# TOWN OF LITTLETON
# HAZARD MITIGATION PLAN
## 2024 UPDATE

**DRAFT FOR TOWN REVIEW**
**May 22, 2024**

Town of Littleton
Metropolitan Area Planning Council

# ACKNOWLEDGEMENTS AND CREDITS

This plan was prepared for the Town of Littleton 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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### Littleton Local Hazard Mitigation Planning Team

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| Cooper Mathews | Assistant Town Planner |
| Matthew Pinard | Police Chief |
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| James Duggan | Town Administrator |
| Ryan Ferrara | Assistant Town Administrator |
| Liz Tretiak | Elder and Human Resources |
| Amy Green | Conservation Coordinator |
| Nick Lawler | General Manager, Littleton Electric Light and Water Dept. |
| Dave Ketchen | Assistant Manager, Littleton Electric Light and Water Dept. |
| Tom Clancy | Interim Fire Chief |
| Sean Coffey | Deputy Fire Chief |
| Francis Dagle | Health Director |
| Dan Kane | Board of Health member |
| James Garreffi | Health Agent |
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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. 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 original Littleton Hazard Mitigation Plan, which was approved by FEMA on April 13, 2017. Prior to that, Littleton's first plan was approved by FEMA on August 7, 2008. Planning for the Hazard Mitigation Plan update was led by the Littleton Local Hazard Mitigation Planning Team, composed of staff from a number of different Town Departments. This team met on July 10, 2023, September 27, 2023, January 4, 2024, and April 4, 2024. The Team discussed 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's Hazard Mitigation Planning Team hosted two public meetings, the first on November 16, 2023 and the second on May 28th, 2024, and the draft plan update was posted on the Town's website for public review. Key town stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments.

## RISK ASSESSMENT

The Littleton Hazard Mitigation Plan assesses the potential impacts to the Town from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, and drought. These are shown on the map series (Appendix B).

The Littleton Local Hazard Mitigation Planning Team identified 71 Critical Facilities. These are also shown on the map series and listed in Table 37, identifying which facilities are located within the mapped hazard zones. The locations of the Critical Facilities are shown on the hazard map series, copies of which are found in Appendix A.

A HAZUS-MH analysis provided estimates of damages from Hurricanes damages of 100 year and 500-year storms ($15 million to $53 million), earthquakes of magnitudes 5 and 7 ($353 million to $2.7billion), and flood damage estimates for the 100- and 500-year storms ($13 million to $19 million).

## HAZARD MITIGATION GOALS

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

**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 potential impacts of future climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning.

**Goal 10: Address** priority populations in the hazard mitigation process, including outreach and engagement, analysis of hazard impacts, and development and implementation of mitigation measures.

**Goal 11:** Take proactive measures to manage trees, invasive species and their impacts on public and private properties.

## HAZARD MITIGATION STRATEGY

The Littleton Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. These include reviewing the open space residential development bylaw, creating a beaver control plan and maintaining fire access roads.

Overall, the hazard mitigation strategy recognizes that mitigating hazards for Littleton 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. Global climate change and a variety of other factors impact the Town's vulnerability now and in the future, 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 Littleton's Hazard Mitigation Plan 2024 Update is summarized in Table 1 below.

**Table 1: Plan Review and Update Process**

| Section | Reviews and Updates |
|---|---|
| 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 Planning Board and the Board of Selectmen. The plan was also available on the Town's website for public comment. |
| 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 impacts of flooding, hurricanes, and earthquakes. |
| 5 - Goals | The Hazard Mitigation Goals were reviewed and endorsed by the Littleton Local Hazard Mitigation Planning Team. |
| 6 – Existing Mitigation Measures | The list of existing mitigation measures was updated to reflect current mitigation activities in the town. |
| 7 & 8 – Hazard Mitigation Strategy | Mitigation measures from the 2017 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 2024 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new |

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| | measures and measures carried forward from the 2017 plan. The Local Hazard Mitigation Team prioritized all of these measures based on current conditions. |
| 9 – Plan Adoption & Maintenance | This section of the plan was updated with a new on-going plan for implementation review and a 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 on Table 43, Littleton made good progress on implementing mitigation measures identified in the 2017 Hazard Mitigation Plan. Several projects have been completed, including drainage improvements at New Estate Road and Nagog Hill Road, installation of a fiber back-up to the radio system, site plan review regulations on slope stabilization; adoption of a stormwater bylaw with operation and maintenance plans for impervious surfaces and alternative designs for impervious surfaces, and with location of additional snow storage areas. Several longer-term measures were partially completed, including purchase of a major open space parcel, revision of the Open Space Development bylaw, adoption of flexible zoning measures, beaver control measures, management of fire access roads, public education on wildfire hazards, installation of Green Roofs, public education on water use and drought, and inclusion of sustainability in the Master Plan and Open Space Recreation Plan.

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, plans, policies, and operations. The Town will document any actions taken within this iteration of the Hazard Mitigation Plan, including challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Littleton Hazard Mitigation Implementation Team, as described in Section 9, Plan Adoption and Maintenance.

# 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.

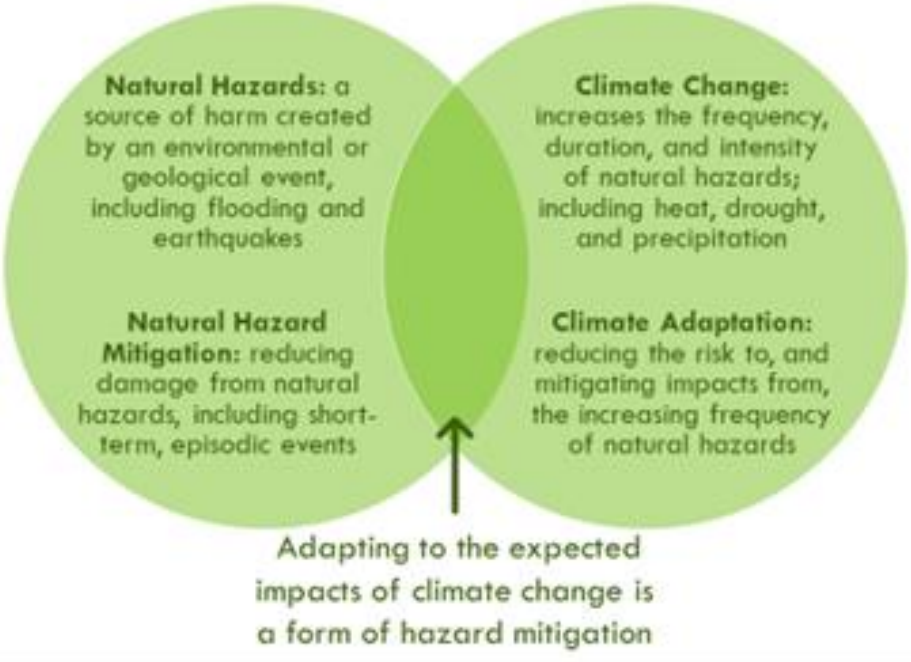
Federal hazard mitigation planning and grant programs are administered by the Federal Emergency Management Agency (FEMA) in collaboration with the states. These programs are administered in Massachusetts by the Massachusetts Emergency Management Agency (MEMA) in partnership with the Department of Conservation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

The Town of Littleton contracted with the Metropolitan Area Planning Council (MAPC), to assist the Town in updating its local Hazard Mitigation Plan, which was first adopted in 2010 as a multijurisdictional plan, and later updated in 2017. This Hazard Mitigation Plan 2024 Update is designed to meet the Town's requirements under the Disaster Mitigation Act for each community while listing regional concerns and hazards that impact the Town. MAPC is the state-designated Regional Planning Agency (RPA) serving the 101 communities in the greater Boston area. MAPC provided facilitation and technical support for Littleton for this project and has provided similar support for 90 municipalities in the region.

## 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 (FEMA, 2022). Therefore, this plan incorporates consideration of future risks due to projections for the increased frequency and severity of extreme weather fueled by a warming planet.

**Figure 1: Natural Hazards and Climate Change Overlap**




## PREVIOUS FEDERAL/STATE DISASTERS

Since 1991, there have been 25 natural hazard events that triggered Federal disaster declarations that included Middlesex County, which includes the Town of Littleton. These are listed in Table 2 below. The majority of these events involved flooding, while others were due to hurricanes or nor'easters, and severe winter weather.

**Table 2: Previous Federal/State Disaster Declaration 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 |
| 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 |
| Snowstorm | December 2003 | Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, Worcester |
| Flooding | April 2004 | Essex, Middlesex, Norfolk, Suffolk, Worcester |
| Snow | 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 |
| Severe Winter Storm, Snowstorm | January 2011 | Berkshire, Essex, Hampden, Hampshire, Middlesex, Norfolk, Suffolk |
| Severe Storm, Snowstorm | October 2011 | Berkshire, Franklin, Hampden, Hampshire, Middlesex, Worcester |
| Severe Winter Storm, Snowstorm, Flooding | February, 2013 | Statewide |
| Severe winter storm, snowstorm, and flooding | April 2015 | Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester |
| Severe winter storm and Snowstorm | March 2018 | Essex, Middlesex, Norfolk, Suffolk, Worcester |

Source: database provided by MEMA

In addition to Federal disaster declarations the Commonwealth of Massachusetts has declared state emergencies fourteen times since 2011. Eight of these emergencies were related to natural hazards such as winter storms, Nor'easters, flooding, and hurricanes (Table 3).

### Table 3: Massachusetts State Declared Emergencies

| Declaration Date | Termination Date | Event |
|---|---|---|
| 9/15/23 | 9/16/23 | Hurricane Lee |
| 9/12/23 | 9/16/23 | Severe Weather & Flooding |
| 2/9/15 | 2/25/15 | Winter Storm |
| 1/26/15 | 1/28/15 | Winter Storm |
| 2/8/13 | 2/13/13 | Winter Storm |
| 10/27/12 | 11/1/12 | Hurricane Sandy |
| 10/29/11 | 11/7/11 | Nor'easter |
| 8/26/11 | 9/6/11 | Hurricane Irene |

Source: Massachusetts Emergency Management Agency State of Emergency Information | Mass.gov

## FEMA FUNDED MITIGATION PROJECTS

The Town of Littleton has not received funding from FEMA for mitigation projects under the various Hazard Mitigation Grant Programs.

## COMMUNITY PROFILE

Littleton is located in Middlesex County in Northeastern Massachusetts and is bordered by Ayer and Harvard on the west, Groton on the northwest, Westford on the northeast, Acton on the southeast, and Boxborough on the south. Littleton is about 12 miles south of Lowell, 20 miles east of Fitchburg, and 26 miles northwest of Boston. Littleton is serviced by State Routes 2, 2A, 110, and 119, and Interstate Route 495. Commuter rail service is available to North Station in Boston. Freight rail service is available from the Springfield Terminal Railway. Littleton is a member of the Montachusett Regional Transit Authority (MART), which provides paratransit services to the elderly and disabled through the Council on Aging. The closest airport to Littleton is the Fitchburg Municipal Airport.

The town is governed by a five-member Board of Selectmen and a Town Administrator. The town operates under the open town meeting format. The Town Manager, appointed by the Selectmen, carries out the day-to-day governing functions of the town.

The Town of Littleton was incorporated in 1715. At the time, the town was primarily agricultural. Over time, the Town established a significant cider industry as well as brick and tile industry, based on the local clay deposits. The town still has an active dairy farm, several vegetable farms, and has preserved several 18th century center-chimney houses and unique brick cottages. Recent development has been primarily suburban, but much of the community has retained its original character.

There are about 6755 jobs in Littleton, most of which historically were centered around tourism, the town center and agriculture. Recently, an influx of technology companies has begun to migrate to King Street in Littleton. Littleton's proximity to Interstate 495 and Route 2 has made it ideal for companies like IBM, that has moved 3,400 workers to the Littleton/Westford software campus.

According to the 2020 Census, just over 10,134 people live in Littleton. Of the town's 3,504 housing units, approximately 650 were built before 1940.

Some of Littleton's unique characteristics to keep in mind include:

- Littleton's small-town character and historic agricultural lands are still present, with a significant amount of open space preserved or in the process of acquisition.
- Littleton contains major transportation infrastructure such as Route 2, Route 495 and the MBTA commuter rail which draws residents who commute to the Boston area.
- Littleton is continuously growing with numerous developments, both residential and commercial.
- Littleton houses a growing technology-oriented job base.
- Littleton relies solely on subsurface wells for drinking water and has a very active water department and stringent aquifer protection regulations.

The Town of Littleton maintains a website at http://www.littletonma.org/

The significant demographic characteristics of the Town of Littleton are summarized in Table 4. Some of these features are important to keep in mind for hazard mitigation as well as emergency preparedness and response in the town.

**Table 4 Town of Littleton Characteristics**

| | |
|---|---|
| **Population** | |
| Total population | 10,134 |
| Residents under 5 years old | 6% |
| Residents 65 years old and over | 16.3% |
| **Race & Ethnicity** | |
| American Indian and Alaska Native | 0.1% |
| Asian | 5.8% |
| Black or African American | 0.1% |
| Native Hawaiian and Pacific Islander | 0.0 |
| White | 89.7% |
| Other Race | |
| Two or More Races | 2.9% |
| Hispanic or Latino | 2% |
| White alone, Not Hispanic or Latino | 88.6% |
| **Household Income** | |
| Occupied Housing Units | 3,504 |
| Mean Household Income | $140,511 |
| Housing units built before 1960 | 1,270 |
| Renter occupied housing units | 7.6% |
| **Languages** | |
| Speak a language other than English at home | 8.7% |
| Spanish | 1.0% |

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| Other Indo-European languages | 2.7% |
| Asian and Pacific Island languages | 2.9% |
| Other languages | 2.1% |
| Speaks English less than "very well" | 1.4% |
| **Additional Information** | |
| Residents with a Disability | 9.9% |
| Age 65 to 74 with a disability | 12.9% |
| Age 75 and over with a disability | 48.2% |
| Residents in Poverty | 6.3% |
| Households with no vehicle | 0.4% |

Sources: 2020 Decennial Census and American Community Survey (ACS) 5-Year Estimates (US Census Bureau, 2021)

# SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION

## PLANNING PROCESS SUMMARY

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 email, webpage content, a flyer, press release to local media, and social media posts,
- A project website at: www.mapc.org/resource-library/littleton-hmp and a dedicated email for public comments,
- Launching a public comment period at the second public meeting, and posting the draft plan to the project website to facilitate public review,
- Outreach to neighboring communities, Town boards and commissions, the local chamber of commerce and businesses, and other local or regional entities.

The six-step planning process outlined in Figure 2 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 2: Six-Step Planning Process**

- **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 A.

- **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:

    - Blue Hills Observatory
    - Town of Littleton, Annual Report 2022
    - Code of the Town of Littleton
    - Commonwealth of Massachusetts, Resilient MA Plan, 2023
    - Commonwealth of Massachusetts, State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), 2018 and 2023
    - Commonwealth of Massachusetts, MA Climate Change Assessment, 2022
    - DCR, Community Information System, Community Overview, 2022
    - DCR, Massachusetts State Dam Inventory, 2012
    - FEMA, Disaster Declarations for States and Counties, 2023
    - Town of Littleton Master Plan 2017
    - Town of Littleton Plan for 2030 (public input)
    - Town of Littleton Open Space and Recreation Plan, 2016
    - Town of Littleton Capital Plan 2017 Review of Requests
    - FEMA, Flood Risk Report, Concord River Watershed, 2/27/2013
    - FEMA, Local Mitigation Plan Review Guide; October 1, 2011
    - FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2012
    - FEMA, Flood Insurance Study for Middlesex County, Updated 2021
    - FEMA, Local Mitigation Planning Policy Guide, 2022
    - Massachusetts Office of Dam Safety, Inventory of Dams, 2018
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
    - New England Seismic Network, Boston College Weston Observatory,
    - NOAA National Centers for Environmental Information,
    - Northeast States Emergency Consortium
    - US Census, 2020, American Community Survey
    - USDA Forest Service, Wildfire Risk to Communities
    - USGS, National Water Information System,
    - US Global Change Research Program, Fourth National Climate Assessment, 2018
    - USACE Ice Jam Database

- **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.

- **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 8.

- **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 Chapter IX and documentation of plan adoption can be found in Appendix D.

- **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.

## 2017 PLAN IMPLEMENTATION & MAINTENANCE

The 2017 Town of Littleton 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. As indicated on Table 43, Littleton made good progress on implementing numerous mitigation measures identified in the 2017 plan. Projects that have been completed include drainage improvements at New Estate Road and Nagog Hill Road, installation of a fiber back-up to the radio system, site plan review regulations on slope stabilization; adoption of a stormwater bylaw with operation and maintenance plans for impervious surfaces and alternative designs for impervious surfaces, and with location of additional snow storage areas.

Several longer-term measures were partially completed, including purchase of a major open space parcel, revision of the Open Space Development bylaw, adoption of flexible zoning measures, beaver control measures, management of fire access roads, public education on wildfire hazards, installation of Green Roofs, public education on water use and drought, and inclusion of sustainability in the Master Plan and Open Space Recreation Plan.
In addition, the Town completed a Municipal Vulnerability Preparedness planning process in 2018 and has been designated an MVP Community by the Executive Office of Energy and Environmental Affairs. The MVP Plan incorporated data from Littleton's Hazard Mitigation Plan such as the assessment of critical infrastructure and local hazard vulnerability. Several mitigation actions discussed at the MVP workshop were reviewed by the local team in considering the mitigation strategy for this plan update.

## THE LOCAL HAZARD COMMUNITY PLANNING TEAM

MAPC worked with the local community representatives to organize a Local Hazard Mitigation Planning Team for Littleton. 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.

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 set plan goals, provide information on the hazards that impact the town, existing mitigation measures, and help to develop new mitigation measures for this plan update. The Local Hazard Mitigation Planning Team membership can be found in Table 5.

The Littleton Planning Board, as well as the Littleton Conservation Commission, are the primary entities responsible for regulating development in town. Feedback from the Planning Board and the Conservation Commission was assured through the participation of the Planning Administrator, Conservation Coordinator and both the Town Administrator and Assistant Town Administrator. In addition, MAPC, the State-designated regional planning authority for Littleton, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as MassDOT.

**Table 5 - Littleton Hazard Mitigation Planning Team**

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|---|---|
| Maren Toohill | Town Planner |
| Cooper Mathews | Assistant Town Planner |
| Matthew Pinard | Police Chief |
| Jeff Patterson | Deputy Police Chief |
| Stephen Jahnle | DPW Director |
| James Duggan | Town Administrator |
| Ryan Ferrara | Assistant Town Administrator |
| Liz Tretiak | Elder and Human Resources |
| Amy Green | Conservation Coordinator |
| Nick Lawler | General Manager, Littleton Electric Light and Water Dept. |
| Dave Ketchen | Assistant Manager, Littleton Electric Light and Water Dept. |
| Tom Clancy | Interim Fire Chief |
| Sean Coffey | Deputy Fire Chief |
| Francis Dagle | Health Director |
| Dan Kane | Board of Health member |
| James Garreffi | Health Agent |
| Sarah Rambacher | Sustainability Committee, Chair |
| Don MacIver | Sustainability Committee, Member |

The Local Team met four times on the dates listed below. The agendas for these meetings are included in Appendix C. The topics of each meeting are summarized below. The agendas for these meetings are included in Appendix B.

- **July 10, 2023:** discuss the project overview and update the inventory and GIS maps of local flood and fire hazard areas and critical facilities.
- **September 27, 2023:** update the hazard mitigation goals and review the current status of the existing mitigation measures, and prepare for Public Meeting #1
- **January 4, 2024:** Review the status of the recommended mitigation from the 2017 plan and determine which measures should be retained in the 2023 plan.
- **April 4, 2024:** to 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 after a complete draft plan was available for review.

One of the best strategies for increasing the impact of local meetings is to invite one of the municipal boards or commissions to host the public discussion of the hazard mitigation plan. With this strategy, the meeting receives widespread advertising and a guaranteed audience of the board or commission members plus those members of the public who attend the meeting. These board and commission members represent an engaged audience that is informed and up to date on many of the issues that relate to hazard mitigation planning in the locality 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 frequently 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 Littleton hazard mitigation planning process during a meeting on November 16, 2023, held in the Planning Board Room of the Town Hall. The draft plan update was presented at a Board of Selectmen meeting on May 28, 2024, at the Reuben Hoar Library. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. See public meeting notices in Appendix C.

## LOCAL STAKEHOLDER INVOLVEMENT

The Hazard Mitigation Planning Team reached 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 towns inviting them to attend the meeting and review the Hazard Mitigation Plan:

**Local Communities**
• Town of Boxborough
• Town of Acton
• Town of Westford
• Town of Groton
• Town of Ayer
• Town of Harvard

**Businesses & Employers**
• Acton Medical
• Acton Toyota
• Amazon
• CVS
• Donelan's Super Market
• FIBA Technology
• Littleton Cinemas
• Littleton Lumber
• Market Basket
• Nashoba Valley Life Care
• Patriot Beverages

**Faith-Based Organizations**
• Blessed Trinity Parish, St. Anne Church
• Boston MetroWest Bible Church
• Congregational Church of Littleton
• First Baptist Church of Littleton
• First Church Unitarian • First Littleton Partnership
• The Church of Jesus Christ of Latter-Day Saints

**Schools, Camps**
• Camp Nashoba
• Littleton Public Schools
• Littleton Park & Rec.
• Oak Meadow Montessori Apartments, etc.
• Mill Pond
• Pine Tree Park
• Pondside at Littleton
• Rodgers Family Holdings
• Village Green Littleton

The draft Littleton Hazard Mitigation Plan 2024 Update was posted on the Town's website for the second public meeting. Members of the public could access the draft document and submit comments or questions to the Town.

## CONTINUING PUBLIC PARTICIPATION

Following the adoption of the plan update, the Littleton Hazard Mitigation 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. The Littleton Fire Chief will act as the coordinator for the Team. 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

### PLAN UPDATE PROCESS 2023-24

Major milestones in the planning process to prepare this plan update included the following:

| | |
|---|---|
| July 10, 2023 | 1st meeting of the Littleton Hazard Mitigation Team |
| September 27, 2023 | 2nd meeting of the Littleton Hazard Mitigation Team |
| November 16, 2023 | First Public Meeting before the Planning Board |
| January 4, 2024 | 3rd meeting of the Littleton Hazard Mitigation Team |
| April 4, 2024 | 4th meeting of the Littleton Hazard Mitigation Team |
| May 28, 2024 | Second Public Meeting before the Board of Selectmen |
| TBD | Draft Plan Update submitted to MEMA |
| TBD | Revised Draft Plan Update submitted to MEMA |
| TBD | Approval Pending Adoption notice issued by FEMA |
| TBD | Plan Adopted by the Town (Board of Selectmen vote) |
| TBD | FEMA Approval of the Plan |

### PLAN IMPLEMENTATION MILESTONES 2023-28

After this plan update is approved by FEMA for a five-year period, the Littleton should take note of the following milestones for the ongoing implementation, review, and updating of this plan:

| | |
|---|---|
| 2027 | 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 2029 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 Littleton 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 Littleton'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' 2018 State Hazard Mitigation and Climate Adaptation Plan (2018 SHMCAP) and the Massachusetts' 2022 Climate Change Assessment.

## CLIMATE CHANGE OBSERVATIONS AND PROJECTIONS

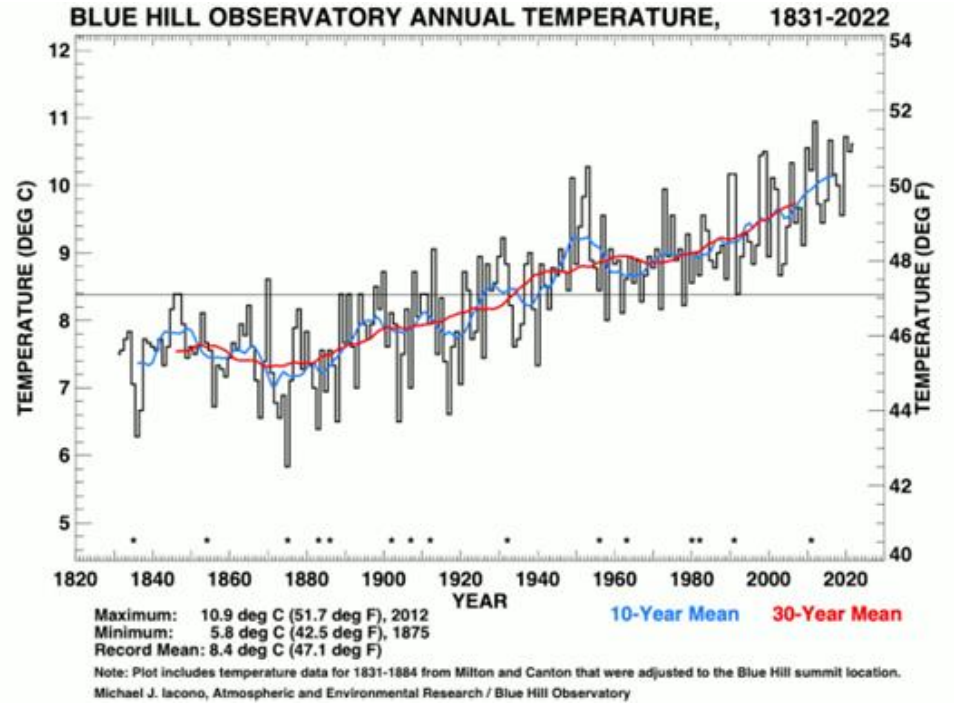
Climate change observations come from a variety of data sources that have measured and recorded changes in recent decades and centuries. Climate change projections, however, predict future climate impacts and, by their nature, cannot be observed or measured. As a result of the inherent uncertainty in 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. According to the Resilient MA: Climate Change

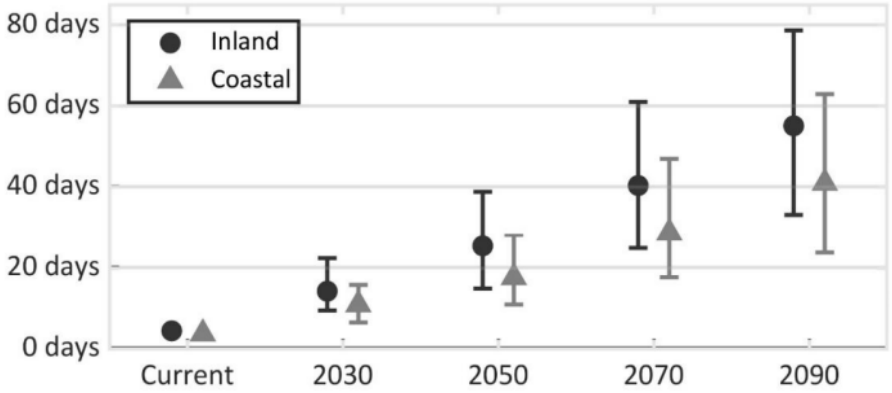
Clearinghouse for the Commonwealth website, Massachusetts has experienced a recorded 3.5°F increase in average temperatures since 1900. Average temperatures during the winter are expected to increase more than average summer temperatures, resulting in less snow and ice, increased invasive species, challenging timber harvests, and other issues related to increasing hazard intensity. Also, according to the Resilient MA website, with increased temperatures, extreme heat days (days with temperatures over 90 degrees) will also increase across the state, increasing public health implications such as heat-related illness and mortality. Between 1971 and 2000, the Commonwealth experienced four days with temperatures over 90°F. By mid-century, it is expected to experience between 10 and 28 such days. 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 Figure 3 below for more information.

**Figure 3: 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 (Commonwealth of Massachusetts, 2022).

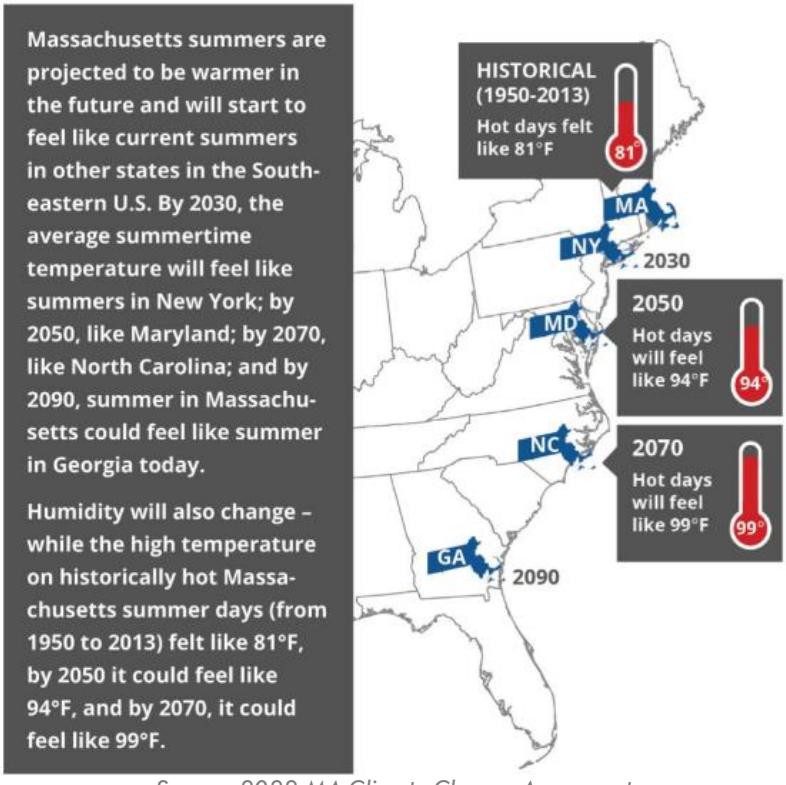
**Figure 4: Change in the Annual Number of Days Over 90°F Compared to Today**




*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 5 from the State's 2022 Climate Change Assessment.

**Figure 5: Change in Average Summertime Temperatures for Massachusetts**

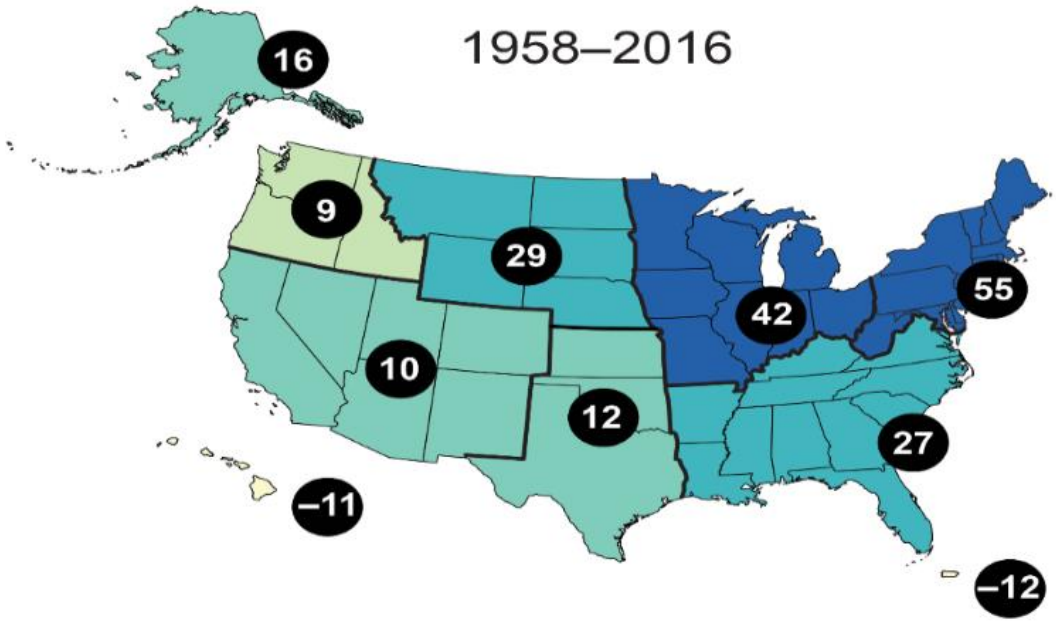



*Source: 2022 MA Climate Change Assessment*

## 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 6 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 6: Observed Change in Total Annual Precipitation in the Heaviest 1% Events**

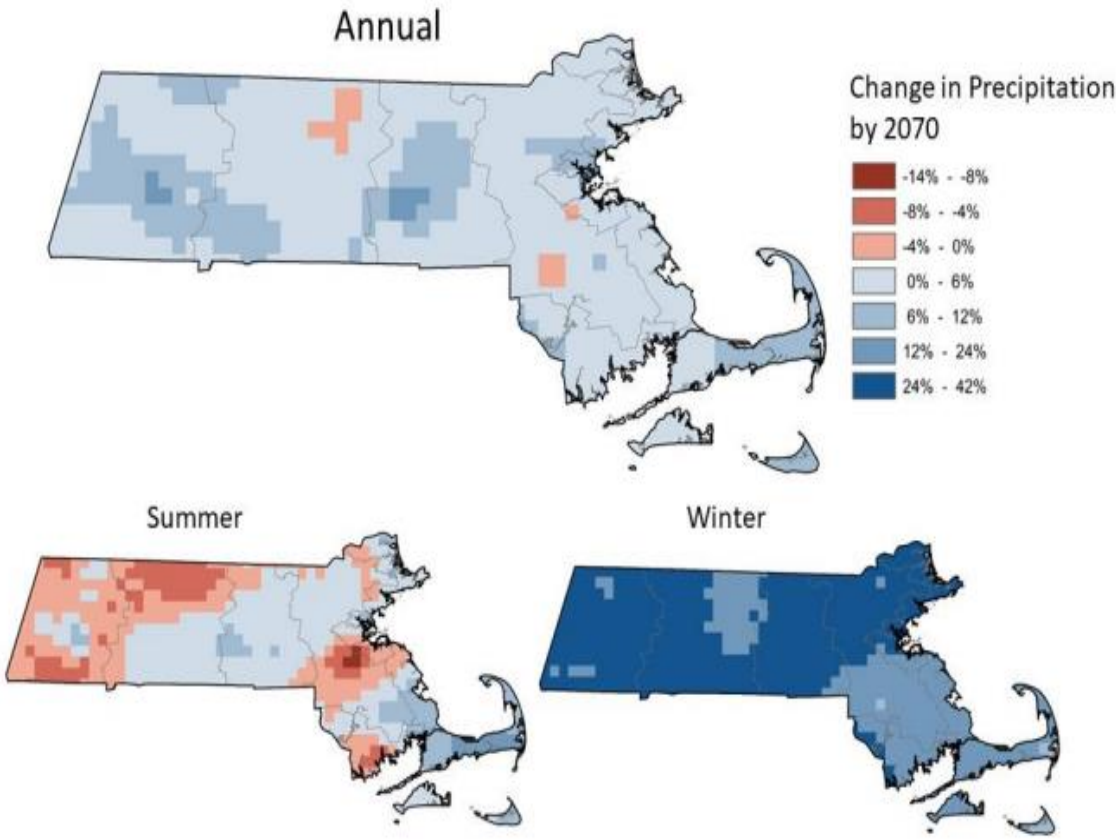



Source: Fourth National Climate Assessment, 2018
Numbers circled in black indicate % change.

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 7 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 7: 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, as 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 Littleton 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 8 below for more information.

**Figure 8: 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)**

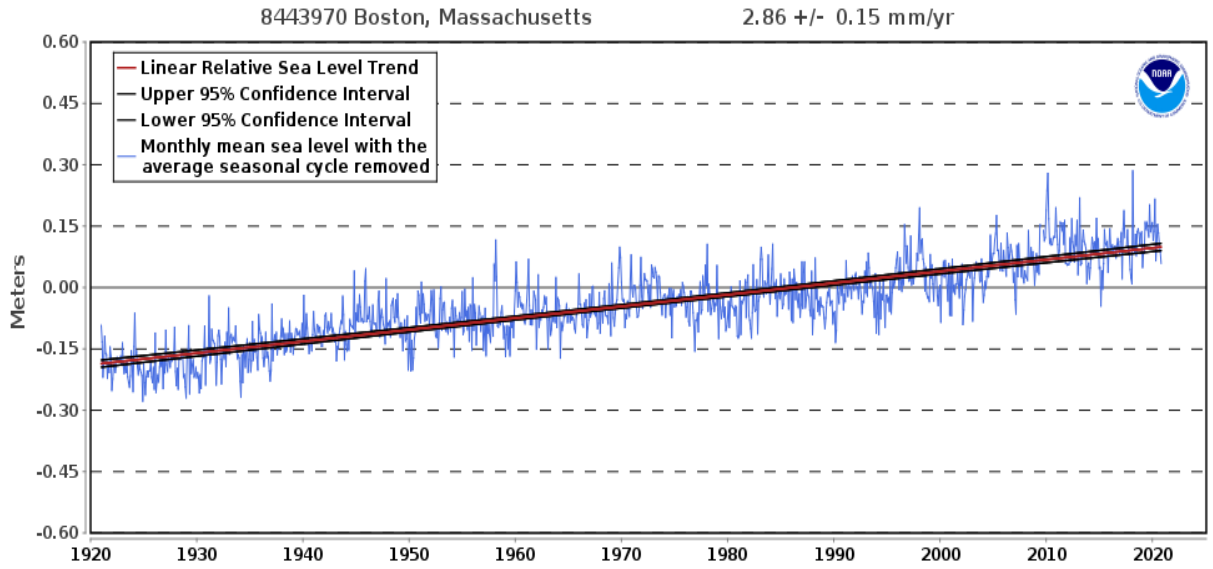
| Region | Baseline | 2030 | 2050 | 2070 | 2090 |
|---|---|---|---|---|---|
| Berkshires & Hilltowns | 159 | 161 | 165 | 167 | 170 |
| Greater Connecticut River Valley | 171 | 172 | 175 | 178 | 181 |
| Central | 180 | 182 | 185 | 188 | 192 |
| Eastern Inland | 186 | 181 | 185 | 188 | 193 |
| Boston Harbor | 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.*

## SEA LEVEL RISE

While Littleton 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 9 below for more information.

**Figure 9: 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:

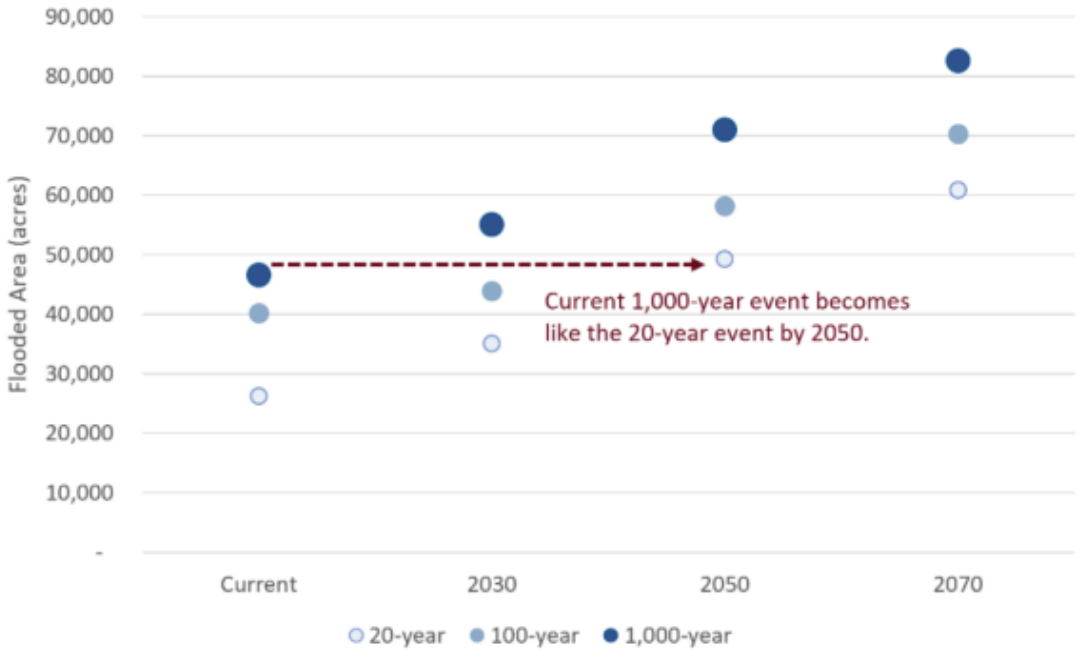
- **Northern Massachusetts:** 21 inches by 2050, and 43 inches by 2070
- **Southern Massachusetts:** 23 inches by 2050 and 45 inches by 2070

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

- the 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 areas could be impacted by the annual probability event by 2070. See Figure 10 below for more information.

**Figure 10: Total Flooded Area of the Commonwealth for Selected Events**

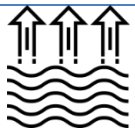
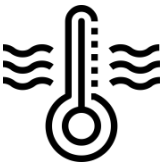



*Source: 2022 MA Climate Change Assessment*

Following the outline of the 2018 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. The table below, which is originally from the SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts.

**Table 6: Climate Change & Natural Hazards**

| Primary Climate Change Interaction | Natural Hazard | Other Climate Change Interactions | Representative Climate Change Impacts |
|---|---|---|---|
|  **Change 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

In order to update Littleton 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. The Resilient MA Plan, the SHMCAP (2018) and the State Hazard Mitigation Plan (2013) are key planning documents that examine natural hazards that have the potential to impact the Commonwealth. The 2013 State HMP set the stage by defining considerations such as frequency and severity and summarizing the frequency and severity of hazards of greatest concern. The 2018 SHMCAP used similar definitions for hazard considerations and expanded on this research by including additional climate projections. Because the 2013 State HMP includes definitions that were not specified in the SHMCAP, both resources are referred to in this report. MAPC also used FEMA's damage estimation software, HAZUS (described below).

Table 7 below summarizes the hazard risks for Littleton. This evaluation takes into account the frequency and severity of each hazard for Massachusetts and Littleton, based on available data, including:

- **State-level data**, including the Resilient MA Plan, the 2022 Climate Change Assessment, and 2018 SHMCAP.
- **County-level data** from NOAA's National Climatic Data Center and Storm Events
- **Local-level information** including input from the Local Team, the hazard mapping included in Appendix A, and the HAZUS results.

The statewide hazard risk assessment is based on the definitions for hazard frequency and severity listed below. The statewide assessment was modified to reflect local conditions in Littleton using the same criteria.

**Definitions of Hazard Frequency and Severity**

***Frequency***

**Very low:** Very unlikely; minimal examples of historical occurrences.
**Low:** Likely to occur at least once by the end of the century; some examples of historical occurrences; anticipated every 100 years.
**Medium:** Likely to occur at least once every 50 years (two or more occurrences in the next century)
**High:** Almost certain to occur at least once a year.
**Very High:** Almost certain to occur multiple times a year.

***Severity***

**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 7 Overview of Hazards and Impacts

| Hazard | Frequency | | Severity | |
|---|---|---|---|---|
| | Massachusetts | Littleton | Massachusetts | Littleton |
| Flooding from Precipitation | Very High | High | Serious | Serious |
| Dam failures | Very Low | Very Low | Extensive | Minor |
| Coastal Erosion | Very High | N/A | Serious-Extensive | N/A |
| Coastal Flooding | Very High | N/A | Serious-Extensive | N/A |
| Tsunami | Very Low | N/A | Extensive-Catastrophic | N/A |
| Hurricane/Tropical Storm | Medium | Medium | Serious - Catastrophic | Extensive |
| Tornadoes | High | Very Low | Serious - Extensive | Serious |
| Other Severe Weather (Wind/Thunderstorms) | Very High | High | Minor - Extensive | Minor-Serious |
| Severe Winter/Nor'easter | High | High | Minor - Extensive | Minor-Serious |
| Winter-Ice Storms | Medium | Medium | Minor - Extensive | Minor |
| Earthquakes | Medium | Medium | Serious - Catastrophic | Serious |
| Landslides | High | Very Low | Minor - Extensive | Minor |
| Wildfire/Brushfires | Very High | Medium | Minor - Extensive | Minor-Serious |
| Extreme Temperatures | Very High | High | Minor -Serious | Minor |
| Drought | Medium | Medium | Minor - Serious | Minor-Serious |

Sources: *Resilient MA Plan (Frequency), State Hazard Mitigation Plan 2013 (Severity), HAZUS, Local information.*

## *CLIMATE TRENDS: CHANGES IN PRECIPITATION*

## FLOODING HAZARDS

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.

Flooding has not been a widespread natural hazard identified by local officials in Littleton, however the town does contain several floodplain areas and is also subject to localized flooding. Despite the limited flooding exposure, the town has been active in implementing regulatory strategies that will serve to prevent future flooding by preserving natural capacity for stormwater infiltration. Flooding can occur during hurricanes, nor'easters, severe rainstorms and thunderstorms. Flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Global climate change has the potential to exacerbate these issues over time with the potential for changing rainfall patterns leading to heavier storms.

## *REGIONALLY SIGNIFICANT FLOODS*

There have been a number of major floods that have affected the Metro Boston region over the last fifty years. Significant historic flood events in Littleton have

- The blizzard of 1978
- January 1979
- April 1987
- October 1991
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- February 2013
- January 2018
- March 2018
- June 2020

The best available local data on flooding events is for Middlesex County through the National Center for Environmental Information (see Table 8). Middlesex County, which includes the Town of Littleton, experienced 60 flood events from 1996 –2016. No deaths or injuries were reported and the total reported property damage in the county was $40.9 million dollars. Of that total, $35.2 million is attributed to the two major events of March 2010.

**Table 8: Middlesex County Flood Events, 2010-2022**

| Date | Deaths | Injuries | Property Damage ($) |
|---|---|---|---|
| 3/14/2010 | 0 | 0 | 26,430,000 |
| 3/29/2010 | 0 | 0 | 8,810,000 |
| 4/1/2010 | 0 | 0 | 0 |
| 8/28/2011 | 0 | 0 | 5,000 |
| 10/14/2011 | 0 | 0 | 0 |
| 6/8/2012 | 0 | 0 | 0 |
| 6/23/2012 | 0 | 0 | 15,000 |

| | | | |
|---|---|---|---|
| 7/18/2012 | 0 | 0 | 5,000 |
| 10/29/2012 | 0 | 0 | 0 |
| 6/7/2013 | 0 | 0 | 0 |
| 7/1/2013 | 0 | 0 | 0 |
| 7/23/2013 | 0 | 0 | 0 |
| 9/1/2013 | 0 | 0 | 10,000 |
| 3/30/2014 | 0 | 0 | 35,000 |
| 7/27/2014 | 0 | 0 | 0 |
| 8/31/2014 | 0 | 0 | 0 |
| 10/22/2014 | 0 | 0 | 20,000 |
| 10/23/2014 | 0 | 0 | 0 |
| 12/9/2014 | 0 | 0 | 5,000 |
| 12/9/2014 | 0 | 0 | 30,000 |
| 5/31/2015 | 0 | 0 | 0 |
| 8/4/2015 | 0 | 0 | 0 |
| 8/15/2015 | 0 | 0 | 125,000 |
| 9/30/2015 | 0 | 0 | 0 |
| 4/6/2017 | 0 | 0 | 0 |
| 6/27/2017 | 0 | 0 | 1,000 |
| 7/12/2017 | 0 | 0 | 1,000,000 |
| 7/18/17 | 0 | 0 | 0 |
| 8/2/2017 | 0 | 0 | 5,000 |
| 10/25/17 | 0 | 0 | 0 |
| 10/30/2017 | 0 | 0 | 0 |
| 1/12/2018 | 0 | 0 | 0 |
| 1/13/2018 | 0 | 0 | 0 |
| 4/16/2018 | 0 | 0 | 0 |
| 6/25/2018 | 0 | 0 | 15,000 |
| 8/8/2018 | 0 | 0 | 35,000 |
| 8/12/2018 | 0 | 0 | 30,000 |
| 8/17/2018 | 0 | 0 | 0 |
| 10/29/2018 | 0 | 0 | 0 |
| 11/3/2018 | 0 | 0 | 0 |
| 11/10/2018 | 0 | 0 | 0 |
| 7/6/2019 | 0 | 0 | 0 |
| 8/07/19 | 0 | 0 | 0 |
| 9/2/2019 | 0 | 0 | 300 |
| 6/21/20 | 0 | 0 | 0 |
| 6/28/20 | 0 | 0 | 5,000 |

| | | | |
|---|---|---|---|
| 7/23/20 | 0 | 0 | 0 |
| 9/10/20 | 0 | 0 | 3,000 |
| 7/9/21 | 0 | 0 | 0 |
| 9/2/21 | 0 | 0 | 0 |
| 11/12/21 | 0 | 0 | 10,000 |
| 8/5/22 | 0 | 0 | 0 |
| 8/7/22 | 0 | 0 | 0 |
| 9/5/22 | 0 | 0 | 0 |
| 5/20/23 | 0 | 0 | 0 |
| 6/26/23 | 0 | 0 | 50,000 |
| **Total** | **0** | **0** | **$42.06 M** |

Source: NOAA, National Centers for Environmental Information

## *OVERVIEW OF TOWN-WIDE FLOODING*

FEMA-designated flood plains are found throughout Littleton, mainly along the town's water ways (see Map 3 in Appendix A). The significant bodies of water in Littleton include Beaver Brook, Spectacle Pond, Mill Pond, Long Pond, Fort Pond, Nagog Pond, Lake Matawanakee, and numerous tributary streams. The northwestern half of Littleton consists mainly of sandy soils and contains the main aquifer for the town's drinking water supply. The other half has glacial till sols and much of the area is tributary to the SuAsCo (Sudbury, Assabet, Concord Rivers) watershed.

Flooding in Littleton is occasional, usually within or near floodplain areas. Damage may consist of flooding of basements, and the Fire Department 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 Littleton Highway Department has been effective at replacing outdated culverts and drainage systems.

Littleton's water supply system depends solely on the subsurface aquifer in the northwestern half of town, therefore water quality has been a main issue. The town has an active water department and aggressive aquifer protection regulations that have been effective in protecting the water quality of the groundwater supply.

Although Littleton's flooding issues in the past have not been as significant as some of its nearby more developed neighbors, Littleton is facing a large amount of new development. New impervious areas and more engineered drainage systems can bring a greater possibility of future flooding problems. Therefore, protection of open space and development controls will be critical to mitigate against future flooding. Littleton has a history of being active in this regard.

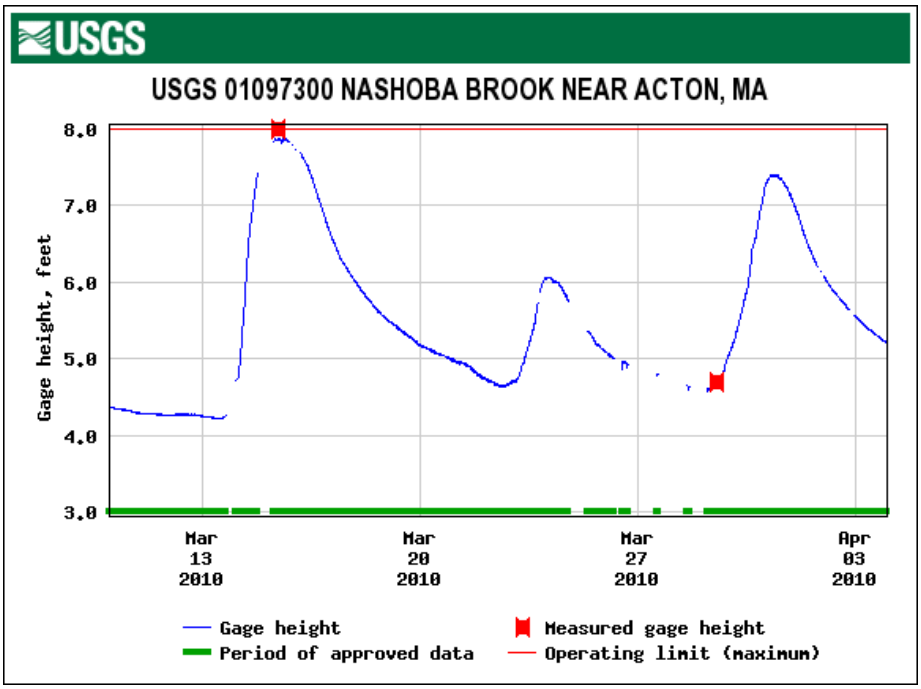
## *SEVERE PRECIPITATION*

The most severe recent flooding occurred during the major storms of March 2010, when a total of 17.7 inches of rainfall was recorded by the Blue Hills Observatory from three storms over 19 days from March 13 to 31. accumulation was officially recorded by the National Weather Service (NWS). The weather pattern that caused these floods 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 height of the garage at the nearest USGS streamflow gauging station, which is on the Nashoba Brook in neighboring Acton, which is in the same watershed as Littleton. The USGS gage height, shown in Figure 11, was nearly eight feet on March 16 (which is the operating limit of the gage), and exceeded 7.3 feet on March 31, 2010. Normal gage height in March is about 4.5 feet.

**Figure 11 Nashoba Brook Gage Heights, March-April 2010**




Source, US Geological Service, National Water Information System

*Damages from flooding from 2010 to 2022 in Middlesex County totaled $42.5 million. It is notable that $35.2 million of that was due to the March 2010* storms. Those storms were a federally declared disaster, making federal assistance available to residents who did not carry flood insurance. The HAZUS analysis estimates damages in Littleton from a 100-year flood at $13.6 million and $19.7 million from a 500-year flood.

## *POTENTIAL FLOOD HAZARD AREAS*

### Flood Insurance Rate Maps

Information on potential flood hazard areas was taken from two sources. The first was the National Flood Insurance Rate Maps (FIRM). The FIRM flood zones are shown on Map 3 in

Appendix A and their definitions are listed below. Mapped flood plains are primarily along the Town's ponds, brooks, and associated wetlands.

**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** (0.2% 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 FIRM maps currently in effect for Littleton were adopted in 2010 and 2014. However, as described below, Revised Preliminary FIRMs have been issued by FEMA, and they are expected to go into effect and replace the current FIRMs in mid-2025. This process is expected to result in a Letter of Final Determination (LFD) from FEMA by late December 2024 or January 2025.

The Town will need to adopt an updated floodplain zoning bylaw to reflect the new FIRM mapping and to comply with a state model floodplain bylaw before the updated Flood Insurance Rate Map (FIRM) and Middlesex County Flood Insurance Study (FIS) become effective in June or July 2025. The State model floodplain ordinance is available from the Department of Conservation and Recreation to assist municipalities with making these updates. Municipalities can also go above and beyond the State's minimum requirements by including additional language. This additional language can be related to strengthening floodplain overlay district requirements, stormwater regulations, site plan review, and more. MAPC's online Climate Resilient Land Use toolkit provides guidance and examples of local bylaws, available at www.mapc.org/resource-library/climate-resilient-land-use-strategies/

The Middlesex County Flood Insurance Study (FIS), Revised July 2016, provides supporting data and analysis regarding flooding in Norfolk. The FIS provides the following overview description of flooding trends and impacts in Middlesex County:

### Principal Flood Problems – Middlesex County

Historically, excessive rainfall along, or in combination with, snowmelt runoff has produced flooding in low-lying areas of Middlesex County. Severe flooding occurred during August 1955. The flood of August 1955 resulted from two hurricanes that arrived almost concurrently-Hurricane Connie, occurring between August 11 and 15; and Hurricane Diane occurring between August 17 and 20. As a result of these two storms, roads and bridges were overtopped, and residences and

businesses were flooded. Further, significant recorded floods were those occurring in May 1850, December 1878, July 1891, July 1897, February and March 1900, November 1927, March 1936, July and September 1938, October 1942, October 1955, April 1960, March 1968, and January 1979.

Flooding in Middlesex County may be caused by a number of factors: inadequate and deteriorated river channels, constricting culverts and bridges, heavy precipitation in combination with frozen ground conditions, summer and fall hurricanes, winter northeasters, inadequate storm drain discharge, increased development, topographic conditions, and undersized culverts The following tabulation, taken from a USACE Flood Plain Information report, presents the relative flood heights at the Carlisle Road bridge (State Route 225) for the 10 major floods in the Concord River basin in order of magnitude.

**Table 9 Historic Floods in Middlesex County**

| Date of Crest | Elevation | Peak Discharge (cfs) |
|---|---|---|
| August 23, 1955 | 118.6 | 4,540 |
| January 26, 1979 | 118.5 | 5,400 |
| March 20, 1936 | 118.4 | 6,000 |
| March 27, 1968 | 117.9 | 4,900 |
| July 29, 1938 1 | 17.3 | 3,790 |
| September 15, 1954 | 116.7 | 3,340 |
| September 24, 1938 | 116.5 | 3,210 |
| March 24, 1948 | 116.5 | 3,200 |
| January 30, 1958 | 116.4 | 3,120 |
| April 18, 1956 | 116.2 | 2,970 |

The duration of flooding is generally sustained due to the large drainage area, shallow channel slopes, and wide meadow flood-storage areas. Records indicate that the 1936 flood remained higher than an elevation of117.2 feet North American Vertical Datum of 1988 (NAVD88) at the Carlisle Road bridge for more than 11 days. Hurricane Diane occurred on August 19 and 20, 1955, but the Concord River did not crest until late on August 22 with water levels remaining above an elevation of 117.2 feet NAVD88 for over 3 days. The Shawsheen River, on the other hand, rises fairly rapidly and crests within 36 to 48 hours after the time of maximum precipitation over the watershed.

Middlesex County also saw flooding from severe storms in October 1996, June 1998, April 2001, April 2004, October 2005 and May 2006. The May 2006 storms damaged 14,000 homes in 44 communities on the North Shore, including Middlesex County (NOAA, 2013). Boston recorded four- and six-day rainfalls of 8.49 and 13-15 inches respectively. Several rivers, including Merrimack, Ipswich, Saugus, and Parker Rivers, and their tributaries, were impacted by flooding. Flooding was heavy in the floodplain of the Shawsheen River, a tributary of the Merrimack River. Widespread flooding caused evacuation of residents threatened by flooding. Redman Cloth Dam, located upstream of Essex Street, was washed away during the 2006 flood event. Shawsheen River watershed experienced flooding again in July 2007.

In March 2010, heavy rainfall of 6 to 10 inches fell over much of Southern New England resulting in major flooding across eastern Massachusetts and Rhode Island, including the Middlesex County area. Each of the seven gaged mainstem rivers in Middlesex County rose above flood stage, the Nashua River at East Pepperell, Shawsheen River at Wilmington and the Assabet River at

Maynard all reach major flood levels. The Concord River at Lowell and the Shawsheen River at Wilmington set record floods stages.

Discharge-frequency relationship data for Beaver Brook in the Town of Littleton and Westford was developed using the procedures described by the USGS in Estimating the Magnitude and Frequency of Floods for Natural-flow Streams in Massachusetts (U.S. Department of the Interior, 1977). The technique was developed using multiple regression analyses to estimate flood peaks in ungauged, natural-flow streams in Massachusetts by relating peak discharges to basin and climatic parameters. The resulting peak discharges were used to develop corresponding peak discharges at the inlet of Forge Pond using multiplications factor equal to the ratio of the drainage areas to 0.75 power. The discharges for Beaver Brook have been incorporated into Table 10 below.

**Table 10 Summary of Discharges Beaver Brook**

| Flooding Source | Drainage Area (sq mi) | Peak Discharge (cfs) 10% | 2% | 1% | 0.2% |
|---|---|---|---|---|---|
| BEAVER BROOK | | | | | |
| At inlet to Forge Pond | 13.6 | 420 | 690 | 845 | 1,280 |
| Downstream of Westford/Littleton corporate limits | 11.8 | 380 | 620 | 760 | 1,150 |
| Approximately 200 feet upstream of King Street | 9.8 | 339 | 563 | 686 | 1,045 |
| Upstream of Mill Pond | 7.9 | 296 | 494 | 601 | 920 |
| At State Route 2 | 5.8 | 241 | 403 | 493 | 756 |
| At Boxborough/Littleton limits | 4.3 | 145 | 215 | 250 | 330 |
| Approximately 7,280 feet upstream of Capt. Isaac Davis Highway/Route 2 | 3.0 | 92 | 140 | 160 | 220 |
| Approximately 3,260 feet downstream Of West Whitcomb Road | 1.9 | 66 | 100 | 120 | 150 |
| At Interstate Route 495 | 1.4 | 55 | 84 | 98 | 120 |

## Flood Protection Measures in Middlesex County

Various measures have been taken in Middlesex County for flood protection. Among them: the adoption of local floodplain zoning ordinances (which are intended to regulate construction, excavation, filling, and grading of any land situated below specified elevations); construction of dams to control flooding (for example, along the Assabet River and its major tributaries); zoning by-laws (which may, for example, allow development within the floodplain only by special permit); stormwater drainage programs; dredging of channels; replacement of inadequate culverts; preserving natural runoff and flow patterns of streams and floodwater storage areas; wetland identification; flood retention structures; formation of Floodplain Conservancy Districts; The Flood Control Acts of 1936 and 1938; flood protection dikes and walls; holding pond storage; natural storage that exists in the many swamps and ponds; and establishing wetlands protection districts. Ten dams have been constructed within the Upper Assabet River basin to control flooding and provide recreation. These dams are in Berlin, Bolton, Stow, Marlborough, Westborough, Northborough, and Shrewsbury, and they were designed to reduce the peak water-surface elevations of the 1-percent-annualchance flood by 2.3 feet at the Maynard USGS gaging station.

## Locally Identified Flood Hazards

In addition, to the Flood Insurance Rate Maps, information on areas subject to flooding was provided by local officials. The Locally Identified Areas of Flooding described below were identified by town staff as areas where flooding is known to occur. All of these areas do not necessarily coincide with the flood zones from the FIRM maps. Some 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, "Local Hazard Areas" in Appendix A.

1. Beaver Brook/Great Road
Beaver Brook at Great Road (a state highway) has not overtopped in heavy rains. At times there will be high water in the brook, but overtopping does not occur (Jeff Patterson, Police Dept, has never seen it overtopped. The cause of the flooding is due more to the fact that it is within a floodplain area than it does with inadequate drainage infrastructure.

2. King Street
The stream located near a floodplain at this King Street location has caused surface flooding in the past. Cupp and Cupp installed two undersized culverts on a private driveway off of King Street that caused some flooding. Note that King Street is a state highway.

3. Nashoba Road
Nashoba Road had routinely flooded, often due to beaver activity. This site is also located near a floodplain. The town raised the road approximately 2.5 feet at its lowest point by installing retaining walls and fill slopes for a total length of 2400 feet, and the road was repaved in the Fall of 2022. This solution has appeared to alleviate the problem. Water still comes up on to the edge of the road but doesn't flood the road.

12. Gilson Road
Gilson road by the train tracks has been having some issues with beaver problems, this has required drains to be cleaned. This has not overtopped the road, but this is an area that needs to be checked.

13. Ayer Road
Ayer Road in front of 39 right by Littleton Electric has experienced occasional problems by intense rainfall, maybe a state culvert issue.

## Repetitive Loss Structures

As defined by the National Flood Insurance Program (NFIP), a repetitive loss property is any property for which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978. There is one repetitive loss structure in Littleton. It is a single-family residence that has received reimbursement for two claims for a total of $21,338, including $18,648 for building damages and $2,490 for damage to contents. For more information on repetitive losses see http://www.fema.gov/business/nfip/replps.shtm

Littleton experiences limited flooding and flood damage compared to most towns in the region. Nevertheless, based on the record of previous occurrences flooding events in Littleton are High frequency events. This hazard may occur more frequently than once in five years, or a greater than 20% chance per year.

### Flooding and Climate Change

Data from the 2022 MA Climate Change Assessment related to changes in precipitation patterns is included in an earlier section of this chapter. 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 196l 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, communities 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 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 is summarized in the table 11 below (NOAA, 2023) .

**Table 11: Rainfall rates for the 10-year 24-hour storm**

| NOAA 14 | NOAA 14+ | NOAA 14++ |
|---|---|---|
| **5.27 inches** | 5.90 **inches** | 6.56 **inches** |

- 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 daily rainfall event (2.8 to 4 inches) could occur four times more frequently
- 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)

## 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.

Dam failure is a highly infrequent occurrence, but a severe incident could result in loss of lives and significant property damage. Since 1984, three dams have failed in or very near to Massachusetts, one of which resulted in a death. There have been no recorded dam breaches in Littleton.
The increasing intensity of precipitation is the primary climate concern related to dams, as they were designed based on historic weather patterns. The 2018 SHMCAP indicates that changing precipitation patterns may increase the likelihood of overflow events.

According to data provided by the Massachusetts Department of Conservation and Recreation and the town, there is one dam located in Littleton. The Mill Pond Dam is located on Beaver Brook and a tributary to Beaver Brook and is owned by the MA DCR. It is classified as a low hazard dam. According to the town, the spillway at Mill Pond Dam has not had any problems within the last 10-15 years.

**Table 12 DCR Inventory of Dams**

| NATID | Dam Name | River | Impoundment | Owner | Hazard Potential |
|---|---|---|---|---|---|
| MA01149 | Mill Pond Dam | Tributary of Beaver Brook | Mill Pond | DOT - Dept. of Transportation | Low |

Source: Office of Dam Safety, Dept. of Conservation and Recreation

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.

### *Probability of Occurrence*

Based on the record of no previous occurrences dam failure in Littleton this is a Very Low frequency event. This hazard may occur less frequently than once in 100 years (less than 1% chance per year

## DROUGHT HAZARDS

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). This is considered the drought of record in Massachusetts.

Average annual precipitation in Massachusetts is 44 inches per year, with approximately 3 to 4 inch average amounts for each month of the year. Regional monthly precipitation ranges from zero to 17 inches. Statewide annual precipitation ranges from 30 to 61 inches. Thus, in the driest calendar year (1965), the statewide precipitation total of 30 inches was 68 percent of average.

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 seven regions: Western, Central, Connecticut River Valley, Northeast, Southeast, Cape Cod, and Islands.

*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)

The Massachusetts drought levels are shown in comparison to the U.S. Drought Monitor levels in Table 13. The two sets of drought indices are similar, but Massachusetts combines the USDM's level D2 and D3 into one category, Critical Droughts.

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.

As shown in Table 13, 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.

**Table 13: 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

Table 14 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.

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

The drought levels provide a framework from which to take actions to assess, communicate, and respond to drought conditions. Drought levels are used to coordinate both state agency and local response to drought situations. Water restrictions might be appropriate at the significant drought stage, depending on the capacity of each individual water supply system. A critical drought 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.

**Table 14: 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

## Previous Occurrences

Because drought tends to be a regional natural hazard, the best available date on previous drought occurrences is state-wide data, summarized below.

The Executive Office of Energy and Environment's Drought Management Task Force also provides information on historic drought status for each drought level in Massachusetts. That information is summarized below.

| | |
|---|---|
| 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 |

A summary of Massachusetts long term historic drought events from 1879 to 2019 is shown in Table 15. This table was prepared for the 2019 Massachusetts Drought Management Plan, so it does not include the more recent droughts of 2020 (Level 3) and 2021(Level 2).

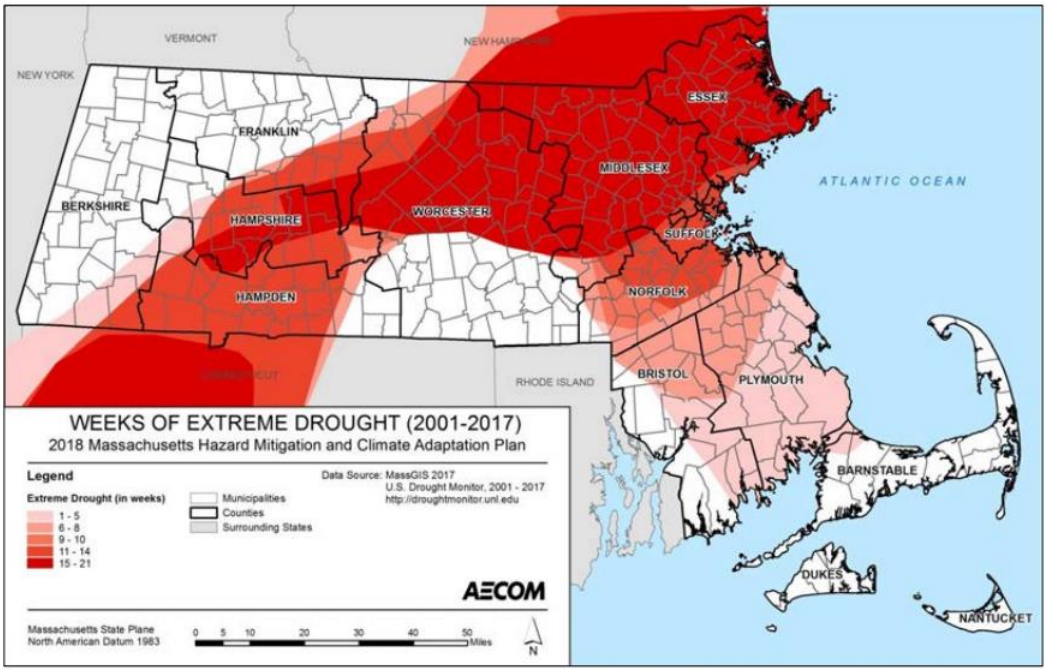
### Table 15 - Chronology of major droughts in Massachusetts since 1879

| 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

As shown in Figure 12, Littleton experienced between 15 and 21 weeks of severe drought between 2001 and 2017.

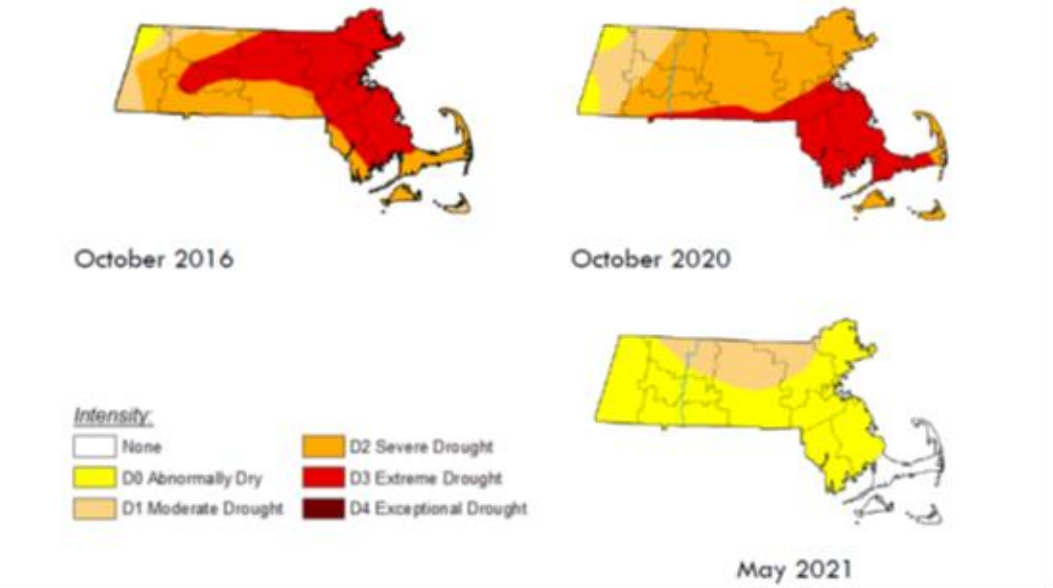
**Figure 12: Weeks of Extreme Drought (2001-2017)**




Source: SHMCAP 2018

In just the last five years there have been three droughts in Massachusetts. The drought of 2016 was the worst one since 1985, with more than half of the state reaching the Extreme Drought stage for several months (Figure 12). This was followed by another drought four years later in 2020, which was most severe in Southeastern Massachusetts.. Finally, in the early spring of 2021 a third, milder, drought was declared. By the summer of 2021 conditions in the northeast region improved.

**Figure 13: Recent Massachusetts Drought Events (2016-2021)**




Source: US Drought Monitor, 2016-2021

### Potential Drought Vulnerability

Under a severe long term drought the Town of Littleton could be vulnerable to restrictions on water supply. Potential damages of a severe drought could include losses of landscaped areas if outdoor watering is restricted and potential loss of business revenues if water supplies were severely restricted for a prolonged period. As this hazard has never occurred to such a severe degree in Littleton, 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. Another potential vulnerability of droughts could be increased risk of wildfires.

### 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. For drought warning and watch levels, the chance is 2% and 8% respectively in any given month. See Table 14 for more information.

**Table 16: Frequency of Massachusetts Drought Levels**

| Drought Level | Frequency Since 1850 | Probability 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*

### 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:

- 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

## LANDSLIDE HAZARDS

According to the USGS, "The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. 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 destructiveness. Table 17 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.

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.

**Table 17: 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

## 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.

Most of Littleton is classified as having a low risk for landslides, while a very small corner of the western edge of Littleton is classified as moderate risk (see Map 4, Appendix A). The Town does not have records of any damages caused by landslides in Littleton.

Should a landslide occur 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 transportation and other infrastructure, and localized road closures. Potential damages would depend on the extent of impact, based on how many properties were affected. Given the relatively high assessed value of property in Littleton, damages affecting a single residence could exceed $500,000, and damages affecting several homes or business properties could theoretically total several million dollars. However, there are no data available on landslide damages in Littleton, 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 Littleton.

Based on past occurrences and the Resilient Massachusetts Plan, landslides are very low, very unlikely, minimal examples of historical occurrences.

## *CLIMATE TRENDS: RISING TEMPERATURES*

# EXTREME TEMPERATURE HAZARDS

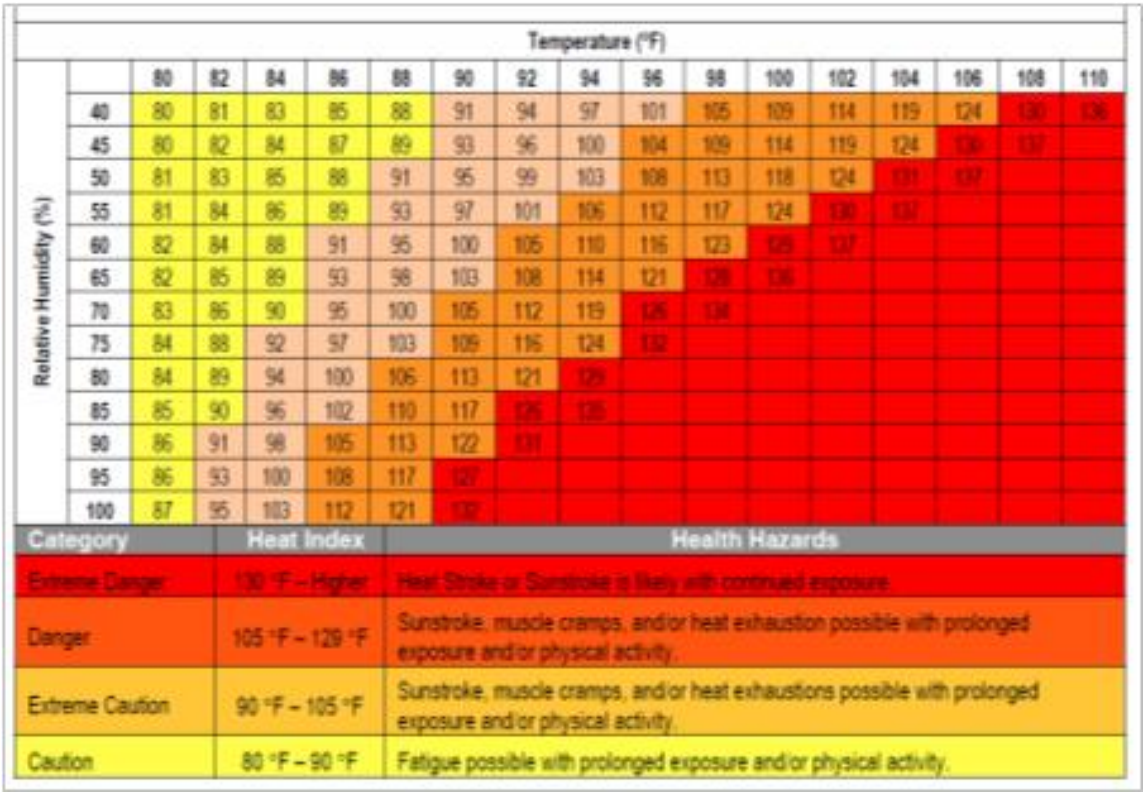
### *AVERAGE AND EXTREME TEMPERATURES*

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. a
Littleton 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 citywide 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 14) 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 above105 degree F.

**Figure 14: Heat Index Chart**




Source: National Weather Service

The best available data on past occurrences of extreme heat events is from NOAA's National Centers for Environmental Information (NCEI) for Middlesex County, which includes Littleton. The NCEI records indicate that In the last decade, there have been two excessive heat events recorded, with one reported death, no injuries, and no property damage (see Table 18).

**Table 18: Middlesex County Extreme Heat Occurrences 2010-2023**

| Date | Deaths | Injuries | Damage |
|---|---|---|---|
| 7/6/2010 | 0 | 0 | 0 |
| 7/5/2013 | 1 | 0 | 0 |
| **TOTAL** | **1** | **0** | **0** |

Source: NOAA, National Centers for Environmental Information

Extreme heat poses a potentially greater risk to the elderly, children, and people with certain medical conditions. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather.

Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions; in Littleton approximately 16.3% of the population is over age 65. People who live in older housing stock and in housing without air conditioning have increased vulnerability to heat-related illnesses. Areas with less shade and darker surfaces (pavement and roofs) will experience even hotter temperatures; these surfaces absorb heat during the day and release it in the evening, keeping nighttime temperatures warmer as well.

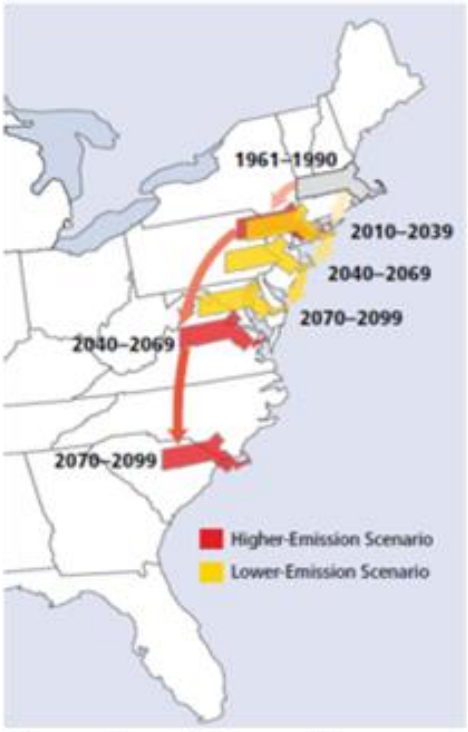
Hot summer days can worsen air pollution. With increased extreme heat, urban areas are likely to experience more days that fail to meet air quality standards. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage.

## Extreme Heat and Climate Change

The 2022 MA Climate Change Assessment includes projections of climate-driven future increases in average temperature and in the number of extreme heat days. The assessment also highlights the following climate impacts for the Eastern Inland Region, related to temperatures. Over time our climate will become more similar to areas well to the south of New England (Figure 15).

- 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 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.
- 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

**Figure 15: Climate Impact Scenarios**



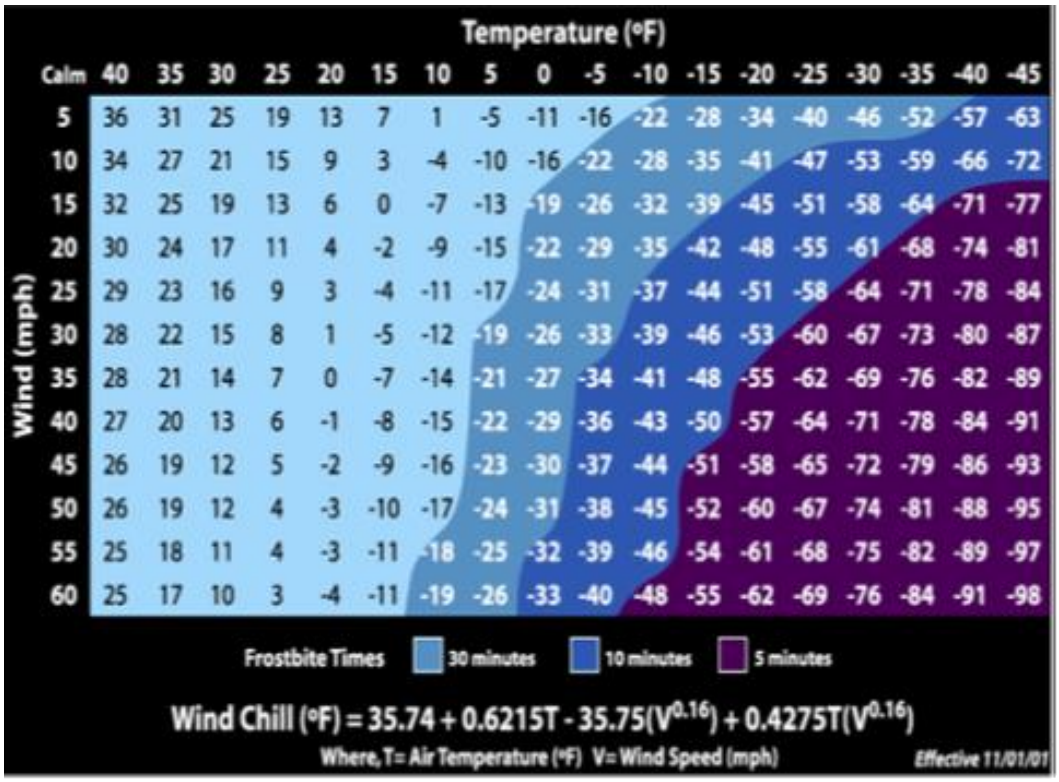

Source: Union of Concerned Scientists

The 2018 SHMCAP identifies ecosystems that are expected to be particularly vulnerable to warming temperatures. These include cold-water fisheries, vernal pools, spruce-fir forests, northern hardwood forests (Maple, Beach, Birch), Hemlock forests, and urban forests (due to heat island impacts). Other Impacts on natural resources include a longer growing season and northern migration of plants and animals, including invasive species.

## *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 severity of extreme cold temperature is typically measured using the Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed. The index is provided in Figure 16. A Wind Chill warning is issued when the Wind Chill Index is forecast to fall below -25 degrees F for at least 3 hours.

**Figure 16: Wind Chill Temperature Index and Frostbite Risk**




Source: National Weather Service

The best available data on past occurrences of extreme cold events are from NOAA's National Centers for Environmental Information (NCEI) for Middlesex County, which includes Littleton. There were three extreme cold events recorded by NCEI in the past ten years (Table 19), which caused no deaths, no injuries, or property damage.

**Table 19: Middlesex County Extreme Cold and Wind Chill Occurrences**

| Date | Deaths | Injuries | Damages |
|---|---|---|---|
| 2/15/2015 | 0 | 0 | 0 |
| 2/16/2015 | 0 | 0 | 0 |
| 2/14/2016 | 0 | 0 | 0 |
| **TOTAL** | **0** | **0** | **0** |

Source: NOAA, National Centers for Environmental Information

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 greatest vulnerability to the Littleton would be a power outage during a winter storm, which could temporarily leave many residents without heat. In Littleton, 16.3% of residents are 65 years old and over, and 7% are living in poverty (US Census Bureau, 2021).

Extreme temperatures are a community-wide hazard in Littleton. Extreme temperature events are projected to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan. 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.

## INVASIVE SPECIES

The 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan includes invasive species as a natural hazard for the first time. They are defined as "non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health". In new habitats invasive species displace native species because they have competitive advantages including no biological controls from their native habitat. Climate change is predicted to increase the abundance of invasive species and expand their habitat ranges. Species hierarchies in ecosystems are also expected to change, and ecosystems that are stressed (due to climate-change associated drought, increased temperatures, wildfires, etc.) will be more susceptible to invasive species.

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.

Littleton is experiencing the loss of flood storage capacity and seeing a minor increase of fire danger from dead vegetation resulting from invasive species. The invasive plant species of concerns in Littleton are currently phragmites, oriental bittersweet, Japanese knotweed as well as the following insects, wooly adelgid, lanternfly, emerald ash borer, and the Asian long-horned beetle.

## WILDFIRE HAZARDS

A wildfire is a non-structure fire occurring in a forested, shrub, 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.

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.

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 (NWCG, 2023) .

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. Fires can present a hazard where there is the potential 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. The most common cause of wildfires is the careless disposal of smoking materials and untended campfires.

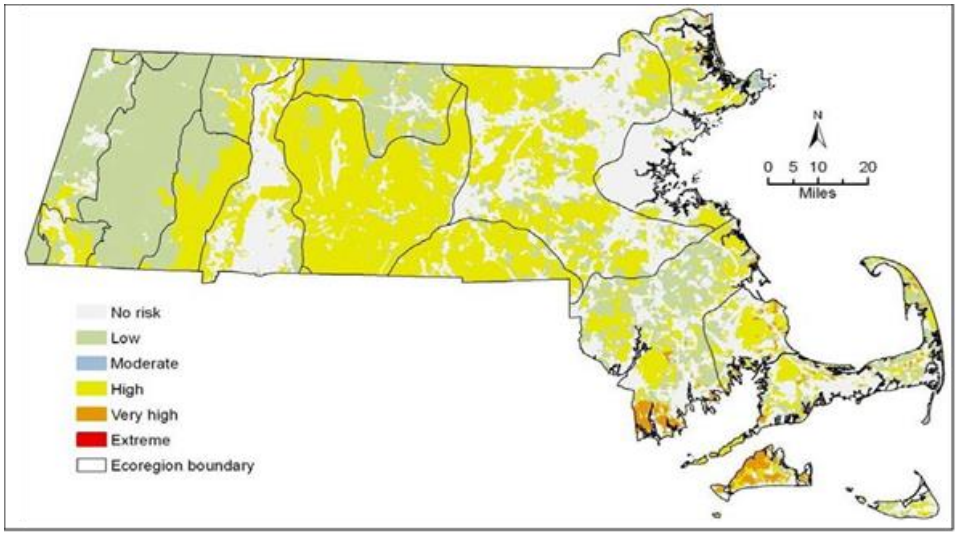
If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If a wildfire destroys ground cover, erosion becomes one of several potential problems.

Wildfires in Massachusetts are measured by the number of fires and the sum of acres burned. The most recent data available for wildfires in Massachusetts, shown in Figure 17 below.

## Potential Wildfire Hazard Areas

The 2018 SHMCAP includes a map that depicts statewide fire risk incorporating three risk components: fuel, wildland-urban interface, and topography (Figure 17). The wildland-urban interface reflects communities where housing and vegetation intermingle, and fire can spread from structures to vegetated areas.

**Figure 17: Wildfire Risk Areas in Massachusetts**




Source: 2018 SHMCAP

Potential vulnerabilities to wildfires include damage to structures and other improvements, and impacts on natural resources such as wildlife habitat. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Should a wildfire occur in Littleton or in other nearby communities, the resulting smoke could have negative impacts on air quality. This could have public health impacts, particularly for those with respiratory conditions such as asthma. The Massachusetts Department of Public Health Bureau of Environmental Health states that Littleton has a lower pediatric asthma prevalence in K-8 students, and a lower rate of asthma emergency department visits, than the state average (MA Dept of Public Health, 2022) . However, given the low extent of wildfires in the town and the immediate response times to reported fires in Littleton the likelihood of injuries and casualties is minimal.

Since 2019, the Fire Department has responded to 3 brushfires in 2019, 6 in 2020, 11 in 2021, 9 in 2022 and 12 in 2023.

## Potential Brushfire Hazard Areas

The following areas of Town were identified as having the highest potential for brush fires based on the accumulation of dried vegetation growth. The numbers correspond to the numbers on Map 8, “Hazard Areas” in Appendix B.

8. Oak Hill Conservation Site, 200 acres.
9. Newtown Hill Conservation Area, 98 acres
10. Morgan Property/Forest Foundation, 50 acres
11. Frost and Whitcomb land off Newton Road, 103 acres
14. Smith Conservation land, Moore Lane/Wickham Lane
15. Cobb/Yapp Conservation land, by Newtown Road

Potential vulnerabilities to wildfires include damage to structures and other improvements, and impacts on natural resources such as town conservation land. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases.

Potential damages from wildfires in Littleton would depend on the extent and type of land affected. Based on past occurrences and the Massachusetts Resilience Plan, brushfires are of Medium frequency, meaning that they are likely to occur at least once every 50 years (two or more occurrences this century).

### *WILDFIRE AND CLIMATE CHANGE*

As the climate warms, drought and warmer temperatures may increase the risk of wildfire as vegetation dries out and becomes more flammable. Increasing drought 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 Littleton is located (Commonwealth of Massachusetts, 2022) .

## *CLIMATE TRENDS: EXTREME WEATHER*

Extreme weather includes wind-related hazards (such as hurricanes, tropical storms, tornadoes, and thunderstorms) as well as winter weather (such as Nor'easters, blizzards, and ice conditions. Following is a description of the types of natural hazards associated with extreme weather events.

## WIND HAZARDS

Wind-related hazards include hurricanes, tropical storms, and tornadoes as well as high winds during Nor'easters and thunderstorms. As with many communities, falling trees that result in downed power lines and power outages are an issue in Littleton. Information on wind related hazards can be found on Map 5 in Appendix A, which indicates that the 100-year wind speed in Littleton is 110 miles per hour.

### *HURRICANES AND TROPICAL STORMS*

A hurricane is a violent wind and rainstorm with wind speeds of 74-200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as the storm hits the land. The Town's entire area is vulnerable to hurricanes. Hurricanes occur between June and November. A tropical storm has similar characteristics, but wind speeds are below 74 miles per hour.

Since 1900, Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm.

As shown in Map 5 in Appendix A, the following storms tracked through Littleton:

- Category 1 Hurricane in 1858
- Category 2 Hurricane in 1960
- Tropical Depression in 1988
- Tropical Storm in 1999

In addition, Littleton experiences the impacts of hurricanes and tropical storms regardless of whether the storm track passes directly through the Town, and numerous hurricanes have affected the communities of eastern Massachusetts (see Table 20).

**Table 20 Hurricane Records for Massachusetts, 1938 - 2023**

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

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. The following gives an overview of the wind speeds, surges, and range of damage caused by different hurricane categories:

| Scale No. (Category) | Winds(mph) Storm | 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: NOAA

Falling trees and branches are a significant problem because they can result in power outages when they fall on power lines or block traffic and emergency routes. Hurricanes are a town-wide hazard in Littleton. Potential hurricane damages to Littleton have been estimated using HAZUS-MH. Total damages are estimated at $15 million for a 100 hurricane and $53 Million for a 500 year hurricane.

Based on records of previous occurrences, hurricanes in Littleton are a medium frequency event as defined by the Massachusetts Resilience Plan. This hazard is likely to occur every fifty years.

### 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

## *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. Generally defined as a storm that includes thunder, which always accompanies lightning, a thunderstorm is a storm event featuring 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.

Eastern Massachusetts is at risk of one to two severe thunderstorms per year. The best available data on previous occurrences of thunderstorms in Littleton is through NOAA's National Centers for Environmental Information (NCEI). For the years 2010 to 2022, NCEI records show 84 thunderstorm wind events in Middlesex County (Table 21). These storms resulted in an estimate of $3.47 million in property damage. There were seven injuries and no death reported.

**Table 21: Middlesex County Thunderstorm Wind Events, 2010 to 2023**

| DATE | MAGNITUDE (knots) | DEATHS | INJURIES | PROPERTY DAMAGE $ |
|---|---|---|---|---|
| **5/4/2010** | 50 | 0 | 0 | 30000 |
| **6/1/2010** | 50 | 0 | 0 | 5000 |
| **6/3/2010** | 50 | 0 | 0 | 20000 |
| **6/5/2010** | 50 | 0 | 0 | 40000 |
| **6/6/2010** | 50 | 0 | 1 | 100000 |
| **6/24/2010** | 50 | 0 | 0 | 30000 |
| **7/12/2010** | 50 | 0 | 0 | 50000 |
| **7/19/2010** | 50 | 0 | 0 | 25000 |
| **6/1/2011** | 50 | 0 | 0 | 5000 |
| **6/9/2011** | 50 | 0 | 0 | 15000 |
| **8/2/2011** | 50 | 0 | 0 | 1000 |

| | | | | |
|---|---|---|---|---|
| **8/19/2011** | 50 | 0 | 0 | 15000 |
| **6/8/2012** | 50 | 0 | 0 | 25000 |
| **6/23/2012** | 45 | 0 | 0 | 5000 |
| **7/4/2012** | 50 | 0 | 0 | 10000 |
| **7/18/2012** | 70 | 0 | 0 | 350000 |
| **9/7/2012** | 50 | 0 | 0 | 10000 |
| **9/8/2012** | 40 | 0 | 0 | 3000 |
| **6/17/2013** | 50 | 0 | 0 | 25000 |
| **6/18/2013** | 45 | 0 | 0 | 10000 |
| **6/24/2013** | 45 | 0 | 0 | 3000 |
| **7/23/2013** | 50 | 0 | 0 | 20000 |
| **7/29/2013** | 50 | 0 | 0 | 5000 |
| **7/3/2014** | 50 | 0 | 0 | 75000 |
| **7/7/2014** | 87 | 0 | 0 | 100000 |
| **7/15/2014** | 50 | 0 | 0 | 25000 |
| **7/28/2014** | 50 | 0 | 0 | 50000 |
| **9/6/2014** | 50 | 0 | 1 | 15000 |
| **5/28/2015** | 45 | 0 | 0 | 5000 |
| **8/4/2015** | 50 | 0 | 0 | 40000 |
| **8/15/2015** | 50 | 0 | 0 | 25000 |
| **2/25/2016** | 50 | 0 | 0 | 30000 |
| **3/17/2016** | 45 | 0 | 0 | 5000 |
| **7/22/2016** | 50 | 0 | 0 | 14,000 |
| **7/23/2016** | 50 | 0 | 0 | 0 |
| **8/22/2016** | 50 | 0 | 0 | 0 |
| **9/11/2016** | 50 | 0 | 0 | 10,000 |
| **5/18/2017** | 50 | 0 | 0 | 0 |
| **6/13/2017** | 52 | 0 | 0 | 0 |
| **6/23/2017** | 52 | 0 | 0 | 1000 |
| **6/27/2017** | 50 | 0 | 0 | 0 |
| **7/12/2017** | 50 | 0 | 0 | 0 |
| **8/2/2017** | 50 | 0 | 0 | 0 |
| **9/6/2017** | 50 | 0 | 0 | 0 |
| **5/15/2018** | 40 | 0 | 0 | 0 |
| **6/18/2018** | 50 | 0 | 0 | 0 |
| **6/25/2018** | 43 | 0 | 0 | 0 |
| **7/17/2018** | 50 | 0 | 0 | 3000 |
| **7/26/2018** | 50 | 0 | 0 | 5000 |
| **8/7/2018** | 50 | 0 | 0 | 3000 |
| **8/17/2018** | 50 | 0 | 0 | 4000 |

| | | | | |
|---|---|---|---|---|
| **9/6/2018** | 50 | 0 | 0 | 2000 |
| **10/23/2018** | 46 | 0 | 0 | 10,000 |
| **6/30/2019** | 50 | 0 | 0 | 800 |
| **7/17/2019** | 50 | 0 | 0 | 7250 |
| **7/31/2019** | 50 | 0 | 0 | 2500 |
| **8/7/2019** | 50 | 0 | 0 | 800 |
| **9/4/2019** | 55 | 0 | 0 | 26700 |
| **5/15/20** | 50 | 0 | 0 | 285,000 |
| **6/06/20** | 50 | 0 | 0 | 7000 |
| **6/21/20** | 50 | 0 | 0 | 38,200 |
| **6/28/20** | 55 | 0 | 0 | 6000 |
| **7/02/20** | 50 | 0 | 0 | 15300 |
| **7/05/20** | 50 | 0 | 0 | 12300 |
| **7/23/20** | 60 | 0 | 0 | 40600 |
| **7/30/20** | 50 | 0 | 0 | 3100 |
| **8/22/20** | 50 | 0 | 0 | 6000 |
| **8/23/20** | 50 | 0 | 0 | 25600 |
| **8/27/20** | 50 | 0 | 0 | 1600 |
| **10/07/20** | 61 | 0 | 5 | 6500 |
| **11/15/20** | 56 | 0 | 0 | 4000 |
| **5/6/21** | 50 | 0 | 0 | 800 |
| **6/30/21** | 50 | 0 | 0 | 500 |
| **7/6/21** | 50 | 0 | 0 | 18,500 |
| **7/7/21** | 55 | 0 | 0 | 7,600 |
| **7/27/21** | 52 | 0 | 0 | 33,800 |
| **8/19/21** | 50 | 0 | 0 | 1,300 |
| **9/13/21** | 50 | 0 | 0 | 400 |
| **3/7/22** | 56 | 0 | 0 | 19,000 |
| **7/2/22** | 50 | 0 | 0 | 800 |
| **7/21/22** | 50 | 0 | 0 | 500 |
| **8/5/22** | 50 | 0 | 0 | 9,900 |
| **8/7/22** | 60 | 0 | 0 | 30,300 |
| **8/26/22** | 50 | 0 | 0 | 7,800 |
| **9/13/22** | 50 | 0 | 0 | 3,000 |
| **6/2/23** | 52 | 0 | 0 | 20,000 |
| **TOTAL** | | **0** | **7** | **$3.48M** |

*Magnitude refers to maximum wind speed Source: NOAA, National Climatic Data Center

Severe thunderstorms are a townwide hazard for Littleton. The town's vulnerability to severe thunderstorms is like 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 Littleton are high frequency events. This hazard 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 events are frequently associated with thunderstorms and other severe storm events. Hail size typically refers to the diameter of the hailstones. Warnings may report hail size through comparisons with real-world objects that correspond to certain diameters as shown in Table 22.

**Table 22: 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 |
| Teacup | 3.00 |
| Grapefruit | 4.00 |
| Softball | 4.50 |

Source: NOAA

Potential damages from larger-size hail could include damage to vehicles, windows, and other structures. The best available data on previous hail events are recorded for Middlesex County through NOAA's National Centers for Environmental Information (NCEI) Storm Events Database. There were 9 hail events recorded from December 2012 through December 2022, as shown in Table 23. There was no property damage, injuries, or deaths reported for any of these hail events.

**Table 23: Middlesex County Hail Events, 2012-2023**

| Date | Magnitude | Deaths | Injuries | Property Damage ($) |
|---|---|---|---|---|
| 5/4/2010 | 0.75 | 0 | 0 | 0 |
| 5/7/2011 | 0.75 | 0 | 0 | 0 |
| 6/1/2011 | 0.75 | 0 | 0 | 0 |
| 8/2/2011 | 0.75 | 0 | 0 | 0 |
| 8/19/2011 | 0.75 | 0 | 0 | 0 |
| 3/13/2012 | 1.25 | 0 | 0 | 0 |
| 3/14/2012 | 1 | 0 | 0 | 0 |
| 6/23/2012 | 0.75 | 0 | 0 | 0 |
| 7/18/2012 | 1 | 0 | 0 | 0 |
| 10/30/201 | 1 | 0 | 0 | 0 |
| 6/17/2013 | 0.75 | 0 | 0 | 0 |
| 5/25/2014 | 0.75 | 0 | 0 | 0 |
| 7/3/2014 | 1 | 0 | 0 | 0 |
| 8/7/2014 | 0.75 | 0 | 0 | 0 |
| 9/6/2014 | 0.88 | 0 | 0 | 0 |
| 8/4/2015 | 1 | 0 | 0 | 0 |
| 8/15/2015 | 0.75 | 0 | 0 | 0 |
| 7/23/2016 | .75 | 0 | 0 | 0 |
| 6/27/2017 | 1.00 | 0 | 0 | 0 |
| 8/2/2017 | .75 | 0 | 0 | 0 |
| 6/29/19 | .75 | 0 | 0 | 0 |
| 6/06/20 | 1.00 | 0 | 0 | 0 |
| 6/28/20 | 1.00 | 0 | 0 | 0 |
| 7/30/20 | .75 | 0 | 0 | 0 |
| 8/23/20 | 1.00 | 0 | 0 | 0 |
| 6/2/23 | .75 | 0 | 0 | 0 |
| **TOTAL** | | **0** | **0** | **0** |

*Source: NOAA, National Centers for Environmental Information*

**Magnitude refers to diameter of hail stones in inches*

The town has not reported any local damages associated with hail. 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. Hail events are a potential town-wide hazard in Littleton. Based on the record of previous occurrences in Middlesex County, hail events in Littleton are a Medium frequency event. This hazard may occur from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

## ***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
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

Tornados are most common in the summer, June through August and most form in the afternoon or evening. Tornados can be associated with strong thunderstorms.

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 the Table below:

**Table 24: Enhanced Fujita Scale**

| Scale | Wind speed | | Relative frequency | Potential damage | |
|---|---|---|---|---|---|
| | mph | km/h | | | |
| EF0 | 65–85 | 105–137 | 53.5% | Minor damage.<br>Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.<br>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.<br>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.<br>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.<br>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.<br>Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated. |  |
| EF5 | >200 | >322 | <0.1% | Massive Damage.<br>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. |  |

Source: SHMCAP 2018

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touchdown somewhere in the Northeast region every year. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC).

Recent tornado events in Massachusetts resulted in significant damage in Springfield in 2011 and in Revere in 2014. The Springfield tornado caused significant damage and resulted in four deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16, 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 damage and 13 homes and businesses were rendered uninhabitable. And 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. According to the report from the National Centers for Environmental Information:

> *"This tornado touched down near the Cambridge Turnpike and headed northeast. Most of the damage was concentrated in an area beginning near the intersection of Lexington Road and Alcott Road and continuing up to the neighborhood of Alcott and Independence Roads. Numerous trees were uprooted or had the tops sheared off. These subsequently blocked roads, damaged homes, and downed power lines, cutting off power to the neighborhood. In addition, utility poles were downed either from the wind or from the downed power lines. Thirty-nine houses in this area were damaged to some degree. Only one house suffered significant structural damage. The tornado continued for a short distance beyond this neighborhood before lifting. The historical home of Louisa May Alcott and her family was right next to the tornado path but was not damaged."*

There has been one recorded tornado within the limits of the Town of Littleton on October 30, 1970. Since 1955 there have been 18 tornadoes in surrounding Middlesex County recorded by the National Center for Environmental Information. Two of these were F3 tornados, and four were F2. These 18 tornadoes resulted in a total of one fatality and six injuries and $4.88 million in damages, as summarized in Table 25.

**Table 25: Tornado Records for Middlesex County**

| Date | Fujita Scale | Fatalities | Injuries | Property Damage $ | Length (mile) | Width (yard) |
|---|---|---|---|---|---|---|
| 10/24/1955 | 1 | 0 | 0 | 2.50K | 10 | 0.1 |
| 6/19/1957 | 1 | 0 | 0 | 25.00K | 17 | 1 |
| 6/19/1957 | 1 | 0 | 0 | 0.25K | 100 | 0.5 |
| 7/11/1958 | 2 | 0 | 0 | 250.00K | 17 | 1.5 |
| 8/25/1958 | 2 | 0 | 0 | 2.50K | 50 | 1 |
| 7/3/1961 | 0 | 0 | 0 | 25.00K | 10 | 0.5 |
| 7/18/1963 | 1 | 0 | 0 | 25.00K | 50 | 1 |
| 8/28/1965 | 2 | 0 | 0 | 250.00K | 10 | 2 |
| 7/11/1970 | 1 | 0 | 0 | 25.00K | 50 | 0.1 |
| 10/3/1970 | 3 | 1 | 0 | 250.00K | 60 | 35.4 |
| 7/1/1971 | 1 | 0 | 1 | 25.00K | 10 | 25.2 |
| 11/7/1971 | 1 | 0 | 0 | 0.25K | 10 | 0.1 |
| 7/21/1972 | 2 | 0 | 4 | 2.500M | 37 | 7.6 |
| 9/29/1974 | 3 | 0 | 1 | 250.00K | 33 | 0.1 |
| 7/18/1983 | 0 | 0 | 0 | 0.25K | 20 | 0.4 |
| 9/27/1985 | 1 | 0 | 0 | 0.25K | 40 | 0.1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8/7/1986 | 1 | 0 | 0 | 250.00K | 73 | 4 |
| 8/22/2016 | 1 | 0 | 0 | 1.000M | 400 | .85 |
| 8/23/2021 | 0 | 0 | 0 | 10.00K | | |
| **TOTAL** | | **1** | **6** | **4.88M** | | |

Source: NOAA, National Center for Environmental Information

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. At this time, the Massachusetts State Building Code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence.

Although tornadoes are a potential town-wide hazard in Littleton, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Littleton would greatly depend on the track of the tornado. Generally, the more densely developed areas including Littleton Common, Long Pond, and other residential clusters, would likely be subject to more damage in the event of a tornado.

Based on the record of previous occurrences since 1950, Tornado events in Littleton are a Medium frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

Tornadoes and Climate Change

According to the SHMCAP, it is possible that severe thunderstorms which can include tornadoes may increase in frequency and intensity. However, scientists have less confidence in the models that seek to project future changes in tornado activity. Massachusetts' 2022 Climate Change Assessment does not include information related to tornadoes.

## WINTER 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.

### *SEVERE WINTER STORM/NOR'EASTER*

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. Nor'easters may

also sit stationary for several days, affecting multiple tide cycles and extended heavy precipitation.

Previous occurrences of Nor'easters are listed in Table 26 from the Massachusetts State Hazard Mitigation Plan:

**Table 26: 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 |

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 December 2010, October 2011, February 2013, and January 2015, and March 2018 were large nor'easters that caused significant snowfall amounts.

Littleton 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, and block access for emergency vehicles.

The entire Town of Littleton 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 is not subject to coastal hazards.

Based on the record of previous occurrences, nor'easters in Littleton are high frequency events as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

## *BLIZZARDS & HEAVY SNOW*

A blizzard is a winter snow storm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below ¼ mile. These conditions must be the predominant condition over a 3 hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. The hazard created by the combination of snow, wind and low visibility significantly increases, however, with temperatures 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 4 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. Blizzards and winter storms are often associated with a Nor'easter event (see Nor'easters section above).

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 24.

**Table 27: 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 winter storm in recent history was the "Blizzard of 1978," which resulted in over 3 feet of snowfall and multiple day closures of roadways, businesses, and schools.

The best available data on previous occurrences and impacts of heavy snow events in Littleton is available for Middlesex County from the National Centers for Environmental Information (NCEI) records. From 2010 to 2022, Middlesex County experienced nearly 40 days with heavy snowfall events, resulting in no injuries, deaths, and property damage of $142,500, as shown in Table 25.

**Table 28: Heavy Snow Events in Middlesex County, 2010 to 2022**

| Date | Deaths | Injuries | Property Damage ($) |
|---|---|---|---|
| 1/18/2010 | 0 | 0 | 0 |
| 2/16/2010 | 0 | 0 | 15,000 |
| 2/23/2010 | 0 | 0 | 8,000 |

| | | | |
|---|---|---|---|
| 1/12/2011 | 0 | 0 | 0 |
| 10/29/2011 | 0 | 0 | 30,000 |
| 12/29/2012 | 0 | 0 | 0 |
| 2/8/2013 | 0 | 0 | 0 |
| 2/8/2013 | 0 | 0 | 0 |
| 2/23/2013 | 0 | 0 | 0 |
| 3/7/2013 | 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 |
| 1/18/2014 | 0 | 0 | 0 |
| 2/5/2014 | 0 | 0 | 0 |
| 2/13/2014 | 0 | 0 | 0 |
| 2/18/2014 | 0 | 0 | 0 |
| 11/26/2014 | 0 | 0 | 10,000 |
| 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 |
| 2/5/2016 | 0 | 0 | 75,000 |
| 3/21/2016 | 0 | 0 | 0 |
| 4/4/2016 | 0 | 0 | 0 |
| 12/29/2016 | 0 | 0 | 0 |
| 3/14/2017 | 0 | 0 | 0 |
| 11/15/2018 | 0 | 0 | 0 |
| 12/1/2019 | 0 | 0 | 4,000 |
| 1/18/20 | 0 | 0 | 0 |
| 3/23/20 | 0 | 0 | 0 |
| 10/30/20 | 0 | 0 | 500 |
| 12/05/20 | 0 | 0 | 0 |
| 12/16/20 | 0 | 0 | 0 |
| 2/1/21 | 0 | 0 | 0 |
| 1/28/22 | 0 | 0 | 0 |
| **TOTAL** | **0** | **0** | **$142,500** |

Source: NOAA, National Climatic Data Center

An indication of previous severe winter events is the list of Presidentially-declared disasters for blizzards snowstorms. There have been 14 since 1978, as shown in Table 29. The most significant single winter storm was the "Blizzard of 1978," which resulted in over three feet of snowfall and multiple day closures of roadways, businesses, and schools. The record snowfall of January 2015

resulted from a series of storms over that month. The most recent significant winter event was Winter Storm Kenan (January 29, 2022), which resulted in 30.9" of snow in Massachusetts (Stucker, 2022) .

**Table 29: Winter-Related Federal Disaster Declarations, 1978-2022**

| Disaster Name | Date of Event |
|---|---|
| Coastal Storms, Flood, Ice & Snow | February 1978 |
| Winter Coastal Storm | December 1992 |
| Blizzard | March 1993 |
| Blizzard | January 1996 |
| Snowstorm | March 2001 |
| Snowstorm | February 2003 |
| Snowstorm | December 2003 |
| Snowstorm | January 2005 |
| Severe Winter Storm, Snowstorm | January 2011 |
| Severe Winter Storm, Snowstorm, Flooding | February 2013 |
| Severe winter storm, snowstorm, flooding | January 2015 |
| Severe winter storm and Snowstorm | March 2018 |
| Severe winter storm and flooding | March 2018 |
| Severe winter storm and snowstorm | January 2022 |

*Sources: OpenFEMA Dataset: Disaster Declarations and FEMA Declared Disasters*

Blizzards are considered to be high frequency events based on past occurrences. This hazard occurs more than once in five years, with a greater than 20 percent chance of occurring yearly.

Potential Snow Hazard Areas

One challenge the town faces is occasional snow drifting onto Nagog Hill Road (4) and Newtown Road (5) see locations on Map 6 in Appendix A). The Town has purchased portable barriers to prevent drifting on these roads.

## 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.

Sleet and hail are other forms of frozen precipitation. Sleet occurs when raindrops fall into subfreezing air thick enough that the raindrops refreeze into ice before hitting the ground. The difference between sleet and hail is that sleet is a wintertime phenomenon whereas hail falls from

convective clouds (usually thunderstorms), often during the warm spring and summer months (a description of hail is included in a subsequent report section).

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. Middlesex County, which includes the Town of Littleton, experienced three events from 1998 to 2023 which caused a total of $3,155,000 in damages (Table 30).

**Table 30: Middlesex County Ice Storm Events, 1998 –2023**

| BEGIN_DATE | EVENT_TYPE | DEATHS | INJURIES | DAMAGE |
|---|---|---|---|---|
| 1/9/1998 | Ice Storm | 0 | 0 | 5,000 |
| 11/16/2002 | Ice Storm | 0 | 0 | 150,000 |
| 12/11/2008 | Ice Storm | 1 | 0 | 3,000,000 |
| **TOTAL** | | 0 | 0 | **3,155,000** |

Source: NOAA, National Centers for Environmental Information.

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.

Ice storms are considered to be medium-frequency events based on past occurrences. This hazard occurs once in 5 years to once in 50 years, with 2% to 20% chance of occurring each year.

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 which can in turn cause property damage and potential injuries.

Winter storms are a potential town-wide hazard in Littleton. The average annual snowfall for Littleton is 48 - 72 inches (see Map 6 in Appendix B). The Town's vulnerability is primarily related to restrictions to travel on roadways, temporary road closures, school closures, and potential restrictions on emergency vehicle access. The Town works to clear roads and carries out general snow removal operations, and bans on-street parking during snow removal to ensure that streets can be plowed and public safety vehicle access is maximized. Commuter rail operations may also be impacted, as they were in the 2015 blizzard which caused the closure of the MBTA system for one day and limited services on several commuter rail lines, including the Fitchburg line which serves Littleton, for several weeks. Another winter storm vulnerability is power outages due to fallen trees and utility lines.

### 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)

## NON-CLIMATE-INFLUENCED HAZARDS

### *EARTHQUAKES*

Earthquakes are the sole natural hazard for which there is no established correlation with climate impacts. 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). Earthquakes can also trigger landslides

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 31.

**Table 31: 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 2016, 408 earthquakes were recorded in Massachusetts (NESEC). 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 in the distant past, 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. A 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historic records of some of the more significant earthquakes in the region are shown in Table 32.

**Table 32: Historic Earthquakes in Massachusetts or Surrounding Area**

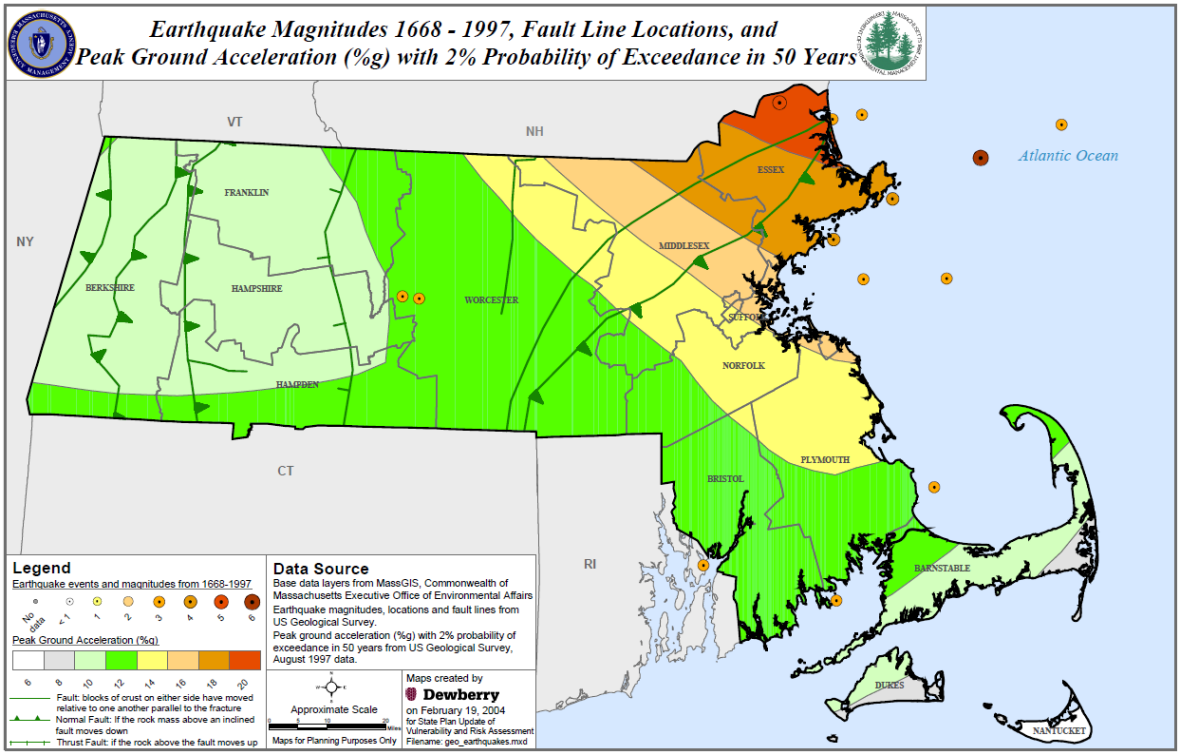
| Location | Date | Magnitude |
|---|---|---|
| MA - Cape Ann | 11/10/1727 | 5 |
| MA - Cape Ann | 12/29/1727 | NA |
| MA - Cape Ann | 2/10/1728 | NA |
| MA - Cape Ann | 3/30/1729 | NA |
| MA - Cape Ann | 12/9/1729 | NA |
| MA - Cape Ann | 2/20/1730 | NA |
| MA - Cape Ann | 3/9/1730 | NA |
| MA – Boston | 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 |
| MA - Nantucket | 4/12/12 | 4.5 |
| ME – Hollis | 10/17/12 | 4.0 |

Source: Boston HIRA

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 10 %g to 20 %g, with a 2% probability of exceedance in 50 years, as shown in Figure 18. Littleton is in the middle part of the range for Massachusetts, at 12-14g, making it a moderate area of earthquake risk relative to the state, although Massachusetts 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 Littleton.

**Figure 18: Massachusetts Earthquake Probability Map**




*Source: 2018 SHMCAP*

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. The majority of older 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 are a potential town-wide hazard in Littleton. The town has many un-reinforced, older buildings which would be vulnerable in the event of a severe earthquake. Potential earthquake damage to Littleton have been estimated using HAZUS-MH. Total damages are

estimated at $353,400,000 for a 5.0 magnitude earthquake and $2.7 billion in a magnitude 7 earthquake.

There are several ways the probability of future occurrences has been estimated. 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. According to the SHMCAP there is a 10-15% chance of a magnitude 5 earthquake in a given ten-year 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,

## LAND USE AND DEVELOPMENT

### EXISTING LAND USE

Table 33 shows the acreage and percentage of land in 15 categories. If the four residential categories are aggregated, residential uses make up 40.6% of the area of the town (4,553 acres). Open land, forest, agriculture, and recreation combined comprise a total of 28.2%, or 3,164 acres. Commercial and industrial combined make up 10.2% of the town, or 1,138 acres.

**Table 33: Littleton Land Use 2016**

| Land Use Category | Acres | Percent (%) |
|---|---|---|
| Open land | 2592 | 23.13 |
| Commercial | 307 | 2.74 |
| Industrial | 798 | 7.12 |
| Forest | 127 | 1.13 |
| Agriculture | 300 | 2.68 |
| Recreation | 145 | 1.29 |
| Tax exempt | 607 | 5.42 |
| Mixed use, primarily residential | 777 | 6.93 |
| Residential - single family | 3365 | 30.03 |
| Residential - multi-family | 278 | 2.48 |
| Residential - other | 133 | 1.19 |
| Mixed use, other | 193 | 1.73 |
| Mixed use, primarily commercial | 33 | 0.29 |
| Right-of-way | 978 | 8.73 |
| Water | 563 | 5.02 |
| **TOTAL** | **11,195** | **100%** |

Source: Massachusetts GIS, 2016 Land Use Inventory

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.

Economic Elements

Littleton has local economic centers located in multiple areas of the town. Business and industrial zones are concentrated in three areas including Littleton Common and the junction of routes 2A/110 and 119, the Route 2 and I-495 interchange, and the western end of Ayer Rd. (Rt. 110). There are approximately 422 businesses and 6755 jobs in Littleton.

Historic, Cultural, and Natural Resource Areas

According to the 2017 Littleton Master Plan, the Littleton Historical Commission has submitted more than 200 properties to MHC's Inventory of Historic and Archaeological Assets of the Commonwealth. The table below shows the town's inventory broken down by the three areas defined in MHC's MACRIS – Littleton, Littleton Common, and Littleton Depot.

**Table 34: Littleton's Historical, Cultural, and Natural Resource Areas**

| Resource Type | Littleton | Littleton Common | Littleton Depot |
|---|---|---|---|
| All types | 21 | 112 | 23 |
| Areas | 1 | 3 | 2 |
| Buildings | 17 | 89 | 21 |
| Objects | 0 | 7 | 0 |
| Structures | 3 | 12 | 0 |
| Burial Grounds | 0 | 1 | 0 |

Source: MACRIS database accessed July 1, 2017.

The Town of Littleton, hosts several arts and cultural institutions. These include the Nashoba Valley Chorale, the Littleton Lyceum (the oldest continuous Lyceum in the United States), The Cannon Theatre, and the Firehouse Coffeehouse. The Master Plan also identifies the Littleton Historical Commission, the Parks and Recreation Commission, the Council on Aging, and the Rueben Hoar Library as important cultural institutions.

Littleton covers about 16.5 square miles of gently rolling hills in northwest Middlesex County. The elevation above sea level ranges between 200 and 500 feet with the higher areas located mostly toward the western end of town. The eastern portion of the Town drains to the Concord River largely via the Nashoba and Fort Pond Brooks to the Assabet River and then to the Concord River. The western portion of Town drains to the Merrimack River via Beaver and Stony Brooks. Water resources, including aquifers and ponds, are shared with neighboring towns. Protection of water resources for drinking, recreation, and aesthetics, is the number one goal of the Town's 2016 Open Space and Recreation Plan. According to the 2016 Plan, nearly 15% of land in Littleton is permanently protected.

## DEVELOPMENT TRENDS

Until the 1940's, agriculture and large land holdings were the predominant land uses. Residential uses have expanded creating a strong suburban component. Supported by improved transportation access, the commercial and industrial sectors have experienced strong growth in the

past three decades. Littleton has experienced housing growth as well, due to the increase in job opportunities in the I-495 corridor, and convenient commuting options for those preferring suburban to urban settings. Development pressure is expected to continue.

Development trends throughout the metropolitan region are tracked by MAPC's Development Database, which provides an inventory of new development over the last decade. The database tracks both completed developments and those currently under construction. The database includes 16 developments in the Town of Littleton since 2017, of which 13 are completed and 3 were under construction or planned in 2024.

The database also includes several attributes of the new development, including site acreage, housing units, and commercial space. Almost of the projects are housing projects.. The 16 developments in Littleton include a total of 109 housing units, and are sited on over 244 acres See the table below.

**Table 35: Summary of Littleton Developments 2017-2023**

| DEVELOPMENTS COMPLETED | ACRES | HOUSING UNITS | PROJECT TYPE | Notes |
|---|---|---|---|---|
| Taylor Street | 87.84 | 0 | Amazon warehouse | Last-mile delivery warehouse completed 2022; included donation of 53-acre new well site parcel to the Water Department |
| Hobbyhorse Hills Subdivision | N/A | | 9-lot single family subdivision. | completed |
| Durkee | 16.50 | 30 | Open Space Subdivision | completed |
| Sanderson | 22.60 | 30 | Open Space Subdivision | completed |
| Chestnut Lane | 40.31 | 6 | Subdivision | completed |
| Russell Street | 9.97 | 0 | 3,000 square foot retail development | Permits approved, but construction not started yet |
| Chase Farm | 9.53 | 0 | Retail development | Tire Barn completed and operating |
| 537 Great Road | 2.62 | 0 | Adult use marijuana manufacturing facility | Adult Use Marijuana retail sales and manufacturing operational inside of existing warehouse building |
| 24 Porter Road | 5.19 | 0 | Dirigible Brewing Company | Use approved operational within existing warehouse space |
| 6 Spectacle Pond Road | 3.15 | 0 | Storage facility with office space | Minor revision approved Jan. 2024; construction not started yet |
| 59 Porter Road | 15.09 | 0 | Co-location of Wireless Telecommunic | This was one of the early cell tower sites in Littleton and remains operational |

| | | | | |
|---|---|---|---|---|
| | | | ations on the cell tower | |
| Webber Village Development | 4.40 | 19 | Senior Residential Development | Complete, includes 2 Affordable units |
| 100 Spectacle Pond Road | 10.46 | 17 | Jones Meadow Senior Residential Development | Complete, includes 2 Affordable units |
| 265 Great Road (Includes 265, 277, 287, 289 Great Road and 25 Robinson Road) | 3.02 | 0 | Branch of Northern bank and commercial facilities | Permitting approved; construction not started yet |
| Kaye Property Subdivision | 11.00 | | Conventional Subdivision | complete |
| The Homes at Croft Corner - 93 Foster Street | 2.35 | 7 | Open Space Development subdivision | complete |
| **TOTAL** | 244.03 | 109 | | |

## Potential Future Development

MAPC consulted with town planning staff to determine areas that may be developed in the future, based on the Town's comprehensive planning efforts and current trends and projects. These areas are described below. 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 with the FEMA Flood Insurance Rate Map. The analysis shows that 11 developments are located partially within a flood zone.

## DEVELOPMENT SITES IN HAZARD AREAS

Table 36 shows the relationship of these parcels to three of the mapped 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.

### Table 36: Littleton New Developments in Relation to Hazard Areas

| Site ID | Parcel | Land Slide Risk | Flood Zone | Brush Fire Risk |
|---|---|---|---|---|
| A | Ayer Road (West) | Low incidence | | No |
| B | Taylor Street | Low incidence | 2.0% in X: 0.2% Annual Chance of Flooding | No |
| C | Hobbyhorse Hills subdivision | Low incidence | | No |
| E | 245 Foster Street | Low incidence | | No |
| F | Gutierrez, 225 Taylor St | Low incidence | | No |
| G | Skyview Lane, 555 Newtown Rd | Low incidence | | Yes |
| H | Durkee | Low incidence | | No |
| I | Sanderson | Low incidence | | No |
| J | Grey Farms | Low incidence | 22.51% in X: 0.2% Annual Chance of Flooding | No |
| K | Chestnut Lane | Low incidence | 0.03% in X: 0.2% Annual Chance of Flooding | No |
| L | Russell Street | Low incidence | | No |
| M | Chase Farms | Low incidence | 3.52% in X: 0.2% Annual Chance of Flooding | No |
| N | 537 Great Road | Low incidence | | No |
| O | 24 Porter Road | Low incidence | 6.47% in AE: 1% Annual Chance of Flooding, with BFE , and 0.37% in AE: Regulatory Floodway , and 9.59% in X: 0.2% Annual Chance of Flooding | No |
| P | 6 Spectacle Pond Road | Low incidence | 26.58% in AE: 1% Annual Chance of Flooding, with BFE | No |
| Q | 59 Porter Road | Low incidence | 41.46% in AE: 1% Annual Chance of Flooding, with BFE | No |
| R | Webber Village Development | Low incidence | | No |
| S | 100 Spectacle Pond Road | Low incidence | | No |
| T | 265 Great Road | Low incidence | | No |
| U | Kaye Property Subdivision | Low incidence | | No |

| | | | | |
|---|---|---|---|---|
| V | The Homes at Croft Corner - 93 Foster St | Low incidence | | No |
| W | 1 and 2 Monarch Drive | Low incidence | 23.31% in AE: 1% Annual Chance of Flooding, with BFE , and 23.87% in X: 0.2% Annual Chance of Flooding | No |
| X | 225 Taylor Street | Low incidence | | No |
| Y | 195 Tahattawan Road | Low incidence | 15.1% in X: 0.2% Annual Chance of Flooding | Yes |
| Z | 555 Newtown Road | Low incidence | | Yes |
| AA | 550 Newtown Road | Low incidence | 61.98% in A: 1% Annual Chance of Flooding, no BFE | No |
| BB | 410 Great Road | Low incidence | | No |
| CC | 254, 256, 260 Ayer Road | Low incidence | | No |
| DD | 336 and 338 King Street | Low incidence | 0.08% in A: 1% Annual Chance of Flooding, no BFE , and 14.42% in AE: 1% Annual Chance of Flooding, with BFE , and 8.9% in X: 0.2% Annual Chance of Flooding | No |
| EE | King Street Commons, 550 King Street | Low incidence | | No |

## CRITICAL INFRASTRUCTURE IN HAZARD AREAS

Critical 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 63 facilities identified in Littleton. These are listed in Table 37 and are shown on the maps in Appendix A.

### Table 37: Critical Facilities and Relationship to Hazard Areas

| ID | NAME | TYPE | LANDSLIDE | WITHIN FEMA FLOOD ZONE | WITHIN LOCALLY IDENTIFIED AREA OF FLOODING | AVERAGE ANNUAL SNOW FALL |
|---|---|---|---|---|---|---|
| 1 | Shaker Lane School | School | Low | No | No | High |
| 2 | Russell Street School | School | Low | No | No | High |
| 3 | Littleton Middle School | School/Primary Emergency Shelter | Low | No | No | High |

| ID | NAME | TYPE | LANDSLIDE | WITHIN FEMA FLOOD ZONE | WITHIN LOCALLY IDENTIFIED AREA OF FLOODING | AVERAGE ANNUAL SNOW FALL |
|---|---|---|---|---|---|---|
| 4 | Littleton High School | School/Secondary Emergency Shelter | Low | No | No | High |
| 5 | Oak Meadow Montessori School | School | Low | No | No | High |
| 6 | Life Care Center | Nursing Home | Low | No | No | High |
| 7 | Police Station | Police Station | Low | No | Beaver Brook/Great Road | High |
| 8 | Fire Station | Fire Station | Low | No | No | High |
| 9 | Town Hall | Town Hall | Low | No | No | High |
| 10 | GFI Distribution Center | Industrial | Low | No | No | High |
| 11 | Shattuck Street Housing | Elderly Housing | Low | No | No | High |
| 12 | First Baptist Church | Place of Assembly | Low | No | No | High |
| 13 | Congregational Church | Place of Assembly | Low | No | No | High |
| 14 | Church of Latter Day Saints | Place of Assembly | Low | No | No | High |
| 15 | Unitarian Church | Place of Assembly | Low | No | No | High |
| 17 | Funeral Home | Funeral Home | Low | No | No | High |
| 18 | Public Water Supply (#1 & #3) | Water | Low | AE | No | High |
| 19 | Littleton Electric Light & Water Dept. | Emergency Operations Center | Low | No | No | High |
| 22 | St. Anne's Church | Place of Assembly | Low | No | No | High |
| 23 | Public Water Supply: Treatment Plant and Well #2 | Water Treatment and Well | Low | No | No | High |
| 24 | Treatment Plant | Water Treatment | Low | No | No | High |
| 25 | Verizon Telephone Hub | Telephone Substation | Low | No | No | High |
| 26 | AT&T Tower and Underground Facility | Telephone Substation | Low | No | No | High |
| 27 | Water Tower (Newtown hill) | Water Tower | Low | No | No | High |

| ID | NAME | TYPE | LANDSLIDE | WITHIN FEMA FLOOD ZONE | WITHIN LOCALLY IDENTIFIED AREA OF FLOODING | AVERAGE ANNUAL SNOW FALL |
|---|---|---|---|---|---|---|
| 28 | Water Tower (Oak Hill) | Water Tower | Low | No | No | High |
| 29 | Water Tower (Cedar Hill) | Water Tower | Low | No | No | High |
| 30 | Littleton Green Apartments | Elderly Housing | Low | No | No | High |
| 31 | Mill Pond Apartments | Elderly Housing | Low | No | No | High |
| 32 | Acton Medical Facility | Medical Office | Low | No | No | High |
| 33 | Sewer Lift Station School & Town Hall | Sewer Lift Station | Low | No | No | High |
| 34 | Minuteman Arc | Group Home | Low | No | Nashoba Road | High |
| 35 | Evergreen Center | Group Home | Low | No | No | High |
| 36 | DSS Group Home | Group Home | Low | No | No | High |
| 38 | Littleton Motor Court | 55+ Trailer Park | Moderate Susceptibility | No | No | High |
| 40 | Littleton Pools | Hazardous Materials | Low | No | No | High |
| 41 | Great Road Garden Center | Hazardous Materials | Low | No | No | High |
| 42 | Aubuchon Hardware | Hardware Store | Low | No | No | High |
| 43 | Middlesex Corporation | Hazardous Materials | Low | No | No | High |
| 44 | Littleton Highway Department | Department of Public Works | Low | No | No | High |
| 5 | Well #5 | Water Supply | Low | No | No | High |
| 46 | Littleton Power Substation | Electric Substation | Low | No | No | High |
| 47 | Aggregate Industries | Hazardous Materials | Low | .2% Annual Chance of Flooding | No | High |
| 49 | Cataldo's | Hazardous Materials | Low | No | No | High |
| 50 | Cupp and Cupp Nursery | Hazardous Materials | Low | No | No | High |
| 52 | Mill Pond Dam | Dam | Low | AE | No | High |

| ID | NAME | TYPE | LANDSLIDE | WITHIN FEMA FLOOD ZONE | WITHIN LOCALLY IDENTIFIED AREA OF FLOODING | AVERAGE ANNUAL SNOW FALL |
|---|---|---|---|---|---|---|
| 53 | Boston Minuteman Campground | Campground | Moderate Susceptibility | No | No | High |
| 54 | The Little Gym | Childcare Facility | Low | No | No | High |
| 55 | MetroWest Bible Church | Place of Worship | Low | No | No | High |
| 56 | Learning Experience | Children's Facility | Low | No | No | High |
| 57 | Fiba Technologies | Hazardous Materials | Low | No | No | High |
| 58 | Horace Mann Group Home | Group Home | Low | AE | No | High |
| 59 | New Group Home | Group Home | Low | No | No | High |
| 60 | Bates Finishing | Hazardous Materials | Low | No | No | High |
| 61 | R&R Pool & Spa | Hazardous Materials | Low | No | No | High |
| 62 | Private Treatment Plant | Treatment Plant | Low | No | No | High |
| 63 | Private Sewage Treatment | Treatment Facility | Low | No | No | High |
| 64 | Indian Hill Music School, King Street | Town-owned site to be redeveloped | Low | No | No | High |
| 65 | Water treatment #3, Whitcomb Ave. | Water treatment | Low | No | No | High |
| 66 | New Wastewater treatment plant to be completed in 2025, 242 King Street | Water treatment | Low | 0.2% Annual Chance of Flooding | No | High |
| 67 | Emerson Health Urgent Care, 830 Constitution Street | Urgent Care | Low | No | No | High |
| 68 | Fiba, 67 Ayre Road | Industrial | Low | No | No | High |
| 69 | PGI Warehouse, Ayre Road | Warehouse | Low | No | No | High |
| 70 | Amazon warehouse, 151 Taylor Road | Warehouse | Low | No | No | High |
| 71 | Reuben Hoar Library | Library | Low | No | No | High |

# 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. For more information on the HAZUS-MH software, go to http://www.fema.gov/plan/prevent/hazus/index.shtm

> "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."

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 Littleton, 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-MH 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 38 - Estimated Damages from Hurricanes**

| | 100 Year | 500 Year |
|---|---|---|
| **Building Characteristics** | | |
| Estimated total number of buildings | 3,873 | |
| Estimated total building replacement value (2006 $) | $2,578,000,000 | |
| | | |
| **Building Damages** | | |
| # of buildings sustaining minor damage | 167 | 648 |
| # of buildings sustaining moderate damage | 12 | 102 |
| # of buildings sustaining severe damage | 0 | 7 |
| # of buildings destroyed | 0 | 8 |
| | | |
| **Population Needs** | | |
| # of households displaced | 0 | 1 |
| # of people seeking public shelter | 0 | 0 |
| | | |
| **Debris** | | |
| Building debris generated (tons) | 657 | 2,916 |
| Tree debris generated (tons) | 1,175 | 2,329 |
| # of truckloads to clear building debris | 26 | 117 |
| | | |
| **Value of Damages** | | |
| Property damage (buildings and content) | $14,570,400 | $49,782,600 |
| Losses due to business interruption | $510,220 | $3,876,900 |
| Total | $15,080,620 | $53,659,500 |

## *ESTIMATED DAMAGES FROM EARTHQUAKES*

The HAZUS-MH 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 magnitude 7.0. Historically, major earthquakes are rare in New England, though a magnitude 5 event occurred in 1963.

**Table 39 - Estimated Damages from Earthquakes**

| | Magnitude 5.0 | Magnitude 7.0 |
|---|---|---|
| **Building Characteristics** | | |
| Estimated total number of buildings | 3,873 | |
| Estimated total building replacement value (2006 $) | $2,578,000,000 | |
| | | |
| **Building Damages** | | |
| # of buildings sustaining slight damage | 1,159 | 109 |
| # of buildings sustaining moderate damage | 588 | 786 |
| # of buildings sustaining extensive damage | 136 | 1,148 |
| # of buildings completely damaged | 30 | 1,823 |
| | | |
| **Population Needs** | | |
| # of households displaced | 67 | 1,766 |
| # of people seeking public shelter | 28 | 723 |
| | | |
| **Debris** | | |
| Building debris generated (tons) | 47,000 | 458,000 |
| # of truckloads to clear debris (@ 25 tons/truck) | 1,880 | 18,320 |
| | | |
| **Value of Damages** | | |
| Property damage | $311,499,200 | $2,408,452,600 |
| Losses due to business interruption | $41,897,000 | $325,743,300 |
| Total | $353,400,000 | $2,734,200,000 |

## *ESTIMATED DAMAGES FROM FLOODING*

The HAZUS-MH flood risk module was used to estimate damages to the municipality at the 100 and 500 return periods. These return periods correspond to flooding events that have a 1% and a 0.2% likelihood of occurring in any given year.

**Table 40: Estimated Damages from Flooding**

| | 100 Year | 500 Year |
|---|---|---|
| **Building Characteristics** | | |
| Estimated total number of buildings | 3,873 | |
| Estimated total building replacement value (2006 $) | $2,578,000,000 | |
| | | |
| **Building Damages** | | |
| # of buildings sustaining slight damage (<10%) | 6 | 2 |
| # of buildings sustaining moderate damage (10-50%) | 4 | 4 |
| # of buildings sustaining substantial damage (>50%) | 0 | 0 |
| | | |
| **Population Needs** | | |
| # of households displaced | 38 | 48 |
| # of people seeking public shelter | 12 | 13 |
| | | |
| **Debris** | | |
| Building debris generated (tons) | 49 | 109 |
| # of truckloads to clear building debris | 2 | 5 |
| | | |
| **Value of Damages** | | |
| Property damage (buildings and content) | $5,060,000 | $8,400,000 |
| Losses due to business interruption | $8,580,000 | $11,380,000 |
| Total: | $13,640,000 | $19,780,000 |

## CLIMATE CHANGE RISK ASSESSMENT SUMMARY

**Table 41: Summary of Hazard Risks for Society, Built Environment, and Natural Resources**

| CLIMATE CHANGE | NATURAL HAZARD | KEY CONCERNS SOCIETY | KEY CONCERNS BUILT ENVIRONMENT | KEY CONCERNS NATURAL RESOURCES |
|---|---|---|---|---|
| **Changes in Precipitation**  | Inland Flooding | Elderly residents and environmental justice populations; property damage. Impacts on businesses | Roadway closures, damage to buildings; impacts on infrastructure | Pollutants, erosion, scouring, damage to habitat |
| | Drought | Increases costs for irrigation, drinking water supply | Impacts on landscaped areas, parks, playing fields, etc. | Impacts on streams, wetlands, vegetation |
| | Landslide | Private property damage | Damage to buildings and infrastructure | Erosion, sedimentation |
| **Sea Level Rise**  | Coastal Flooding | Property damage, impacts on businesses | Roadway closures, damage to buildings; impacts on infrastructure | Damage to coastal habitat |
| **Rising Temperatures**  | Average and Extreme Temperatures | Elderly populations if no access to cooling or financial resources to buy an AC | | Increasing invasives, stress on aquatic and terrestrial habitats |
| | Wildfires | Air Quality - Smoke | Damage to buildings | Damage to resources |
| | Invasive species | Potential health impacts of pests | Impaired use of park and open space | Loss of biodiversity |
| **Extreme Weather**  | Hurricanes / Tropical Storms | Power outages; property damage, impacts to businesses | Street closures, house flooding, emergency access, wind damage to buildings, power outages | Tree damage |
| | Severe Winter Storms | Power outages, elderly, or isolated residents | Damage to public buildings with snow loads, power outages that can affect municipal operations, road blockages. | Tree damage |
| | Tornadoes | Property damage, impacts on businesses | Damage to buildings and infrastructure | Tree damage |
| | Thunderstorms/ Microbursts) | Power outages, property damage | Power loss, road closures (same as above) | Tree damage |
| **Non-Climate Hazard** | Earthquake | Property damage, impacts on businesses | Damage to buildings and Infrastructure | Landslides |

# SECTION 5: HAZARD MITIGATION GOALS

The Littleton Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2017 Hazard Mitigation Plan for the Town of Littleton. All of the goals were found to continue to be reflective of the Town's priorities and concerns relative to natural hazard mitigation. An 11th goal was added to reflect need further mitigate invasive specifies. 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 potential impacts of future climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning.

**Goal 10:** Address priority populations in the hazard mitigation process, including outreach and engagement, analysis of hazard impacts, and development and implementation of mitigation measures.

**Goal 11:** Take proactive measures to manage trees, and invasive species and their impacts on public and private properties.

# SECTION 6: EXISTING MITIGATION MEASURES

The existing protections in the Town of Littleton 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, which were in place prior to the original 2017 Plan, are listed by hazard type here and are summarized in Table 42 below.

### Mitigation Measures Relating to Multiple Hazards

There are several mitigation measures that impact more than one hazard. These include the Comprehensive Emergency Management Plan (CEMP), the Massachusetts State Building Code and participation in a local Emergency Planning Committee.

*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. Littleton's CEMP is currently being updated.

*Massachusetts State Building Code*
The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads. The Town of Littleton has adopted the "Stretch Code." For enhanced energy efficiency.

*Participation in the Local Emergency Planning Committee (LEPC)*

## Flood Related Hazards

### National Flood Insurance Program (NFIP)

Littleton participates in the NFIP with 11 policies in force as of May 1, 2023. The reporting period covers from 1978 to the present day. The following information is provided for the Town of Littleton.

The following information is provided for the Town of Littleton:

| | |
|---|---|
| Flood insurance policies in force (as of May 1, 2023) | 11 |
| Coverage amount of flood insurance policies | $4,324,000 |
| Substantial Damage Claims Since 1978 | 0 |
| Total losses (all losses submitted regardless of the status) | 14 |
| Total payments (Total amount paid on losses) | $101,007 |

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. The Zoning Enforcement Officer enforces the requirements of the floodplain regulations under the National Flood Insurance Program.

Since 1978 there have been no claims paid for substantial damage in Littleton (see table above). The Town implements the Substantial Improvements/Substantial Damages provisions of the floodplain management regulations as required per the NFIP (CFR Title 44, Parts 59 through 65) and Massachusetts State Building Code (780CMR). The Town will also coordinate with State Flood Hazard Management Program staff to assure that proper practices are followed and that a post-disaster plan will be in place to implement all Substantial Improvements/Substantial Damages provisions.

### Other Flood Mitigation Measures

a) All streets are swept twice per year. The Highway Department begins as soon as possible in the spring. The Department has sufficient equipment for sweeping and does the sweeping in-house, although a small portion was contracted out in past years.
b) The Highway Department does sand the roads in the winter, but not in excessive amounts. They mix magnesium chloride with salt to work faster at colder temperatures. All 1300 catch basins are cleaned yearly.
c) The Highway Department is mapping stormwater outlets with GPS.
d) The town uses a trapper to mitigate beaver activity as necessary. A permit to do so is required by state law through the local Board of Health.
e) The town has floodplain regulations (Chapter 173 Zoning, Article XVI Wetlands and Floodplain Regulations) that restrict certain activities and require a special permit for activities located within a flood zone.
f) The town has a wetlands protection bylaw (Chapter 171) to protect resource areas in and around wetlands.
g) The Massachusetts Stormwater Policy is applied to developments within the jurisdiction of the Conservation Commission.
h) The subdivision regulations encourage a preliminary submission to discuss development issues up-front with the Planning Board prior to a significant investment in design efforts. Runoff from subdivision developments may not increase in proposed conditions more than in existing conditions for the 25-year storm. Pipes and detention basins must be designed for the 25-year storm and culverts must be designed for the 50-year storm event.
i) The town has Site Plan review requirements (Chapter 173 Zoning, Article IV Site Plan Requirements). The drainage requirements for site plans must meet those stated in the subdivision regulations.
j) The Aquifer Protection District (Chap. 173 Zoning, Article XIV Aquifer and Water Resource District) requires a permit for any development with 15% or greater impervious coverage. Recharge is required in the aquifer protection district where feasible.
k) A consultant prepared a Low-Impact Development (LID) guide for the Water Department and Town Meeting in 2007 approved to include usage of the recommended LID techniques to the maximum extent practicable for all developments within the aquifer protection district. This is now required for all development.
l) The town has acquired land for open space protection. The Water Department has a land acquisition fund. The Town recently purchased 87 acres of Hartwell property and a conservation restriction on 85 acres of Prouty Woods. The Conservation Commission and Littleton Conservation Trust also purchase and/or oversee conservation areas in the town.
m) The town adopted the Community Preservation Act with a 1% surcharge in May of 2007.

n) The town continues to implement its MS 4 which includes public education programs. The Water Department provides education on stormwater such as: a stormwater media campaign, articles in the Watts and Drops newsletter, information posted on the Water Department website, and a traveling stormwater display posted around town.
o) The May 7, 2024, Annual Town Meeting voted to purchase the 36.49 acre Webster Property for conservation purposes from CPA funds

### Flooding: Existing Site-Specific Mitigation

The following sites were identified by Town staff as areas that have experienced more significant flooding in the past. The numbers in parentheses refer to the Areas of Concern on Map 8 in Appendix A.

*Beaver Brook/Great Road (1)*
Beaver Brook at Great Road (a state highway) has not overtopped in heavy rains. At times there will be high water in the brook, but overtopping does not occur (Jeff Patterson, Police Dept, has never seen it overtopped. The cause of the flooding is due more to the fact that it is within a floodplain area than it does with inadequate drainage infrastructure.

*King Street (2)*
The stream located near a floodplain at this King Street location has caused surface flooding in the past. Cupp and Cupp installed two undersized culverts on a private driveway off of King Street that caused some flooding. Note that King Street is a state highway.

*Nashoba Road (3)*
Nashoba Road had routinely flooded, often due to beaver activity. This site is also located near a floodplain. The town raised the road approximately 2.5 feet at its lowest point by installing retaining walls and fill slopes for a total length of 2400 feet, and the road was repaved in the Fall of 2022. This solution has appeared to alleviate the problem. Water still comes up on to the edge of the road, but doesn't flood the road.

Gilson Road (12)
Gilson road by the train tracks has been having issues with beaver problems, this has required drains to be cleaned. This has not overtopped the road but it's an area that needs to be checked.

## Dam Failures

a) 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.
b) Permits required for construction – State law requires a permit for the construction of any dam.

## Wind-Related Hazards

a) A contracting agency acts as town's Tree Warden. They do minimal trimming around town and concentrate mostly on dead tree removals. They remove approximately 75 to 125 trees per year. They also have a roadside mower to keep vegetation back from the edge of pavement.

b) The Light Department helps with the larger tree removals and trims around the wires. They have a multi-year plan trimming program (approximately a 5 year cycle) to go over their whole system.

c) The Highway Department also has a brush chipper and access to two additional brush chippers from the Light Department. They do not have in-house capability for stump grinding, but contract out yearly for stump grinding needs.

## Winter-Related Hazards

a) The Highway Department provides standard snow plowing operations, including salting and sanding. They are in the process of using a liquid deicer (Magnesium Chloride) in order to minimize sand usage. Currently in the process of exploring a salt brine preapplication that would require no sand.

b) They have enough storage space for the snow, including the parking area of a town-owned field that has a parking area at 57 Russell Street, and town-owned land located at 500 Great Road. Additional space at the Littleton Transfer Station, 38 Spectacle Pond Road and the intersection of Pickard Lane and Great Road has been identified.

## Brush Fire-Related Hazards

a) Town bylaws allow controlled open burning in accordance with state regulations, but a permit is required from the Fire Chief for each day of intended burning.

b) The Fire department reviews all subdivision and site plans for compliance with site access, water supply needs, and all other applicable regulations.

c) The Fire Department maintains a website with substantial public education on fire prevention at:
http://www.littletonma.org/content/19735/19465/26710/26714/default.aspx

## Geologic Hazards

### Earthquakes

a) The middle school and high school are new buildings with backup power that could act as shelters if necessary.

b) The town does have an evacuation plan as specified in its Comprehensive Emergency Management Plan (CEMP).

c) Rivers and ponds in town are available to be tapped into for water supply if necessary.

d) A tanker task force is available through State Fire mobilization. FEMA has 8-12 tankers that can be deployed anywhere in the US within 72 hours.

e) The El Paso gas company monitors provides educational information and training on hazard mitigation for its Tennessee Gas Pipeline.

### Landslides

a) The subdivision regulations do have maximum slope requirements for new roads. Chapter 147of the Town Code, Soil Removal, states a permit is required for moving large amounts of soil to or from a site.

## MULTIHAZARD MITIGATION MEASURES

The Town of Littleton has several mitigation measures in place that address more than one hazard. Major issues in preventing natural hazards in Littleton are the ability of the Fire and Police departments to operate efficiently, or at all, in outdated facilities in the event of a significant natural hazard.

a) *Multi-Department Review of Developments* – Multiple departments, such as Planning, Zoning, Health, Highway, Fire, Police, and Conservation, review all subdivision and site plans prior to approval.

b) *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.

c) *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.

d) *Local Emergency Management Planning Committee (LEPC)*

e) The middle school and high school are new buildings with backup power that could act as shelters if necessary.

f) The town has a backup 911 system in Ayer, and redundant emergency communications systems. The Police Department recently updated its communications network with new radio consoles and towers. The main antenna is at the water tower and the backup antennas are at the Fire and Police Stations.

Existing mitigation measures are summarized in Table 42 below.

### Table 42: Existing Mitigation Measures

| Mitigation Measure | Area Covered | Effectiveness / Comments | Updates and or Improvements since 2017 Plan |
|---|---|---|---|
| **FLOOD RELATED HAZARDS** | | | |
| A) Participation in the National Flood Insurance Program | Town-Wide | Effective/11 policies in force | |
| B) Annual street sweeping | Flood Mitigation | Effective | Sweep twice a year |
| C) Annual catch basin cleaning | Town-Wide | Effective | |
| D) Ongoing drainage system upgrades and maintenance | Flood Mitigation | Effective, six drainage projects completed since the 2010 update | |
| E) Stormwater system mapped in GIS | Town-Wide | Effective | |
| F) Beaver mitigation | Flood Mitigation | Effective | Concord water is handling the beavers that bother Nagog Reservoir. All being managed by the Board of Health. |
| G) Wetlands and Flood Plain Regulations | Town-Wide | Effective | Will need to changed with the new FEMA maps in 2025. |
| H) Wetlands Protection Bylaw | Town-Wide | Effective | |
| I) Massachusetts Stormwater Policy | Town-Wide | Effective, expanded town-wide | |
| J) Stormwater Requirements in Subdivision Regulations | Town-Wide | Effective, expanded town-wide | These regs are set to change in the coming year. |
| K) Stormwater Requirements in Site Plan Review | Town-Wide | Effective | These regs are set to change in the coming year. |
| L) Aquifer Protection District | Town-Wide | Effective | Updated the boundaries of the district, to better protect |

| | | | |
|---|---|---|---|
| | | | ground water beaver brook wells. |
| M) LID Guidebook produced for the Water Department | Town-Wide | Effective, now required for all development | |
| N) Land Acquisition: | Town-Wide | Effective | The Town acquired Williams Property-35 acres.<br>The Town acquired Browns Woods through MVP Action Grant- about 22 acres.<br>Tthe May 7, 2024, Annual Town Meeting voted to purchase the 36.49 acre Webster Property for conservation purposes from CPA funds |
| O) Community Preservation Act | Town-Wide | Effective | On going discussion about if the 1% should change. |
| P) Public Education on stormwater through the NPDES Phase II program | Town-Wide | Effective | Renamed MS 4 |
| Q) Culvert upgraded by the Town. | King Street (2) | Effective | |
| R) Road raised by the Town. | Nashoba Road (3) | Effective | |
| S) New culvert installed by the Town. | Newtown Road (7) | Reduced flooding | |
| **DAM HAZARDS** | | | |
| T) DCR Dam Safety Regulations | Town-Wide | Effective | |
| U) Construction permits required | Town-Wide | Effective | |
| **WIND HAZARDS** | | | |
| V) Tree Maintenance Program by the Highway Dept. | Town-Wide | Effective | Gone from contractors to a tree crew now |

| | | | |
|---|---|---|---|
| W) Tree Maintenance Program by the Light Dept. | Town-Wide | Effective | |
| X) Highway Department has access to brush chippers | Town-Wide | Effective | |
| **WINTER HAZARDS** | | | |
| Y) Snow removal operations, liquid deicer (magnesium chloride); reduce sand usage | Town-Wide | Generally effective, extreme snow in 2015 was a challenge | Starting to look at Salt Brine preapplication, no sand |
| Z) Sufficient snow storage space | Town-Wide | Generally effective, extreme snow in 2015 was a challenge | |
| **GEOLOGIC HAZARDS** | | | |
| AA) Middle and High school are new buildings with backup power that can act as shelters | Town-wide | Effective | |
| BB) Evacuation plan in CEMP | Town-Wide | Effective | |
| CC) Rivers and ponds can be tapped into for firefighting if necessary | Town-Wide | Effective | |
| DD) Tanker task force available through State Fire mobilization. | Town-Wide | Effective | |
| EE) El Paso gas company monitors and provides training for its gas pipeline. | Town-Wide | Effective | |
| FF) Maximum slopes for subdivision roads | Town-Wide | Effective | |
| GG) Soil removal permits required | Town-Wide | Effective | Selectboard updated this law. |
| HH) Massachusetts Building code enforced by the Town | Town-Wide | Effective for new construction and major renovations | |
| **BRUSHFIRE HAZARDS** | | | |
| II) Burning Permits -- Open Burning Permits required by the Fire Department | Town-wide | Effective | |

| | | | |
|---|---|---|---|
| JJ) Development Review – the Fire Department reviews all development plans for fire safety | Town-wide | Effective | |
| KK) Fire Department provides public education on its website | Town-Wide | Effective | |
| **MULTI-HAZARDS** | | | |
| LL) Multi-department review of developments | Town-Wide | Effective | |
| MM) Comprehensive Emergency Management Plan (CEMP) | Town-Wide | Effective | |
| NN) Enforcement of State Building Code | Town-Wide | Effective | |
| OO) Local Emergency Management Planning Committee (LEPC) | Town-Wide | Effective | |
| PP) Middle and High school are new buildings with backup power that can act as shelters | Town-Wide | Effective | |
| QQ) Back-up 911 system in Ayer, redundant emergency communications systems, and recent upgrades to the Police Department communications network | Town-Wide | Effective | All radio systems for police are digital and all new |
| **DROUGHT HAZARDS** | | | |
| SS) A new well is currently being built for redundancy. | Town-wide | Not yet completed | |
| **EXTREME TEMPERATURE HAZARDS** | | | |
| TT) Community room at fire station is used for short term emergency temps and middle school is used for long term extreme temps and they use the Littleton volunteer Corp for these things. | Town-wide | Effective | |

## Local Capabilities for Implementation

Under the Massachusetts system of "Home Rule," the Town of Littleton 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. The Town of Littleton has recognized several existing mitigation measures that require implementation or improvements, and has the capacity based on these Home Rule powers within its local boards and departments to address these.

The new zoning and regulatory measures identified in this plan include adopting cluster-by-right, flexible development zoning provisions, alternative design requirements to reduce impervious surfaces, adding slope stabilization requirements to site plan review, and adopting binding operation and maintenance agreements for private drainage facilities. The Littleton 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 Dept. of Public Works together with the Planning Board and Conservation Commission will coordinate implementation and enforcement of the Stormwater Bylaw.

# SECTION 7: MITIGATION MEASURES FROM THE 2017 PLAN

## IMPLEMENTATION PROGRESS OF THE PREVIOUS PLAN

At a meeting of the Littleton Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures identified in the 2017 Littleton 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 Update. 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. Table 43 summarizes the status of mitigation measures, and mitigation projects completed are described in more detail below.

**Table 43: Status of Mitigation Measures**

| Mitigation Measure | Priority in 2017 Plan | CURRENT STATUS | FOR THE 2024 PLAN UPDATE |
|---|---|---|---|
| **FLOODNG MITIGATION** | | | |
| Pursue Open Space purchases of Joyce Williams property, surplus Mass DOT property, Boxborough Rd Area | High | **Partially Completed** | **Keep in plan update.** Town will create criteria for purchase of open space parcels including flood mitigation |
| Revise Open Space Development bylaw, adopt cluster-by-right | High | **Partially completed** The Town has not adopted cluster by right by law | **Keep in plan update** Adopt open space development by right |
| Adopt flexible development zoning provisions | High | **Partially completed.** The Town adopted village common mixed-used district and King Street Common mixed-use district | **Keep in plan update** Continue to develop updated zoning |
| Provide alternative design requirements for impervious surfaces | High | **Completed.** Storm water bylaw was adopted | **Delete from plan update** |
| Require binding operation and maintenance plans for impervious surfaces | High | **Completed** Storm water by law covers this | **Delete from plan update** |
| Include slope stabilization | High | **Completed** | **Delete from plan update** |

| | | | |
|---|---|---|---|
| requirements in site planning | | | |
| Drainage Improvements: New Estate Rd., Nagog Hill Rd. | High | **Completed**<br>The drainage has been fully reconstructed with new basins. | **Delete from plan update** |
| Implement beaver control measures. | High | **Partially completed**<br>A few beaver deceivers installed at greatest culvert crossing | **Keep in plan update** and add development of a beaver management plan |
| **WINTER HAZARDS MITIGATION** | | | |
| Locate additional snow storage areas for back-up use during significant snowfall events. | Medium | **Completed** | **Delete from plan update** |
| Locate storage for one year of salt usage | Medium | **Not Completed**<br>No longer a priority. The Town has adequate facilities. | **Delete from plan update** |
| **BRUSHFIRE MITIGATION** | | | |
| Maintain fire access roads at Oak Hill, Long Lake, Yapp Conservation Land, and NE Forestry Foundation Property | High | **Partially Completed**<br>Oak Hill Road was done but the others were not. | **Keep in plan update;** The Town will continue these endeavors |
| Public Education on Brush Fire Prevention | High | **Partially Completed**<br>Yearly public education is done for residents who obtain an open-air burning permit. | **Keep in plan update;** continue and expand upon these efforts |
| **EARTHQUAKE MITIGATION** | | | |
| Conduct feasibility study on how to make town facilities earthquake resistant. | Medium | **Not completed** | **Keep in plan update** |
| **EXTREME TEMPERATURE MITIGATION** | | | |

| | | | |
|---|---|---|---|
| Promote green roofs and cool roofs Town- wide | Medium | **Partially completed** Several buildings are currently being installed with green roofs, including the emergency management building, the library, and the senior center. | **Keep in plan update;** the town will continue to add green roofs to future municipal buildings. |
| **DROUGHT MITIGATION** | | | |
| Include drought tolerant landscaping in site plan review | High | **Not completed** | **Keep in plan update;** consider drought resistant grass seed. |
| Provide education on drought and water use | High | **Partially completed** The Littleton Water District works with Boxboro on initiative to educate on water conservation. | **Keep in plan update;** enhance the Boxboro and Littleton water conservation project region wide |
| **DAM MITIGATION** | | | |
| Implement beaver management as required. | High | **Not completed** | **Keep in plan update;** create Beaver Management Plan as mentioned in the flooding mitigation section |
| **WIND MITIGATION MEASURES** | | | |
| Install fiber back-up to radio system between Police and Cedar Hill tower | High | **Completed** | **Remove from plan** |
| **CLIMATE RESILIENCE/ADAPTATION** | | | |
| Include sustainability in planning efforts | High | **Partially completed** Town has worked to include sustainability in the Master Plan and Open Space Recreation Plan. | **Keep in plan update;** The town will continue to make climate considerations and sustainability a priority in the budgeting and capitol investment plans. |
| Include climate consideration in master plan process. | High | **Partially complete** This has been included in the Master Plan. | **Keep in plan update;** explore producing a Climate Action Plan using the Town's climate action committee. |

As indicated on Table 43, Littleton made good progress on implementing mitigation measures identified in the 2017 Hazard Mitigation Plan. Several projects have been completed, including drainage improvements at New Estate Road and Nagog Hill Road, installation of a fiber back-up to the radio system, site plan review regulations on slope stabilization; adoption of a stormwater bylaw with operation and maintenance plans for impervious surfaces and alternative designs for impervious surfaces, and with location of additional snow storage areas. Several longer-term measures were partially completed, including purchase of a major open space parcel, revision of the Open Space Development bylaw, adoption of flexible zoning measures, beaver control measures, management of fire access roads, public education on wildfire hazards, installation of Green Roofs, public education on water use and drought, and inclusion of sustainability in the Master Plan and Open Space Recreation Plan.

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.

# 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 Building Resilient Infrastructure and Communities (BRIC) grant, and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

- https://www.fema.gov/hazard-mitigation-grant-program
- https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities
- https://www.fema.gov/flood-mitigation-assistance-grant-program

According to FEMA Local Multi-Hazard Mitigation Planning Guidance, identified 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.

## REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be 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 many communities, mitigating natural hazards is more than a local issue. The facilities that serve these communities are complex systems owned and operated by a wide array of agencies, government, and private entities. In Littleton, this includes but is not limited to the Town of Littleton, Massachusetts Dept of Transportation (MassDOT), and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operations and maintenance of these facilities are integral to the 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 numerous competing priorities. In the sections that follow, the plan includes recommendations for activities to be undertaken by these other agencies. Implementation of these recommendations will require that all parties work together to develop solutions.

### *REGIONAL ISSUES*

Major facilities owned, operated and maintained by federal, state, regional or private entities in Littleton include Routes 2, 2A, 110, 119 and 495 (MassDOT); MBTA Commuter Rail Service to Boston (MBTA); and Natural Gas Line.

## 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 expansion of LID and stormwater requirements town-wide, the Wetlands Bylaw enforced by the Conservation Commission, the Comprehensive Plan, and the Open Space 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. Beaver control measures and drainage upgrades are also priorities in this plan.

## PROCESS FOR 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 Hazard Mitigation Planning Team 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.

Table 44 below demonstrates the prioritization of the Town's potential hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of:

| **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 $250,000 |
| Medium | Estimated costs between $100,000 to $250,000 |
| Low | Estimated costs less than $100,000 and/or staff time |
| **Mitigation 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 44: Mitigation Measure Prioritization

| Mitigation Action | Geographic Coverage | Estimated Benefit | Estimated Cost | Overall Priority |
|---|---|---|---|---|
| **Flood Hazard Mitigation** | | | | |
| 1.Create criteria for future parcels such as including flood mitigation for purchase of open space parcels and interconnected and diverse open space land | Town-wide | High | Low | High |
| 2. Review Open Space Residential Development bylaw, adopt cluster-by-right | Town-wide | High | Low | High |
| 3. Concentrate development in existing areas of development | Town-wide | High | Low | High |
| 4. Beaver control measures-Create beaver mitigation plan | Town-wide | Medium | Low | Medium |
| 5, Review options for extending wetlands buffer zones | Town-wide | Medium | Low | Medium |
| 6. Conduct hydraulic analysis of flow and flooding issues in the Mill Pond Area | Mill-Pond Area | High | Medium | High |
| 7. Identifying more rain gardens and water retention basins on steep slopes | Town-wide | Medium | Low | Medium |
| 8.Educate and make public aware of watershed sb-basins with signate at water divides | Town-wide | Low | Low | Low |
| **Wind Mitigation Measures** | | | | |
| 9. Installing wind resistant windows in public buildings | Town-wide | Medium | High | High |
| **Wildfire Mitigation** | | | | |
| 10. Maintain fire access roads at Oak Hill, Long Lake, Yapp Conservation Land, and NE Forestry Foundation Property | Local | High | Low | High |
| 11. Public Education on Brush Fire Prevention | Town-wide | High | Low | High |
| **Winter Storm Hazard Mitigation** | | | | |

## Table 44: Mitigation Measure Prioritization

| Mitigation Action | Geographic Coverage | Estimated Benefit | Estimated Cost | Overall Priority |
|---|---|---|---|---|
| 12. Assessing snow loads on flat building roofs. | Town-wide | Low | Low | Low |
| **Earthquake Mitigation** | | | | |
| 13. Conduct feasibility study on how to make town facilities earthquake resistant. | Local | Medium | Medium | Medium |
| **Dam Mitigation** | | | | |
| 14. Implement beaver management plan as required | Mill, Spectacle Pond | High | Low | High |
| **Extreme Temperature Mitigation** | | | | |
| 15. The town will continue to add green roofs and solar canopies to future municipal properties. | Town-wide | Medium | Low | Medium |
| 16. Update site plan requirements to eliminate heat islands in parking lots and to increase shade. | Town-wide | Medium | Low | Medium |
| **Drought Mitigation** | | | | |
| 17. Include drought tolerant landscaping in site plan review | Town-wide | High | Low | High |
| 18. Provide education on drought and water use, continue and enhance the Boxborough and Littleton water conservation project regionwide | Town-wide | High | Low | High |
| 19. Include rain barrels and drought resistant grass seeds in future projects | Town-wide | Medium | Medium | Medium |
| 20. Public Education on reducing water consumption specifically regarding large area water consuming lawns | Town-wide | Low | Low | Low |
| **Climate Resilience/Adaptation** | | | | |
| 21. Will continue to make climate considerations and sustainability a priority in the budgeting and capital investment plans. | Town-wide | High | Low | High |
| 22, Explore producing a climate action | Town-wide | High | Low | High |

### Table 44: Mitigation Measure Prioritization

| Mitigation Action | Geographic Coverage | Estimated Benefit | Estimated Cost | Overall Priority |
|---|---|---|---|---|
| plan/municipal sustainable action plan using the sustainability committee | | | | |
| **INVASIVE SPECIES HAZARDS** | | | | |
| 23. Strategically reduce invasive plants (e.g. garlic mustard pull) and combine with town-wide week-long clean-up effort as is done successfully in abutting towns) | Town-wide | Medium | Low | Medium |

## Recommended Mitigation Strategy

The recommended mitigation strategy is summarized in Table 45, which provides the following information about each recommended mitigation measure:

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 and summarized in Table 44, the designation of high, medium, or low priority was done considering potential benefits and estimated project costs, as well as other factors in the STAPLEE analysis.

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 http://www.mass.gov/dem/programs/mitigate/grants.htm has a useful table that compares eligible projects for the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program.

**Table 45: Recommended Mitigation Strategy**

| Mitigation Measure | Priority | Lead Agency | Estimated Cost* | Estimated Timeframe 2024-29 | Potential Funding Sources |
|---|---|---|---|---|---|
| FLOOD HAZARDS | | | | | |
| 1. Create criteria for future parcels such as including flood mitigation for purchase of open space parcels and interconnected and diverse open space land | High | Conservation Commission /Department | Low | 2025/26 | Town/Land Grant/MVP |
| 2. Review Open Space Residential Development bylaw, adopt cluster-by-right | High | Planning | Low | 2026-28 | Town |
| 3. Concentrate development in existing areas of development | High | Planning | Low | 2024-29 | Technical Assistance Program/Town |
| 4. Beaver control measures- Create beaver mitigation plan | High | Water | Low | 2024-2029 | Town |
| 5. Review options for extending wetlands buffer zones | Medium | Conservation Commission | Low | 2027 | Town |
| 6. *Conduct hydraulic analysis of flow and flooding* | Medium | Department of Public Works | Medium | 2028 | Town |

| | | | | | |
|---|---|---|---|---|---|
| *issues in the Mill Pond Area* | | | | | |
| 7. *Identifying more rain gardens and water retention basins on steep slopes* | Medium | Water | Medium | 2024-26 | Climate Resiliency Grant/DEP Grant |
| 8. *Educate and make public aware of watershed sub-basins with signate at water divides* | Medium | Water | Low | 2026 | Town |
| WIND/EXTREME WEATHER | | | | | |
| 9. Installing wind resistant windows in public buildings | Medium | Facilities | Medium | 2028/29 | Town of Littleton Capital budget, |
| WILDFIRE HAZARDS | | | | | |
| 10. Maintain fire access roads at Oak Hill, Long Lake, Yapp Conservation Land, and NE Forestry Foundation Property | High | Fire | Low | 2024-2029 | Town |
| 11. Public Education on Brush Fire Prevention | High | Fire | Low | 2024-2029 | SAFE Grant |
| WINTER HAZARDS | | | | | |
| 12. Assessing snow loads on flat building roofs.<br>13. | Medium | Facilities | Low | 2028 | Town |

| | | | | | |
|---|---|---|---|---|---|
| **GEOLOGIC HAZARDS** | | | | | |
| 14. Conduct feasibility study on how to make town facilities earthquake resistant | Medium | Facilities | Medium | 2027 | Town |
| **DAM MITIGATION** | | | | | |
| 15. Implement a beaver management plan as required | High | Clean Lakes Committee/Water | Low | 2024-29 | Town |
| **EXTREME TEMPERATURE HAZARDS** | | | | | |
| 16. The town will continue to add green roofs and solar canopies to future municipal properties. | Medium | Sustainability Committee | Low | 2024-2029 | Town |
| 17. Update site plan requirements to eliminate heat islands in parking lots and to increase shade. | High | Planning | Low | 2026 | Town |
| **DROUGHT HAZARDS** | | | | | |
| 18. Include drought tolerant landscaping in site plan review, including a look at drought | High | Planning | Low | 2026 | Town |

| | | | | | |
|---|---|---|---|---|---|
| resistant grass seed | | | | | |
| 19. Continue and enhance the Boxboro and Littleton water conservation project region wide | High | Water | Low | 2024-2029 | Town |
| 20. Include rain barrels and drought resistant grass seeds in future projects | Medium | Water | Medium | 2027 | Water Dept. |
| 21. Public Education on reducing water consumption specifically regarding large area water consuming lawns | Medium | Water | Low | 2025-26 | Water |
| CLIMATE RESILIENCE/ADAPTATION | | | | | |
| 22. Will continue to make climate considerations and sustainability a priority in the budgeting and capital investment plans. | High | Office of Town Administrator | Low | 2024-2029 | Town |
| 23. Explore producing a climate action plan/municipal sustainable action plan using the sustainability committee | High | Planning | Low | 2024 | Town/DOER Grant |

| INVASIVE SPECIES HAZARDS | | | | | |
|---|---|---|---|---|---|
| 24. Strategically reduce invasive plants (e.g. garlic mustard pull) and combine with town-wide week-long clean-up effort as is done successfully in abutting towns) | High | Conservation Commission | Medium | 2024-2029 | CISMA Grant |

# SECTION 9: PLAN ADOPTION AND MAINTENANCE

## Plan Adoption

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

## Plan Maintenance

MAPC worked with the Littleton Hazard Mitigation Team to prepare this plan. After approval of the plan by FEMA, the local Team will meet on a regular basis to oversee implementation of the plan and prepare for the next plan update. Additional members could be added to the local implementation team from other town departments, local businesses, non-profits, and institutions.

The town will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the local Team, these will be placed on the project's website, and any meetings of the Local Team will be publicly noticed in accordance with the town and state open meeting laws. The posting will include a mechanism for citizen feedback such as an e-mail address to send comments.

## Implementation 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 Commissioner of Public Works, 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 Littleton Hazard Mitigation Plan Update will be forwarded to MEMA and DCR for review and to FEMA for approval.

## Integration of the Plans with Other Planning Initiatives

Upon approval of the Littleton Hazard Mitigation Plan 2017 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. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire
- Emergency Management
- Police
- Highway
- Light and Water
- Planning
- Conservation
- Parks, Recreation, and Community Education
- Health
- Building

Other stakeholders that will be coordinated will include land conservation organizations, watershed groups, business groups, and nonprofit institutions.

Moving forward, the Hazard Mitigation Plan 2023 Update will be integrated into other town plans and policies as they are updated and renewed, including the Master Plan, Open Space and Recreation Plan, Capital Investment Program and Comprehensive Emergency Management Plan

# SECTION 10: LIST OF REFERENCES

Town of Littleton, Annual Report 2022

Code of the Town of Littleton

Town of Littleton Master Plan 2017

Town of Littleton Plan for 2030 (public input)

Town of Littleton Open Space and Recreation Plan, 2016

Town of Littleton Capital Plan 2017 Review of Requests

Environment America Research and Policy Center, *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation,* July 2012

FEMA, Flood Risk Report, Concord River Watershed, 2/27/2013

FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2012

FEMA, Local Mitigation Plan Review Guide; October 1, 2011.

MA Emergency Management Agency, State *Hazard Mitigation Plan*, 2013

MA Geographic Information System, *McConnell Land Use Statistics*, 2005

MA Office of Dam Safety, Inventory of Massachusetts Dams

Metropolitan Area Planning Council, Geographic Information Systems Lab

New England Seismic Network, Weston Observatory, http://aki.bc.edu/index.htm

Northeast States Emergency Consortium, website http://www.nesec.org/

NOAA, National Climatic Data Center, website

Union of Concerned Scientists, *Confronting Climate Change in the U.S. Northeast*, 2007

U. S. Census, 2020, American Community Survey

USGS, National Water Information Center, website

# APPENDIX A: HAZARD MAP SERIES

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 twelve map panels displaying the following information:

| | |
|---|---|
| Map 1. | Population Density |
| Map 1a. | Environmental Justice |
| Map 2. | Land Use |
| Map 3. | Flood Zones |
| Map 3b. | Flood Claims from March 2010 Disaster Declaration |
| Map 4. | Earthquakes and Landslides |
| Map 5. | Hurricanes and Tornadoes |
| Map 6. | Average Snowfall |
| Map 7. | Composite Natural Hazards |
| Map 8. | Local Hazard Areas |
| Map 9 | Land Surface Temperature |
| Map 10 | Wildfires |

***Map 1: Population Density*** – This map uses the US Census block data for 2020 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 1b: Environmental Justice*** – This map shows Environmental Justice (EJ) populations using 2020 data. EJ designations from the State include English isolation, income, and minority residents.

***Map 2: Land Use –*** This map shows land cover and land use from MassGIS' 2016 Land Cover/Land Use dataset.

***Map 3: Flood Zones*** – The map of flood zones used the FEMA NFIP Flood Zones for Middlesex County as its source. 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 municipally owned and protected open space.

***Map3b: Flood Claims –*** This map shows flood insurance and disaster claim records from March 2010. The March 29, 2010 federal disaster declaration associated with severe rainfall and flooding triggered the launch of the Federal Emergency Management Agency's (FEMA's) Individual Assistance Program through which residential property owners, businesses, and institutions without flood insurance were eligible to apply for relief to pay for storm-related expenditures and repairs.

***Map 4: Earthquakes and Landslides (Regional) –*** This map depicts landslide risk and recorded earthquake epicenters in the community and surrounding region. 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 (Regional) –*** This map shows the spatial characteristics of several different meteorological properties and past events in the community and surrounding region. The map includes the storm tracks for both hurricanes and tropical storms. 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 and areas that could be inundated by storm surge during a hurricane, if any.

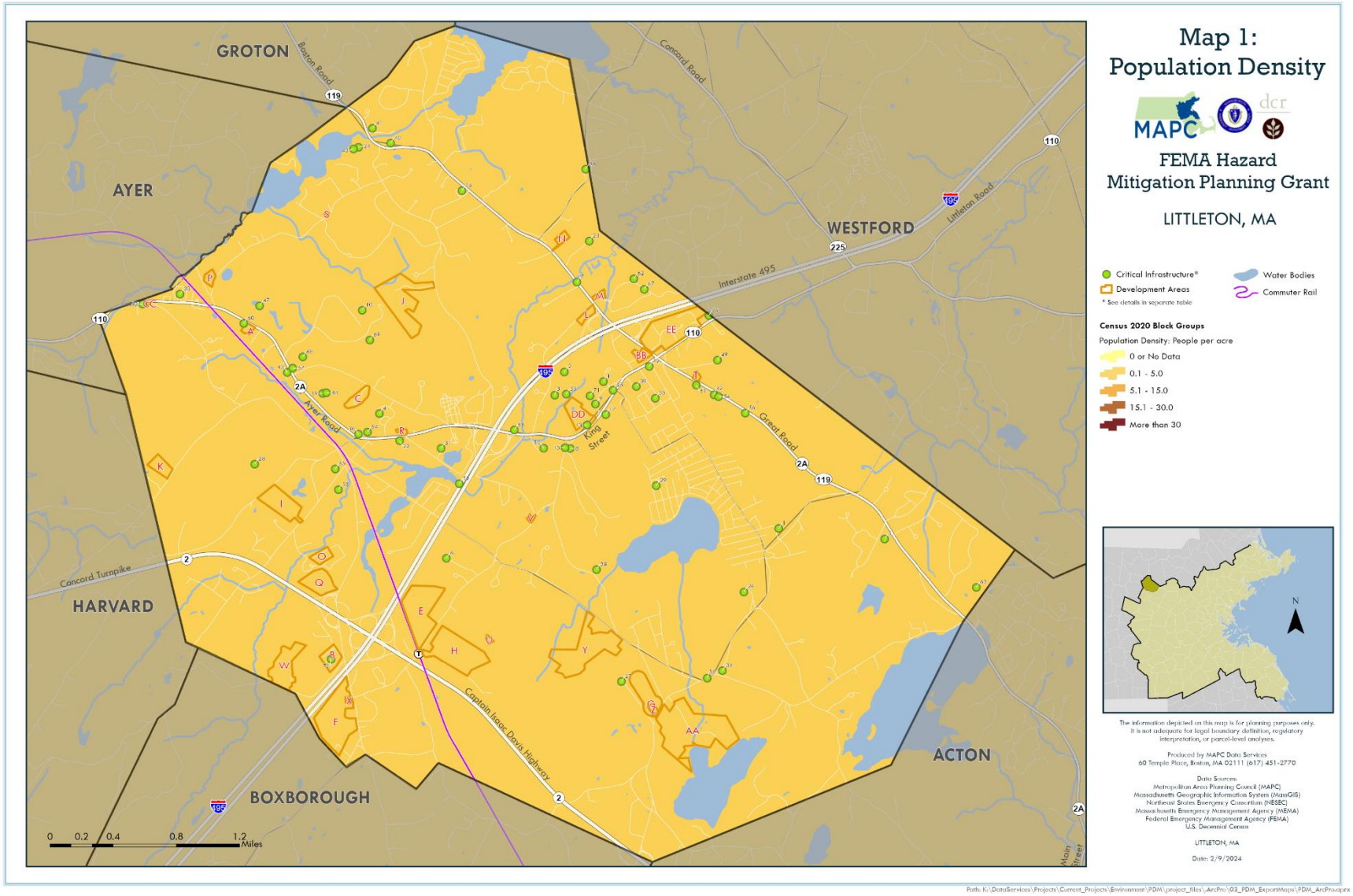
***Map 6: Average Snowfall (Regional) -*** This map shows the average snowfall in the community and the surrounding region.

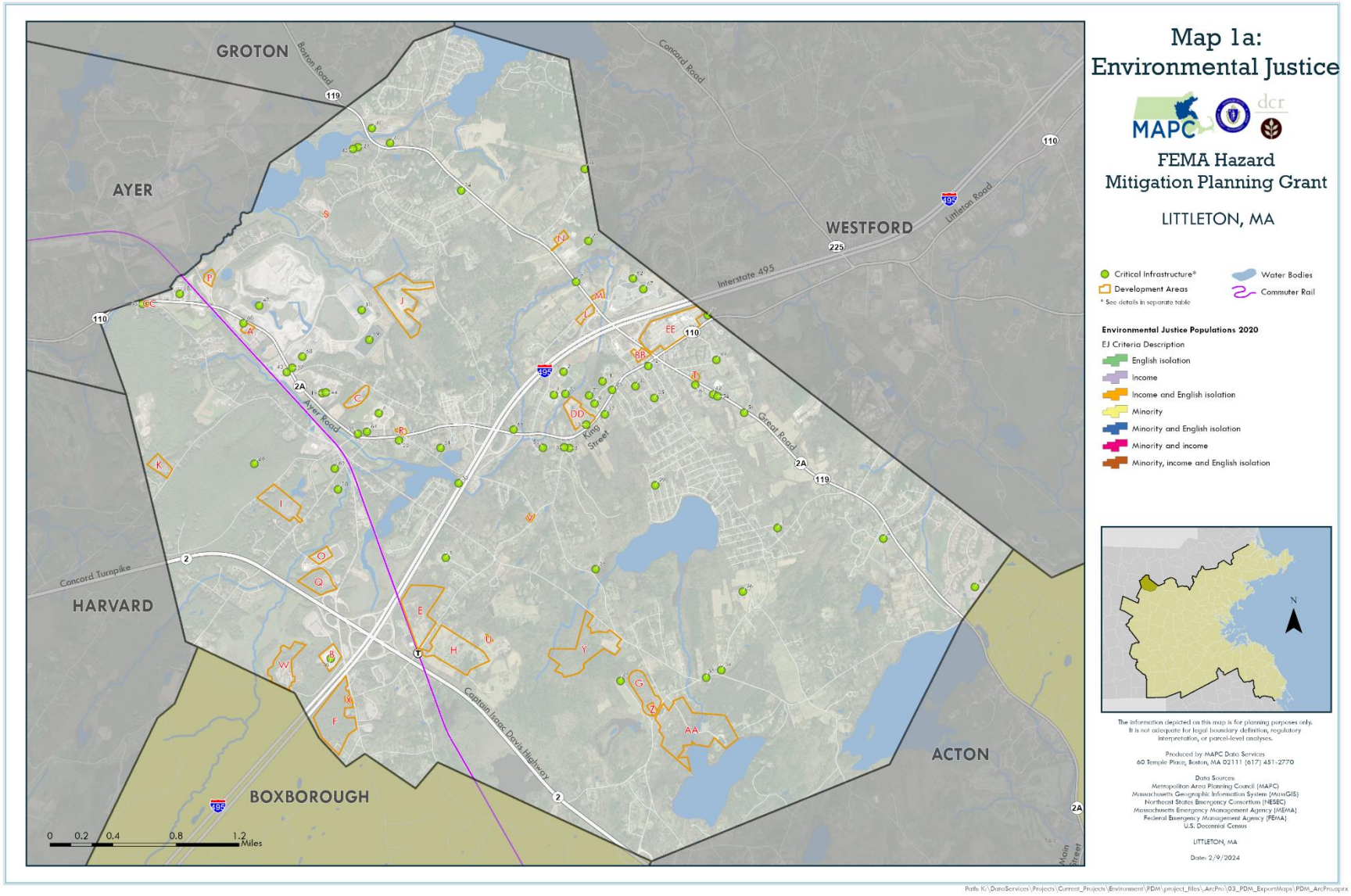
***Map 7: Composite Natural Hazards (Regional) -*** This map shows four categories of composite natural hazards. The hazards included in this map are 100-year wind speeds of 110 mph or higher, low, and moderate landslide risk, FEMA Q3 flood zones (100 year and 500 year) and hurricane surge inundation 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: Local Hazard Areas –*** For each community, locally identified hazard areas are overlaid on an aerial photograph. The critical infrastructure sites and planned development areas are also shown. The source of the aerial photograph is Mass GIS.

***Map 9: Land Surface Temperature-*** MAPC's Statewide Land Surface Temperature (LST) Index was created by combining estimates of surface temperature from days in 2018, 2019, and 2020 where the daily air temperature maximum exceeded 70 degrees Fahrenheit. The Statewide LST Index "Hot Spots" data depicts the 5% highest LST index areas in each Regional Planning Agency (RPA) region. The data was generated by identifying pixels whose LST index values are equal to or greater than 95% of LST index values in the region, and then delineating cohesive regions where pixels meet this criterion as polygons. Map 9 represents the "Hot Spots" relative to the MAPC region, mapped on top of the National Land Cover Database's 2016 30-m tree canopy data.

***Map 10: Wildfires –*** This map shows wildfire risk to the community using USDA data. Wildfire risk is classified as very low, low, moderate, high, and very high.


Map 1:
Population Density
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Census 2020 Block Groups
Population Density: People per acre
0 or No Data
0.1 - 5.0
5.1 - 15.0
15.1 - 30.0
More than 30
GROTON
AYER
WESTFORD
HARVARD
BOXBOROUGH
ACTON
Boston Road
Concord Road
Littleton Road
Interstate 495
Ayer Road
King Street
Great Road
Concord Turnpike
Captain Isaac Davis Highway
Main Street
0 0.2 0.4 0.8 1.2 Miles
N
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)
U.S. Decennial Census
LITTLETON, MA
Date: 2/9/2024


GROTON
AYER
WESTFORD
HARVARD
BOXBOROUGH
ACTON
Boston Road
Concord Road
Littleton Road
Interstate 495
Ayer Road
King Street
Great Road
Concord Turnpike
Captain Isaac Davis Highway
Main Street
0 0.2 0.4 0.8 1.2 Miles
Map 1a:
Environmental Justice
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Environmental Justice Populations 2020
EJ Criteria Description
English isolation
Income
Income and English isolation
Minority
Minority and English isolation
Minority and income
Minority, income and English isolation
N
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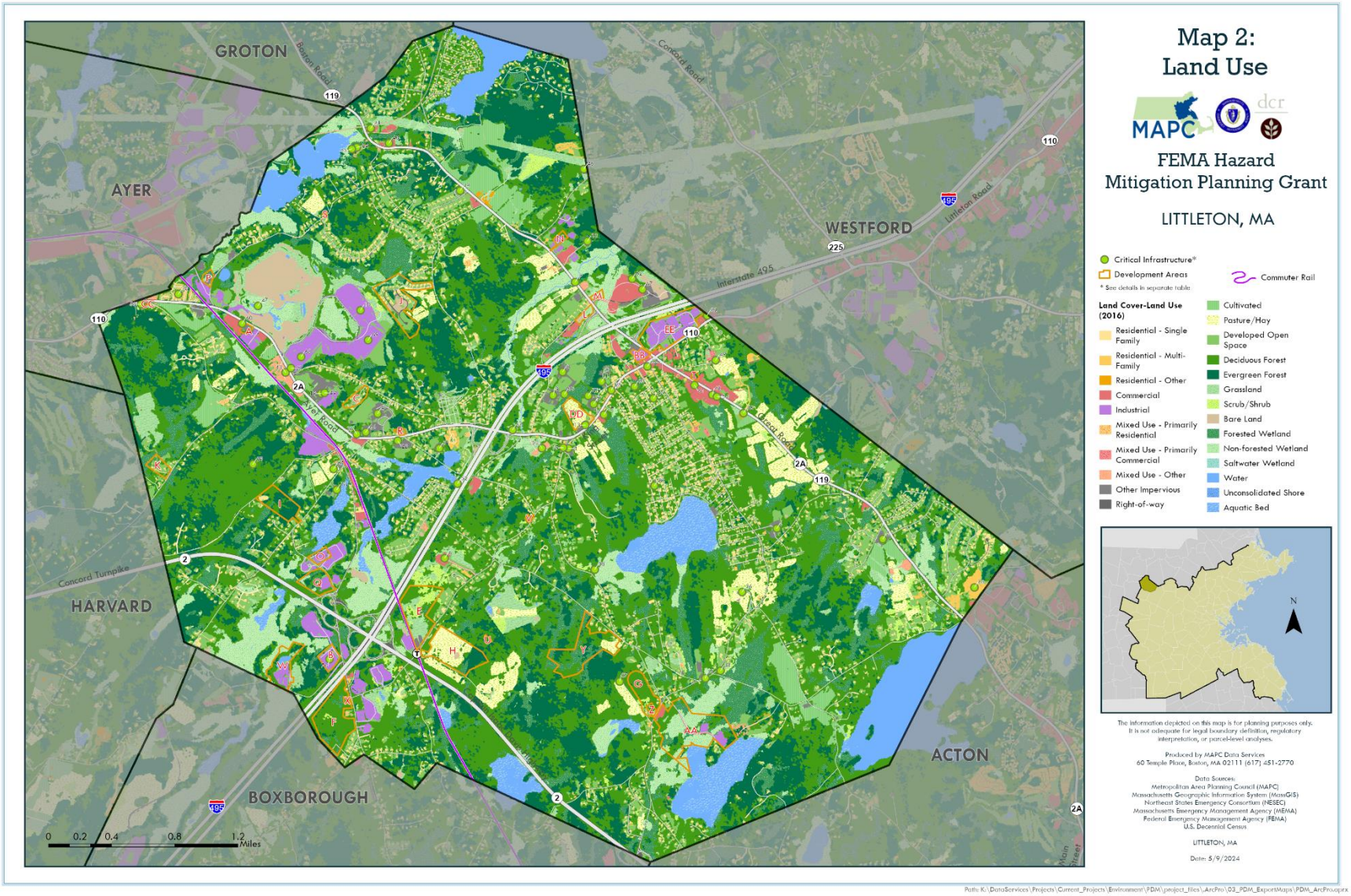
LITTLETON, MA
Date: 2/9/2024


Map 2:
Land Use
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
GROTON
AYER
WESTFORD
HARVARD
BOXBOROUGH
ACTON
Boston Road
Concord Road
Littleton Road
Interstate 495
Ayer Road
Forest Road
Concord Turnpike
Main Street
Critical Infrastructure*
Development Areas
* See details in separate table
Commuter Rail
Land Cover-Land Use (2016)
Residential - Single Family
Residential - Multi-Family
Residential - Other
Commercial
Industrial
Mixed Use - Primarily Residential
Mixed Use - Primarily Commercial
Mixed Use - Other
Other Impervious
Right-of-way
Cultivated
Pasture/Hay
Developed Open Space
Deciduous Forest
Evergreen Forest
Grassland
Scrub/Shrub
Bare Land
Forested Wetland
Non-forested Wetland
Saltwater Wetland
Water
Unconsolidated Shore
Aquatic Bed
N
0 0.2 0.4 0.8 1.2 Miles
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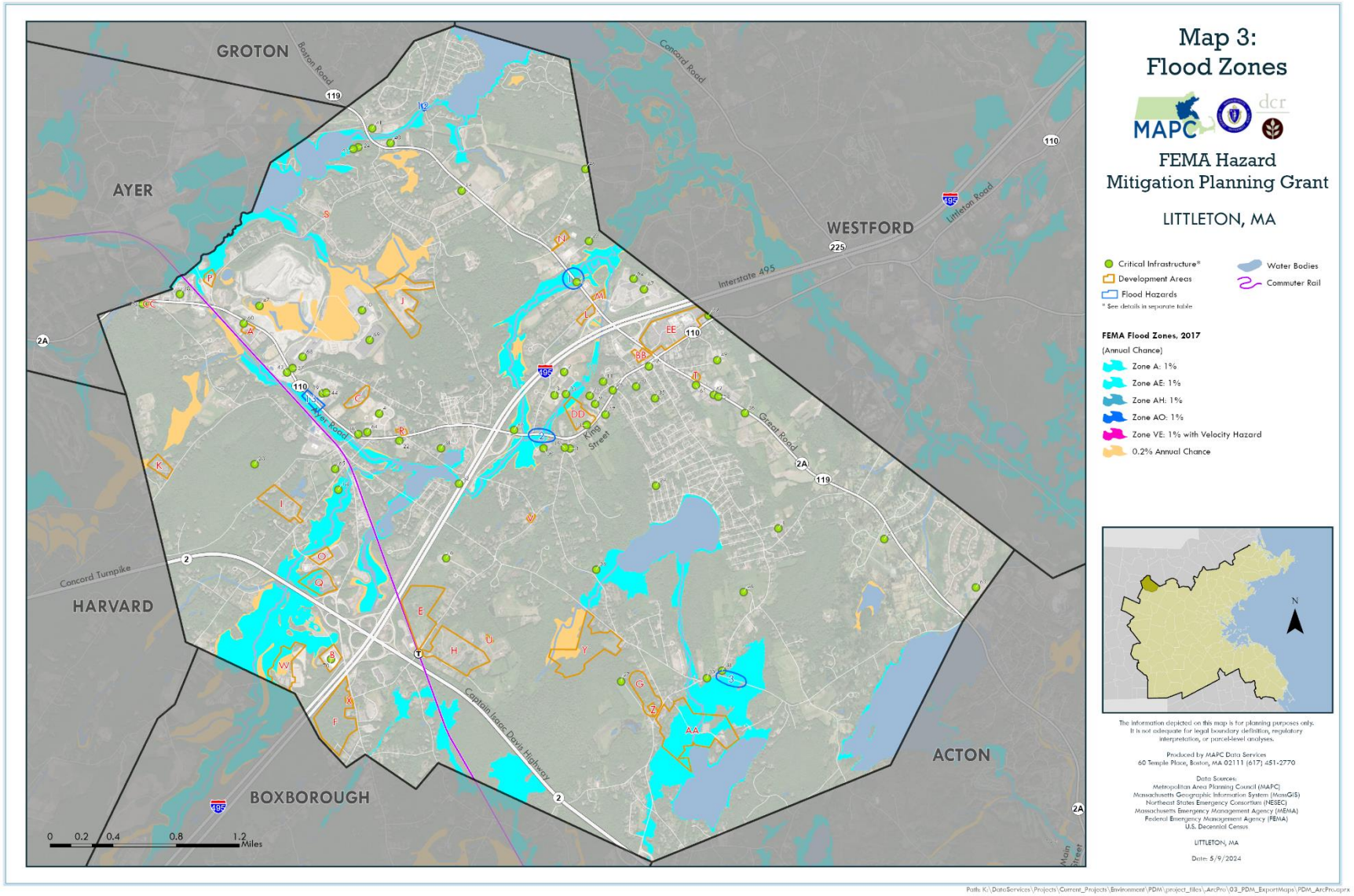
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
LITTLETON, MA
Date: 5/9/2024


Map 3:
Flood Zones
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Critical Infrastructure*
Development Areas
Flood Hazards
* See details in separate table
Water Bodies
Commuter Rail
FEMA Flood Zones, 2017
(Annual Chance)
Zone A: 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone VE: 1% with Velocity Hazard
0.2% Annual Chance
GROTON
AYER
WESTFORD
HARVARD
BOXBOROUGH
ACTON
Boston Road
Concord Road
Littleton Road
Interstate 495
Ayer Road
King Street
Great Road
Concord Turnpike
Captain Isaac Davis Highway
Main Street
0 0.2 0.4 0.8 1.2 Miles
N
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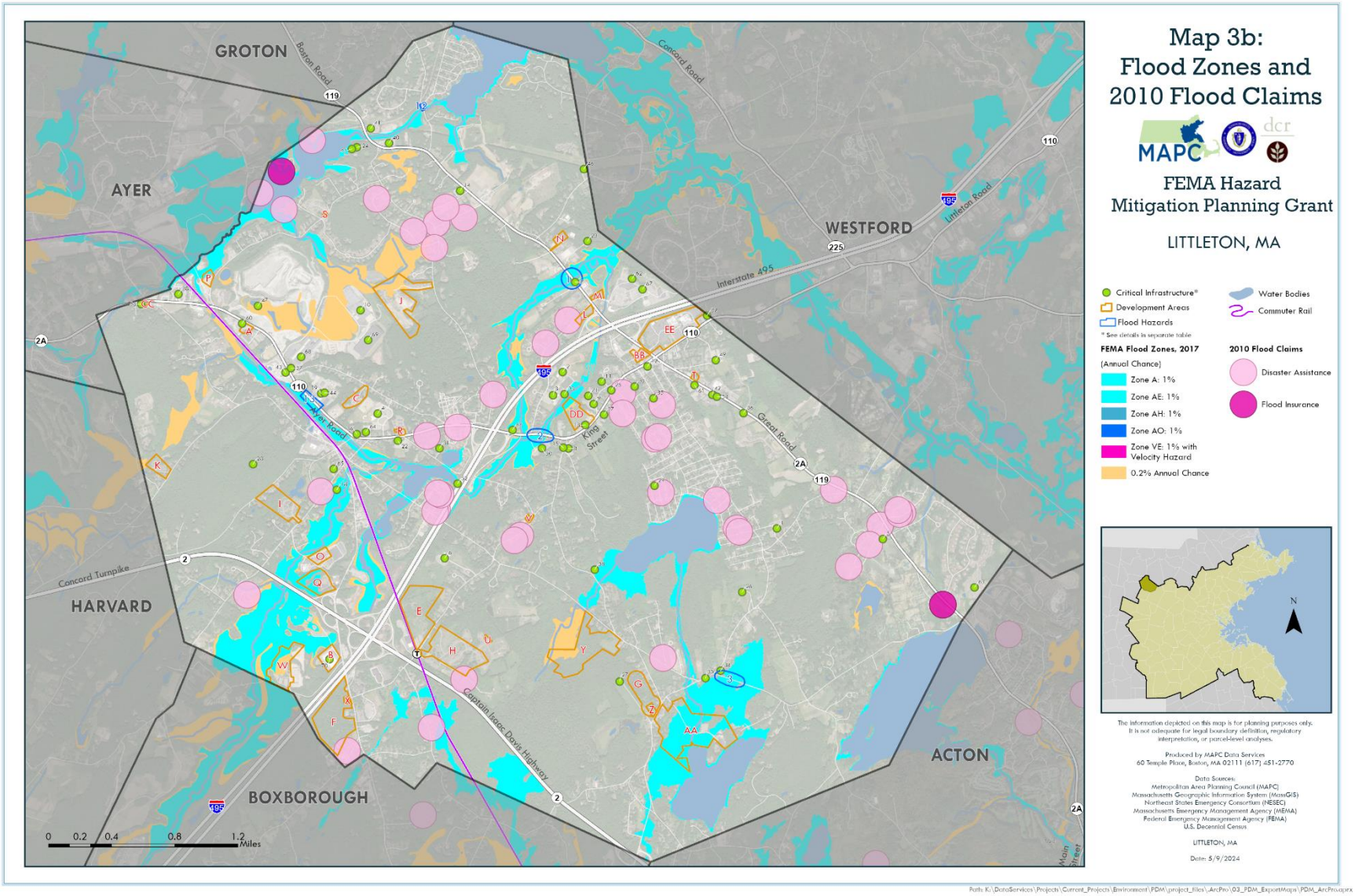
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
LITTLETON, MA
Date: 5/9/2024


GROTON
AYER
WESTFORD
HARVARD
BOXBOROUGH
ACTON
Boston Road
Concord Road
Littleton Road
Interstate 495
Ayer Road
King Street
Great Road
Concord Turnpike
Captain Isaac Davis Highway
Main Street
0 0.2 0.4 0.8 1.2 Miles
Map 3b:
Flood Zones and
2010 Flood Claims
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Critical Infrastructure*
Development Areas
Flood Hazards
* See details in separate table
Water Bodies
Commuter Rail
FEMA Flood Zones, 2017
(Annual Chance)
Zone A: 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone VE: 1% with Velocity Hazard
0.2% Annual Chance
2010 Flood Claims
Disaster Assistance
Flood Insurance
N
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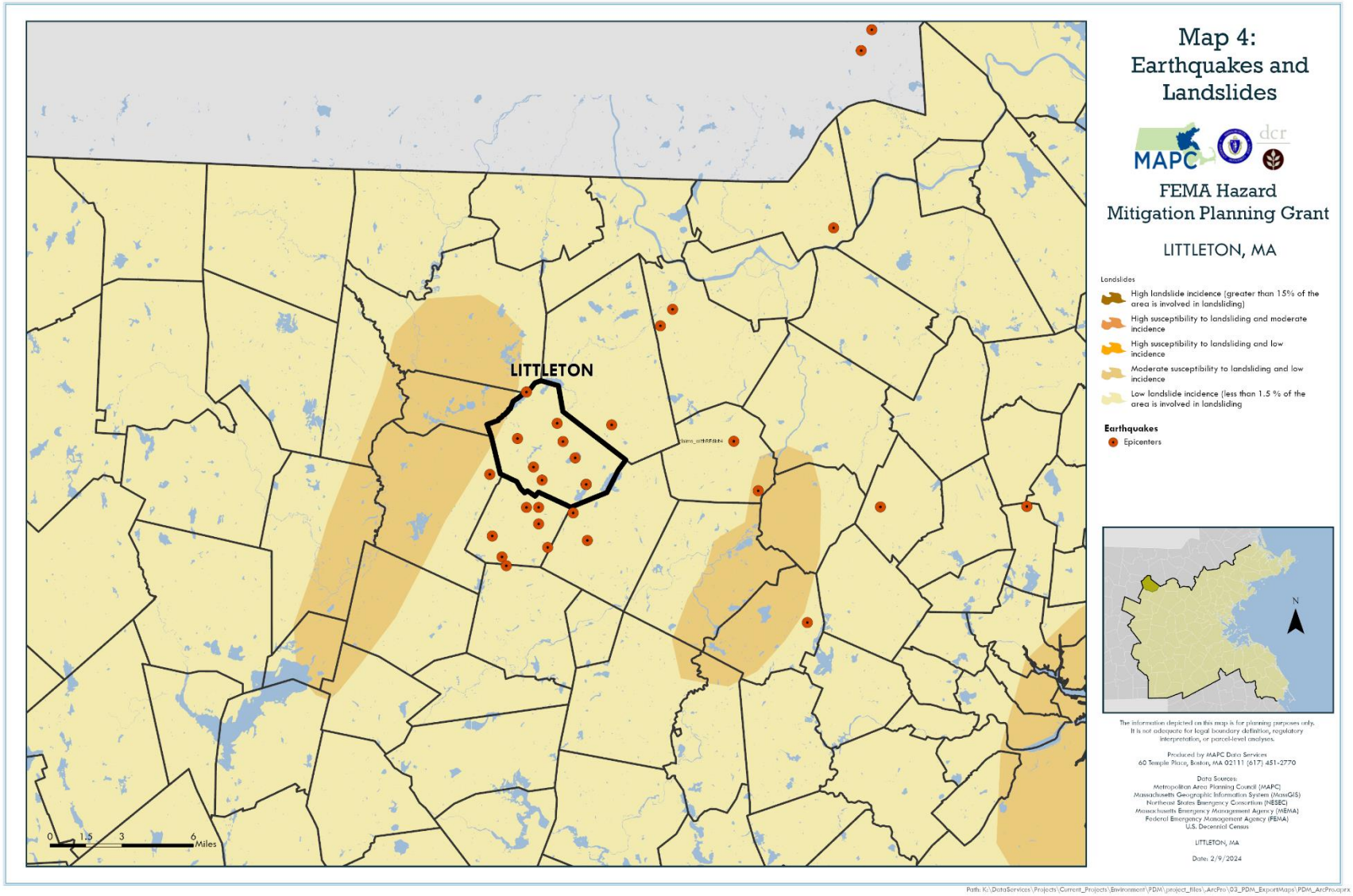
U.S. Decennial Census
LITTLETON, MA
Date: 5/9/2024


Map 4:
Earthquakes and Landslides
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
LITTLETON, MA
Landslides
High landslide incidence (greater than 1.5% 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
Earthquakes
Epicenters
LITTLETON
0 1.5 3 6 Miles
N
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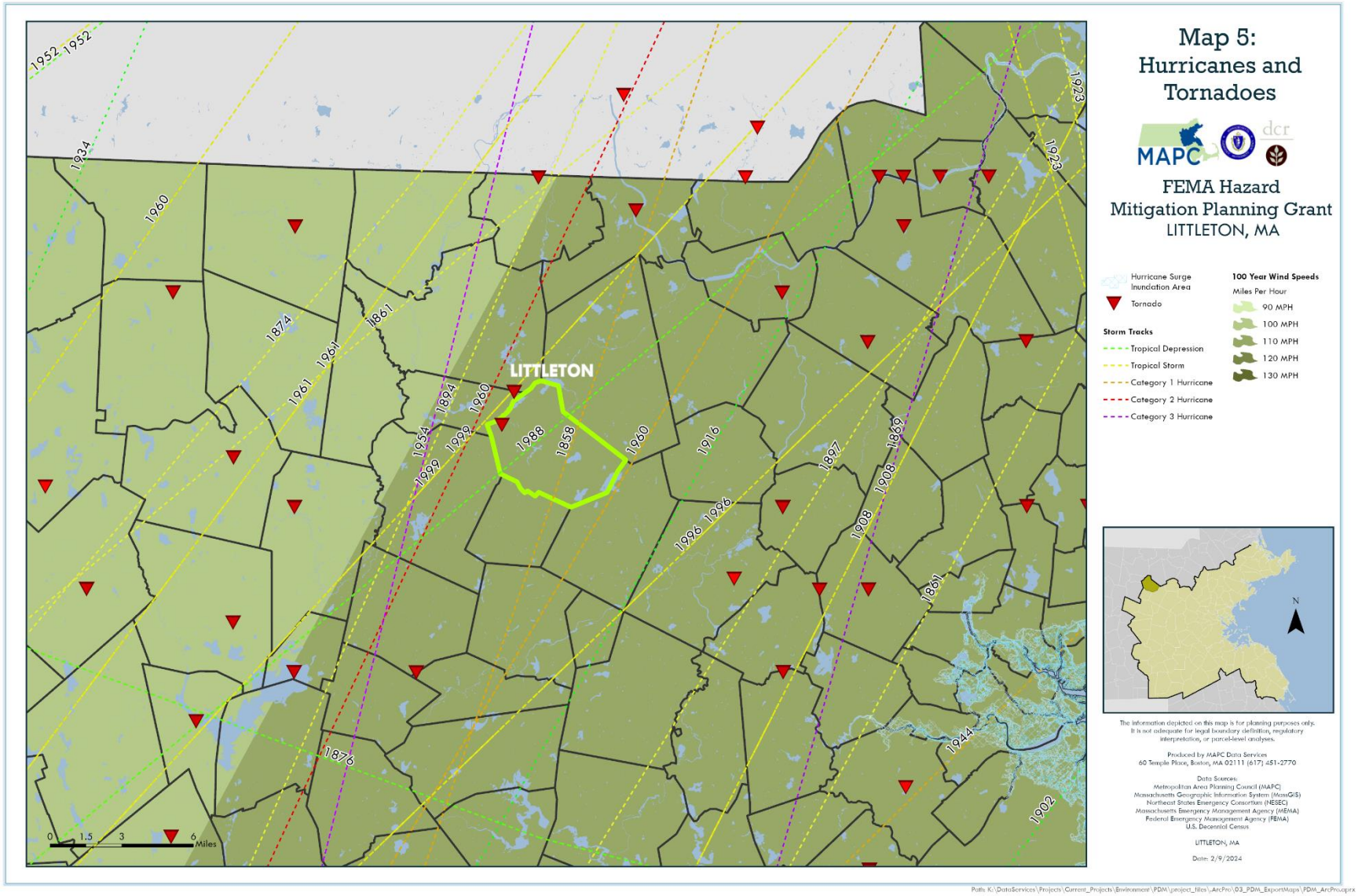
LITTLETON, MA
Date: 2/9/2024


Map 5:
Hurricanes and
Tornadoes
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Hurricane Surge Inundation Area
Tornado
Storm Tracks
Tropical Depression
Tropical Storm
Category 1 Hurricane
Category 2 Hurricane
Category 3 Hurricane
100 Year Wind Speeds
Miles Per Hour
90 MPH
100 MPH
110 MPH
120 MPH
130 MPH
LITTLETON
0 1.5 3 6 Miles
N
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.
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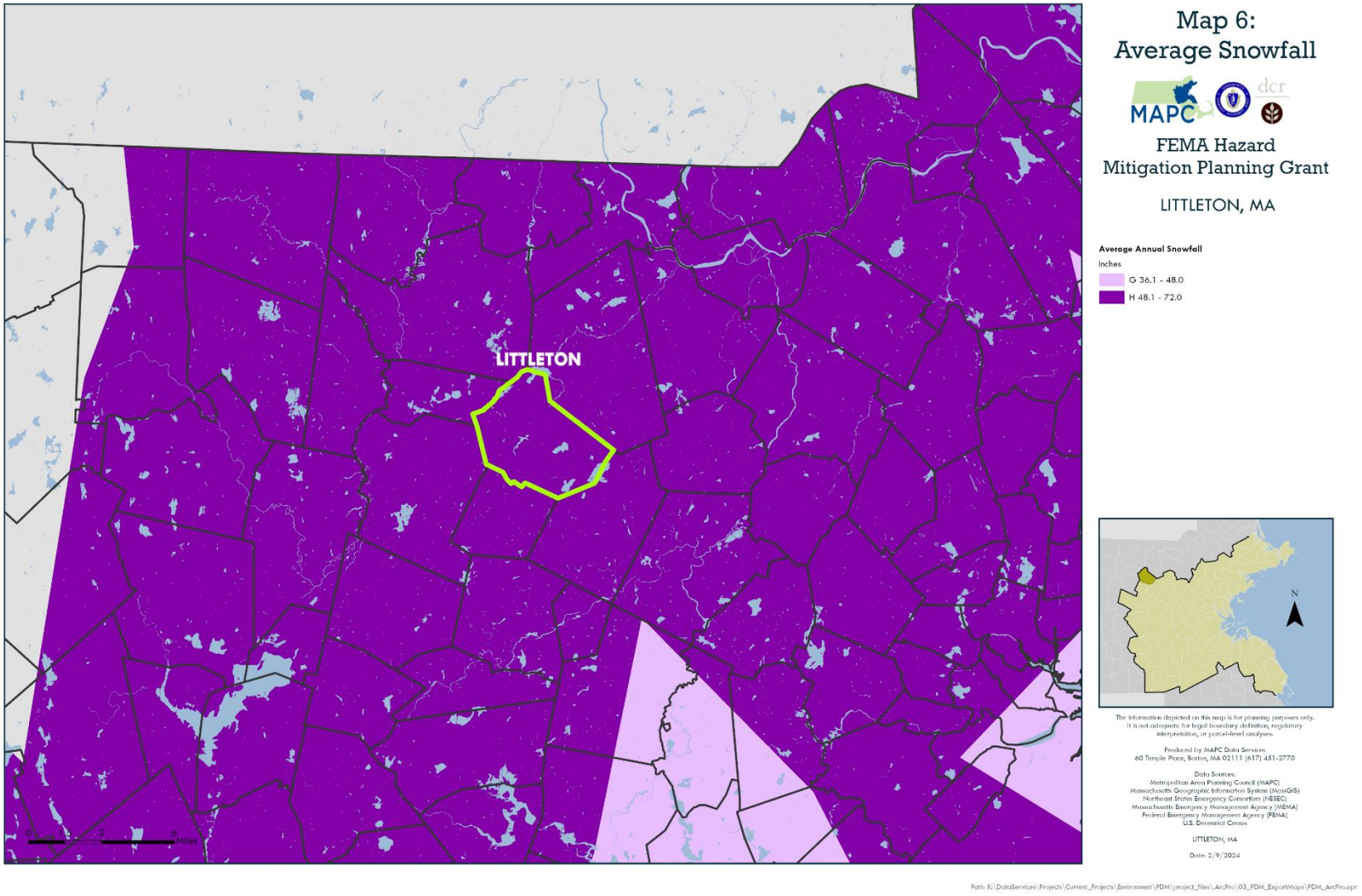
LITTLETON, MA
Date: 2/9/2024


LITTLETON
0 1.5 3 6 Miles
Map 6:
Average Snowfall
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Average Annual Snowfall
Inches
G 36.1 - 48.0
H 48.1 - 72.0
N
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)
U.S. Decennial Census
LITTLETON, MA
Date: 2/9/2024
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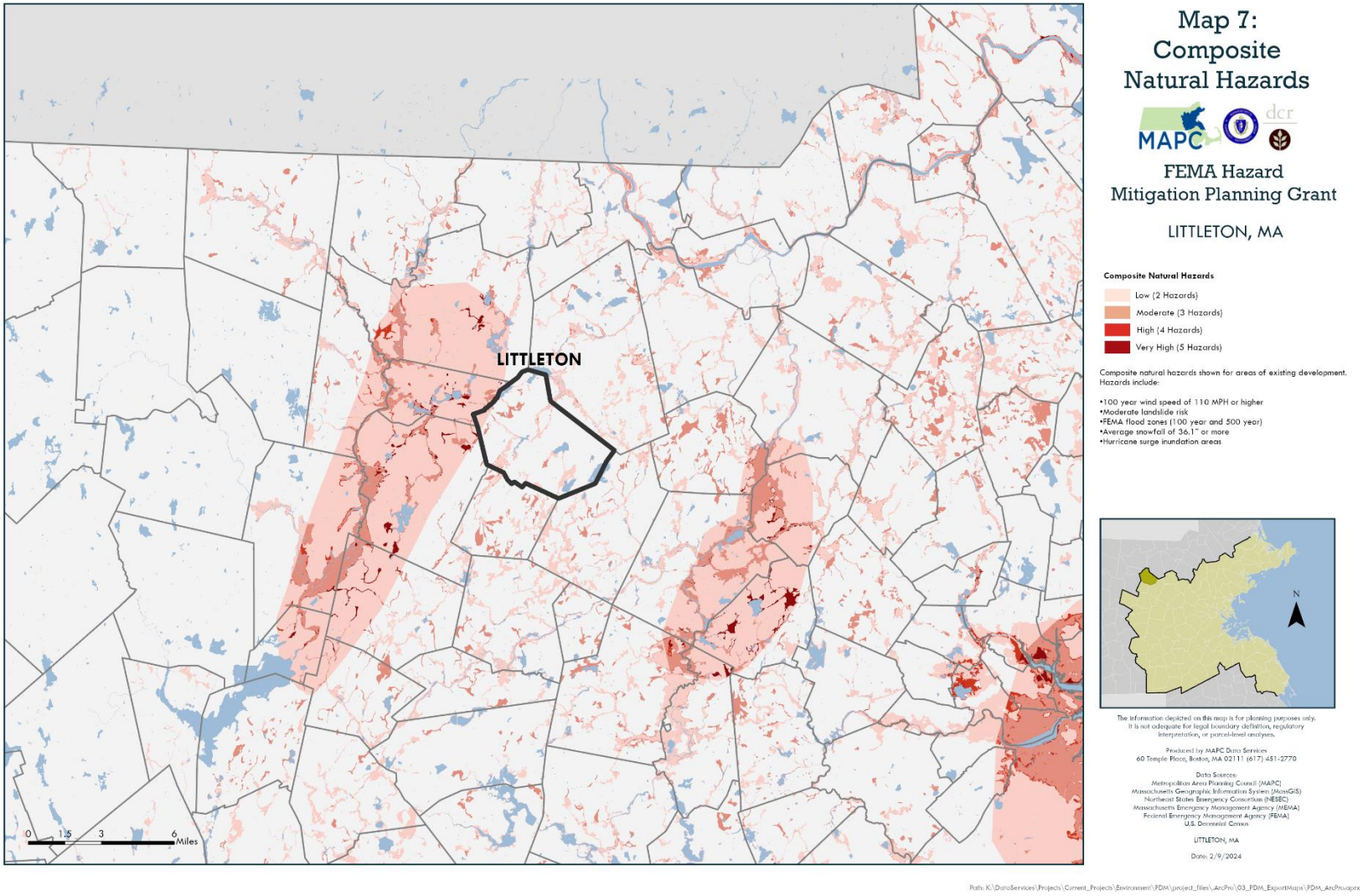
LITTLETON
0 1.5 3 6 Miles
Map 7:
Composite
Natural Hazards
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Composite Natural Hazards
Low (2 Hazards)
Moderate (3 Hazards)
High (4 Hazards)
Very High (5 Hazards)
Composite natural hazards shown for areas of existing development.
Hazards include:
•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 inundation areas
N
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U.S. Decennial Census
LITTLETON, MA
Date: 2/9/2024
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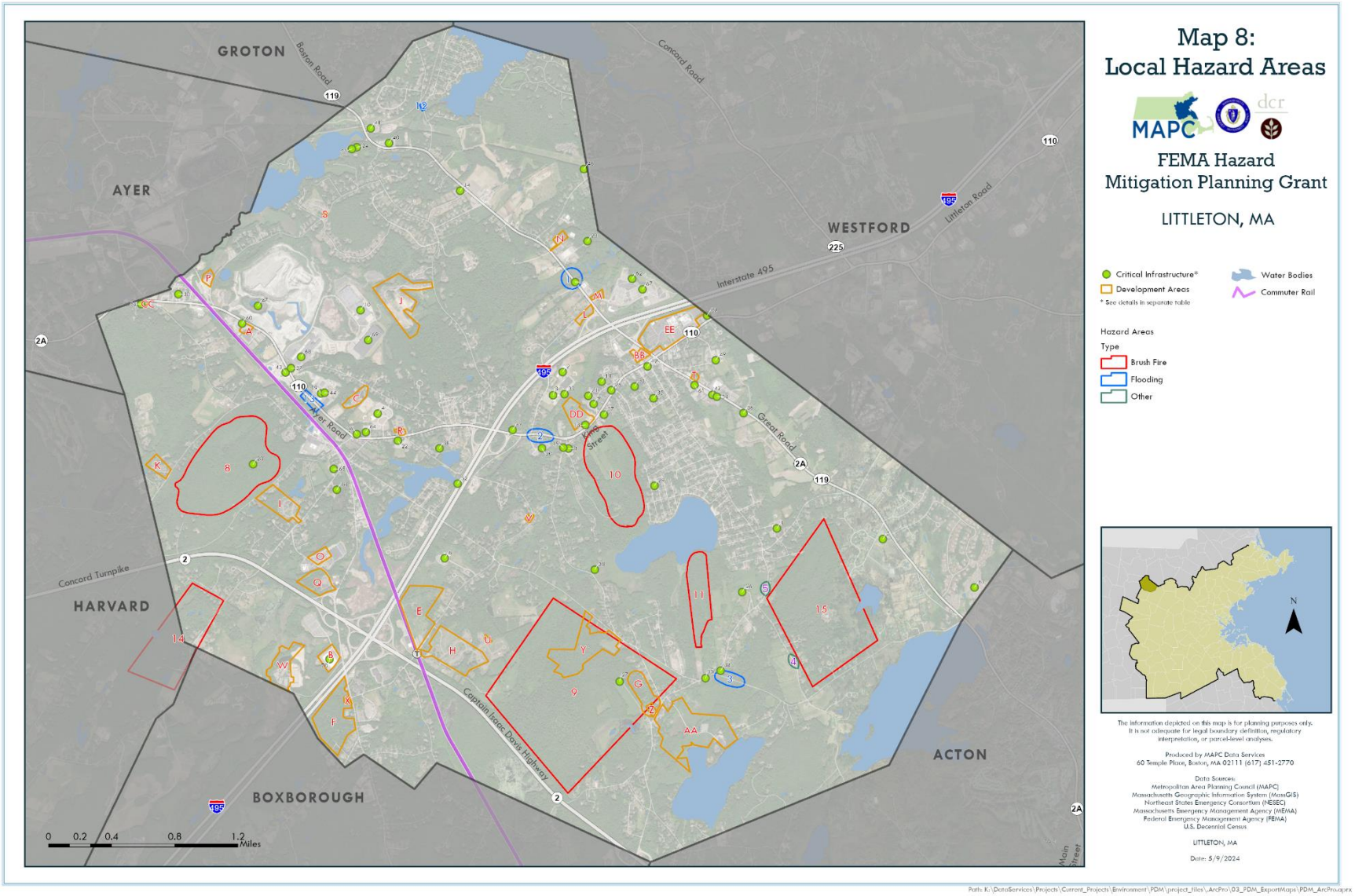
GROTON
AYER
WESTFORD
HARVARD
BOXBOROUGH
ACTON
Boston Road
Concord Road
Littleton Road
Interstate 495
Great Road
Concord Turnpike
Captain Isaac Davis Highway
Main Street
Map 8:
Local Hazard Areas
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Hazard Areas
Type
Brush Fire
Flooding
Other
0 0.2 0.4 0.8 1.2 Miles
N
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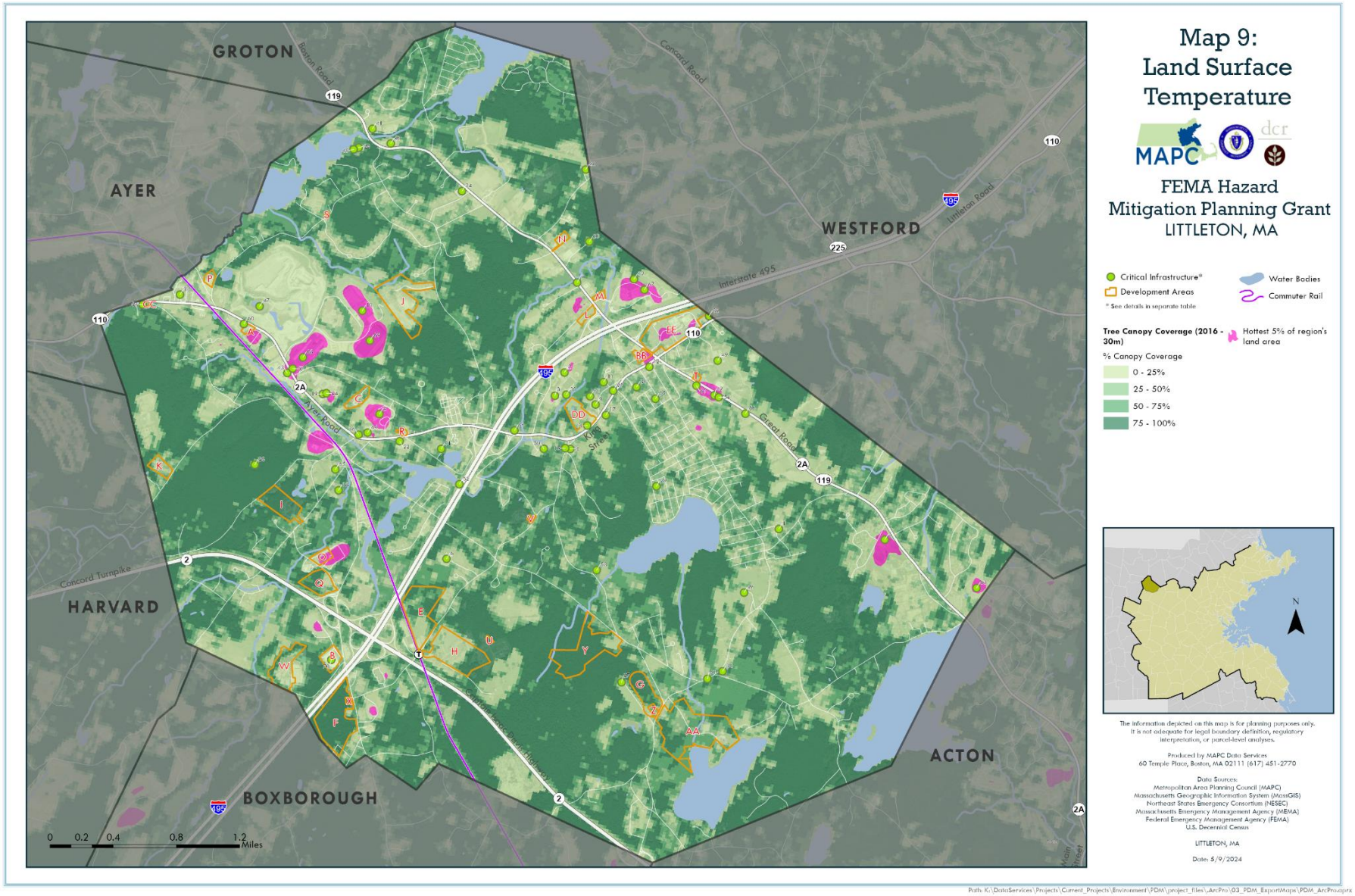
U.S. Decennial Census
LITTLETON, MA
Date: 5/9/2024


GROTON
AYER
WESTFORD
HARVARD
BOXBOROUGH
ACTON
Boston Road
Concord Road
Littleton Road
Interstate 495
Ayer Road
Great Road
Concord Turnpike
Main Street
0 0.2 0.4 0.8 1.2 Miles
Map 9:
Land Surface
Temperature
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Tree Canopy Coverage (2016 - 30m)
Hottest 5% of region's land area
% Canopy Coverage
0 - 25%
25 - 50%
50 - 75%
75 - 100%
N
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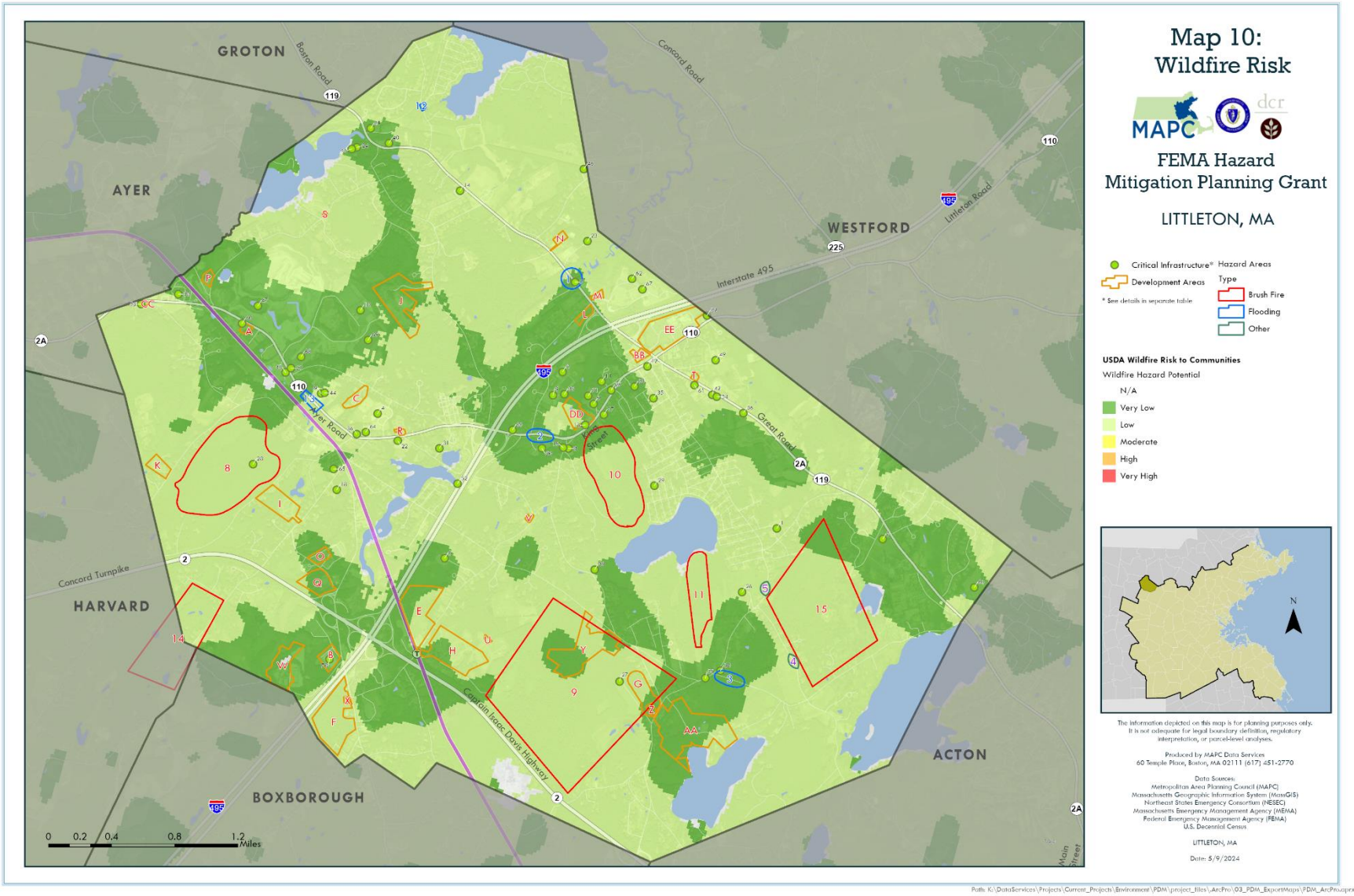
U.S. Decennial Census
LITTLETON, MA
Date: 5/9/2024


GROTON
AYER
WESTFORD
HARVARD
BOXBOROUGH
ACTON
Boston Road
Concord Road
Littleton Road
Interstate 495
Great Road
Concord Turnpike
Captain Isaac Davis Highway
Main Street
Map 10:
Wildfire Risk
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
LITTLETON, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Hazard Areas
Type
Brush Fire
Flooding
Other
USDA Wildfire Risk to Communities
Wildfire Hazard Potential
N/A
Very Low
Low
Moderate
High
Very High
0 0.2 0.4 0.8 1.2 Miles
N
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Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
LITTLETON, MA
Date: 5/9/2024

# APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

## Littleton Hazard Mitigation Plan Update 2023
**Local Team Meeting #1**

**Monday, July 10, 2023**
**2:00 – 3:30 PM**

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## AGENDA

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### 1. Welcome and Introductions

### 2. Overview of the HMP Project

- Overview of the FEMA Hazard Mitigation Plans
- Project tasks and schedule (see attached Summary of the Process)

### 3. Getting Started: Local Data Updates from the 2017 Plan

- *We will update the following 3 types of local data from the 2017 plan (see attached worksheets for updating each of the 3 data types):*
  - Local Hazard Areas of Concern (Flooding & Wildfire)
  - Critical Facilities
  - New Development sites
- *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

- Two Public Meetings: during planning process, and review draft plan
- Identify local stakeholders to invite (review MVP Workshop invitees)

# APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

## Littleton Hazard Mitigation Plan Update
**Summary of the Planning Process**

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**1) Littleton Team Meeting #1: Overview / Data & Map Update — July 2023**

- Review project tasks and timeline
- Update: **Critical Facilities**: Inventory and Map
- Update: **Local Hazard Areas** and Map
- Update: **Development Sites** and Map
- Public Meetings, outreach to stakeholders

**2) Littleton Team Meeting #2: Update of Existing Mitigation — Oct. 2023**

- Update: **Hazard Mitigation Goals** for the Plan
- Update: **Existing Mitigation Measures**
- Prepare for **Public Meeting #1**

**3) Littleton Public Meeting #1: Plan Overview/Public Input — Nov. 2023**

**4) Littleton Team Meeting #3: Develop Mitigation Strategy — Jan. 2024**

- Review status of **Recommended Mitigation Strategies** from the Previous Plan
- Discuss possible changes to mitigation strategies and need for new strategies

**5) Littleton Team Meeting #4: Develop Mitigation Strategy — Apr. 2024**

- Develop Recommended Mitigation Measures and Prioritize
- Designate Implementing agencies, Timeframes, Estimated Costs, Funding Sources
- Prepare for 2nd Public Meeting and outreach to stakeholders

**6) Littleton Public Meeting #2: Presentation of Draft HMP — May 2024**

**7) Draft HMP: submitted to MEMA & FEMA — May 2024**

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# APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

## Littleton Hazard Mitigation Plan Update 2023
**Local Team Meeting #2**

**Wednesday, September 27, 2023**
**10:00 – 11:30 AM**

**Zoom Meeting**
https://us06web.zoom.us/j/88631566663

**Dial-In numbers**
+1 646 931 3860 US or +1 301 715 8592 US
Meeting ID: 886 3156 6663

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## AGENDA

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### 1. Welcome and Project Update

### 2. Review and Update of Mitigation Goals for the Plan
***See Worksheet #4 Mitigation Goals from the 2017 plan attached***

### 3. Review Status of Existing Mitigation Measures
***See Worksheet #5 Existing Mitigation from the 2017 Plan attached***

- Note any **Changes for 2023**
- Update any **Improvements Needed**
- Add any **New Measures** adopted since 2017

### 4. Prepare for First Public Meeting and Community Survey

- Meeting date and host board/commission (target November)
- *Meeting Invitation/outreach:*
  - *Identify local stakeholders to invite* (refer to MVP invitees)
  - *Community groups, businesses, NGO's, etc.*
  - Public outreach on Town website, social media, etc.
  - MAPC to prepare flyer, social media card, press advisory

# APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

## Littleton Hazard Mitigation Plan Update
**Local Team Meeting #3**

**Thursday, January 4, 2024**
**10:00 – 11:30 AM**

**Virtual Meeting**
https://us06web.zoom.us/j/89310279917

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## AGENDA

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### 1. Welcome and Project Update

### 2. Review Status of Mitigation Strategies from the 2017 Plan

The Team will review the recommended mitigation measures from the 2017 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.*

### 3. Next Steps

- **Final Team Meeting – April**
  - To be Scheduled in April 2024
  - Finalize mitigation recommendations for the 2024 plan
- **Second Public Meeting–May**
  - Presentation of the draft plan and public questions/comments
  - Draft plan to be posted on the Town's website for public review
- **Draft Plan to be submitted for MEMA & FEMA review – May**
  - Revisions to the draft plan if required by MEMA or FEMA
  - FEMA will issue "Approval Pending Adoption" notice
- **Adoption of the Final Plan by the Town**
  - FEMA will issue "Approval Pending Adoption" notice
- **FEMA will issue a 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: HAZARD MITIGATION TEAM MEETINGS

## Littleton Hazard Mitigation Plan Update

**Local Team Meeting #4 (Final Meeting)**

**Thursday, April 4, 2024**
**10:00 – 12:00**

*Zoom*
**Passcode: 387455**

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## AGENDA

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### 1. Welcome and Project Update

### 2. Finalize the Mitigation Strategies for 2024 Plan

- The Team will review the draft recommended mitigation measures for the 2024 plan
- We will confirm the recommendations, lead agencies, timeframes, and costs
- *See the attached worksheet.*

### 3. Next Steps

- **Second Public Meeting / Review of Draft Plan**
  - **Need to Schedule Public Meeting for May**
  - Meeting notice and social media outreach, please advise on public engagement
  - Presentation of the draft plan and public questions/comments
  - Draft plan to be posted on the Town's website for public review

- **Draft Plan to be submitted for MEMA & FEMA review**
  - Revisions to the draft plan if required by MEMA or FEMA
  - FEMA will issue "Approval Pending Adoption" notice

- **Adoption of the Final Plan by the Town**
  - FEMA will issue "Approval Pending Adoption" notice
  - The Select Board will vote to adopt the plan

- **FEMA will issue a 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

# APPDENCIX C: PUBLIC MEETINGS

**PLANNING BOARD**
P.O. Box 1305
Littleton, Massachusetts 01460

RECEIVED
NOV 09 2023
By
3:30pm

**PLANNING BOARD MEETING**
**THURSDAY, November 16, 2023 at 6:00 p.m.**
**Room 103**
**Shattuck Street Town Offices at 37 Shattuck Street**

**This LIVE meeting may be viewed online at LCTV On-Demand at**
**https://littleton.vod.castus.tv/vod**

*Public meetings may be broadcast live, streamed live, or recorded for later playback on LCTV and/or the Internet. PARTICIPANTS/ATTENDEES ARE REMINDED THAT BY JOINING THIS MEETING THAT YOU CONSENT TO YOUR LIKENESS AND AUDIO BEING USED AND REBROADCAST BY LCTV. If attending virtually, please identify your screen name with your full name. This is to protect the integrity of the meeting. Attendees of all public meetings should be aware of Massachusetts Recording Law M.G.L. Ch. 20A §20 (f)* if they are personally considering recording any part of a meeting or a meeting in its entirety.*

**Proposed Agenda –** items may be taken out of order or at times other than listed

1. 6:00 Littleton's Hazard Mitigation Plan – First Public Meeting – Metropolitan Area Planning Council (MAPC)
   A. Overview
   B. Process
   C. Input Needed
   D. Next Steps

2. 6:30 Board Business
   A. Introduce Assistant Town Planner
   B. Minutes of prior meetings: Sept. 14, 2023
   C. Bills
   D. Town Meeting Follow-Up
      1. Article 18 Firearms Business Zoning Bylaw Update
      2. Article 19 MBTA Communities Zoning Bylaw
      3. Article 20 Webster Parcel
   E. Member Input and Member Update on Projects:
      1. Northern Bank (25 Robinson Road and 265-289 Great Rd)
      2. Hager Homestead (336 and 338 King Street)
      3. Bicycle and Pedestrian Plan
   F. Public Input: *Public Input will last for no more than 10 minutes and speakers are allowed to speak for no longer than 2 minutes. Speakers addressing the meeting are required to do so from the podium, provide name and address for the record, and all comments must be through the Chair. Public Input on a posted public hearing agenda item will be taken during that public hearing.*

3. 6:45 Stormwater Permit Review – Taylor Street Wells and Water Main Extension - LELWD

**PLANNING BOARD**
P.O. Box 1305
Littleton, Massachusetts 01460

4. 7:00 Continued Public Hearing – 234 Taylor Street – Adult Use Marijuana Establishment and Water Resource District Special Permit – Sanctuary Medicinals Inc.
   *The Public Hearing for 234 Taylor Street will be continued to a future meeting.*

5. 7:05 550 King Street Definitive Subdivision –
   A. Endorse Mylars
   B. Endorse Covenant

6. 7:10 160 Ayer Road – Littleton Apothecary – Board Discussion regarding determination of "good cause" – Adult Use Marijuana Special Permit for Retail Establishment

7. 7:15 Continued Public Hearing - 550 Newtown Road – Major Commercial/Industrial Use Special Permit, Site Plan Amendment, and Stormwater Permit – add self-storage building to existing site – Storage Rentals of America
   *The Public Hearing for 550 Newtown Road will be continued to a future meeting.*

8. 7:20 Executive Session to Discuss Pending Litigation – Town Counsel Chris Heep – Regarding Homelit Realty appeal of Glavey Family Trust "Healy Corner" Subdivision

ADJOURN

**(f) After notifying the chair of the public body, any person may make a video or audio recording of an open session of a meeting of a public body, or may transmit the meeting through any medium, subject to reasonable requirements of the chair as to the number, placement and operation of equipment used so as not to interfere with the conduct of the meeting. At the beginning of the meeting, the chair shall inform other attendees of any recordings.*

RECEIVED
NOV 09 2023
By
3:30pm

# APPDENCIX C: PUBLIC MEETINGS

# APPDENCIX C: PUBLIC PARTICIPATION

## Littleton Draft Hazard Mitigation Plan
## Public Meeting

**When:** Tuesday, May 28, 2024, 6:35 PM

**Where:** Littleton Select Board (Live in-person meeting)
Sturtz Meeting Room- Reuben Hoar Library
35 Shattuck Street, Littleton
May be viewed online
at https://cloud.castus.tv/vod/littleton/?page=HOME

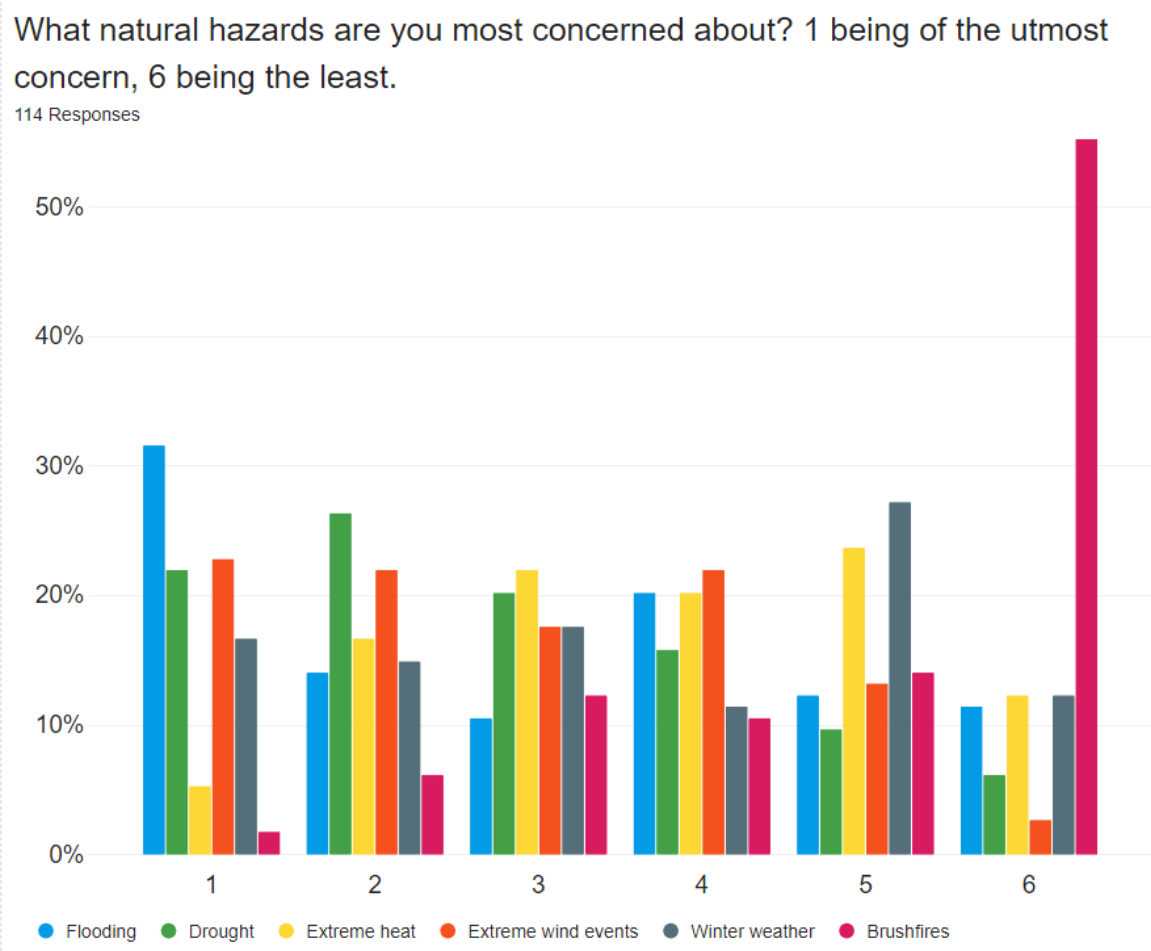
**Littleton experiences natural hazards** that can impact residents and businesses, including flooding, severe winter storms, and drought.

**The Town has prepared a draft 2024 Hazard Mitigation Plan** to assess its vulnerability to natural hazards and identify strategies to increase the resilience of our community, infrastructure, and natural resources.

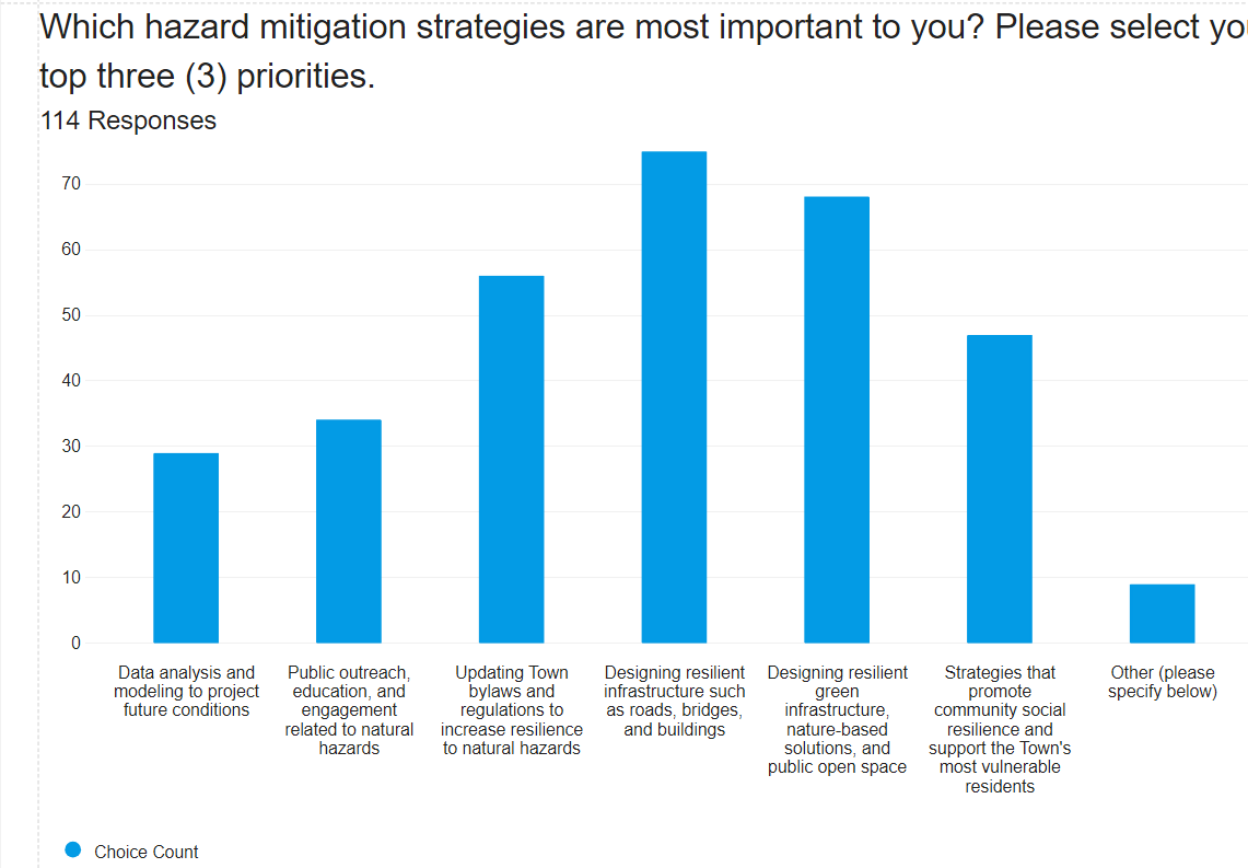
***Please join us for a presentation on the plan hosted by the Select Board on May 28!***

If you have questions or comments, please email Maren Toohill
Town Planner
MToohill@littletonma.org

# APPDENCIX C: PUBLIC PARTICIPATION



# APPDENCIX C: PUBLIC PARTICIPATION



# APPDENCIX D: PLAN ADOPTION CERTIFICATE

TO BE ADDED AFTER FEMA APPROVAL OF THE PLAN