TOWN OF MILLIS
HAZARD MITIGATION PLAN
DRAFT 2024 UPDATE

DRAFT
JUNE 23, 2024

MAPC
METROPOLITAN AREA PLANNING COUNCIL

ACKNOWLEGEMENT AND CREDITS

This plan was prepared for the Town of Millis by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP).

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John Engler	School Department
Anne-Marie Gagnon	Council on Aging
Michael Guzinski	Town Administrator
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Erin Underhill	Select Board Member
Robert Weiss	Director of Planning & Economic Development

Cover: Boggastowe Mill Pond historic image, CardCow.com

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SECTION 1: EXECUTIVE SUMMARY

Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events. In the communities of the Boston region of Massachusetts, hazard mitigation planning tends to focus most on flooding, the most likely natural hazard to impact these communities. Other common concerns are the impacts of extreme heat, drought, and nor'easters. This plan also considers how our changing climate will affect natural hazards. Warming temperatures will fuel changing precipitation patterns and an increasing frequency and intensity of severe storms. The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five-year intervals.

PLANNING PROCESS

This is an update of the Millis Hazard Mitigation Plan that was approved by FEMA on xxx, 2019, which was the town's second Hazard Mitigation Plan.. The original Millis plan was approved by FEMA on November 22, 2010. Planning for the Hazard Mitigation Plan update was led by the Millis Local Hazard Mitigation Planning Team, composed of staff from a number of different Town Departments (see Table 6). This team met four times, on

- July 26, 2023
- November 20, 2023
- April 20, 2024,
- May 9, 2024.

The Team discussed and mapped where the impacts of natural hazards most affect the Town, goals for addressing these impacts, updates to the Town's existing mitigation measures and new or revised hazard mitigation measures that would benefit the Town.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the Town takes to mitigate them. The Town hosted two public meetings. The first was on January 22, 2024 hosted by the Millis Select Board and the second on June 24, 2024, also hosted by the Select Board. The draft plan update was posted on the a dedicated project web page for public review. Key town stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments.

RISK ASSESSMENT

The Millis Hazard Mitigation Plan assesses the potential impacts to the Town from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, and drought. Flooding, driven by Nor'easters, thunderstorms, and other storms, clearly presents the greatest hazard to the Town. These are shown on the map series (Appendix A).

The Millis Local Hazard Mitigation Planning Team identified 67 Critical Facilities. These are also shown on the map series and listed in Table 44, identifying which facilities are located within the mapped hazard zones.

A HAZUS-MH analysis provided estimates of damages from Hurricanes of 1% and 0.2% Annual Chance at $7,000,000 million and $25 million, respectively. Earthquakes of magnitudes 5 and 7 analysis provided $9,880,000 to $542,460,000 million respectively in property damages. Flood damage for the 1% and the 0.2% Annual Chance Flood at $2,210,000 and $2,830,000 respectively.

HAZARD MITIGATION GOALS

The Millis Local Hazard Mitigation Planning Team identified the following hazard mitigation goals for the Town:

1. Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.

2. Prevent and reduce the damage to public infrastructure resulting from all hazards.

3. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.

4. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

5. Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

6. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

7. Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

8. Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

9. Consider the impacts of climate change. Incorporate climate resilience and clean energy in hazard mitigation planning.

10. Partnering and working with traditionally underrepresented communities and climate vulnerable populations to reduce disproportionately experienced hazards.

HAZARD MITIGATION STRATEGY

The Millis Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. Overall, the hazard mitigation strategy recognizes that mitigating hazards for Millis will be an ongoing process as our understanding of natural hazards and the steps that can be taken to mitigate their damages changes over time. Climate change and a variety of other factors impact the Town's vulnerability, and local officials will need to work together across municipal lines and with state and federal agencies in order to understand and address these changes. The Hazard Mitigation Strategy will be incorporated into the Town's other related plans and policies.

PLAN REVIEW & UPDATE PROCESS

The process for developing Millis's Hazard Mitigation Plan 2018 Update is summarized in Table 1 below.

Table 1: Plan Review and Update Process

Chapter	Reviews and Updates
Section 3: Public Participation	The Local Hazard Mitigation Planning Team placed an emphasis on public participation for the update of the Hazard Mitigation Plan, discussing strategies to enhance participation opportunities at the first local committee meeting. During plan development, the plan was discussed at two public meetings hosted by the Select Board. The plan was also available on a dedicated project web page for public comment.
Section 4: Risk Assessment	MAPC gathered the most recently available hazard and land use data and met with Town staff to identify changes in local hazard areas and development trends. Town staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. MAPC also used the most recently available version of HAZUS to assess the potential impacts of flooding, hurricanes and earthquakes.
Section 5: Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Millis Local Hazard Mitigation Planning Team. One additional goal was added since the previous plan.
Section:6: Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the Town.
Section s 7 & 8: Hazard Mitigation Strategy	Mitigation measures from the 2018 plan were reviewed and assessed as to whether they were completed, in-progress, or deferred. The Local Hazard Mitigation Planning Team determined whether to carry forward measures into the 2018 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2018 plan. The Local Hazard Mitigation Team prioritized all of these measures based on current conditions.

Section 9 – Plan Adoption & Maintenance	This section of the plan was updated with a new on-going plan implementation review and five year update process that will assist the Town in incorporating hazard mitigation issues into other Town planning and regulatory review processes and better prepare the Town for the next comprehensive plan update.

As indicated Section 7: Mitigation Measures from the 2018 Plan, the Town has made progress implementing mitigation measures identified in the 2018 HMP. Below is a summary of the progress:

- **5** mitigation recommendations were completed, including:
  - Larch Road-Road Elevation and Culvert Enlargement
  - Water-Related Public Education on non-point pollution
  - Investigate separate metering for outdoor watering
  - Update Open Space and Recreation Plan
  - Revisions to Development Bylaws and Regulations
- **8** mitigation measures from the 2018 plan were partially completed and will be carried over to this 2024 updated plan to continue to make progress in the next 5-year planning period. Some of these partially completed measures are being revised to reflect current needs or conditions in the Town.
- **10** mitigation measures from the 2018 plan were not completed. Nine of these will be carried forward into then new plan, and the Town will pursue implementation of them in the next 5-year planning period.
- **1** mitigation measures will not be carried over to the 2024 plan as the local Team determined it is no longer relevant to the town.

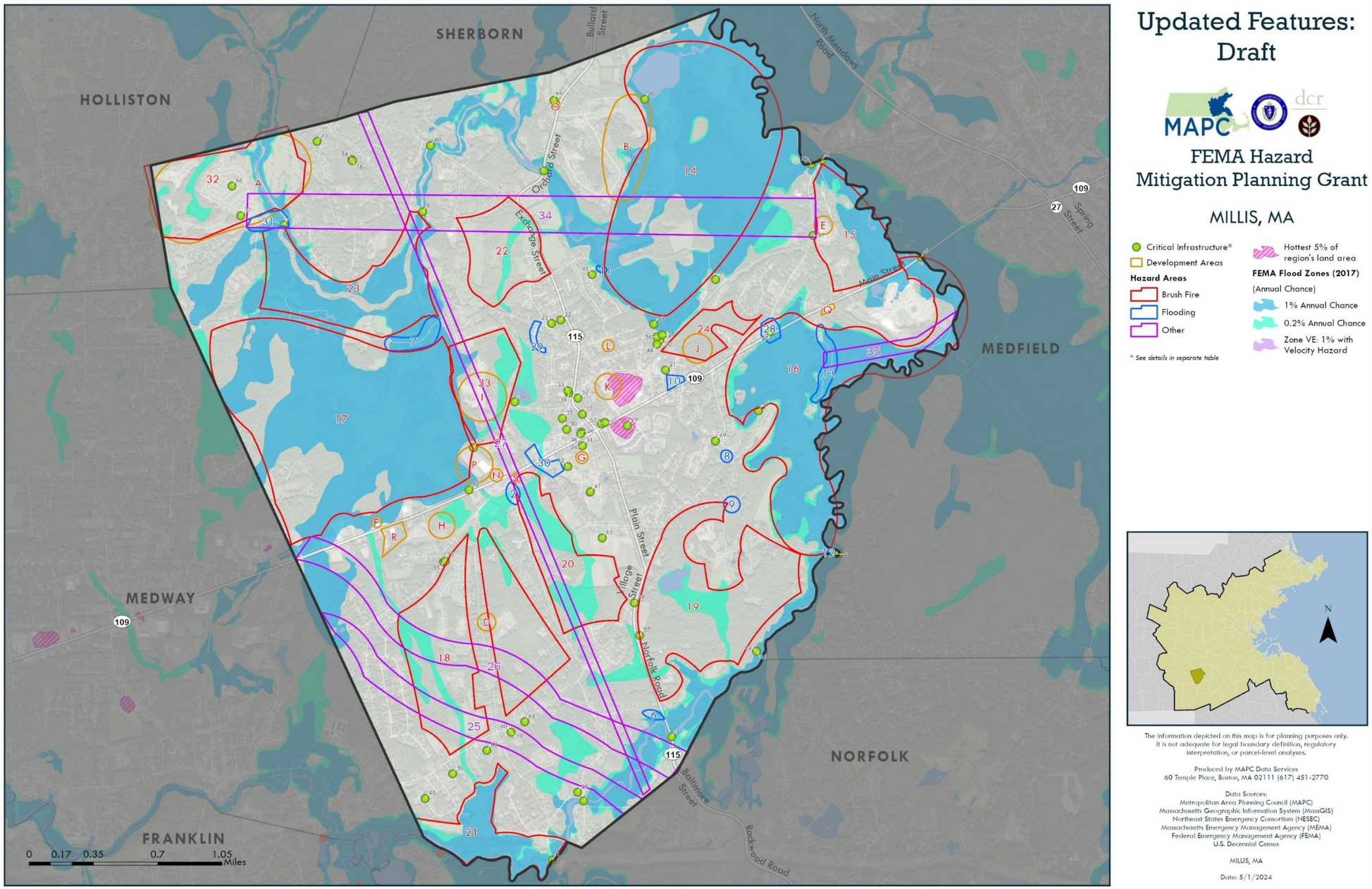
The town will also revise the priority ranking of four of the mitigation measures being carried over to the 2024 plan. One will be increased to a higher ranking and three others will have their priority rankings lowered.

- Farm and Pleasant Street-Beaver Control HIGH > MEDIUM
- Island Road elevation/culvert enlargement LOW > HIGH
- Larch Road-elevation/culvert enlargement MEDIUM > LOW
- Site Design to increase tree plantings near buildings, parking areas, public ways HIGH > MEDIUM

With these revised priorities, of the 22 total recommendations included in Section 8 of this 2024 plan update, 10 are high priority, 8 are medium priority, and 4 are low priority.

Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision making processes. The challenges the Town faces in implementing these measures are primarily due to limited funding and available staff time. This plan should help the Town prioritize the best use of its limited resources for enhanced mitigation of natural hazards.

Figure 1 Existing Features: Critical Facilities, Development Sites, Open Space, & Local Hazard Areas



SECTION 2: INTRODUCTION

PLANNING REQUIREMENTS UNDER THE FEDERAL DISASTER MITIGATION ACT

The Federal Disaster Mitigation Act, passed in 2000, requires that after November 1 2004, all municipalities that wish to continue to be eligible to receive FEMA funding for hazard mitigation grants, must adopt a local multi-hazard mitigation plan and update this plan in five year intervals. This planning requirement does not affect disaster assistance funding.

Federal hazard mitigation planning and grant programs are administered by the Federal Emergency Management Agency (FEMA) in collaboration with the states. These programs are administered in Massachusetts by the Massachusetts Emergency Management Agency (MEMA) in partnership with the Department of Conservation and Recreation (DCR).

The Town of Millis received a FEMA planning grant from the Massachusetts Emergency Management Agency (MEMA) and hired the Metropolitan Area Planning Council (MAPC) to assist the Town to update its local Hazard Mitigation Plan. MAPC is the Regional Planning Agency (RPA) serving 101 communities in the greater Boston area, and provided facilitation, GIS mapping services, and planning support for this project.

WHAT IS A HAZARD MITIGATION PLAN?

Natural hazard mitigation planning is the process of determining how to systematically reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities. FEMA's 2022 Local Mitigation Planning Policy Guide recognized that adapting to the expected impacts of climate change is a form of hazard mitigation. Therefore, this plan incorporates consideration of future risks due to projections for the increased frequency and severity of extreme weather fueled by global climate change effects (Figure 2).

PREVIOUS FEDERAL AND STATE DISASTERS

Since 1991, there have been 36 natural hazard events that triggered disaster declarations that included Norfolk County. These are listed in Table 2 below. The majority of these events involved flooding and winter weather, while others were due to hurricanes or the COVID-19 pandemic.

Figure 2. Natural Hazards and Climate Change

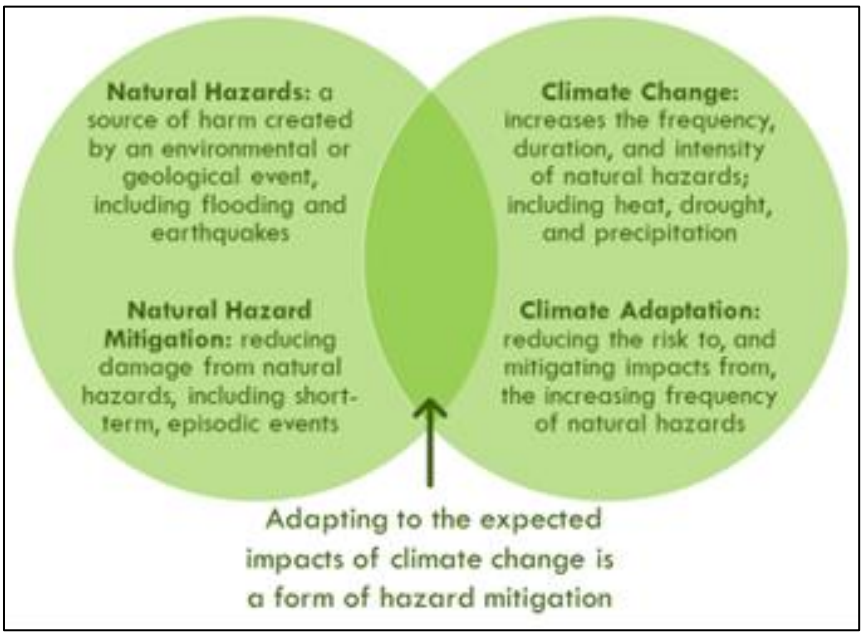


Table 2: Federal/State Declared Disasters 1991-2023

Disaster Name	Date of Event	Declared Areas
Hurricane Bob	August 1991	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Severe Coastal Storm No Name Storm	October 1991	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Blizzard	March 1993	Statewide
Blizzard	January 1996	Statewide
Windstorm	May 1996	Counties of Plymouth, Norfolk, Bristol
Severe Storms, Flood	October 1996	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
Heavy Rain, Flood	June 1998	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Severe Storms, Flood	March 2001	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Snowstorm	March 2001	Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, Worcester
Snowstorm	February 2003	Statewide

Disaster Name	Date of Event	Declared Areas
Snowstorm	December 2003	Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, Worcester
Flooding	April 2004	Essex, Middlesex, Norfolk, Suffolk, Worcester
Snowstorm	January 2005	Statewide
Hurricane Katrina	August 2005	Statewide
Severe Storms, Flooding	October 2005	Statewide
Severe Storms, Flooding	May 2006	Statewide
Severe Storm, Inland, Coastal Flooding	April 2007	Statewide
Severe Winter Storm	December 2008	Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Suffolk, Worcester
Severe Storms, Flooding	December 2008	Statewide
Severe Storms, Flooding	March/April 2010	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
Hurricane (Hurricane Earl)	September 2010	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Severe Winter Storm, Snowstorm	January 2011	Berkshire, Essex, Hampden, Hampshire, Middlesex, Norfolk, Suffolk
Hurricane (Hurricane/Tropical Storm Irene)	August 2011	Barnstable, Berkshire, Bristol, Dukes, Franklin, Hampden, Hampshire, Norfolk, Plymouth
Severe Storm, Snowstorm	October 2011	Berkshire, Franklin, Hampden, Hampshire, Middlesex, Worcester
Severe Winter Storm, Snowstorm, Flooding	February 2013	Statewide
Severe winter storm, snowstorm, flooding	January 2015	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Severe winter storm and Snowstorm	March 2018	Essex, Middlesex, Norfolk, Suffolk, Worcester
Severe winter storm and flooding	March 2018	Barnstable, Bristol, Essex, Nantucket, Norfolk, Plymouth

Disaster Name	Date of Event	Declared Areas
COVID-19 Pandemic	January 2020	Statewide
COVID-19	January 2020	Statewide
Severe winter storm and snowstorm	January 2022	Bristol, Norfolk, Plymouth, Suffolk

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Since 2018, there have been 6 Massachusetts State Declared Disasters, most related to winter storms and the Covid-19 pandemic (Table 3).

Table 3: State Disaster Declarations since 2018

Disaster Name	Date of Event	Declared Areas
Massachusetts Severe Winter Storm and Flooding	March 2-3, 2018	Statewide
Massachusetts Severe Winter Storm and Snowstorm	March 13-14, 2018	Statewide
Massachusetts Covid-19	January 20, 2020 – May 11, 2023	Statewide
Massachusetts Covid-19 Pandemic	January 20, 2020 – May 11, 2023	Statewide
Massachusetts Sever Winter Storm and Snowstorm	January 28-29, 2022	Statewide
Massachusetts Hurricane Lee	September 15-17, 2023	Statewide

FEMA FUNDED MITIGATION PROJECTS

Town of Millis has received funding from FEMA for mitigation projects under the Hazard Mitigation Grant Program (HMGP). The projects are summarized in Table 4 below.

Table 4: FEMA-Funded Mitigation Projects[i]

Grant	Project Description	Total Project Cost
1813-08	Dover Road Sewage Pump Station Flood Improvement	$64,888
1813-23	Farm Street/Route 109/ Old Railroad Bed Flood Improvement	$120,922

COMMUNITY PROFILE

The Town of Millis is a suburban industrial town in the Charles River Valley, incorporated in 1885. First settled in 1658, the first mill was built in town in 1662 on Boggastowe Pond. The town's early economy was based largely on agriculture and grazing. King Philip's War destroyed every building in town except the fortified stone house built for protection. There were taverns, grist and sawmills serving the farming population in town after 1710, and the community remained a prosperous agricultural town throughout the century. In the next century, the town's character changed with the two cotton mills established in 1805. One of these mills is reputed to have installed the first lace loom in America in 1818. Brickyards, organ and organ pipe factories, along with a paper mill and canning factory, in operation in 1837, joined the textile operations as significant town industries. In modern times, however, all that remained of early industrial operations were Herman Shoes, Safe Pack Mills and the Cliquot Club ginger ale plant. Millis retains a significant number of bungalow-style houses as well as some Greek Revival and Italianate buildings.

The town is located in southeastern Massachusetts and is bordered by Medway on the west, Holliston on the northwest, Sherborn on the north, Medfield on the east, and Norfolk on the south. Millis is 15 miles southwest of Boston, and 30 miles southeast of Worcester. Principal highways are State Route 109, which connects State Route 128 with Interstate Route 495, and State Route 115 running N-S. Commuter rail service to Back Bay Station and South Station is available in neighboring Norfolk. The Bay Colony Railroad (BCRR) formerly provided freight service to Millis, until the GAF plant on Curve Street closed.. Millis is a member of the Massachusetts Bay Transportation Authority (MBTA).

Millis is governed by a Select Board with a Town Administrator. The town operates under the open town meeting format. The town maintains a website at http://www.millis.org Important characteristics of Millis in regards to natural hazard mitigation and planning are listed in Table 5.

Table 5: Millis Demographic Characteristics

Population = 8,565

- 5.7% are under age 5
- 21.1% are under age 18
- 21.2% are over age 65
- 27.2% have a disability
- 1.5% speak English less than “very well”
- 1.8% of households have no vehicle

Number of Housing Units = 3,296

1. 15.3% are renter-occupied housing units
2. 12.7% of housing units were built before 1940

In addition, the Town of Millis has several unique characteristics to keep in mind while planning for natural hazards:

- Millis has a bucolic landscape with extensive forests and forested wetlands and its residents value the semi-rural character of the Town. Commercial and industrial development is largely located in the center of Town and along the Route 109 corridor.
- A defining characteristic of Millis is its rivers and streams, the Charles River and its tributary, Bogastow Brook surround the Town on three sides. These are all prone to extensive flood in severe storms or localized flooding during more frequent, minor storms.
- Another defining characteristic of the town are the tree-lined streets. Although these trees are vulnerable to high winds and ice storms, they are a tradeoff the town is willing to have.
- The town has proactive municipal officials that frequently share information and coordinate on a regular basis. An example of this was the first data collection session for the PDM plan, at which representatives of four different departments were present.
- Millis is home to historic structures surrounded by fields and forests and sites that are irreplaceable and bring economic value to the town.
- Millis contains several major roadways that provide emergency routes for evacuation and for routes to medical facilities.
- Millis has some bridge crossings that could be at risk in the event of flooding.
- Millis would be a good candidate for flood-related grants due to the potential impact to property, transportation emergency routes, economic/historic resources, and the ability to solve the flooding problems through structural measures such as culvert upgrades, dam and bridge upgrades or flood proofing. The cost-benefit analysis would likely be in the town's favor.
- Much of the critical infrastructure in the town is located in clusters, often near areas of floodplain. These facilities are therefore at higher risk during natural hazards.

SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION

This is an update of the previous Millis Hazard Mitigation Plan, which was approved by FEMA in 2018. MAPC employs a six step planning process based on FEMA's hazard mitigation planning guidance focusing on local needs and priorities but maintaining a regional perspective matched to the scale and nature of natural hazard events. Public participation is a central component of this 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. MAPC supports participation by the general public and other plan stakeholders through:

- Meetings and work with the Local Teams
- Two public meetings, shared on Local Access TV and advertised through e-blasts, webpage content, a flyer, and social media posts
- A dedicated project web page hosted by MAPC, making the draft plan available to download
- Launching a public comment period at the second public meeting, and posting the draft plan to the project website to facilitate public comment
- Community stakeholders contacted include Town boards and commissions, local business, non-profits, community-based organizations and neighboring communities.

PLANNING PROCESS SUMMARY

The six-step planning process outlined below is based on the guidance provided by FEMA in the Local Multi-Hazard Mitigation Planning Guidance. Public participation is a central element of this process, which attempts to focus on local problem areas and identify needed mitigation measures based on where gaps occur in the existing mitigation efforts of the municipality. By working on municipal hazard mitigation plans in groups of neighboring cities and towns, MAPC is able to identify regional opportunities for collaboration and facilitate communication between communities. In plan updates, the process described below allows staff to bring the most recent hazard information into the plan, including new hazard occurrence data, changes to a municipality's existing mitigation measures, and progress made on actions identified in previous plans.

Figure 3: Six-Step Planning Process

1. Map the Hazards – MAPC relies on data from a number of different federal, state, and local sources in order to map the areas with the potential to experience natural hazards. This mapping represents a multi-hazard assessment of the municipality and is used as a set of base maps for the remainder of the planning process. A particularly important source of information is the knowledge drawn from local municipal staff on where natural hazard impacts have occurred. These maps can be found in Appendix B.

2. Assess the Risks & Potential Damages – Working with local staff, critical facilities, infrastructure, vulnerable populations, and other features are mapped and contrasted with the hazard data from the first step to identify those that might represent particular vulnerabilities to these hazards. Land use data and development trends are also incorporated into this analysis. In addition, MAPC develops estimates of the potential impacts of certain hazard events on the community. MAPC drew on the following resources to complete the plan:

    - Town of Millis, General Bylaws
    - Town of Millis, Zoning Bylaw
    - Town of Millis Master Plan
    - Town of Millis Open Space Plan
    - Blue Hill Observatory
    - Commonwealth of Massachusetts, Resilient MA Plan (SHMCAP), 2023
    - Commonwealth of Massachusetts, Massachusetts Climate Change Assessment, 2022
    - Commonwealth of Massachusetts, Resilient MA Climate Change Clearinghouse
    - DCR, Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams, 2018
    - FEMA, Local Mitigation Planning Policy Guide, 2022
    - FEMA, Disaster Declarations for States and Counties, 2023
    - FEMA, Flood Insurance Rate Maps for Norfolk County, Massachusetts, 2012
    - FEMA, HAZUS, 2022
    - MA Dept of Public Health, Massachusetts Environmental Public Health Tracking, 2022
    - MA Climate Change Adaptation Report, 2011
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
    - Morrison, Sara. 2014. Tornados of Massachusetts Past.

- New England Seismic Network, Boston College Weston Observatory
- NOAA, National Centers for Environmental Information, Storm Events Database
- Northeast States Emergency Consortium
- Tornado History Project
- US Census, 2020, American Community Survey, 2022
- USDA Forest Service, Wildfire Risk to Communities
- USGS, National Water Information System
- U.S. Global Change Research Program, Fourth National Climate Assessment, 2018
- USACE Ice Jam Database

3. Review Existing Mitigation – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as most have adopted flood plain zoning districts, wetlands protection programs, and other measures as well as enforcing the State building code, which has strong provisions related to hazard resistant building requirements. All current municipal mitigation measures must be documented.

4. Develop Mitigation Strategies – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Section 7.

5. Plan Approval & Adoption – Once a final draft of the plan is complete it is sent to MEMA for the state level review and, following that, to FEMA for approval. Typically, once FEMA has approved the plan the agency issues a conditional approval (Approval Pending Adoption), with the condition being adoption of the plan by the municipality. More information on plan adoption can be found in Section 9 and documentation of plan adoption can be found in Appendix D.

6. Implement & Update the Plan – Implementation is the final and most important part of any planning process. Hazard Mitigation Plans must also be updated on a five year basis making preparation for the next plan update an important on-going activity. Chapter IX includes more detailed information on plan implementation.

2018 PLAN IMPLEMENTATION & MAINTENANCE

The 2018 Town of Millis Hazard Mitigation Plan contained a risk assessment of identified hazards for the Town and mitigation measures to address the risk and vulnerability from these hazards. Since approval of the plan by FEMA and local adoption, progress has been made on implementation of the measures. The Town has advanced a number of projects for implementation, including the following

- Update Open Space and Recreation Plan
- Revisions to Development Bylaws and Regulations
- Larch Road-Road Elevation and Culvert Enlargement
- Water-Related Public Education on non-point pollution
- Investigate separate metering for outdoor watering

Eight other mitigation measures were partially completed, as described in Section 8.

THE LOCAL HAZARD MITIGTAION TEAM

MAPC worked with the local community representatives to convene a Local Hazard Mitigation Team for Millis. MAPC briefed the local representatives as to the desired composition of that team as well as the need for public participation in the local planning process. Milis already has an active Local Emergency Planning Committee representing all relevant Town functions so the LECP was designated by the Town Administrator to also serve as the Local Hazard Mitigation Team for this plan update. The LEPA and this Team are coordinated by the Millis Fire Chief.

The Local Hazard Mitigation Planning Team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The local team was tasked with working with MAPC to provide information on the hazards that impact the town, review existing mitigation measures, and track the progress of implementation of the 2018 plan, update the mitigation strategies for this 2024 plan update, and review and update the plan's mitigation goals. The Local Hazard Mitigation Planning Team membership is shown in Table 6.

Table 6: Membership of the Millis Hazard Mitigation Planning Team

Name	Role
Richard Barrett	Fire Chief
Karen Bouret-DeMarzo	Assistant Town Administrator/HR Manager
John Engler	School Department
Anne-Marie Gagnon	Council on Aging
Michael Guzinski	Town Administrator
Sandra LeBarge	Bus Transportation
Erin Mallette	Animal Control Officer
James McKay	Department of Public Works
John McVeigh	Board of Health
Chris Soffayer	Police Chief
Erin Underhill	Select Board Member
Robert Weiss	Director of Planning & Economic Development

The Local Hazard Mitigation Planning Team met four times on the following dates, focusing each meeting on the key topics listed below. The Team meeting agendas are included in Appendix B.

- **July 26, 2023:** Project overview and update local hazard areas and critical facilities inventory
- **November 20, 2023:** Update hazard mitigation goals and existing mitigation measures and prepare for Public Meeting #1
- **April 3, 2024:** Update the recommended mitigation strategies from the 2018 HMP
- **May 9, 2024:** Develop new recommended mitigation measures and prepare for Public Meeting #2

PUBLIC MEETINGS

Public participation in the hazard mitigation planning process is 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 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, one during the planning process and one at the completion of the draft plan and made available for review.

One of the most effective strategies for engaging the community is to include discussion of the hazard mitigation plan at a municipal board or commission, such as a Select Board, Planning Board, or Conservation Commission. With this strategy, the meeting receives widespread advertising and an audience of the board or commission members plus those members of the public who attend the meeting. These members represent an engaged audience that is informed on many of the issues that relate to hazard mitigation planning in the municipality and will likely be involved in plan implementation, making them an important audience with which to build support for hazard mitigation measures. In addition, these meetings are frequently broadcast of Local Access TV, and receive press coverage, expanding the audience that has the opportunity to hear the presentation and provide comments.

The public had an opportunity to provide input to the Millis hazard mitigation planning process during two public presentations before the Select Board, which is the governing body of the Town, on January 22, 2024 and before the Board of Selectmen on June 24, 2024.

LOCAL STAKEHOLDER INVOLVEMENT

The Local Hazard Mitigation Planning Team was encouraged to reach out to local stakeholders that might have an interest in the Hazard Mitigation Plan including neighboring communities, agencies, businesses, nonprofits, and other interested parties. Notice was sent to the following organizations and neighboring municipalities inviting them to review the Hazard Mitigation Plan and submit comments to the Town:

Tresca Bros. Concrete
Jeffrey Germagian, realtor
Millis Public Schools, Robert Mullaney, Supt.
Sparhawk Academy
Historic Commission, Nate Maltinsky
Millis Housing Authority, Candace Loewn
Charles Rive Watershed Association, Julie Wood
Millis Energy Committee, Craig Gibbons
Conservation Commission, Dr. James Lederer
Millis Board of Health, John McVeigh, Director
Millis Planning Board, R. Nichols, C. Standley
Millis Zoning Board of Appeals, P. Koufopoul
Council on Ageing, Anne-Marie Gagnon, Director
Energy Committee
Tangerinis Spring Street Farm
Local Emergency Planning Committee
Town of Holliston
Town of Medfield
Town of Medway
Town of Norfolk
Town of Sherborn

See Appendix C for public meeting notices. The draft Millis Hazard Mitigation Plan 2024 Update was posted on a dedicated project web page hosted by MAPC, with the draft plan available to download. Members of the public could access the draft document and submit comments or questions to a dedicated project email address.

CONTINUING PUBLIC PARTICIPATION

Following the adoption of the plan update, the planning team will continue to provide residents, businesses, and other stakeholders the opportunity to learn about the hazard mitigation planning process and to contribute information that will update the town's understanding of local hazards. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with town and state open meeting laws.

PLANNING TIMELINE

The chronology of milestones in preparing this plan and the review and approval process is summarized in Table 7.

Table 7: Planning Timeline for Plan Development and Approval

July 26, 2023	First Meeting of the Millis Local Hazard Mitigation Team
November 20, 2023	Second Meeting of the Millis Local Hazard Mitigation Team
January 22, 2023	First Public Meeting with Millis Select Board
April 3, 2024	Third Meeting of the Millis Local Hazard Mitigation Team
May 9, 2024	Fourth Meeting of the Millis Local Hazard Mitigation Team
June 24, 2024	Second Public Meeting with Millis Select Board
TBD	Draft Plan Update submitted to MEMA
TBD	FEMA notice of Approval Pending Adoption
TBD	Plan Adopted by the Board of Selectmen

After this plan update is approved by FEMA for a five-year period, the Town should take notice of the following milestones for the ongoing implementation, review, and updating of this plan shown in Table 8.

Table 8: Post-Plan Approval Implementation & Plan Update Timeline

2026	Conduct Mid-Term Plan Survey on Progress
2027	Seek FEMA grant to prepare next plan update
2028	Begin process to update the plan
2029	Submit Draft 2028 Plan Update to MEMA and FEMA
2029	FEMA approval of 2029 Plan Update

SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Millis as well as the relationship between those hazards and current land uses, potential future development, and critical infrastructure. This section also includes a vulnerability assessment that estimates the potential damages that could result from certain large scale natural hazard events.

In order to update Millis's risk assessment, MAPC gathered the most recently available hazard and land use data and met with Town staff to identify changes in local hazard areas and development trends. MAPC also used FEMA's damage estimation software, HAZUS (described below).

> *"Global climate is changing rapidly compared to the pace of natural variations in climate that have occurred throughout Earth's history. Global average temperature has increased by about 1.8°F from 1901 to 2016, and observational evidence does not support any credible natural explanations for this amount of warming; instead, the evidence consistently points to human activities, especially emissions of greenhouse or heat-trapping gases, as the dominant cause."*
> Fourth National Climate Assessment, 2018 (Chapter 2-1)

The projected impacts of our warming climate on natural hazards are integrated throughout this risk assessment. Key impacts include rising temperatures, which in turn affect precipitation patterns and extreme weather. Analysis of these impacts included in this plan aligned closely with the data and assessment presented in Massachusetts' 2023 Resilient MA Plan (SHMCAP) and Massachusetts' 2022 Climate Change Assessment.

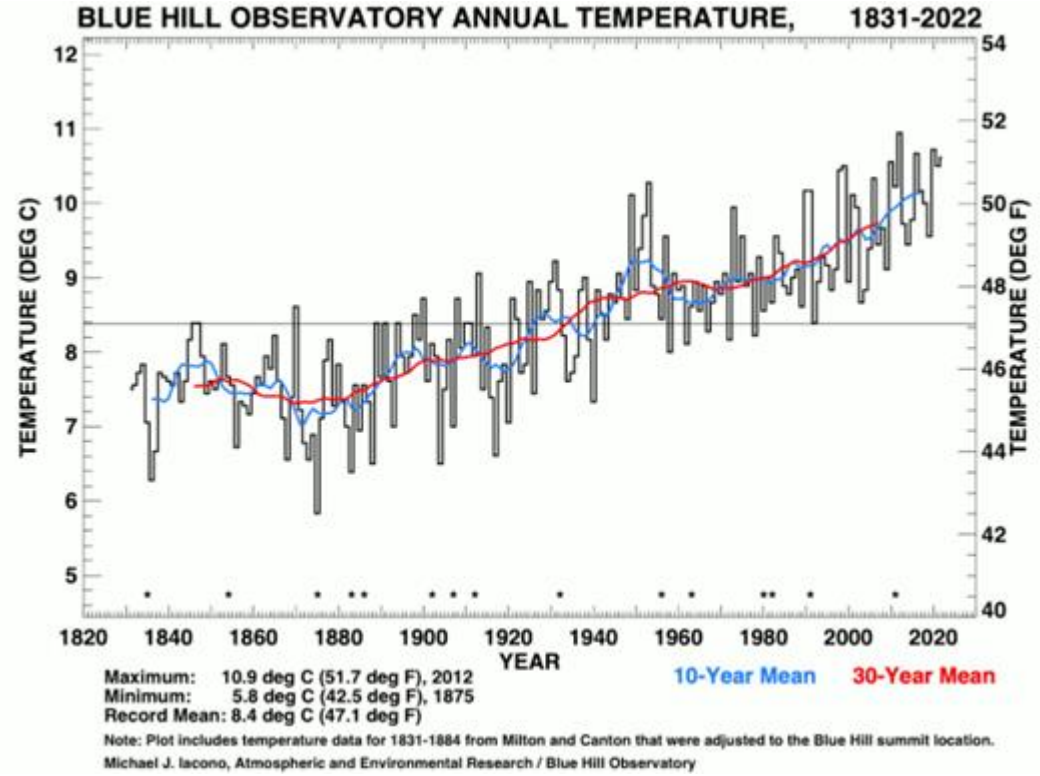
CLIMATE CHANGE OBSERVATIONS AND PROJECTIONS

Climate change observations come from a variety of data sources that have measured and recorded changes in recent decades and centuries. Climate change projections, however, predict future climate impacts and, by their nature, cannot be observed or measured. As a result of the inherent uncertainty in predicting future conditions, climate projections are generally expressed as a range of possible impacts.

Temperature

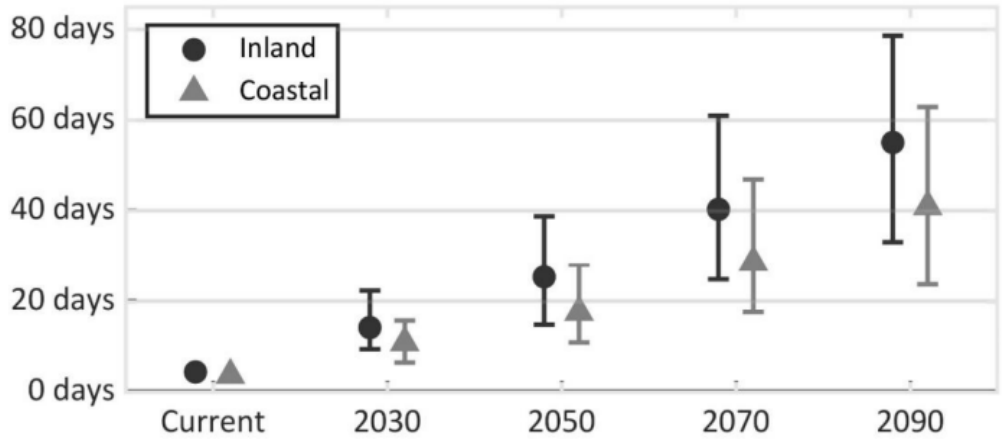
Our climate has always been regulated by gases, including carbon dioxide, methane, and nitrous oxide, which blanket the earth. These gases trap heat that would otherwise be reflected out to space; without them our planet would be too cold to support life. We refer to these gases as "greenhouse gases" (GHGs) for their heat trapping capacity. The combustion of fossil fuels, our primary energy source in the age of industrialization, releases GHGs into the atmosphere. In the past century, human activity associated with industrialization has contributed to a growing concentration of GHGs in our atmosphere. Records from the Blue Hill Observatory in Milton, MA show that average temperatures (30-year mean) have risen approximately 3 degrees (F) in the almost 200 years since record keeping began in 1831. See Figure4 below for more information.

Figure 4: Observed Increase in Temperature



Climate projections include an increase in average temperature and in the number of extreme heat days. Extreme cold days are projected to decrease in number. By 2030, the summer mean temperature could increase by 3.6°F from the historical period (1950-2013). By 2070, there could be 58 fewer days below freezing, which could lead to an increase in ticks. By mid-century, the State anticipates about 25 more days per year where the temperature exceeds 90°F for inland areas, and about 19 more days above 90°F for coastal areas, as shown in Figure 5 (Commonwealth of Massachusetts, 2022).

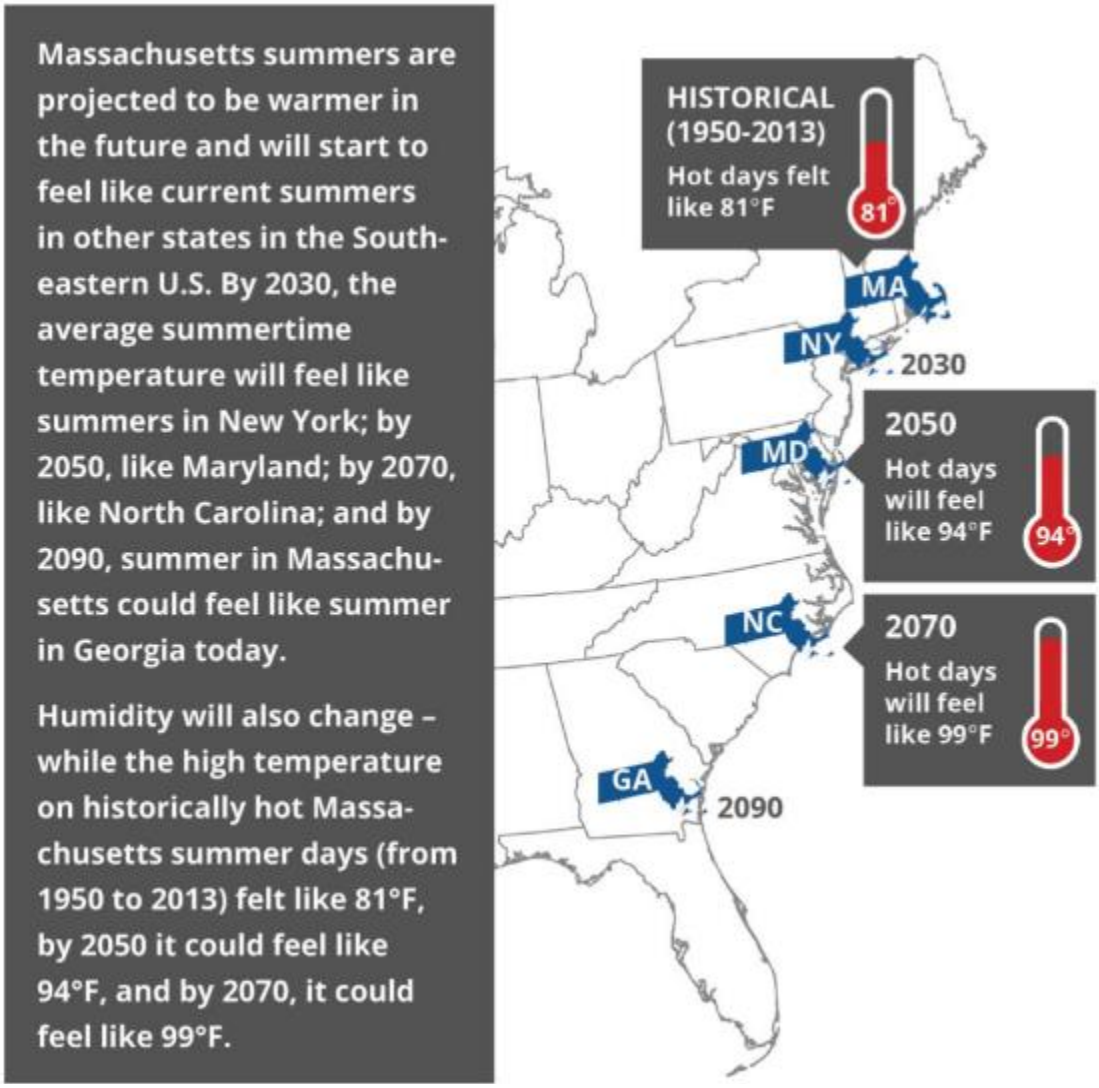
Figure 5: Change in the Annual Number of Days Over 90°F Compared to Today



Sources: 2022 MA Climate Change Assessment and Stochastic Weather Generator

These changes could result in Massachusetts summers feeling like a more southern state, as described in the infographic in Figure 6 from the State's 2022 Climate Change Assessment.

Figure 6: Change in Average Summertime Temperatures for Massachusetts

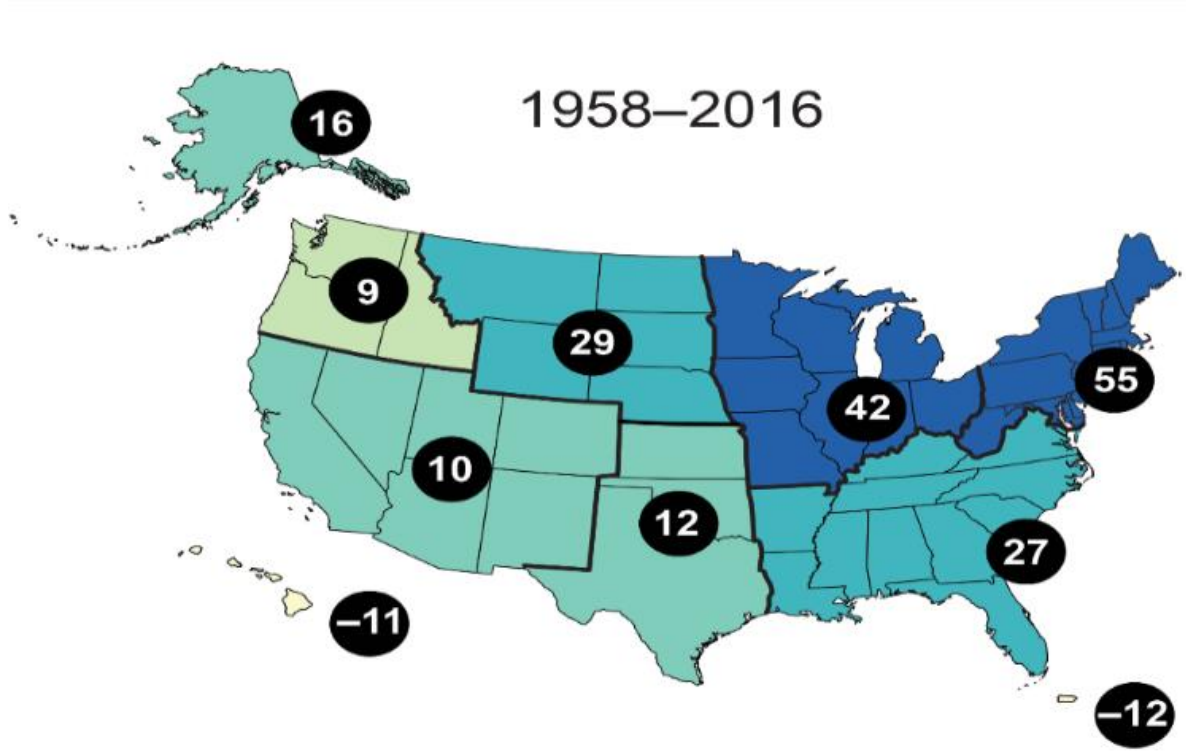


Source: 2022 MA Climate Change Assessment

Precipitation Patterns

Annual precipitation in Massachusetts has increased by approximately 10% in the fifty-year period from 1960 to 2010 (MA EEA, 2011). Moreover, there has been a significant increase in the frequency and intensity of large rain events. For the Northeast US, according to the Fourth National Climate Assessment 2018, in the past sixty years there has been a 55% increase in the amount of annual precipitation that falls in the top 1% of storm events, as shown in Figure 7 below (US Global Change Research Program, 2018). Changes in precipitation are fueled by warming temperatures which increase evaporation and, therefore, the amount of water vapor in the air

Figure 7: Observed Change in Total Annual Precipitation in the Heaviest 1% Events

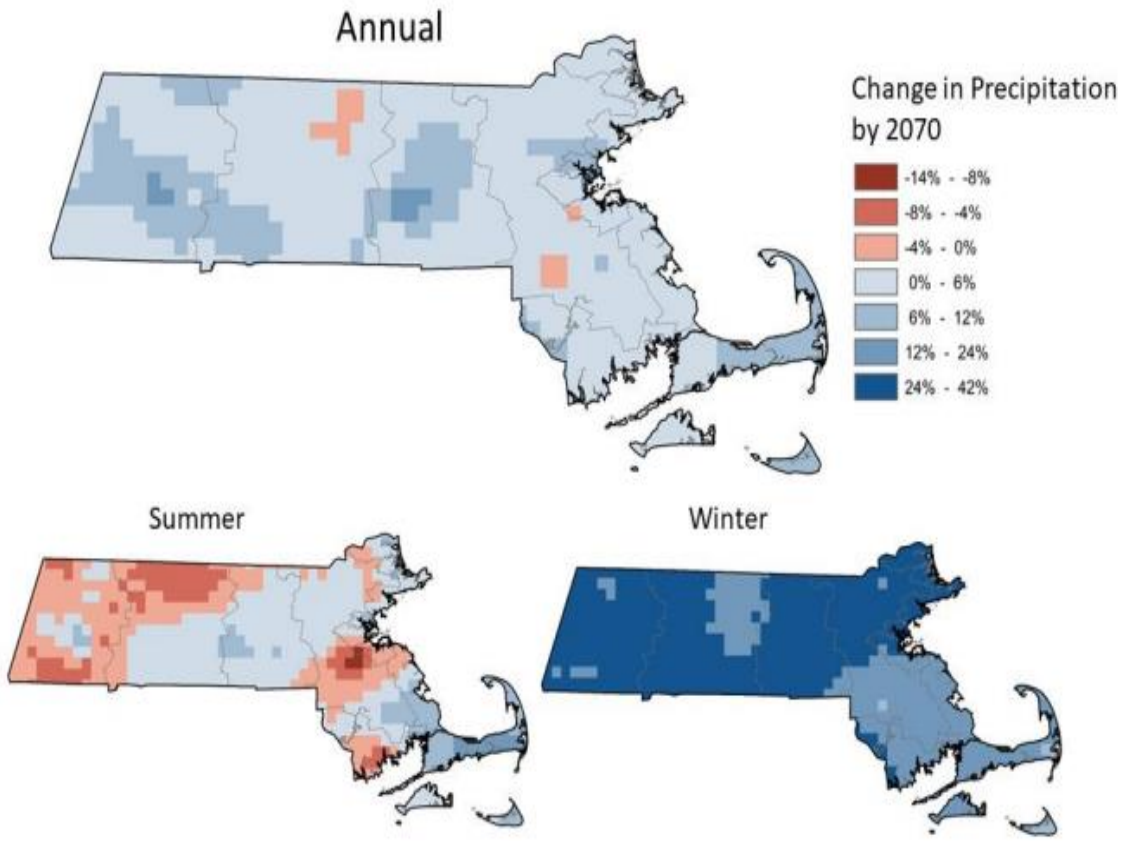


Source: Fourth National Climate Assessment, 2018
Numbers circled in black indicate % change.

Massachusetts' 2022 Climate Change Assessment anticipates that most parts of the State will see a future increase in annual total precipitation of less than 8% per year. Most of these increases are anticipated during the winter months (see Figure 8 below).

Additionally, the historic 10% annual chance daily rainfall event (2.8-4.0" of rain) could occur four times more frequently by 2090 (Commonwealth of Massachusetts, 2022).

Figure 8: Change in Annual and Seasonal Precipitation in 2070 Compared to Today



Source: 2022 MA Climate Change Assessment. Current climate is the 1986-2005 era, the projection for 2070 is for a 20-year era centered on 2070. Maps show LOCA downscaled GCM projections at the 50th percentile across 20 LOCA GCMs that overlap with the GCMs used in the Stochastic Weather Generator.

Despite overall increasing precipitation, more frequent and significant summer droughts are also a projected consequence of climate change. This is due to projections that precipitation will increase in winter and spring and decrease slightly in the summer and, a result of earlier snow melt, and higher temperatures that will reduce soil moisture. Massachusetts' 2022 Climate Change Assessment anticipates that these changes will vary by region. The Eastern Inland region where Millis is located may experience slightly more consecutive dry days, and significantly more days without rain per year, by 2090 (Commonwealth of Massachusetts, 2022). See Figure 9 below for more information.

Figure 9: Consecutive dry day events (number of multiple-dry-day events per year)

Panel A: Consecutive dry day events (number of multiple-dry-day events per year)

Region	Baseline	2030	2050	2070	2090
Berkshires & Hilltowns	29	29	30	30	31
Greater Connecticut River Valley	31	31	32	32	33
Central	32	32	32	33	33
Eastern Inland	32	32	32	33	33
Boston Harbor	31	31	32	32	33
North & South Shores	31	31	32	32	33
Cape, Islands, & South Coast	31	31	32	32	33
Statewide	**31**	**31**	**31**	**32**	**33**
Statewide Percent Change	**0%**	**1%**	**2%**	**4%**	**6%**

Source: Stochastic Weather Generator

Panel B: Annual number of days without rain (days per year)

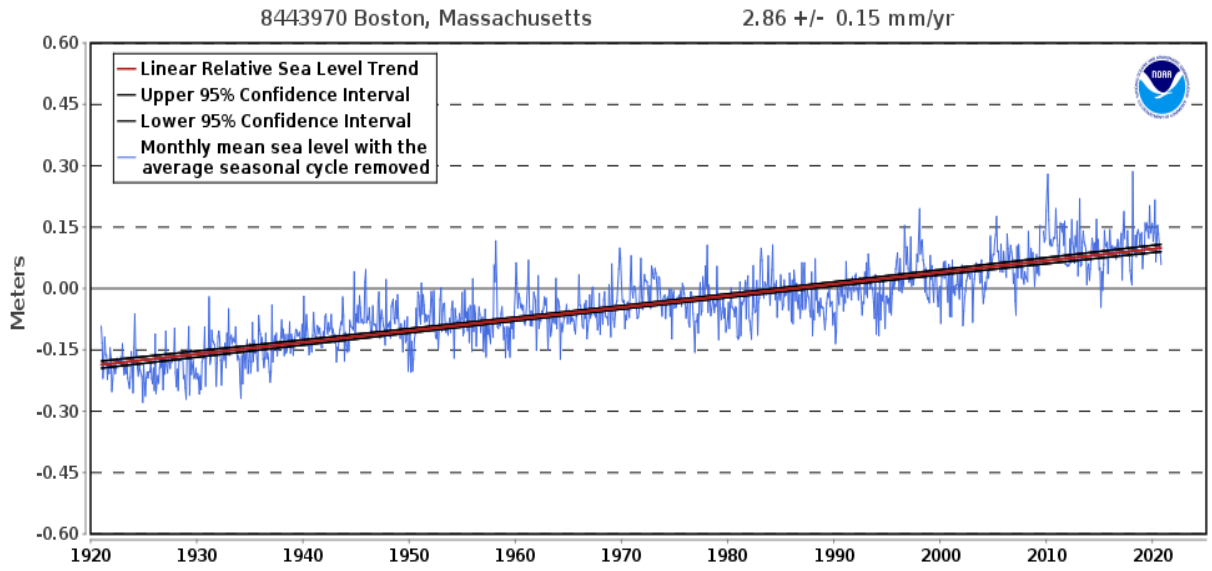
Region	Baseline	2030	2050	2070	2090
Berkshires & Hilltowns	159	161	165	167	170
Greater Connecticut River Valley	171	172	175	178	181
Central	180	182	185	188	192
Eastern Inland	186	181	185	188	193
Boston Harbor	192	185	192	194	198
North & South Shores	184	182	187	190	195
Cape, Islands, & South Coast	186	182	187	191	194
Statewide	**176**	**175**	**179**	**182**	**187**
Statewide Percent Change	**0%**	**-1%**	**2%**	**3%**	**6%**

Source: 2022 MA Climate Change Assessment. The Town of Millis is located in the Eastern Region, outlined by the blue box above.

Sea Level Rise

While Millis is not a coastal community, high-level information on sea level rise is discussed here as the regional economy of the Boston Metro area may be impacted by sea level rise in the future. Warming temperatures contribute to sea level rise in three ways. First, warm water expands to take up more space. Second, rising temperatures are melting land-based ice which enters the oceans as melt water. A third, quite minor, contributor to sea level rise in New England is not related to climate change. New England is still experiencing a small amount of land subsidence (drop in elevation) in response to the last glacial period. NOAA's records from the Boston Tide Station show nearly one foot of sea level rise over the past century. See Figure 10 below for more information.

Figure 10: Observed Increase in Sea Level Rise



Source: NOAA

The sea level rise information in Massachusetts' 2022 Climate Change Assessment considers sea-level changes, land-level changes, and other regional facts that can impact the rate of change. The report includes the following approximate sea level rise projections for the State:

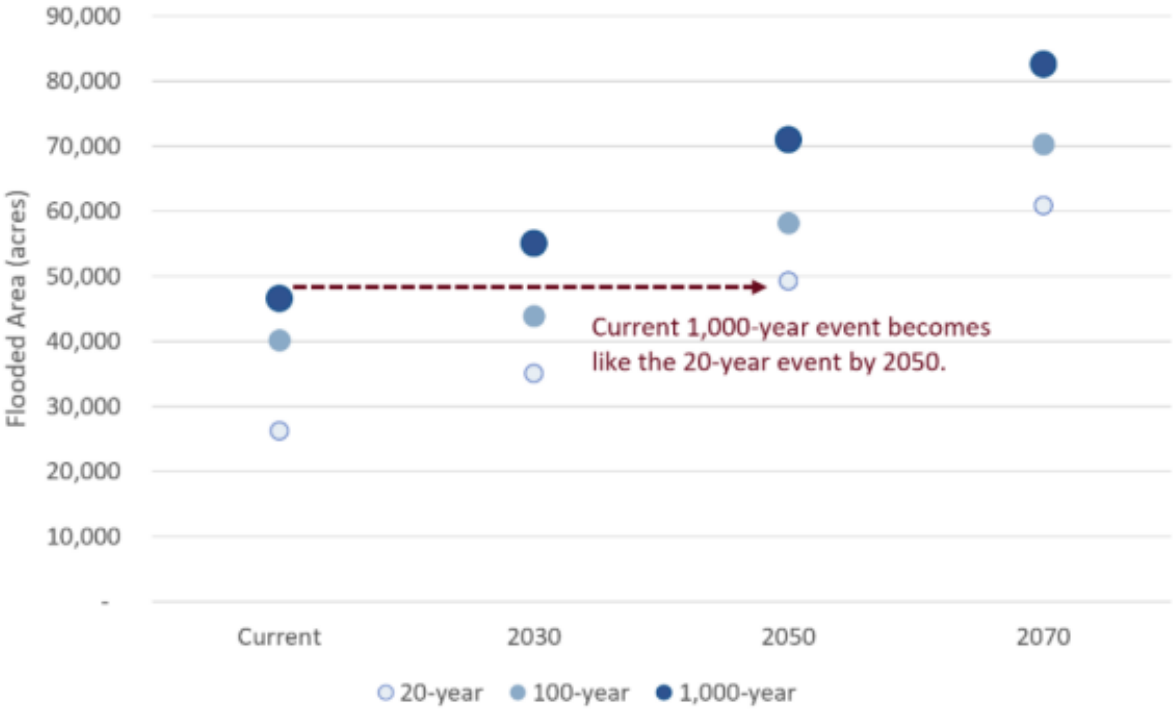
- **Northern Massachusetts:** 21 inches by 2050, and 43 inches by 2070
- **Southern Massachusetts:** 23 inches by 2050 and 45 inches by 2070

The 2022 Climate Change Assessment also quantified the developed land area flooded for events including:

- 20-year (5% annual probability)
- 100-year (1% probability)
- 1000-year (0.1% probability) events

This approach found that the area flooded by the current 1000-year event is comparable to the area of a 20-year event by 2050. Even more area could be impacted by the annual probability event by 2070. See Figure 11 below for more information.

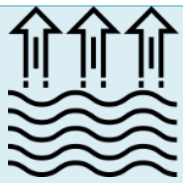
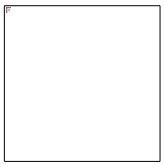
Figure 11: Total Flooded Area of the Commonwealth for Selected Events



Source: 2022 MA Climate Change Assessment

Following the outline of the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), this local hazard mitigation plan organizes consideration of natural hazards based on their relationship to projected climate changes. Table 9 below, which is originally from the SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts.

Table 9: Climate Change & Natural Hazards

Primary Climate Change Interaction	Natural Hazard	Other Climate Change Interactions	Representative Climate Change Impacts
 Changes In Precipitation	Inland Flooding	Extreme Weather	Flash flooding, urban flooding, drainage system impacts (natural and human-made), lack of groundwater recharge, impacts to drinking water supply, public health impacts from mold and worsened indoor air quality, vector-borne diseases from stagnant water, increased potential for loss of life, episodic drought, changes in snow-rain ratios, changes in extent and duration of snow cover, degradation of stream channels and wetland
	Drought	Rising Temperatures, Extreme Weather	
	Landslide	Rising Temperatures, Extreme Weather	
 Sea Level Rise	Coastal Flooding	Extreme Weather	Increase in tidal and coastal floods, storm surge, coastal erosion, marsh migration, inundation of coastal and marine ecosystems, loss of wetlands
	Coastal Erosion	Extreme Precipitation	
	Tsunami	Rising Temperatures	
 Rising Temperatures	Average/Extreme Temperatures	N/A	Shifting in seasons (longer summer, early spring, including earlier timing of spring peak flow), increase in length of growing season, increase of invasive species, increase in vector-borne illnesses (West Nile, Zika, EEE), ecosystem stress, energy brownouts from higher energy demands, more intense heat waves, public health impacts from high heat exposure and poor outdoor air quality, increased potential for loss of life, drying of streams and wetlands, eutrophication of lakes and ponds
	Wildfires	Changes in Precipitation	
	Invasive Species	Changes in Precipitation, Extreme Weather	
 Extreme Weather	Hurricanes/Tropical Storms	Rising Temperatures, Changes in Precipitation	Increase in frequency and intensity of extreme weather events, resulting in greater damage to natural resources, property, and infrastructure, as well as increased potential for loss of life
	Severe Winter Storm / Nor'easter		
	Tornadoes		
	Other Severe Weather (Strong Wind & Thunderstorms)		

OVERVIEW OF HAZARDS AND IMPACTS

The Resilient MA Plan provides an in-depth overview of natural hazards in Massachusetts. Previous state and federal disaster declarations since 1991 are summarized in Table 2. In order to update Millis's risk assessment, MAPC gathered the most recently available hazard and land use data and met with the local Hazard Mitigation Team to identify changes in local hazard areas, critical infrastructure, and development trends. MAPC also used FEMA's damage estimation software, HAZUS (described in the Vulnerability Assessment).

The Resilient MA Plan and the 2018 SHMCAP are two key planning documents that examine natural hazards that have the potential to impact the Commonwealth. The SHMCAP uses definitions for hazard considerations based on the range of frequency and severity of each hazard category, as follows

Definitions used in the Commonwealth of Massachusetts State Hazard Mitigation Plan

Frequency - *The frequency designations used for Millis were based on the 2018 State Hazard Mitigation and Climate Action plan supplemented with NOAA's county-level storm event data, local information from the Hazard Mitigation Team, and HAZUS results, as well as the 2013 State HMP definitions, which define frequency categories as:*

- **Very low frequency:** events that occur less frequently than once in 100 years (less than 1% per year)
- **Low frequency:** events that occur from once in 50 years to once in 100 years (1% to 2% per year);
- **Medium frequency:** events that occur from once in 5 years to once in 50 years (2% to 20% per year);
- **High frequency**: events that occur more frequently than once in 5 years (Greater than 20% per year).

Severity - *The 2018 SHMCAP defines severity as, "the extent or magnitude of a hazard, as measured against an established indicator (e.g., Richter Scale, Saffir-Simpson Hurricane Scale, or Regional Snowfall Index)." The severity designations used for Millis were based on the 2013 State HMP definitions, which define severity categories as follows:*

- **Minor**: Limited and scattered property damage; limited damage to public infrastructure and essential services not interrupted; limited injuries or fatalities.
- **Serious:** Scattered major property damage; some minor infrastructure damage; essential services are briefly interrupted; some injuries and/or fatalities.
- **Extensive:** Widespread major property damage; major public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and/or fatalities.
- **Catastrophic:** Property and public infrastructure destroyed; essential services stopped; numerous injuries and fatalities.

Table 10 summarizes the hazard risks for Massachusetts and the Town of Millis. This evaluation is based on the vulnerability assessment in the Massachusetts State Hazard Mitigation Plan, but the statewide assessment was modified to reflect local conditions in Millis using the definitions for hazard frequency and severity above..

Table 10: Hazard Risks Summary

Natural Hazard	Frequency		Severity	
	MA	Millis	MA	Millis
Inland Flooding	High	High	Serious to Catastrophic	Serious to extensive
Dam Failures	Low	Low	Extensive	Extensive
Drought	Medium	Low	Minor to Serious	Minor
Landslide	High	Low	Minor to Extensive	Minor
Coastal Flooding	High	N/A	Serious to Extensive	N/A
Coastal Erosion	Variable	N/A	Serious to Extensive	N/A
Tsunami	Very Low	N/A	Extensive to Catastrophic	N/A
Extreme Temperatures	High	Medium	Minor to Serious	Minor
Wildfires/Brushfire	High	Medium	Minor to Extensive	Minor
Invasive Species	High	Low	Minor	Minor
Hurricanes/Tropical Storms	Medium	Medium	Serious to Catastrophic	Extensive to Catastrophic
Severe Winter Storm / Nor'easter	High	High	Minor to Extensive	Minor
Tornadoes	High	Medium	Serious to Extensive	Minor
Other Severe Weather (Strong Wind, Hail & Thunderstorms)	High	High	Minor to Extensive	Minor
Earthquakes	Very Low	Very Low	Serious to Catastrophic	Serious

Sources: Frequency information for MA comes from the 2018 SHMCAP. Severity information for MA comes from the 2013 State HMP.

Note: Not all hazards included in the 2022 Climate Change Assessment or the 2018 SHMCAP are relevant to the Town. Given Millis's inland location, coastal hazards and tsunamis would not affect the Town and are therefore listed as Not Applicable ("N/A") in Table 10 above. Ice jams are also not a hazard in Millis. The US Army Corps Ice Jam Database shows no record of ice jams in Millis, and the Town did not identify ice jams as an issue of concern. Invasive species, although present, were also not identified as a major issue to the Town. Given the Town's location in an area of low landslide incidence (Map 6 in Appendix B), and designated in the table above as the lowest category of frequency (very low) and the lowest category of

severity (minor), as well as the lack of previous documented landslide events, the Town did not identify landslides as a hazard of concern that warrants mitigation measures.

CHANGES IN PRECIPITATION

Changes in precipitation are major drivers of frequency and severity of several natural hazards, including flooding, drought, and extreme weather events.

FLOOD HAZARDS

Flooding was the most prevalent serious natural hazard identified by local officials in Millis. Flooding is generally caused by severe rainstorms, thunderstorms, hurricanes, and nor'easters. Large rainstorms can occur year-round. Hurricanes are most common in the summer and early fall. Nor'easters are most common in winter. Spring snowmelt may exacerbate flooding during storm events. Large rainstorms can occur year-round. Climate change has the potential to exacerbate these issues over time due to increasing extreme rainfall events. Increase in average annual rainfall may also lead to more incidents of basement flooding caused by high seasonal groundwater levels.

Millis located in the Charles River Watershed and flooding is one of the most prevalent natural hazards in the watershed. Flooding can be associated with overflowing rivers and streams, as well as stormwater associated with impervious surfaces which overwhelms the capacity of drainage systems and stormwater infrastructure.

REGIONALLY SIGNIFICANT FLOODS

There have been a number of major storms that have affected the Metro Boston region over the last forty years. Significant historic flood events in the region have included:

- February 1978
- January 1979
- April 1987
- October 1991
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- March 2018

Local data for previous flooding occurrences are not collected by the Town of Millis. The best available local data is for Norfolk County, which includes the Town of Millis, through the National Centers for Environmental Information. Norfolk County experienced 45 flood events from 2010 –2023 (Table 11). No

deaths or injuries were reported and the total reported property damage in the county was $25.08 million dollars. Of that total, $24.9 million, or 99% of the 13-year total, is attributed to the two major storm events of March 2010.

Table 11: Norfolk County Flood Events, 2010-2023[ii]

Date	Deaths	Injuries	Property Damage
03/14/2010	0	0	16.64 M
03/29/2010	0	0	8.32 M
04/01/2010	0	0	0
07/24/2010	0	0	20.00K
08/05/2010	0	0	0
08/25/2010	0	0	8.00 K
08/28/2011	0	0	0
08/15/2012	0	0	0
10/29/2012	0	0	0
07/29/2013	0	0	0
08/09/2013	0	0	15.00 K
10/22/2014	0	0	0
10/23/2014	0	0	0
8/15/2015	0	0	0
8/18/2015	0	0	0
6/07/2016	0	0	5.00 K
8/14/2016	0	0	5.00 K
4/1/2017	0	0	5.00 k
7/12/2017	0	0	0
7/18/2017	0	0	1.00 k
8/2/2017	0	0	0
9/30/2017	0	0	10.0k
10/29/2017	0	0	0
1/12/2018	0	0	0
1/13/2018	0	0	0
4/16/2018	0	0	0
7/6/2018	0	0	10.0 K
10/29/2018	0	0	0
11/3/2018	0	0	500
4/15/2019	0	0	0
7/6/2019	0	0	0
7/17/2019	0	0	0
6/21/2020	0	0	0
6/28/2020	0	0	14.7 K
8/23/2020	0	0	2.0 K
12/25/2020	0	0	0
7/7/2021	0	0	0
7/18/2021	0	0	0
9/5/2022	0	0	0
10/14/2022	0	0	0
7/10/2023	0	0	0
8/8/2023	0	0	0
8/8/2023	0	0	0

Date	Deaths	Injuries	Property Damage
9/9/2023	0	0	0
9/9/2023	0	0	0
Total	**0**	**0**	**25.08 M**

Source: NOAA, National Centers for Environmental Information

Additionally, Norfolk County experienced 3 flash flood events since 2010. No deaths or injuries were reported and the total reported property damage in the county exceeded $30 million. Most of the reported property damage occurred during the flash flood event on June 28, 2020. See Table 12 for more information.

Table 12: Norfolk County Flash Flood Events, 2012-2022

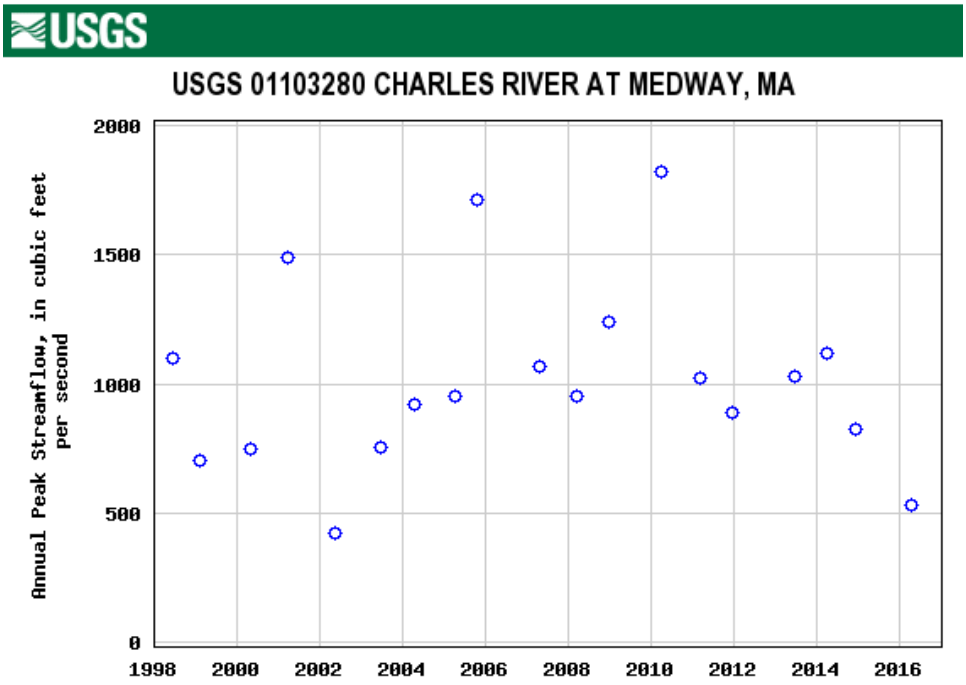
DATE	DEATHS	INJURIES	PROPERTY DAMAGE ($)
9/1/2013	0	0	$85,000
9/18/2018	0	0	0
6/28/2020	0	0	$30,000,000
TOTAL	**0**	**0**	**$30,085,000**

Source: NOAA, National Centers for Environmental Information

The most severe flooding since the previous plan occurred during March 2010, when a total of 14.83 inches of rainfall accumulation was recorded by the National Weather Service (NWS). The weather pattern that consisted of early springtime prevailing westerly winds that moved three successive storms, combined with tropical moisture from the Gulf of Mexico, across New England. Torrential rainfall caused March 2010 to be the wettest month on record. The March 2010 rainstorms fit the profile of a type of severe precipitation event expected to increase in frequency as the climate warms. That is, significant precipitation, falling in late winter as rain rather than snow, on frozen ground, and while vegetation is still dormant.

One indication of the extent of flooding is the gage discharge at the nearest USGS streamflow gauging station on Charles Street in Medway at the Walker Street Bridge. Figure 12 illustrates that 2010 had the highest streamflow at nearly 2,000 cubic feet per second for the years of 1998-2016.

Figure 12: USGS Flood Gage Discharge Data for Charles River at Medway[iii]



Source USGA National Water Information System

Potential damages from flooding in the Town of Millis were estimated using FEMA's HAZUS-MH program. The results, shown in Table , indicate potential damages from a 1% Annual Chance Flood (100-year) at $2,210,000 and from a 0.2% Annual Chance Flood (500-year) at $2,830,000.

OVERVIEW OF TOWN-WIDE FLOODING

As with most of eastern Massachusetts, flooding the natural hazard threat that is prevalent in the town of Millis and therefore the focus of much of the town's hazard mitigation effort. Millis is bordered by the town of Medway on the west, Holliston and Sherborn to the north, Medfield to the east and Norfolk to the south, with the Charles River forming the boundary between Millis and neighboring Medfield and Norfolk.

Millis has very little topographical relief and much of the flat, undeveloped land is wetland. The town is affected by several bodies of water, including but not limited to the Charles River (and surrounding wetlands), Bogastow Brook, Bogastow Pond, Richardson Pond, and South End Pond. However, the Charles River, the largest river in Massachusetts which traverses through the eastern and southeastern boundary of Millis, tends to have the largest impact on flooding, as does inadequate flood storage and under-sized drainage systems.

The Charles River is 80 miles in length - the longest river with its entire length in Massachusetts. The Charles River Watershed has a drainage area of approximately 308 square miles and encompasses all or part of 35 municipalities. The watershed drains northward and is divided into three distinct regions, which include the rural, forested upper watershed, the suburban lakes or middle watershed, and the urban lower watershed, which drains through the Boston metropolitan area. In general, the upper and middle watersheds are characterized by forest cover and residential land use, while the lower watershed is

characterized by commercial land use. Since 1995, the water quality of the Charles River has improved dramatically, and is now clean enough for boating and swimming for the greater part of each year, according to the Environmental Protection Agency (EPA). The greatest source of pollution to the river is non-point source pollution, especially from stormwater runoff and Combined Sewer Overflows (CSOs). The quantity of water available for residential and commercial use is also threatened by overuse, which has lowered groundwater levels and decreased stream flow.

In the 1960's studies by the Corps of Engineers revealed that the communities above Newton had a history of only minimal flooding. Extensive marshes, swamps and wet meadows scattered around the upper watershed were holding floodwaters and then only slowly letting them go. In 1974 Congress authorized the "Charles River Natural Valley Storage Area," allowing for the acquisition and permanent protection of 17 scattered wetlands in the middle and upper watershed. Final acquisition totaled 8,103 acres, with 3,221 acres of land acquired in fee and 4,882 acres in flood easement, at total project cost of $8,300,000. Millis therefore, has the responsibility of preserving floodplains and other water storage areas in efforts reduce downstream flooding. It must be noted that within the Charles River Watershed, flooding within the lower watershed (Boston metro area) is controlled with dams and channelization, while the upper and middle watersheds, wetlands and other natural storage areas are relied upon to protect the area from flooding.

According to the DPW, most of the town's flood-related hazards are related to high rain events, such as heavy rainstorms, tropical storms or winter rain and snow storms and often occurs near floodplains. In addition, the spring rainy season is a particularly hazardous time, as runoff from winter snowfalls saturates much of the town's wetlands and fills the town's streams and brooks. A heavy or severe rain event at this time of year can often overwhelm the natural flood storage areas of the town and create flood hazards on streets and around residential and business areas in town.

Flood damage may consist of flooding of basements, and the Fire Department/Department of Public Works may be called in to help pump out basements. In some areas of town, localized flooding occurs due to beaver activity or improperly functioning drainage infrastructure. The Millis Department of Public Works has been effective at replacing outdated culverts, drainage systems, bridges, and other structures that regulate flow.

The Millis water supply system depends solely on the subsurface aquifers; therefore water quality has been a main issue. The town has aggressive aquifer protection regulations that have been effective in protecting the water quality of the groundwater supply.

POTENTIAL FLOOD HAZARD AREAS

Information on potential flood hazard areas was taken from two sources. The first was the current National Flood Insurance Rate Maps, dated July 17, 2012. The FIRM flood zones are shown on Map 3 in Appendix A and their definitions are listed below. The current effective Flood Insurance Study (FIS) for Norfolk County can be found here. Flooding sources included in Millis include Bogatow Brook and the Charle River. This report includes peak discharge rates for each flooding source, and the 3 flood zones that are designated in Millis, which are A, AE, and X.

It should also be noted that the Town of Millis will be impacted by the Preliminary Flood Insurance Rate Maps prepared by FEMA for Norfolk County. These maps will replace the current FIRMs. This process is expected to result in a Letter of Final Determination (LFD) from FEMA by late December 2023 or January 2024, six months after which the updated Flood Insurance Rate Maps and Flood Insurance Study will become effective, which is expected in June or July 2025.

By that time the Town of Millis will need to adopt an updated floodplain zoning district bylaw to reflect the new FIRM maps. The updated bylaw will also have to be amended to meet the requirements of the Massachusetts state model floodplain ordinances. The Town is already working on those revisions with MAPC's assistance.

Municipalities can also go above and beyond the State's minimum requirements by including additional regulatory measures. These can be related to strengthening floodplain overlay district requirements, stormwater regulations, wetlands regulations, site plan review, and more.

Flood Insurance Rate Map Zone Definitions

Zone A (1% annual chance) - Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone AE and A1-A30 (1% annual chance) **-** Zones AE and A1-A30 are the flood insurance rate zones that correspond to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

Zones X500 (.2% annual chance) **-** Zone X500 is the flood insurance rate zone that correspond to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone.

Zone VE (1% annual chance) **-** Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply

The second source of Information on areas subject to flooding was provided by the local Hazard Mitigation Team. The locally identified areas of flooding listed in Table 13 and described below were identified by the Local Hazard Mitigation Team as areas where local flooding occurs. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, "Hazard Areas". The numbers do not reflect priority order.

Table 13 Locally Identified Areas of Flooding

Map Site ID	Area	Hazard Type
2	Pleasant Street	Flooding
6	Baltimore Road	Flooding
7	Causeway Street	Flooding
8	Village Street and Birch Street	Flooding
9	Forest Road and Birch Street	Flooding
10	Union Street, Rte. 109 and Parnel Street Triangle	Flooding
11	Island Road	Flooding
12	Forest Road Bridge	Flooding
13	Larch Road	Flooding
28	Route 109 at Dover Road to Eaton Street	Flooding
29	Rosenfeld Road and Union Street	Flooding
30	Auburn Road and Main Street	Fooding
31	Orchard Street and Grove Street	Flooding

2. Pleasant Street

Pleasant Street, just south of Main Street sustains regularly flooding. This flooding is caused by the same system causing the Farm Street flooding. Factors that contribute the drainage problems include two undersized culverts and beaver dams. At the tail end of the system, Main Street has a 48 inch culvert which can handle flow, but the culverts on either side cannot handle water capacity. Pleasant Street flooding is caused by an undersized culvert at Farm Street that causes upstream backups. Also, beaver dams in the area serve to further exacerbate flooding. There are six single family homes, a restaurant, and commercial properties along Pleasant Street that sustain substantial flood damages about every five to ten years. Mitigation in this area is high priority for the town and is tied to Farm Street.

6. Baltimore Road

The Charles River makes a hair pin turn at Baltimore Road. When the water level is high, water backs up at the turn and floods Baltimore Road and the surrounding homes and businesses. Flooding has also resulted in partial and complete closure of Baltimore Road, a secondary escape route for the town. The town is currently upgrading the upstream and downstream bridges; they hope this work will help to mitigate the problem. Raising Baltimore Road may also help to prevent flooding.

7. Causeway Street

Causeway Street floods about once a year. The low laying road surface, couple with an undersized culvert cause the flooding. Potential mitigation measures include raising the road and expanding the culvert. All three culverts have been upgraded by flooding still occurs because of beaver activity.

8. Village Street and Birch Street

The intersection of Village Street and Birch Street frequently floods during large rain storms. The abutting leaching field exceeds its drainage capacity during large storms causing the floods the road. At times, high water levels pop the tops off manhole covers. Potential mitigation measures include improvements to the drainage system and the installation of a retention basin. Also, purchasing the abutting property as floodplain to alleviate potential future flooding. This is a top mitigation priority.

9. Forest Street and Birch Street

In most heavy rains, the intersection of Forest Street and Birch Street experiences flooding. Flooding results in partial road closure. The town is currently building a detention basin to mitigate the problem. This is the second top priority for mitigation for the Town.

10. Union Street, Rout 109, and Parnell Street Triangle

The parcels between these three roads reside in a bowl. During large rain storms, water flows down Route 109 / Main Street and collects at this location. There is an inadequate drainage system that causes five residential properties to flood. The town has identified installation of a new drainage system flowing either east or west as a potential solution.

11. Island Road

In the event of a large rain storm, large puddles form on Island Road. This is a reoccurring problem, but the road has never been closed. Raising the road or enlarging the culvert could mitigate this problem.

12. Forest Road Bridge

When the water table is high and in the event of substantial rains, the water levels on the Charles River exceed their banks in the Forest Road Bridge vicinity. The bridge has never been closed, but private residents near the bridge sustain minor flooding. To mitigate the flooding, the road could be raised and/or the bridge and its embankments could be reinforced. Upgrades and improvements are required for proper function.

13. Larch Road

Larch Road floods about once a year. There are several factors that contribute to flooding at Larch Road; the entire road resides within the floodplain, a low laying road surface, and undersized culverts. This is a dead end road and is the only axis for a commercial property and its caretaker that reside at the end. Potential mitigation measures include raising the roadway and enlarging the culverts. This is the top third priority for mitigation for the Town.

28. Route 109 at Dover Road to Eaton Street flooding

A stormwater pipe under Route 109 is partially blocked. Under heavy rain the drainage system backs up and pops open a manhole cover.

29. Union Street and Rosenfeld flooding

There has been some improvement at this site, but it can still be flooded with heavy precipitation.

30. Auburn Road and Main Street Flooding

The stormwater flow at this site exceeds the systems maximum capacity, cause flooding of a field behind the school.

31. Orchard Street and Grove Street flooding

Ongoing stormwater drainage related flooding at this site.

REPETITIVE LOSS PROPERTIES

As defined by the National Flood Insurance Program (NFIP), a repetitive loss property is any property which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978. For more information on repetitive losses see https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt

The state plan indicates that Massachusetts is one of the 10 states that cumulatively account for 76% of repetitive losses in the United States. However, there are no repetitive loss structures in the town of Millis.

FLOODING AND CLIMTE CHANGE

Data from the 2022 MA Climate Change Assessment related to changes in precipitation patterns is included in an earlier part of this Section. Those projections suggest that future rain events will be increasingly intense and lengthy, which could lead to increased inland and stormwater flooding.

Precipitation frequency estimates, which are used to derive stormwater design standards, were published in 1961 by the U.S. Commerce Department in a document known as TP-40 (Technical Paper 40). The 10-year, 24-hour storm for eastern Massachusetts was calculated as a 4.5-inch event. Recently the National Oceanic and Atmospheric Administration published updated estimates (NOAA Atlas 14), which increased this design storm by 0.6 inches to 5.14 inches for eastern Massachusetts. Communities should consider future rainfall rates when designing infrastructure. For example, towns could consider using NOAA Atlas 14 rainfall rates with an additional allowance to account for projected rainfall during the life of projects permitted today when sizing stormwater infrastructure. DEP takes a similar approach in its proposed regulations to describe current (not future) rainfall rates, called "NOAA14+". Mystic River Watershed Association (MyRWA) communities propose "NOAA14++", which they say reflects 2070 projections. The NOAA 14+ number is calculated by multiplying the NOAA 14 precipitation frequency estimate upper confidence interval by 0.9 (i.e., current but extreme precipitation events reflect 90% of upper confidence intervals). The NOAA 14++ number is the upper confidence interval. A comparison of these numbers for the Town of Millis is summarized in Table 14.

Table 14. Rainfall rates for the 10-year 24-hour storm

NOAA 14	NOAA 14+	NOAA 14++
5.27 inches	5.90 inches	6.56 inches

The 2022 MA Climate Change Assessment also highlights the following climate impacts for the Eastern Inland Region (where Millis is located), related to flooding:

- By 2050, the 1 percent annual chance river flood could be two times more likely to occur
- By 2090, the historical 10 percent annual chance rainfall event could be four times more frequent
- Damage could occur to inland buildings from heavy rainfall and overwhelmed drainage systems
- Damage could occur to transit service due to flooding
- There could be a reduction in the availability of affordably priced housing from direct damage including from flooding (Commonwealth of Massachusetts, 2022)

CHARLES RIVER FLOOD MODEL

As the climate continues to warm, more intense precipitation has been observed since the mid-20th century and is expected to accelerate in future decades. How much this trend increases in the future will depend on the degree to which Greenhouse Gases (GHG) are controlled in this century, thus the two temperature scenarios, for lower and higher GHG emissions projected to 2070-2099.

To assess how these global trends may affect the Charles River Watershed, which includes the Town of Millis, the Charles River Watershed Association (CRWA)and15 communities in the watershed worked together to develop the Charles River Flood Model to identify areas vulnerable to flooding under future climate conditions. The following description of the project comes from the Charles River Watershed Model final report prepared by Weston and Sampson for the Charles River Watershed Association under a Municipal Vulnerability Preparedness grant.

The project resulted in an interactive display of model results showing areas in the upper and middle Charles River watershed at risk from projected flooding events. The model was developed for the watershed area draining to the Watertown Dam and comprises of over 270 square miles. This represents the upper/middle Charles River watershed, which includes the Town of Millis.

The Charles River Flood Model represents the impacts of flooding across the watershed from various types and sizes of rainstorms under both present and future climate scenarios and can also be used to test the efficacy of various flood mitigation measures. This model will help the region take steps to protect the people, property and nature in the watershed.

The model results estimate that future rain events can impact between 1,200 and 1,900 additional acres of watershed that are not flooded under current conditions, depending on the type of the storm. Additionally, many areas that currently experience modest or nuisance flooding are likely to experience more severe flooding as a result of larger and more frequent storms. This increased flooding could also impact additional critical facilities and infrastructure and climate vulnerable residents.

The model's future scenarios are based on projections of precipitation patterns for 2030-2050 and 2070-2090. The model assesses ten different 24-hour duration rainstorms:

- **Present day** 2-, 10-, and 100-year events
- **2030**-2050 2-, 10-, and 100-year events
- **2070-2090** 2-, 10-, and 100-year events
- **Mystic River 2070** 100-year event (an extreme rainfall event of 11.7 inches)

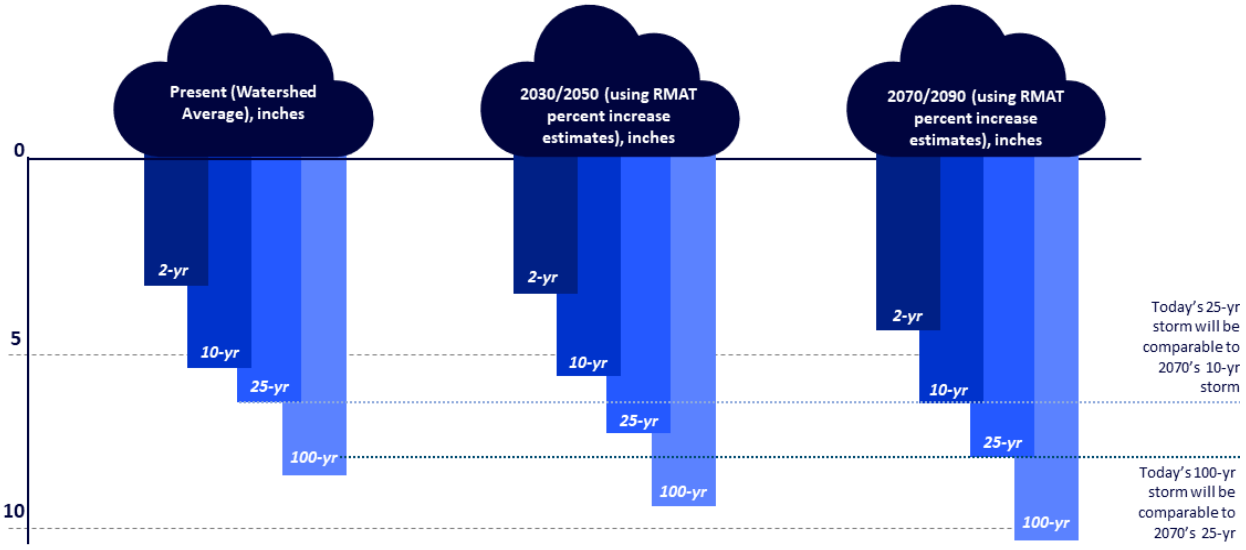
The present-day baseline precipitation is based on NOAA Atlas 14, a widely used standard by government agencies, engineers, and developers. Future increases in precipitation above the Atlas 14 baseline were applied using projections from the Massachusetts RMAT tool, which projects an increase of 8% to15% for 2030/2050 and from 20% to 36% for 2070/2090. Based on these increases, the future scenarios for storms from 2-year to 500-year are shown in Table 15 and are illustrated in Figure 13.

Table 15: Proposed Design Rainfall Depths for Future Storms in the Charles River Watershed

Recurrence Interval	Present (Watershed Average), inches	2030/2050 (using RMAT percent increase estimates), inches	2070/2090 (using RMAT percent increase estimates), inches
2-yr	3.34	3.60	4.00
10-yr	5.20	5.62	6.25
25-yr	6.37	6.88	7.64
100-yr	8.17	9.07	10.37
500-yr	11.12	12.79	15.12

Source: Charles River Watershed Association

Figure 13: Projected future increase in precipitation scenarios in the Charles River Watershed Model



Source: Charles River Watershed Association

The Charles River stormwater flood model is capable of estimating peak and total runoff from more than 700 sub-catchments within the watershed; peak and total runoff in nearly 200 miles of the Charles River and its tributaries; of estimating peak water levels and flood depths at more than 450 dams and bridge crossings; and of estimating flood levels, depths, and extents throughout nearly 19,000 acres of floodplain.

On average watershed-wide, flood prone areas in the Charles River watershed are projected to increase by 1,685 acres for the 10-year storm by 2070, a 23% increase. For the 100-year storm the projected increase is 1,433 acres, a 13% increase in flood prone areas (Table 16). However, there is considerable variability in different sub-basins throughout the watershed in the anticipated increase in flood-prone area. Most of the Town of Millis is located in the Bogastow Brook sub-basin and the Charles River from Bogastow Brook to Medway, both of which projected to experience increases of 50% to 75% in total runoff volume for the year 2070 10-year storm event versus the baseline current 10-year event (see Figure 14).

Table 16: Change in flooding Between Present and 2070, Charles River Watershed

		Acres of flooding (ac)	Runoff Volume (MG)
2-yr Storm	Present	3,490	3,053
	2070	4,719	4,264
	Increase from Present	*+1,229 (+35%)*	*+1,211 (+40%)*
10-yr Storm	Present	7,243	7,368
	2070	8,928	10,651
	Increase from Present	*+1,685 (+23%)*	*+3,283 (+45%)*
100-yr Storm	Present	11,067	17,321
	2070	12,500	25,568
	Increase from Present	*+1,433 (+13%)*	*+8,247 (+48%)*
Mystic 100-yr Storm	2070	13,001	30,794
	Increase from Present	*+1,934 (+18%)*	*+16,473 (+95%)*
March 2010 Storm (8.99 inches)		10,446	20,831

Source: Charles River Watershed Association

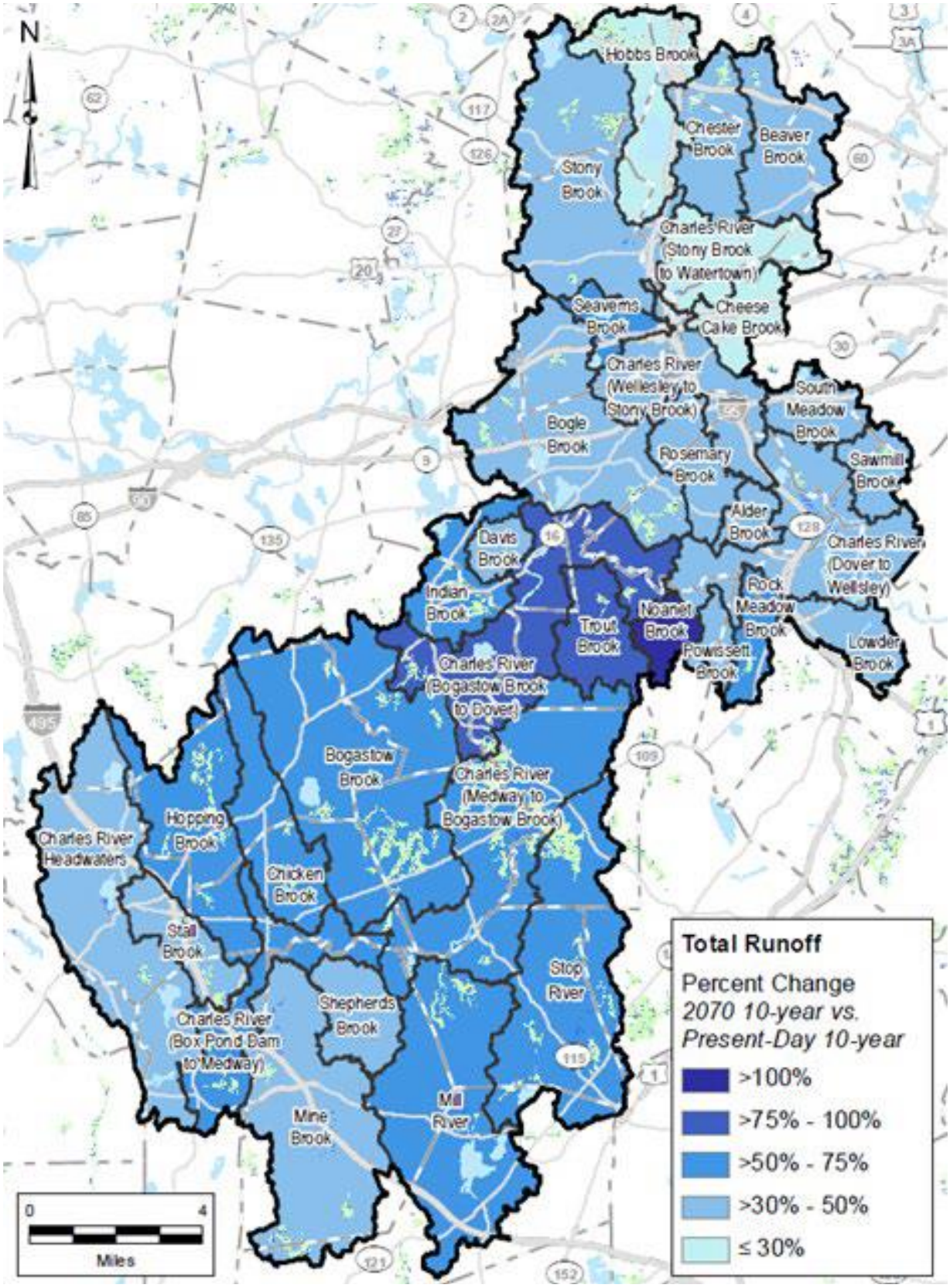
The project also considered the benefits of six mitigation strategies, summarized in Table 17.

Table 17: Six Flood Mitigation Scenarios for the Charles River Watershed

Category	Scenario Number	Strategy
Green Stormwater Infrastructure	1	Green stormwater infrastructure (GSI) stores 2" storm runoff from up to 50% of all impervious cover town-wide
	2	20% of feasible/priority land area is GSI
	3	Storage on large (>5 acres) public properties (GSI, underground storage, "blue roofs")
Reduce Impervious Cover	4	Reduce effective impervious cover watershed wide by 10% (for subbasins over 10%)
Land Conservation	5	Allow 50% of remaining undeveloped/unprotected land to become impervious
Increase Tree Canopy	6	25% public ROWS become green streets: tree box filters/bioswales connected to leaching catch basins

Source: Charles River Watershed Association

Figure 14: Percent increase in 10-year event runoff, 2070 vs. baseline, by sub-basin



Source: Charles River Watershed Association

The watershed model estimated the change in inundated area and critical facilities impacted by each of the six mitigation strategies. An example of mitigation strategy #2 is shown in Table 18.

Table 18: Mitigation 2 Scenario Results for the 2070 10-Year Storm

Mitigation 2 Scenario Results for the Present and 2070 10-year Storm	Critical Facilities Impacted	Inundated Area (acres)	Total Runoff (MG)
Present 10-yr storm – No Action	53	7,243	7,368
Present 10-yr storm + Green Infrastructure Scenario 2	45	6,694	6,493
Change from No Action	**-8 (-15%)**	**-549 (-8%)**	**-875(-12%)**
2070 10-yr storm – No Action	56	8,928	10,651
2070 10-yr storm + GI Sc 2	55	8,501	9,817
Change from No Action	**-1 (-2%)**	**-427 (-5%)**	**-834 (-8%)**

Source: Charles River Watershed Association

DAM HAZARDS

Dam failure can occur as a result of structural failure, independent of a hazard event, or as the result of the impacts of a hazard event such as flooding associated with storms or an earthquake. In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the area in the path of the dam's floodwaters. With an anticipated increase in the intensity or amount of precipitation, a primary climate change dam concern is failure and/or overtopping since they were most likely designed based on historic weather patterns.

Dam failure is a highly infrequent occurrence but a severe incident could result in loss of lives and significant property damage. Since 1984, according to the Association of State Dam Safety Officials, three dams have failed in Massachusetts, one of which resulted in a death. There have been no recorded dam breaches in Millis.

According to data provided by the Massachusetts Department of Conservation and Recreation (DCR) and the town, there is only one dam in the Town of Millis and it is a low hazard dam creating a minor risk of dam failure (Table 19).

Table 19 Inventory of Dams in Millis[iv]

Dam Name	River	Owner	Owner Type	Hazard Potential Classification
Bogastow Pond Dam	Bogastow Brook	Private	Private	Low Hazard

Source: MA DCR Dam Inventory

DCR defines dam hazard classifications as follows:

High: Dams located where failure or mis-operation will likely cause loss of life and serious damage to homes(s), industrial or commercial facilities, important public utilities, main highways(s) or railroad(s).

Significant: Dams located where failure or mis-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.

Low: Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

There have been no dam failures documented for the Town of Millis. Based on the record of previous occurrences, dam failure in Medway is a very low frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur less frequently than once in 100 years (less than 1% per year).

DROUGHT

Drought is a temporary irregularity in precipitation and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought is a period characterized by long durations of below normal precipitation. Drought conditions occur in virtually all climatic zones yet its characteristics vary significantly from one region to another, since it is relative to the normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

In Massachusetts, droughts are caused by the prevalence of dry northern continental air and a decrease in coastal- and tropical-cyclone activity. During the 1960's, a cool drought occurred because dry air from the north caused lower temperatures in the spring and summer of 1962-65. The northerly winds drove frontal systems to sea along the Southeast Coast and prevented the Northeastern States from receiving moisture (U.S. Geological Survey). Average annual precipitation in Massachusetts is 44 inches per year, and during the 1965 drought, the statewide precipitation total of 30 inches was 68 percent of average. The drought was so severe, the Quabbin Reservoir was 20 feet below its current level today. This is considered to be the drought of record I Massachusetts.

Although Massachusetts is relatively small, it has a number of distinct regions that experience significantly different weather patterns and react differently to the amounts of precipitation they receive. The DCR precipitation index divides the state into six regions: Western, Central, Connecticut River Valley, Northeast, Southeast, and Cape, and the Islands. Millis is located in the Northeast Region. In Millis, drought is a potential town-wide hazard.

The Massachusetts Drought Management Plan was revised in 2019 to change the state's classification of droughts by establishing four levels to characterize drought severity beyond normal conditions:

- Level 0-Normal Conditions (no drought)
- Level 1-Mild Drought (formerly Advisory)
- Level 2-Significant Drought (formerly Watch)
- Level 3-Critical Drought (formerly Warning)
- Level 4-Emergency Drought (formerly Emergency)

These levels are based on conditions of natural resources and provide information on the current status of water resources. As dry conditions can have a range of different impacts, a number of drought indices are available to assess these impacts. Massachusetts uses a multi-index system that takes advantage of several of these indices to determine the severity of a given drought or extended period of dry conditions.

Drought level is determined monthly based on the number of indices which have reached a given drought level. Drought levels are declared on a regional basis for each of seven regions in Massachusetts. County by county or watershed-specific determinations may also be made. A determination of drought level is based on seven indices:

1. Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. Crop Moisture Index: (CMI) reflects soil moisture conditions for agriculture.
3. Keetch Byram Drought Index (KBDI) is designed for fire potential assessment.
4. Precipitation Index is a comparison of measured precipitation amounts to historic normal precipitation.
5. The Groundwater Level Index is based on the number of consecutive month's groundwater levels are below normal (lowest 25% of period of record).
6. The Stream flow Index is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record).
7. The Reservoir Index is based on the water levels of small, medium and large index reservoirs across the state, relative to normal conditions for each month.

Table 20 shows the range of values for each of the indices associated with the drought levels. Because drought tends to be a regional natural hazard, this plan references state data as the best available data for previous drought occurrences.

Table 20:. Indices Values Corresponding to Drought Index Severity Levels

Index Severity Level	Standardized Precipitation Index	Streamflow	Lakes and Impoundments	Groundwater	Keetch-Byram Drought Index	Crop Moisture Index
0	>30th percentile				< 200	> -1.0
1	≤30 and >20				200-400	≤-1.0 and > -2.0
2	≤20 and >10				400-600	≤-2.0 and < -3.0
3	≤10 and >2				600-700	≤ -3.0 and > -4.0
4	≤2				700-800	≤-4.0

Source Massachusetts Drought Management Plan, 2019

The drought levels provide a framework from which to take actions to assess, communicate, and respond to drought conditions. They begin with a normal situation where data are routinely collected and distributed, move to heightened vigilance with increased data collection during an advisory, to increased assessment and proactive education during a watch. Water restrictions might be appropriate at the watch or warning stage, depending on the capacity of each individual water supply system. A warning level indicates a severe situation and the possibility that a drought emergency may be necessary. A drought emergency is one in which mandatory water restrictions or use of emergency supplies is necessary. Drought levels are used to coordinate both state agency and local response to drought situations.

As shown in Figure 15, another measure of drought is the U.S. Drought Monitor, which characterizes droughts as abnormally dry, moderate, severe, extreme, and exceptional. Extreme drought is characterized by likely crop and pasture losses, water shortages, and water restrictions.

The Massachusetts drought levels are shown in comparison to the U.S. Drought Monitor levels in Figure 15. The two sets of drought indices are similar, but Massachusetts combines the USDM's level D2 and D3 into one category, Critical Droughts.

Figure 12 US Drought Monitor Compared to MA Statewide Drought Levels

USDM Names	Recurrence	Percentile Ranges	MA DMP Levels	MA Percentile Ranges	MA DMP Names
D0: Abnormally Dry	once per 3 to 5 years	21 to 30	1	>20 and ≤30%	Mild Drought
D1: Moderate	once per 5 to 10 years	11 to 20	2	>10 and ≤20%	Significant Drought
D2: Severe Drought	once per 10 to 20 years	6 to 10	3	>2 and ≤10%	Critical Drought
D3: Extreme Drought	once per 20 to 50 years	3 to 5			
D4: Exceptional Drought	once per 50 to 100 years	0 to 2	4	≤2%	Emergency

Source: Massachusetts Drought Management Plan, 2019

Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture and potential for forest fires.

Previous Occurrences of Drought

Because drought tends to be a regional natural hazard, this plan references state data as the best available data for drought. The statewide scale is a composite of six regions of the state. Regional composite precipitation values are based on monthly values from six stations, and three stations in the smaller regions (Cape Cod/Islands and West).

A summary of Massachusetts long term historic drought events from 1879 to 2019 is shown in Table 21. This table was prepared for the Massachusetts Drought Management Plan in 2019, so it does not include droughts of 2020 and 2022 (those most recent droughts are shown in Figure17).

EEA's Drought Management Task Force provides information on historic drought status since 2001for the Northeast region in Massachusetts, where Millis is located. That information is summarized in Table 22 below.

Table 21: Chronology of Major Droughts in Massachusetts since 1879

Date	Area affected	Recurrence interval (years)	Remarks	Reference
1879-83	–	–	Kinnison 1931 referenced these periods as two of three worst droughts on record in 1931, the third being the then current drought of 1929-1932.	Kinnison 1931
1908-12	–	–		
1929-32	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.	USGS 1989
1939-44	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.	USGS 1989
1957-59	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.	USGS 1989
1961-69	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.	USGS 1989
1980-83	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.	USGS 1989
1985-88	Housatonic River Basin	25	Duration and severity as yet unknown. Streamflow showed mixed trends elsewhere.	USGS 1989
1995	–	–	Based on statewide average precipitation	DMP 2013
1998-1999	–	–	Based on statewide average precipitation	DMP 2013
Dec 2001 - Jan 2003	Statewide	–	Level 2 drought (out of 4 levels) was reached statewide for several months	DCR 2017
Oct 2007 - Mar 2008	Statewide except West and Cape & Islands regions	-	Level 1 drought (out of 4 levels)	DCR 2017
Aug 2010 - Nov 2010	Connecticut River Valley, Central and Northeast regions	–	Level 1 drought (out of 4 levels)	DCR 2017
Oct 2014 - Nov 2014	Southeast and Cape & Islands regions	–	Level 1 drought (out of 4 levels)	DCR 2017
Jul 2016 - Apr 2017	Statewide	–	Level 3 drought (out of 4 levels)	DCR 2017

Source: Massachusetts Drought Management Plan, 2019

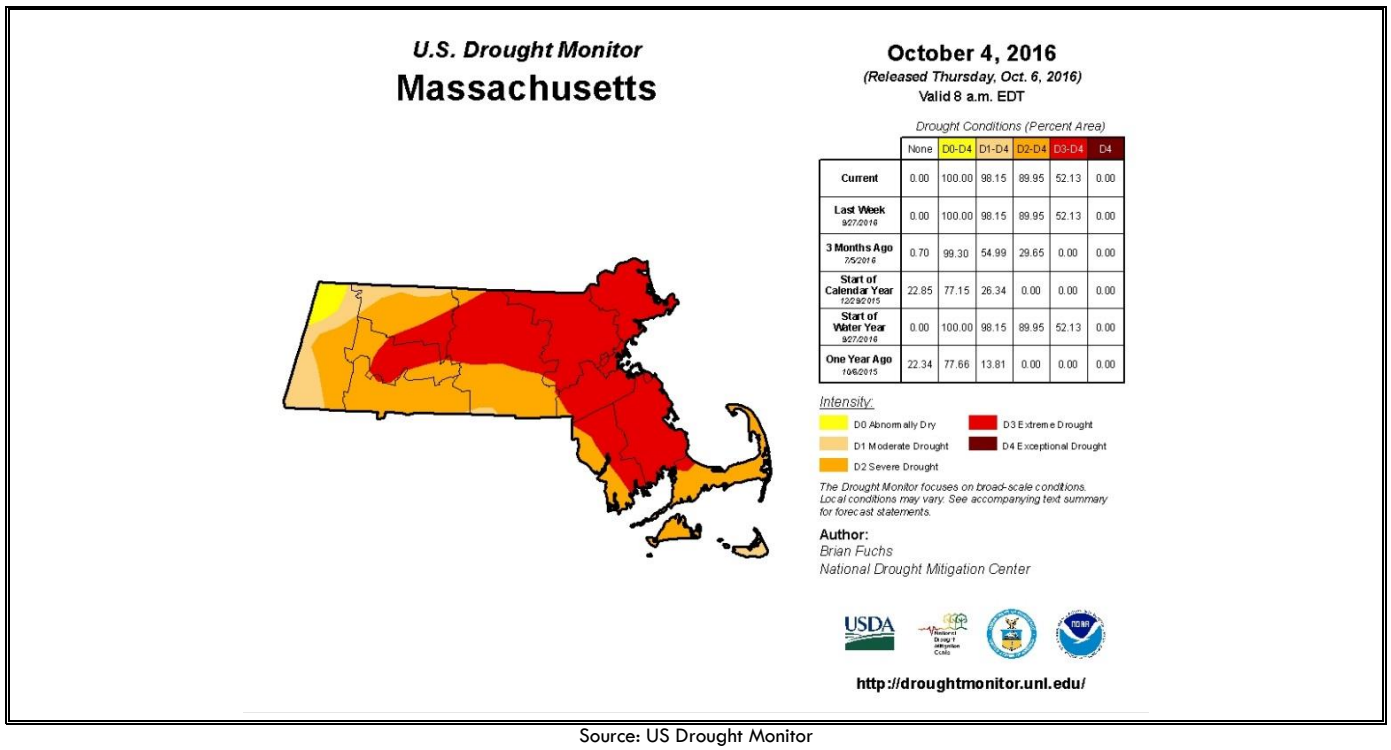
Table 22: Drought Status History for the MA Northeast Region, 2001-2024

Mild Drought/Advisory	2001, 2002, 2007, 2014, 2016, 2017, 2020, 2021, 2022
Significant Drought/Watch	2002, 2016, 2017, 2020, 2021, 2022
Critical Drought/Warning	2016, 2017, 2020, 2022
Emergency Drought/Emergency	None

Source: Drought Management Task Force, 2023

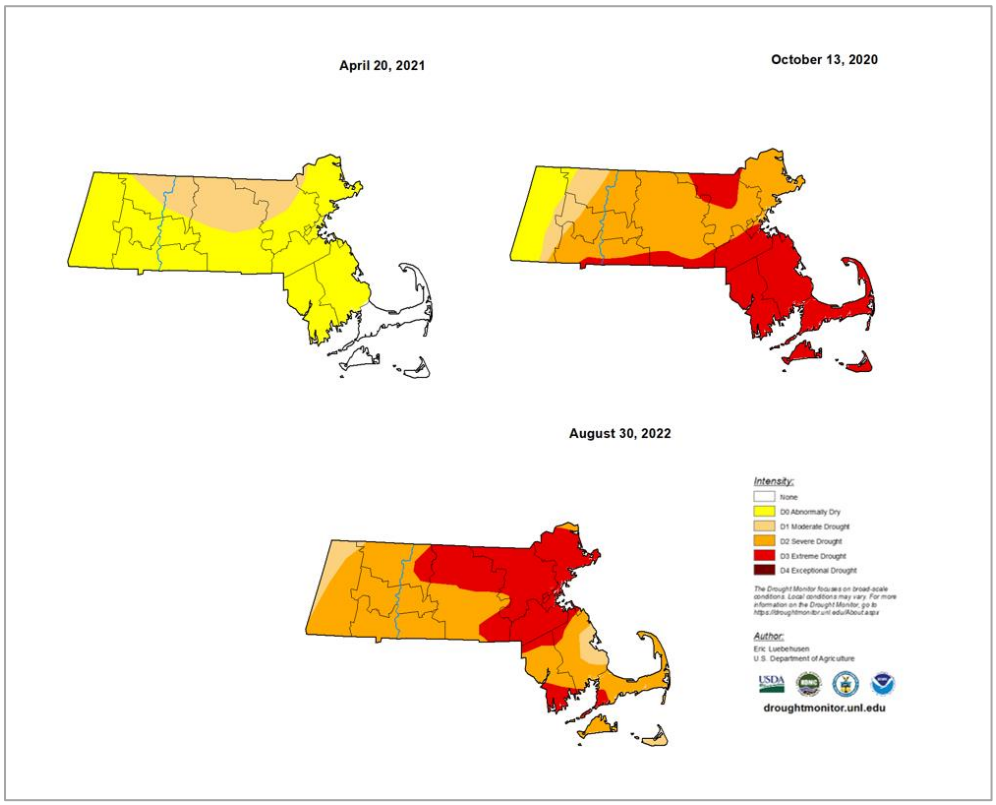
In recent past there have been several droughts in Massachusetts. The drought of 2016-17 was the worst one since 1983, with more than half of the state reaching the Extreme Drought stage for several months (Figure 16). The 2016-17 drought affected 6.5 million people, forcing communities to buy drinking water from the Massachusetts Water Resources Authority,[v] and prompting State aid to farmers for crop losses. This was followed by another drought four years later in 2020, which was most severe in Southeastern Massachusetts.. By the summer of 2021 conditions in the northeast region improved but the region experienced yet another drought in the summer of 2022 (Figure 17).

Figure 16. Extreme Drought Conditions in Massachusetts 2016



Source: US Drought Monitor

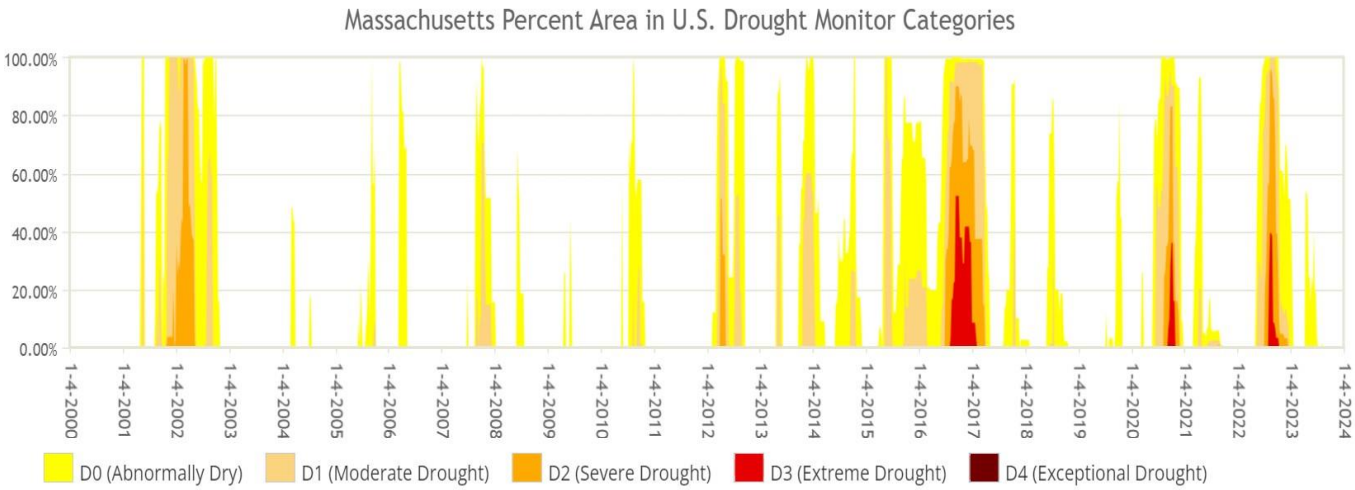
Figure 17 Recent Massachusetts Drought Events (2018-2023)



Source: US Drought Monitor

As measured by the U.S. Drought Monitor, the drought of 2016 and the two that followed in 2020 and 2022 were the worst on record for the last 20 years. Figure 18 shows the percentage of the state's area that was subject to drought conditions of varying severity from 2000 to 2023.

Figure 18. Percent Area in Massachusetts with Drought Conditions 2000-2023



Source: US Drought Monitor

Potential Drought Vulnerability

The town's vulnerability to drought could include impacts on public and private water supplies, agriculture, aquatic ecology, wildlife, and fire hazards. Prolonged drought could lower streamflow and water tables and reduce the amount of water available from pumping wells. Lowering the water table could also result in reductions in water quality. A severe drought could also increase the risk of wildfire on forested lands and other vegetated areas, which are a dominant feature of Millis. Due to it's reliance on water supply wells in the Charles River watershed, under a severe long-term drought the Town of Millis could be vulnerable to restrictions on water supply.

Potential damages of a severe drought could include losses of landscaped areas if outdoor watering is severely restricted and potential loss of business revenues if water supplies were severely restricted for a prolonged period. A critical water shortage could affect adequate supplies for firefighting. As this hazard has never occurred to such a severe degree in Millis, there are no data or estimates of potential damages, but under a severe long term drought scenario it would be reasonable to expect a range of potential damages from several million to tens of millions of dollars.

Probability of Future Occurrence

The SHMCAP, using data collected since 1850, calculates that statewide there is a 1% chance of being in a drought emergency in any given month (Table 23). For drought warning and watch levels, the chance is 2% and 8% respectively in any given month. See the table below for more information.

Table 23. Frequency of Massachusetts Drought Levels

Drought Level	Frequency Since 1850	Probability of Occurrence in a Given Month
Drought Emergency	5 occurrences	1% chance
Drought Warning	5 occurrences	2% chance
Drought Watch	46 occurrences	8% chance

Source: 2018 SHMCAP

Drought Emergency

Drought emergencies have been reached infrequently, with 5 events occurring in the period between 1850 and 2012: in 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought period is viewed as the most severe drought to have occurred in modern times in Massachusetts because of its long duration. On a monthly basis over the 162-year period of record, there is a one percent chance of being in a drought Emergency.

Drought Warning

Drought Warning levels not associated with drought Emergencies have occurred five times, in 1894, 1915, 1930, and 1985, and 2016. On a monthly basis over the 162-year period of record, there is a two percent chance of being in a drought Warning level. As of July 2016, a Drought Warning has been declared for the Northeast region, which includes the Town of Millis. December 2016 marked the ninth consecutive month of below average rainfall.

Drought Watch

Drought Watches not associated with higher levels of drought generally have occurred in three to four years per decade between 1850 and 1950. In the 1980s, there was a lengthy drought Watch level of precipitation between 1980 and 1981, followed by a drought Warning in 1985. The frequency of drought Watches at a rate of three years per decade resumed in the 1990s (1995, 1998, 1999). In the 2000s, Drought Watches occurred in 2001 and 2002. The overall frequency of being in a drought Watch is 8% on a monthly basis over the 162-year period of record.

Droughts And Climate Change

Droughts are projected to increase in frequency and intensity in the summer and fall as weather patterns change. Factors contributing to this include increasing evaporation as a result of warmer weather, earlier snow melt, and more extreme weather patterns. Information from the 2022 Massachusetts Climate Change Assessment related to drought is included in the "Climate Change Observations and Projections" section of this report. Additionally, the 2022 Assessment highlights the following drought-related impacts to the Eastern Inland region where Millis is located:

- Freshwater ecosystem degradation due to drought and other impacts
- Increased contaminant concentrations in freshwater during drought conditions
- Loss of tree cover due to drought and other impacts

EXTREME WEATHER

Extreme weather, which may be exacerbated by climate change, includes hurricanes, tropical storms, tornadoes, Nor'easters, thunderstorms, and severe winter storms. These may be characterized by more damaging high winds, extreme precipitation, or both.

WIND HAZARDS

Wind-related hazards include hurricanes and tropical storms, tornadoes, and severe thunderstorms. As with many communities, falling trees that result in downed power lines and power outages are an issue in Millis. Information on wind related hazards can be found on Map 5 in Appendix B.

Tree damage during high winds has the potential to be a significant hazard in Millis. Trees can knock out power lines and block major roadways, which hinders emergency response. While Millis does experience downed trees that have caused isolated power outages and roadway blockages, the town also takes pride in its tree-lined streets. Therefore, maintaining trees in a proactive fashion has been a trade-off for the tree amenities. The Town has recently increased funding for tree maintenance efforts, which are conducted in coordination with the electric utility.

Microbursts have been a recorded on three occasions in Millis, twice in the 1990s and one since the 2018 plan was completed. The locations of these events are shown on the hazard maps in Appendix. A.

HURRICANES AND TROPICAL STORMS

A hurricane is a violent wind and rainstorm with wind speeds of 74 to 200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as the storm hits land. Given its location not too distant from the coast, the Town of Millis's entire area is vulnerable to hurricanes, which occur between June and November. A tropical storm has similar characteristics, but wind speeds are below 74 miles per hour. Since 1900, 39 tropical storms have impacted New England.(NESEC), including the hurricanes listed in Table 24.

Table 24: Hurricane Records for Massachusetts, 1938 to 2018[vi]

Hurricane Event	Date
Great New England Hurricane	September 21, 1938
Great Atlantic Hurricane	September 14-15, 1944
Hurricane Doug	September 11-12, 1950
Hurricane Carol	August 31, 1954
Hurricane Edna	September 11, 1954
Hurricane Diane	August 17-19, 1955
Hurricane Donna	September 12, 1960
Hurricane Gloria	September 27, 1985
Hurricane Bob	August 19, 1991

Hurricane Event	Date
Hurricane Earl	September 4, 2010
Tropical Storm Irene	August 28, 2011
Hurricane Sandy	October 29-30, 2012

Source: National Oceanic and Atmospheric Administration

Hurricane intensity is measured according to the Saffir/Simpson scale, which categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. These are combined to estimate potential damage. Table 25 gives an overview of the wind speeds, surges, and range of damage caused by different hurricane categories:

Table 25: Saffir/Simpson Scale[vii]

Scale No. (Category)	Winds (mph)	Surge (ft)	Potential Damage
1	74 – 95	4 - 5	Minimal
2	96 – 110	6 - 8	Moderate
3	111 – 130	9 - 12	Extensive
4	131 – 155	13 - 18	Extreme
5	> 155	>18	Catastrophic

Source: National Oceanic and Atmospheric Administration

There have been three major storms tracks through Millis. A tropical storm in 1861 and hurricanes in 1869 and 1944 (Map 5 in Appendix A). A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. However, hurricanes typically have regional impacts beyond their immediate tracks. Millis can experience the impacts of the wind and rain of hurricanes and tropical storms regardless of whether the storm track passes through the town.

The impacts of hurricanes include falling trees and branches which are a significant problem because they can result in power outages or block traffic and emergency routes. Hurricanes are a town-wide hazard in Millis. Potential hurricane damages in Millis have been estimated using HAZUS-MH. Total damages are estimated at $6.7 million for a Category 2 hurricane and $23.3 million for a Category 4 hurricane. Other potential impacts such as households displaced, sheltering needs, and debris generation, are detailed in Table 45.

Based on records of previous occurrences, hurricanes in Millis are a Medium frequency event as defined by the Massachusetts State Hazard Mitigation Plan. This hazard occurs from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

Hurricanes and Climate Change

Climate models suggest that hurricanes and tropical storms will become more intense as warmer ocean waters provide more fuel for the storms. In addition, rainfall amounts associated with hurricanes are predicted to increase because warmer air can hold more water vapor

TORNADOES

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. These events are spawned by thunderstorms and occasionally by hurricanes, and may occur singularly or in multiples. They develop when cool air overrides a layer of warm air, causing the warm air to rise rapidly. Most vortices remain suspended in the atmosphere. Should they touch down, they become a force of destruction. Some ingredients for tornado formation include:

- Very strong winds in the mid and upper levels of the atmosphere;
- Clockwise turning of the wind with height (from southeast at the surface to west aloft)
- Increasing wind speed with altitude in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet);
- Very warm, moist air near the ground with unusually cooler air aloft; and
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity.

Tornado damage severity is measured by the Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. As of February 01, 2007, the National Weather Service began rating tornados using the Enhanced Fujita-scale (EF-scale), which allows surveyors to create more precise assessments of tornado severity. The EF-scale is summarized in Figure 19.

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touch down somewhere in the Northeast region every year. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953, killing 94 people, injuring 1,288 and costing $52.1 million in damages (worth $465.3 million today).[viii]

The most recent tornado events in Massachusetts were in Springfield in 2011, Revere in 2014, Concord in 2016 and Webster in 2018. The Springfield tornado caused significant damage and resulted in 4 deaths in June of 2011. The Revere tornado touched down at in Chelsea just south of Route 16 and moved north into Revere's business district along Broadway and ended near the intersection of Routes 1 and 60. The path was approximately two miles long and 3/8 mile wide, with wind speeds up to 120 miles per hour. Approximately 65 homes had substantial damages and 13 homes and businesses were uninhabitable. On August 22, 2016, an F1 tornado passed through part of nearby Concord. It impacted an area 0.85 miles long by 400 yards wide. In August of 2018 an EF1 tornado hit the town center of Webster, destroying at least two buildings and damaging others.

There is one locally identified tornado that tracked through the limits of the Town of Millis and since 1956, there have been 13 tornadoes in surrounding Norfolk County recorded by the NOAA National Centers for Environmental Information (Table 26). One of these was an F3 tornado, one an F2, and three were F1 (22). These 13 tornadoes caused a total of $4.11 million in damages, 21 injuries, and one death.

Figure 19:13 Enhanced Fujita Scale

Scale	Wind speed mph	Wind speed km/h	Relative frequency	Potential damage	
EF0	65–85	105–137	53.5%	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.	
EF1	86–110	138–178	31.6%	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.	
EF2	111–135	179–218	10.7%	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.	
EF3	136–165	219–266	3.4%	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.	
EF4	166–200	267–322	0.7%	Extreme damage to near-total destruction. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.	
EF5	>200	>322	<0.1%	Massive Damage. Strong frame houses leveled off foundations and swept away; steel-reinforced concrete structures critically damaged; high-rise buildings have severe structural deformation. Incredible phenomena will occur.	

Table 26: Tornado Records for Norfolk County[ix]

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
6/9/1953	3	0	15	667	28	$2.5 M
11/21/1956	2	0	0	17	0.1	$2.5 K
8/9/1972	1	1	6	30	4.9	$25 K
9/6/1973	1	0	0	10	1.1	$25 K
7/10/1989	0	0	0	23	0.1	$2.5 K
5/18/1990	0	0	0	10	0.2	$2.5 K
5/18/1990	0	0	0	10	0.2	$2.5 K
6/30/2001	0	0	0	80	0.1	$0.0 K
8/21/2004	1	0	0	40	6	$1.5 M
5/9/2013	0	0	0	50	0.38	$20 K
6/23/2015	0	0	0	200	0.48	$20 K
10/7/2020	EF0	0	0	--	--	$6 K
7/29/2023	EF0	0	0	25	0.16	$5 K
TOTAL		**1**	**6**			**4.11 M**

Source: NOAA National Centers for Environmental Information

Although tornadoes are a potential town-wide hazard in Millis, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Millis would greatly depend on the track of the tornado. The greatest potential damages would be in the most densely developed part of town in the town center and along the Route 109 corridor, which is more densely developed with retail and commercial buildings. While there are no existing estimates for potential damages from tornadoes in Millis, Norfolk County's 13 recorded tornadoes resulted in a range of damages of $4.11 million since 1956. T

Buildings constructed prior to current building codes may be more vulnerable to damages caused by tornadoes. Evacuation of impacted areas may be required on short notice. Sheltering and mass feeding efforts may be required along with debris clearance, search and rescue, and emergency fire and medical services. Key routes may be blocked by downed trees and other debris, and widespread power outages are also typically associated with tornadoes.

Based on the record of previous occurrences since 1956, Tornado events in Millis are a low frequency event as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 50 to 100 years, or a 1% to 2% chance per year.

SEVERE THUNDERSTORMS

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. A thunderstorm typically features lightning, strong winds, and rain and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 15 miles in diameter and last for about 30 minutes. A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding. The severity of thunderstorms ranges from commonplace and of short duration to intense storms that cause damage due to high winds, flooding, or lightning strikes.

The best available data on previous occurrences of thunderstorms in Millis is for Norfolk County through the National Centers for Environmental Information. Between the years 2013 and 2023, Norfolk County experienced 47 thunderstorm events (Table 27). These storms resulted in a total of $651,200 in property damages. There were no injuries or deaths reported.

Table 27 Norfolk County Thunderstorm Events, 1995-2017[x]

Date	Magnitude	Deaths	Injuries	Property Damage ($)
6/17/2013	50	0	0	11,000
7/29/2013	50	0	0	20,500
7/3/2014	50	0	0	20,000
7/28/2014	60	0	0	50,000
6/23/2015	50	0	0	5,000
8/4/2015	50	0	0	30,000
8/15/2015	50	0	0	35,000
2/25/2016	50	0	0	94,000
6/7/2016	50	0	0	10,000
7/18/2016	50	0	0	90,000

7/22/2016	50	0	0	65,000
7/23/2016	40	0	0	35,000
8/14/2016	50	0	0	5,000
6/9/2017	45	0	0	1,000
6/13/2017	48	0	0	1,000
6/23/2017	50	0	0	1,000
8/2/2017	50	0	0	2,500
9/6/2017	50	0	0	1,000
7/17/2018	45	0	0	3,000
9/6/2018	50	0	0	6,000
11/3/2018	50	0	0	500
7/17/2019	50	0	0	5,000
7/31/2019	50	0	0	9,000
6/6/2020	50	0	0	10,000
6/28/2020	50	0	0	8,900
7/2/2020	50	0	0	31,000
7/5/2020	50	0	0	500
7/23/20	50	0	0	11,200
8/22/2020	50	0	0	2,000
8/23/2020	50	0	0	5,600
10/7/2020	55	0	0	35,800
11/15/20	50	0	0	500
6/8/2021	50	0	0	12,200
6/29/2021	50	0	0	1,100
6/30/21	55	0	0	1,500
7/7/2021	550	0	0	4,700
7/8/2021	50	0	0	1,000
7/16/2021	50	0	0	500
7/21/2021	50	0	0	600
7/27/2021	52	0	0	7,300
11/13/2021	50	0	0	1000
5/22/2022	50	0	0	8600
8/5/2022	50	0	0	800
8/26/2022	50	0	0	0
6/02/2023	43	0	0	2,100
7/27/2023	50	0	0	500
7/29/2023	50	0	0	500
TOTAL		**0**	**0**	**$651,200**

Magnitude refers to maximum wind speed

Source: NOAA, National Climatic Data Center

Severe thunderstorms are a town-wide hazard for Millis. The town's vulnerability to severe thunderstorms is similar to that of Nor'easters. High winds can cause falling trees and power outages, as well as obstruction of key routes and emergency access. Heavy precipitation may also cause localized flooding, both riverine and urban drainage related.

Based on the record of previous occurrences, severe thunderstorms in Millis are high frequency events as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

Thunderstorms and Climate Change

As noted previously, the intensity of rainfall events has increased significantly, and those trends are expected to continue. Neither the 2018 SHMCAP, nor the 2022 Massachusetts Climate Change Assessment, specifically address whether climate will affect the intensity or frequency of thunderstorms.

HAIL

Hail and sleet are forms of frozen precipitation. Hail occurs when precipitation falls through subfreezing air thick enough that the raindrops freeze into ice before hitting the ground. While sleet is a wintertime phenomenon, hail falls from convective clouds (usually thunderstorms), often during the warm spring and summer month.

Hail size typically refers to the diameter of the hailstones. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters, shown in Table 28.

Table 28: Hail Size Comparisons

Description	Diameter (inches)
Pea	0.25
Marble or mothball	0.50
Penny or dime	0.75
Nickel	0.88
Quarter	1.00
Half dollar	1.25
Walnut or ping pong ball	1.50
Golf ball	1.75
Hen's egg	2.00
Tennis ball	2.50
Baseball	2.75
Tea cup	3.00
Grapefruit	4.00
Softball	4.50

Source: NOAA

Hail events are a potential town-wide hazard in Millis. Town-specific data for previous hail events occurrences are not collected by the Town of Millis. The best available local data are for Norfolk County through the National Centers for Environmental Information. Norfolk County, which includes the Town of Mills, experienced 10 events from 2013-2023 shown in Table 29. There was no property damage, injuries, or deaths reported for any of these hail events.

Table 29: Norfolk County Hail Events, 2013-2023

Date	Hail Size	Deaths	Injuries	Property Damage ($)
5/21/2013	0.75	0	0	0
9/1/2013	0.75	0	0	0
8/7/2014	0.75	0	0	0
5/12/2015	0.75	0	0	0
6/23/2015	1	0	0	0
8/4/2015	1	0	0	0
6/30/2019	0.75	0	0	0
6/28/2020	1.5	0	0	0
7/7/2021	1	0	0	0
6/2/2023	0.75	0	0	0
TOTAL		**0**	**0**	**0**

Source: NOAA, National Centers for Environmental Information
*Magnitude refers to diameter of hail stones in inches

Potential damages from larger-size hail could include damage to vehicles, windows, and other structures. Should a significant hail event occur, the most likely damages would be to vehicles, both town-owned and privately owned, damage to vegetation which could cause power outages, and damage to some buildings. People outdoors directly exposed to large hail could be at risk of injuries.

Hail event are considered to be medium frequency events based on past occurrences, and as defined by the Massachusetts State Hazard Mitigation Plan. This hazard occurs once in five years to once in 50 years, with a 2% to 20% chance of occurring each year.

WINTER STORM HAZARDS

Winter storms, including heavy snow, blizzards, and ice storms, are the most common and most familiar of the region's hazards that affect large geographic areas. The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response.

HEAVY SNOW AND BLIZZARDS

A blizzard is a winter snowstorm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow which reduces visibility to or below ¼ mile. These conditions must be the predominant condition over a three-hour period. Extremely cold temperatures are often associated with blizzard conditions but are not a formal part of the definition. The hazard related to the combination of snow, wind, and low visibility significantly increases when temperatures drop below 20 degrees.

Winter storms are a combination hazard because they often involve wind, ice, and heavy snow fall. The National Weather Service defines "heavy snow fall" as an event generating at least four inches of snowfall within a 12 hour period. Winter Storms are often associated with a Nor'easter event, a large counter-clockwise wind circulation around a low-pressure center often resulting in heavy snow, high winds, and rain.

The Regional Snowfall Index (RSI) characterizes and ranks the severity of northeast snowstorms. RSI has five categories: Extreme, Crippling, Major, Significant, and Notable. RSI scores are a function of the area affected by the storm, the amount of snow, and the number of people living in the path of the storm. The largest RSI values result from storms producing heavy snowfall over large areas that include major metropolitan centers. The RSI categories are shown in Table 30.

Table 30: Regional Snowfall Index

Category	RSI	Value Description
1	1 – 3	Notable
2	3-6	Significant
3	6-10	Major
4	10-18	Crippling
5	18+	Extreme

Source: 2018 SHMCAP

The most significant recent winter event was Winter Storm Kenan (January 29, 2022), which resulted in 30.9" of snow in Massachusetts. Table 31shows presidentially declared disasters in Norfolk County related to winter weather since 1978.

Table 31: Norfolk County Winter Federal Disaster Declarations, 1978-2023

Disaster Name	Date of Event	Declared Areas
Coastal Storms, Flood, Ice & Snow	February 1978	Barnstable, Bristol, Dukes, Essex, Nantucket, Norfolk, Plymouth, Suffolk
Winter Coastal Storm	December 1992	Barnstable, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Blizzard	March 1993	Statewide
Blizzard	January 1996	Statewide

Disaster Name	Date of Event	Declared Areas
Snowstorm	March 2001	Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, Worcester
Snowstorm	February 2003	Statewide
Snowstorm	December 2003	Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, Worcester
Snowstorm	January 2005	Statewide
Severe Winter Storm, Snowstorm	January 2011	Berkshire, Essex, Hampden, Hampshire, Middlesex, Norfolk, Suffolk
Severe Winter Storm, Snowstorm, Flooding	February 2013	Statewide
Severe winter storm, snowstorm, flooding	January 2015	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Severe winter storm and Snowstorm	March 2018	Essex, Middlesex, Norfolk, Suffolk, Worcester
Severe winter storm and flooding	March 2018	Barnstable, Bristol, Essex, Nantucket, Norfolk, Plymouth
Severe winter storm and snowstorm	January 2022	Bristol, Norfolk, Plymouth, Suffolk

Sources: OpenFEMA Dataset: Disaster Declarations and FEMA Declared Disasters

The best available data on past occurrences and impacts of winter storm events are reported for Norfolk County by NOAA's National Centers for Environmental Information (NCEI) Storm Events Database. From December 2012 through December 2022, Norfolk County experienced 8 days with recorded blizzards and 27 days with heavy snow, as shown in Tables 32 and 33 below. Reported damages for blizzards totaled $490,500 for the blizzards and $216,800 for the heavy snow events.

Table 32: Blizzards in Norfolk County, 2012-2022

Date	Deaths	Injuries	Damages ($)
2/8/2013	0	0	353000
1/2/2014	0	0	5000
1/26/2015	0	0	0
2/14/2015	0	0	10000
1/23/2016	0	0	50000
2/8/2016	0	0	10000
3/13/2018	0	0	60000
1/28/2022	0	0	2500
TOTAL	**0**	**0**	**$490,500**

Source: NOAA, National Centers for Environmental Information

Table 33: Heavy Snow in Norfolk County, 2012-2022

Date	Deaths	Injuries	Damages ($)
2/8/2013	0	0	0
3/18/2013	0	0	0
12/14/2013	0	0	0
12/17/2013	0	0	0
1/2/2014	0	0	0
1/21/2014	0	0	0
2/5/2014	0	0	0
2/15/2014	0	0	5000
1/24/2015	0	0	0
1/26/2015	0	0	0
2/2/2015	0	0	0
2/8/2015	0	0	0
2/14/2015	0	0	0
3/5/2015	0	0	0
1/23/2016	0	0	0
2/5/2016	2	0	210000
2/8/2016	0	0	0
4/4/2016	0	0	0
3/14/2017	0	0	0
11/15/2018	0	0	0
10/30/2020	0	0	1800
12/16/2020	0	0	0
2/7/2021	0	0	0
1/7/2022	0	0	0
2/13/2022	0	0	0
2/25/2022	0	0	0
TOTAL	**2**	**0**	**$216,800**

Source: NOAA, National Centers for Environmental Information

Map 6 in Appendix A demonstrates that the average annual snowfall in Millis is between 36.1-48.0 inches. Winter storms are a potential town-wide hazard in Millis.

The impacts of winter storms are often related to the weight of snow and ice, which can cause roof collapses and also causes tree limbs to fall. This in turn can cause property damage and potential injuries. Power outages may also result from fallen trees and utility lines.

A number of public safety issues can arise during snowstorms. Impassible streets are a challenge for emergency vehicles and affect residents and employers. Large piles of snow can also block sight lines for drivers, particularly at intersections, and snow-covered sidewalks force people to walk in streets, which can be dangerous. Not all residents are able to clear their properties, especially the elderly.

Refreezing of melting snow can cause dangerous roadway conditions Refreezing of melting snow can cause dangerous roadway conditions. In addition, transit operations may be impacted, as they were in the 2015 blizzards which caused the closure of the MBTA system for one day and limited services on the commuter rail for several weeks.

Blizzards are considered to be high frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan. This hazard occurs more than once in five years, with a greater than 20% chance of occurring each year.

NOR'EASTERS

A northeast coastal storm, known as a nor'easter, is typically a large counter-clockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 20 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rains or snows, depending on temperatures.

Previous occurrences of nor'easters include the storm events included in Table 34. Many of the historic flood events identified in the previous section were precipitated by nor'easters, including the "Perfect Storm" event in 1991. More recently, blizzards in February 2013, January 2015, and in March 2018 were large nor'easters that caused significant snowfall amounts.

Table 34: Nor'easter Events for Massachusetts, 1978 - 2021

Date	Nor'easter Event
February 1978	Blizzard of 1978
October 1991	Severe Coastal Storm ("Perfect Storm")
December 1992	Great Nor'easter of 1992
January 2005	Blizzard/Nor'easter
October 2005	Coastal Storm/Nor'easter
April 2007	Severe Storms, Inland & Coastal Flooding/Nor'easter
January 2011	Winter Storm/Nor'easter
October 2011	Severe Storm/Nor'easter
February 2013	Blizzard of 2013
January 2015	Blizzard of 2015
March 2015	March 2015 Nor'easters
January 2018	January 2018
March 2018	March 2018

Millis is vulnerable to both the wind and precipitation that accompanies nor'easters. High winds can cause damage to structures, fallen trees, and downed power lines leading to power outages. Intense rainfall can overwhelm drainage systems causing localized flooding of rivers and streams as well as urban stormwater ponding and localized flooding. Fallen tree limbs as well as heavy snow accumulation and intense rainfall can impede local transportation corridors, block access for emergency vehicles, severely damage utilities, and cause injury and death.

The entire Town of Millis could be at risk from the wind, rain or snow impacts from a nor'easter, depending on the track and radius of the storm, but due to its inland location the town would not be

subject to coastal hazards. Based on the record of previous occurrences, Nor'easters in Millis are high frequency events as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

ICE STORMS

The ice storm category covers a range of different weather phenomena that collectively involve rain or snow being converted to ice in the lower atmosphere leading to potentially hazardous conditions on the ground. Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects, creating ice buildups of one-fourth of an inch or more.

An ice storm warning, which is now included in the criteria for a winter storm warning, is issued when a half inch or more of accretion of freezing rain is expected.

The best available data on previous ice storm events are recorded at the county level through NOAA's National Centers for Environmental Information (NCEI) Storm Events Database. However, there are no recorded ice storm events recorded for Norfolk County over the last 70 years. Given the regional nature of ice storms, most of the ice storm damages in Massachusetts occur in Central and Western portions of the state, farther inland and at a higher elevation than Millis. The Town's location in the milder region closer to the coast and at lower elevations makes it less vulnerable to ice storms.

The greatest hazard is created by freezing rain conditions, which is rain that freezes on contact with hard surfaces leading to a layer of ice on roads, walkways, trees, and other surfaces. The conditions created by freezing rain can make driving particularly dangerous and emergency response more difficult. The weight of ice on tree branches can also lead to falling branches causing power outages and blocking roadways. The impacts of winter storms may also include roof collapses and property damage and injuries related to the weight of snow and ice.

The Town's vulnerability to ice storms should they occur would primarily be related to restrictions to travel on roadways, temporary road closures, school closures, and potential restrictions on emergency vehicle access. Another common ice storm vulnerability is power outages due to fallen trees and utility lines. Transit operations may also be impacted, affecting Millis resident that rely on regional transit to commute to work.

Ice storms are considered to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occurs once in 5 years to once in 50 years, with 2% to 20% chance of occurring each year.

ICE JAMS

Ice jams occur in cold weather when normally flowing water begins to freeze effectively damming the waterway and causing localized flooding in the area. Flooding may also occur when ice jams break up and ice may pile up at culverts or around bridges. There is no known history of ice jams in Millis and the local team did not identify this hazard as an issue for the Town.

WINTER WEATHER AND CLIMATE CHANGE

As with hurricanes, warmer ocean water and air will provide more fuel for winter storms. According to the 2018 SHMCAP it appears that Atlantic coast nor'easters are increasing in frequency and intensity. Further, the SHMCAP notes that research suggests that warmer weather in the Artic is producing changes to atmospheric circulation patterns that favor the development of winter storms in the Eastern United States. There is also some indication that as winters warm, temperatures may be more likely to produce icing conditions. Massachusetts' 2022 Climate Change Assessment predicts more mild winters, increased precipitation in the winter months, and multiple freeze-thaw cycles every winter due to warming temperatures (Commonwealth of Massachusetts, 2022).

RISING TEMPERATURES

Natural hazards related to climate change trends for rising temperatures include extreme temperatures, wildfire, and invasive species.

EXTREME TEMPERATURES

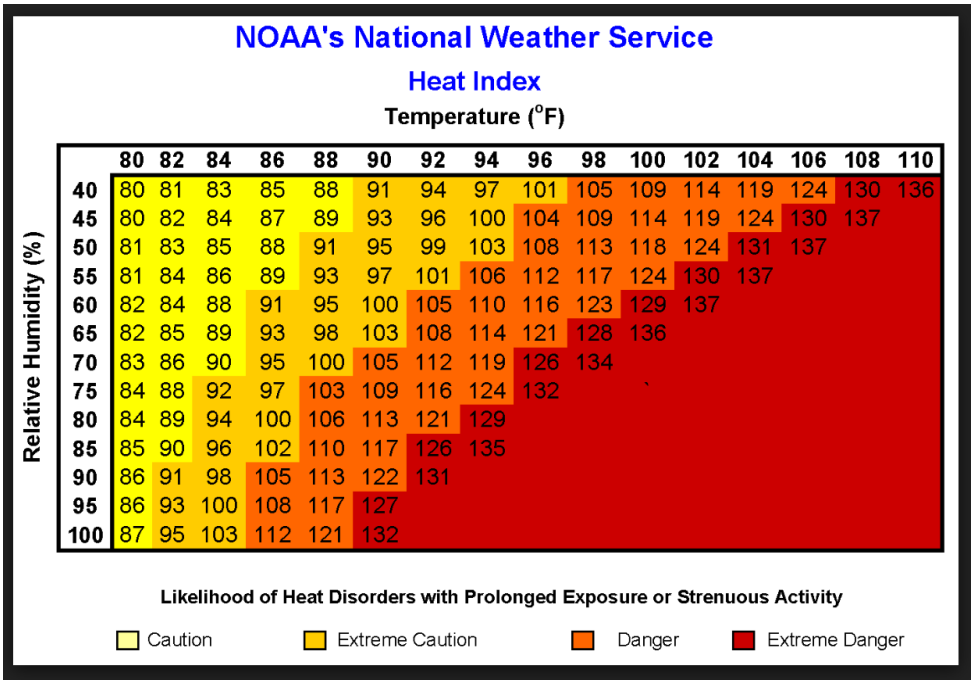
Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time where there is prolonged period of excessively hot or cold weather.

Millis has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those, which are far outside of the normal seasonal ranges for Massachusetts. The average temperatures for Massachusetts are: winter (Dec-Feb) Average = 31.8°F and summer (Jun-Aug) Average = 71°F. Extreme temperatures are a town-wide hazard.

EXTREME HEAT

While a heat wave for Massachusetts is defined as three or more consecutive days above 90°F, another measure used for identifying extreme heat events is through a Heat Advisory from the NWS. These advisories are issued when the heat index (Figure 20) is forecast to exceed 100 degree Fahrenheit (F) for 2 or more hours; an excessive heat advisory is issued if forecast predicts the temperature to rise above 105 degree F.

Figure 20: Heat Index Chart[xi]



Extreme heat poses many health risks. Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat exhaustion, heat stroke, and in severe cases, death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. Prolonged heat exposure can also exacerbate pre-existing conditions, including respiratory illnesses, cardiovascular disease, and mental illnesses.

Senior adults are at particularly high risk to heat for several reasons. They may not adjust to sudden changes in temperature as quickly as younger people, they are more likely to have a chronic medical condition whose symptoms may be exacerbated by heat, and they are more likely to be taking prescription medications that affect their ability to control body temperature. In Millis 21.2% of the population is over 65 years old.

Power failures can occur during heat waves, where intense heat spikes electricity demand and aging infrastructure. This occurred in June 2017 in the Town of Belmont, MA where intense heat cause a spike in electricity demand. With its aging infrastructure, the combination of these factors led to equipment failure. Loss of electricity not only impair a resident's ability to cool, but can cause significant medical emergency for those who require electronic medical equipment or from food-borne illnesses from contaminated food, ingested after loss of refrigeration.

Heat waves and lower air quality, which can threaten the health of vulnerable populations, including the very young, the elderly, and people with certain medical conditions. However, even healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. People who work outdoors, such as construction, farming, and landscaping can be at higher risk of exposure to extreme heat combined with physical activity.

The Town of Millis does not collect data on excessive heat occurrences. The best available local data are for Norfolk County, through the National Climatic Data Center. There have been three days of excessive heat recorded from December 2012-December 2023, which caused zero deaths, injuries or property damage. See Table 35. Extreme heat is considered a town-wide hazard for Millis.

Table 35: Norfolk County Excessive Heat, 2012-2023

Date	Deaths	Injuries	Damages
7/1/2018	0	0	0
7/3/2018	0	0	0
8/28/2018	0	0	0

Source: NOAA, Centers for Environmental Information

In developed urban and suburban areas, the impacts of extreme heat can be exacerbated the heat island affect. MAPC performed a heat island analysis to ascertain the areas most at risk to extreme heat. A heat island is defined as an area whose temperature ranges more than 1.8- 0.54˚F greater during the daytime or up to 22˚ F greater in the evening than the surrounding areas. MAPC used LANDSAT satellite imagery at 30m resolution to ascertain land surface temperatures during the daytime in the warmest months of 2016. In Millis, there are two areas in the center of Town whose land surface temperature is in the top 5% of Metropolitan Boston region. These include two shopping plazas, Roche Brothers plaza and Ann and Hope, shown in Appendix A Map 9. These areas of extreme heat are likely a result of the significant impervious surface comprising the shopping areas including the big box stores and extensive asphalt parking areas.

Extreme Heat and Climate Change

With our changing climate, extreme heat will become a more frequent experience. According to the Northeast Climate Science Center, the Charles River Basin, which includes the Town of Millis, could experience 10-35 more days over 90˚ by 2050 and 15-76 more days over 90˚ by the end of the century.

Data from the 2022 MA Climate Change Assessment related to changes in temperature is included in an earlier section of this chapter. Those projections predict an increase in average temperature and in the number of extreme heat days. The 2022 Assessment also highlights the following climate impacts for the Eastern Inland Region (where Millis is located), related to temperatures:

- Warmer temperatures and more frequent heat waves are connected to impaired human health, increased droughts, reduced agriculture yields, species range shifts, and damaged infrastructure.
- By 2030, the summer mean temperature could increase by 3.6˚F from the historical period (1950-2013), worsening stress on electric transmission and utility distribution infrastructure.
- By 2070, there could be 58 fewer days below freezing, increasing the chance of ticks overwintering and reducing winter recreation opportunities.
- Increase in vector borne diseases incidence and bacterial infections, including West Nile Virus and Lyme disease due to more favorable conditions for ticks and mosquitoes.
- Damage to electric transmission and utility distribution infrastructure associated with heat stress
- Damage to rails and loss of rail/ transit service, including flooding and track buckling during high heat events.

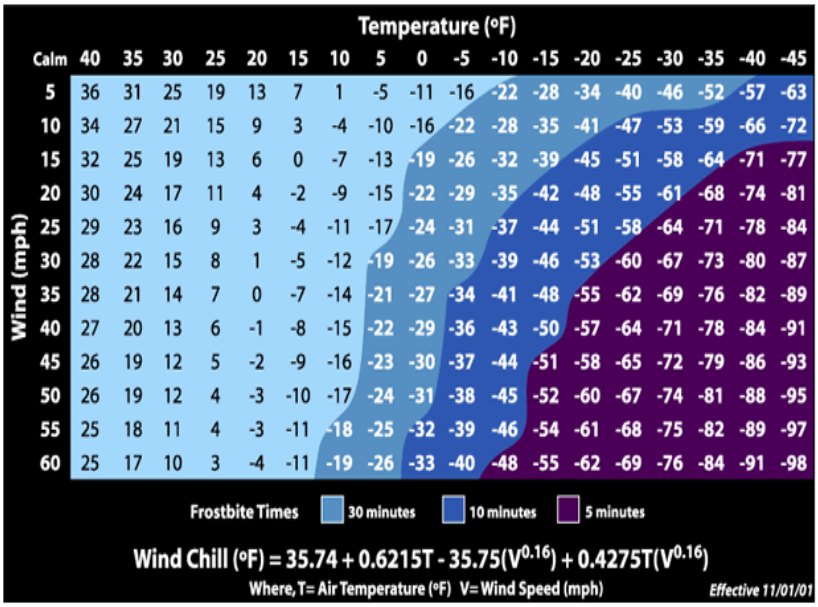
- Reduced ability to work, particularly for outdoor workers during extreme heat, as well as commute delays due to damaged infrastructure
- Freshwater ecosystem degradation due to warming waters
- Forest health degradation from warming temperatures and increasing pest occurrence (Commonwealth of Massachusetts, 2022).

EXTREME COLD

Extreme cold is relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed.

For extreme cold, temperature is typically measured using Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The latest version of the index was implemented in 2001 and it shows how cold conditions feel on unexposed skin. The index is shown in Figure 21. The National Weather Service (NWS) issues a Wind Chill Advisory if the Wind Chills of -5F to -19F are expected. A Wind Chill Warning issued when wind chills of -20F or lower are expected.

Figure 21 Wind Chill Temperature Index and Frostbit Risk[xii]



Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. The elderly and people with disabilities are often most vulnerable. In Millis, 21.2% of the population people are over 65 years old, and 5.1% are under the age of five, ages that are more at risk to health challenges with extreme temperatures. The greatest vulnerability to the town would be a power outage during a winter storm, which could temporarily leave many residents without heat.

The Town of Millis does not collect data for previous occurrences of extreme cold. The best available local data are for Norfolk County, through the National Centers for Environmental Information. There was one

extreme cold event in February 2007 which caused one death and no injuries or property damage (Table 36). Four other occurrences in 2015, 2016, and 2017 did not lead to any reported deaths or damages.

Table 36: Norfolk County Extreme Cold Events, 2007-2023

Date	Deaths	Injuries	Damages
02/03/2007	1	0	0
2/16/2015	0	0	$0
2/13/2016	0	0	$0
2/14/2016	0	0	$0
1/6/2018	0	0	$0

Source: NOAA, Centers for Environmental Information

Extreme temperatures are a medium frequency event based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2013. Both extreme cold and hot weather events occur between once in five years to once in 50 years, or a 2 percent to 20 percent chance of occurring each year.

WILDFIRE HAZARDS

Wildfire is a non-structure uncontrolled fire occurring in a forested or grassland area. In the Boston Metro region these fires rarely grow to the size of a wildfire as seen more typically in the western U.S. As their name implies, these fires typically burn no more than the underbrush of a forested area. There are three different classes of wild fires:

- Surface fires are the most common type and burn along the floor of a forest, moving slowly and killing or damaging trees;
- Ground fires are usually started by lightning and burn on or below the forest floor;
- Crown fires spread rapidly by wind, jumping along the tops of trees.

A wildfire differs greatly from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to unexpectedly change direction, and its ability to jump gaps such as roads, rivers and fire breaks. The National Wildfire Coordinating Group (NWCG) classifies the severity of wildfires based on their acreage as follows:

- Class A - one-fourth acre or less;
- Class B - more than one-fourth acre, but less than 10 acres;
- Class C - 10 acres or more, but less than 100 acres;
- Class D - 100 acres or more, but less than 300 acres;
- Class E - 300 acres or more, but less than 1,000 acres;
- Class F - 1,000 acres or more, but less than 5,000 acres;
- Class G - 5,000 acres or more

These fires can present a hazard where there is the potential for them to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials might exist to allow the fire

the spread into homes. Protecting structures from fire poses special problems, and can stretch firefighting resources to the limit. If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If the wild fire destroys the ground cover, then erosion becomes one of several potential problems.

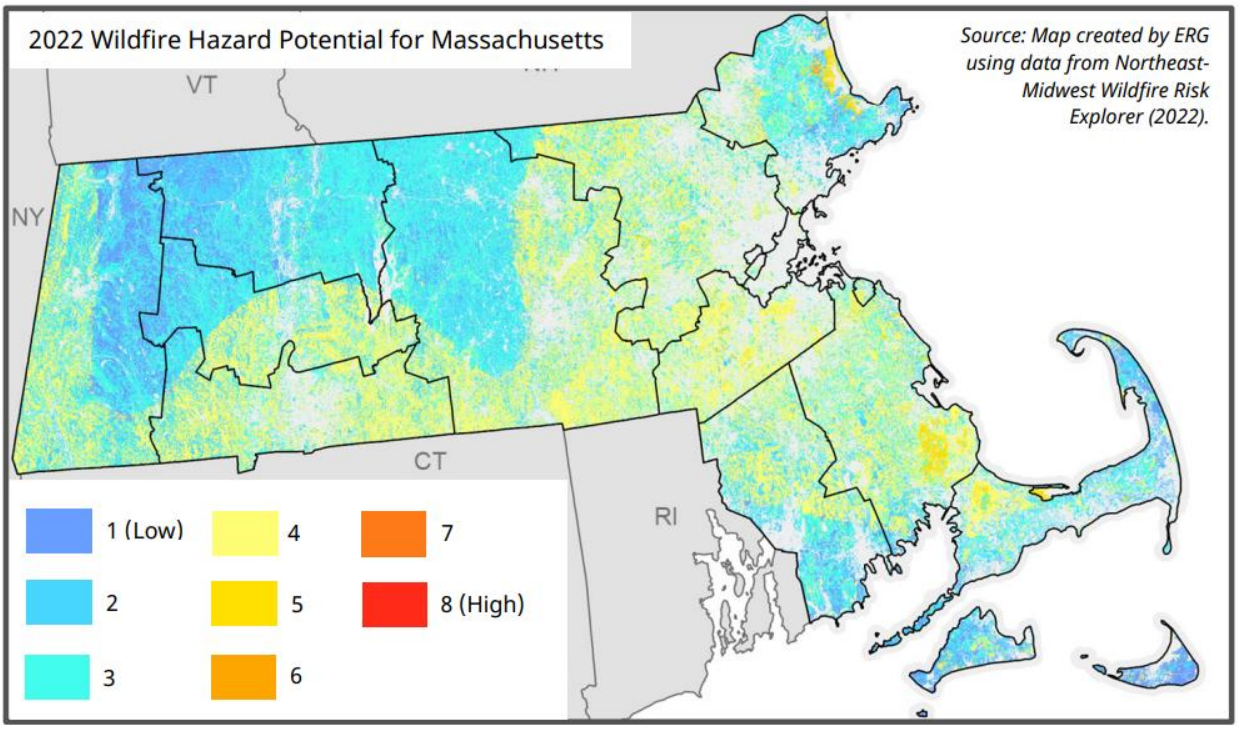
The most susceptible fuels are pitch pine, scrub oak and oak forests. Topography can affect the behavior of fires, as fire spreads more easily uphill. The most common cause of wildfires is the careless disposal of smoking materials and untended campfires.

Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when most vegetation is void of any appreciable moisture, making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced somewhat.

POTENTIAL WILDFIRE AREAS

The 2023 ResilientMass Plan includes a state-wide map that depicts statewide fire risk into eight categories, from Low to High (Figure 22). Much of Norfolk County is designated as category 4 of 8.

Figure 22: 2022 Wildfire Hazard Potential for Massachusetts



Source: ResilientMass Plan, Map created by ERG using data from Northeast-Midwest Wildfire Risk Explorer (2022)

The Wildfire Risk map shown in Appendix A shows a more detailed view for Millis using USDA data for wildfire risk to communities. Millis is shown to have areas of very low, low, and moderate risk.

According to the Millis Fire Chief, there are about 30 brush fires annually. The majority of these fires occur near areas of public open space. These fires typically result in minimal property damage and there have been no deaths as the result of brush fires. In most areas of town, fires are inadvertently caused by pedestrian recreational use, careless disposal of cigarettes, and by weather conditions such as lack of rainfall, winds and lightning. Most of these fires are small, but some are larger. There is a potential for severe fires, especially during dry summers and fall months.

POTENTIAL WILDFIRE AREAS

The Local Hazard Mitigation Team identified the following 13 potential fire hazard areas (Table 37). The numbers correspond to the numbers on Map 8, "Hazard Areas" (Appendix A), and do not reflect priority order.

Table 37: Norfolk County Extreme Cold Events

Map Site ID	Area	Hazard Type
14	Army Corps of Engineers Site #1	Brush Fire
15	Army Corps of Engineers Site #2	Brush Fire
16	Army Corps of Engineers Site #3	Brush Fire
17	Great Black Swamp	Brush Fire
18	Acorn and Farm Street	Brush Fire
19	Walker Pond and Apple Knoll Farm	Brush Fire
20	Verderber Farm and Conservation Land	Brush Fire
21	High Tension Lines at Village and Myrtle Street	Brush Fire
22	Oak Grove Farm	Brush Fire
23	Boggastowe Meadow and North Causeway	Brush Fire
24	Environmental Way	Brush Fire
32	Emerson Place Fire	Brush Fire
33	Toll Brothers Fire	Brush Fire

Less than 1% result in any significant property damage and there have been no deaths as a result of brush fires. The areas with the highest incidence of brush fires are the Town Forest and Adams Farm. Potential damages from wildfires in Millis would depend on the extent and type of land affected. There could be the need for post-fire revegetation to restore a burned property, which could cost from a few thousand dollars to tens of thousands for an extensive area. However, there are no data on actual wildfire damages in the town.

There are no recorded wildfire events for Norfolk County in NOAA's Storm Events Database. Based on past occurrences and the Massachusetts Hazard Mitigation Plan, wildfires are of medium frequency in Millis, events that occur from once in 5 years to once in 50 years (2% to 20% probability per year).

WILDFIRES ANDCLIMATE CHANGE

As the climate warms, drought and warmer temperatures may increase the risk of wildfire as vegetation dries out and becomes more flammable. Increasing frequency of lightning and increasing damage to trees from pests, can also lead to greater fire risk. The 2022 Assessment cites anticipated forest health degradation from increasing wildfire frequency for the Eastern Inland Region, where Millis is located.

INVASIVE SPECIES

The 2018 SHMCAP defines invasive species as "non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health". As the move into new habitats, invasive species displace native species because they have competitive advantages including no biological controls from their native habitat. Some of the more recognizable invasive plant species noted in the SHMCAP include Norway maple, garlic mustard, Japanese barberry, black swallowwort, buckthorn, purple loosestrife, water milfoil, Japanese knotweed, and phragmites. Invasive pests include emerald ash borer, hemlock wooly adelgid, and the Asian long-horned beetle. The Massachusetts Invasive Plant Advisory Group categorizes invasive severity as either limited prevalence in Massachusetts, partial containment potential, or public health threat.

In Millis, the local Hazard Mitigation Team did not raise any specific concerns about invasive species, as invasive species in Millis are of limited prevalence and their impacts are not severe and do not pose a public health threat. The local Team did not identify the need for mitigation measures related to invasive species.

NON-CLIMATE INFLUENCED HAZARDS

GEOLOGIC HAZARDS

Geologic hazards in Massachusetts include earthquakes and landslides. Information on geologic hazards in Millis can be found on Map 4 in Appendix A.

EARTHQUAKES

Damage in an earthquake stems from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location. An earthquake in New England affects a much wider area than a similar earthquake in California due to New England's solid bedrock geology (NESEC).

Seismologists use a Magnitude scale known as the Richter Scale to express the seismic energy released by each earthquake. The typical effects of earthquakes in various ranges are summarized in Table 38.

Table 38: Richter Scale and Effects

Richter Magnitudes	Earthquake Effects
Less than 3.5	Generally, not felt, but recorded
3.5- 5.4	Often felt, but rarely causes damage
Under 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas up to about 100 km. across where people live.
7.0- 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred meters across.

Source: Nevada Seismological Library (NSL), 2005

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2007, 355 earthquakes were recorded in Massachusetts.[xiii] Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Anne. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940, and a 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historical records of some of the more significant earthquakes in the region are shown in Table 39.

Table 39: Historical Earthquakes in Massachusetts or Surrounding Area[xiv]

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA – Cape Ann	2/10/1728	NA
MA – Cape Ann	3/30/1729	NA
MA – Cape Ann	12/9/1729	NA
MA – Cape Ann	2/20/1730	NA
Location	**Date**	**Magnitude**
MA – Cape Ann	3/9/1730	NA
MA - Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA - Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA – Off Cape Cod	11/23/1755	NA
MA - Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA - Offshore	1/2/1785	5.4
MA – Wareham/Taunton	12/25/1800	NA
MA - Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA - Brewster	8/8/1847	4.2

MA - Boxford	5/12/1880	NA
MA - Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA – Cape Ann	1/7/1925	4
MA – Nantucket	10/25/1965	NA
MA – Boston	12/27/74	2.3
VA –Mineral	8/23/11	5.8
MA - Nantucket	4/12/12	4.5
ME - Hollis	10/17/12	4.0
CT-Wauregan	1/12/2015	3.3
CT-Wauregan	1/13/2015	2.6
NH-East Kingston	2/15/2018	2.7

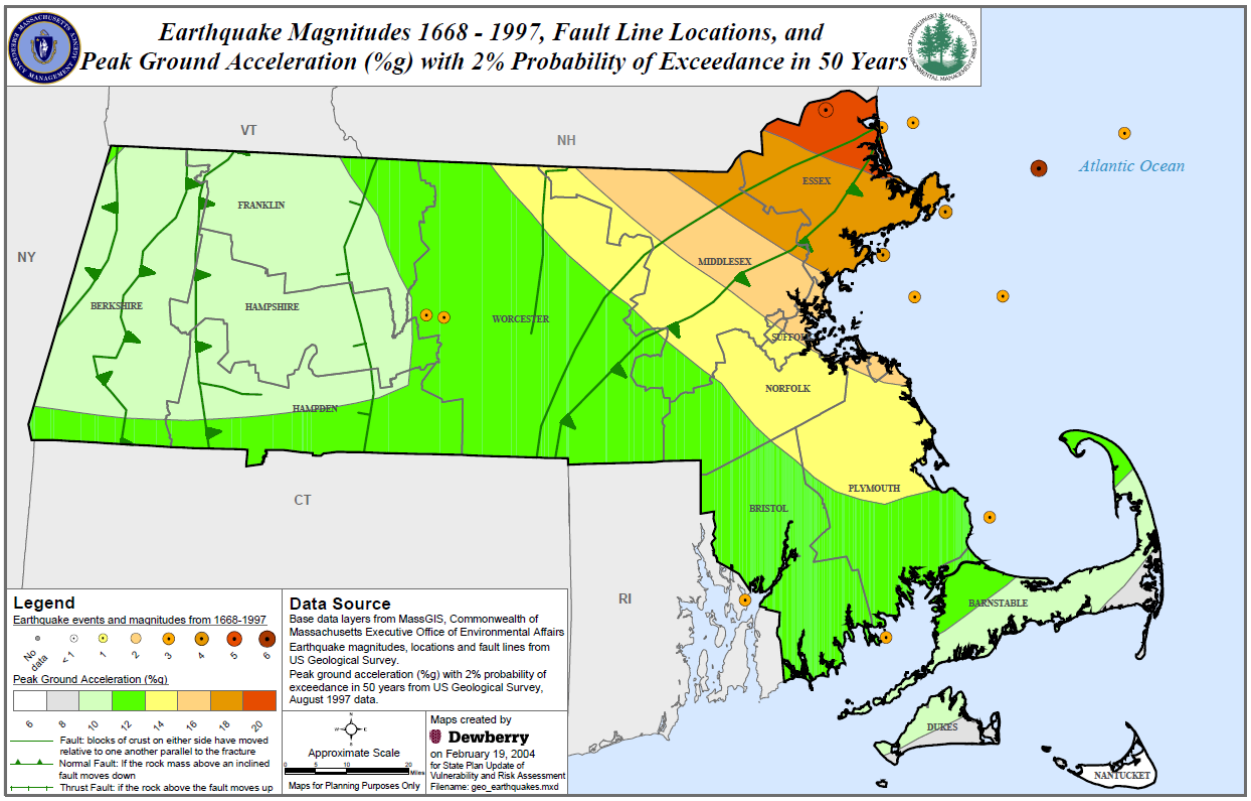
One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (%g). The range of peak ground acceleration in Massachusetts is from 10g to 20g, with a 2% probability of exceedance in 50 years. Millis is in the middle part of the range for Massachusetts, at 14g to 16g, making it a relatively moderate area of earthquake risk relative to the rest of the state (Figure), although the state as a whole is considered to have a low risk of earthquakes compared to the rest of the country. There have been no recorded earthquake epicenters within Millis.

Although New England has not experienced a damaging earthquake since 1755, seismologists state that a serious earthquake occurrence is possible. There are five seismological faults in Massachusetts, but there is no discernible pattern of previous earthquakes along these fault lines. Earthquakes occur without warning and may be followed by aftershocks. Most old buildings and infrastructure were constructed without specific earthquake resistant design features.

Earthquakes are a hazard with multiple impacts beyond the obvious building collapse. Buildings may suffer structural damage which may or may not be readily apparent. Earthquakes can cause major damage to roadways, making emergency response difficult. Water lines and gas lines can break, causing flooding and fires. Another potential vulnerability is equipment within structures. For example, a hospital may be structurally engineered to withstand an earthquake, but if the equipment inside the building is not properly secured, the operations at the hospital could be severely impacted during an earthquake. Earthquakes can also trigger landslides.

Earthquakes are a potential town-wide hazard in Millis, however there have been no recorded earthquake epicenters in or near to Millis. The Town's vulnerability to earthquakes relates to the many older buildings that pre-date the current building code which could be impacted in the event of a severe earthquake. The Town is also concerned about potential vulnerability of the water supply infrastructure.

Figure 23: Massachusetts Earthquake Probability Map[xv]



Source: MA State Hazard Mitigation Plan 2013

Potential earthquake damages to Millis have been estimated using HAZUS-MH. Total building damages are estimated at $9,880,000 for a 5.0 magnitude earthquake and $542,460,000 for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 46..

According to the Boston College Weston Observatory, in most parts of New England, there is a one in ten chance that a potentially damaging earthquake will occur in a 50 year time period. The Massachusetts State Hazard Mitigation Plan classifies earthquakes as "very low" frequency events that occur less frequently than once in 100 years, or a less than 1% per year. The Steering Committee state earthquakes are not a major concern for the Town.

LANDSLIDES

According to the United States Geological Society (USGS), a landslide describes a process that results in movement of rock, soil, fill, or combination downward and outward by falling, toppling, sliding, spreading or flowing.[xvi] Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors. Among the contributing factors are: erosion by rivers or ocean waves over steepened slopes; rock and soil slopes weakened through saturation by snowmelt or heavy rains; earthquakes create stresses that make weak slopes fail; and excess weight from accumulation of rain or snow, and stockpiling of rock or ore, from waste piles, or from man-made structures.

Landslides can result from human activities that destabilize an area or can occur as a secondary impact from another natural hazard such as flooding. In addition to structural damage to buildings and the blockage of transportation corridors, landslides can lead to sedimentation of water bodies. Typically, a landslide occurs when the condition of a slope changes from stable to unstable. Natural precipitation such as heavy snow accumulation, torrential rain and run-off may saturate soil creating instability enough to contribute to a landslide. The lack of vegetation and root structure that stabilizes soil can destabilize hilly terrain.

In Massachusetts, according to the SHMCAP, the most common cause of landslides are geologic conditions combined with steep slopes and/or heavy rains. Landslides associated with heavy rains typically occur on steep slopes with permeable soils underlain by till or bedrock.

There is no universally accepted measure of landslide extent but it has been represented as a measure of the destructiveness. Table 40 summarizes the estimated intensity for a range of landslides. For a given landslide volume, fast moving rock falls have the highest intensity while slow moving landslides have the lowest intensity.

Table 40: Landslide Volume and Velocity

Estimated Volume (m^3)	Expected Landslide Velocity		
	Fast moving (rock fall)	Rapid moving (debris flow)	Slow moving (slide)
<0.001	Slight intensity	--	--
<0.5	Medium intensity	--	--
>0.5	High intensity	---	--
<500	High intensity	Slight intensity	--
500-10,000	High intensity	Medium intensity	Slight intensity
10,000 – 50,000	Very high intensity	High intensity	Medium intensity
>500,000	--	Very high intensity	High intensity
>500,000	--	--	Very high intensity

Source: *A Geomorphological Approach to the Estimation of Landslide Hazards and Risks in Umbria, Central Italy*, M. Cardinali et al, 2002

The SHMCAP utilized data from the MA Department of Transportation from 1986 to 2006 to estimates that, on average, roughly one to three known landslides have occurred each year in the state. A slope stability map published by the MA Geological Survey and UMass-Amherst indicates that the most significant risk of landslide is in western Massachusetts.

Most of Millis has been classified as having a low risk for landslides (see Map 4, Appendix B), and the Local Planning Team stated that they were unaware of any areas of geologic instability. Millis is low-lying with few steep slopes and the Team concurs that landslides are not a major threat or occurrence in Millis. Rather, there may be localized issues of erosion during construction, as a result of development, or as a result of clearing vegetation.

Should a landslide occur in Millis in the future, the type and degree of impacts would be highly localized, and the town's vulnerabilities could include damage to structures, damage to infrastructure, and localized

road closures. The value of potential damages would depend on how many and which properties were affected. There are no data available on landslide damages in Millis, as there are no records of any damages caused by landslides in the town. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Millis.

Based on past occurrences and the Massachusetts Hazard Mitigation Plan, landslides are of Low frequency, events that can occur once in 50 to 100 years (a 1% to 2% chance of occurring each year).

CLIMATE CHANGE AND LANDSLIDES

Changes in precipitation may increase the chance of landslides, as extreme rain events could result in more frequent saturated soils which are conducive to landslides. Drought may also increase the likelihood of landslides if loss of vegetation decreases soil stability.

LAND USE AND DEVELOPMENT TRENDS

Existing Land Use

The most recent land use statistics available from the state are from aerial photography done in 2016. Table 41 shows the acreage and percentage of land in categories relevant to Millis. More than half of the land use in Millis is natural lands including 37% forest and 26% wetlands (forested and non-forested) totaling 4,937 acres. Medium and low density residential comprise 15% of the land use and commercial and industrial comprise approximately 2% of the Town or 165 acres. [xvii]

Table 41 Town of Millis, MA Land Use

Land Use	Acres	Percent
Forest	2922.15	37%
Forested Wetland	1027.75	13%
Wetland	986.87	13%
Medium Density Residential	593.25	8%
Low Density Residential	572.37	7%
Crop Land	429.82	5%
Very Low Density Res.	274.69	4%
Pasture	229.06	3%
Water	130.84	2%
Golf Course	102.43	1%
Commercial	95.02	1%
Industrial	72.05	1%
Multi-Family Residential	70.58	1%
Open Land	64.43	1%
Mining	55.92	1%
Participation Recreation	51.47	1%
Urban Open	26.07	0%
Junkyards	23.44	0%
Powerline	21.89	0%
Urban Public	21.43	0%
Transportation	20.79	0%
High Density Residential	16.26	0%
Waste Disposal	15.61	0%
Cemetery	13.44	0%
Water-Based Recreation	8.62	0%
Nursery	1.58	0%
TOTAL ACRES	7847.84	100%

Natural, Cultural, and Historic Resource Areas

Millis has experienced only modest growth since 2000 population where the 2010 Census indicated a population of 7,902 people and 3,066 housing units. American Community Survey estimates the population has only increased by 3% with a projected 2016 population of 8,810.[xviii] Containing nearly 60% of its land area as forest and wetlands, Millis retains its small-town, rural landscape. It passed the Community Preservation Act in 2006 providing a dedicated source of funding for historic preservation, affordable housing, open space and recreation. They have completed 13 historic preservation projects, four open space and recreation projects and two affordable housing projects.

MILLIS NATURAL ASSETS

Millis contains 13 designated scenic roads and important open space and recreation areas such as Henry Shattuck Conservation Land, Noon Hill Reservation, Millis Park, and the Charles River Natural Valley Storage Areas, owned by the Army Corps of Engineers. There are 2,268 acres of protected land in Millis constituting 28.9 % of the total land area. Of its total area, 1,984 acres are BioMap2 Core Habitat, of which nearly 75% is protected. BioMap2 is a program created in partnership with the MA Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program and The Nature Conservancy to identify exemplary and important natural ecosystems that support the biodiversity and protect the nature of Massachusetts. [xix] Millis's forests, wetlands, and natural areas support two exemplary or priority natural community cores, two threatened species and three species of conservation concerns. These include Long's Bulrush (T), Britton's Violet (T), Eastern Pondmussel (SC), Blue-spotted Salamander (SC), and Spatterdock Darner (SC).[xx] Further, nearly 60% of Millis is covered by tree canopy. The tree canopy serves as a great resource for community health, beauty, livability, flood management, and climate resilience. Its tree canopy mitigates 396,521 pounds of air pollutants per year, intercepts 420 million gallons of stormwater a year and sequesters 522,915 tons of carbon a year.[xxi]

MILLIS HISTORICL ASSETS

The Charles River is a prominent natural and recreational amenity which in part has shaped Millis's community character. Beginning as an agricultural community, Millis soon emerged as a suburban industrial town when it incorporated in 1885. Its development and expansion came from the several mills established in Town. The first in 1662 on Bogastow Pond. Other mills include the first lace loom in American in 1818, brickyards, paper mills, canning factories, and other textile operations.[xxii]

Overall, the town has 295 historic structures registered with the Massachusetts Historic Registry. Most of these structures are located in the Towns Historic District in the center of Millis. The oldest building is a single-family home dating to 1659 called the John Parker House. Of the 295 historic structures, only two lie within a 1% Annual Chance Flood and none within the 0.2% Annual Chance Flood. These include the John Clark Clay Pits and a private historic residence on Larch Road.

Development Trends

Millis has significant protected land or wetlands that center development and growth in a more clustered manner. It has had modest growth since the 2010 Census, though residents appreciate the rural nature of

the Town, making it an important community asset. And the Town encourages centering future residential, commercial, and industrial in a manner that enhances its natural, rural character and creates more livability in its center for walking.

In 2000, Millis had a population of 7,902 people and 3,066 housing units and this population slightly decreased by the 2010 census with a population of 7,891 and modest growth in housing to 3,127 housing units. There was modest growth n the next decade. By 2020, the population was 8,565 and there were 3,296 housing units.

New Developments

MAPC consulted with town planning staff to identify 17 new developments in Millis. These sites are listed in Table shown on Map 8 in Appendix B. The type of development and current status is shown.

Table 42 New Development Sites

Map Site Id	Name	Type	Status 2024
A	Boggastowe Country Club	Country club	Completed
B	South End Farms	Residential	Completed
D	Hickory Hills	Single family homes	Completed
E	Bridge Street Assisted Living	100+ beds Assisted Living, Memory Care	Completed
F	Private Solar Farm 1375 Main St.	Solar facility	Completed
G	New Elementary School	Replacing old school	Completed
H	Millis E Community Solar Array	Solar facility	Completed
I	Emerson Place	50 single-family homes	Permitting
J	Off Main Street at Cottage Ave.	Single family homes	Completed
K	GAF Site	Residential/mixed use	Completed
L	Kensington Place	12 single family homes	Completed
N	The Sportsmen Lounge Potential Commercial Development.	Commercial development	Completed
O	Mill Brook School	Boys school 500 students	Completed
P	617-THC	Growing facility	Permitting
Q	32-248 Main Street	48 Rental apartments	Pending
R	Cobble Knoll Estate, 1344 Main St.	Residential - 32 units duplex	Pending
S	1060 Main Street	Mixed Use - 24 res units Comm. Building, Media	Pending

NEW DEVELOPMENTS IN HAZARD AREAS

In order to characterize any change in the town's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites in relation to locally identified hazards, FEMA Flood Zones and other natural hazards. This information is provided so that planners can

ensure that development proposals comply with flood plain zoning and that careful attention is paid to drainage issues and other natural hazards. Table shows the relationship of these 17 new development parcels to the mapped hazards, FEMA flood zones, Locally Identified Hazard Areas, and landslides.

Table 43 New development in Millis in FEMA Flood Zones.

Map Site ID	Development Name	FEMA Flood Zone	Local Identified Hazards	Landslide
A	Boggastowe Country Club	----		Low
B	South End Farms	1% and 0.2% Annual Chance	Brush Fire	Low
D	Hickory Hills	-----	Brush Fire	Low
E	Bridge Street Assisted Living	-----	Brush Fire	Low
F	Private Solar Farm 1375 Main St.	1% Annual Chance	----	Low
G	New Elementary School	------	----	Low
H	Millis E Community Solar Array	0.2% Annual Chance	----	Low
I	Emerson Place	0.2% Annual Chance	Tornado	Low
J	Off Main Street at Cottage Ave.	------	Brush Fire	Low
K	GAF Site	------	----	Low
L	Kensington Place	------	----	Low
N	The Sportsmen Lounge Potential Commercial Development.	------	----	Low
O	Mill Brook School	------	----	Low
P	617-THC	1% Annual Chance	Brush Fire	Low
Q	32-248 Main Street	----	----	Low
R	Cobble Knoll Estate, 1344 Main St.	----	----	Low
S	1060 Main Street	----	----	Low

Five of the 17 development sites are partially located in a FEMA zone, typically a part of the site that is not built on. Any developments in these areas must meet the requirements of the Town's Floodplain District zoning bylaw to minimize impacts of flooding. All of the development sites are located in the area designated as "Low Incidence" for landslides. With respect to average annual snowfall, all of the development sites are within the zone of 36 to 48 inches average annual snowfall. With respect to wind, there is no variation across the town of Millis; tall development sites in town are in the same category, which has a 100-year wind maximum speed of 110 miles per hour.

Critical FACILITIES & Infrastructure in Hazard Areas

Critical facilities and infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are 67 facilities identified in Millis. These are listed in Table 44 and are shown on the maps in Appendix A.

Explanation of Columns in Table 44

- ***Column 1: ID #:*** The first column in Table 21 is an ID number which appears on the maps that are part of this plan. See Appendix B.
- ***Column 2: Name****:* The second column is the name of the site. If no name appears in this column, this information was not provided to MAPC by the community.
- ***Column 3: Type*****:** The third column indicates what type of site it is.
- ***Column 4: Locally Identified Hazard.*** This column indicates whether the critical infrastructure is within a hazard area identified by the local steering committee. It includes local areas of flooding, brush fire, and other hazards like tornados.
- ***Column 5: FEMA Flood Zone*****:** The fifth column addresses the risk of flooding. A "No" entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone.
- ***Column 6. Landslide Risk:*** The fourth column indicates the degree of landslide risk for that site. This information came from NESEC. The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in nature. For more information on how landslide susceptibility was mapped, refer to http://pubs.usgs.gov/pp/p1183/pp1183.html
- ***Column 7: Snowfall.*** Areas designated "low" receive an annual average of 36.1 to 48.0 inches of snow. Areas designated "high" receive an annual average of 48.1 to 72 inches of snow, as shown on Map 6 in Appendix B.

Table 44 Critical Facilities and Relationship to Hazard Areas

Critical Infrastructure Map ID	Name	TYPE	Local ID Hazard	FEMA Flood Zone	Landslides	Average Snowfall
1	Myrtle Street Bridge	Bridge	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
2	Pleasant Street/Dean Street Bridge	Bridge	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
3	Norfolk Road Bridge	Bridge	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
4	Forest Road Bridge	Bridge	Flooding	AE: 1% Annual Chance of Flooding	Low	36-48 in
5	Main Street Bridge	Bridge	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
6	Dover Road Bridge	Bridge	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
7	Orchard Street Bridge at 312 Orchard St.	Bridge	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
8	Orchard Street Bridge at 219 Orchard St	Bridge	No	AE: Regulatory Floodway	Low	36-48 in
9	Orchard Street Bridge at 84 Orchard St	Bridge	No	AE: Regulatory Floodway	Low	36-48 in
10	Middlesex Street Bridge	Bridge	No	AE: Regulatory Floodway	Low	36-48 in
11	Plain Street Railroad Bridge	Bridge	No	No	Low	36-48 in
12	Dover Road Tressel	Bridge	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
13	T Mobile Cellular Tower	Communication Tower - Future site	No	No	Low	36-48 in
14	Verizon Transfer Station	Communications	No	No	Low	36-48 in
15	Main Public Safety Radio Repeater	Communications Repeaters /Antennas	No	No	Low	36-48 in
16	Public Safety Satellite Radio Receiver	Communications Repeaters/Antennas	No	No	Low	36-48 in
17	Cingular Cellular Tower	Communications Tower	No	No	Low	36-48 in
18	Richardson Pond Dam	Dam	No	X: 0.2% Annual Chance of Flooding	Low	36-48 in
19	Woodside Montessori Academy	Daycare	Other	No	Low	36-48 in
20	Department of Public Works	Department of Public Works	No	No	Low	36-48 in
21	Willowbrook Manor	Elderly Housing	No	No	Low	36-48 in
22	Millis Housing Auth. - Kennedy Terrace	Elderly Housing	No	No	Low	36-48 in
23	Millis Housing Auth. - H. King Terrace	Elderly Housing	No	No	Low	36-48 in
24	Town Hall	EOC - Primary	No	No	Low	36-48 in
25	Fire Station #2	Fire Station	No	No	Low	36-48 in
26	Fire Station #1	Fire Station	No	No	Low	36-48 in
27	Fuel Station	Fuel Depot	No	No	Low	36-48 in
29	Millis Family Health Center	Medical Facility	No	No	Low	36-48 in
30	Amvets #495	Place of Assembly	No	No	Low	36-48 in
32	American Legion #208	Place of Assembly	No	No	Low	36-48 in
33	Church of Christ	Place of Worship	No	No	Low	36-48 in
35	St. Thomas Church	Place of Worship	No	No	Low	36-48 in

Critical Infrastructure Map ID	**Name**	**TYPE**	**Local ID Hazard**	**FEMA Flood Zone**	**Landslides**	**Average Snowfall**
36	Police	Police Station	No	No	Low	36-48 in
39	Happy Hours Preschool	School	No	No	Low	36-48 in
40	Woodside Montessori Academy	School	Other	No	Low	36-48 in
41	Millis Middle/High School	School	No	No	Low	36-48 in
42	Clyde Brown Elementary School	School	No	No	Low	36-48 in
44	Sewer Pumping Station	Sewer Treatment Plant	No	No	Low	36-48 in
45	Sewer Pumping Station	Sewer Treatment Plant	No	No	Low	36-48 in
46	Sewer Pumping Station	Sewer Treatment Plant	No	No	Low	36-48 in
47	Sewer Pumping Station	Sewer Treatment Plant	Brush Fire	No	Low	36-48 in
48	Private Sewer Pumping Station	Sewer Treatment Plant	No	No	Low	36-48 in
49	Private Sewer Pumping Station	Sewer Treatment Plant	No	No	Low	36-48 in
50	Life Experience School	Special Needs Facility for Adults	No	No	Low	36-48 in
51	Millis Town Hall	Town Hall	No	No	Low	36-48 in
52	Millis Animal Hospital PC	Veterinary Facility	No	No	Low	36-48 in
53	Main Street Veterinary Hospital	Veterinary Facility	No	No	Low	36-48 in
54	Water Tank	Water Storage Tank	No	No	Low	36-48 in
55	Water Tank	Water Storage Tank	No	No	Low	36-48 in
56	Water Treatment Facility	Water Treatment Facility	No	No	Low	36-48 in
57	Water Treatment Facility	Water Treatment Facility	Brush Fire	No	Low	36-48 in
58	Well # 1 & 2 & PFAS Treatment	Well & PFAS Treatment Facility	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
59	Well #3	Well	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
60	Well #4	Well	Brush Fire	AE: 1% Annual Chance of Flooding	Low	36-48 in
61	Well #5	Well	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
62	Well #6	Well	No	AE: 1% Annual Chance of Flooding	Low	36-48 in
63	The Ashram	Place of Assembly	No	No	Low	36-48 in
64	Ael-Schunon Congregation	Place of Assembly	No	No	Low	36-48 in
65	TANGERINIS	FARM	No	No	Low	36-48 in
66	Communications Tower	Cell Tower, 121Norfolk Road				
67	Anthology Assisted Living	Assisted Living facility				
68	Regency at the Glen	3 Sewer-lift stations, 84 Orchard St				
69	Sparhawk Academy	Private Boys School, 376 Orchard				

VULNERABILITY ASSESSMENT

The purpose of the vulnerability assessment is to estimate the extent of potential damages from natural hazards of varying types and intensities. A vulnerability assessment and estimation of damages was performed for hurricanes, earthquakes, and flooding. The methodology used for hurricanes and earthquakes was the HAZUS-MH software. The methodology for flooding was developed specifically to address the issue in many of the communities where flooding was not solely related to location within a floodplain.

Introduction to HAZUS-MH

HAZUS- MH (multiple-hazards) is a computer program developed by FEMA to estimate losses due to a variety of natural hazards. The following overview of HAZUS-MH is taken from the FEMA website.

> "HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response and recovery planning.
>
> HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations."[xxiii]

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data. Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the Town of Millis, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is "subject to a great deal of uncertainty."

However, for the purposes of this plan, the analysis is useful. This plan is attempting to generally indicate the possible extent of damages due to certain types of natural disasters and to allow for a comparison between different types of disasters. Therefore, this analysis should be considered to be a starting point for understanding potential damages from the hazards.

Estimated Damages from Hurricanes

The HAZUS software was used to model potential damages to the community from a 100 year and 500 year hurricane event; storms that are 1% and 0.2% likely to happen in a given year, and roughly equivalent to a Category 2 and Category 4 hurricane. The damages caused by these hypothetical storms were modeled as if the storm track passed directly through the Town, bringing the strongest winds and greatest damage potential.

Though there are no recorded instances of a hurricane equivalent to a 500 year storm passing through Massachusetts, this model was included in order to present a reasonable "worst case scenario" that would help planners and emergency personnel evaluate the impacts of storms that might be more likely in the future, as we enter into a period of more intense and frequent storms.

Table 45 Estimated Damages from Hurricanes

Hurricanes	Category 2	Category 4
Building Characteristics		
Estimated total number of buildings	2,000	
Estimated total building replacement value	$1,061,000,000	
Building Damages		
# of buildings sustaining minor damage	107	512
# of buildings sustaining moderate damage	9	90
# of buildings sustaining severe damage	0	5
# of buildings destroyed	0	2
Population Needs		
# of households displaced	0	5
# of people seeking public shelter	0	1
Debris		
Building debris generated (tons)	4,584	11,554
Tree debris generated (tons)	3,154	2,457
# of truckloads to clear building debris (25 ton trucks)	15	68
Value of Damages		
Total property damage (buildings and content)	$6,679,290	$23,294,330
Total losses due to business interruption	$ 260,600	$1,573,110

Estimated Damages from Earthquakes

The HAZUS earthquake module allows users to define an earthquake magnitude and model the potential damages caused by that earthquake as if its epicenter had been at the geographic center of the study area. For the purposes of this plan, two earthquakes were selected: magnitude 5.0 and a magnitude 7.0. Historically, major earthquakes are rare in New England, though a magnitude 5 event occurred in 1963.

Table 465 Estimated Damages from Earthquakes

Earthquakes	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	4,000	
Estimated total building replacement value	$1,060,000,000	
Building Damages		
# of buildings sustaining slight damage	208	862
# of buildings sustaining moderate damage	50	854
# of buildings sustaining extensive damage	6	325
# of buildings completely damaged	1	395
Population Needs		
# of households displaced	5	526
# of people seeking public shelter	2	255
Debris		
Building debris generated (tons)	<100,000	120,000
# of truckloads to clear debris (@ 25 tons/truck)	40	4,920
Value of Damages (Millions of dollars)		
Total property damage	$9,880,000	$462,230,000
Total losses due to business interruption	$1,540,000	$80,230,000

Estimated Damages from Flooding

The HAZUS flooding module allows users model the potential damages caused by a 100 Year Flood event and a 500 Year Flood event.

Table 47 Estimated Damages from Flooding

Flooding	100 Year Flood	500 Year Flood
Building Characteristics		
Estimated total number of buildings	2,911	
Estimated total building replacement value	$1,061,000	
Building Damages		
# of buildings sustaining moderate damage	13	12
# of buildings sustaining extensive damage	0	1
# of buildings substantially damaged	0	0
Population Needs		
# of households displaced	65	26
# of people seeking public shelter	23	70
Value of Damages		
Total property damage	$6,090,000	$7,870,000
Total losses due to business interruption	$10,000	$20,000

SECTION 5: HAZARD MITIGATION GOALS

The Millis Local Hazard Mitigation Planning Team reviewed and discussed the mitigation goals from the 2018 Hazard Mitigation Plan. The Team determined that these goals continue to reflect the mitigation priorities of the town and one new goal was added to address vulnerable and Environmental Justice populations. The local team adopted the following updated list of goals for this 2024 updated plan. All of the goals are considered critical for the Town and they are not listed in order of importance.

GOAL 1: Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.

GOAL 2: Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.

GOAL 3: Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

GOAL 4: Prevent and reduce the damage to public infrastructure resulting from all hazards.

GOAL 5: Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

GOAL 6: Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

GOAL 7: Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

GOAL 8: Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

GOAL 9: Consider the impacts of climate change and incorporate climate mitigation and adaptation in hazard mitigation planning.

GOAL 10: Incorporate environmental justice considerations throughout natural hazard mitigation, including in supporting and outreach to climate vulnerable populations, identification of hazard impacts, and related mitigation measures.

SECTON 6: EXISTING MITIGATION MEASURES

The existing protections in the Town of Millis are a combination of zoning, land use, and environmental regulations, infrastructure maintenance and drainage infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage clogging problems, while large scale capacity problems may require pipe replacement or invert elevation modifications. These more expensive projects are subject to the capital budget process and lack of funding is one of the biggest obstacles to completion of some of these.

The Town's existing mitigation measures are listed by hazard type here and are summarized in Table 48 below.

FLOOD-RELATED HAZARDS EXISTING MITIGATION

Millis employs a number of practices to help minimize potential flooding and impacts from flooding, and to maintain existing drainage infrastructure. Existing town-wide mitigation measures include the following:

- *Participation in the National Flood Insurance Program (NFIP)* – Millis participates in the National Flood Insurance Program. NFIP provides access to funds in the case of flood related damages. Table provides an overview of NFIP information for the Town of Millis.

Table 48 National Flood Insurance Policy Statistics for Millis

Flood insurance policies in force	19
Coverage amount of flood insurance policies	$5,280,000
Total losses paid	$15,653.44
Total losses (all losses submitted regardless of the status)	13
Substantial Damage claims paid)	0

Source: Flood Insurance Program Community Information System, provided by MA DCR

The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.

- *Catch Basin Cleaning* – All 984 catch basins are cleaned once a year. This includes about 100 new catch basins located along Rt. 109 between Millis and Medfield and catch basins from two new developments. This service is contracted out.
- *Street Sweeping* – All streets are swept at least once per year or as needed in select areas of town. The Department of Public Works (DPW) begins street sweeping as soon as possible each spring. According to James McKay, Assistant DPW Director, the town has sufficient equipment for sweeping and does the sweeping in-house.
- *Roadway Treatments* – The Highway Department sands the roads in the winter, but not in excessive amounts. They mix magnesium chloride with salt to work faster at colder temperatures.
- *Enforcement of the State Building Code* – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.
- *Stormwater Bylaw and Enterprise Fund* – Millis has instituted a stormwater bylaw requiring all construction to submit a stormwater management plan as part of the permitting process. The Town also

voted to institute a stormwater enterprise fund in 2018 to finance stormwater infrastructure and management in compliance with National Pollution Discharges Elimination System MS4 permits.

- *Community Preservation Act (CPA)* – The town adopted the CPA (permitted by Massachusetts General Law Chapter 44B, Sections 3 through 7), in May of 2006. CPA establishes a dedicated funding source, derived from a 1% surcharge on the annual property tax and state matching funds, for the purpose of preserving open space, historical preservation, community housing and recreation.
- *Infrastructure Improvements* – Within the past 5-10 years, the town upgraded much of the town's infrastructure such as culverts, bridges, roads, and drainage systems. Some of these improvements include:
    - Enlarged the culvert on Route 109/Main Street, north of Farm Street
    - Replaced the pump station at Dover and Main Street
    - Raised a portion of Route 109/Main Street
    - Replace the Norfolk Bridge (pending project)
- *Regulations and By-Laws* – The town has adopted many regulations and bylaws that serve to reduce flooding, preserve open space, and protect the community from natural hazards. Brief descriptions of town-wide regulations, bylaws, and ordinances are included in Appendix F.

DAM FAILURE EXISTING MITIGATION

The Massachusetts Department of Conservation and Recreation decommissioned the public dams in the Town of Millis and this is no longer a hazard. However, the Town of Millis has the following in place for dam failure:

- *DCR dam safety regulations* – All dams are subject to the Division of Conservation and Recreation's dam safety regulations. The dams must be inspected regularly and reports filed with the DCR Office of Dam Safety.
- *Permits required for construction* – State law requires a permit for the construction of any dam.
- *The Comprehensive Emergency Management Plan* – The CEMP addresses dam safety.

WIND-RELATED HAZARDS EXISTING MITIGATION

- *Massachusetts State Building Code* – The town enforces the Massachusetts State Building Code whose provisions are generally adequate enough to mitigate most wind damage. The code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence. If a tornado were to occur, the potential for severe damages would be extremely high.
- *Tree-Trimming*– The local electric company, NStar, conducts regular tree trimming. The town responds to downed tree limbs caused by winds, lightning strike reports and other weather related incidents.

WINTER-RELATED HAZARDS EXISTING MITIGATION

- *Snow disposal* – The town does not do any snow disposal except for removing snow at the library.

- *Roadway Treatments* – The town uses a mixture of sand and salt with a bit more salt in the mix. This is done to minimize the amount of sand that enters catch basins and streams. The area near Glenn Allen is only lightly salted due to residential wells.

FIRE-RELATED HAZARDS EXISTING MITIGATION

- *Permits Required for Outdoor Burning* – The Fire Department requires a written permit for outdoor burning. The property-owner must come into the Fire Station, fill out a form and pay a $15.00 fee.
- *Subdivision Review* – The Fire Department is involved in reviewing subdivision plans from conceptual design through occupancy to ensure that there is adequate access for fire trucks and an adequate water supply.
- *Portable Water Pumps* – Rivers and ponds in town are available to be tapped into for water supply if necessary.

EARTHQUAKE HAZARDS EXISTING MITIGATION

- *Massachusetts State Building Code* – The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is "to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake". This section goes on to state that due to the complexity of seismic design, the criteria presented are the minimum considered to be "prudent and economically justified" for the protection of life safety. The code also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.
- *Comprehensive Emergency Management Plan* – The town does have an evacuation plan as specified in its Comprehensive Emergency Management Plan (CEMP).

LANDSLIDE HAZARDS EXISTING MITIGATION

- The subdivision regulations do have maximum slope requirements for new roads.

MULTI-HAZARD MITIGATION MEASURES

- *Massachusetts State Building Code* – The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is "to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake". This section goes on to state that due to the complexity of seismic design, the criteria presented are the minimum considered to be "prudent and economically justified" for the protection of life safety. The code also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.

  Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to a Table 1612.2.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which are

required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.

- *Multi-Department Review of Developments* – Multiple departments, such as the Town Administrator, Planning, Zoning, Health, Highway, Fire, Police, and Conservation, review all subdivision and site plans prior to approval.
- *Comprehensive Emergency Management Plan (CEMP)* – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan. The CEMP is available online through secure access for town personnel.

COMPILATION OF EXISTING MITIGATION

Table 49 below summarizes the many existing natural hazard mitigation measures already in place in Millis. Any changes to these since the 1018 plan are noted, as are any changes or revisions the local Hazard Mitigation Team has identified the need for.

Table 49 Existing Hazard Mitigation Measures in Millis

Mitigation Measure	Description	Changes since the 2018 Plan?	Effectiveness / Improvements Needed?
FLOOD RELATED HAZARDS			
1) The town participates in NFIP and has adopted the effective FIRM maps.	The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.	NO	FEMA has published Preliminary Flood Insurance Rate Maps (FIRM) that are scheduled to go into effect in January 2025. The Town will need to amend its floodplain bylaw to reflect the new FIRM's once they are finalized by FEMA (see also #7 below for other changes).
2) Annual Street Sweeping	All streets are swept at least once per year or as needed in select areas, beginning annually each Spring. The town has sufficient equipment and does the sweeping in-house.	The street sweeping program has been revised to meet the requirements of the MS4 permit.	Effective
3) Annual Catch Basin Cleaning	All 984 catch basins are cleaned once a year. This service is contracted out.	Catch basin cleaning program has been revised to meet the requirements of the MS4 permit	Effective
4) Stormwater Bylaw and Enterprise Fund	Millis established a stormwater bylaw requiring all construction to submit a stormwater management plan as part of the permitting process. The Town also voted to institute a stormwater enterprise fund in 2018 to finance stormwater infrastructure and management in compliance with the MS4 Stormwater Permit.	Stormwater Fee has been adopted by the town. Stormwater Enterprise Fund provides additional resources to manage and improve stormwater infrastructure and meet requirements of the MS4 permit.	Consider adopting stormwater fee credits for properties that provide on-site mitigation of stormwater impacts. MAPC to provide a report on options for structuring a fee credit program.
5) Community Preservation Act	The town adopted the CPA in 2006. CPA establishes a dedicated fund, derived from a 1% surcharge on the property tax plus state matching funds, for the purpose of preserving open space, historical preservation, community housing and recreation.	NO	Effective

Table 49 Existing Hazard Mitigation Measures in Millis

Mitigation Measure	Description	Changes since the 2018 Plan?	Effectiveness / Improvements Needed?
6) Infrastructure Improvements	Within the past 10 years, the town upgraded much of its infrastructure such as culverts, bridges, roads, and drainage systems. Some of these improvements include: • *Enlarged the culvert on Route 109/Main Street, north of Farm Street* • *Replace the pump station at Dover and Main Street* • *Raised a portion of Route 109/Main Street* • *Replace the Norfolk Bridge (pending project)*	Replacement of the pump station at Dover Street is in progress. The Town is waiting for funding from the developer for this. Other projects since the 2018 Plan: • Replacement of culvert at Birch Street. • Two new water treatment facilities • Booster station at Walnut Street The town's consultant conducted the Millis Flood Resiliency Plan that identifies three priority projects to upgrade the stormwater system and mitigate flooding. The Town participated in a regional flood modeling project for the Charles River watershed that identifies potential future impact of increased precipitation due to climate change.	Implement priority recommendations of the Millis Flood Resiliency Plan. Continue to participate in the Charles River Climate Compact and identify local projects to implement in future years.
7) Regulations and By-Laws	The town has adopted several regulations and bylaws that serve to reduce flooding, preserve open space, and protect the community from natural hazards. These include the Special Flood Hazard District, the Water Protection Districts, Wastewater regulations and Stormwater regulations. Brief descriptions of these are included in Appendix F.	NO	Due to the Preliminary FIRM's (#1 above), the Town will need to amend its Floodplain Zoning bylaw to meet the requirement of a new sate Model Floodplain Zoning bylaw prepared by the Dept. of Conservation and Recreation (DCR). MAPC is currently assisting the Town with preparing the amended Floodplain bylaw,, which is planned to be sent to the Spring 2025 Town Meeting for a vote of adoption.

Table 49 Existing Hazard Mitigation Measures in Millis

Mitigation Measure	Description	Changes since the 2018 Plan?	Effectiveness / Improvements Needed?
DAM RELATED HAZARDS			
8) DCR Dam Safety Regulations	All dams are subject to the Dept. of Conservation and Recreation's dam safety regulations. The dams must be inspected regularly and reports filed with the Office of Dam Safety.	NO	Effective
9) Construction permits required	State law requires a permit for the construction of any dam.	NO	Effective
WIND RELATED HAZARDS			
10) Tree trimming	The local electric utility company, NStar, conducts regular tree trimming. The town responds to downed tree limbs caused by winds, lightning strike reports and other weather-related incidents.	Tree trimming is conducted by the Town along with utilities NStar and Eversource. The Town increased its tree trimming efforts over the last several years, with a $150,000 special appropriation, in conjunction with Eversource.	Consider continuing enhanced tree trimming efforts given the increased frequency of severe storms causing tree damage and power outages.
WINTER RELATED HAZARDS			
11) Snow removal operations, roadway treatments	The town uses a mixture of sand and salt with a bit more salt in the mix. This is done to minimize the amount of sand that enters catch basins and streams. The area near Glenn Ellen is only lightly salted due to residential wells.	Snow has been cleared from sidewalks in the Glen Ellen area. About two miles of sidewalks are cleared to provide access to schools.	Effective
12) Snow Disposal	The town does not do any snow disposal except for removing snow at the library.	NO	Effective

Table 49 Existing Hazard Mitigation Measures in Millis

Mitigation Measure	Description	Changes since the 2018 Plan?	Effectiveness / Improvements Needed?
BRUSHFIRE HAZARDS			
13) Open burning permits required	The Fire Department requires a permit for outdoor burning. The property-owner must fill out a form and pay a $15.00 fee.	Outdoor burning fee is $5.00	Effective
14) Fire Department reviews all development plans for fire safety	The Fire Department is involved in reviewing subdivision plans from conceptual design through occupancy to ensure that there is adequate access for fire trucks and an adequate water supply.	NO	Effective
15) Public education on fire safety	The Fire Department provides public education on its website.	NO	Effective
GEOLOGIC HAZARDS			
16) MA State Building Code	The State Building Code contains a section on designing for earthquake loads. Section 1612.2.5 sets up seismic hazard exposure groups. Group II includes buildings which have a substantial public hazard due to occupancy and Group III are buildings having essential facilities required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.	NO	Effective
17) Maximum slope requirements for developments	The subdivision regulations do have maximum slope requirements for new roads	NO	Effective

Table 49 Existing Hazard Mitigation Measures in Millis

Mitigation Measure	Description	Changes since the 2018 Plan?	Effectiveness / Improvements Needed?
MULTI-HAZARDS			
18) Massachusetts State Building Code	The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and roof snow loads.	NO	Effective
19) Multi-department review of developments	Multiple town departments, such as the Town Administrator, Planning, Zoning, Health, Highway, Fire, Police, and Conservation, review all subdivision and site plans prior to approval.	NO	Effective
20) Comprehensive Emergency Management Plan (CEMP)	These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan. The CEMP is available online through secure access for town personnel.	NO	The Town is beginning the process of updating its CEMP. The Local Emergency Planning Committee has been convened for this task
21) Public education	Emergency Preparedness public education on website	This is a work in progress	Complete this task.
22) Reverse 911	Reverse 911 to notify residents of emergencies	The town in the process of switching this service to RAV.	Effective
35) Backup generators	All municipal buildings and schools have generators	NO	Upgrade the generator at Veterans Memorial Building (Town Hall).
36) Local Emergency Management Planning Committee (LEPC)	The town has an active LEPA and also participate in a regional committee for Norfolk County	NO	Effective

MITIGATION CAPABILITIES AND LOCAL CAPACITY FOR IMPLEMENTATION

Under the Massachusetts system of "Home Rule," the Town of Millis is authorized to adopt and from time to time amend a number of local bylaws and regulations that support the town's capabilities to mitigate natural hazards. These include Zoning Bylaws, Subdivision and Site Plan Review Regulations, Wetlands Bylaws, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Bylaws may be amended each year at the annual Town Meeting to improve the town's capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission, such as the Planning Board or Conservation Commission. For example, in 2024 the Town is preparing to amend its Floodplain Zoning District Bylaw to reflect the new Flood Insurance Rate Maps expected in 2025, and to meet the new requirements of the Massachusetts Model Floodplain Bylaw.

The Town of Millis has recognized several existing mitigation measures that require implementation or improvements, and has the capacity within its local boards and departments to address these. The Millis Department of Public Works will address the needs for catch basin cleaning, repairs and upgrades to drainage infrastructure. The town's Planning Board will address the updates to the Master Plan and implementation of the Zoning Ordinance, Floodplain District, and Subdivision Rules and Regulations. The Conservation Commission will oversee implementation of the Wetlands Bylaw and the Open Space Plan. The Department of Public Works oversee the Stormwater Enterprise Fund and stormwater infrastructure improvements.

SECTION 7: MITIGATION MEASURES FROM THE 2018 PLAN

IMPLEMENTATION PROGRESS ON THE PREVIOUS PLAN

At a meeting of the Millis Hazard Mitigation Local Planning Team, Town staff reviewed the mitigation measures identified in the 2018 Millis Hazard Mitigation Plan and determined whether each measure had been implemented or deferred. Of those measures that had been deferred, the committee evaluated whether the measure should be deleted or carried forward into this Hazard Mitigation Plan 2024 updated plan. The decision on whether to delete or retain a particular measure was based on the committee's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the Town to take action on the measure. T
able 50 summarizes the status of mitigation measures from the 2018 plan that are being continued as part of the 2024 update.

Millis has made considerable progress on implementing mitigation measures identified in the 2018 Hazard Mitigation Plan. This includes completion of five recommended mitigation measures and partial completion of eight others:

Completed Mitigation Measures since the 2018 Plan

5) Update Open Space and Recreation Plan
6) Revisions to Development Bylaws and Regulations
9) Larch Road-Road Elevation and Culvert Enlargement
10) Water-Related Public Education on non-point pollution
23) Investigate separate metering for outdoor watering

Partially Completed Mitigation Measures since the 2018 Plan

1) Farm and Pleasant Street-Beaver Control
4) Protection of Open Space
7) Drainage Improvement/Detention Basin Village and Birch Street
13) Acquire ATVs to fight remote brush fires
14) Cart Path Restoration
19) Earthquake-proof the drinking water supply infrastructure
24) Institute tree trimming program and collaborate with utilities.
25) Emergency Communication for intra-operability especially with Police, Fire, and DPW.
26) Implement Municipal Vulnerability Preparedness plan

The local Team reviewed the remaining mitigation recommendations not yet completed, and determined that one will not continue to be included in the 2024 updated plan. The recommendation to adopt a 75-foot required setback regulation for new development was reevaluated and found not to be a relevant measure for Millis.

The Team also reviewed the priorities for each mitigation recommendation in the 2018 plan and determined that four of them will have revised priority rankings in the 2024 updated plan:

1) Farm and Pleasant Street-Beaver Control	HIGH > MEDIUM
8) Island Road elevation/culvert enlargement	LOW > HIGH
9) Larch Road-elevation/culvert enlargement	MEDIUM > LOW
22) Site Design to increase tree plantings near buildings, parking areas, public ways	HIGH > MEDIUM

Nine mitigation measure not yet completed will e carried forward into this 2024 updated, plan, and the Town will focus on efforts to implement these during the next five-year planning period.

Moving forward into the next five year plan implementation period there will be more opportunities to incorporate hazard mitigation into the Town's decision making processes. The challenges the Town faces in implementing these measures are primarily due to limited funding and available staff time. This plan should help the Town prioritize the best use of its limited resources for enhanced mitigation of natural hazards.

Table 50 Status of Mitigation Recommendations from the 2018 Plan			
Mitigation Measure	**Priority in 2018 Plan / Description**	**CURRENT STATUS** 1. Completed 2. Partially Completed (Describe) 3. Not Completed (Reasons/Constraints?)	**2024 PLAN UPDATE** 1. Retain as-is in the 2024 Plan? 2. Keep and Revise for 2024 Plan? 3. Change Priority for 2024 Plan? 4. Delete from the 2024 Plan?
FLOODNG MITIGATION			
1) Farm and Pleasant Street-Beaver Control	MEDIUM	**Partially completed** – installed beaver defender at openings of structure	Retain in 2024 Plan
2) Dover Road Mitigation- Levy on the abutting Maple Swamp; Repair culvert under Route 109	HIGH:	**Not completed**	Retain in 2024 Plan
3) Dover Rd. Mitigation-Floodgate on the upstream dam	HIGH	**Not completed**	Retain in 2024 Plan
4) Protection of Open Space (Town bought land on Main Street, Tresca property)	MEDIUM	**Partially completed.** The Town acquired 23 acre Baun property on Village Street	Retain in 2024 Plan
5) Update Open Space and Recreation Plan	HIGH	**Completed** – OSRP Updated in 20219. Next plan update due in 2026 (every 7 years)	Retain in 2024 Plan
6) Revisions to Development Bylaws and Regulations	MEDIUM	**Completed,** Town adopted Stormwater Bylaw in 2019, and the Select Board will soon update the regulations. The Town also adopted a Stormwater Enterprise Fund for a dedicated revenue source to manage and improve the stormwater system.	Delete for 2024 - completed

Table 50 Status of Mitigation Recommendations from the 2018 Plan

Mitigation Measure	Priority in 2018 Plan / Description	CURRENT STATUS 1. Completed 2. Partially Completed (Describe) 3. Not Completed (Reasons/Constraints?)	2024 PLAN UPDATE 1. Retain as-is in the 2024 Plan? 2. Keep and Revise for 2024 Plan? 3. Change Priority for 2024 Plan? 4. Delete from the 2024 Plan?
7) Drainage Improvement/Detention Basin Village and Birch Street	HIGH: Repaving the road in 2018	**Partially Completed** – Town repaired the catch basin and did engineering study, which found that a gas main is in a different location.	Retain in 2024 Plan
8) Island Road-Road elevation and Culvert Enlargement	HIGH	**Not Completed -** There have been complaints from neighbors about problems caused by beavers	Retain in 2024 Plan
9) Larch Road-Road Elevation and Culvert Enlargement	LOW	**Completed** – drainage pipe was enlarged and headwall repaired. Continue to monitor.	Keep and Revise – Monitor performance
10) Water-Related Public Education on non-point pollution; Stormwater Enterprise Fund for education and outreach to public.	MEDIUM	**Completed** – The town published public information leaflets and posted on the web site.	Delete for 2024 - completed
WINTER HAZARDS MITIGATION			
11) Increase the size of the salt shed.	MEDIUM	**Not completed**	Retain in 2024 Plan
12) Evaluate public buildings to withstand snow loads.	MEDIUM	**Not completed**	Retain in 2024 Plan
BRUSHFIRE MITIGATION			
13) Acquire ATVs to fight remote brush fires	HIGH	**Partially completed** – The Town applied for grants to acquire an ATV	Retain in 2024 Plan

Table 50 Status of Mitigation Recommendations from the 2018 Plan

Mitigation Measure	Priority in 2018 Plan / Description	CURRENT STATUS 1. Completed 2. Partially Completed (Describe) 3. Not Completed (Reasons/Constraints?)	2024 PLAN UPDATE 1. Retain as-is in the 2024 Plan? 2. Keep and Revise for 2024 Plan? 3. Change Priority for 2024 Plan? 4. Delete from the 2024 Plan?
14) Cart Path Restoration	HIGH	**Partially completed** – The Town upgraded Oak Grove	Retain in 2024 Plan
15) Water Main Installation Causeway Street to Boggastowe Meadow	LOW	**Not completed**	Retain in 2024 Plan
16) Adopt a 75-foot required setback regulation for new development	MEDIUM	**Not completed;** the town has reevaluated this and finds it is not a useful measure for Millis.	Delete for 2024 Plan
17) Public Education on Fire Prevention	HIGH	**Completed;** ongoing activities for public education	Delete for 2024 - completed
EARTHQUAKE MITIGATION			
18) Evaluation of municipal assets; Investigate earthquake and landslide resilience of two water towers, communication towers, Town Hall. Backup in the event it breaks down	LOW.	**Not completed**	Retain in 2024 Plan
19) Earthquake-proof the drinking water supply infrastructure; Raise the booster station at Walnut Street to aboveground	LOW	**Partially completed** – The Town acquired land for water treatment upgrades for PFAS	Retain in 2024 Plan

Table 50 Status of Mitigation Recommendations from the 2018 Plan

Mitigation Measure	Priority in 2018 Plan / Description	CURRENT STATUS 1. Completed 2. Partially Completed (Describe) 3. Not Completed (Reasons/Constraints?)	2024 PLAN UPDATE 1. Retain as-is in the 2024 Plan? 2. Keep and Revise for 2024 Plan? 3. Change Priority for 2024 Plan? 4. Delete from the 2024 Plan?
EXTREME TEMPERATURE MITIGATION			
20) Investigate cooling and warming centers, upgrades to serve the community. Install generators.	MEDIUM	**Partially completed:** The Town installed generators at Clyde Brown Elementary school and at the water tanks; upgraded generator at Town Hall but that needs to be replaced.	Retain in 2024 Plan
21) Public education on cooling centers and warming centers.	HIGH	**Not completed**	Retain in 2024 Plan
22) Site Design to increase tree plantings near buildings, increase the percentage of trees used in parking areas, and along public ways.	MEDIUM	**Not completed**	Retain in 2024 Plan
DROUGHT MITIGATION			
23) Investigate separate metering for outdoor watering	MEDIUM	**Completed** for the Drought Plan, will be approved at November 2024 vote on Town Charger	Delete for 2024 - completed
WIND MITIGATION MEASURES			
24) Institute tree trimming program and collaborate with utilities.	MEDIUM	**Partially Completed:** Town Meeting approved $50,000 per year for enhanced tree trimming; Town collaborates with electric utility, Eversource	Retain in 2024 Plan - continue to support annual program

Table 50 Status of Mitigation Recommendations from the 2018 Plan

Mitigation Measure	Priority in 2018 Plan / Description	CURRENT STATUS 1. Completed 2. Partially Completed (Describe) 3. Not Completed (Reasons/Constraints?)	2024 PLAN UPDATE 1. Retain as-is in the 2024 Plan? 2. Keep and Revise for 2024 Plan? 3. Change Priority for 2024 Plan? 4. Delete from the 2024 Plan?
MULTIHAZARD MITIGATION			
25) Emergency Communication for intra-operability especially with Police, Fire, and DPW. Upgrading from copper to fiber for radio repeaters, upgraded from analog to digital	MEDIUM	**Partially Completed:** The Town converted to fiber communications and is planning to add a new antenna	Retain in 2024 Plan
CLIMATE RESILIENCE/ADAPTATION			
26) Implement Municipal Vulnerability Preparedness plan	HIGH	**Partially completed**	Retain in 2024 Plan

SECTION 8: HAZARD MITIGATION STRATEGY

WHAT IS HAZARD MITIGATION?

Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, education programs, infrastructure projects and other activities. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation program (PDM), and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.
http://www.fema.gov/government/grant/hmgp/index.shtm
http://www.fema.gov/government/grant/fma/index.shtm

Hazard Mitigation Measures can generally be sorted into the following groups:

- Prevention: Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.
- Property Protection: Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter resistant glass.
- Public Education & Awareness: Actions to inform and educate citizens, elected officials, and property owners about the potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- Natural Resource Protection: Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- Structural Projects: Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (e.g., culverts), floodwalls, seawalls, retaining walls, and safe rooms.
- Emergency Services Protection: Actions that will protect emergency services before, during, and immediately after an occurrence. Examples of these actions include protection of warning system capability, protection of critical facilities, and protection of emergency response infrastructure.
(Source: *FEMA Local Multi-Hazard Mitigation Planning Guidance*)

IDENTIFICATION OF RECOMMENDED MITIGATION MEASURES

During the local hazard team meetings, officials in Millis determined possible mitigation measures for the various natural hazards that have impacted or could impact the town. In addition, MAPC solicited suggestions for mitigation measures when it collected hazard information from town officials and from other town plans and studies. MAPC compiled all suggested potential mitigation measures for the Local Hazard Mitigation to consider as part of the Towns recommended mitigation strategy for this 2024 updated plan. The mitigation recommendations were developed with the Local Team considering factors such as regional and inter-community issues, regional partners and facilities, and new development and infrastructure. Based on those considerations and the prioritization of mitigation measures described below, the Local Team endorsed the mitigation measures summarized in the recommended mitigation strategy shown in Table 51.

Introduction to Potential Mitigation Measures (Table 52)

Description of the Mitigation Measure – The description of each mitigation measure is brief and cost information is given only if cost data were already available from the community. The cost data represent a point in time and would need to be adjusted for inflation and for any changes or refinements in the design of a particular mitigation measure.

Priority – As described above, the designation of high, medium, or low priority was done considering the geographic area addressed, an estimate of potential benefits and estimated project costs.

Implementation Responsibility – The designation of implementation responsibility was done based on a general knowledge of what each municipal department is responsible for. It is likely that most mitigation measures will require that several departments work together and assigning staff is the sole responsibility of the governing body of each community.

Time Frame – The time frame was based on a combination of the priority for that measure, the complexity of the measure and whether or not the measure is conceptual, in design, or already designed and awaiting funding. Because the time frame for this plan is five years, the timing for all mitigation measures has been kept within this framework. The identification of a likely time frame is not meant to constrain a community from taking advantage of funding opportunities as they arise.

Potential Funding Sources – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated or designed, or if it is still in the conceptual stages. MEMA and DCR assisted MAPC in reviewing the potential eligibility for hazard mitigation funding. Each grant program and agency has specific eligibility requirements that would need to be taken into consideration. In most instances, the measure will require a number of different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for, or selected for funding. Upon adoption of this plan, the local team responsible for its implementation should begin to explore the funding sources in more detail.

Additional information on funding sources – The best way to determine eligibility for a particular funding source is to review the project with a staff person at the funding agency. The following websites provide an overview of programs and funding sources.

Army Corps of Engineers (ACOE) – The website for the North Atlantic district office is http://www.nae.usace.army.mil/. The ACOE provides assistance in a number of types of projects including shoreline/streambank protection, flood damage reduction, flood plain management services and planning services.

Massachusetts Emergency Management Agency (MEMA) – The grants page h has a useful table that compares eligible projects for the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program http://www.mass.gov/dem/programs/mitigate/grants.htm

Abbreviations Used in Table 52

FEMA Mitigation Grants includes:
- FMA = Flood Mitigation Assistance Program.
- HMGP = Hazard Mitigation Grant Program.
- PDM = Pre-Disaster Mitigation Program

ACOE = Army Corps of Engineers.
DHS/EOPS = Department of Homeland Security/Emergency Operations
DEP (SRF) = Department of Environmental Protection (State Revolving Fund)
USDA = United States Department of Agriculture
Mass DOT = Massachusetts Department of Transportation
DCR = MA Department of Conservation and Recreation
TOM= Town of Millis
EEA=MA Executive Office of Energy and Environmental Affairs
CPA= Community Preservation Act

SETTING PRIORITIES FOR MITIGATION MEASURES

The last step in developing the Town's mitigation strategy is to assign a level of priority to each mitigation measure so as to guide the focus of the Town's limited resources towards those actions with the greatest potential benefit. At this stage in the process, the Local Hazard Mitigation Planning Team had limited access to detailed analyses of the cost and benefits of any given mitigation measure, so prioritization is based on the local team members' understanding of existing and potential hazard impacts and an approximate sense of the costs associated with pursuing any given mitigation measure.

Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events, the extent of the area impacted, and the relation of a given mitigation measure to the Town's goals. In addition, the Local Steering Committee also took into consideration factors such as the number of homes and businesses affected, whether or not road closures occurred and what impact closures had on delivery of emergency

services and the local economy, anticipated project costs, whether any environmental constraints existed, and whether the Town would be able to justify the costs relative to the anticipated benefits.

The following factors regarding each recommended mitigation measure shown in Table 51 were considered in setting the priorities of the recommended mitigation strategies shown in Table xx: geographic extent of the mitigation measure, its estimated benefits and estimated cost. These were evaluated according to the following criteria:

Table 51 Criteria for Prioritizing Recommended Mitigation Measures

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event
Estimated Costs	
High	Estimated costs greater than $100,000
Medium	Estimated costs between $10,000 to $100,000
Low	Estimated costs less than $10,000 and/or staff time
Priority	
High	Action very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure
Medium	Action may have political and public support and necessary maintenance has potential to occur following the project
Low	Not clear if action has political and public support and not certain that necessary maintenance can occur following the project

Table 52 Recommended Mitigation Measures for Millis Hazard Mitigation Strategy

Mitigation Measure	Priority	Lead Implementation	Time Frame (2024-2029)	Estimated Cost	Potential Funding
FLOOD RELATED HAZARDS					
1. Farm and Pleasant Street - implement Beaver Control measures	Medium	DPW	2024-2029	<$10,000	CMRP, DCR, NCMCP, Town of Millis General Fund
2. Dover Road Mitigation - Repair culvert under route 109; levy on the abutting Maple Swamp.	High	DPW	2024-2025	$250,000	BRIC, CMRP, DCR, NCMCP, Town of Millis General Fund
3. Dover Rd. Mitigation – install floodgate on the upstream dam	High	DPW	2024-2026	$250,000	BRIC, CMRP, NCMCP, Town of Millis General Fund
4. Protection of Open Space: acquire key properties that can help reduce runoff by absorbing or recharging stormwater.	Medium	Conservation Commission Community Preservation Commission	2024-2029	TBD	CPA, EEA, Private
5. Update Open Space and Recreation Plan: next renewal due in 2026	High	Conservation Commission	2025-2026	$30,000	Town of Millis General Fund, EOEA, MAPC
6. Implement drainage improvements/detention basin on Village Street and Birch Street	High	DPW	2024-2025	$150,000	BRIC, CMRP, EOT, NCMCP, Town of Millis General Fund

Table 52 Recommended Mitigation Measures for Millis Hazard Mitigation Strategy

Mitigation Measure	Priority	Lead Implementation	Time Frame (2024-2029)	Estimated Cost	Potential Funding
7. Island Road-Road elevation and Culvert Enlargement and address beaver concerns	High	DPW	2025-26	$50,000	BRID, CMRP, Town of Millis General Fund
8. Larch Road culvert enlargement – Monitor performance of recent drainage upgrades	Low	DPW	2024-2029	$50,000	BRIC, CMRP, Town of Millis General Fund
WINTER STORM RELATED HAZARDS (ICE STORMS, BLIZZARDS, HEAVY SNOW)					
9. Increase the size of the salt shed.	Medium	DPW	2027-28	$350,000	Town of Millis General Fund
10. Evaluate public buildings to withstand snow loads.	Medium	DPW	2026-27	$35,000-$50,000	Town of Millis General Fund
BRUSHFIRE HAZARDS					
11. Continue Cart Path Restoration (Oak Grove was upgraded; funding obtained for finishing trails work)	High	DPW, Fire Dept.	2024-2029	$25,000	Town of Millis General Fund
12. Install water mains from Causeway Street to Boggastowe Meadow.	Low	DPW, Fire Dept.	2027-2029	$2 million	DEP, Town of Millis General Fund
13. Acquire ATVs to fight remote brush fires (grant applied for)	High	Fire Department, Town Meeting	2024-2025	$25,000	Town of Millis General Fund

Table 52 Recommended Mitigation Measures for Millis Hazard Mitigation Strategy

Mitigation Measure	Priority	Lead Implementation	Time Frame (2024-2029)	Estimated Cost	Potential Funding
GEOLOGIC HAZARDS (EARTHQUAKES/LANDSLIDES)					
14. Evaluate municipal assets vulnerability to earthquakes and landslides: Assess resilience of water towers, communication towers, Town Hall. Investigate backup in case of break down.	Low	Building Department/Engineering	2026-2027	$35,000-$50,000	Town of Millis General Fund
15. Earthquake-proof the drinking water supply infrastructure. Raise the booster station at Walnut Street to aboveground	Low	DPW	2024-2029	$500,000	BRIC, DEP, Town of Millis General Fund
EXTREME TEMPERATURES					
16. Investigate cooling and warming centers. Install new generator in Town Hall.	Medium	LEPC	2024-2025	$75,000	BRIC, Town of Millis General Fund
17. Public education on cooling centers and warming centers.	High	LEPC	2024-2029	Staff Time	Town of Millis General Fund
18. Adopt Site Design standards to increase tree plantings near buildings, increase the percentage of trees in parking areas, and along public ways.	Medium	Planning Department	2024-2029	Staff Time	Town of Millis General Fund

Table 52 Recommended Mitigation Measures for Millis Hazard Mitigation Strategy

Mitigation Measure	Priority	Lead Implementation	Time Frame (2024-2029)	Estimated Cost	Potential Funding
DROUGHT RELATED HAZARDS					
19. Implement reduced outdoor watering bylaw under the Town's Water Management Act Permit.	Medium	DPW	2024-25	Staff Time	Town of Millis General Fund
WIND RELATED HAZARDS (TORNADOS, HURRICANES, NOR'EASTERS)					
20. Continue funding Town tree trimming program and collaborate with Eversource.	Medium	DPW, Tree Warden, Board of Selectmen	2024-2029	$25,000-$35,000	Town of Millis General Fund
MULTI-HAZARDS					
21. Upgrade Emergency Communication for intra-operability especially with Police, Fire, and DPW: install a new antenna.	High	DPW	2024-2025	$100,000-$150,000	HMS, Town of Millis General Fund
CLIMATE CHANGE					
22. Implement the Municipal Vulnerability Preparedness plan	High	Energy Manager	2024-2029	TBD	MVP Action Grants, Town of Millis General Fund,

NEW DEVELOPMENT AND INFRASTRUCTURE

As part of the process of developing recommendations for new mitigation measures for this plan update, the Town considered the issues related to new development, redevelopment, and infrastructure needs in order limit future risks. Taking into consideration the town's stormwater requirements town-wide, the Wetlands Bylaw enforced by the Conservation Commission, the Comprehensive Emergency Management Plan, and the Master Plan, the town determined that existing regulatory measures are taking good advantage of local Home Rule land use regulatory authority to minimize natural hazard impacts of development. Priorities for the future include further regulatory changes and public education efforts toward ensuring that future development occurs in a sustainable manner. Open Space purchases and drainage/stormwater infrastructure upgrades are also priorities in this plan.

REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

Some hazard mitigation issues are strictly local where hazards originate primarily within the municipality and are solved at the municipal level. Other issues are inter-community and require cooperation between two or more municipalities. There is a third level of mitigation which is regional and may involve a state, regional or federal agency or three or more municipalities.

Regional Partners

In densely developed urban communities such as the metropolitan Boston area, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are complex systems of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including the Town, the Department of Conservation and Recreation (DCR), the Charles River Pollution District, and Massachusetts Department of Transportation (MassDOT). The planning, construction, operation and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the communities' regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and they must make decisions about numerous competing priorities. Following, is a brief overview of regional facilities found in Millis and a discussion of inter-municipal issues.

Overview of Regional Facilities within Millis

Major facilities owned, operated and maintained by state or regional entities include:

- Interstate I-495 (Mass Highways)
- State roads Routes 109 and 115 (Mass Highways)
- Charles River (MA DCR, Charles River Watershed Association)
- Major power utility lines, power plants, and substations
- Charles River Pollution Control District, a regional wastewater treatment facility servicing Medway, Millis, Franklin, and Bellingham

Inter-Community Considerations

Mitigation measures for the following regional issues should be taken into account as Millis develops its own local plan:

A) Coordinate and Review Developments on a Regional Basis

As Millis and the surrounding communities are undergoing development, it is vital that these communities communicate and provide input during the review processes. When addressing housing, transportation, and economic development projects, the impacts to neighbors must be addressed. Priority development areas established with the 495 Metro West Partnership is a good example of inter-community coordination.

B) Long-Term Regional Management Plan To Control Beaver Activity

One regional issue of significance is the widespread effects of beaver dams in the area. Most streams, wetland areas, and ponds in the region have had some degree of beaver activity in the past several years. Much of the localized flooding that occurs is due to beaver activity. The towns will mitigate the problem temporarily by hiring trappers, removing dams, or installing pipes, but a long-term comprehensive approach should be considered.

C) Stormwater Management within and along the Charles River Watershed

Millis lies along the Charles River and is one of the municipalities serviced by the Charles River Pollution Control District. Collaboration and cooperation on stormwater with the Towns of Millis, Bellingham, and Franklin, will minimize potential infrastructure capacity challenges during extreme precipitation events, minimize localized flooding, and enhance the water quality of the Charles River.

D) Dam Conditions and Emergency Plans Upstream of the Town of Millis

Dams in upstream communities are frequently of concern to downstream communities. In the case of Millis, the dams along the Charles River upstream such as the Sanford Mill Pond in Medway, a significant concern dam could be a concern, particularly since it is privately owned and likely designed to historic precipitation and flooding events. The communities should continue to coordinate with each other to address concerns of dam conditions and emergency response plans in the event of a hazardous storm event.

PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION AND APPROVAL

The Millis Hazard Mitigation Plan 2024 Update was adopted by the Select Board on [*ADD DATE*]. See Appendix D for documentation of plan adoption. The plan was approved by FEMA on [*ADD DATE*] for a five-year period that will expire on [*ADD DATE*].

PLAN MAINTENANCE

Although several of the mitigation measures from the Town's previous Hazard Mitigation Plan have been implemented, since that plan was adopted there has not been an ongoing local process to guide implementation of the plan. Such a process is needed over the next five years for the implementation of this plan update, and will be structured as described below.

MAPC worked with the Millis Local Planning Team to prepare this plan. After approval of the plan by FEMA, this group will meet to function as the Hazard Mitigation Implementation Team, with the Director of Public Works designated as the coordinator. Additional members could be added to the local implementation team from businesses, non-profits and institutions. The Town will encourage public participation during the next 5-year planning cycle. In addition, mitigation recommendations and submitted public comments for this plan will be incorporated into the Town's Municipal Vulnerability Preparedness program workshop and plan, as well as the ongoing implementation and evaluation of this plan as described below. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with town and state open meeting laws.

IMPLEMENTATION AND EVALUATION SCHEDULE

Mid-Term Survey on Progress– The coordinator of the Hazard Mitigation Implementation Team will prepare and distribute a survey in year three of the plan. The survey will be distributed to all of the local implementation group members and other interested local stakeholders. The survey will poll the members on any changes or revisions to the plan that may be needed, progress and accomplishments for implementation, and any new hazards or problem areas that have been identified.

This information will be used to prepare a report or addendum to the local hazard mitigation plan in order to evaluate its effectiveness in meeting the plan's goals and identify areas that need to be updated in the next plan. The Hazard Mitigation Implementation Team, coordinated by the Fire Chief, will have primary responsibility for tracking progress, evaluating, and updating the plan.

Begin to Prepare for the next Plan Update -- FEMA's approval of this plan is valid for five years, by which time an updated plan must be approved by FEMA in order to maintain the town's approved plan status and its eligibility for FEMA mitigation grants. Given the lead time needed to secure funding and conduct the planning process, the Hazard Mitigation Implementation Team will begin to prepare for an update of the plan in year three. This will help the Town avoid a lapse in its approved plan status and grant eligibility when the current plan expires.

The Hazard Mitigation Implementation Team will use the information from the Mid-Term progress review to identify the needs and priorities for the plan update and seek funding for the plan update process. Potential sources of funding may include FEMA Pre-Disaster Mitigation grants and the Hazard Mitigation

Grant Program. Both grant programs can pay for 75% of a planning project, with a 25% local cost share required.

Prepare and Adopt an Updated Local Hazard Mitigation Plan –Once the resources have been secured to update the plan, the Hazard Mitigation Implementation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the group will need to review the current FEMA hazard mitigation plan guidelines for any changes. The Millis Hazard Mitigation Plan Update will be forwarded to MEMA and DCR for review and to FEMA for approval.

INTEGRATION WITH OTHER LCOAL PLANS AND POLICIES

Upon approval of the Millis Hazard Mitigation Plan 2018 Update by FEMA, the Local Hazard Mitigation Team 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. The plan will be reviewed and discussed with the following departments. During updates of any Town department's plans or policies, the relevant portions of this mitigation strategy will be incorporated.

- Fire Department
- Emergency Management
- Police Department
- Public Works Department
- Energy Committee
- Engineering
- Planning and Community Development
- Conservation Commission
- Parks and Recreation
- Public Health
- Building
- Land use

Other groups that will be coordinated with include community based organizations, local businesses, land conservation organizations, watershed groups, and service providers for vulnerable populations. The plans will also be posted on a community's website with the caveat that local team coordinator will review the plan for sensitive information that would be inappropriate for public posting. The posting of the plan on a web site will include a mechanism for citizen feedback such as an e-mail address to send comments.

The Hazard Mitigation Plan will be integrated into other town plans and policies as they are updated and renewed, including the Millis Master Plan, Open Space Plan, which is due for renewal in 2026, Municipal Vulnerability Preparedness Plan, Comprehensive Emergency Management Plan, and Capital Investment Program.

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APPENDIX A: HAZARD MAPPING

The MAPC GIS (Geographic Information Systems) Lab produced a series of maps for each community. Some of the data came from the Northeast States Emergency Consortium (NESEC). More information on NESEC can be found at http://www.serve.com/NESEC/. Due to the various sources for the data and varying levels of accuracy, the identification of an area as being in one of the hazard categories must be considered as a general classification that should always be supplemented with more local knowledge.

The map series consists of eight maps as described below. The maps in this appendix are necessarily reduced scale versions for general reference. Full sized higher resolution PDF's of the maps can be downloaded from the MAPC File Transfer Protocol (FTP) website at: ftp://ftp.mapc.org/Hazard_Mitigation_Plans/maps/Millis/

Map 1.	Population Density
Map 2.	Potential Development
Map 3.	Flood Zones
Map 4.	Earthquakes and Landslides
Map 5.	Hurricanes and Tornadoes
Map 6.	Average Snowfall
Map 7.	Composite Natural Hazards
Map 8.	Hazard Areas
Map 9	Areas of Extreme Heat

Map1: Population Density – This map uses the US Census block data for 2010 and shows population density as the number of people per acre in seven categories with 60 or more people per acre representing the highest density areas.

Map 2: Land Use – This map depicts existing land use, based on the MacConnell Land Use map series from University of Massachusetts, available from MassGIS . The map displays 33 categories of land use based on interpretation of aerial photos. For more information on how the land use statistics were developed and the definitions of the categories, please go to http://www.mass.gov/mgis/lus.htm

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones as depicted on the FIRMs (Federal Insurance Rate Maps) for Norfolk County dated July 17, 2012 as its source. This map is not intended for use in determining whether or not a specific property is located within a FEMA NFIP flood zone. The currently adopted FIRMS for Millis are kept by the Town. For more information, refer to the FEMA Map Service Center website http://www.msc.fema.gov. The definitions of the flood zones are described in detail on this site as well. The flood zone map for each community also shows critical infrastructure and repetitive loss areas.

Map 4: Earthquakes and Landslides – This information came from NESEC. For most communities, there was no data for earthquakes because only the epicenters of an earthquake are mapped.

The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in nature. For more information on how landslide susceptibility was mapped, refer to http://pubs.usgs.gov/pp/p1183/pp1183.html.

Map 5: Hurricanes and Tornadoes – This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms, if any occurred in this community. This information must be viewed in context. A storm track only shows where the eye of the storm passed through. In most cases, the effects of the wind and rain from these storms were felt in other communities even if the track was not within that community.

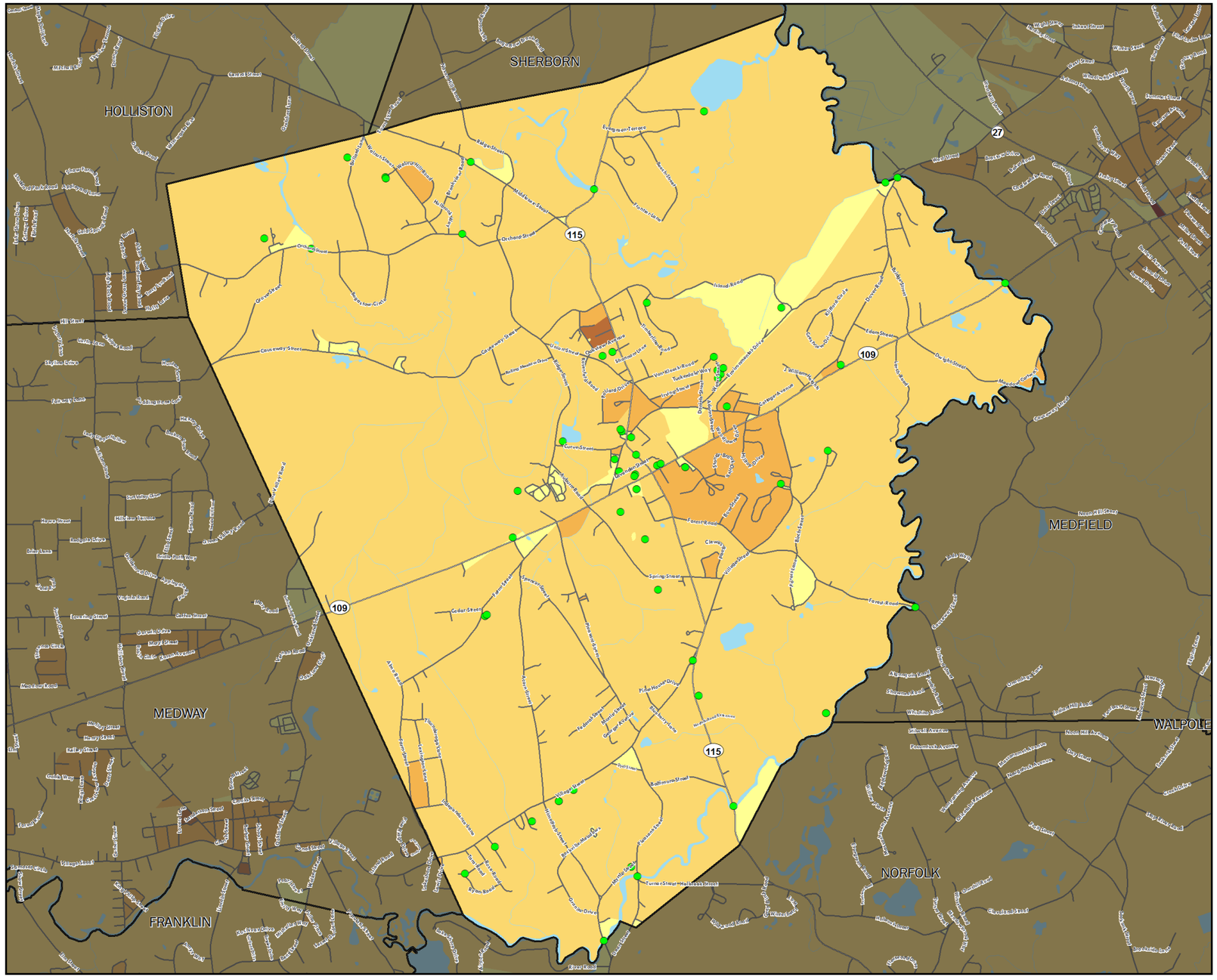
This map also shows the location of tornadoes with a classification as to the level of damages. What appears on the map varies by community since not all communities experience the same wind-related events. These maps also show the 100 year wind speed.

Map 6: Average Snowfall - - This map shows the average snowfall. It also shows storm tracks for nor'easters, if any storms tracked through the community.

Map 7: Composite Natural Hazards - This map shows four categories of composite natural hazards for areas of existing development. The hazards included in this map are 100 year wind speeds of 110 mph or higher, low and moderate landslide risk, FEMA Q3 flood zones (100 year and 500 year) and hurricane surge inundation areas. Areas with only one hazard were considered to be low hazard areas. Moderate areas have two of the hazards present. High hazard areas have three hazards present and severe hazard areas have four hazards present.

Map 8: Hazard Areas – For each community, locally identified hazard areas are overlaid on an aerial photograph dated April, 2009. The source of the aerial photograph is Mass GIS. This map also shows potential future developments, and critical infrastructure sites. MAPC consulted with town staff to determine areas that were likely to be developed or redeveloped in the future.

Map 9: Extreme Heat- MAPC uses LANDSAT 30m spatial resolution satellite data to extract land surface temperature to assess a community's exposure to present-day extreme heat and any vulnerabilities to rising temperatures with climate change. The extreme heat analysis uses date from 2016 with satellite images on days of 90° or higher at Logan Airport, July 13 and August 30, 2016 and created land surface temperature using a methodology development by Walawender, Hajto, and Iwaniuk (2012) called Landsat TRS Tools. This map illustrates the hottest areas in the top fifth percentile for the 101 towns in Metropolitan Boston.



FEMA Hazard
Mitigation Planning Grant

MILLIS, MA

Map 1: Population Density

Sites
- Critical Infrastructure Sites*

* See details in separate table

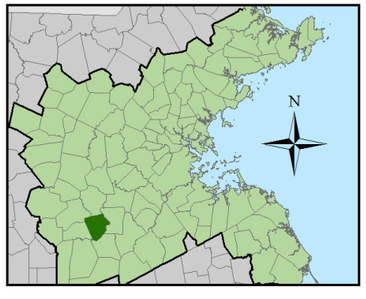
Water Bodies

Population Density
2010 Census Blocks
People Per Acre
- 0 or No Data
- 0.1 - 5.0
- 5.1 - 15.0
- 15.1 - 30.0
- More than 30

- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

0 0.25 0.5 Miles



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Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
MILLIS, MA

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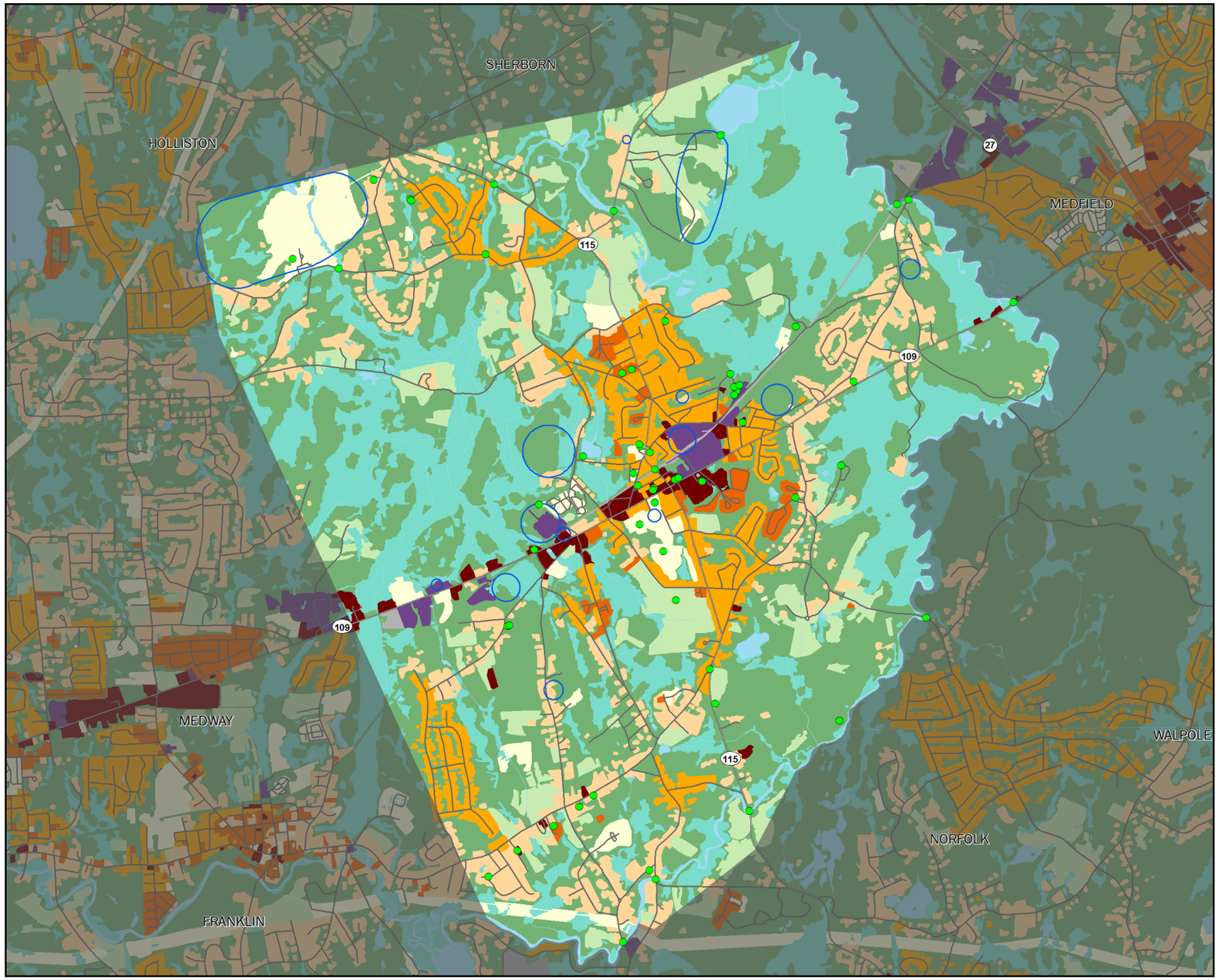


FEMA Hazard Mitigation Planning Grant

MILLIS, MA

Map 2: Land Use

Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites

* See details in separate table

Development Areas
* See details in separate table

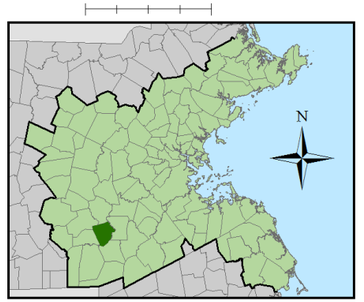
Land Use (2005)
- High Density Residential
- Medium Density Residential
- Low Density Residential
- Non-Residential Developed
- Commercial
- Industrial
- Transportation
- Agriculture
- Undeveloped
- Undeveloped Wetlands

- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

Water Bodies

0 0.25 0.5 Miles



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Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
MILLIS, MA

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TOWN OF MILLIS
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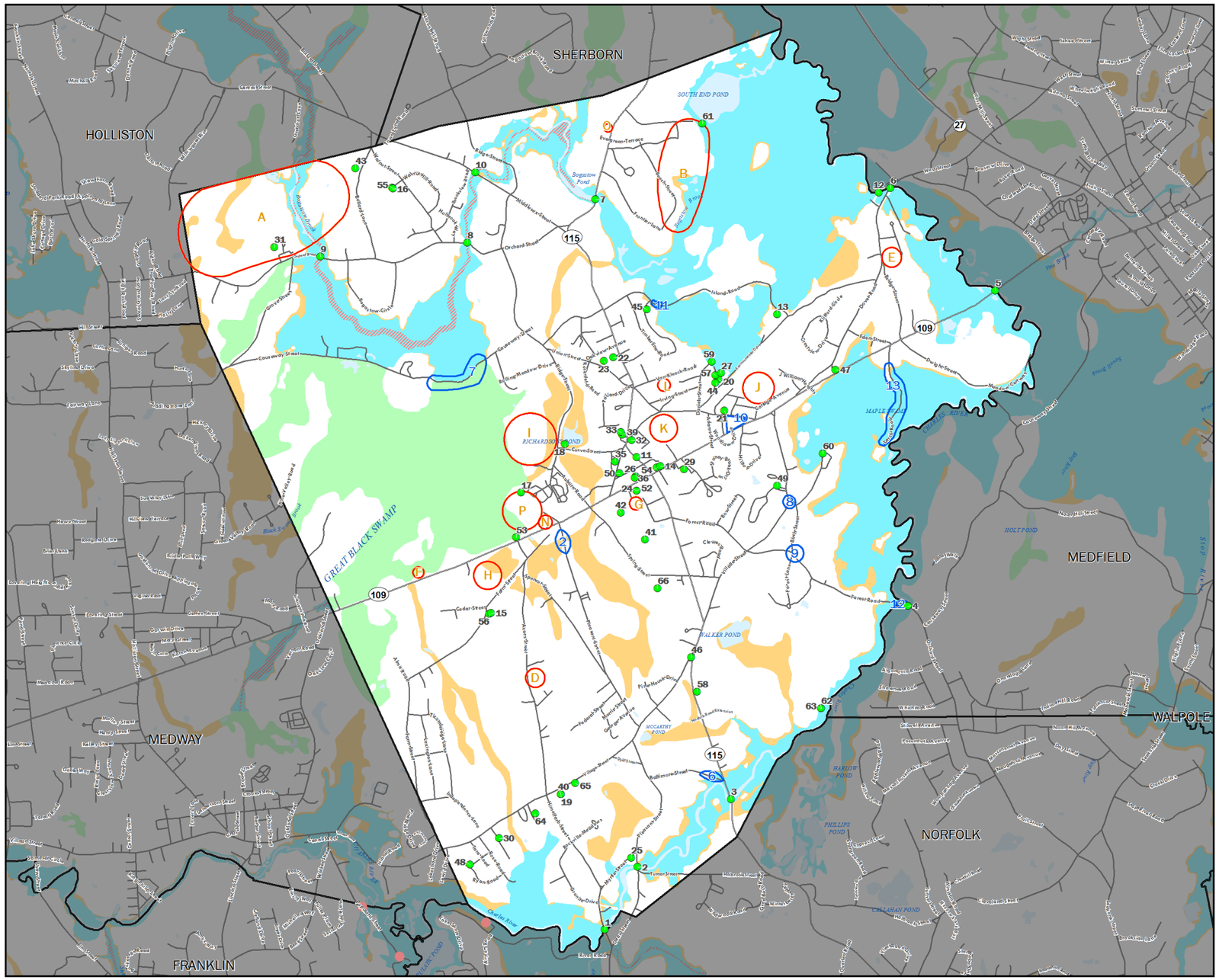

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MILLIS, MA

Map 3: Flood Zones

Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites

* See details in separate table

Water Bodies

Locally Identified Hazard Areas*
- Flooding

* See Section IV Risk Assessment

Development Areas*

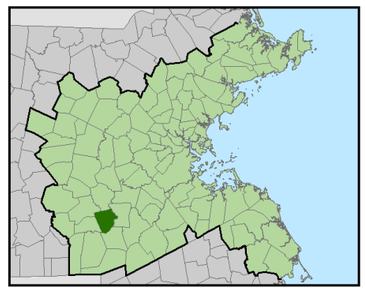
* See details in separate table

Train Stations
Commuter Rail Lines
Trains

Flood Zones, 2017 (Annual Chance)
- A: 1% Annual Chance of Flooding.
- AE: 1% Annual Chance of Flooding.
- AE: Regulatory
- X: 0.2% Annual

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

0 0.25 0.5 Mil



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Data Sources:
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Massachusetts Geographic Information System (MassGIS)

Flood Zones datalayer updated by MassGIS October 2013 from finalized data provided by Federal Emergency Management Agency (FEMA)

MILLIS, MA
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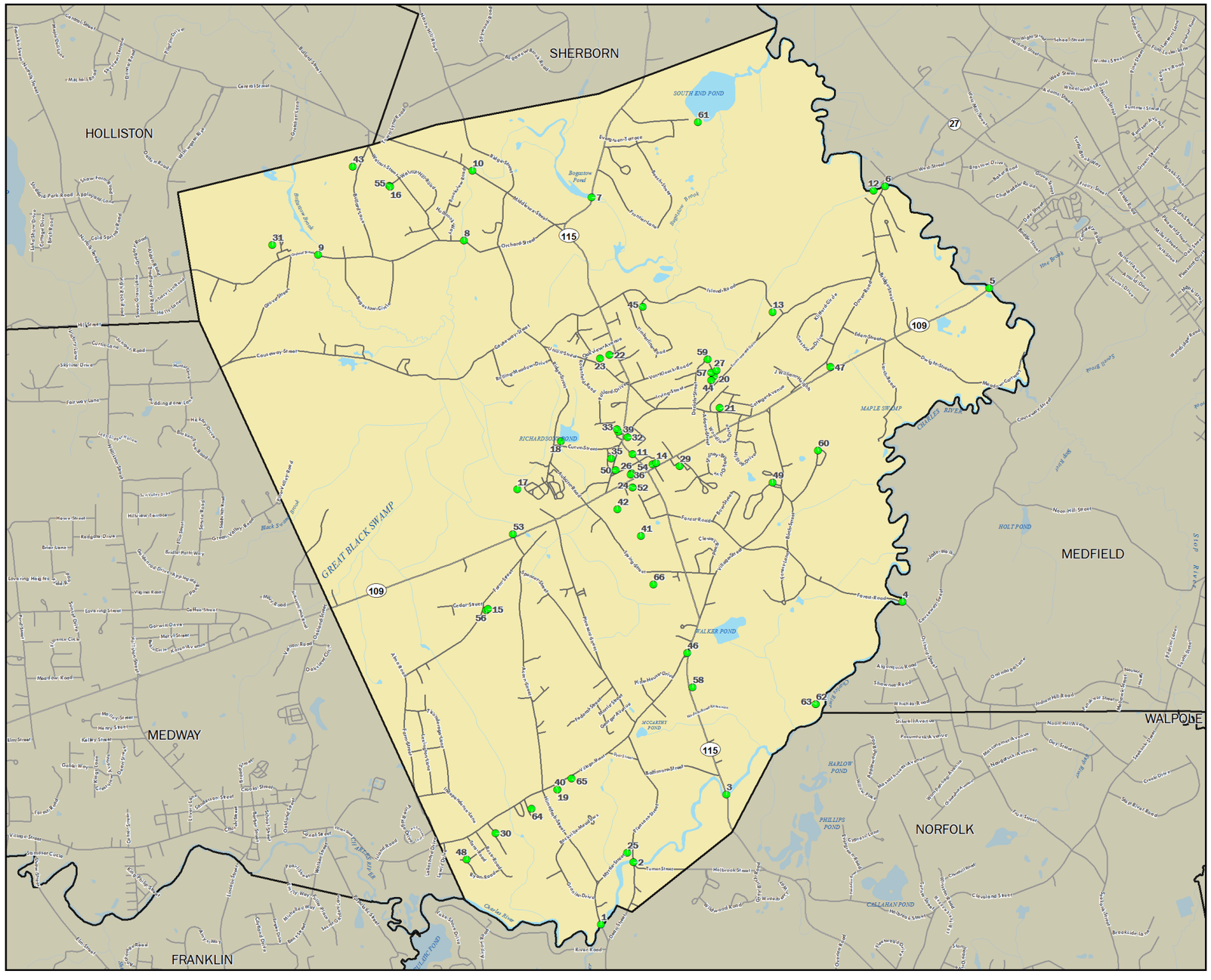

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MILLIS, MA

Map 4: Earthquakes / Landslides

Sites
- Critical Infrastructure Sites*
- Water Bodies

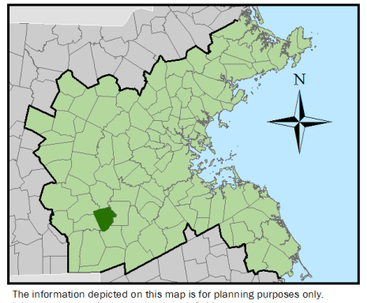
* See details in separate table

Earthquakes
- Epicenters
- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

Landslides
- High landslide incidence (greater than 15% of the area is involved in landsliding)
- High susceptibility to landsliding and moderate incidence
- High susceptibility to landsliding and low incidence
- Moderate susceptibility to landsliding and low incidence
- Low landslide incidence (less than 1.5 % of the area is involved in landsliding)

0 0.25 0.5 Miles



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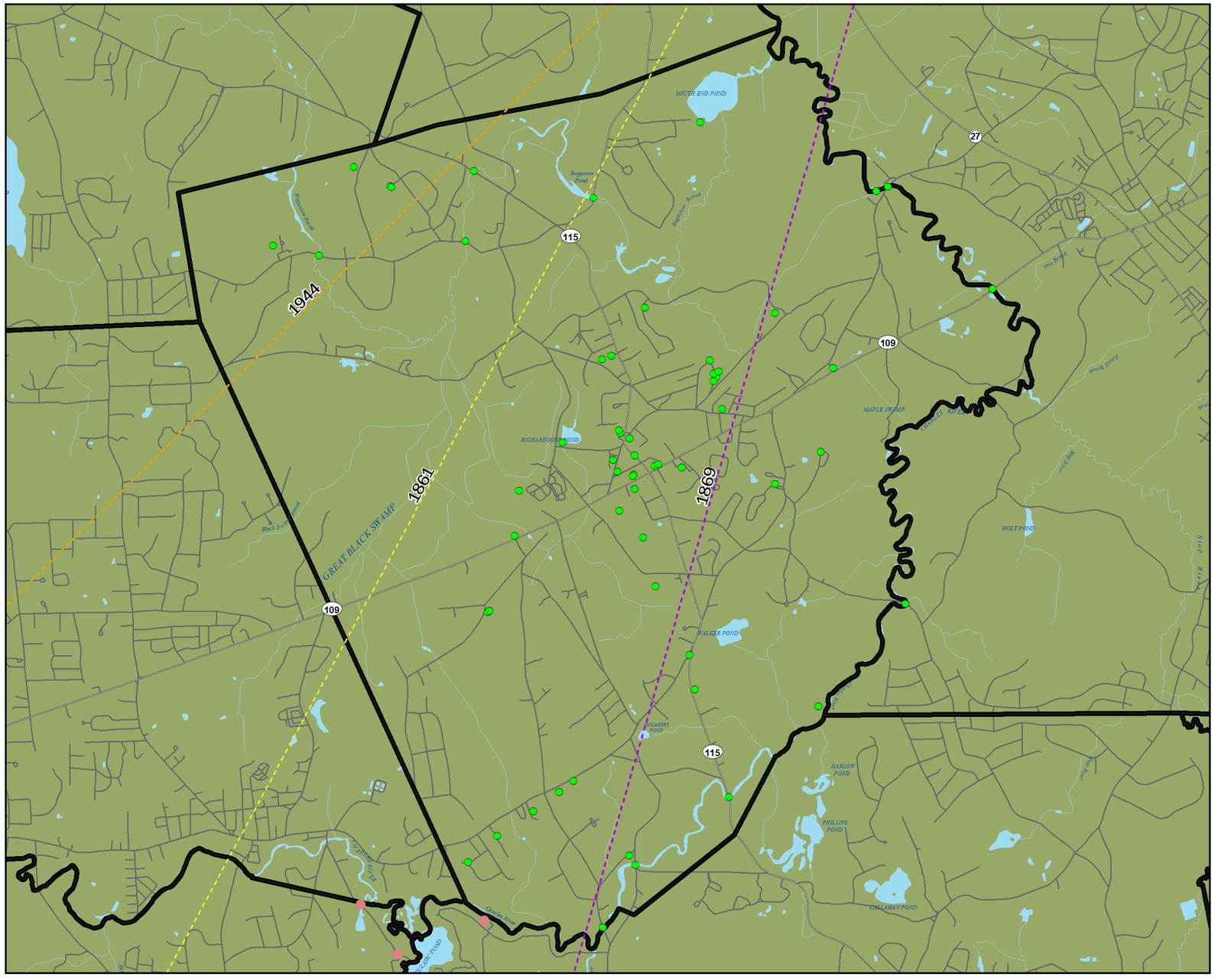

MAPC

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Mitigation Planning Grant

MILLIS, MA

Map 5: Hurricanes / Tornadoes

Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites

* See details in separate table

Tornadoes
- Tornado

Storm Tracks
- Tropical Depression
- Tropical Storm
- Category 1 Hurricane
- Category 2 Hurricane
- Category 3 Hurricane

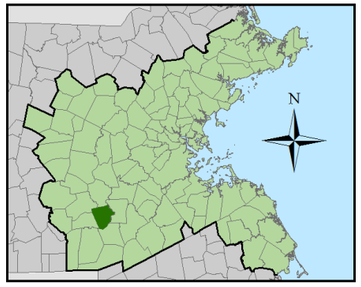
Year of storm noted on map

- Hurricane Surge Innudation Ares
- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street
- Water Bodies

100 Year Wind Speeds
Miles Per Hour
- 90 MPH
- 100 MPH
- 110 MPH
- 120 MPH
- 130 MPH

0 0.25 0.5 Miles



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Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
MILLIS, MA

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TOWN OF MILLIS
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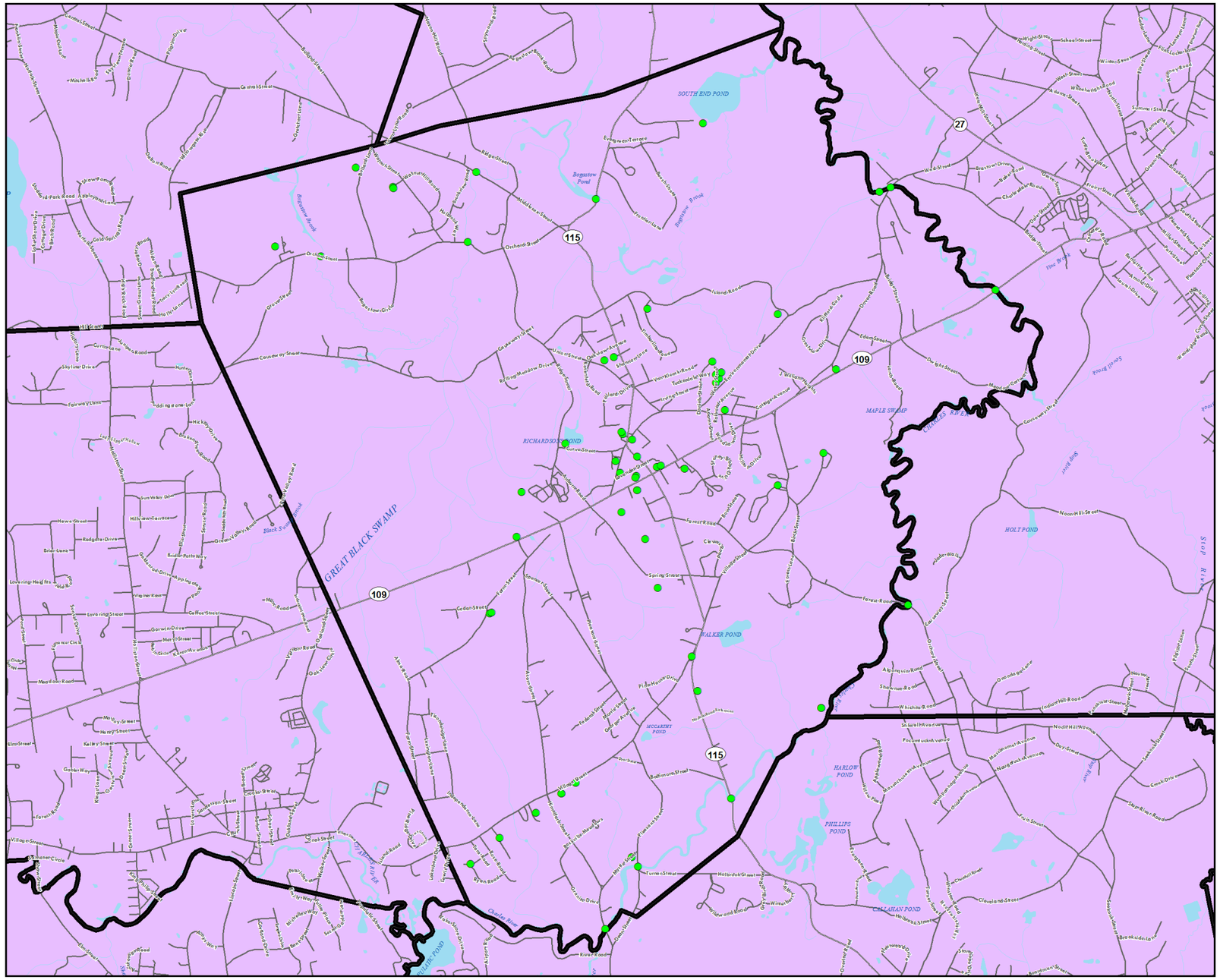

MAPC dcr

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Mitigation Planning Grant

MILLIS, MA

Map 6: Average Snowfall

Sites
- Critical Infrastructure Sites*

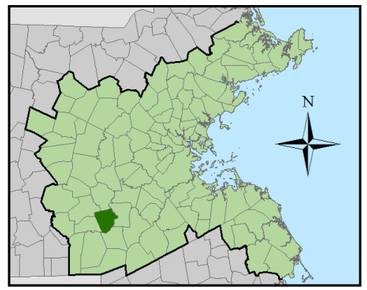
* See details in separate table

Average Annual Snowfall
- 36.1 to 48.0 inches
- 48.1 to 72.0 inches

- Water Bodies
- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

0 0.25 0.5 Miles



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

Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770

Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
MILLIS, MA

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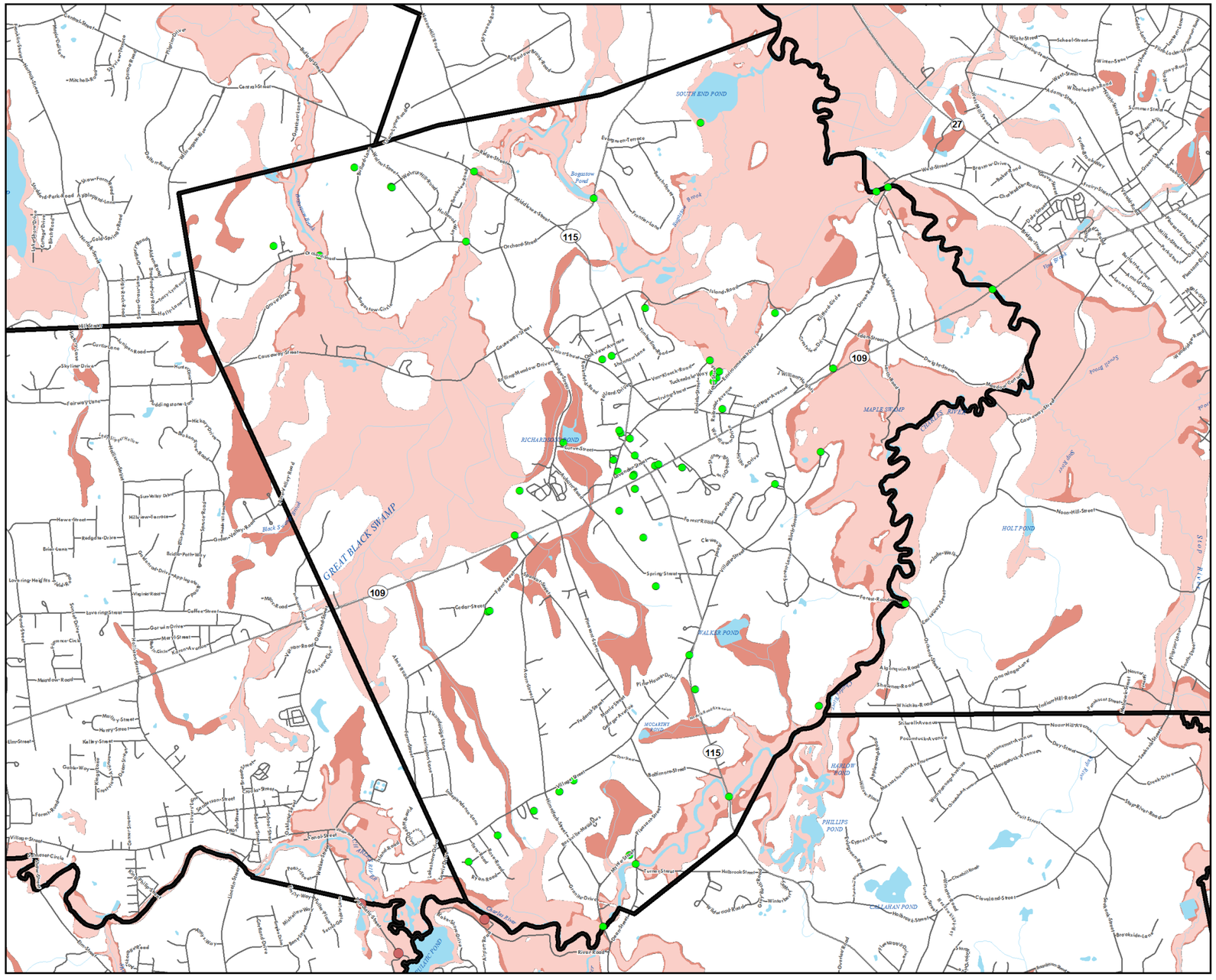
Date: 6/14/2018



MAPC

FEMA Hazard
Mitigation Planning Grant

MILLIS, MA

Map 7: Composite Natural Hazards

Composite Natural Hazards

- Low (2 Hazards)
- Moderate (3 Hazards)
- High (4 Hazards)
- Very High (5 Hazards)

Composite natural hazards shown for areas of existing development. Hazards include:

- 100 year wind speed of 110 MPH or higher
- Moderate landslide risk
- FEMA flood zones (100 year and 500 year)
- Average snowfall of 36.1" or more
- Hurricane surge innundation areas

Sites

- Critical Infrastructure Sites*
- Repetitive Loss Sites

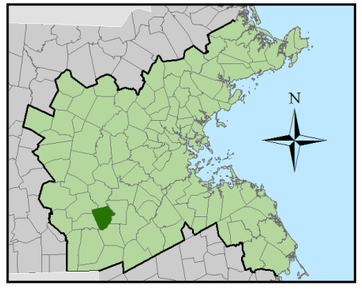
* See details in separate table

- Water Bodies

All Roads

- Interstate
- U.S. Highway
- State Route
- Street
- Train Stations
- Commuter Rail Lines
- Trains

0 0.25 0.5 Miles



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

Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770

Data Sources

Composite Natural Hazard:
Wind, Landslide Risk, Snow -Northeast States Emergency Consortium (NESEC)
Flood Zones - 2013 FEMA/MassGIS
Hurricane Surge - 2013 U.S. Army Corps of Engineers, New England District

Roads/Trains: MassDOT/ CTPS

Repetitive Loss Sites: DCR/Office of Flood Hazard Management

Critical Infrastructure: Metropolitan Area Planning Council (MAPC) / MILLIS, MA

Path: K:\DataServices\Projects\Current_Projects\PDM\project_files\PDM_Map7.mxd

Date: 6/14/2018

FEMA Hazard
Mitigation Planning Grant

MILLIS, MA

Map 8: Local Hazard Areas

Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites

* See details in separate table

Locally Identified Hazard Areas
- Brush Fires
- Flooding
- Historic

* See Section IV Risk Assessment

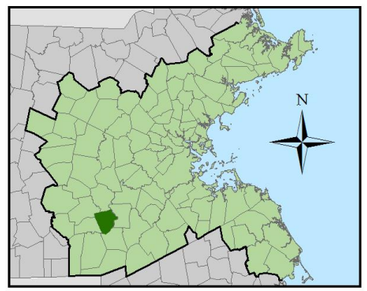
- Development Sites

* See details in separate table

- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

0 0.5 1 Miles



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Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770

Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
MILLIS, MA

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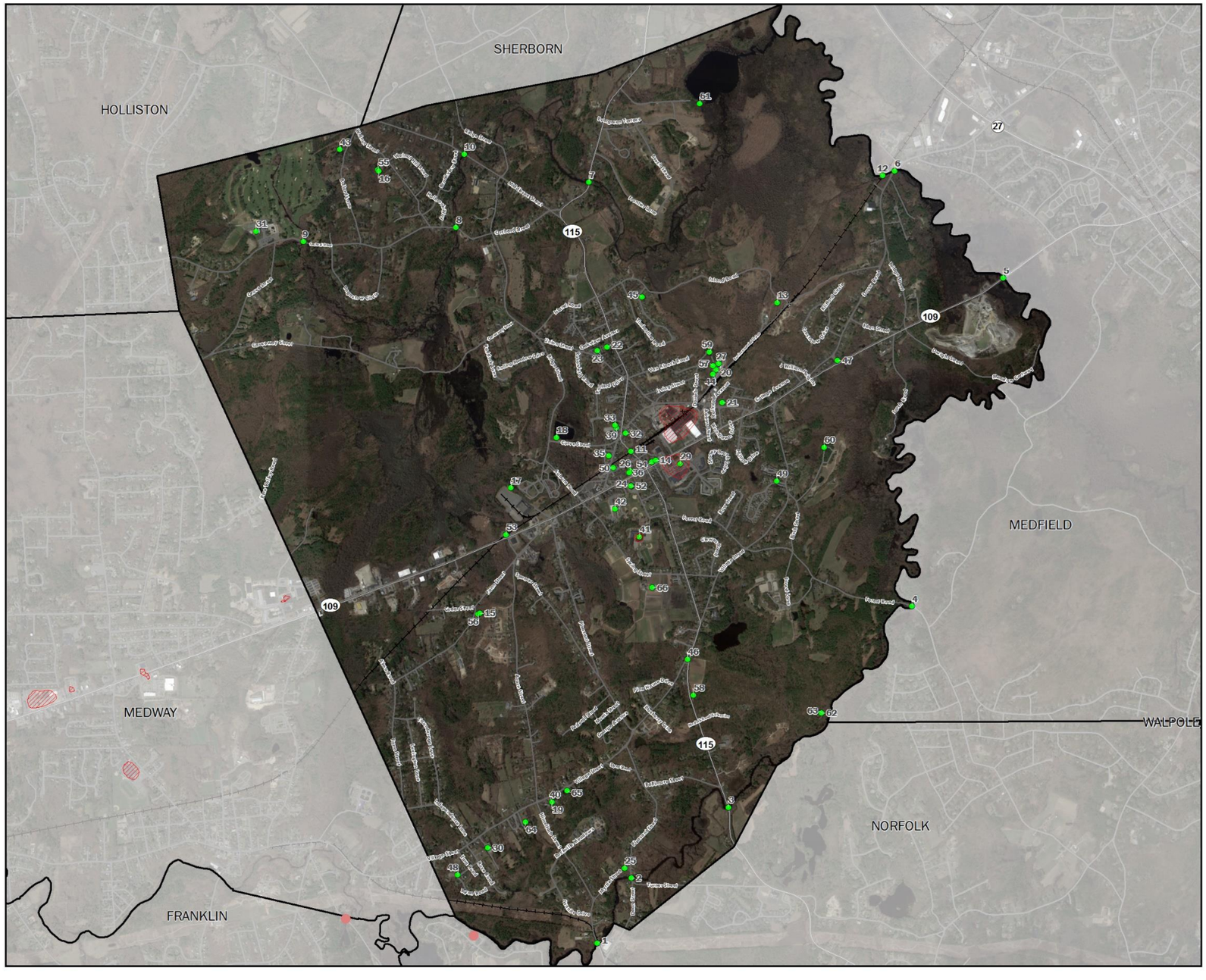
Date: 6/14/2018



MAPC dcr

FEMA Hazard
Mitigation Planning Grant

MILLIS, MA

Map 9: Areas of Extreme Heat

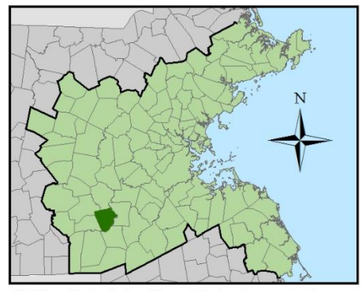
Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites
- Areas of Extreme Heat*

* See details in separate table

- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

0 0.5 1 Miles



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Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
MILLIS, MA

Path: K:\DataServices\Projects\Current_Projects\PDM\project_files\PDM_Map9.mxd

Date: 7/2/2018

TOWN OF MILLIS
DRAFT HAZARD MITIGATION PLAN 2024 UPDATE

APPENDIX B: LOCAL TEAM MEETINGS

Millis Hazard Mitigation Plan Update
Team Meeting #1

Wednesday, July 26
10:00 to 11:30 AM

Millis Fire Department
885 Main St.

With Zoom for GIS Mapping:
https://us02web.zoom.us/j/85961045879?pwd=UWQySVNMYm5xWloxVktLQXphWFB1Zz09
Meeting ID: 859 6104 5879 / Passcode: 617522

AGENDA

---

1. Welcome and Introductions

2. Review of HMP Project and Schedule (see attached timeline)

3. Getting Started: Local Data Updates from the 2018 Plan

- *We will update the following 3 types of local data from the 2016 plan (see attached worksheets):*
  1. **Local Hazard Areas** *(Flooding, Brushfire, Wind)*
  2. **Critical Facilities**
  3. **New Development sites** *(may be reviewed separately with planner)*
- *MAPC's GIS Planner will join via Zoom to map new or revised sites using the online platform Google MyMaps*

4. Next steps: Prepare for Public Meetings and Outreach

- We will hold 2 Public Meetings:
  1st public meeting during the planning process (November 2023)
  2nd public meeting at the end to present the draft plan (May 2024)
- Local team to identify local stakeholders to invite
- Team to consider meeting formats: existing town board, or standalone

APPENDIX B: LOCAL TEAM MEETINGS

Millis Hazard Mitigation Plan Update
Team Meeting #2

Monday, November 20
10:00 to 11:30 AM

Millis Fire Department
885 Main St.

AGENDA

---

1. Welcome and Project Update

2. Review and Update of Mitigation Goals for the Plan
See Mitigation Goals from the 2018 plan attached

3. Review Status of Existing Mitigation Measures
See Worksheet#4 - Existing Mitigation from the 2018 Plan attached

- Note any **Changes for 2023**
- Update with any **Improvements Needed**
- Add any **New Measures** adopted since 2018

4. Prepare for First Public Meeting

- Location (host board/commission?)
- Date (target January 2024)
- *Meeting Invitation/outreach to the community:*
  - *Identify local stakeholders to invite* (refer to MVP invitees)
  - *Community groups, businesses, NGO's, etc.*
  - Public outreach on Town website, social media, local press

APPENDIX B: LOCAL TEAM MEETINGS

Millis Hazard Mitigation Plan Update
Team Meeting #3

Wednesday, April 3, 2024
10:00 to 11:30 AM

Millis Fire Department
885 Main St.

AGENDA

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1. Welcome and Project Update

2. Review Status of Mitigation Strategies from the 2018 Plan

The Team will review the recommended mitigation measures from the 2018 plan and note those that have been implemented, are in progress, or have not been implemented.
See the attached worksheet to note the status of mitigation recommendations.

Review of Next Steps

- **Final Team Meeting – May**
  - To be Scheduled in early February 2024
  - Finalize mitigation recommendations for the 2024 plan
- **Second Public Meeting– June**
  - Presentation of the draft plan at a Selectmen's meeting
  - Draft plan to be posted online for public review period

FEMA REVIEW AND APPROVAL

- **Draft Plan submitted for MEMA & FEMA review**
  - Revisions if required, FEMA will issue "Approval Pending Adoption" notice
- **Adoption of the Final Plan by the Town**
  - Vote of adoption by the Selectmen
- **FEMA formal Letter of Plan Approval**
  - The new plan will be in effect for 5 years, until 2029
  - The Town will be eligible to apply for BRIC grants for mitigation projects

APPENDIX B: LOCAL TEAM MEETINGS

Millis Hazard Mitigation Plan Update
Team Meeting #4 (Final Meeting)

Thursday, May 9, 2024
10:00 to 11:30 AM

Millis Fire Department
885 Main Street

AGENDA

---

1. Welcome and Project Update

2. Finalize the Mitigation Strategies for 2024 Plan

- Corrections or updates to ***Worksheet #4*** (attached) from the last Team Meeting, if any
- Review the draft mitigation strategies for the 2024 plan, ***Worksheet #5***
- We will confirm the recommendations, priorities, lead agencies, timeframes, and costs

---

3. Next Steps for Millis

- **Final Public Meeting June 11 / Public Review of Draft Plan**
  - Presentation of the draft plan at the Select Board meeting June 11
  - Outreach to local stakeholders and organizations; social media; press
  - Draft plan to be posted online for public review after the meeting (June 30)
  - Team to review public comments received and decide if any edits to plan

4. FEMA Review and Approval

- **Draft Plan will be submitted for MEMA & FEMA review**
  - Revise plan if required by MEMA or FEMA comments
- **Adoption of the Final Plan by the Town**
  - FEMA will issue notice of "Approvable Pending Adoption"
  - Vote of plan adoption by the Select Board
- **FEMA formal Letter of Plan Approval**
  - The new plan will be in effect for 5 years, until 2029
  - The Town will be eligible to apply for BRIC grants for mitigation projects

APPENDIX C: PUBLIC PARTICIPATION

APPENDIX C: PUBLIC PARTICIPATION

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

CALENDAR LISTING / MEDIA ADVISORY

MILLIS HAZARD MITIGATION PLAN TO BE DISCUSSED AT JANUARY 22 PUBLIC MEETING

Who: Millis residents, business owners, institutions, and non-profit organizations, and others interested in preventing and reducing damage from natural hazards.

What: At a public meeting on Monday, January 22 at 7:15 PM, a presentation on the Millis Hazard Mitigation Plan will be given at a meeting of the Millis Select Board. The meeting will be held online via Zoom, see details below. The presentation will be given by the Metropolitan Area Planning Council, which is assisting the Town's Hazard Mitigation Team prepare the plan.

The Town of Millis is preparing an updated Hazard Mitigation Plan to document natural hazards that affect the Town, such as floods, hurricanes, droughts, and severe winter storms. The plan will recommend mitigation actions the Town can take to reduce its vulnerability to these natural hazards.

By preparing an updated Hazard Mitigation Plan, the Town of Millis will be eligible for FEMA grants to fund mitigation projects such as drainage improvements.

When: **Monday, January 22, 2024, 7:15 PM**

Where: **Millis Select Board Meeting**
Veterans Memorial Building, Room 229
900 Main Street
Millis, MA 02054

MAPC is the regional planning agency for 101 communities in the metropolitan Boston area, promoting smart growth and regional collaboration. More information about MAPC is available at www.mapc.org.

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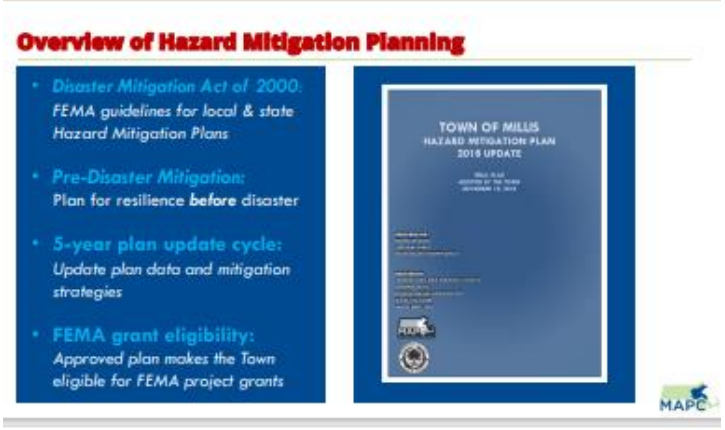
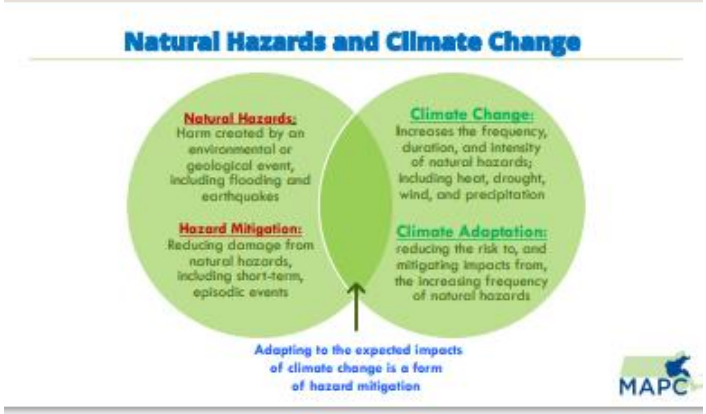
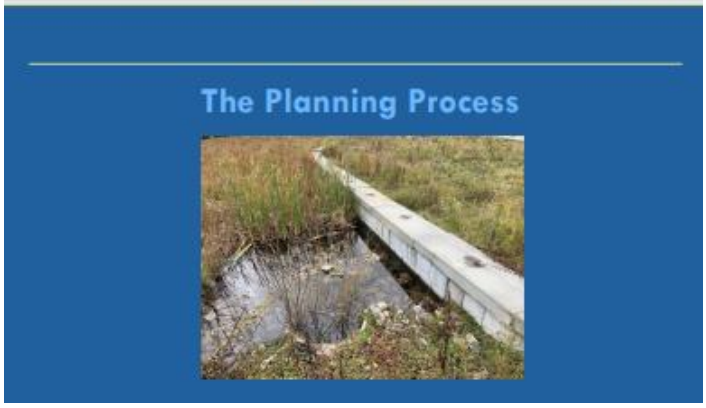
APPENDIX C: PUBLIC PARTICIPATION



APPENDIX C: PUBLIC PARTICIPATION





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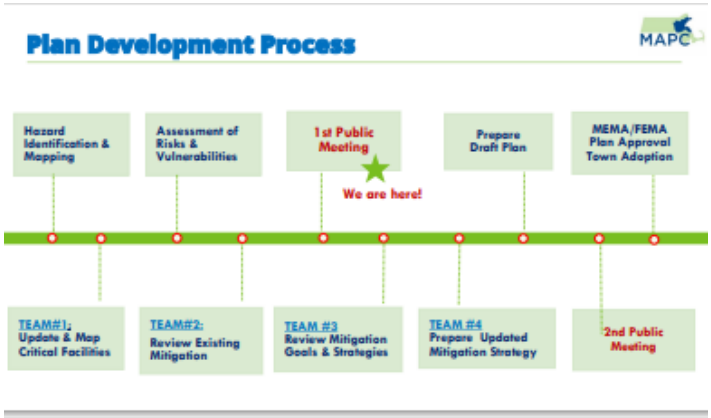

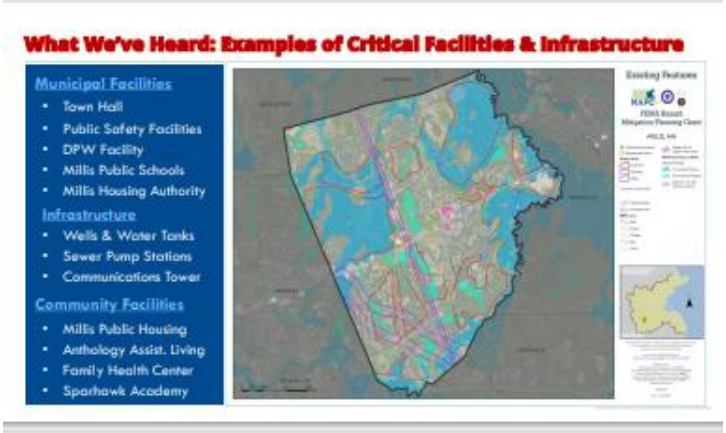

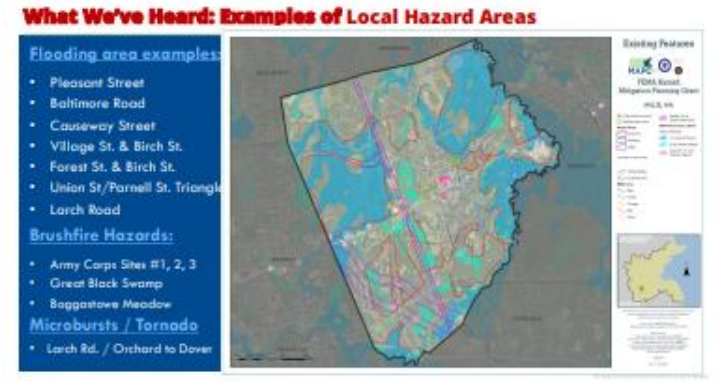

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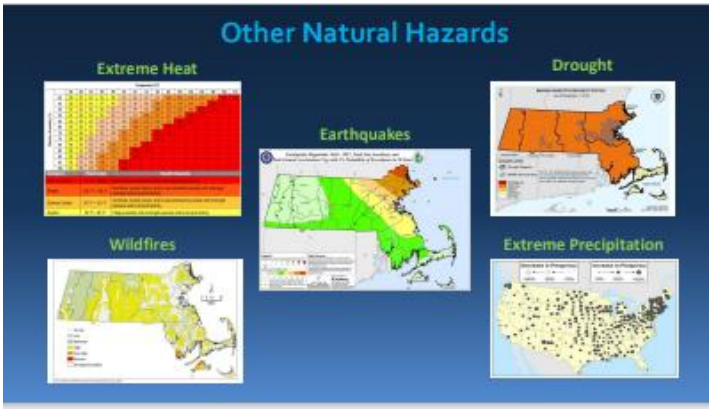


Wind & Winter Hazards: Nor'easters/Blizzards

Storm Event	Date
Severe Winter Storm and Snowstorm	March 2018
Severe Winter Storm, Snowstorm, Flooding	January 2015
Severe Winter Storm, Snowstorm, Flooding	February 2013
Hurricane Sandy	October/November 2012

What We've Heard: Examples of Existing Mitigation Measures

Multiple Hazard Mitigation:

Municipal Vulnerability Preparedness (MVP)
Local Emergency Management Comm. (LEPC)
Comp. Emergency Management Plan (CEMP)

Flood Mitigation:

- National Flood Insurance Program (NFIP)
- Zoning – Floodplain Overlay District
- Stormwater Bylaw & Utility
- Several culvert & drainage upgrades
- Millis Flood Resiliency Plan
- Building Resiliency Across the Charles River (Climate Compact flooding model).

Brush Fire Mitigation:

- Permits required for outdoor burning
- Fire department review of subdivision plans for fire safety

Winter Hazard Mitigation:

- Snow removal operations, roadway treatments

Wind and Winter Mitigation:

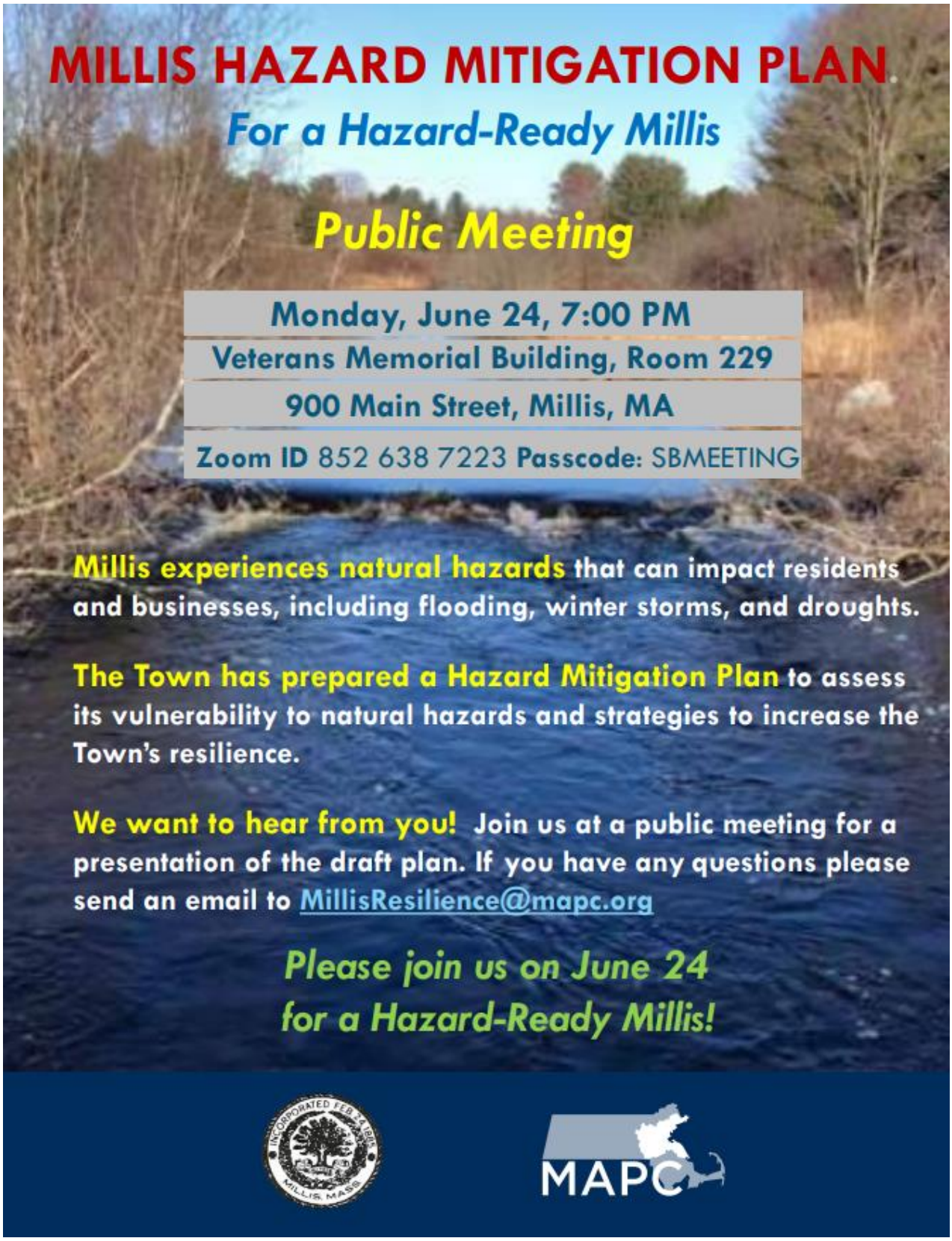
- Enhanced trees trimmed for resilience to wind and ice hazards / power outages
- MA State Building Code

Next Steps for Developing the Plan

- **3rd Local Team Meeting** – Review status of mitigation from 2018 plan (February)
- **4th Local Team Meeting** – Prepare Updated Mitigation Strategy (March)
- **2nd Public Meeting** – Present Draft Plan, public comments (April)
- **Submit Draft Plan** – review of draft plan by MEMA & FEMA (April)
- **Town Adoption of Final Plan** – Select Board vote to adopt the final plan
- **FEMA Approval** – the Town will receive a letter approving the plan for 5 years

After FEMA approval of the plan, Millis will be eligible for FEMA grants for hazard mitigation projects

APPENDIX C: PUBLIC PARTICIPATION



APPENDIX C: PUBLIC PARTICIPATION

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

CALENDAR LISTING / MEDIA ADVISORY

MILLIS DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT JUNE 24 PUBLIC MEETING

Who: Millis residents, business owners, institutions, and non-profit organizations, and others interested in preventing and reducing damage from natural hazards.

What: On Monday, June 24 at 7:15 PM, the draft Millis Hazard Mitigation Plan will be presented at a meeting of the Millis Select Board. The meeting will be held at the Veterans Memorial Building, see details below. The presentation will be given by the Metropolitan Area Planning Council, which is assisting the Town's Hazard Mitigation Team to prepare the plan.

The Town of Millis prepared an updated Hazard Mitigation Plan to assess how natural hazards affect the Town, such as floods, hurricanes, droughts, and severe winter storms. The plan recommends mitigation actions the Town can take to reduce its vulnerability to these natural hazards.

By preparing an updated Hazard Mitigation Plan, the Town of Millis will be eligible for FEMA grants to fund mitigation projects such as drainage improvements.

When: **Monday, June 10, 2024, 7:15 PM**

Where: **Millis Select Board Meeting**
Veterans Memorial Building, Room 229
900 Main Street
Millis, MA 02054

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##

APPENDIX C: PUBLIC PARTICIPATION

To Town Clerks in Holliston, Medfield, Medway, Norfolk, and Sherborn

The Town of Millis has prepared the 2024 update of the Millis Hazard Mitigation Plan, which is intended to reduce the Town's vulnerability to natural hazards such as flooding, drought, hurricanes, and winter storms. The plan identifies recommend hazard mitigation measures, including infrastructure improvements, regulatory measures, and educational and outreach efforts related to natural hazards.

As part of the planning process, as required by FEMA, Millis's neighboring municipalities are being notified of a public presentation on the draft plan to be held at a meeting of the Millis Select Board. The Select Board meeting will be held as follows:

Date:
June 24, 2024, 7:00 PM

Location:
Millis Select Board Meeting
Veterans Memorial Building, Room 229
900 Main Street, Millis, MA 02054

A flyer announcing the meeting with the above information is also attached.

After the public meeting, the draft plan will be available for public review online on the MAPC's website www.mapc.org, and questions and comments are welcome. Comments are requested to be submitted by July 26, 2024.

Thank you,
Martin Pillsbury

Martin Pillsbury
Director of Environmental Planning
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111
617-939-3896
mpillsbury@mapc.org

APPENDIX C: PUBLIC PARTICIPATION

TOWN OF MILLIS

OFFICE OF THE SELECT BOARD
Veterans Memorial Building (VMB)
900 Main Street • Millis, MA 02054
Phone: 508-376-7041

Ellen Rosenfeld, *Chair*
Erin T. Underhill, *Vice Chair*
Craig W. Schultze, *Clerk*

Michael J. Guzinski
Town Administrator
mguzinski@millisma.gov

Karen Bouret DeMarzo
Assistant Town Administrator/
Human Resources Manager
kbouret@millisma.gov

SELECT BOARD MEETING AGENDA
MONDAY, JUNE 24, 2024; 7:00 PM
VETERANS MEMORIAL BUILDING ROOM 229

SELECT BOARD MEETINGS ARE BROADCAST, WHENEVER POSSIBLE, THROUGH MILLIS COMMUNITY MEDIA ON COMCAST CHANNEL 6 AND VERIZON CHANNEL 38

ZOOM (BROADCAST ONLY)
MEETING ID: 852 638 7223
PASSCODE: SBMEETING

	Topic	Time	Speaker
I.	**Call to Order**	**7:00 PM**	**Chair Rosenfeld**
II.	**Announcements** Carnival & Fireworks		
III.	**Scheduled Items**		
24-122	Appointment of: • Tri-County School Representative • Finance Director • On Call Firefighters • Deputy Regional Animal Control Officer • Recreation Program Coordinator • Recreation Dept. Camp Counselors • DPW Summer Workers • Temp. Building Department Assistant	7:05 PM	Chair Rosenfeld R. Cantoreggi R. Briggs M. Guzinski E. Mallette K. Fogarty
24-123	Approval of Additional Voluntary Retirement Plan Provider	7:10 PM	V. Schindler M. Guzinski
24-124	Draft Hazard Mitigation Plan – Public Meeting #2	7:15 PM	M. Pillsbury
IV.	**Open Session Items**		
24-125	Review/Approval of Outdoor Dining Extension Requests		K. B. DeMarzo
24-126	Discuss/Vote FY25 Select Board Goals		Chair Rosenfeld
24-127	Review Town Administrator's Annual Evaluation		Chair Rosenfeld
24-128	FY25 Reappointment of Board/Committee Members		K. B. DeMarzo

The Town of Millis is an equal opportunity employer.

APPENDIX D: PLAN ADOPTION

Certificate to Document Adoption of the
Hazard Mitigation Plan Update
By the Select Board after Approval of the Plan by FEMA

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