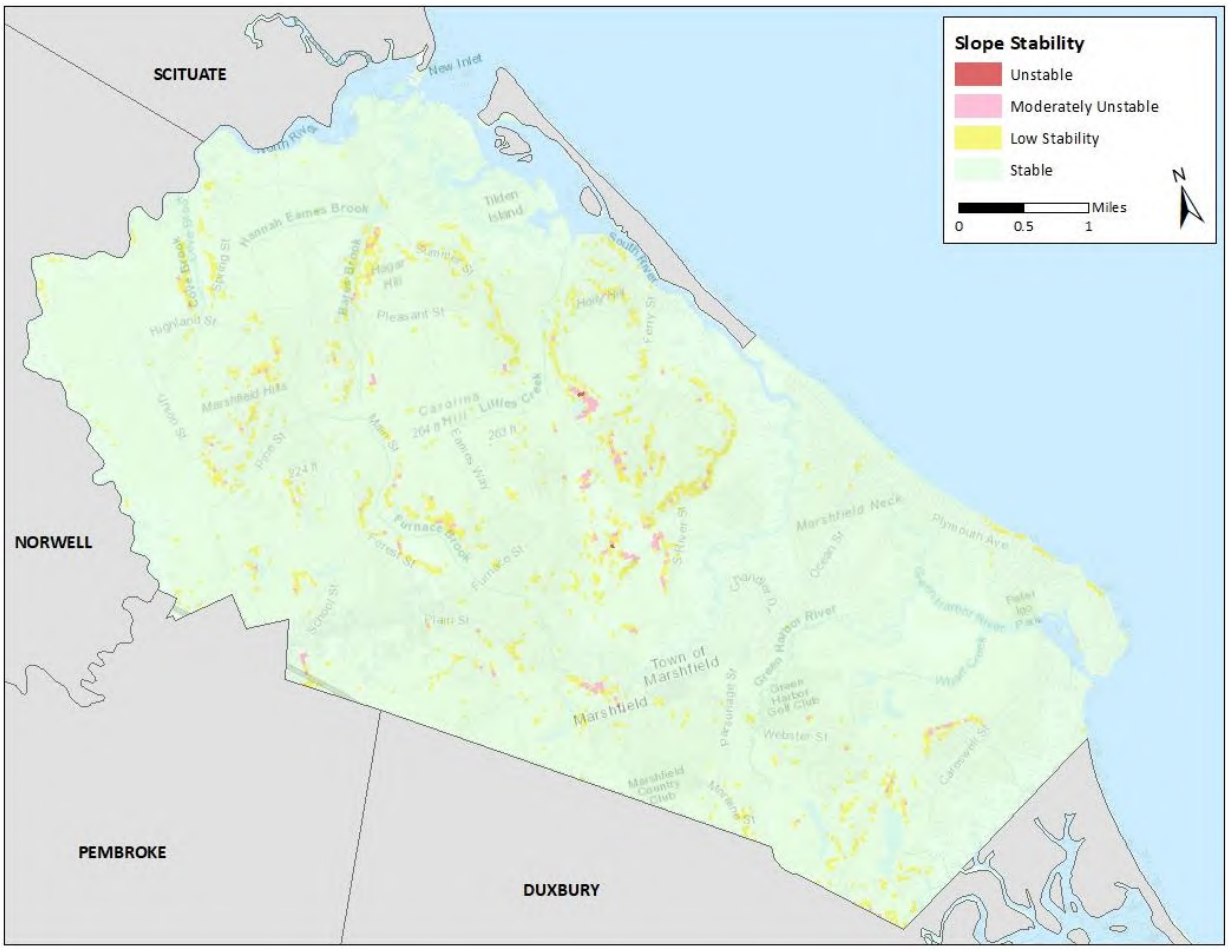


Figure 3-29. Slope stability of Marshfield (Massachusetts Geological Survey, 2013).

Previous Occurrences & Extent

B1.c
B2.a
B2.c

Although there have been no reported landslides within the Town of Marshfield since 1900, there have been seven (7) reported landslides within 100 miles of Marshfield. These events are shown in Figure 3-29 and listed in Table 3-15. 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 Marshfield in each category are listed below:

- High confidence in extent or nature of the landslide (0);
- Confident consequential landslide at this location (0);
- Likely landslide at or near this location (0);
- Probable landslide in the area (10); and
- Possible landslide in the area (0).

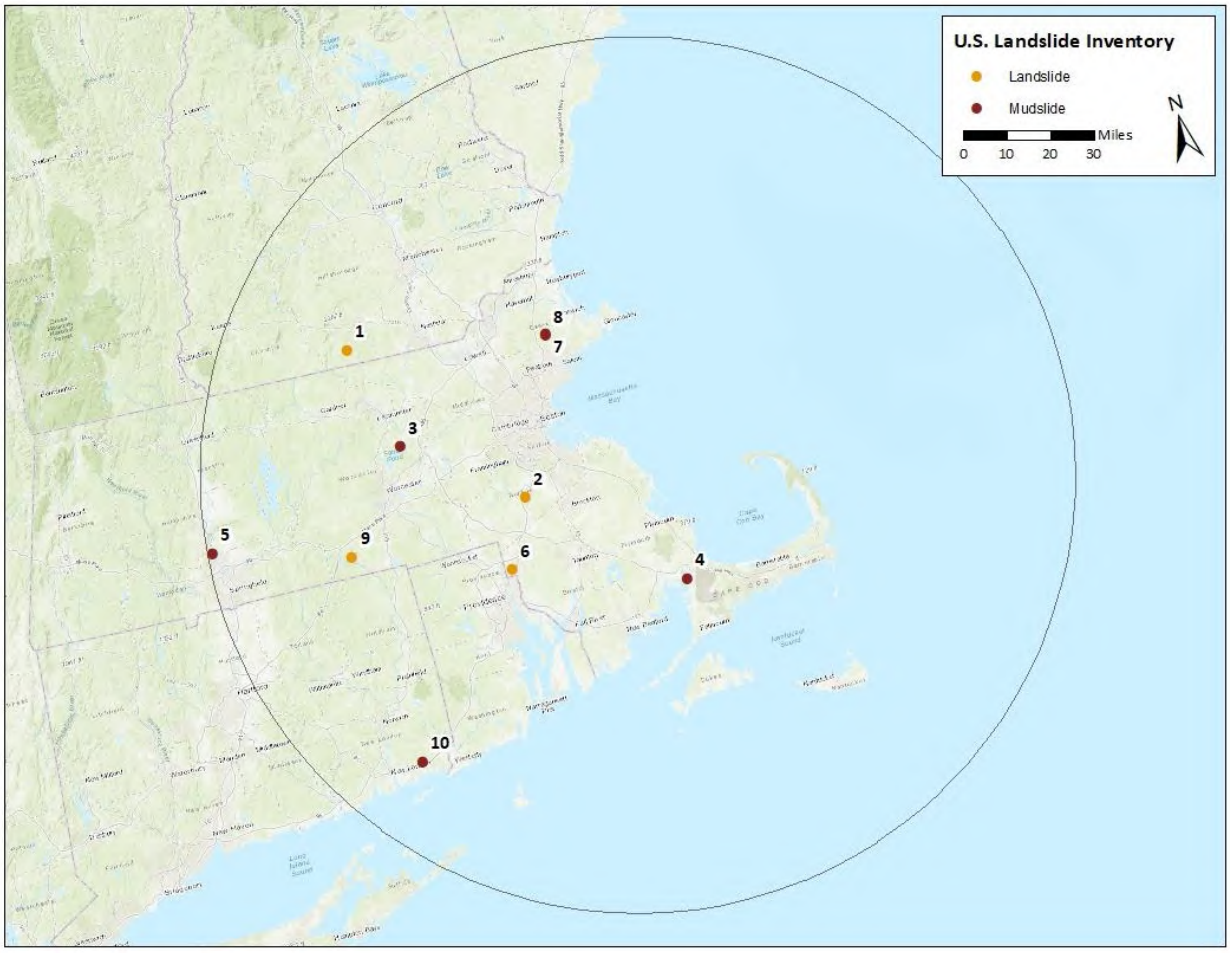


Figure 3-30. Landslides that have occurred within 100 miles of Marshfield from 1900 to 2019 (USGS 2022).

Table 3-15. Landslide Inventory from 1900 to 2019 Within 100 Miles of Marshfield.

ID	Date	Location	Category	Trigger	Size	Confidence
1	3/31/2010	Greenville, NH	Landslide	Rain	Medium	Probable landslide in the area
2	3/15/2010	Norwood, MA	Landslide	Downpour	Small	Probable landslide in the area
3	3/15/2010	Clinton, MA	Mudslide	Rain	Small	Probable landslide in the area
4	7/7/2017	Wareham, MA	Mudslide	Downpour	Small	Probable landslide in the area
5	9/6/2008	Easthampton, MA	Mudslide	Tropical Cyclone	Medium	Probable landslide in the area
6	11/4/2014	Attleboro, MA	Landslide	Mining	Small	Probable landslide in the area
7	12/9/2014	Beverly, MA	Mudslide	Rain	Small	Probable landslide in the area
8	3/14/2010	Beverly, MA	Mudslide	Downpour	Medium	Probable landslide in the area
9	9/30/2013	Southbridge, MA	Landslide	Continuous Rain	Medium	Probable landslide in the area
10	6/7/2013	Groton, CT	Mudslide	Tropical Cyclone	Small	Probable landslide in the area

Probability

B2.b

Considering the low occurrence of landslides within the vicinity of the Town of Marshfield, as well as the flat topography and lack of major hills, the likelihood of a landlside occuring within Marshfield is unlikley (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.

Impact

B3.a

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.

Hazard Location

B1.c
B2.a

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.

Previous Occurrences & Extent

B1.c
B2.a
B2.c

Although there are no records of a tsunami occurring in Marshfield, there are three (3) reported tsunamis within 100 miles of Marshfield since the mid-1500s (Figure 3-30), the most recent of which occurred in 1879.

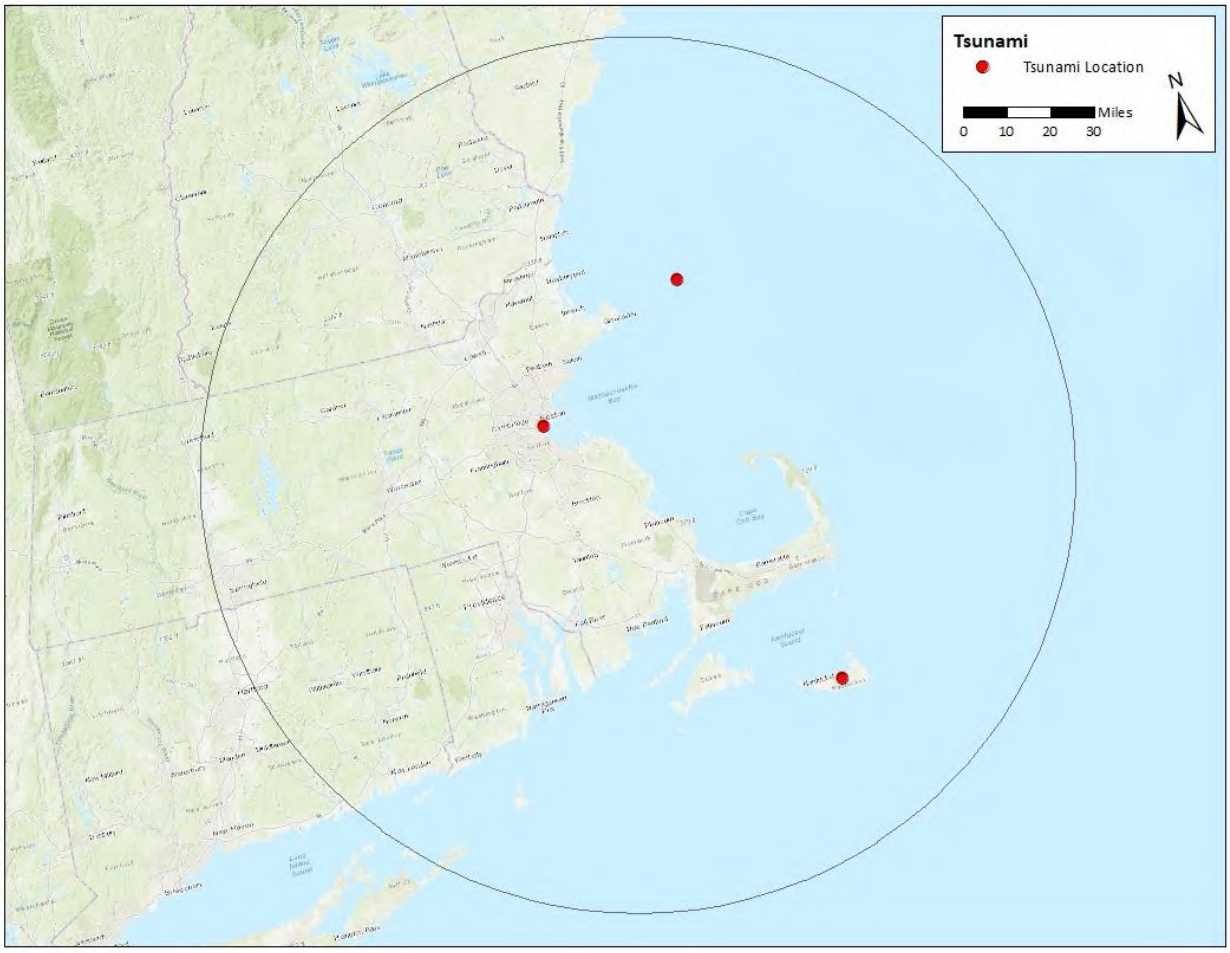


Figure 3-31. Tsunamis that have occurred within 100 miles of Marshfield from the mid-1500s to 2022 (NCEI/WDS Global Historical Tsunami Database, 2023).

Probability

B2.b

There is no record of tsunamis ever occuring in Marshfield, 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 Marshfield. As sea level rises, the extent of inland flooding resulting from a tsunami will likley increase, however, the overall risk to Marshfield will still likley be very low.

Impact

B3.a

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 without 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, fifteen (15) of which are located in Marshfield (Figure 3-31).

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 Marshfield's Municipal Maintenance Department has identified 59 culverts within the Town (Figure 3-31).

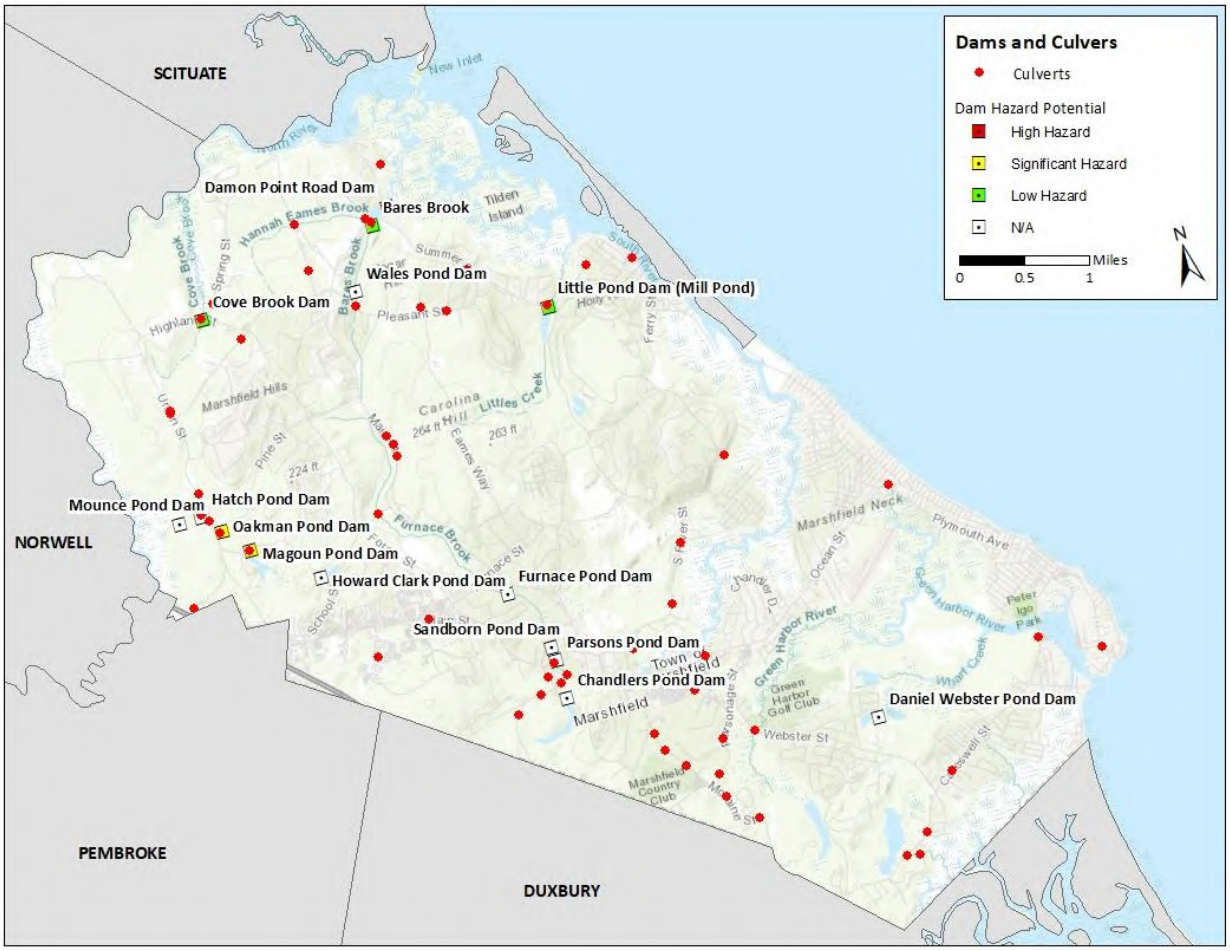


Figure 3-32. Locations of dams and culverts within Marshfield (MassGIS, 2012).

Hazard Location

B1.c
B2.a

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 fifteen (15) dams located in Marshfield, two (2) are classified as a significant hazard and four (4) are listed as low hazards by the Office of Dam Safety (Figure 3-31). The remaining dams have not been classified. The Magoun Pond Dam has an Emergency Action Plan recently revised in April 7, 2022.

Previous Occurrences & Extent

B1.c
B2.a
B2.c

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

Probability

B2.b

Even though a dam or culvert failure has never occurred in the Town of Marshfield, the probability of it occuring 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.

Impact

B3.a

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 SUMMARY OF HAZARDS

As suggested by the FEMA planning guidance, the Local Hazard Mitigation Planning Committee (LHMPC) 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 Marshfield in the future, or that have impacted the Town in the past (Chapter 3). The 14 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 worse- 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 LHMPC members, data from the 2018 Massachusetts State Hazard and Climate Mitigation Plan and other resources.

The LHMPC 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 un-necessary. 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 Marshfield.

	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	16
Extreme Temperature				X		X				X	16
Flooding (Inland & Coastal)				X			X		X		12
Other Severe Weather				X			X	P	X	P	12
Coastal Erosion				X		X	P		X		8
Earthquake		X				X		P		X	8
Hurricane & Tropical Storm			X			X	P		X	P	6
Drought		X			X					X	4
Dam/Culvert Failure		X				X			X		4
Wildfire		X				X	P		X		4
Invasive Species									X	P	4
Tornado		X			X				X		2
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.

Brant Rock – January 2014
Winter Storm

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 Marshfield 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 Marshfield (2022). 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 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 was quantified. Table 4-1 summarizes the Land Use Codes attributed to each land use type used in this report.

Table 4-1. Marshfield 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, 103, 104, 105, 109, 111, 112, 121, 125
Temporary Lodging	301, 303
Commercial - Retail/Offices/Services	031, 037, 321, 322, 323, 324, 325, 326, 327, 330, 331, 332, 335, 337, 338, 340, 343, 374, 423, 900
Commercial - Manufacturing/Distribution	310, 313, 316, 333, 334, 400, 401, 402, 410, 427, 444
Public Services	140, 305, 341, 342, 350, 352, 384, 424, 430, 431, 432, 433, 901, 903, 906, 908, 931, 934, 935
Agricultural	016, 017, 018, 601, 710, 717, 718
Open Space	385, 601, 720, 905, 911, 932
Recreation	038, 805
Vacant	130, 131, 132, 390, 391, 392, 440, 441, 442,444, 930, 933

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 the GIS based 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 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 of 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 Marshfield tax rate for fiscal year 2023 is $11.32 per thousand.

To assess the vulnerabilities of Marshfield'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.

Category	ID	Name	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
Coastal Infrastructure	1	Timber Bulkhead	AE	2	12%	75%	75%
	2	South River Revetment	AE	2	25%	78%	78%
	3	Fieldston Sea Wall	VE	1	75%	76%	81%
	4	Ocean Bluff Sea Wall	AO	1	97%	100%	100%
	5	Ocean Bluff Stone Revetment	AO	1	100%	100%	100%
	6	Hewitt's Point Sea Wall	VE	4	48%	48%	69%
	7	Hewitt's Revetment	VE	4	91%	91%	100%
	8	Brant Rock Seawall – Part A	VE	4	45%	80%	83%
	9	Brant Rock Seawall – Part B	VE	3	72%	80%	80%
	10	Brant Rock Revetment	VE	4	72%	82%	84%
	11	Brant Rock Rip Rap Slope	VE	2	40%	40%	48%
	12	Town Pier Sea Wall	AE	2	58%	77%	89%
	13	Green Harbor Stone Jetty East	VE	2	100%	100%	100%
	14	Green Harbor Stone Jetty West	VE	3	100%	100%	100%
	15	Bay Ave Sea Wall	VE	1	98%	98%	98%

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

Category	ID	Name	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
Energy Infrastructure	16	Ocean Bluff Auto	AE	1	9%	53%	75%
	17	Cedar View Filling Station					
	18	A L Prime			1%	6%	29%
	19	Rand Handy Oil Co		2		75%	75%
	20	Public Petro	AE	4			
	21	Bill's Sunco	AE	4			2%
	22	Speedway Gas Station	AE				
	23	Shell Gas Station	AE				
	24	Taylor Marine	AE	2	22%	45%	80%
	25	Roht Marine	AE	1	58%	59%	76%
	26	Town of Marshfield Fuel Station	AE	3	3%	22%	35%
	27	Taylor Lumber Propane		4			
	28	Maintenance Facility					
	29	Williams Coal & Oil Co.					
	30	Bay State Gas					
	31	Rand Handy Propane					
Public Health	32	Brant Rock Food Market	AE	2	14%	63%	75%
	33	Roche Brothers					
	34	Star Market					
	35	CVS		4			
	36	Walgreens Pharmacy					

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

Category	ID	Name	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
Public Safety	37	Prence Grant Apt No. 1					
	38	Prence Grant Apt No. 2		4		6%	6%
	39	Proprietors Green Village (Welch Healthcare)					
	40	Marshfield Veterans Home		4			
	41	Winslow Village No. 1		4			
	42	Winslow Village No. 2		4			
	43	Coastguard Relay Antenna					
	44	WATD media/Fire Municipal Radio System					
	45	Monopole	AE	3		2%	30%
	46	Verizon Telephone Exchange					
	47	Eversource Sub Station No. 1		3			
	48	Eversource Sub Station No. 2					
	49	Eversource Sub Station LAT 42.0886 Long -70.6544	AE	1	7%	46%	74%
	50	Industrial Commercial Cell/Radio Tower					
	51	Radio Tower - Carolina Hill					
	52	WATD Media/Fire Municipal radio system					
	53	Cell Phone Tower	AE	1	9%	53%	75%
	54	Cell Phone Tower (American)					
	55	Cell Phone Tower					
	56	Marshfield Housing Authority - Housing					
	57	Grace Ryder Apartments					
	58	Main Post Office					

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

Category	ID	Name	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
Public Safety	59	Marshfield Town Hall					59%
	60	Marshfield Animal Shelter					60%
	61	DPW Barn		3			1%
	62	DPW Main Office					
	63	Marshfield Senior Center					
	64	Road to Responsibility/Ventress Public Library	AE	3	1%	75%	75%
	65	Marshfield Town Pier/Harbor Master Building	AE	2	29%	43%	81%
	66	Town Airport	AE	1	9%	53%	75%
	67	Daniel Webster School		4			1%
	68	South River School				4%	17%
	69	Furnace Brook Middle School					
	70	Marshfield High School					
	71	Martinson Elementary School					
	72	Eames Way Elementary School					
	73	Gov Edward Winslow School					
	74	Marshfield Police Station/EOC		4			
	75	Fire Station No. 2					
	76	Marshfield Fire Department – Central Fire Station					
	77	Fire Station No. 1	AO			5%	51%

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

Category	ID	Name	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
Wastewater/ Water Infrastructure	78	Central Street Wastewater Pump Station	AE	2	12%	65%	75%
	79	Solid Waste Transfer Station					
	80	Wastewater Treatment Plant	AE	3		2%	42%
	81	Marshfield High School Wastewater Treatment Facility					
	82	Homestead Ave. Wastewater Pump Station		3	14%	15%	21%
	83	Plymouth Ave. Wastewater Pump Station	AE	1	9%	53%	75%
	84	Macker Terrace Wastewater Pump Station	AE	1	9%	53%	75%
	85	Anderson Dr. Wastewater Pump Station	AE	2	65%	75%	75%
	86	Carolina Hill Water Tank					
	87	Furnace Brook Water Pumping Station No. 4					
	88	Mt. Skirgo Rd. Water Pump					
	89	South River Pumping Station					
	90	Avon St. Wastewater Pump Station	AE	2	12%	75%	75%
	91	Webster St. Pumping Station No. 1					
	92	Church St. Water Pumping Station					
	93	Webster St. Pumping Station No. 2		3			4%

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

Category	ID	Name	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
Wastewater/ Water Infrastructure	94	Furnace Brook Water Pumping Station No. 1					
	95	Union St. Water Pump Station No. 2					
	96	Furnace Brook Water Pumping Station No. 3					
	97	Ferry St. Water Pumping Station No. 2					
	98	Main Lift Pump Station	AE	2	14%	62%	75%
	99	Furnace Brook No. 2 Water Treatment Facility					
	100	Spring St. Water Pump					
	101	Union St. Water Pump Station No. 2					
	102	Pudding Hill Lane Water Tank					
	103	Telegraph Hill Water Tank					
	104	Ferry St. Water Pumping Station No. 1					
	105	Furnace Brook Water Pumping Station No. 2					
	106	School St. Water Pumping Station					
	107	Fairgrounds Well Site					
	108	Water Standpipe Forest St.					
	109	Dam - Dyke Rd. Dam	AE	3	44%	53%	80%
	110	Dam - Magoun Pond Dam					

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.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	2,155	23%	$2,462,858,350	$474,491,400	19%	$4,935,214,965	$1,076,511,373	22%
Residential - Multi-Family	83	21	25%	$166,521,000	$19,771,500	12%	$213,178,500	$28,405,300	13%
Temporary Lodging	1	0	0%	$597,900	$0	0%	$902,100	$0	0%
Commercial - Retail/Offices/ Services	195	62	32%	$100,789,507	$18,760,075	19%	$197,621,107	$43,287,875	22%
Commercial - Manufacturing/ Distribution	46	6	13%	$27,831,400	$1,657,300	6%	$54,824,400	$3,789,000	7%
Public Services	117	36	31%	$204,347,708	$31,220,500	15%	$276,934,708	$64,122,500	23%
Agricultural	6	2	33%	$223,700	$223,700	100%	$1,549,439	$1,418,200	92%
Open Space	944	303	32%	$3,462,200	$498,200	14%	$137,403,070	$45,514,690	33%
Recreation	9	5	56%	$4,101,000	$919,500	22%	$18,064,046	$4,252,340	24%
Vacant	935	325	35%	$17,884,900	$1,358,600	8%	$92,893,336	$21,337,300	23%
Total	**11,714**	**2,915**	**25%**	**$2,988,617,665**	**$548,900,775**	**18%**	**$5,928,585,671**	**$1,288,638,578**	**22%**

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

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	318	3%	$2,462,858,350	$57,341,000	2%	$4,935,214,965	$161,310,600	3%
Residential - Multi-Family	83	3	4%	$166,521,000	$616,400	0%	$213,178,500	$4,029,700	2%
Temporary Lodging	1	0	0%	$597,900	$0	0%	$902,100	$0	0%
Commercial - Retail/Offices/ Services	195	1	1%	$100,789,507	$421,300	0%	$197,621,107	$741,000	0%
Commercial - Manufacturing/ Distribution	46	0	0%	$27,831,400	$0	0%	$54,824,400	$0	0%
Public Services	117	1	1%	$204,347,708	$1,125,000	1%	$276,934,708	$1,395,400	1%
Agricultural	6	0	0%	$223,700	$0	0%	$1,549,439	$0	0%
Open Space	944	1	0%	$3,462,200	$0	0%	$137,403,070	$24,500	0%
Recreation	9	0	0%	$4,101,000	$0	0%	$18,064,046	$0	0%
Vacant	935	14	1%	$17,884,900	$0	0%	$92,893,336	$565,100	1%
Total	**11,714**	**338**	**3%**	**$2,988,617,665**	**$59,503,700**	**2%**	**$5,928,585,671**	**$168,066,300**	**3%**

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

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	305	3%	$2,462,858,350	$70,295,100	3%	$4,935,214,965	$212,734,700	4%
Residential - Multi-Family	83	2	2%	$166,521,000	$1,582,900	1%	$213,178,500	$1,950,400	1%
Temporary Lodging	1	0	0%	$597,900	$0	0%	$902,100	$0	0%
Commercial - Retail/Offices/ Services	195	1	1%	$100,789,507	$0	0%	$197,621,107	$259,900	0%
Commercial - Manufacturing/ Distribution	46	0	0%	$27,831,400	$0	0%	$54,824,400	$0	0%
Public Services	117	0	0%	$204,347,708	$0	0%	$276,934,708	$0	0%
Agricultural	6	0	0%	$223,700	$0	0%	$1,549,439	$0	0%
Open Space	944	21	2%	$3,462,200	$358,500	10%	$137,403,070	$8,360,900	6%
Recreation	9	0	0%	$4,101,000	$0	0%	$18,064,046	$0	0%
Vacant	935	17	2%	$17,884,900	$113,200	1%	$92,893,336	$1,532,700	2%
Total	**11,714**	**346**	**3%**	**$2,988,617,665**	**$72,349,700**	**2%**	**$5,928,585,671**	**$224,838,600**	**4%**

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

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	453	5%	$2,462,858,350	$64,632,200	3%	$4,935,214,965	$168,153,800	3%
Residential - Multi-Family	83	6	7%	$166,521,000	$1,609,000	1%	$213,178,500	$2,551,900	1%
Temporary Lodging	1	0	0%	$597,900	$0	0%	$902,100	$0	0%
Commercial - Retail/Offices/ Services	195	6	3%	$100,789,507	$1,317,200	1%	$197,621,107	$3,431,200	2%
Commercial - Manufacturing/ Distribution	46	1	2%	$27,831,400	$527,900	2%	$54,824,400	$996,200	2%
Public Services	117	0	0%	$204,347,708	$0	0%	$276,934,708	$0	0%
Agricultural	6	0	0%	$223,700	$0	0%	$1,549,439	$0	0%
Open Space	944	144	15%	$3,462,200	$155,600	4%	$137,403,070	$8,898,100	6%
Recreation	9	0	0%	$4,101,000	$0	0%	$18,064,046	$0	0%
Vacant	935	120	13%	$17,884,900	$0	0%	$92,893,336	$3,770,600	4%
Total	**11,714**	**730**	**6%**	**$2,988,617,665**	**$68,241,900**	**2%**	**$5,928,585,671**	**$187,801,800**	**3%**

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

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	523	6%	$2,462,858,350	$92,069,500	4%	$4,935,214,965	$222,651,900	5%
Residential - Multi-Family	83	4	5%	$166,521,000	$1,584,800	1%	$213,178,500	$2,319,600	1%
Temporary Lodging	1	0	0%	$597,900	$0	0%	$902,100	$0	0%
Commercial - Retail/Offices/ Services	195	17	9%	$100,789,507	$4,267,900	4%	$197,621,107	$8,376,500	4%
Commercial - Manufacturing/ Distribution	46	3	7%	$27,831,400	$545,800	2%	$54,824,400	$1,251,300	2%
Public Services	117	9	8%	$204,347,708	$738,500	0%	$276,934,708	$3,979,800	1%
Agricultural	6	0	0%	$223,700	$0	0%	$1,549,439	$0	0%
Open Space	944	51	5%	$3,462,200	$0	0%	$137,403,070	$3,803,300	3%
Recreation	9	1	11%	$4,101,000	$0	0%	$18,064,046	$15,284	0%
Vacant	935	64	7%	$17,884,900	$59,500	0%	$92,893,336	$4,084,400	4%
Total	**11,714**	**672**	**6%**	**$2,988,617,665**	**$99,266,000**	**3%**	**$5,928,585,671**	**$246,482,084**	**4%**

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

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	763	8%	$2,462,858,350	$141,887,900	6%	$4,935,214,965	$344,937,400	7%
Residential - Multi-Family	83	9	11%	$166,521,000	$3,344,900	2%	$213,178,500	$5,590,100	3%
Temporary Lodging	1	0	0%	$597,900	$0	0%	$902,100	$0	0%
Commercial - Retail/Offices/ Services	195	16	8%	$100,789,507	$5,692,075	6%	$197,621,107	$12,808,475	6%
Commercial - Manufacturing/ Distribution	46	2	4%	$27,831,400	$510,600	2%	$54,824,400	$1,222,100	2%
Public Services	117	8	7%	$204,347,708	$2,311,900	1%	$276,934,708	$9,200,300	3%
Agricultural	6	1	17%	$223,700	$112,100	50%	$1,549,439	$362,300	23%
Open Space	944	51	5%	$3,462,200	$0	0%	$137,403,070	$5,438,800	4%
Recreation	9	0	0%	$4,101,000	$0	0%	$18,064,046	$0	0%
Vacant	935	89	10%	$17,884,900	$0	0%	$92,893,336	$4,115,000	4%
Total	**11,714**	**939**	**8%**	**$2,988,617,665**	**$153,859,475**	**5%**	**$5,928,585,671**	**$383,674,475**	**6%**

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

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	2,244	24%	$2,462,858,350	$576,344,800	23%	$4,935,214,965	$1,269,592,865	26%
Residential - Multi-Family	83	20	24%	$166,521,000	$29,415,800	18%	$213,178,500	$42,627,200	20%
Temporary Lodging	1	0	0%	$597,900	$0	0%	$902,100	$0	0%
Commercial - Retail/Offices/ Services	195	72	37%	$100,789,507	$37,649,800	37%	$197,621,107	$72,743,200	37%
Commercial - Manufacturing/ Distribution	46	6	13%	$27,831,400	$1,686,900	6%	$54,824,400	$6,042,300	11%
Public Services	117	37	32%	$204,347,708	$45,190,500	22%	$276,934,708	$76,534,300	28%
Agricultural	6	3	50%	$223,700	$111,600	50%	$1,549,439	$1,098,621	71%
Open Space	944	185	20%	$3,462,200	$1,190,400	34%	$137,403,070	$42,789,210	31%
Recreation	9	5	56%	$4,101,000	$1,827,000	45%	$18,064,046	$11,936,556	66%
Vacant	935	170	18%	$17,884,900	$2,320,000	13%	$92,893,336	$18,522,214	20%
Total	**11,714**	**2,742**	**23%**	**$2,988,617,665**	**$695,736,800**	**23%**	**$5,928,585,671**	**$1,541,886,466**	**26%**

Table 4-10. Parcels and Buildings Vulnerable to Flooding During a Major Storm Event in 2030.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	3,059	33%	$2,462,858,350	$662,824,400	27%	$4,935,214,965	$903,436,873	18%
Residential - Multi-Family	83	29	35%	$166,521,000	$26,619,600	16%	$213,178,500	$12,807,700	6%
Temporary Lodging	1	0	0%	$597,900	$0	0%	$902,100	$0	0%
Commercial - Retail/Offices/ Services	195	61	31%	$100,789,507	$20,176,875	20%	$197,621,107	$22,201,500	11%
Commercial - Manufacturing/ Distribution	46	6	13%	$27,831,400	$1,657,300	6%	$54,824,400	$2,050,200	4%
Public Services	117	42	36%	$204,347,708	$38,614,200	19%	$276,934,708	$26,481,500	10%
Agricultural	6	2	33%	$223,700	$223,700	100%	$1,549,439	$1,158,800	75%
Open Space	944	331	35%	$3,462,200	$770,300	22%	$137,403,070	$49,761,090	36%
Recreation	9	6	67%	$4,101,000	$1,827,000	45%	$18,064,046	$7,368,540	41%
Vacant	935	376	40%	$17,884,900	$1,471,800	8%	$92,893,336	$22,952,200	25%
Total	**11,714**	**3,912**	**33%**	**$2,988,617,665**	**$754,185,175**	**25%**	**$5,928,585,671**	**$1,048,218,403**	**18%**

Table 4-11. Parcels and Buildings Vulnerable to Flooding During a Major Storm Event in 2050.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	3,543	38%	$2,462,858,350	$772,538,000	31%	$4,935,214,965	$1,018,616,947	21%
Residential - Multi-Family	83	39	47%	$166,521,000	$35,887,100	22%	$213,178,500	$16,400,200	8%
Temporary Lodging	1	0	0%	$597,900	$0	0%	$902,100	$0	0%
Commercial - Retail/Offices/ Services	195	86	44%	$100,789,507	$40,266,675	40%	$197,621,107	$37,099,300	19%
Commercial - Manufacturing/ Distribution	46	8	17%	$27,831,400	$2,091,800	8%	$54,824,400	$398,100	1%
Public Services	117	47	40%	$204,347,708		0%	$276,934,708	$28,015,300	10%
Agricultural	6	2	33%	$223,700	$223,700	100%	$1,549,439	$1,158,800	75%
Open Space	944	355	38%	$3,462,200	$794,600	23%	$137,403,070	$51,858,890	38%
Recreation	9	6	67%	$4,101,000	$1,827,000	45%	$18,064,046	$7,368,540	41%
Vacant	935	413	44%	$17,884,900	$3,371,600	19%	$92,893,336	$27,139,300	29%
Total	11,714	4,499	38%	$2,988,617,665	$857,000,475	29%	$5,928,585,671	$1,188,055,377	20%

Table 4-12. Parcels and Buildings Vulnerable to Flooding During a Major Storm Event in 2070.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**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	9,378	3,892	42%	$2,462,858,350	$848,884,600	34%	$4,935,214,965	$1,100,964,647	22%
Residential - Multi-Family	83	40	48%	$166,521,000	$36,253,400	22%	$213,178,500	$16,644,000	8%
Temporary Lodging	1	0	0%	$597,900	0	0%	$902,100	0	0%
Commercial - Retail/Offices/ Services	195	94	48%	$100,789,507	$46,159,575	46%	$197,621,107	$39,919,500	20%
Commercial - Manufacturing/ Distribution	46	10	22%	$27,831,400	$2,547,200	9%	$54,824,400	$3,763,700	7%
Public Services	117	50	43%	$204,347,708	$46,240,500	23%	$276,934,708	$29,000,800	10%
Agricultural	6	2	33%	$223,700	$223,700	100%	$1,549,439	$1,158,800	75%
Open Space	944	370	39%	$3,462,200	$794,600	23%	$137,403,070	$53,113,290	39%
Recreation	9	6	67%	$4,101,000	$1,827,000	45%	$18,064,046	$7,368,540	41%
Vacant	935	435	47%	$17,884,900	$3,371,600	19%	$92,893,336	$28,361,500	31%
Total	**11,714**	**4,899**	**42%**	**$2,988,617,665**	**$986,302,175**	**33%**	**$5,928,585,671**	**$1,280,294,777**	**22%**

The LHMPC 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 Marshfield is not available and therefore 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.

However, the impacts from hazards ranked in Table 3-16, including Severe Winter Weather, Hurricane/Tropical Storm, Other Severe Weather, Landslide, and Wildfire on critical facilities were qualitatively discussed with the LHMPC, and are summarized below in Table 4-13.

Table 4-13. Results of the Qualitative Vulnerability Assessment of Critical Facilities.

Vulnerability	Applicable Critical Facilities
Severe Winter Weather (Roof vulnerable to collapse due to heavy snowfall or precipitation event)	Ocean Bluff Auto A L Prime Bill's Sunco Taylor Lumber Propane Brant Rock Food Market Roche Brothers Star Market CVS Walgreens Pharmacy Road to Responsibility/Ventress Public Library Daniel Webster School South River School Martinson Elementary School Eames Way Elementary School Marshfield HS Wastewater Treatment Facility Webster St Pumping Station #2 Furnace Brook Water Pumping Station #2
Heavy Precipitation (Access limited due to roadway flooding during precipitation event)	Taylor Marine Plymouth Avenue Wastewater Pump Station Mt Skirgo Rd Water Pump Macker Terrace Wastewater Pump Station

Table 4-13. (Cont.) Results of the Qualitative Vulnerability Assessment of Critical Facilities.

Landslide (Slope Stability (Massachusetts Geological Survey) listed as low stability to moderately unstable)	Bay Ave. Seawall Ocean Bluff Sea Wall (Area #4) Ocean Bluff Stone Revetment (Area #4) Hewitt's Point Sea Wall (Area #5) Hewitt's Revetment (Area #5) Brant Rock Revetment Town Pier Sea Wall Walgreens Pharmacy Eversource Sub Station #2 Church Street Water Pumping Station Speedway Gas Station
Wildfire (Located in a forested area)	Eames Way School Roche Brothers Proprietors Green Village (Welch Healthcare) Eversource Sub Station #1 Radio Tower - Carolina Hill Cell Phone Tower Marshfield Senior Center Carolina Hill Water Tank Furnace Brook Water Pumping Station #4 South River Pumping Station Webster St Pumping Station #1 Webster St Pumping Station #2 Furnace Brook Water Pumping Station #1 Union Street Water Pump Station #1 Ferry Street Water Pumping Station #2 Furnace Brook No. 2 Water Treatment Facility Spring Street Water Pump Union Street Water Pump Station #2 Pudding Hill Lane Water Tank Ferry Street Water Pumping Station #1 Furnace Brook Water Pumping Station #2 School St Water Pumping Station Fairgrounds Well Site Water Standpipe Forest St Dam - Magoun Pond Dam

4.3 VULNERABLE PROPERTIES AND CRITICAL FACILITIES

B3.b

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 $1.7 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 Marshfield is approximately $6.8 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 $2.5 million, with the structures and buildings on those properties valuing $99 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 Library, Town Pier and Harbormasters Building, Airport, Main Wastewater Treatment lift station, and one of the Eversource sub stations.

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 (2,155 and 305 parcels, respectively, out of a total of 9,378 single family residential parcels), which cumulatively represents 26% of the single-family residential land use category. The inundation projected from a Category 2 hurricane will also impact primarily single-family residential properties (523 parcels out of a total of 9,378 parcels), which represents 6% 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. The MC-FRM results are based on a high sea level rise projection for 2030, 2050, and 2070. In 2030, 3,912 parcels have the

potential to experience some level of coastal flooding (Table 4-10). These numbers increase to 4,499 parcels in 2050 and 4,899 parcels in 2070 (Tables 4-11 and 4-12).

4.4 VULNERABLE POPULATIONS

B3.b

Marshfield has several vulnerable populations, including areas with a high concentration of elderly residents, childcare facilities, isolated coastal communities, and environmental justice populations.

Concentrations of Elderly or Disabled People

Marshfield has a number of age restricted communities. These places, in addition to senior care and nursing facilities, would need special attention during emergencies, or if evacuations become necessary. Table 4-14 lists age restricted communities, which represent concentrated areas of elderly populations. These locations are also shown in Figure 4-1.

There are also disabled individuals who live in Marshfield. While some of these individuals may reside in age restricted communities, or senior care and nursing facilities, it is likely that there are also many disabled residents residing in single- or multi-family homes throughout Town. Disabled residents may need additional help to exit buildings during an emergency, particularly those in wheelchairs and on a floor above the ground level.

Concentrations of Children

The Town of Marshfield has multiple areas with a high concentration of young children. 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 and listed in Table 4-14.

Environmental Justice Populations

Marshfield has one environmental justice populations based on income which is listed as Block Group 5, Census Tract 5061.02. This EJ population includes a median household income of $42,000, compared to the Marshfield median household income of $105,000, and a minority population of 7%. This population does not include any households with language isolation. EJ populations may need extra assistance during a natural hazard emergency to safely prepare and to evacuate, if necessary. The location of this population is shown in Figure 4-1.

Potentially Isolated Coastal Communities

As an oceanfront community, Marshfield is an attractive place to live for both year-round and summer residents. For many, their enjoyment of the coastline is contingent on their proximity to the shore. However, due to Marshfield's unique topography, and extensive network of tidal creeks, many of these coastal neighborhoods become "isolated" during a storm event or similar flood occurrence. During flood events, numerous roads can become submerged, leaving no means of access to particular neighborhoods. Table 4-15 lists 48 roads that can become isolated during a flood event, as well as the number of residences and businesses that would be affected during an event and the length of roadway involved. These areas range in size from the

Esplanade/Blue Fish Cove area, with 278 residences, to the island access roads in the northern part of Town, with 39 residences. Roads within communities that are isolated during flood events are shown in Figure 4-1 in green. Note, not all areas shown in red will actually flood. Some roads and neighborhoods may be dry, but inaccessible due to flooding of surrounding access ways.

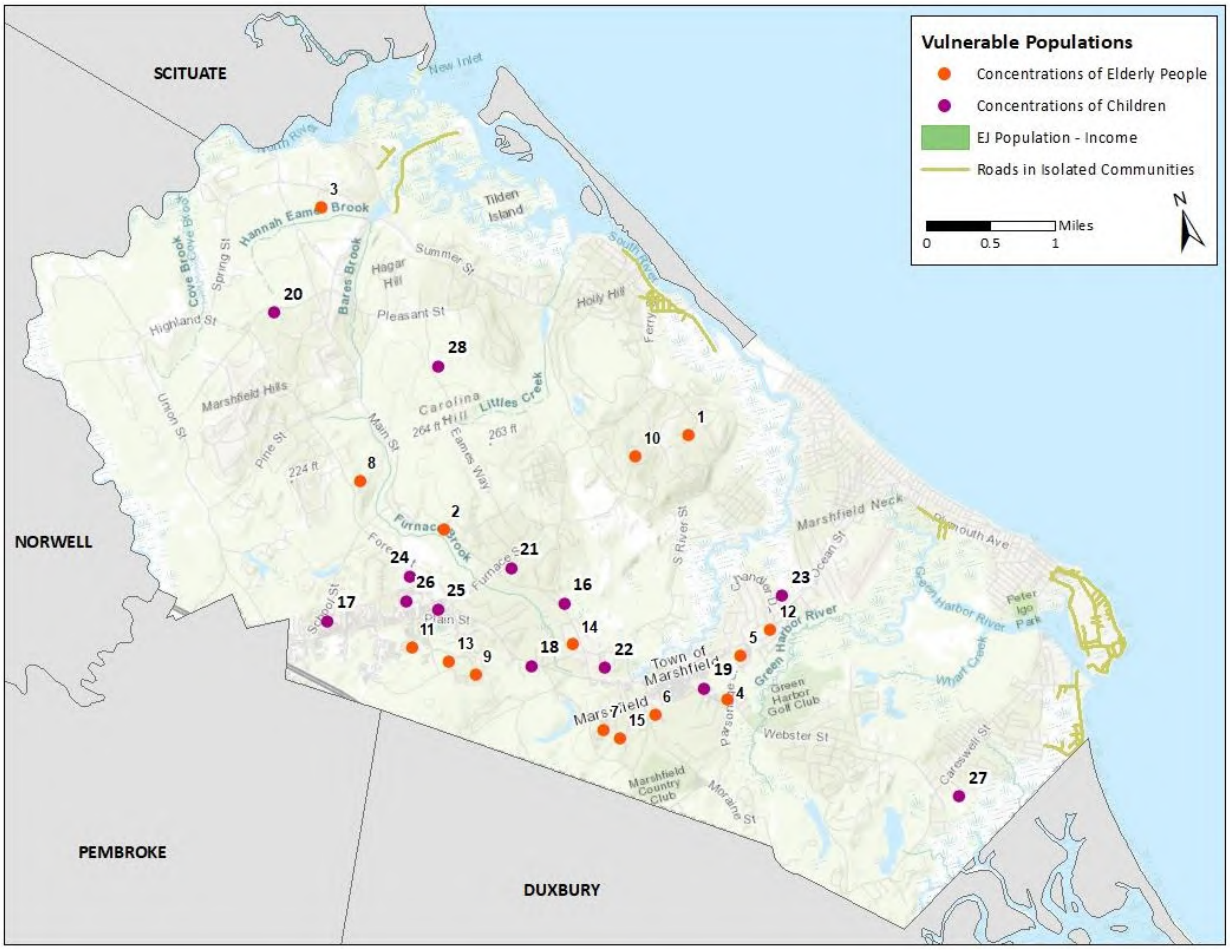


Figure 4-1. Locations of vulnerable populations in Marshfield (MassGIS, 2022).

Table 4-14. List of Vulnerable Populations in Marshfield.

#	Name	Address
Concentrations of Elderly People		
1	Peregrine Woods	Autumn Lane
2	Carolina Hill Shelter	728 Main St.
3	Eames Brook Farm	Hannah Brook Way
4	Independent Living I	780 Webster St.
5	Independent Living II	40 Parsonage St.
6	The Maples	Maple Lane
7	Pudding Hill	Mariners Drive
8	Overlook Farm	Samuel Curtis Way
9	The Seasons	Seth Sprague Drive
10	Spyglass Landing	Stonybrook Rd.

11	Village at Proprietors Green Proprietors Way	Proprietors Way
12	Winslow Village I and II	1554 Ocean St.
13	Highland Green	Snowy Owl Lane
14	Grace Ryder	135 Main St.
15	Tea Rock Gardens	17 Tea Rock Gardens

Table 4-14. (Cont.) List of Vulnerable Populations in Marshfield.

#	Name	Address
Concentrations of Children		
16	Cherubs Child Development Center	260 Main Street
17	KinderCare Learning Center	495 School Street
18	Pudding Hill Preschool	185 Plain Street
19	South Shore Community Action Council - Marshfield	832 Webster Street
20	The Steeple School of Trinity Church	229 Highland Street
21	Town of Marshfield Pre-School	255 Furnace Street
22	South River School	59 Hatch Street
23	Daniel Webster School	1456 Ocean Street
24	Martinson Elementary School	275 Forest Street
25	Furnace Brook Middle School	500 Furnace Street
26	Marshfield High School	167 Forest Street
27	Gov. Edward Winslow School	60 Regis Road
28	Eames Way School	165 Eames Way

Table 4-15. Potentially Isolated Coastal Communities

Area	Street Name	Length (LF)	# of Homes	# Businesses
Bay Ave Area	Marion St.	515	13	n/a
	Naomi St.	250	6	n/a
	Beach St.	675	2	1
	Bay Ave.	2,975	102	n/a
	Brighton St.	460	15	n/a
	Bay St.	800	19	n/a
	Creek St.	380	5	n/a
	Canal St.	1,040	15	1
	Avon St.	1,005	23	n/a
	Pearl St.	350	6	n/a
	Stage Lane	435	6	n/a
Esplanade Area to Blue Fish Cove	Central St.	970	15	n/a
	A St. (Blue Fish Cove)	500	5	n/a
	Cove St. (Blue Fish Cove)	1,315	18	n/a
	Island St.	3,005	68	1
	Cherry St.	1,225	16	3
	Ocean St.	3,095	80	7
	Dyke Rd./ Town Pier Rd./Plymouth Ave.	1,210	1	3
	Branch St.	580	11	n/a

Table 4-15. (Cont.) Potentially Isolated Coastal Communities

Esplanade Area to Blue Fish Cove	South St.	200	10	n/a
	Middle St.	305	10	n/a
	Town Pier Rd.	3,400	n/a	2
	Reed St.	390	4	n/a
	Thomas St.	470	7	n/a
	Bradford St.	605	9	n/a
	Jersey St.	185	3	n/a
	Iowa St.	190	2	n/a
	Dana St.	200	3	n/a
	Linden St.	140	1	n/a
	Lindwood St.	375	5	n/a
	Bancroft St.	360	8	n/a
	Laurel St.	220	2	n/a
Plymouth Ave	Hutchinson Rd. to 2nd Rd.	1,680	13	n/a
	Johnson Ter.	610	22	n/a
	MacArthur Ln.	675	21	n/a
Island Access Routes	Macombers Way (Trouant Is.)	4,800	25	n/a
	Bartletts Isle Way	1,800	14	n/a
Ridge Road Area	Ridge Rd.	3,705	71	n/a
	Bayberry Rd.	1,245	7	n/a
	Shipyard Rd.	550	10	n/a
	Shady Ln.	335	6	n/a
	Old Ferry St.	450	6	n/a
	Ferry St. (South of Sea St.)	1,895	20	3
	Ferry St. (North of Sea St.)	1,070	8	1
	Keene Rd.	665	5	n/a
	Meadow Ln.	375	5	n/a
	Mallard Rd.	720	13	n/a
	Newtown Rd.	480	0	n/a

Brant Rock – January 2018
Winter Storm Grayson

The first sections of this plan discuss the potential hazards that could occur in Marshfield 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 Marshfield will accomplish their mitigation goals.

This chapter documents Marshfield'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 LHMPC 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. All of the goals are reflective of the Town's priorities and concerns relative to natural hazard mitigation. The following eight (8) goals were endorsed by the LHMPC for this Multi-Hazard Mitigation Plan:

1. Investigate, design, and implement projects that will reduce and minimize the risks and impacts from natural hazards to critical municipal facilities and resources.
2. Develop and implement strategies for hazard prone areas of Town that improve resiliency to existing infrastructure and enhance public safety.
3. Reduce the loss of life, property, infrastructure, and environmental and cultural resources from natural disaster by maintaining accessibility for emergency responders during and after natural hazard events.
4. Review and update existing policies, programs, and regulations to further reduce or eliminate the impacts of natural hazards.
5. Engage with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities.
6. Encourage future development that minimizes risks to natural hazards, such as coastal and riverine flooding.
7. Identify public education opportunities and develop materials to inform residents about what to expect during natural disasters. Promote pre-disaster planning and provide education materials on appropriate mitigation actions to reduce vulnerability.
8. Identify and seek the funding necessary to study, design and construct projects that will reduce the Town's vulnerability to natural hazards.

5.2 EXISTING CAPABILITIES

Marshfield 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

C6.d

Since implementing Marshfield's 2018 Multi-Hazard Mitigation Plan, the Town has produced a series of planning documents that address natural hazards. These plans demonstrate the Town's progress in local hazard mitigation efforts. By implementing these plans, the Town can act in its effort to reduce hazard vulnerability. These plans include:

1. **Municipal Vulnerability Preparedness (MVP) Workshop Summary of Findings (2020)**: This plan and workshop engaged multiple stakeholder groups to examine Marshfield's existing vulnerabilities to natural hazards as well as recommendations to improve resiliency. The Summary of Findings includes top recommendations to improve resilience which were incorporated into the updated mitigation goals and objectives.
2. **Marshfield (Brant Rock) Rapid Recovery Plan (2021):** This plan included a study goal that sought to enhance infrastructure, storefronts, businesses, and developments to become more resilient against hazards since the majority of businesses and retail storefronts in Brant Rock experience annual flooding during storm surge events. Projects recommendations included flood mitigation and climate adaptation. Public outreach efforts for the Rapid Recovery Program involved both interactive, open house workshops as well as virtual, COVID-19-friendly meetings.
3. **Marshfield Long-Term Coastal Resiliency Plan (2022):** This plan is aimed at the Town's 2018 mitigation action of Conduct an analysis of engineering alternatives to reduce flooding and improve drainage in the (Brant Rock) Esplanade area and developing recommendations for Repetitive Loss Areas. This plan includes damage and loss estimates for the Town, potential mitigation strategies, policy scenarios, and policy and zoning recommendations. As part of the planning process, Town departments, elected officials, board/commission/committee members, residents (including high school students), and businesses were engaged through interviews, a public workshop, public meetings, and an online survey. Engagement activities focused on learning from local knowledge, educating and raising public awareness about future coastal flooding threats and gathering ideas, feedback, and preferences on different mitigation strategies, policies, and draft recommendations. Project information is publicly available on the Town's Planning Department website.

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.

C6.a
C6.b

Many of the existing Town policies and ordinances also provide an effective means of mitigating hazards. Marshfield relies on the Massachusetts state building code (780 CMR Ninth Edition) with amendments to the 2015 International Building cod and 2015 International Residential Code to

ensure that new buildings and structures are built safely and to the state-standards for hazard preparedness. Marshfield also has Town-specific Zoning and Floodplain ordinances. The local Marshfield Wetlands Regulations have floodplain specific regulations designed to minimize flooding damages and build resiliency to future flooding.

Town Staff

The Town of Marshfield has a very capable staff that includes an Emergency Manager, a Town Planner, and a Chief Engineer. Together these staff allow the Town to effectively plan for and implement specific mitigation actions. In addition, the Town has a Local Emergency Management Agency and a Local Planning Board, which are instrumental in developing and coordinating mitigation actions.

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 assessment or outreach efforts, which require little to no costs other than staff time and existing operating budgets. Alternatively, higher cost actions, such as the acquisition of flood-prone properties, could require a substantial monetary commitment from local, state, and federal funding sources.

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

1. Town Meeting article
2. Operating budget
3. Fees from water and sewer services

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. 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.

Existing Mitigation Measures

C1.a

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

1. **Emergency Response Plan:** Marshfield 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 Marshfield's citizens. The plan is periodically updated to reflect the most up-to-date information available.

2. **Emergency Operations Center:** Marshfield maintains an Emergency Operations Center (EOC) at the Police Department Headquarters Building at 1639 Ocean 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 Police Department.
3. **Emergency Shelters:** Marshfield has established the following emergency shelters for use in the event of a natural disaster:
    - Primary – Furnace Brook Middle School (100+ residents)
    - Secondary – Council on Aging
    - Warming Centers – Town Hall and Library have been used in the past when the have had power outages.

    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 equipment that will assist public safety efforts during a natural hazard event. The Town recently purchased the RAVE alert notification system, which will allow the Town to communicate directly with Town staff and residents in case of an emergency. The Town also utilizes the Plymouth County Sherriff's Department's CodeRED emergency alert system, which can reach residents via phone call, text message, or email.
5. **Emergency Power Generators:** Emergency power generators can be found in a number of Town buildings. These generators serve to protect government functionality during and immediately after a natural hazard event and also serve the operation of emergency shelters. Locations include Town Hall, Police/EOC, Central Fire Station, Council on Aging Building, DPW Building, Governor Winslow School, Furnace Brook School, South River School, Daniel Webster School, High School, Martinson School, Eames Way School, and the School Administration Building.
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. **Regional Emergency Management Planning Committee (REPC):** Marshfield is a member of a regional emergency planning committee together with Kingston, Duxbury, and Plymouth.
8. **Public Information & Outreach**: Marshfield 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 their PPI website, local brochures, radio segments, and TV spots. Marshfield also uses the town website as a means of conveying information to the public. The website provides links to applicable emergency agencies, such as Marshfield 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.
9. **Public Works Operations/ Maintenance Activities**: The Public Works Department actively maintains the Town's storm drainage system. The following specific activities serve to

maintain the capability of the drainage system through the reduction of sediment and litter build up and proper maintenance and repair through street sweeping, catch basin cleaning, and roadway treatments during winter storms.

10. **Tree Trimming Program**: The electric and telephone utilities trim branches near the electric lines while Town staff maintain trees in other areas.
11. **Snow Disposal**: The town conducts general snow removal operations with its own equipment and has adequate space for snow storage as needed.
12. **Water Restrictions**: During a drought, or other periods of high demand (typically occurring in the summer months), restrictions are placed on those connected to the Town's public water system and include odd/even day outdoor watering, limited outdoor watering hours, outdoor watering bans, prohibitions on filling swimming pools, and the use of automatic irrigation sprinkler systems (Town Article 82).
13. **Floodplain Zoning District**: Zoning is intended to protect the public health and safety through the regulation of land use. The Marshfield Zoning Bylaw includes a Floodplain District (Article XV). The purposes of this district are:
    a. Protect human life and health and minimize danger to emergency response officials in the event of flooding;
    b. Minimize expenditure of public money for flood control projects and emergency response and clean up;
    c. Reduce damage to public and private property and utilities resulting from flooding waters and debris; and
    d. Ensure that the Town of Marshfield qualifies for participation in the National Flood Insurance Program.

    The Floodplain District is an overlay district, defined by the 100-year floodplain as designated by FEMA.
14. **Subdivision Rules and Regulations**: The Marshfield Subdivision Rules and Regulations contain provisions intended to reduce the impacts of floods and erosion. Through its design and layout standards, the bylaws contribute to the Town's overall efforts to mitigate the risks for damage through flooding.
15. **Wetlands Protection Bylaw**: The purpose of the Wetlands Protection By-Law (Article 37) is to further protect the Town's shores, ponds, rivers, and wetlands for, among other reasons, flood control, erosion and sedimentation control, and public safety. The by-law builds on the State Wetlands Protection Act offering more stringent controls over dredging and filling activities. Any activity that might fill or otherwise alter these resource areas requires a permit from the Marshfield Conservation Commission.
16. **Coastal Wetlands Zoning District**: The Coastal Wetlands District (section 13.02) is an overlay district established for the following purposes: protecting the health and safety of residents whose lands are subject to seasonal or periodic tidal flooding; preservation of salt marshes and tidal flats (thereby maintaining their functions of drainage and flood

control, as well as filtration of contaminants); and, maintaining the purity of water and the safe operation of utilities subject to damage in floods.

17. **Stormwater Management Overlay District**: The Stormwater Management Overlay District is intended to limit impervious surfaces and stormwater run-off in a designated area north of the South River. By promoting infiltration of storm water where it lands, the potential for flooding can be reduced.
18. **DCR Dam Safety Regulations**: The state has enacted dam safety regulations mandating inspections and emergency action plans. All new dams are subject to state permitting.
19. **Seawalls, Jetties and Dikes**: The Town of Marshfield coastline is protected by a series of seawalls, jetties, and dikes. Repairs have recently been made following a study of this protection system that indicated repairs were necessary.
20. **Plymouth County Mutual Aid System**: The Marshfield Fire Department is part of the Plymouth County mutual aid system. This system is run by the Plymouth County Control, which can supply as little as a single ambulance to as much as an entire taskforce.

Participation in the National Flood Insurance Program (NFIP)

C2.a

Marshfield 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 and has been adopted by the Town.

As part of ongoing NFIP requirements, Marshfield 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.

Marshfield also works with nearby communities to establish mutual aid agreements to address administration of the NFIP following a major storm.

The NFIP also has a Community Rating System (CRS), which recognizes community efforts beyond those minimum standards by reducing flood insurance premiums for the community's property owners. CRS discounts on flood insurance premiums range from 5% (for a rate class of 9) up to 45% (for a rate class of 1) (FEMA 2015). The Town of Marshfield is currently part of the CRS program, and has a rate class of 7, which affords a 15% insurance discount.

D2.a

5.3 PROGRESS ON MITIGATION ACTIONS SINCE 2018

Before identifying new mitigation actions for the 2023 Marshfield Multi-Hazard Mitigation Plan, the LHMPC discussed the status of the mitigation actions identified in the 2018 Marshfield Multi-Hazard Mitigation Plan. One of the following status determinations was given to each mitigation action identified from the 2004 plan:

- **Complete**: The project was implemented and completed in 2018-2023.
- **Existing Capability**: The project was implemented and completed in 2018-2023, and it will continue to be implemented on an annual basis.
- **In Progress**: The project was started in the 2018-2023 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 2018 Proposed Mitigation Actions.

Action Category 1: Ensure that critical infrastructure sites are protected from natural hazards.

Action	Current Status
1a. Evaluate the creation of a dike around the WWTP.	**In Progress –** The Town explored the feasibility of creating a dike around the WWTP to minimize flooding impacts. The Town is currently engaging with contractors to evaluate the feasibility of using sheet pile to create the dike; however, more study is needed to understand when flood protection will need to be implemented. Additionally, costs and design estimates are needed.
1b. Move and rebuild the DPW Barn in a less vulnerable location.	**Completed –** The DPW barn was demolished in 2020 and a new DPW barn is being finalized at 965 Plain Street in 2023.
1c. Evaluate the need for enhanced drainage for Mt. Skirgo wellhead protection.	**In Progress –** The Town needs to evaluate the size of the culvert and downstream impact.
1d. Discuss the possibility of elevating flood prone NSTAR substation.	**Deferred** – This now Eversource South River Station substation is located off Webster S in Brant Rock (near 51 Allen St). At this time the Town lacks the budget or capacity to complete this project.
1e. Evaluate the potential risk to the Webster Wells from sea-level rise.	**Deferred –** Change status of Webster Street well #1 due to location and surrounding Topo not a concern. Webster Street Well #2 is up stream of the water flowing under Webster to get to Green Harbor. Size of culvert under Webster and location will make problem unlikely to at least the 2030 MHMP.
1f. Evaluate the vulnerability of the radio antenna to wind hazards.	**In Progress** – The Grove Street antenna is not protected; while the Pleasant St. antenna is new; Four locations have been addressed in police operations plan.
1g. Consider fire prevention vegetation clearing at Marcia Thomas house.	**Deleted** – No immediate need to remove vegetation for fire prevention

Action Category 2: Protect existing residential and business areas from flooding.

Action	Current Status
2a. Add batter boards at Old Rexhame Road to close opening.	**Deferred –** A solution for flood control at Old Rexhame Rd. needs to be explored further. The north side of the opening is a private seawall and the road is open to the public. Addressing future protections at the site would take Town council advice. The return wall was lost in the 2018 storm – which included significant erosion. Batter boards are

	not seen as being resilient to future coastal hazards.
2b. Ditch cleaning and maintenance of the Bass Creek headwaters.	**Existing Capability –** In conjunction with Plymouth County Mosquito Control ditch cleaning has been conducted. More marsh mats are needed to complete the work (Mabey mats).
2c. Conduct an analysis of engineering alternatives to reduce flooding and improve drainage in the Esplanade.	**In Progress** - Flooding during storm events is over wash from sea walls. The raising of the seawalls has improved flooding. During major storms there is flooding around the intersection of dike road parking lot. Barrier wall would be needed to stop major flooding. Some talked about adding a pump station. Study is needed.

Action Category 3: Maintain existing mitigation infrastructure in good condition.

Action	Current Status
3a. Raise elevation of the Brant Rock seawall.	**Completed –** The first phase 2018 and the second phase was completed in 2022. The project included elevating 1200 feet seawall by 3 ½ feet. Additional, footing and scour protection were added to the seawall.
3b. Review and upgrade the Master Plan for Seawalls.	**In Progress –** Master Plan for seawalls has not been updated since 2006, and still needs to be updated. Ocean bluff revetment study ongoing and funded by the state. An ENF will be filed soon.
3c. Maintain Rexhame dunes.	**In Progress –** Nourishment in Rexhame dunes is being permitted under a 2023 CZM Coastal Resiliency Grant.
3d. Develop a large-scale town-wide beach nourishment program.	**In Progress –** Permits for beach nourishment at key locations throughout town are being sought under a 2023 CZM Coastal Resiliency Grant.
3e. Create special conditions for Orders of Conditions to require beneficial reuse.	**In Progress –** The Conservation Department is currently in the process of looking into specifications for various species and replanting requirements.

Action Category 4: Continue to enforce existing zoning and building regulations.

Action	Current Status
4. Continue to restrict additional uses at the airport due to flood prone elevations.	**Existing Capability –** Existing building and zoning regulations in place that restrict additional uses at the airport.

Action Category 5: Educate the public about zoning and building regulations, particularly with regard to changes in regulations that may affect tear-downs and new construction.

Action	Current Status
5a. Confirm the properties on the Repetitive Loss list and refine if necessary.	**In Progress –** The Town received an updated repetitive loss list in the fall of 2022 and plans to file an AW-501 Worksheet with FEMA to reflect the true repetitive loss status of properties on the list.
5b. Hire a Community Rating System (CRS) Coordinator.	**Completed –** The position was approved by the Select Board and Nanci Porreca was hired as the CRS Coordinator.

Action Category 6: Work with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities, such as coastal erosion.

Action	Current Status
6a. Discuss potential repairs to Duxbury dams with the Town of Duxbury.	**Deleted –** Concern regarding these dams is low for the Towns of Marshfield and Duxbury.
6b. Investigate installing a drainage system under Bay Street.	**Deferred –** The work has yet to be completed, however, there is low land between the seawall and Bay Street. A culvert is needed to increase drainage capacity. Conservation Commission has rejected the proposal for direct discharge of street storm water into the Cut River. Proposal would need enhanced BMP upgrades that would be difficult to site in that neighborhood. Area in Duxbury that floods where a pipe under the road would drain into Marshfield. Will need to treat stormwater before discharge into marsh.

Action Category 7: Encourage future development in areas that are not prone to natural hazards.

Action	Current Status
7a. Develop specific recommendations for each Repetitive Loss Area.	**Deferred –** Currently the Town lacks the budget or capacity to complete this project, however, the Town still identifies that this project should continue to be a priority.
7b. Purchase wetlands and other flood prone lands for conservation.	**In Progress –** The Town just purchased 33 acres near South River and has identified lands where owners have neglected to pay taxes. A tax lien may be utilized to foreclose the rights of owners to redeem the property.
7c. Inform Repetitive Loss property owners annually about financial assistance options.	**Existing Capabilities –** The Town regularly sends out a mailing to repetitive loss

	property owners that outlines mitigation actions and funding options. The Town will add privately owned critical facilities to future mailing lists.

Action Category 8: Educate the public about natural hazards and mitigation measures.

Action	Current Status
8a. Conduct outreach to owners/managers of privately held critical facilities.	**Existing Capabilities –** This outreach is conducted through the Town's PPI meetings. The Town organizes meetings in locations that increase the likelihood that owners will participate.
8b. Develop cable TV programming to increase public outreach.	**Existing Capabilities –** A series of PSA have been produced to assist in the Town's digital outreach every year. The outreach consists of an hour long program that replayed periodically through the year.
8c. Develop a Public Plan for Information (PPI) website.	**Completed –** The Town has a PPI/CRS website where all outreaches, media appearances, and other CRS and FEMA resources are posted. After major flooding events, local resources for disaster recovery are posted to the site such as post disaster recovery guides, claims information, contacts to make damage assessments, etc. *https://www.marshfield-ma.gov/program-public-information-crs*
8d. Develop a summary brochure with this Multi-Hazard Mitigation Plan is complete.	**Completed –** A brochure on the MHMP was completed in 2019. Mailed out annually across town, warnings and what to do
8e. Conduct community outreach about the Code Red program.	**Existing Capabilities –** The Town will continue to utilize the Plymouth County Sherriff's Department's CodeRED emergency alert system, however, the Town recently (2023) purchased the RAVE alert notification system, which will allow the Town to communicate directly with Town staff and residents in case of an emergency.

Action Category 9: Make efficient use of public funds for hazard mitigation.

Action	Current Status
9a. Raise the elevation of the Dyke Road bridge and its approaches.	**In Progress** – An application was submitted for a hazard mitigation grant to receive funding to design a replacement for the tide gates and increase the dike sluiceway opening. The Town is considering the

	potential of raising the dike. Exploring how to make the design resilient through 2070. (New Mitigation Action 1c)
9b. Rebuild Willow Street bridge (to a higher elevation).	**In Progress –** The road surface is being raised 1.5 to 2 ft and there is significant increase in hydraulic capacity proposed. Additional height would require retaining walls which would significantly impact wetlands. Preliminary design with MassDOT is being completed, however, the Town has not started the permitting process.
9c. Rebuild the Canal and Beach Street bridges (to a higher elevation).	**Completed –** Canal Street bridge was rebuilt in 2019 but was not raised. Beach St. bridge was rebuilt in 2020 and elevated by 1ft.
9d. Raise intersection of Town Pier Road and Route 139.	**Deferred –** Study needed to evaluate feasibility and impacts to neighbors, engineering studies.
9e. Implement recommended tide gate upgrades at Dyke Road.	**In Progress –** See 9a above.
9f. Complete the Green Harbor beneficial reuse study.	**Completed –** This study was completed in 2018 and was funded by a Coastal Zone Management Coastal Resiliency Grant.
9g. Repair emergency spillway at Mill Pond Lane (Magoun Pond) Dam	**Completed –** This mitigation action was completed in 2021.
9h. Apply to be a Municipal Vulnerability Preparedness (MVP) Community.	**Completed –** Marshfield became a MVP Certified community in 2019.
9i. Create an emergency repair money account.	**In Progress –** DPW water and wastewater enterprise budgets include an annual emergency line of $100k to respond to emergencies. The DPW general budget, that would fund repair of roads, bridges, seawalls etc. has not yet been established, but the Town plans to address this in the coming years.

Action Category 10: Protect the Town's ability to respond to various natural hazard events.

Action	Current Status
10a. Review WWTP operations and maintenance plan.	**In Progress –** The DPW is seeking funding to update the wastewater comprehensive master plan last updated in 1995 for 20-year planning period. Since 1995 the DPW conducted Sewer Assessment and Alternative Analysis in 2012 two environmental sensitive areas of Town currently not sewered,

	including Black Mount Area and Kent Park Area.
10b. Develop an evacuation plan for Housing Authority units.	**Deferred –** The Town recently approved funding to add emergency power generators to the Grace Ryder and Tea Rock Gardens housing, however, the Town has not had the funding or capacity to create an evacuation plan for Housing Authority units.
10c. Develop a pre-storm checklist for the installation of seawall batter boards.	**In Progress –** The Pre-storm list for seawall batter board installation is being formalized.
10d. Consider acquiring larger snow removal machinery.	**Existing Capabilities –** In 2019 the Town purchased three new pieces of snow moving equipment, however, more equipment is needed in the future.
10e. Evaluate additional snow storage needs within the Town.	**Completed –** There is sufficient area for snow storage at 35 Parsonage Street now that some of the equipment has been moved to 965 Plain St. The other area being used for storage is the Towns Salt shed area off Clay Pit Road.
10f. Develop a fire/forest management plan for select properties and woodlots.	**In Progress –** The Conservation Commission was been working to develop a plan for forest management. Additionally, a hazardous tree removal plan is underway.
10g. Evaluate potential alternatives to improve the Veterans Park Dam.	**In Progress –** CPC has approved funding and the project is currently in the process of being permitted.
10h. Stockpile steel sheet panels and boulders.	**Existing Capabilities –** The Town currently has enough material to manage a small break in the seawall as a temporary measure.

5.4 PROPOSED MITIGATION

Planning Process

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

C4.a
C5.a
C5.b

- **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

Proposed Mitigation Actions

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

The final proposed mitigation actions developed during the planning process are summarized in this section. A total of twenty six (26) 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 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: 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 1a: **Ensure that all town-owned buildings that can provide emergency support services are equipped with generators for use as cooling/heating station during hazard events, power outages, etc.**	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Extreme Temperature, Other Severe Weather
CRS CATEGORY	Emergency Services
PURPOSE	This measure will ensure adequate access to sufficient heating and/or cooling systems in Town and will better enable residents to access services during a hazard event.
RESPONSIBILITY	Town Administrator, EOC, Planning Department
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Operating Budget, FEMA Building Resilient Infrastructure and Communities (BRIC) Grant
PRIORITY	High
TIMELINE	Over the next 5 years

Mitigation Action 1b: **Enhance the flood control capacity of Dyke Road.**	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Structural Projects
PURPOSE	To provide flood control for low lying areas of Town along Route 139, the Wastewater Treatment Plant, airport, and other residential areas around the edges of inner Green Harbor.
RESPONSIBILITY	DPW, Conservation Commission
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, FEMA Building Resilient Infrastructure and Communities (BRIC) Grant
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action 1c: **Evaluate adaptation alternatives for low-lying roads and bridges throughout Town.**	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Property Protection
PURPOSE	A number of existing roadways in the Town of Marshfield 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. Consider raising sections of several roadways (Bay Avenue,

	Dyke Road, Ocean Street, Island Street, Cove Street, Macombers Ridge, Macombers Way, Bartletts Isle Way) to reduce flooding and maintain access to flood prone areas.
RESPONSIBILITY	DPW, Conservation Commission
ESTIMATED COST	Medium
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant; FEMA Building Resilient Infrastructure and Communities (BRIC), Municipal Small Bridge Program (MassDOT), Bridge Investment Program (DOT)
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action: 1d: Evaluate alternatives for reducing vulnerability of the Wastewater Treatment Plant to natural hazards particularly flooding.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding
CRS CATEGORY	Property Protection
PURPOSE	Recommended actions could include replacing, maintaining, moving, or protecting the Wastewater Treatment Plant. Implementing flood mitigation measures for pump stations and the Wastewater Treatment Plant such as a dike and/or dry floodproofing could also be evaluated.
RESPONSIBILITY	DPW
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant, FEMA Building Resilient Infrastructure and Communities (BRIC)
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action 1e: Identify public water infrastructure that needs increased capacity in order to withstand the effects of climate change and recover after severe events.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Preventative
PURPOSE	Improve facilities ability to avoid damage from sea level rise, flooding, or extreme precipitation, providing backup power for critical services, anticipating rising temperatures, and replacing aging infrastructure that is increasingly vulnerable because of climate changes.
RESPONSIBILITY	DPW
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant, FEMA Building Resilient Infrastructure and Communities (BRIC)
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action 1f: Implement stormwater best management practices (BMPs) to address sections of roadway that regularly flood after heavy rains.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Other Severe Weather
CRS CATEGORY	Preventative
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	Town Administrator, DPW, Conservation Commission
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Operating Budget, Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant
PRIORITY	Medium
TIMELINE	Over the next 5 years

Goal 2: Develop and implement strategies for hazard prone areas of Town that improve resiliency to existing infrastructure and enhance public safety.

Mitigation Action 2a: Prepare a Substantial Damage Management Plan.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Preventative
PURPOSE	The Town can utilize a Substantial Damage Management Plan to describe the community's process for evaluating damage to buildings and addressing those that have been substantially damaged, as required by NFIP.
RESPONSIBILITY	Planning Department, Building Department
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	MVP Planning Grant, CZM Coastal Resiliency Grant, Town Meeting Article
PRIORITY	High
TIMELINE	Within the next 2 years

Mitigation Action 2b: Create a Master Stormwater Management Plan	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Other Severe Weather
CRS CATEGORY	Preventative
PURPOSE	A stormwater management plan will help to reduce the potential for flooding of roadways and evacuation routes during coastal storms and rainfall events. It will also help to reduce pollution and contamination by controlling runoff of rainwater or melted snow.
RESPONSIBILITY	DPW, Conservation Commission

ESTIMATED COST	Medium
POTENTIAL FUNDING SOURCES	MVP Planning Grant, CZM Coastal Resiliency Grant, Town Meeting Article
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action 2c: Eliminate unnecessary dune paths and revegetate bare areas to minimize disturbance to the Coastal Dune and Barrier Beach system and improve storm damage protection and flood control measures.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Natural Resource Protection
PURPOSE	Take measures to maintain the natural protective features of Coastal Dunes and Barrier Beaches by eliminating unnecessary paths and implementing a program of annual dune revegetation. Critical areas for this mitigation action are Rexhame Public Beach and Winslow Ave. Beach.
RESPONSIBILITY	DPW, Beach Administrator, Conservation Commission
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action 2d: Develop a set of resources to address the vulnerability of coastal business districts. Provide education regarding a private building's ability to undergo retrofits and access funding sources.	
HAZARD ADDRESSED	Multiple Hazards
CRS CATEGORY	Public Information
PURPOSE	Several of the business areas in Marshfield are in flood prone areas. By providing the business owners with resources describing their vulnerability to flooding, as well as steps that can be taken to reduce vulnerability, damages from coastal storms, heavy precipitation, and winter storms will be minimized.
RESPONSIBILITY	Town Manager, EOC, Marshfield Building Department, Program for Public Information
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget, CZM Coastal Resilience, Seaport Economic Council Grant
PRIORITY	High
TIMELINE	Within the next 1-2 years

Goal 3: Reduce the loss of life, property, infrastructure, and environmental and cultural resources from natural disasters by maintaining accessibility for emergency responders during and after natural hazard events.

Mitigation Action 3a: Improve flood warning and response capabilities, including the development a flood warning and response plan.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Other Severe Weather
CRS CATEGORY	Emergency Services
PURPOSE	The Town currently utilizes the Plymouth County Sherriff Department's CodeRED system (i.e., "reverse 911) to disseminate important emergency information to residents. Explore the capabilities of a flood threat recognition system that would improve the flood response operations and emergency warning dissemination so that public safety can be enhanced.
RESPONSIBILITY	Town Manager, EOC, Planning Department, Program for Public Information
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	MVP Planning Grant
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action 3b: Ensure that the Town treats roads quickly and effectively to maintain safe transportation routes during a snow event.	
HAZARD ADDRESSED	Severe Winter Weather
CRS CATEGORY	Emergency Services
PURPOSE	To improve public safety during winter storms, the Town needs to secure enough private plow contracts to complete snow removal throughout its neighborhoods and identify snow storage locations for larger snowfall events. Adequate supplies of sand, salt, and other road treatment materials should be stockpiled for use during severe winter weather.
RESPONSIBILITY	DPW
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Reserve Fund, Operating Budget
PRIORITY	High
TIMELINE	Every year

Mitigation Action 3c: Establish a regular program of trimming trees on municipal properties that have the potential to impact power supply during storms. Communicate with Eversource about utility pole infrastructure, maintenance, and vegetation management. Establish an education program aimed at improving public understanding of the importance of tree trimming.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Other Severe Weather, Wildfires
CRS CATEGORY	Preventative
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. Education of Marshfield residents regarding the benefits of tree trimming could provide opportunities for cooperation regarding
RESPONSIBILITY	DPW, Program for Public Information, Conservation Commission
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	Low
TIMELINE	Over the next 5 years

Goal 4: Review and update existing policies, programs, and regulations to further reduce or eliminate the impacts of natural hazards.

Mitigation Action 4a: Maintain a list of municipal construction projects, bylaw/code revisions, and properties to acquire to reduce risk from natural hazards. Develop a priority ranking for the projects/revisions/properties.	
HAZARD ADDRESSED	Multiple Hazards
CRS CATEGORY	Preventative
PURPOSE	A regularly updated list of important projects, regulatory updates, and potential property acquisitions, increases Marshfield's long-term resiliency by identifying and prioritizing the most effective next steps involved with hazard mitigation.
RESPONSIBILITY	Marshfield Building Department, Conservation Commission, Planning Department, Program for Public Information
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action 4b: Evaluate all zoning, bylaws, and codes as necessary to increase the resiliency of the built, natural, and landscaped environment to natural hazards. Strengthen existing Wetlands Protection Bylaw and Regulations, Zoning Bylaw, and Article XV (Floodplain Zoning). Streamline and gain consistency across town department codes	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Preventative
PURPOSE	Revising local codes and bylaws to increase the resiliency of construction projects will ensure that future buildings and structures constructed in Marshfield will be more resilient, and less likely to experience damage in the event of a natural hazard. This could include establishing higher elevation standards, increasing a maximum building height for elevation

	projects, creating a 30-Foot no build setback from seawalls and establishing a set of building elevation case studies.
RESPONSIBILITY	Marshfield Building Department, Planning Department, Conservation Commission
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant
PRIORITY	High
TIMELINE	Within the next 1-2 years

Mitigation Action 4c: **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. Inform existing Repetitive Loss property owners annually about financial assistance options.**	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Public Information
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 (Update AW-501 Worksheet).
RESPONSIBILITY	Marshfield Building Department, Planning Department
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	High
TIMELINE	Over the next 5 years

Goal 5: Engage with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities.

Mitigation Action 5a: **Examine, prioritize, design, and seek funding for culvert replacement and salt marsh restoration projects. Collaborate with the Towns of Situate and Duxbury on salt marsh evaluation, restoration and storm water systems that impact coastal wetlands.**	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion, Dam and Culvert Failure
CRS Category	Structural Projects
PURPOSE	Implementation of this action would enhance flood protection and shoreline erosion control, among other benefits. Wetland restoration activities would provide additional trees, removal of invasive vegetation, root mats and other wetland vegetation that would act to slow the speed of stormwaters and distribute them more slowly over the floodplain throughout the coastal areas of Marshfield. Additionally, the Town could investigate acquisition opportunities to acquire land for marsh migration.

RESPONSIBILITY	DPW, Conservation Commission
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant, FEMA Building Resilient Infrastructure and Communities (BRIC), Coastal Habitat and Water Quality Grant, MassBays Healthy Estuaries Grants
PRIORITY	Medium
TIMELINE	Over the next 5 years (one drainage area per year)

Mitigation Action 5b: **Develop evacuation routes to improve transportation needs prior to or during a natural hazard. Consideration should also be given to neighboring communities, such as Hummarock (Scituate) and Gurnet Road (Duxbury), which would need to evacuate through Marshfield. Once developed, communication with residents and visitors to inform them of the new designations and emergency preparation procedures.**	
HAZARD ADDRESSED	Multiple Hazards
CRS CATEGORY	Emergency Services
PURPOSE	Due to the unique topography of Marshfield, there are multiple areas of Town that could be completely isolated due to flooding in a major storm. Having an evacuation plan will help ensure that vulnerable residents such as seniors, individuals with disabilities, and coastally isolated populations can be informed early and directed to safer locations until conditions are safe to return home. Since the main transportation routes leaving Marshfield run through neighboring communities, regional coordination will be important.
RESPONSIBILITY	EOC, Program for Public Information
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant, Community Transit Grant Program (MassDOT)
PRIORITY	Medium
TIMELINE	Over the next 5 years

Goal 6: Encourage future development that minimizes risks to natural hazards, such as coastal and riverine flooding.

Mitigation Action 6a: **Develop a framework that addresses buy outs and incentives for relocation from low-lying neighborhoods.**	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Property Protection
PURPOSE	With rising sea levels, more low-lying areas in the Town of Marshfield will become vulnerable to flooding. By developing a framework for identifying vulnerable properties, contacting the owners, and establishing financial resources for a buyout program, the Town will be able to mitigate the flooding impacts.

RESPONSIBILITY	Marshfield Building Department, Planning Department, Conservation Commission, Town Administrator, Treasurer/Collector
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	FEMA Flood Mitigation Assistance (FMA), FEMA Building Resilient Infrastructure and Communities (BRIC)
PRIORITY	Low
TIMELINE	Over the next 5 years

Goal 7: Identify public education opportunities and develop materials to inform residents about what to expect during natural disasters. Promote pre-disaster planning and provide education materials on appropriate mitigation actions to reduce vulnerability.

Mitigation Action 7a: **Develop strategies and materials to increase community awareness and involvement regarding climate resiliency, such as informational brochures, targeted education signs in vulnerable locations, school coastal resiliency curriculum, and neighborhood outreach programs.**	
HAZARD ADDRESSED	Multiple Hazards
CRS CATEGORY	Public Outreach
PURPOSE	Easily accessible information in the form of informational brochures and targeted community signage will inform residents and visitors about the types of natural hazards in Marshfield and how they can reduce their vulnerability. The Town should take actions to generate discussion, enhance local understanding of coastal hazards and encourage agency through school curriculum and neighborhood outreach programs.
RESPONSIBILITY	Building Department, Program for Public Information, Fire Department, EOC
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action 7b: **Work with local marinas and yacht clubs to prepare storm preparedness plan (plans could incorporate hauling vessels, notifying customers, and moving equipment/floats to higher ground). Awareness campaigns, and possible by laws to eliminate creation of debris fields.**	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Preventative
PURPOSE	During a natural hazard marine vessels, equipment and floats are exceptionally likely to be impacted by flooding, high winds, hurricanes, and tropical storms. A working with local marinas and yacht clubs such as Roht Marine, Green Harbor Marina, Taylor Marina, Marshfield Yacht Club and Green Harbor Yacht Club could increase collaboration. Preparedness could help improve resiliency in flood prone areas of Town, account for

	property vulnerable to coastal hazards, and reduce private property damage from marine vessels and floats.
RESPONSIBILITY	EOC, Harbormaster, Program for Public Information, Conservation Commission
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget, CZM Coastal Resilience, Seaport Economic Council Grant
PRIORITY	Medium
TIMELINE	Within the next 5 years

Mitigation Action 7c: Maintain programing that promotes flood insurance.	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Public Information
PURPOSE	In Marshfield if all buildings at risk were insured to the maximum available through NFIP, most of the losses included during a natural hazard would be covered by flood insurance. As of 2018, only about 50% of Marshfield buildings in the FEMA floodplain were insured. The Town should continue and increase Community Rating System (CRS) participation to maintain or improve flood insurance discounts and make coverage more affordable. The Town should create additional flood insurance outreach projects: direct mailings of brochures, flood insurance meetings, better advertise free technical assistance, incorporate damage and loss estimates, and promote Increased Cost of Compliance coverage, host flood insurance clinic for one-on-one support.
RESPONSIBILITY	Marshfield Building Department, Program for Public Information
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating Budget
PRIORITY	High
TIMELINE	Ongoing each year

Goal 8: Identify and seek the funding necessary to study, design and construct projects that will reduce the Town's vulnerability to natural hazards.

Mitigation Action 8a: Assess critical infrastructure that is subject to damage from natural hazards. Develop, prioritize, and seek funding for a list of needed infrastructure improvement projects.	
HAZARD ADDRESSED	Multiple Hazards
CRS CATEGORY	Structural Projects
PURPOSE	Continuing to coordinate between various Town departments and community groups to facilitate the planning, prioritization, and implementation of projects that address the Town's vulnerability and increase resiliency. The Town should aggressively pursue federal grants to incentivize property owners to voluntarily elevate their homes or dry

	floodproof their businesses to higher levels or voluntarily sell their property to the Town.
RESPONSIBILITY	Town Administrator, DPW,
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant, Building Resilient Infrastructure and Communities (BRIC)
PRIORITY	Medium
TIMELINE	Over the next 5 years (1 or 2 projects)

Mitigation Action 8b: Integrate municipal mitigation and adaptation projects into the Town's operating and capital budgets.	
HAZARD ADDRESSED	Multiple Hazards
CRS CATEGORY	Preventative
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	Town Administrator, Select Board
ESTIMATED COST	Low
POTENTIAL FUNDING SOURCES	Town Operating and Capital Budgets
PRIORITY	High
TIMELINE	Mid-term and ongoing within the next 5 years

Mitigation Action 8c: Explore opportunities to conserve the Town's existing open space, and possibilities to expand Marshfield's existing open space. Purchase wetlands and other flood prone lands for conservation. Evaluate the future use of open space including marsh restoration, resiliency planning, and the creation of parks and trails.	
HAZARD ADDRESSED	Hurricane & Tropical Storms, Flooding, Coastal Erosion
CRS CATEGORY	Natural Resource Protection
PURPOSE	Research unprotected properties adjacent to existing preserved land and recreation areas that may improve an area's resilience to natural hazards. Prioritize land for acquisition, and update inventory of remaining undeveloped land. In the process the Town could identify properties that would be beneficial in 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 Department, Marshfield Building Department, Conservation Commission, Open Space Committee and Select Board.
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant, MassTrails
PRIORITY	Medium
TIMELINE	Over the next 5 years

Mitigation Action 8d: **Investigate the repair and removal of damaged dams, culverts, tide gates, coastal flood control and protection structures.**	
HAZARD ADDRESSED	Severe Winter Weather, Hurricane & Tropical Storms, Flooding, Coastal Erosion, Dam and Culvert Failure
CRS CATEGORY	Structural Projects
PURPOSE	Identify structures that no longer serve their purpose to establish if the structure needs to be repaired or removed. Increase the removal of ineffective structures to create opportunities to restore ecological systems. Explore funding opportunities for the repair and replacement of existing structures.
RESPONSIBILITY	DPW, Conservation Commission
ESTIMATED COST	High
POTENTIAL FUNDING SOURCES	Town Meeting Article, MVP Planning Grant, CZM Coastal Resilience Grant, Building Resilient Infrastructure and Communities (BRIC), Dam and Seawall Repair or Removal Program (EEA)
PRIORITY	Medium
TIMELINE	Over the next 5 years

Chapter 6

Plan Maintenance Process

Sunrise Beach – May 2018

The Marshfield 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 Marshfield will meet these Plan maintenance requirements.

6.1 PLAN MONITORING, EVALUATION AND UPDATES

A6.a
A6.b
A6.c
A6.d

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 LHMPC will conduct quarterly 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, LHMPC members and/or departments may be added or removed from the LHMPC 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 LHMPC, 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 LHMPC 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:

- Fire Department
- Police Department
- Department of Public Works

- Planning Board
- Conservation Commission
- Building Department
- CRS and PPI Committee

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 LHMPC will review whether any of these plans are in the process of being updated. If so, the LHMPC 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 LHMPC 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 LHMPC, the draft of the Marshfield MHMP was reviewed by the LHMPC, stakeholders and the general public, and informally approved by all applicable Town departments, boards, and other agencies identified as members of the LHMPC. 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 Marshfield 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 Marshfield, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF MARSHFIELD MULTI-HAZARD MITIGATION PLAN (2023)

WHEREAS, the Town of Marshfield 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 Marshfield established a Committee to prepare the *Town of Marshfield* Multi-*Hazard Mitigation Plan (2023)*; and

WHEREAS, the *Town of Marshfield* Multi-*Hazard Mitigation Plan (2023)* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Marshfield, and

WHEREAS, duly-noticed public meetings were held by the Local Hazard Mitigation Planning Committee on December 14th, 2022 and February 27th, 2023, and

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

NOW, THEREFORE BE IT RESOLVED that the Town of Marshfield BOARD OF SELECTMEN adopts the *Town of Marshfield* Multi-*Hazard Mitigation Plan (2023)*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Marshfield.

ADOPTED AND SIGNED this Date. _____

Name(s)
Title(s)
Signature(s)

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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:

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)*** ***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.*	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. ***Document*** *means provide the factual evidence for how the jurisdictions developed the plan.* 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. ***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. 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. *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.*

ELEMENT	REQUIREMENTS
***Intent**: To demonstrate a deliberative planning process that involves stakeholders with the data and expertise needed to develop the plan, with responsibility or authority to implement hazard mitigation activities, and who will be most affected by the plan's outcomes.*	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)*** ***Intent**: To ensure citizens understand what the community is doing on their behalf, and to provide a chance for input on community vulnerabilities and mitigation activities that will inform the plan's content. Public involvement is also an opportunity to educate the public about hazards and risks in the community, types of activities to mitigate those risks, and how these impact them.*	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)* ***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.*	a. The plan **must** document *what* 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 *how* relevant information was incorporated into the mitigation plan. ***Incorporate** means to reference or include information from other existing sources to form the content of the mitigation plan*.
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)* ***Intent**: To identify how the public will continue to have an opportunity to participate in the plan's maintenance and implementation over time.*	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. ***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.
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)* ***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.*	*a.* The plan **must** identify how, when, and by whom the plan will be monitored. ***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.* *b.* The plan **must** identify how, when, and by whom the plan will be evaluated. ***Evaluating** means assessing the effectiveness of the plan at achieving its stated purpose and goals.* *c.* The plan **must** identify how, when, and by whom the plan will be updated. ***Updating** means reviewing and revising the plan at least once every five years.* 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)* ***Intent**: To understand the potential and chronic hazards affecting the planning area in order to identify which hazard risks are most significant and which jurisdictions or locations are most adversely affected.*	a. The plan **must** include a description of the natural hazards that can affect the jurisdiction(s) in the planning area. *A **natural hazard** is a source of harm or difficulty created by a meteorological, environmental, or geological event*[3]*.* 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. 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. ***Location** means the geographic areas in the planning area that are affected by the hazard.* For many hazards, maps are the best way to illustrate location. However, location may be described in other formats. For example, if a geographically-specific location cannot be identified for a hazard, such as tornados, the plan may state that the entire planning area is equally at risk to that hazard. ***Extent** means the strength or magnitude of the hazard*. For example, extent could be described in terms of the specific measurement of an occurrence on a scientific scale (*for example*, Enhanced Fujita Scale, Saffir-Simpson Hurricane Scale, Richter Scale, flood depth grids) and/or other hazard factors, such as duration and speed of onset. Extent is not the same as impacts, which are described in sub-element B3.

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

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

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

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

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

ELEMENT	REQUIREMENTS
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)* ***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.*	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)* ***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.*	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 not 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)* ***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.*	a. The plan **must** include general hazard mitigation goals that represent what the jurisdiction(s) seeks to accomplish through mitigation plan implementation. ***Goals** are broad policy statements that explain what is to be achieved.* 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)* ***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.*	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. ***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. 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. *A **comprehensive range** consists of different hazard mitigation alternatives that address the vulnerabilities to the hazards that the jurisdiction(s) determine are most important.* 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. ***With emphasis on new and existing building and infrastructure** means that the action plan includes a consideration of actions that address the built environment.*

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)* ***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.*	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 (*for example*, 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)* ***Intent**: To assist communities in capitalizing on all available mechanisms that they have at their disposal to accomplish hazard mitigation and reduce risk.*	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. ***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.* 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.

ELEMENT	REQUIREMENTS
D1. Was the plan revised to reflect changes in development? ***44 CFR 201.6(d)(3)*** ***Intent****: To ensure that the mitigation strategy continues to address the risk and vulnerabilities to existing and potential development, and takes into consideration possible future conditions that can impact the vulnerability of the community.*	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. ***Changes in development*** means recent development (*for example*, construction completed since the last plan was approved), potential development (*for example*, development planned or under consideration by the jurisdiction), or conditions that may affect the risks and vulnerabilities of the jurisdictions (*for example*, 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)* ***Intent**: To evaluate and demonstrate progress made in the past five years in achieving goals and implementing actions outlined in their mitigation strategy.*	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)* ***Intent**: To ensure the plan reflects current conditions, including financial, legal, and political realities as well as post-disaster conditions.*	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.

ELEMENT	REQUIREMENTS
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, *Plan Review Procedure* 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)* ***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. 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, *Plan Review Procedure* 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 Marshfield, Massachusetts	**Title of Plan:** Marshfield Multi-Hazard Mitigation Plan	**Date of Plan:** March 2022
Local Point of Contact: Greg Guimond	**Address:** Marshfield Town Hall 870 Moraine Street Marshfield, MA 02050	
Title: Town Planner		
Agency: Planning Department		
Phone Number: (781) 834-5554	**E-Mail:** gguimond@townofmarshfield.org	

State Reviewer:	**Title:**	**Date:**

FEMA Reviewer:	**Title:**	**Date:**
Date Received in FEMA Region ***(insert #)***		
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 **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan (section and/or page number)**	**Met**	**Not Met**
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 1-6)		
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 (page 1-3)		
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 1-6)		
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 **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
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 4-21 to 4-26)		
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 (pages 2-9)		
ELEMENT B: REQUIRED REVISIONS			
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 5-4 to 5-7)		
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 5-7)		
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 5-24)		
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 5-24)		
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)		
ELEMENT C: REQUIRED REVISIONS			

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
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 2.8 (page 2-7)		
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Section 5.3 (pages 5-8 to 5-12)		
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Section 5.1 (page 5-2)		
ELEMENT D: REQUIRED REVISIONS			
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		
ELEMENT E: REQUIRED REVISIONS			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
ELEMENT F: REQUIRED REVISIONS			

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 Require-ments
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 Require-ments
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
2. Meeting Agendas
3. Copy of Announcements for Public Presentations
4. Online Public Survey Results
5. Screenshot of Town Homepage with Link to Draft Report
6. Email Sent to Neighboring Towns
7. Comment Response Document

Town of Marshfield
Local Hazard Mitigation Planning Committee (LHMPC) 2023

	Name	Title	Department/Affiliation
1	Jack Sullivan	NE Environmental Officer (FEMA)	Coastal Advisory Committee
2	Mike Steele	Conservation Agent	Conservation Commission
3	Rod Procaccino	Town Engineer	Department of Public Works
4	Tom Reynolds	DPW Superintendent	Department of Public Works
5	Arthur Shaw	Lieutenant / Director	Marshfield Emergency Management Agency
7	Andrew Stewart	Building Commissioner / Zoning Enforcement Officer / Floodplain Administrator	Marshfield Building Department
8	Timothy Williams	Vice Chair	Program for Public Information - CRS
11	Joe Rossi	Chair	Program for Public Information - CRS
12	Michael Maresco	Town Administrator	Administration Department
13	Greg Guimond	Town Planner	Planning Department
14	Nanci Porreca	CRS Coordinator/ZBA	Zoning Board of Appeals / Program for Public Information - CRS
15	Karen Horne	Assistant Town Planner	Planning Department
16	Jeff Simpson	Fire Chief	Marshfield Fire Depardment
17	Gary Russell	Director	Marshfield Board of Health
18	Carol Hamilton	Director	Council on Aging
19	Carin L. Paulette	Veterans' Service Officer	Veterans' Services
20	Helen Bennett	ADA Committee Chair	ADA Committee
22	Cyndee Marcoux	Library Director	Ventress Memorial Library Director

09/06/2022 2:00 PM

Town of Marshfield
Multi-Hazard Mitigation Plan Update
Kick-off Meeting September 6th, 2022

Meeting Information:

Name of Public Body: LHMPC
Date: September 06, 2022
Time: 2:00 PM
Place: Microsoft Teams Meeting
Meeting ID: 398 804 832 001
Passcode: WUezZi

Agenda Items:

1. **Welcome and Introductions:**

2. **Overview of the MHMP Update Process:**
   a. Marshfield last completed a Multi-Hazard Mitigation Plan (MHMP) in March 2018 (expires April 2023).
   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 2018 plan during the update process.
      - What worked well for the Town when developing the 2018 plan?
      - Anything that the Town would like to do differently this time around?
   d. Review Scope of Work.

3. **Data Requirements:**
   a. Review State Hazard List and Marshfield MHMP 2018 Hazard List:
      - Any additional hazards to include in the 2023 plan?
      - Review data sources.
      - Any newly available hazard related data?
      - Need for recent photos including: vistas around Marshfield, flooding events, wildfire incidents storms (Winter Storm Riley (2018), Winter Storm Kenan (2022)), etc.
   b. Selection of critical facilities:
      - Start with the 2018 list of facilities (will review during the first working meeting).
   c. Town of Marshfield 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 2018 MHMP, which utilized categories assigned by MassGIS):

Land Use Category
Residential (Single Family)
Residential (Multi-Family)

Commercial (Retail/Offices/Services)
Commercial (Manufacture/Distribution)
Public Services
Temporary Lodging (i.e. Hotels, Inns)
Agriculture
Open Space
Vacant
Recreation

f. Relevant Town plans/reports:

	Plans/ Reports	Relevance to 2023 MHMP
1	Marshfield (Brant Rock) Rapid Recovery Plan (2021)	
2	Town of Marshfield Long-Term Coastal Resilience Plan (2022)	
3	Marshfield Master Plan (2015)	
4	Sea Level Rise Study (2013)	
5	Beach Management Plan (2017)	
6	Multi-Hazard Mitigation Plan Annual Evaluation (2019)	
7	Library Square Vision Plan (2021)	
8	Draft Housing Production Plan (2019)	
9	Town of Marshfield Community Resilience Building Workshop Summary of Findings (2020)	
10	USACE Brant Rock and Fieldston Coastal Storm Damage Reduction Report (2016)	
11	South Shore Coastal Hazards Adaptation Study (2011)	
12	Green Harbor River Tide Gate Study (2017)	
13	Massachusetts Coastal Infrastructure Inventory and Assessment Project (2011)	
14	Marshfield Harbor, Rivers and Waterways Management Plan (2014)	
15	Preparing for the Storm: Recommendations for Management of Risk from Coastal Hazards in MA (2007)	
16	Master Plan for Seawalls?	
17	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 2018 plan development included:

- Two public meetings – August/ December 2017
- A public online survey was also administered to assess the community's experience with local natural hazards and their perception of the risk.
- An opportunity for the public to review and comment on draft plan.

c. What should be included or excluded for the 2023 planning process?

5. Timeline for Plan Completion

a. Draft for planning team review February 7, 2023 (Submit plan to MEMA/FEMA for approval 3/21/23)
   - Aggressive schedule requiring a high level of participation during meetings.

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

Meeting Information:

Name of Public Body: LHMPC
Date: October 04, 2022
Time: 2:00 PM
Place: Microsoft Teams Meeting
Meeting ID: 355 523 473 085
Passcode: kZDWR9

Agenda Items:

1. **Outstanding Tasks:**
    a. Review task list

2. **Public Survey Questions:**
    a. Review/identify questions for the survey
    b. Confirm public survey details (public survey open 10/10/22- 10/23/22, how will the public access the survey, etc.)

3. **Review Critical Facilities List:**
    a. Review identification of critical facilities
    b. Additional facilities to add? Are any to be removed?

4. **Review of Hazard Profiles:**
    a. Data gaps:
        - More pictures: coastal/inland flooding, coastal erosion, severe winter weather
        - Wildfire data
        - Local coastal erosion data
        - Local invasive species data
        - Dams/Culverts:
            - Review list of dams and culverts
            - Any history of dam or culvert failure? Are there EAPs?
    b. Review hazard maps
    c. Review hazard ranking process

5. **Town Capabilities Assessment (email attachment):**
    a. FEMA's Capabilities Assessment Questionnaire will help document Town capabilities

6. **Schedule Next Working Meeting:**
    a. Working Meeting #2 November 1st, 2022

11/01/2022 2:00 PM

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

Meeting Information:

Name of Public Body: LHMPC
Date: November 11, 2022
Time: 2:00 PM
Place: Microsoft Teams Meeting
Meeting ID: 364 366 742 361
Passcode: eaGSZW

Agenda Items:

1. **Outstanding Tasks:**
    a. Review task list

2. **Review Results of Public Survey:**

3. **Review Critical Facilities List:**
    a. Review identification of critical facilities – 2018: 139 Critical Facilities / Current list down to 125 Critical Facilities
    b. Some facilities being assets vs. critical facilities (e.g., historical properties).
    c. Additional facilities to add? Are any to be removed?

4. **Identifying Community Assets (People):**
    a. Identify concentrations of residents to help target preparedness, response, and mitigation actions.
    b. Identify locations and concentrations of access and functional need populations (groups that may not comfortably or safely access the standard resources offered in emergencies) to develop mitigation actions to assist them.
    c. May include children, the elderly, the physically or mentally disabled, non-English speakers, or the medically or chemically dependent.
    d. 2018 Included:
        - Concentrations of Elderly or Disabled People
        - Isolated Coastal Communities
        - Visitor/Tourist Centers

5. **Vulnerability Assessment:**
    a. Parcels and Buildings Vulnerable to Flooding in the AE Zone.

6. **Important Dates:**
    a. Next Working Meeting #3 November 29st, 2022
    b. Initial Public Outreach Presentation December 13th, 2022
        - Describe MHMP process, present initial results

7. Repetitive Loss Data:

11/29/2022 2:00 PM

Town of Marshfield
Multi-Hazard Mitigation Plan Update
Working Meeting 3

Meeting Information:

Name of Public Body: LHMPC
Date: November 29, 2022
Time: 2:00 PM
Place: Microsoft Teams Meeting
Meeting ID: 368 108 161 576
Passcode: o9vVR9

Agenda Items:

1. **Outstanding Tasks:**
    a. Review task list

2. **Public Survey Update:**

3. **Review Critical Facilities List:**
    a. Finalize critical facilities list

4. **Identifying Community Assets (People):**
    a. Concentrations of residents to help target preparedness, response, and mitigation actions have been identified as:
        - Concentrations of Elderly or Disabled People
        - Child Care Centers
        - Potentially Isolated Coastal Communities

5. **Vulnerability Assessment:**
    a. Review results of flood vulnerability assessment for critical facilities and parcel data

6. **Develop Hazard Mitigation Plan Goals**

7. **Important Dates:**
    a. Next Working Meeting #4 January 3, 2022
    b. Initial Public Outreach Presentation December 13th, 2022
        - Describe MHMP process, present initial results

1/10/2023 2:00 PM

Town of Marshfield
Multi-Hazard Mitigation Plan Update
Working Meeting 4

Meeting Information:

Name of Public Body: LHMPC
Date: January 10, 2023
Time: 2:00 PM
Place: Microsoft Teams Meeting
Meeting ID: 374 708 067 877
Passcode: 5hYbFz

Agenda Items:

1. **Review Qualitative Vulnerability Assessment:**

2. **Hazard Mitigation:**
   a. Review hazard mitigation plan goals.
   b. Review/update hazard mitigation actions from the 2018 plan.
   c. Develop additional hazard mitigation actions for the 2023 plan.

3. **Revised MHMP Schedule:**
   a. Next Working Meeting #5 February 14th, 2022.
   b. Draft Plan for Planning Team to Review February 21st, 2023.
   c. Comments due back to Woods Hole Group after a two-week review period February 28th, 2023.
   d. Revised Draft Plan for Neighboring Communities and Public to Review, Open Public Comment Period March 3rd, 2023.
   e. Next Public Outreach Presentation March 7th, 2022.

2/14/2023 2:00 PM

Town of Marshfield
Multi-Hazard Mitigation Plan Update
Working Meeting 5

Meeting Information:

Name of Public Body: LHMPC
Date: February 14, 2022
Time: 2:00 PM
Place: Zoom Meeting
Meeting ID: 868 8706 4428
Passcode: 761002

Agenda Items:

1. **Review of Vulnerable Populations**

2. **Review Status of Hazard Mitigation Actions for 2018**

3. **Review Proposed Hazard Mitigation Actions for 2023**
    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 February 21, 2023. One-week review period with comments back to WHG by February 28, 2023.
        - Draft MHMP will then be distributed to/open for comments from neighboring towns, the regional agency, and the public from March 3rd to March 17th, 2022 (two-week review period).
    b. Second public presentation – February 27, 2023
    c. Submit Plan to MEMA/FEMA – March 24, 2023

Published on *Marshfield MA* (https://www.marshfield-ma.gov)

Marshfield Flood Information Outreach and Multi-Hazard Mitigation Plan Update Public Meeting

Event Date:
Wednesday, December 14, 2022 - 7:00pm to 9:00pm

Marshfield Multi-Hazard Mitigation Plan Update Public Meeting

The Town of Marshfield requests that you join the Town for a public meeting to hear from Woods Hole Group on the Marshfield Multi-Hazard Mitigation Plan Update and from the Community Rating System Committee for their annual fall outreach. Come share your ideas on how to keep your community, neighbors, and family safe from the various natural hazards that Marshfield experiences!

The meeting will be in person on **Wednesday, December 14th, from 7:00 to 9:00 pm** at the Marshfield Council on Aging (230 Webster Street, Marshfield, MA). The session will consist of presentations on hazard mitigation planning, flood hazards, and flood insurance.

The Town of Marshfield is currently updating the 2018 Hazard Mitigation Plan.
There will be a presentation by the Woods Hole Group to:

- Describe the Hazard Mitigation Plan process;
- Why the Town's plan needs to be current;
- Progress to date, including identification of critical facilities and preliminary results from the vulnerability assessments.

This plan is critical because it helps the Town plan and receive funding for projects that reduce the risk of injury or damage to property from future natural hazard events such as flooding and hurricanes.

To further encourage resiliency in the community and to address ongoing concerns and questions on flood insurance, the Marshfield CRS Committee's flood insurance outreach will discuss the following:

- How to protect your home before and during a flood;
- Info on private flood insurance;
- What to do after a flood;
- Updates to the NFIP's rating system, called Risk Rating 2.0.

Additionally, the Committee will spend time answering attendees' specific questions on flood insurance on their own flood policy, and any generic questions that attendees have.

For more information on the Multi-Hazard Mitigation plan, contact Greg Guimond at (781) 834-5554 or at gguimond@townofmarshfield.org.
For more information on the Community Rating System, contact Nanci Porreca at (781) 834-5557 or at nporreca@townofmarshfield.org.

Source URL: https://www.marshfield-ma.gov/marshfield-building-department/events/96111

12/14/2022 6:00 PM

Town of Marshfield
Multi-Hazard Mitigation Plan Update
Public Presentation 1

Meeting Information:

Name of Public Body: LHMPC
Date: December 14th, 2022
Time: 7:00 PM
Place: Marshfield Senior Center - COA 230 Webster Street, Marshfield MA

Agenda Items:

1. **Overview of Hazard Mitigation Plan Process**
    a. What is a Hazard Mitigation Plan and why should Marshfield have a current one?

2. **Overview of MHMP Chapters**
    a. Chapter 3: Hazard Identification
    b. Chapter 4: Vulnerability Assessment

3. **Public Participation**

4. **Schedule**

02/27/2023 6:45 PM

Town of Marshfield
Multi-Hazard Mitigation Plan Update
Public Presentation 2

Meeting Information:

Name of Public Body: LHMPC, Select Board
Date: February 27th, 2023
Time: 6:45 PM
Place: Marshfield Town Hall, Select Board Hearing Room

Agenda Items:

1. **Overview of Hazard Mitigation Plan Process**
    a. **What is a Hazard Mitigation Plan and why should Marshfield have a current one?**

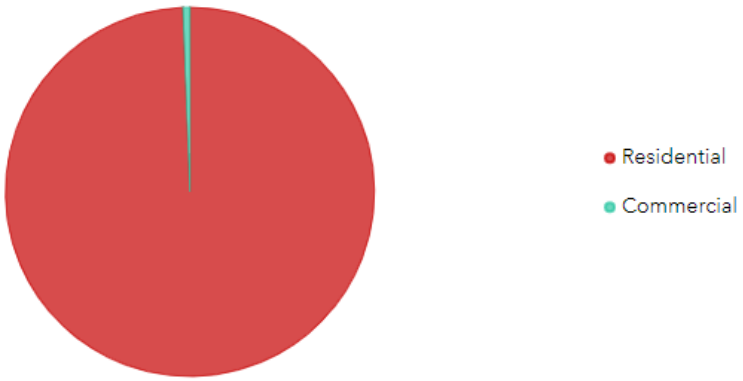
2. **Overview of MHMP Chapters**
    a. Chapter 3: Hazard Identification
    b. Chapter 4: Vulnerability Assessment
    c. Chapter 5: Mitigation Measures
    d. Chapter 6: Plan Maintenance Process

3. **Opportunities to Provide Comment on MHMP Draft**

Personal Information

Are you responding on behalf of a residential or commercial property?

Column Bar Pie Map



Hide table

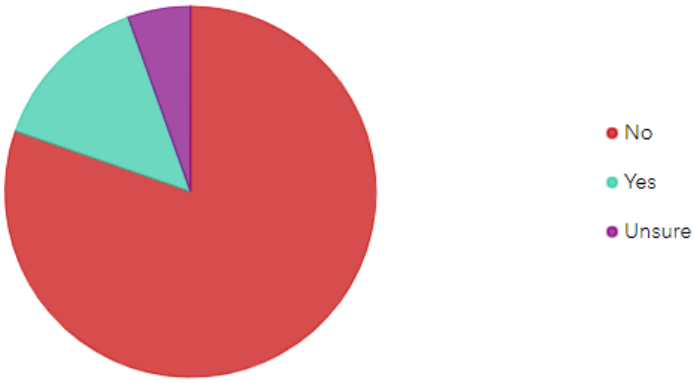
Empty categories Sort

Answers	Count	Percentage
Residential	326	98.79%
Commercial	2	0.61%

Answered: 328 Skipped: 2

Is your property located in a FEMA designated floodplain?

Column Bar Pie Map



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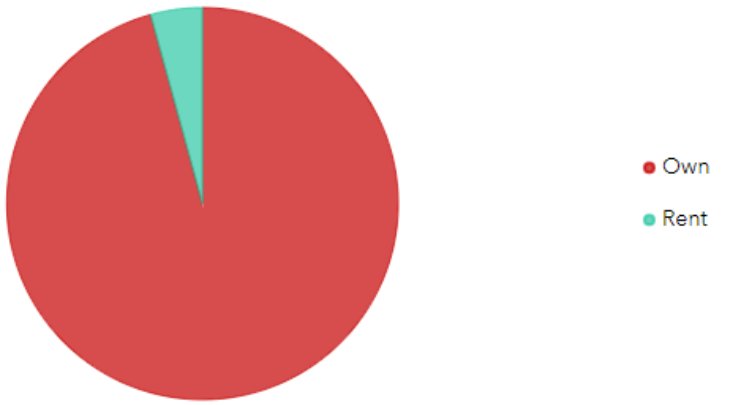
Answers	Count	Percentage
No	265	80.3%
Yes	47	14.24%
Unsure	18	5.45%

Answered: 330 Skipped: 0

Do you own or rent your place of residence/business?

Column Bar Pie Map



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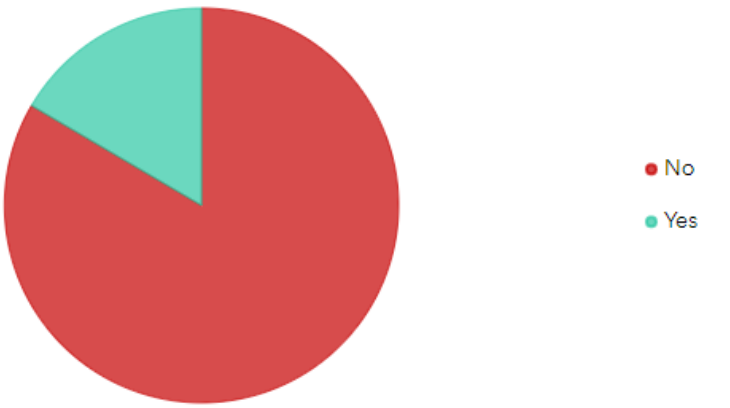
Answers	Count	Percentage
Own	314	95.15%
Rent	14	4.24%

Answered: 328 Skipped: 2

Do you currently have a flood insurance policy for your property? *

Column Bar Pie Map



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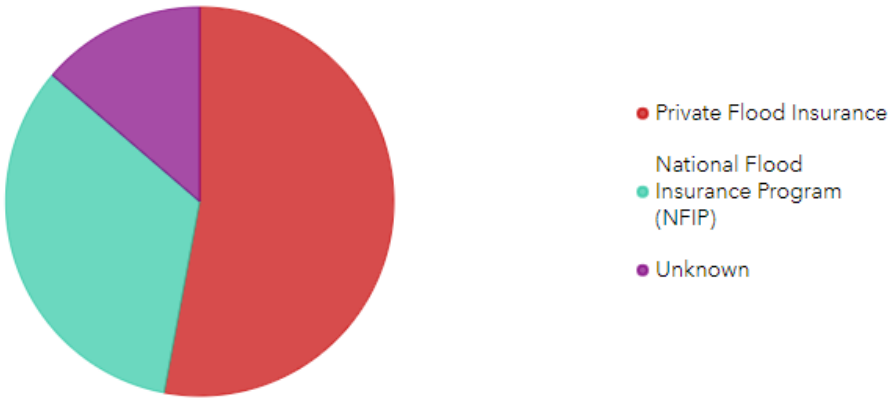
Empty categories Sort

Answers	Count	Percentage
No	262	79.39%
Yes	52	15.76%

Answered: 314 Skipped: 16

Who is your flood insurance provider?

Column Bar Pie Map



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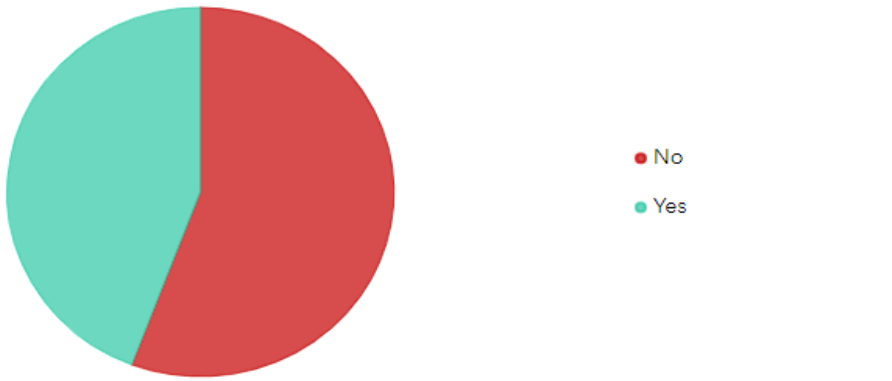
Answers	Count	Percentage
Private Flood Insurance	27	8.18%
National Flood Insurance Program (NFIP)	17	5.15%
Unknown	7	2.12%

Answered: 51 Skipped: 279

Do you know where to go in Town if you need access to an emergency shelter or generato...

*Column Bar Pie Map



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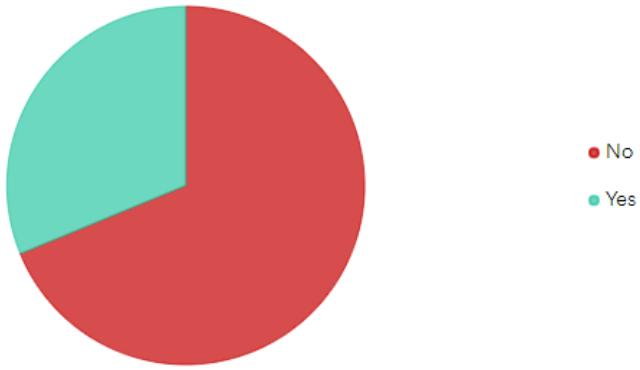
Answers	Count	Percentage
No	184	55.76%
Yes	146	44.24%

Answered: 330 Skipped: 0

Have you ever received information about how to make members of your household and...

Column Bar Pie Map



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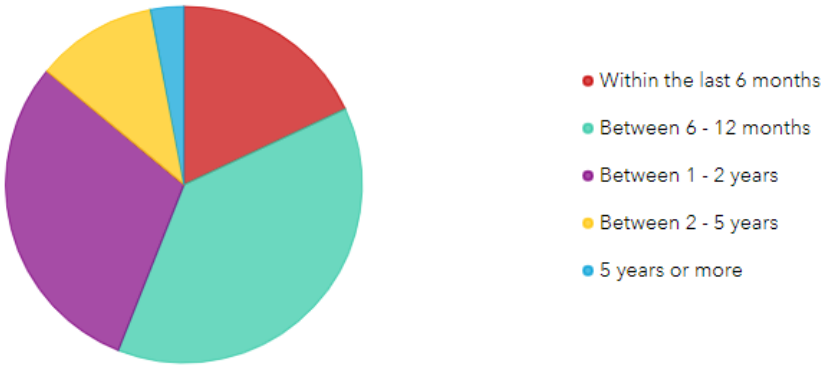
Empty categories Sort

Answers	Count	Percentage
No	227	68.79%
Yes	103	31.21%

Answered: 330 Skipped: 0

How recently did you received information about how to make members of your household...

Column Bar Pie Map



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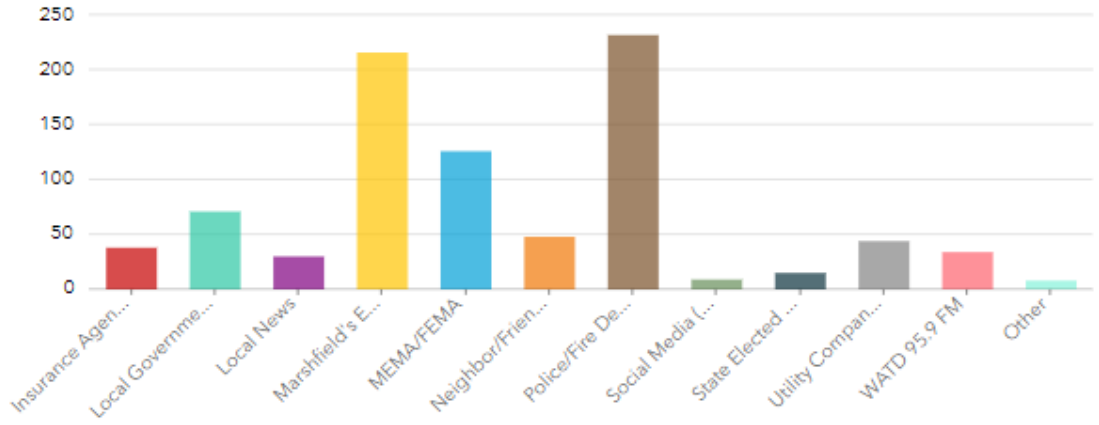
Empty categories Sort

Answers	Count	Percentage
Within the last 6 months	18	5.45%
Between 6 - 12 months	38	11.52%
Between 1 - 2 years	30	9.09%
Between 2 - 5 years	11	3.33%
5 years or more	3	0.91%

Answered: 100 Skipped: 230

Who would you most trust to provide you with information about making your household and home safe... Column Bar

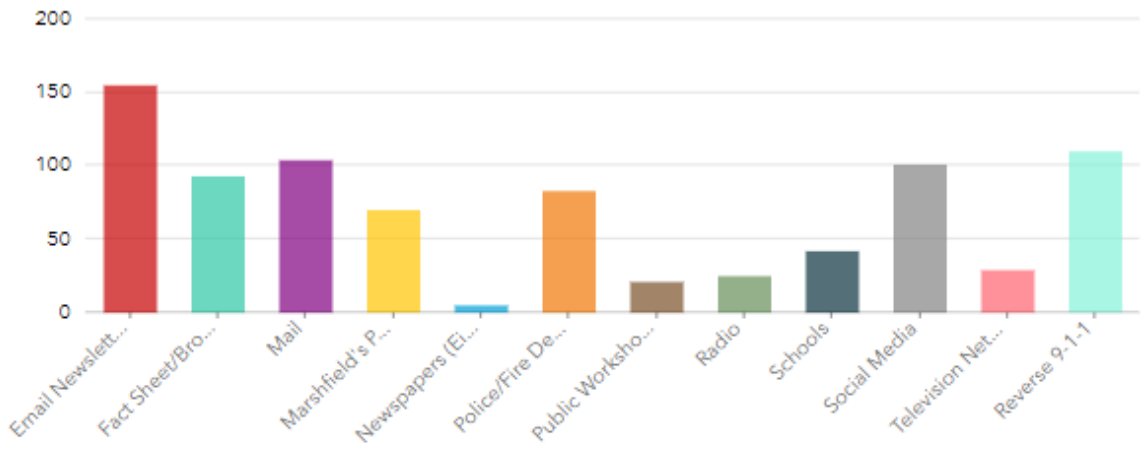


Hide table Other response Empty categories Sort

Answers	Count	Percentage
Insurance Agent or Company	38	11.52%
Local Government Official	71	21.52%
Local News	30	9.09%
Marshfield's Emergency Operations Center (EOC)	216	65.45%
MEMA/FEMA	126	38.18%
Neighbor/Friend/ Family Member	48	14.55%
Police/Fire Department	232	70.3%
Social Media (e.g. Facebook)	9	2.73%
State Elected Officials	15	4.55%
Utility Company	44	13.33%
WATD 95.9 FM	34	10.3%

Answered: 330 Skipped: 0

What is the most effective way for you to receive information about how to make your household and... * Column Bar



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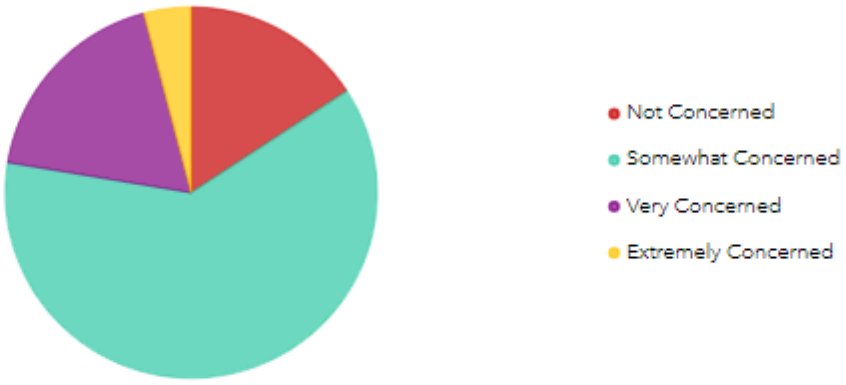
Answers	Count	Percentage
Email Newsletters	155	46.97%
Fact Sheet/Brochure	93	28.18%
Mail	104	31.52%
Marshfield's Portable Roadway Signs	70	21.21%
Newspapers (Either Print or Online)	5	1.52%
Police/Fire Department	83	25.15%
Public Workshops	21	6.36%
Radio	25	7.58%
Schools	42	12.73%
Social Media	101	30.61%
Television Networks (Local and Public)	29	8.79%

Answered: 330 Skipped: 0

Opinions

● You may have noticed that natural hazards have been getting some attention in the news.... Column Bar Pie Map



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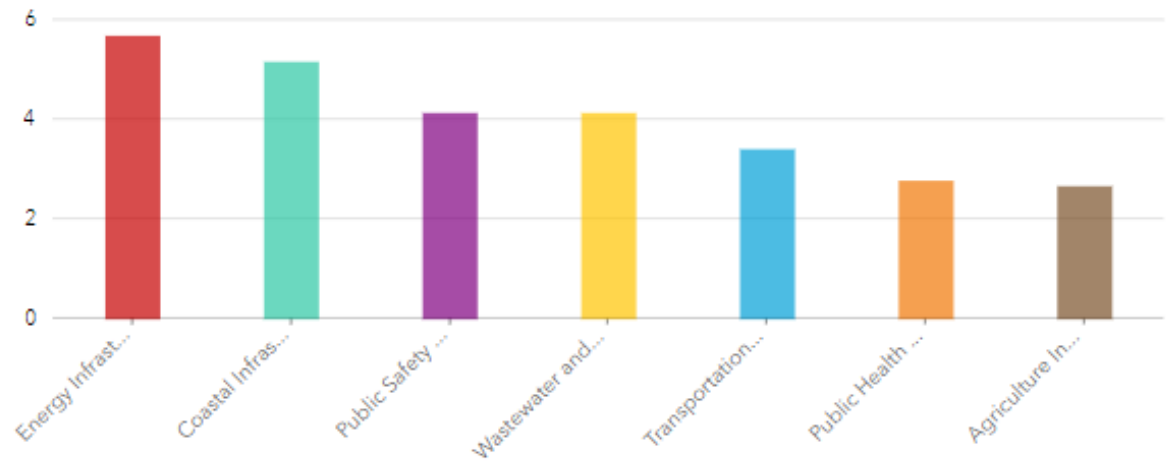
Empty categories Sort

Answers	Count	Percentage
Not Concerned	50	15.15%
Somewhat Concerned	196	59.39%
Very Concerned	58	17.58%
Extremely Concerned	13	3.94%

Answered: 317 Skipped: 13

● Rank the critical facilities in Marshfield's built environment that you are most concerned woul... Column Bar

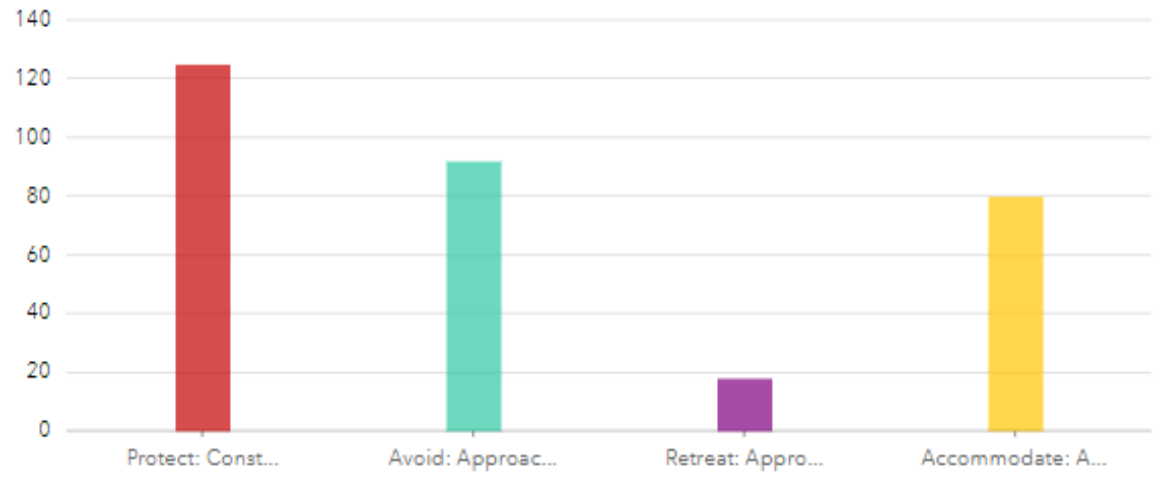


Hide table Show/hide choices Sort

Rank	Answers	1	2	3	4	5	6	7	Average score
1	Energy Infrastructure (Electric Lines, Gas Stations, Fuel Storage, etc.)	31.87% 102	28.75% 92	22.5% 72	12.5% 40	2.81% 9	0.63% 2	0.94% 3	5.69
2	Coastal Infrastructure (Seawalls, Jetties, etc.)	39.38% 126	15.63% 50	15% 48	6.25% 20	6.88% 22	9.69% 31	7.19% 23	5.17
3	Public Safety Infrastructure (Police and Fire Stations, Communication Systems, Schools, Emergency Shelters, etc.)	8.75% 28	10.63% 34	15.94% 51	31.56% 101	19.38% 62	11.25% 36	2.5% 8	4.14
	Wastewater and Water								

Answered: 320 Skipped: 10

● 14. The PARA framework (Protect, Avoid, Retreat, Accommodate) categorizes and examines... Column Bar Pie Map



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Answers	Count	Percentage
Protect: Construction of engineered structures and systems (e.g., sea walls) designed to keep flood waters away from homes, communities, critical facilities, and valued infrastructure.	125	37.88%
Avoid: Approaches that proactively prevent homes, communities, facilities, or infrastructure from being built in flood-prone areas.	92	27.88%
Retreat: Approaches that permanently relocate homes, communities, facilities, and infrastructure that are subject to repeat flooding outside the floodplain.	18	5.45%
Accommodate: Adaptive strategies that allow continued use of flood-prone areas by improving the resilience of communities or valued facilities/ infrastructure (e.g., raising structures, food proofing foundations).	80	24.24%

Answered: 315 Skipped: 15

APPENDIX C: CRITICAL FACILITIES AND VULNERABILITY

1. Critical Facilities List w/Vulnerabilities
2. Mitigation Actions Prioritization
3. Removed Mitigation Actions

ID	Name	Address	Category	FEMA Flood Zone	SLOSH Zone	MCFRM 2030	MCFRM 2050	MCFRM 2070	Wildfire	Slope Stability
1	Timber Bulk Head		Coastal Infrastructure	AE	2	12%	75%	75%		
2	South River Revetment (Area #2)		Coastal Infrastructure	AE	2	25%	78%	78%		
3	Fieldston Sea Wall (Area 3)		Coastal Infrastructure	VE	1	75%	76%	81%		
4	Ocean Bluff Sea Wall (Area #4)		Coastal Infrastructure	AO	1					4
5	Ocean Bluff Stone Revetment (Area #4)		Coastal Infrastructure	AO	1					4
6	Hewitt's Point Sea Wall (Area #5)		Coastal Infrastructure	VE	4	48%	48%	69%		4
7	Hewit's Revetment (Area #5)		Coastal Infrastructure	VE		91%	91%	100%		3
8	Brant Rock Seawall (Area #6) Part A		Coastal Infrastructure	VE	4	45%	80%	83%		
9	Brant Rock Seawall (Area #6) Part B		Coastal Infrastructure	VE	3	72%	80%	80%		
10	Brant Rock Revetment		Coastal Infrastructure	VE	4	72%	82%	84%		3
11	Brant Rock Rip Rap Slope		Coastal Infrastructure	VE	2	40%	40%	48%		
12	Town Pier Sea Wall		Coastal Infrastructure	AE	2	58%	77%	89%		4
13	Green Harbor Stone Jetty East		Coastal Infrastructure	VE	2	82%	82%	89%		
14	Green Harbor Stone Jetty West		Coastal Infrastructure	VE	3	2%	5%	19%		
15	Bay Ave Sea Wall		Coastal Infrastructure	VE	1	98%	98%	98%		
16	Ocean Bluff Auto	969 Ocean St	Energy Infrastructure	AE	1	9%	53%	75%		
17	Cedar View Filling Station	430 Careswell St	Energy Infrastructure							
18	A L Prime	2170 Ocean St	Energy Infrastructure			1%	6%	29%		
19	Rand Handy Oil Co	900 Webster St	Energy Infrastructure		2		75%	75%		
20	Public Petro	1933 Ocean St	Energy Infrastructure		4					
21	Bill's Sunco	2054 Ocean St	Energy Infrastructure		4			2%		
22	Speedway Gas Station	2139 Ocean St	Energy Infrastructure							2
23	Shell Gas Station	2126 Ocean St	Energy Infrastructure							
24	Taylor Marine	95 Central St	Energy Infrastructure	AE	2	22%	45%	80%		
25	Roht Marine	2205 Main St	Energy Infrastructure	AE	1	58%	59%	76%		

26	Town of Marshfield Fuel Staton		Energy Infrastructure		3	3%	22%	35%		
27	Taylor Lumber Propane	2075 Ocean St	Energy Infrastructure		4					
28	Maintenance Facility	86 Enterprise Dr	Energy Infrastructure							
29	Williams Coal & Oil Co.	717 Plain St	Energy Infrastructure							
30	Bay State Gas	South of 180 Enterprise Dr	Energy Infrastructure							
31	Rand Handy Propane	851 Webster St	Energy Infrastructure							
32	Brant Rock Food Market	72 Dyke Rd	Public Health	AE	2	14%	63%	75%		
33	Roche Brothers	605 Plain St	Public Health						Forested Areas	
34	Star Market	0 Snow Rd	Public Health							
35	CVS	1880 Ocean St	Public Health		4					
36	Walgreens Pharmacy	2177 Ocean St	Public Health							3
37	Prence Grant Apt #1	780 Webster St	Public Safety							
38	Prence Grant Apt #2	40 Parsonage St	Public Safety		4		6%	6%		
39	Proprietors Green Village (Welch Healthcare)	10 VIllage Green	Public Safety						Forested Areas	
40	Marshfield Veterans Home	2033 Ocean St	Public Safety		4					
41	Winslow Village #1	1520 Ocean St	Public Safety		4					
42	Winslow Village #2	1554 Ocean St	Public Safety		4					
43	Coastguard Relay antenna	Across from 1299 South River St	Public Safety							
44	WATD media/Fire Municipal radio system	Behind 125 Grove St	Public Safety							
45	Monopole		Public Safety	AE	3		2%	30%		
46	Verizon Telephone Exchange	200 Main St	Public Safety							
47	Eversource Sub Station #1	West of 260 South River St	Public Safety		3				Forested Areas	
48	Eversource Sub Station #2	West of 53 Station St	Public Safety							3
49	Eversource Sub Station LAT 42.0886 Long -70.6544	Webster Street	Public Safety	AE	1	7%	46%	74%		
50	Indust. Comm Cell/Radio Tower	40 Lone St	Public Safety							

51	Radio Tower - Carolina Hill	South of 164 Eames St	Public Safety						Forested Areas	
52	WATD Media/Fire Municipal radio system	110 Enterprise Dr	Public Safety							
53	Cell Phone Tower	969 Ocean Street	Public Safety	AE	1	9%	53%	75%		
54	Cell Phone Tower (American)	Webster Square	Public Safety							
55	Cell Phone Tower	1204 Union Street	Public Safety						Forested Areas	
56	Marshfield Housing Authority - Housing	12 Tea Rock Gardens	Public Safety							
57	Grace Ryder Apartments	135 Main St	Public Safety							
58	Main Post Office	11 Snow Rd	Public Safety							
59	Marshfield Town Hall	870 Moraine St	Public Safety							
60	Marshfield Animal Shelter	156 Clay Pit Rd	Public Safety							
61	DPW Barn	35 Parsonage St	Public Safety		3			1%		
62	DPW Main Office	965 Plain St	Public Safety							
63	Marshfield Senior Center	230 Webster St	Public Safety						Forested Areas	
64	Road to Responsibility/Ventress Public Library	1831 Ocean St	Public Safety		3	1%	75%	75%		
65	Marshfield Town Pier/Harbor Master Building	100 Central St	Public Safety	AE	2	29%	43%	81%		
66	Town Airport		Public Safety	AE	1	9%	53%	75%		
67	Daniel Webster School	1456 Ocean St	Public Safety		4			1%		
68	South River School	59 Hatch St	Public Safety				4%	17%		
69	Furnace Brook Middle School	500 Furnace St	Public Safety							
70	Marshfield High School	167 Forest St	Public Safety							
71	Martinson Elementary School	257 Forest St	Public Safety							
72	Eames Way Elementary School	165 Eames Way	Public Safety							
73	Gov Edward Winslow School	60 Regis St	Public Safety							
74	Marshfield Police Station/EOC	1639 Ocean St	Public Safety		4					

75	Fire Station #2	229 Old Main St	Public Safety							
76	Marshfield Fire Department	60 South River Street	Public Safety							
77	Fire Station #1	21 Massasoit St	Public Safety	AO			5%	51%		
78	Central Street Waste Water Pump Station		Wastewater/ Water Infrastructure	AE	2	12%	65%	75%		
79	Solid Waste Transfer Station	23 Clay Pit Rd	Wastewater/ Water Infrastructure							
80	Waste Water Treatment Plant	200 Joseph Dribeek Way	Wastewater/ Water Infrastructure	AE	3		2%	42%		
81	Marshfield HS waste water treatment facility	167 Forest St	Wastewater/ Water Infrastructure							
82	Homestead Ave Waste Water Pump Station		Wastewater/ Water Infrastructure		3	14%	15%	21%		
83	Plymouth Avenue Wastewater Pump Station		Wastewater/ Water Infrastructure	AE	1	9%	53%	75%		
84	Macker Terrace Waste Water Pump Station		Wastewater/ Water Infrastructure	AE	1	9%	53%	75%		
85	Anderson Drive Waste Water Pump Station		Wastewater/ Water Infrastructure	AE	2	65%	75%	75%		
86	Carolina Hill Water Tank	South of 164 Eames Way	Wastewater/ Water Infrastructure						Forested Areas	
87	Furnace Brook Water Pumping Station #4		Wastewater/ Water Infrastructure						Forested Areas	
88	Mt Skirgo Rd Water Pump		Wastewater/ Water Infrastructure							
89	South River Pumping Station	227 South River	Wastewater/ Water Infrastructure						Forested Areas	
90	Avon Street Waste Water Pump Station		Wastewater/ Water Infrastructure	AE	2	12%	75%	75%		
91	Webster St Pumping Station #1		Wastewater/ Water Infrastructure						Forested Areas	
92	Church Street Water Pumping Station		Wastewater/ Water Infrastructure							4
93	Webster St Pumping Station #2		Wastewater/ Water Infrastructure		3			4%	Forested Areas	
94	Furnace Brook Water Pumping Station #1		Wastewater/ Water Infrastructure						Forested Areas	

95	Union Street Water Pump Station #1		Wastewater/ Water Infrastructure						Forested Areas	
96	Furnace Brook Water Pumping Station #3		Wastewater/ Water Infrastructure							
97	Ferry Street Water Pumping Station #2		Wastewater/ Water Infrastructure						Forested Areas	
98	Main Lift Pump Station		Wastewater/ Water Infrastructure	AE	2	14%	62%	75%		
99	Furnace Brook No. 2 Water Treatment Facility		Wastewater/ Water Infrastructure						Forested Areas	
100	Spring Street Water Pump		Wastewater/ Water Infrastructure						Forested Areas	
101	Union Street Water Pump Station #2		Wastewater/ Water Infrastructure						Forested Areas	
102	Pudding Hill Lane Water Tank		Wastewater/ Water Infrastructure						Forested Areas	
103	Telegraph Hill water Tank	97 Eagle Rd	Wastewater/ Water Infrastructure							
104	Ferry Street Water Pumping Station #1		Wastewater/ Water Infrastructure						Forested Areas	
105	Furnace Brook Water Pumping Station #2		Wastewater/ Water Infrastructure						Forested Areas	
106	School St Water Pumping Station		Wastewater/ Water Infrastructure						Forested Areas	
107	Fairgrounds Well Site		Wastewater/ Water Infrastructure						Forested Areas	
108	Water Standpipe Forest St		Wastewater/ Water Infrastructure						Forested Areas	
109	Dam - Dyke Rd Dam	Dyke Rd	Wastewater/ Water Infrastructure	AE	3	44%	53%	80%		
110	Dam - Magoun Pond Dam	East of 71 Mill Pond Lane	Wastewater/ Water Infrastructure						Forested Areas	

Proposed Mitigation Actions Dismissed from the Final Plan

Mitigation Action	Reason Removed
Identify low-lying parking lots susceptible to flooding and develop and implement a plan to address road flooding problems and beach access issues.	This mitigation action was recommended in Marshfield's Beach Management Plan, however, during the MHMP evaluation, only one beach parking lot (Dyke Rd) was identified, and as a result other mitigation actions were prioritized in this plan.
Work with local land trust to identify if these entities would be willing to buy out properties in the event of substantial damage, with the intent that these properties would be restored to their natural state and managed by the land trust.	After further discussion, it was noted that the local land trust would not be likely to want to purchase smaller parcels of land spread out throughout town. Alternatively, components of this mitigation action were incorporated into other mitigation actions.
Create an educational program for homeowners for those who provide housing to tourists about how to notify guests about access to emergency services during a hazard event.	After additional discussion, the LHMPC determined that this action would be better suited if it was incorporated into the Town's mitigation action that identified the need to create a flood warning and response plan.
Explore neighborhood specific specialized planning where residents and businesses can determine neighborhood specific hazard concerns and identify adaptation needs and opportunities.	The LHMPC concluded that this action is already achieved through other ongoing programs- future planning regarding this action will be included in the Town's economic development meetings.