City of Leominster
Natural Hazard Mitigation Plan Update

Leominster, Massachusetts

FINAL Draft for Review

Local Natural Hazard Mitigation Plan Update

Prepared in accordance with the requirements presented in the 44 Code of Federal Regulations (CFR) Part 201.6, FEMA Local Mitigation Plan Review Guide and the Local Mitigation Handbook

Prepared by:
GZA GeoEnvironmental, Inc.

Prepared For:
The City of Leominster, Massachusetts

January 2023

Photo credit: City of Leominster (Leominster - Parks (leominster-ma.gov))

GZA GeoEnvironmental, Inc.

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SAMPLE PLAN ADOPTION LETTER

<CITY LETTERHEAD>

Certificate of Adoption Resolution
City Council
City of Leominster, Massachusetts

A RESOLUTION ADOPTING THE CITY OF LEOMINSTER *NATURAL HAZARD MITIGATION PLAN UPDATE*

WHEREAS, the City of Leominster recognizes the threat that natural hazards pose to people and property within the City of Leominster; and

WHEREAS, the City of Leominster established a Local Planning Team to prepare the Natural Hazards Mitigation Plan Update; and

WHEREAS, City of Leominster has prepared a multi-hazard mitigation plan, hereby known as the *LEOMINSTER MULTI-HAZARD MITIGATION PLAN UPDATE* in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS, the *LEOMINSTER NATURAL HAZARD MITIGATION PLAN UPDATE* contains several potential future projects to mitigate potential impacts from natural hazards in the City of Leominster; and

WHEREAS, a duly-noticed public meeting was held by the City of Leominster Local Planning Team on May 11, 2022 and August 29, 2022 for the public and municipality to review prior to consideration of this resolution; and

WHEREAS, the City of Leominster authorizes responsible departments and / or agencies to execute their responsibilities demonstrated in the plan; and

NOW, THEREFORE, BE IT RESOLVED that the City of Leominster CITY COUNCIL, formally approves and adopts the *LEOMINSTER NATURAL HAZARD MITIGATION PLAN UPDATE*, in accordance with M.G.L. c. 40 §4 or the charter and bylaws of the City of Leominster.

ADOPTED AND SIGNED this Date _____

Name(s):_____

Title(s):_____

Signature (s):_____

FEMA Approval LETTER

QUICK PLAN REFERENCE GUIDE

The following provides a Quick Reference Guide to the City of Leominster Natural Hazard Mitigation Plan Update:

STEP 1: UNDERSTAND THE PLANNING PROCESS

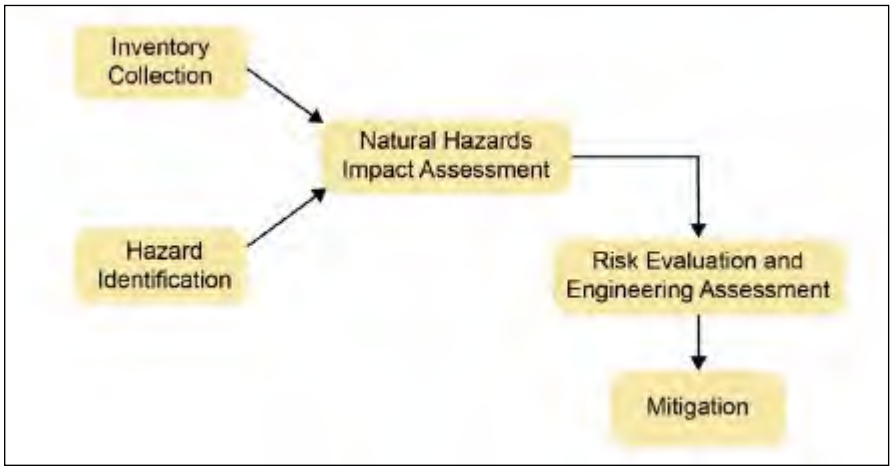
Section 2 - Planning Process describes the planning process and identifies the members of the Local Planning Team (LPT) that participated in the Plan development. **Attachment 6** presents public outreach documentation.

STEP 2: INVENTORY CITY ASSETS (COMMUNITY PROFILE)

Section 3 - Community Profile presents a brief overview of the City assets. **Attachment 1** provides a detailed description of these assets, including the City population, and an inventory of Essential and Lifeline Systems, High Potential Loss Facilities, Transportation Infrastructure, and City Facilities and Zoning Districts and General Building Stock.

STEP 3: IDENTIFY NATURAL HAZARDS

Section 4 - Natural Hazard Risk identifies and summarizes the natural hazards applicable to the City. **Attachment 2** provides the detailed description of relevant natural hazards. The hazards are characterized including past hazard events and expected probability of occurrence. Future climate-related changes to severe weather and climate-related hazards are also presented based on the current available science.



Conceptual Steps in Assessing and Mitigating Losses due to Natural Hazards (FEMA)

STEP 4: ASSESS NATURAL HAZARD IMPACTS AND RISK

Section 4 - Natural Hazard Risk also presents the results of an assessment of the vulnerability of the City to the natural hazards. **Attachment 3** provides a detailed hazard vulnerability assessment. FEMA HAZUS-MH simulations were performed for Hurricane (probabilistic), Flood (1% and 0.2% Annual Exceedance Probability [AEP] floods), and Earthquake (2% in 50 years). The simulation results are presented in **Attachment 4**.

STEP 5: MITIGATION PLAN AND IMPLEMENTATION

Sections 5, 6 and 7 present mitigation strategies and actions, regional and intercommunity considerations and plan implementation details. **Attachment 3** provides the basis for ranking natural hazard priorities. **Attachment 5** presents state and federal hazard mitigation and response grant funding sources. References and resources, and key contacts are presented in **Attachments 7** and **8.**

UNDERSTANDING NATURAL HAZARD RISK

This Natural Hazard Mitigation Plan Update is intended to provide the City of Leominster with a risk-based approach to making planning decisions. In simple terms...

Risk = the probability of an event occurring x the consequences of that event

Risk can be assessed qualitatively or quantitatively. The evaluation of the risks associated with Leominster's natural hazards required: 1) identifying the type of natural hazard(s) applicable to Leominster; 2) evaluating their probability of occurrence; and 3) evaluating their consequences. For example, a flood could impact Leominster resulting in damage to property, injury or death and/or other economic or natural resource impacts. Different flood conditions (water level, limit of flooding, etc.) are associated with different probabilities of occurrence and different degrees of consequences. By characterizing the hazard, evaluating its probability and evaluating the consequences, the likelihood that these consequences will be experienced is determined. Once the consequences are understood in this way, value and risk-based planning decisions can be made.

Quantitative Risk Assessment

Quantitative assessment of natural hazard risk typically defines hazard probability in terms of Annual Exceedance Probability (AEP). The AEP refers to the probability that an event (e.g. , a specific flood water level) will be experienced or exceeded in any given year. For example, the 1% AEP event has a 1 in 100 chance of being met or exceeded in any given year. This probability is often described in terms of a recurrence interval. The recurrence interval is also a statistical indication of the probability of an event and can be considered as the "expected" frequency of an event, on average and over a long period of time. The 100-year recurrence interval is consistent with a 1% AEP. Estimates of AEP are typically presented as "mean" values and have uncertainty often represented by lower and upper bounds.

Quantitative estimates of natural hazard probabilities, to be statistically meaningful, require long periods of record of actual historical hazard data or use of other statistical methods. Certain natural hazards such as earthquakes have been defined quantitatively by the federal government (FEMA, USGS and/or the US Army Corps of Engineers), and these values have been used for this Plan. For other natural hazards (e.g., Hail), this Plan has used limited historical data to extrapolate probabilities. While not statistically valid, the extrapolated estimates are useful in categorizing likelihood of occurrence (e.g., high to very low). Even though these "quantitative" values are presented in the Plan, the reader should be aware that they are not statistically meaningful due to the limited period of record of historical data.

Evaluating Consequences

This Plan Update evaluates the consequences associated with natural hazards in several different ways. The FEMA HAZUS-MH software is used to calculate losses (e.g. building damage) associated with hurricanes (high winds), flooding and earthquakes. For the other natural hazards, the consequences were extrapolated from available historical data. Similar to the estimated probabilities for these hazards, this approach is not statistically valid; however, it is useful for categorizing the consequences (minor to catastrophic).

Risk Over Time

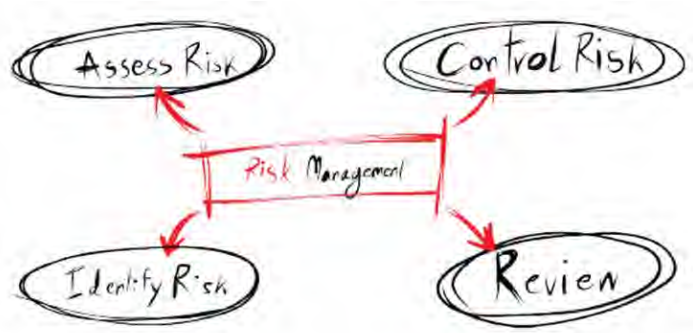
While AEPs and recurrence intervals define the annual risk (i.e., risk in any given year), the risk of experiencing that same hazard event at least once will increase when longer periods of time are considered. For example, the 1% AEP flood has a 1 in 4 chance (25%) of occurring at least once over a 30-year period.

Climate Change

Climate change can effect the risk of severe weather and climate-related hazards. For example, a flood level that has a 1% AEP today may have a much higher probability of occurrence in the future due to increased precipitation.

Low Probability is not the Same as Impossible

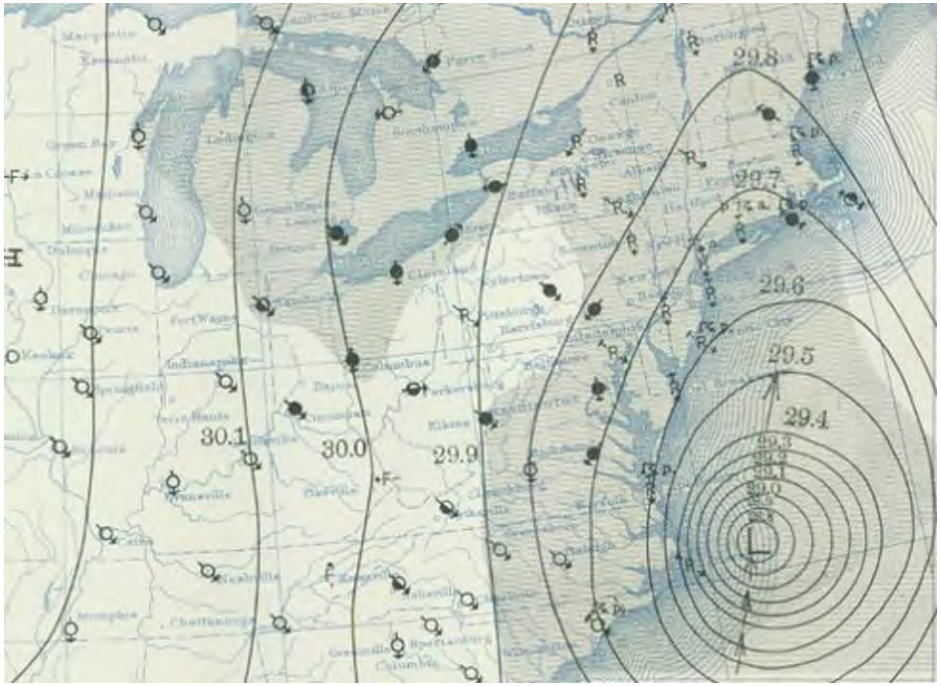
Even though a hazard is predicted to have a low probability of occurrence, that does not mean it cannot happen. For example, a major hurricane is unlikely to occur at Leominster based on the available historical data, but it could happen - it is just predicted to be a low probability for planning purposes.



Risk Management Planning Process

Section 1: Plan Introduction

SECTION 1- INTRODUCTION



Historical Surface Weather Map of the Hurricane of 1938 on September 9, 1938

PURPOSE OF PLAN

This is the Natural Hazard Mitigation Plan Update for the City of Leominster, Massachusetts. The City has developed this Plan to identify the risks and vulnerabilities associated with natural disasters and to develop long-term strategies for protecting people and property from future hazard events.

The City of Leominster is a residential, commercial and industrial community of 43,782 residents, located in Worcester County, about 35 miles northwest of Boston. The City is situated between the Nashua River to the east and the Monoosnoc Hills to the west.

Leominster is vulnerable to severe weather and riverine flooding within the Nashua River Plateau. The City is also vulnerable to climate-related hazards (e.g., extreme heat and cold) and geologic hazards (e.g., earthquakes).

The goal of the Plan Update is to enable action to reduce loss of life and property by lessening the impact of natural disasters.

The development of the Plan Update enables the City to:

- Increase education and awareness about the City's vulnerability to natural hazards;
- Build partnerships for risk reduction involving government, organizations, businesses, and the public;
- Identify long-term, broadly-supported strategies for risk reduction;
- Align risk reduction with other state, tribal, or community objectives;
- Identify implementation approaches that focus resources on the greatest risks and vulnerabilities; and
- Communicate priorities to potential sources of funding.

PLAN REQUIREMENT

FEMA requires state, tribal, and local governments to develop and adopt hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects. Jurisdictions must update their hazard mitigation plans and re-submit them for FEMA approval every five years to maintain eligibility.

Previously, the Montachusett Regional Planning Commission (MRPC) assisted the City of Leominster and twenty-two other communities in the development of the Montachusett Region Natural Hazard Mitigation Plan, with a local natural hazard risk assessment for the City to meet the requirements of the Disaster Mitigation Act (Montachusett Region Natural Hazard Mitigation Plan 2015 Update, prepared by MRPC, 2015). This Plan has been prepared to update and replace the 2015 Plan.

The Commonwealth of Massachusetts encourages local municipalities to take ownership of the multi-hazard mitigation planning process by pursuing and developing local multi-hazard mitigation plans (MHMP).

Section 2: Planning Process

SECTION 2 - PLANNING PROCESS

The FEMA planning process includes the following steps:

1. Organize the Planning Process and Resources

At the start, focus on assembling the resources needed for a successful mitigation planning process. This includes securing technical expertise, defining the planning area, and identifying key individuals, agencies, neighboring jurisdictions, businesses, and/or other stakeholders to participate in the process. The planning process for local and tribal governments must include opportunities for the public to comment on the plan.

2. Assess Natural Hazard Risks

Identify the characteristics and potential consequences of hazards. It is important to understand what geographic areas each hazard might impact and what people, property, or other assets might be vulnerable.

3. Develop Mitigation Strategies

Develop long-term strategies for avoiding or minimizing the undesired effects of disasters. The mitigation strategy addresses how the mitigation actions will be implemented and administered.

4. Adopt and Implement the Plan

Once FEMA has received the adoption from the governing body and approved the plan, the state, tribe, or local government can bring the mitigation plan to life in a variety of ways, ranging from implementing specific mitigation projects to changing aspects of day-to-day organizational operations. To ensure success, the plan must remain a relevant, living document through routine maintenance. The state, tribe, or local government needs to conduct periodic evaluations to assess changing risks and priorities and make revisions as needed.

The City of Leominster followed this process, including:

- Organizing a diverse local planning team.
- Retaining GZA to provide technical and planning expertise.
- Providing opportunities for the public to comment on a draft of the plan prior to final plan approval.
- Providing opportunities for neighboring communities and local and regional agencies involved in natural hazard mitigation activities that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.
- Reviewing and incorporating applicable existing plans, studies, reports, and technical information into this plan.

Figure credit FEMA/Jenny Burmester – Aug 21, 2017

The City assembled a Local Planning Team (LPT) with critical City leadership responsibilities. The LPT was tasked with providing oversight and guidance in developing the Plan.

LOCAL PLANNING TEAM MEMBERS

- Mark Piermarini, Assistant DPW Director
- Raymond Racine, DPW Director
- Wendy Wiiks, Mayor's Office
- John Roseberry, City Engineer
- Robert Sideleau, Fire Chief
- Craig Long, Deputy Fire Chief
- Aaron Kennedy, Chief of Police
- John Fraher, Police Captain
- Arthur Elbthal, Emergency Management
- Butch Nadeau, School Facility Director
- Elizabeth Wood, Planning and Development Director
- Amanda Curtis, Economic Development Coordinator
- Jacob Fleming, City Business Manager
- Jeffrey Stephens, Health Director
- Angela Chebuske, Conservation Agent

SECTION 2 - PLANNING PROCESS cont.

The LPT conducted three formal working group meetings to provide input and guidance in developing the plan throughout the planning process. The meetings were held on 03/15/2022, 05/25/2022, and 08/05/2022. The purpose of each working group meeting is summarized below:

- Working Group Meeting No. 1: Reviewed, discussed and finalized the inventory of City assets as presented in Section 3 and **Attachment 1**. LPT members also reviewed and discussed natural and climate change related hazard characterizations with respect to Leominster as presented in Section 4 and **Attachment 2.**
- Working Group Meeting No. 2: Reviewed and discussed the results of the Risk Assessment. Based on a review of the results and hazard characterizations the LPT confirmed the hazard rankings for the City based on the consistent criteria as presented in Section 4 and **Attachment 3**. The LPT also reviewed, discussed and revised the City's goals, capabilities and hazard mitigation actions presented in the 2015 Montachusett Region Natural Hazard Mitigation Update and 2020 MVP Plan and identified new actions for the Plan Update.
- Working Group Meeting No. 3: Discussed and evaluated the hazard mitigation strategy including the benefit-cost review of each mitigation action using a consistent criteria as presented in Sections 4 and 5.

The City conducted two public meetings that provided residents, community stakeholders, business, neighboring communities, state agencies, regional planning authorities, and City officials, including the LPT members the opportunity to participate during the planning process. The purpose of these meetings was to solicit input during the planning process for consideration and integration into the development of the Plan. The meetings were held at City Hall and publicized on the City's website, by the City Council and through City's constant contact list that reached over 3,000 people including the neighboring communities of Fitchburg, Lunenburg, Lancaster, Serling, Princeton, and Westminster. At the first public meeting, a presentation was given to provide background on Hazard Mitigation Planning and to describe the City's assets inventory, hazards characterization, and preliminary risk assessment. At the second public meeting, a presentation was given to present the hazard mitigation strategy including the benefit-cost review of each mitigation action. The list of participants who attended the public meetings is included in **Attachment 6**. The City hosted the meetings on the following dates: May 11, 2022 and August 29, 2022.

EXISTING PLAN CAPABILITIES

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

- 2011 Montachusett Regional Strategic Framework Plan
- 2015 Montachusett Region Natural Hazard Mitigation Update (2015 HMP Update)
- 2019 Montachusett Region Comprehensive Economic Development Strategy July 2019—July 2024
- 2020 Municipal Preparedness Vulnerability (MVP) CRB Plan (2020 MVP Plan)
- Leominster's 2020 Zoning Ordinance
- Leominster 2012 Subdivision Regulations
- State 2018 Massachusetts State Climate Adaptation and Hazard Mitigation Plan
- Resilient MA Resiliency planning and policy documents
- Federal and state flood regulations
- National Flood Insurance Program
- State and federal permits related to natural hazard mitigation, resilience and adaptation measures

A brief overview of relevant City details is also provided in Section 3 and **Attachment 1.**

Section 3: Community Profile

SECTION 3 - COMMUNITY PROFILE OVERVIEW

The City of Leominster is a residential, commercial and industrial community of 43,782 residents, located in Worcester County, about 35 miles northwest of Boston (see **Figure 1**). As described in the 2015 *Montachusett Regional Natural Hazard Mitigation Plan 2015 Update*, the Montachusett region is in north-central Massachusetts, and is bordered by New Hampshire in the north, metropolitan Worcester to the south, and metro Boston to the east. The Nashua River runs through the east, the Monoosnoc Hills make up the western portion of Leominster, and the central region is largely developed as industrial, commercial, and residential area. The City has a total area of 29.8 square miles with approximately 3% of that area being water. Leominster was incorporated as a Town in 1740, and chartered as a City in 1915.

The City is governed by a mayor who holds sole executive power. The mayor has the power to appoint members of city boards and department heads. The City is also one of twenty-three cities and towns within the Montachusett Regional Planning Commission (MRPC), supporting regional land use, transportation, community and economic development, public health and environmental planning.

Attachment 1 provides a detailed description of City's community profile including population, building stock, essential facilities and lifeline systems and natural resources. The following pages provide a brief overview.

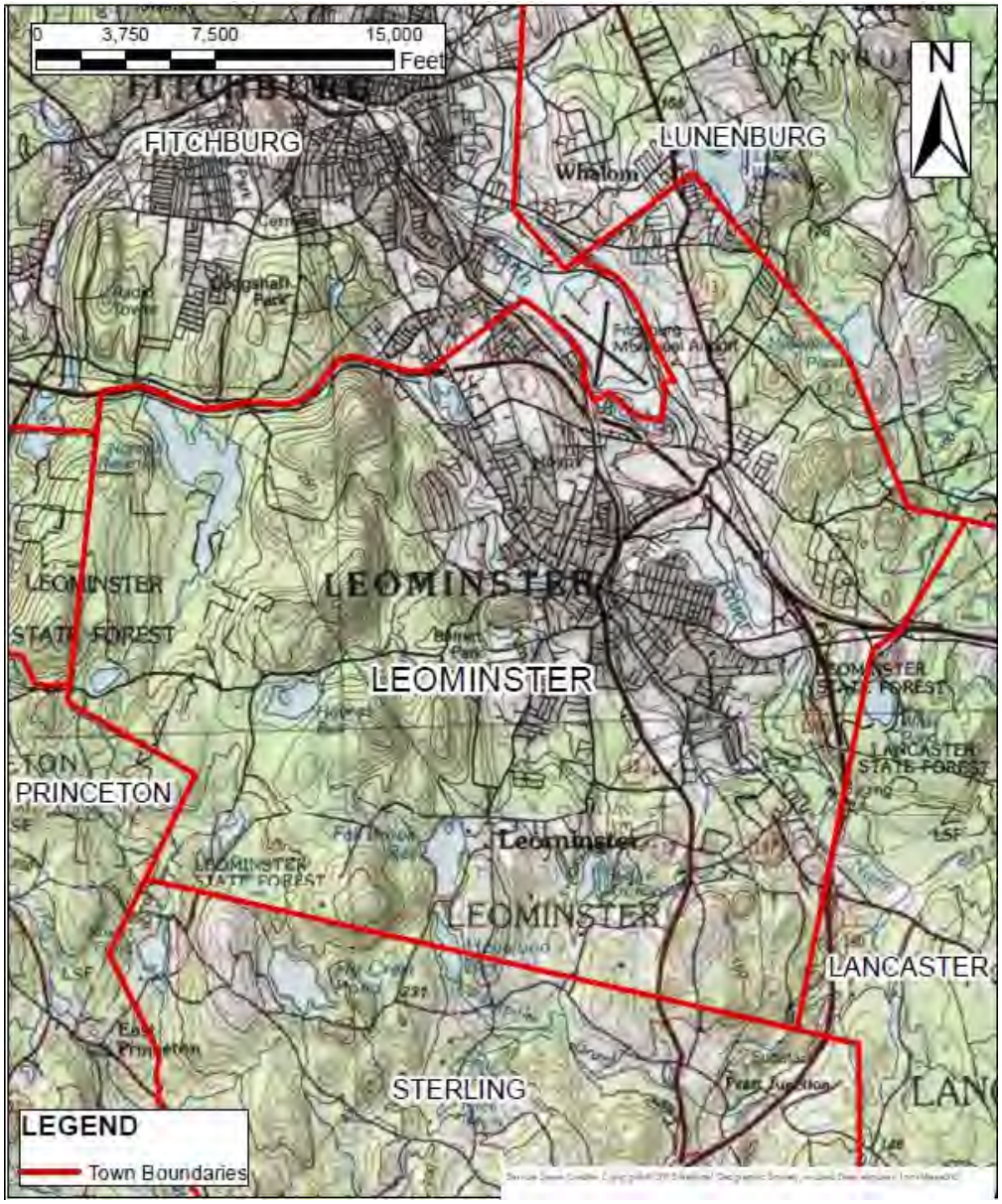


Figure 1: Leominster Site Locus and City Limits

Community Profile Snapshot:

Per the U.S. Census Bureau Decennial Census (2020) and American Community Survey 5-year estimates (2019):

Age and Sex:

Population:	43,782
Population change since 2010*:	3,023 (+ 7.4%)

**Leominster population of 40,759 from 2010 Decennial Census*

Percent female/male:	52.5%/47.5%
Age:	
persons <18 years:	21.7%
persons 18 to 64:	62.4%
persons ≥ 65 years:	15.9%

Race:

White alone:	67.7%
Black or African Amer. alone:	7%
Amer. Indian or Alaska Native alone:	0.3%
Asian alone:	3.2%
Two or more races:	12.4%
Hispanic or Latino:	18.9%
White alone, not Hispanic or Latino:	64%

Education:

High school graduate or higher:	79.3%
Bachelor's degree or higher:	14.5%

Economy:

In civilian labor force, total, greater 16 years: (2012 to 2016)	63.9%
In civilian labor force, female, greater 16 years: (2012 to 2016)	73.5%

Income and Poverty:

Median household income:	$61,825
Per capita income:	$33,676
Persons in poverty:	12.6%

Family and Living Arrangements:

Households:	16,830
Persons per Household:	2.45
Language spoken at home other than English, greater than 5 years:	26.2%
Median house cost:	$241,800
Percent owner-occupied:	57.8%

Population Density:

1,474/sq. mile

Social Vulnerability Index:

Leominster's Overall Social Vulnerability ranges from Lowest Vulnerability to Highest Vulnerability based on census tract as presented in **Attachment 1**.

Community Profile Snapshot:

Building Stock: 12,956 Buildings

- 71.9% Residential (building exposure: $4.03B)
- 14.8% Commercial (building exposure: $829.3M)
- 10.6% Industrial (building exposure: $594.6M)
- 1.1% Religion (building exposure: $60.9M)
- 0.8% Education (building exposure: $46.1M)
- 0.4% Government (building exposure: $22.4M)
- 0.3% Agriculture (building exposure: $18.9M)
- Total building exposure: $5.6B (see Attachment 4 for more details)

Support, High Occupancy and Vulnerable Population Facilities:

- City Administration and Public Buildings
- Elementary and Secondary Schools
- Daycare and Pre-school
- Assisted Living Facilities and Nursing Homes
- Primary Healthcare Facilities
- Religious Institutions

Land Use/Land Cover, % by area:

- 8.4% Residential
- 3.7% Commercial
- 3.4% Industrial
- 52.3% Forest
- 11.2% Other Impervious/Right of Way
- 2.9% Water
- 1.9% Developed Open Space

Overlay Districts:

- Downtown Overlay District
- Mechanic Street Overlay District
- Urban Corridor Overlay District
- Health Care Overlay District

Special Districts:

- Floodplain District
- Water Supply District

Historic Districts:

- Five (5) properties and two (2) historic districts on National Register of Historic Places

Transportation Infrastructure:

- City Roads, State Routes, and Interstate Highways
- 27 MassDOT Bridges and 24 City Bridges
- Public Railroad
- Private Railroad
- Bus Routes

Essential Facilities:

- Emergency Management
- Hospitals
- Police
- Fire and Rescue
- Department of Public Works
- Designated Emergency Shelters

Lifeline Systems:

- Potable Water Supply
- Drinking Water Treatment Facilities
- Sanitary Wastewater Treatment Facilities
- Electricity (National Grid)
- Natural Gas (Boston Gas)
- Telecommunications (Xfinity and Verizon)

Hazardous Materials:

- 39 HazMat Sites

High Potential Loss Facilities:

- 24 Dams
- 6 High Hazard Dams

Natural Resources:

- Nashua River Watershed
- Natural Heritage and Endangered Species (MA NHESP)
- Over 6,500 acres dedicated open space / recreational lands

Section 4: Natural Hazard Risk

SECTION 4 - NATURAL HAZARD RISK OVERVIEW

GZA conducted a Natural Hazard Risk Assessment to evaluate the potential consequences of natural hazards to the people, economy, and built and natural environments of the City of Leominster. The FEMA National Risk Index was used to score the natural hazards based on the expected annual for each hazard, as well as the community resilience and social vulnerability for each community. A FEMA National Risk Index score was not available for flooding in Leominster. Therefore, the FEMA Multi-Hazard HAZUS-MH program was used to evaluate economic losses due to flood hazards and provide a ranking for the risk assessment. The HAZUS-MH simulation results are presented in **Attachment 4**. In addition to the hazards identified in this section, the Hazard Mitigation Team determined that Tsunami, Sea Level Rise, and Coastal Erosion are not relevant due to the Town's location, and therefore were omitted from this plan.

The top 3 ranked hazards include:

- Flooding  1

  Although the extent of riverine flooding is limited to the areas along the Nashua River, Monoosnoc Brook, and Fall Brook, it is highly-ranked due to potential for: 1) high economic losses associated with damages to buildings within the floodplain; and 2) impacts to transportation infrastructure. Flooding caused by poor drainage or beaver dams may pose a hazard in other areas not necessarily impacted by riverine flooding.

- Strong Wind/ Tornadoes  2

  Severe wind due to hurricanes and tropical storms, nor'easters, thunderstorms, and tornadoes is ranked second. Damages due to strong wind include tree damage which can lead to power outages, and structure damage. In particular, a tornado strike at or near Leominster with a magnitude of EF4 or larger could be catastrophic (similar to the 1953 tornado).

- Ice Storms and Severe Winter Weather  3

  Severe winter weather (greater than 10-inches snowfall) most frequently occurs during nor'easters, coincident with high winds, cold temperatures and/or blizzard conditions. Winter storms present risks due to transportation impacts (limited use of roadways), cold temperatures (including wind chill) and the potential for structure damage (roof failures). Ice storms are an occasional component of severe winter weather. Heavy accumulation of ice can bring down trees or tree branches that can cause power outages or damage property. Their relative high probability of occurrence makes severe winter weather a highly ranked hazard.

Severe Weather Hazards:	**Hazard Index**
Strong Wind	11.94
Tornadoes	16.55
Hurricanes/ Tropical Storms	3.98
Lightning	19.66
Hail	2.79
Flooding	-
Severe Winter Weather	7.83
Ice Storms	18.49
Climate-Related Hazards:	
Heat Wave	5.20
Cold Wave	7.11
Drought	3.58
Wildfire	1.55
Geologic Hazards:	
Earthquake	9.69
Landslides	3.00
Secondary Hazard:	
Dam Failure	-

Table 1: Leominster Natural Hazard Ranking based on the hazard frequency of occurrence, severity and extent of impact area. See Attachment 4 for more information about flooding.

SECTION 4 - NATURAL HAZARD RISK OVERVIEW

Table 2 presents a summary of the predicted hazard likelihood of occurrence/frequency, severity/magnitude and impact area for each natural hazard that is relevant to Leominster. The hazard probability of occurrence (frequency) is characterized as:

Frequency:

Very Low: Events that occur less frequently than once in 1,000 years (less than 0.1% per year).

Low: Events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year)

Medium: Events that occur from once in 10 years to once in 100 years (1% to 10% per year).

High: Events that occur more frequently than once in 10 years (greater than 10% per year).

The hazard impact in part is characterized as follows:

Severity:

Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., 1 or 2 communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.

Serious: Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.

Extensive: Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.

Catastrophic: Property and public infrastructure destroyed; essential services stopped, thousands of injuries and fatalities.

Climate change will have an effect on Severe Weather Hazards and Climate-Related Hazards. **Table 3** compares key components of Leominster's climate today to changes predicted by the year 2050. The impact of certain climate change effects on the City such as precipitation increases and flooding are predictable. The impact of other effects such as the increase in the frequency and duration of Heat Waves are less predictable. However, these Climate-Related hazards are predicted to become a high priority for Leominster over the next decade.

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
SEVERE WEATHER HAZARDS			
Severe Wind:			
Hurricanes/Tropical Storms/ Nor'easters	• Hurricane Wind Warning (>74mph): 1.3% AEP or 75-year recurrence interval; **Medium**	Catastrophic	City-wide
Thunderstorms (wind >58 mph)	• 77% AEP or minimum of 1.3-year recurrence interval; **High**	Serious	City-wide or portions of City
Tornadoes	• Tornadoes within Worcester County: 39% AEP or 2.6-year recurrence interval; **High** • Major tornado (≥ EF4) within Worcester County: 1.4% AEP or 69-year recurrence interval; **Medium**	Catastrophic	City-wide or portions of City
Lightning	• Events resulting in fatality, injury and/or damage: 88% AEP or 1.1-year recurrence interval; **High**	Serious	City-wide or portions of City
Intense Rainfall	• 4% AEP or 25-year recurrence interval; **Medium**	Minor	City-wide or portions of City
Hail (≥ 3/4 inch)	• 70% AEP or 1.4-year recurrence interval; **High**	Minor	City-wide or portions of City
Flooding:			
Riverine Flooding	• 85% AEP or 1.2-year recurrence interval; **High**	Serious	Portions of City
Poor Drainage Flooding	• 77% AEP or 1.3-year recurrence interval; **High**	Serious	Portions of City

Table 2: Leominster Natural Hazard Overview

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
SEVERE WEATHER HAZARDS			
Severe Winter Weather:			
Snowfall	• 96% AEP or 1.04-year recurrence interval; **High**	Serious	City-wide
Ice Storms	• 17% AEP or 6-year recurrence interval; **High**	Serious	City-wide or portions of City
CLIMATE-RELATED HAZARDS			
Extreme Temperatures:			
Excessive Heat	• 4.8% AEP or 21-year recurrence interval; **Medium**	Minor	City-wide
Extreme Cold/ Wind Chill	• 4.5% AEP or 22-year recurrence interval; **Medium**	Minor	City-wide
Drought	• 13% AEP or 7.7-year recurrence interval; **High** • Massachusetts experiences extended, multi-year droughts about every 20 years; **Medium**	Minor (could be Serious if affects Water Supply)	City-wide
Wildfire	• The historical data indicates that the probability of wildfire within Leominster is low. Wildfire Hazard Potential Index for City is Very Low, Low, or Non-burnable area. Likelihood may coincide with drought. **Low**	Serious	Portions of City 52% of City area is forest

Table 2 cont.: Leominster Natural Hazard Overview

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
GEOLOGIC HAZARDS			
Earthquake	• The occurrence of historic earthquakes, PGA, and Site Class indicate that the seismic risk at Leominster is low; **Low**	Serious	City-wide
Landslide	• According to the FEMA National Risk Index, the area near Leominster has relatively low potential for landslides; **Low**	Minor	City-wide

City climate considerations:

Periods of colder temperatures occur at Leominster and can cause wind chill conditions. Wind chill conditions example:

- 0° F and 25 mph sustained wind speeds, 30-minute exposure
- 5° F and 55 mph sustained wind speeds, 30-minute exposure

The severity and magnitude of extreme heat events at Leominster is, in part, dependent upon: 1) demographics; and 2) the capability of residents to get cool (e.g. air conditioners in homes). Leominster demographic data indicates that certain sectors of the population may be at a greater than average vulnerability:

- 15.9% of Leominster population is older than 65 years
- 12.6% of Leominster's population is at or below the poverty level

About earthquakes at Leominster

1. The direct earthquake risk to Leominster is due to the ground motion that results during the earthquake. The 10% in 50 years (500-year recurrence interval) ground motion would be experienced as light to moderate perceived shaking and none to very light damage. The 2% in 50 years (2,500-year recurrence interval) ground motion would be experienced as very strong perceived shaking and moderate damage. Based on HAZUS-MH simulations of Leominster, 1,852 buildings are predicted to experience damage, ranging from slight to extensive, from the 2,500-year (2% in 50 years) recurrence interval earthquake. The estimated economic losses are about $112 million for the 2,500-year event. An earthquake strong enough to cause damage to the natural gas pipelines crossing through Leominster could result in severe damage and loss of life.

Table 2 cont.: Leominster Natural Hazard Overview

Climate Change and Leominster

Leominster Climate Today	Leominster Climate 2050
Temperature: The average annual temperature is about 47°F. • The average minimum temperature in Winter (December, January and February) ranges from 10.8°F to 21.3°F • The average maximum temperature in Summer (June, July, August) ranges from 77.1°F to 81.3°F, • Average annual days above 90°F (based on Nashua Basin data): 6 days	Temperature: The average annual temperature could be between 2.9°F and 7.4°F higher than today. • Average Summer temperature (based on Nashua Basin data): could be between 2.7°F and 8.2°F higher than today. • Days above 90°F (based on Nashua River data): 15t o 25 days • Spring will arrive sooner, summers will grow hotter, and the weather will become more extreme with swings between above-average winter temperatures to extreme cold with large snowfall events.
Intense Precipitation: • The 25-year recurrence interval, 24-hour rainfall at Leominster 5.75 inches (NOAA Atlas 14)	Intense Precipitation: Within the Northeast U.S., from 1996 to 2014, the amount of intense rainfall (heaviest 1% of all daily events) was about 50% higher than the period of 1901 to 1995. The frequency and intensity of intense rainfall is expected to increase.

Data source: Resilient MA
https://resilientma.org/map/

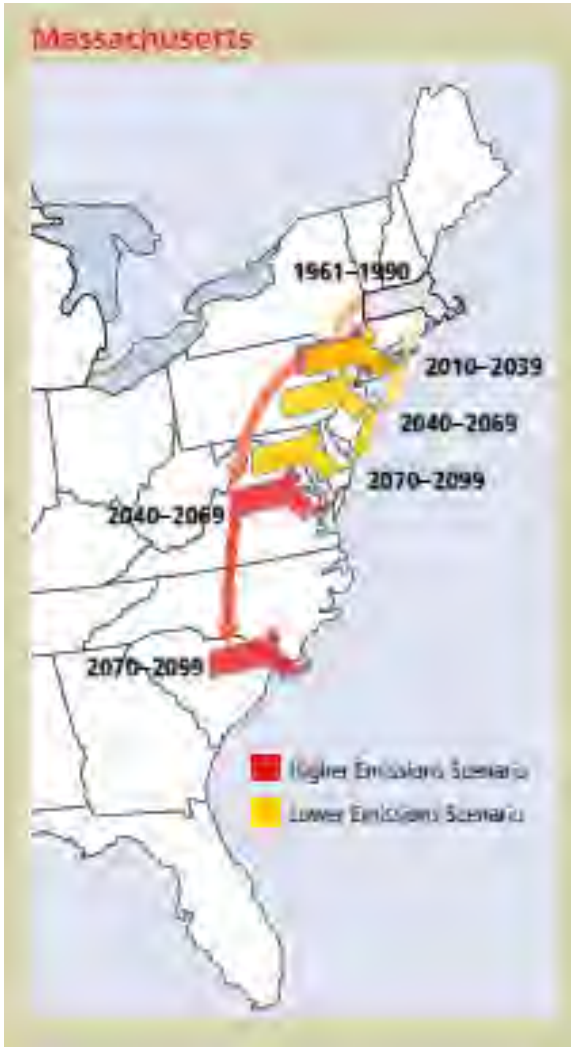


Figure 2: Latitudinal Changes in Regional Climate (source Union of Concerned Scientists)

Table 3: Climate Change and Leominster

Section 5: Natural Hazard Mitigation Strategies

SECTION 5 - NATURAL HAZARD MITIGATION STRATEGIES

The Leominster Local Planning Team (LPT) prepared an updated mitigation strategy to reduce the potential losses identified in the risk assessment (see **Section 4** and **Attachment 3**) based on the City's existing mitigation capabilities and ability to improve these capabilities in the future. This updated strategy serves as a roadmap for the next 5 years that builds upon the natural hazard mitigation related work carried out over the last five years based on the 2015 HMP Update and actions outlined in the City's recent 2020 MVP Plan. This strategy includes the following four elements as per 44 Code of Federal Regulations (CFR) part 201.6:

1. Hazard Risk Mitigation Goals
2. Hazard Mitigation Implementation and Progress
3. Existing Hazard Mitigation Capabilities
4. Hazard Risk Mitigation Measures/Actions

In the 2015 HMP Update existing capabilities and actions included in elements 3 and 4 above as separate tables. This Plan Update also present elements 3 and 4 as separate tables relative to the type of natural and climate related hazard. It is important to note that a majority of the new measures and actions outlined in this HMP Update focus on the highest ranked hazards due to the potential impacts these hazards may have on the City.

1. HAZARD RISK MITIGATION GOALS

The Leominster Local Planning Team (LPT) met on May 25, 2022 to review proposed hazard mitigation goals. The following eleven goals were endorsed by the team.

Mitigation Goals

1. Reduce the loss of life, property, infrastructure, and environmental and cultural resources from natural disasters.
2. Investigate, design and implement structural projects that will reduce and minimize the risk of flooding.
3. Increase the capacity of local Emergency Managers, DPWs, and Fire, Police and Health Departments to plan for and mitigate natural hazards.
4. Increase public awareness of natural hazard risks and mitigation activities available to them.
5. Improve the quality of the data for the region as it pertains to natural hazards.
6. Improve existing local policies, plans, regulations, and practices to reduce or eliminate the impacts of natural hazards.
7. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
8. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.
9. Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards including impacts from climate change.
10. Work with surrounding communities, regional, the Commonwealth and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

2. HAZARD MITIGATION IMPLEMENTATION AND PROGRESS SINCE 2015

The Leominster LPT met on May 25, 2022 to document the progress made by the City over the last 5 years based on the actions outlined in the 2015 HMP Update. Based on the input provided by members of the LPT, the team identified the following progress based on the Existing Protections, Goals, Objectives and Strategies for Actions outlined in the 2015 HMP Update. It is important to note that many of the following items continue to be ongoing activities which are included as existing capabilities presented in **Table 4** as well as **Table 5,** which presents the status of the mitigation actions that were identified in the 2015 HMP Update.

Natural Hazard Mitigation Plan Implementation, Maintenance & Review

ANNUAL REVIEW OF MITIGATION EFFORTS & PLAN IMPLEMENTATION: The City's lead agencies reported on implementation of the Plan each year and integrated updates into its annual reports.

5-YEAR REVIEW & UPDATE NATURAL HAZARD MITIGATION PLAN: The City started the update process in October of 2021.

CAPITAL IMPROVEMENT PROGRAM: Participated in annual updates to the 5-year capital improvement programs at the State, Regional and municipal levels that resulted in funding hazard mitigation actions;

INTERDEPARTMENTAL COORDINATION: Increased coordination between departments in pre-disaster planning, disaster recovery and continuous hazard mitigation implementation.

BENEFIT COST ANALYSIS: Evaluated opportunities for public funding of mitigation projects where public benefits exceed costs, but did not apply for public grant opportunities.

HAZARD MITIGATION IIMPLEMENTATION AND PROGRESS (cont.)

Planning & Regulatory Standards

LAND USE REGULATIONS: Maintained, and strengthened (as needed), Subdivision Rules and Regulations to require 1) temporary and permanent erosion control measures for streams and surface water bodies; 2) fire suppression provisions for new residential developments.

FLOODPLAIN MANAGEMENT & ENFORCEMENT: Continued to ensure that all new construction or substantial improvements meet or exceed NFIP requirements. Enforced flood proof construction standards.

FLOODPLAIN MANAGEMENT & ENFORCEMENT: Added more specific requirements to address flood related issues in the Special Permit and Site Plan Approval provisions in the Zoning City Ordinance and included topographic change, removal of cover vegetation, risk of erosion or siltation and increased stormwater runoff. .

ROAD STANDARDS: Updated existing road standards to reflect current best management practices for low impact development and amended subdivision regulations accordingly.

BUIDLING STANDARDS: Implemented State Building/Fire Code and local Flood Code for construction that minimizes loss of life and property damage due to Natural Hazards including mandatory wind code compliance (as outlined below).

MANDATORY WIND CODE COMPLIANCE: Ensured all building permit applicants construct their projects to meet 110 mile per hour wind load standard per the State Building Code.

STORMWATER MANAGEMENT: Required land use permitting within new and redeveloping areas that require stormwater retention as appropriate to avoid downstream impacts.

STORMWATER MANAGEMENT: Continued to maintain stormwater infrastructure (annually).

PUBLIC UTILITIES: Limit extension of public utilities that would encourage new development in areas vulnerable to natural hazards.

DEVELPOMENT CHANGES: Encouraged future development in areas that are not prone to natural disasters .

WILDLAND FIRE: Amended the Subdivision Rules and Regulations of Required Improvements Section to include fire and suppression provisions for new residential development.

Information Systems, Data Management & Analysis

RISK ASSESSMENT: Updated the information for risk assessment based on additional natural and climate related hazards as a part of this Plan Update.

GEOGRAPHIC INFORMATION SYSTEM: Updated the information for risk assessment in this Plan Update to better identify and assess areas, structures and populations potentially affected by natural disasters. Updates made based on updates made annually over the last 5 years to the City's GIS Data.

ASSET MANAGEMENT: Updated Critical Infrastructure and Facilities Listing Inventory included in this HMP Update in coordination with National Grid.

Natural Systems Protection Improvements

PROTECTION FROM BEAVERS: Continued to 1) support local city departments to continue present methods to prevent beaver caused flooding; 2) seek assistance from beaver management professionals, including trappers; 3) install beaver management devices.

WATER SUPPLY MANAGEMENT: The City update the Water Conservation Plan for Leominster

Physical & Infrastructure Improvements

STORMWATER INFRASTRUCUTURE: The City continued to clean the catch basins on an annual basis.

EMERGENCY GENERATORS: The City continued to assess the adequacy of emergency generators in all critical facilities. Make upgrades as necessary.

FACILTIES EVALUATION: The City continued to identify all structures throughout community that need to be elevated above the BFE.

DAM SAFETY: Continued to 1) identify sources of funding for dam safety inspections; 2) ensure that an emergency action plan exists for every dam in the community including private and public dam owners; 3) develop lines of communications with all dam owners to ensure maintenance, testing status changes are brought to the community in a timely fashion; 4) exchange dam data including EAPs with neighboring downstream communities..

HAZARD MITIGATION IIMPLEMENTATION AND PROGRESS (cont.)

HAZARD MITIGATION GRANT PROGRAM LIST: Continued to develop a priority list and seek funding through the Hazard Mitigation Grant Program (HMGP) for the replacement of undersized culverts throughout the community

Emergency Management

REGIONAL COORDINATION: The OEM continued to update and implement Memorandums of Understanding (MOUs) with neighboring communities.

SHELTER STRATEGY: Revised, implemented and communicated a shelter strategy that ensures that the city meets FEMA and ARC accepted shelter standards including shelter capacity, accessibility, structured integrity and support services.

CONTINUITY OF OPERATIONS PLAN: Continued to update the Comprehensive Emergency Management Plan annually that included 1) identification of emergency distribution sites and community resources and plans in place 2) revised debris management plans and MOUs with vendors who can assist the city with debris removal; 3) plans for providing access to water, information, shelter, and food stores to people in remote locations in the event of a severe winter storm; 4) evaluated all shelters and reception centers to determine if they are earthquake resistant; 5) ensured that all identified shelters have sufficient back-up utility service in the event of primary power failure; 6) improvements to supporting and interrelated community-wide and interdepartmental plans.

Public Information and Outreach

OEM WEBPAGE/FACEBOOK: Continued to maintain and update the OEM website and Facebook page with Natural Hazard Preparedness & Recovery Information.

ON-LINE MAPPING: The City continued to publicize the availability of GIS hazard mapping on the City website.

PUBLIC EDUCATION: Educated the public about the threat of natural hazards and the possible mitigation measures that can be taken to protect public health and safety, as well as infrastructure and property; and to educate the public as well about zoning and building regulations, particularly regulations that relate to new construction.

DISASTER WARNING SYSTEM: Updated pre-disaster warning system that effectively, efficiently and in a timely fashion warns citizens of impending

DAM INTERJURSDICTIONAL ALERTS: Continued to conduct interjurisdictional alerts for Dam Safety training and awareness.

FIRE SAFETY AWARENESS: Updated and distributed an educational pamphlet on fire safety and prevention

EXTREME TEMPERATURES AWARENESS: Updated and distributed educational information regarding the threats from extreme heat and cold. Also, the City continued to educate the residents as to the causes and effects of global warming; and how it affects the residents of the community and what they could be doing to help improve the situation.

Actions to Reduce Risk and Minimize Impacts

MUNICPAL VULNERABILITY PREPAREDNESS (MVP) PLAN: Prepared an MVP Plan by facilitating a CRB Workshop and identifying new priority MVP actions for the City.

FIREFIGHTER TRAINING AND EDUCATION: The Leominster Fire Department completed annual training and education of firefighters for brush and forest fires.

VULNERABLE POPULATIONS ASSISTANCE: Continued to address the needs of the elderly, sick and disabled.

DISASTER TEAM COORDINATION: Continued to coordinate with National Grid disaster team in advance, during and after natural hazard events.

3. EXISITING HAZARD MITIGATION CAPABILITIES

Leominster has an effective staff in-place to plan for and respond to natural disasters including the Mayor's Office, Emergency Management Director, DPW Director, City Engineer and others (see Key Contacts in **Attachment 8** for more details). Many of the existing City policies and ordinances provide an effective means of mitigating hazards that include hazard mitigation best practices, such as limitations on development in floodplains, stormwater management, etc. Leominster utilizes the Massachusetts state building code to make sure that new buildings and structures are built safely and to the state-standards for hazard mitigation. Leominster also has City-specific Zoning, Subdivision and Floodplain ordinances. The floodplain district requires that new construction adhere to the applicable State Building Code and the Wetlands Protection Act, but it does not discourage new construction in flood-prone areas. Improvements to further strengthen the floodplain and zoning bylaws to provide increased hazard mitigation could be made in the future, but would require additional funding and staff to expand and improve these regulations.

Table 4 presented on the following pages summarizes an updated overview of the existing natural hazard mitigation capabilities already in place including: 1) the mitigation capabilities included in the 2015 Plan Update as "Existing Protections," and 2) additional capabilities developed by the City since the last update.

EXISTING CAPABILITY	DESCRIPTION	AREA COVERED	IMPLEMENTATION RESOURCES AND FUNDING	IMPROVEMENTS OR CHANGES NEEDED
GENERAL MULTIIPLE HAZARDS				
Design/Building Standards (i.e. Enforcement of State Building and Fire Codes)	Continue to implement State Building/Fire Code and local Flood Code for construction that minimizes loss of life and property damage due to Natural and Climate-related hazards. The 9th Edition of the MA State Building Code 780 contains many detailed regulations regarding wind loads, earthquake resistant design, flood resistant design, flood-proofing and snow loads.	City-wide	Enforced by the Building Inspector (municipal staff) and Planning Board.	Update when updates are made to the MA State Building Code
Land Use Regulations: Subdivision and Zoning Regulations:	The Planning Board reviews and approves applications for permits as required by the city's Zoning Ordinance, reviews and approves subdivisions and developments, and conducts site plan reviews. The Planning Department provides technical assistance to the Planning Board. City permitting agencies and public officials should assist businesses, through the site plan review process, to plan for, adapt to and mitigate against future natural hazards and climate change impacts.	City-wide	Enforced by the Building Inspector (municipal staff) and Planning Board.	As needed.
Continuity of Operations Plan (COOP)	A Continuity of Operations Plan (COOP Plan) identifies mission-critical organizational functions which must continue when normal operations are, or may be disrupted, and provides a framework for the continued operation of these mission essential functions under all threats and conditions. The Plan also helps to identify lines of succession, alternate facilities, critical systems, essential records, and delegations of authority.	City-wide	Led and prepared by the Office of Emergency Management (OEM)	Updated Annually.
Office of Emergency Management Website/ Facebook	OEM maintains City website with updated with NH preparedness and recovery information and assistance	City-wide	Facilitated by OEM.	Updated on a regular basis.
Emergency Generators	City has invested in backup emergency generators for its critical facilities. These generators give the City the ability to sustain operations during the event of an emergency.	City-wide	Operated and maintained by various City departments.	Maintenance continues. No improvements or changes needed.
Centralized Fire and Police Dispatch/Emergency-Alert System	City utilizes joint communications and dispatch for public safety. The City's emergency Alert system sends emergency notices to Leominster residents via phone, email or social media.	City-wide	Managed by the Fire and Police Departments.	Maintenance continues. No improvements or changes needed.

Table 4: Existing Hazard Mitigation Capabilities

EXISTING CAPABILITY	DESCRIPTION	AREA COVERED	IMPLEMENTATION RESOURCES AND FUNDING	IMPROVEMENTS OR CHANGES NEEDED
GENERAL MULTIIPLE HAZARDS (cont.)				
FEMA Resources		City-Wide	Undertaken by the FEMA in coordination with MEMA during natural hazard events.	Maintenance continues. FEMA provides Improvements or changes as needed.
Geographic Information System:	The City maintain a comprehensive GIS Database of City assets to assist in assessing the natural and climate related hazard risks in the City.	City-wide		Update when new GIS data becomes available.
Electronic and Paper Records Preservation	Maintain electronic database and multiple back-up servers for preserving electronic files. Convert remaining paper records into electronic format consistent with state recommendations	At offices City-wide	Undertaken by all City Departments	No improvements or changes needed.
FLOOD RELATED HAZARDS				
Storm water management standards	State Regulation under the Wetlands Protection Act to regulate storm water and other point source discharge	City-Wide	Enforced by the Leominster Conservation Commission (Wetlands Protection Act) staffed by the municipal Environmental Inspector and Leominster Planning Board (Subdivision Control Law and site plan review) staffed by the municipal Office of Planning and Development.	Storm water management standards remain in effect. No improvements or changes needed
Wetlands Protection Act (state)	State law regulating development and activity within wetland buffer zone	100-foot state buffer around wetland area; 200 foot buffer around river front areas.	Enforced by the Leominster Conservation Commission staffed by the municipal Environmental Inspector.	No improvements or changes needed.
100 Year Flood Zone	Federal law requiring elevation above 100-year flood level of new and substantially improved residential structures in floodplain	100-year floodplain as shown on Flood Insurance Rate Map dated April 3, 1989.	Enforced by the Building Inspector (municipal staff) and Planning Board.	Update Insurance Flood Rate Maps as needed
City Zoning Bylaw Flood Plain Districts	Local bylaw enhancing federal/ state laws and regulating any development in the flood plain district	100-year floodplain as shown on Flood Insurance Rate Map dated April 3, 1989.	Enforced by the Building Inspector (municipal staff) and Planning Board.	Update Insurance Flood Rate Maps if new Maps become effective.

Table 4: Existing Hazard Mitigation Capabilities

EXISTING CAPABILITY	DESCRIPTION	AREA COVERED	IMPLEMENTATION RESOURCES AND FUNDING	IMPROVEMENTS OR CHANGES NEEDED
FLOOD RELATED HAZARDS (cont.)				
Maintenance of municipal storm water drainage system	Regular cleaning of catch basins, storm drains, and culverts	City-Wide	The Department of Public Works municipal staff actively maintains the City's storm-water infrastructure that supports Citywide mitigation for flood related hazards.	Maintenance continues but additional Personnel and Equipment Needed to complete this task.
Culverts replacement	Replacement of Culverts that are Undersized and/or Deteriorated	City-Wide	Directed by the Department of Public Works municipal staff.	No improvements or changes needed. Culvert in flood areas to be replaced.
Maintenance of public water bodies (ponds, streams, brooks, wetlands)	Periodic cleaning of waterways undertaken, i.e., remove trash, debris	City-Wide	Undertaken by the Department of Public Works municipal staff with guidance from Leominster Conservation Commission	Maintenance continues. No improvements or changes needed.
Inspection of major dams	Annual inspections of the structural integrity of the dam	Major Dams	Coordinated by dam owners as directed by Massachusetts Department of Conservation and Recreation.	Update dam failure studies for the dams rated as high hazard.
Emergency action plans are developed	Develop EAPS for all dams private and publicly owned.	All dams	Dam Owners	All dam inspections must be completed and EAPS be developed and available in the event of a crisis.
Develop Maintenance and Operational Manuals	Maintenance and operational manuals do not exist for most dams	All dams	Developed by Dam Owners as directed by the Massachusetts Department of Conservation and Recreation, Office of Dam Safety.	Manuals will be available to engineers during a possible crisis.
Participate in the National Flood Insurance Program (NFIP)	The City is a NFIP community that enforces flood regulations per the City's Zoning Bylaw. There are 108 flood insurance polices in force.	City-wide	City's flood regulations are enforced by the Building Inspector (municipal staff) and Planning Board. See Attachment 3 for more details on the NFIP and repetitive loss properties.	No improvements or changes needed.
Water Quality Monitoring	Monitor water quality from storm-water runoff at public beaches in the City following flooding or heavy rain events.	City-wide	The Water Division is responsible or providing high-quality water and monitors the public drinking water for the City.	No improvements or changes needed.
Street Sweeping and Leaf Removal	Remove leaves in advance of a major potential rainfall and/or flooding event.	City-wide	Department of Public Works conducts street sweeping annually.	No improvements or changes needed.

Table 4: Existing Hazard Mitigation Capabilities

EXISTING CAPABILITY	DESCRIPTION	AREA COVERED	IMPLEMENTATION RESOURCES AND FUNDING	IMPROVEMENTS OR CHANGES NEEDED
WIND RELATED HAZARDS				
State Building Code	State Law related to design loads to include wind effects	City-Wide	Enforced by Building Department municipal staff.	Enforcement continues. No improvements or changes needed.
Tree Maintenance	Regular inspection and tree maintenance to cut branches threatening	power lines and overhead utilities	City-Wide	Utility company and DPW
Roadway Treatments	Regular treatment of roadways with salt in advance of winter weather when needed.	Roadways City-wide	DPW treats roadways in advance of winter weather	No improvements or changes needed.
FIRE RELATED HAZARDS				
Limited Brush Clearing	Brush clearing to provide access to Emergency Service vehicles.	City-Wide	Department of Public Works municipal staff.	Continue to identify additional Areas with Potential for Brushfires
Permits Required for Outdoor Burning	City requires a certificate of open burning for outdoor burning of brush.	City-Wide	The Fire Department enforces the permits required for outdoor burning.	Enforcement continues. No improvements or changes needed.
Fire Hydrant Regulations	City regulates that fire hydrants be installed at all new developments at the expense of the developer.	New developments City-Wide	Hydrants are spaced / located as directed by the Leominster Fire Department.	Enforcement continues. No improvements or changes needed.
Subdivision Review	Fire and Building Departments are involved in reviewing subdivision plans from conceptual design through occupancy to ensure that there is adequate access for fire trucks and an adequate water supply	City-Wide	Enforced by the Building Inspector (municipal staff) and Planning Board	Reviewed annually, changes made as necessary.
WINTER STORMS RELATED				
Residential Parking Bans	Parking Bans to Enable Snow Removal Effectively from Residential Streets	City-Wide	Department of Public Works municipal staff and Police Dept.	Enforcement continues but additional personnel and equipment needed
Roadway Treatments	Regular treatment of roadways with salt in advance of winter weather when needed.	Roadways City-wide	DPW treats roadways in advance of winter weather	No improvements or changes needed.
Clearing Snow from Major Arterial Routes	Ensure Access to Emergency Services	City-Wide	Department of Public Works municipal staff.	Snow clearing continues but additional personnel and equipment needed.

Table 4: Existing Hazard Mitigation Capabilities

Development Approach

The LPT used a two-phased approach to developing hazard risk mitigation measures for this Plan Update. First, the LPT and planning consultant identified 17 mitigation actions from the 2015 HMP Update and 18 actions in the 2020 MVP Plan as ongoing mitigation activities or actions that have yet to be implemented. The LPT and planning consultant then organized these mitigation actions by the type of natural hazard as presented in **Table 1** of **Section 4**. Of the 17 mitigation actions from the 2015 HMP Update, the City implemented 15 actions, and did not implement 2 actions. The City integrated the completed actions into existing programs as presented in **Table 5**. **Table 5** also provides an overview of the status of these actions since the adoption of the 2015 and whether an action was selected for inclusion in this Plan Update. Second, the LPT and planning consultant focused the development of the new mitigation actions on the highest ranked hazards due to the potential impacts these hazards may have on the City in the future. In preparing the new mitigation actions, the LPT and planning consultant integrated similar and complementary mitigation actions outlined in the 2015 HMP Update and 2020 MVP Plan with new actions. The purpose of this approach was to reduce redundancies and enhance previously developed actions based on revised the updated vulnerability assessment outlined in this Plan Update.

Prioritization

During the LPT Working Group Meeting on August 5, 2022, mitigation measures were prioritized using a qualitative benefit/cost evaluation framework[1] based on local knowledge of the area and its hazard exposure, estimated cost information for each measure, timeline estimate for implementation, and an assessment of the reduction of risk exposure to life and property. The purpose of this evaluation is to provide support for assigning adaptation priority ratings for each measure.

This approach uses a qualitative benefit/cost analysis (less detailed than used for FEMA's Hazard Mitigation Assistance Grants Programs). The approach qualitatively rates benefit and costs in terms of: high, medium and low, as follows:

Benefits

- **High:** Action will support compliance with a legal mandate or community priority or once completed, will have an immediate or short-term impact on the reduction of risk exposure to life and property.
- **Medium:** Once completed, action will have a long-term impact on the reduction of risk exposure to life and property, has a substantial life safety component, or project will provide an immediate reduction in the risk exposure to property.
- **Low:** Long-term benefits of the action are currently difficult to quantify or are expected to result in modest reductions of risk exposure to life or property.

[1] The City adapted a qualitative benefit/cost analysis framework from the City of Portland, Oregon's 2016 Mitigation Action Plan (2016 PMAP).

Costs

- **High**: Would require an increase in revenue via an alternative source (i.e., municipal bonds, grants, fee increases) to implement. Existing funding levels are not expected to be adequate to cover the costs of the proposed project.
- **Medium:** Could budget for under existing capital budget but would require a reapportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low**: Possible to fund under existing budget. Project is or can be part of an existing ongoing program or would not require substantial effort to initiate or appropriate funds.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly. To support the benefit/cost review, the LPT also estimated the length of time for each mitigation action as follows:

Estimated Timeline

For actions where funding is already available the action or strategy is identified as "ongoing." Since most of the actions were identified as a part of preparing this initial plan, most do not currently have funding. Therefore, length of time for implementation of each mitigation action is based on the amount of time it would take upon receiving funding. The estimated timeframes included:

- 1-2 years,
- 3-5 years,
- 5+ years, and

Estimated Cost

To support the benefit/cost review the LPT used the following estimated cost categories:

- **Low:** Less than $50,000
- **Medium:** Between $50,000 - $100,000
- **High**: Over $100,000

Note: The estimated costs vary from the "Costs" included in the benefit/cost analysis in that the costs provide preliminary cost estimates in dollars of each action to assist the City for future planning and budgeting purposes.

Hazard Type	Action	Implementation Responsibility	Resources/ Funding	Timetable	Priority (STAPLEE Score)	Cost/ Benefit Evaluation	Action has Been Implemented/ Completed? Y/N/Partial	Include in Updated Plan? Y/N	Priority: High/ Medium/ Low	Comments
Wildland Fire	Action 1. Increase awareness by educating property owners regarding actions that they can take to reduce risk to property by hosting an Open House at the Fire Department, Develop and Distribute an Educational Pamphlet on Fire Safety and Prevention (SAFE PROGRAM) (SENIOR SAFE) & wildfire prevention.	Fire Department	Municipal Staff	2015 - 2020	21	benefits exceed costs	Y	Y	H	Action was Integrated into the City's existing Fire Safety and Prevention Program.
All Natural Hazards	Action 2. Increase hazard education and risk awareness to public by Collecting, Updating, and Disseminating Information on Local Radio/TV Stations to educate the public and alert them of emergency information including shelter locations and other instructions related to all natural hazards.	Emergency Management Director	Municipal Staff	2015 - 2020	21	benefits exceed costs	Y	Y	H	Action was Integrated into the City's Continuity of Operation Program.
All Natural Hazards	Action 3. Ensure that all identified shelters have sufficient back-up utility service in the event of a primary power failure to eliminate or reduce risk to human life.	Building Inspector, Emergency Management Director	School Department	2015 - 2020;	14	benefits equal/ exceed costs	Y	Y	H	Action was Integrated into the City's Continuity of Operation Program.

Table 5: Update to Mitigation Measures from 2015 HMP Update

Hazard Type	Action	Implementation Responsibility	Resources/ Funding	Timetable	Priority (STAPLEE Score)	Cost/ Benefit Evaluation	Action has Been Implemented/ Completed? Y/N/Partial	Include in Updated Plan? Y/N	Priority: High/ Medium/ Low	Comments
Flood Related Hazards	Action 4. Develop a priority list and possibly seek funding through the Hazard Mitigation Grant Program (HMGP) for the replacement of undersized culverts throughout Town to reduce or eliminate flooding risk.	Highway Department	Municipal Staff/ FEMA HMGP grant 75%	2015 - 2020	19	benefits equal costs	Y	Y	H	Action was Integrated into the City's Grants Program.
Other Natural Hazards (wildland fire)	Action 5. Consider amending the Subdivision Rules and Regulations of Required Improvements Section to include fire and suppression provisions for new residential development.	Fire Department	Municipal Staff/ Volunteers	2015 – 2020	16	benefits exceed costs	N	Y	H	Action not completed due to time constraints.
Flood Related Hazards	Action 6. Amend the Special Permit and Site Plan Approval Provisions in the Zoning Bylaw adding more specific requirements to address flood related issues.	Conservation Commission, Planning Board	Municipal Staff/ Volunteers	2015 - 2020	21	benefits exceed costs	N	Y	H	Action was Integrated into the City's Zoning Bylaws.
Flood Related Hazards	Action 7. Educate property owners regarding options for mitigating their properties from flooding through outreach programs that address measures that residents can take (i.e., installing backflow valves, securing debris, etc.)	Emergency Management Director, Fire Department	Municipal Staff and Property Owners	2015 - 2020	20	benefits exceed costs	Y	Y	H	Action was Integrated into the City's Continuity of Operation Program.

Table 5: Update to Mitigation Measures from 2015 HMP Update

Hazard Type	Action	Implementation Responsibility	Resources/ Funding	Timetable	Priority (STAPLEE Score)	Cost/ Benefit Evaluation	Action has Been Implemented/ Completed? Y/N/Partial	Include in Updated Plan? Y/N	Priority: High/ Medium/ Low	Comments
Wildland Fire	Action 8. Update Debris Management Plan for local officials to utilize in order to reduce the risk of wildland fire.	City Council, Emergency Management Director	Western Region Homeland Security Advisory Council Funding	2015	18	costs exceed benefits	Y	Y	H	Action was Integrated into the City's Continuity of Operation Program.
Flood Related Hazards	Action 9. Continue Participation in the National Flood Insurance Program to enable property owners to purchase insurance protection against flood losses.	City Council, Conservation Commission	FEMA/ MEMA	2015 - 2020	21	benefits exceed costs	Y	Y	H	Action is a part of the City's Floodplain Management Program.
Flood Related Hazards	Action 10. Evaluate and relocate valuable and historical items and furnaces, Water heaters, and electrical equipment in any municipal owned buildings that might be located in areas prone to flooding to reduce flood damage.	Emergency Management Director, Fire Department	Municipal Staff	2015 - 2020	21	benefits equal costs	Y	Y	M	Action was Integrated into the City's Continuity of Operation Program.
Atmospheric Related Hazards	Action 11. Enforce state building codes related to design loads to include wind effects generated from atmospheric related hazards.	Building Inspector	Municipal Staff	2015 - 2020	21	benefits exceed costs	Y	Y	H	Action is a part of the City's Zoning Regulations.

Table 5: Update to Mitigation Measures from 2015 HMP Update

Hazard Type	Action	Implementation Responsibility	Resources/ Funding	Timetable	Priority (STAPLEE Score)	Cost/ Benefit Evaluation	Action has Been Implemented/ Completed? Y/N/Partial	Include in Updated Plan? Y/N	Priority: High/ Medium/Low	Comments
Other Natural Hazards (Wildland fire)	Action 12. Identify areas with potential for brush fires to track community vulnerability by developing and maintaining a data base.	Department of Public Works (DPW)	Municipal Staff	2015 - 2020	21	benefits exceed costs	Y	Y	H	Action was Integrated into the City's DPW mitigation program.
All Natural Hazards	Action 13. Utilize interactive mapping application prepared by MRPC/CMRPC to update critical infrastructure and simulate real time evacuation scenarios to mitigate hazards to the public.	Emergency Management Director	Emergency Management Director	2015.	21	benefits exceed costs	Y	Y	H	Action was Integrated into the City's Continuity of Operation Program.
Flood Related Hazards	Action 14. Install "beaver diverters" and water control devices to mitigate flooding caused by beaver dams.	Department of Public Works	Municipal Staff	2015 – 2020	21	benefits exceed costs	Y	Y	H	Action was Integrated into the City's DPW mitigation program.
Flood Related Hazards	Action 15. Hire trapper for removal of beavers to mitigate flooding caused by beaver dams.	Department of Public Works	Municipal Staff	2015 – 2020	21	benefits exceed costs	Y	Y	H	Action was Integrated into the City's DPW mitigation program.

Table 5: Update to Mitigation Measures from 2015 HMP Update

Hazard Type	Action	Implementation Responsibility	Resources/ Funding	Timetable	Priority (STAPLEE Score)	Cost/ Benefit Evaluation	Action has Been Implemented/ Completed? Y/N/Partial	Include in Updated Plan? Y/N	Priority: High/ Medium/ Low	Comments
All Natural Hazards	Action 16. Implement recommendations regarding natural hazard mitigation in existing planning documents including the five year action plan of the open space and recreation plan and the emergency evacuation plan	Conservation Commission, City Council, Planning Board, Emergency Management Director, Recreation Commission	Municipal Staff, Conservation Commission, City Council, Planning Board, Emergency Management Director	2015 - 2020	21	benefits exceed costs	Y	Y	H	Action was Integrated into the City's Continuity of Operation Program.
Flood Related Hazards	Action 17. Purchase equipment to block streets in case of flood hazard to reduce or eliminate the risk to human life.	Police Department, Emergency Management Director	Grant Money if available	2015 – 2020	21	benefits exceed costs	Partial	Y	H	Action was Integrated into the City's Continuity of Operation Program.

Table 5: Update to Mitigation Measures from 2015 HMP Update

MITIGATION ACTION PRIORITIZATION

Based on an evaluation of the results of the benefit/cost review, the LPT prioritized each mitigation action and strategy using the following qualitative rating system of high, medium and low.

High Priority: An action that has benefits that exceed cost, has funding secured or is an ongoing project. High priority actions can be completed in the short-term or mid-term (1 to 5 years) or are projects that are long-term projects that can be initiated in the short-term and will have large positive impacts once completed.

Medium Priority: An action that has benefits that exceed costs, and for which funding has not yet been secured, but is eligible for funding. Actions can be completed in the short- or mid-term, once funding is secured, or are projects that are long-term projects that can be initiated in the short-term and will have large positive impacts once completed.

Low Priority: An action that will mitigate the risk of a hazard that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for grant funding, and for which the time line for completion is long-term or uncertain. Low priority actions may be eligible for grant funding from other programs that have not yet been identified. Financing is unknown, and they can be completed over the long term.

The LPT prioritized the mitigation action plan based on the results of the benefit/cost review of the proposed actions as presented in **Table 6** on the next pages. In addition to the benefit/cost review results, **Table 6** provides details for each action relative to the agencies responsible for leading and coordinating the implementation of each action and potential funding sources.

CODES FOR TABLE 6 (following pages):

Responsible Agencies	
BO = Building Official	EEA = MA Executive Office of Energy and Environ. Affairs
CC = City Council	FEMA = Fed. Emerg. Mgmt. Agency
CO = Comptroller's Office	FA= Finance Administration
CC = Conservation Commission	FD = Fire Department
DPW = Dept. of Public Works	HC = Historical Commission

CODES FOR TABLE 5 (cont.):

Potential Funding Sources
BRIC: Building Resilient Infrastructure and Communities Grant (FEMA)
CIP = Capital Improvement Program
CDBG-DR = Community Development Block Grant (Disaster Recovery)
DSW: MA Dams and Seawalls Grant Program
EMGP = Emergency Management Performance Grant
FMA = Flood Mitigation Assistance
HMGP = Hazard Mitigation Grant Program
MVP = EEA Municipal Vulnerability Preparedness Grant Program
OBs = Operating Budgets
OPs = Other Programs
RTP = Regional Transportation Program
Silver Jackets (FEMA/USACE)
STIP = Statewide Transportation Improvement Project

Responsible Agencies	
HUD = Dept. of Housing & Urban Dev	PD = Police Department
MassDOT = Massachusetts Dept. of Transportation	RD = Recreation Department
MEMA = Massachusetts Emergency Management Agency	TE = City Engineer
NOAA—Nat'l Ocean. & Atmos. Admin.	TW = Tree Warden
OEM = Office of Emergency Mgmt.	USACE = US Army Corp. of Eng.
PB = Planning Board	ZBA: Zoning Board of Appeals

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
MULTIPLE HAZARDS							
Action 1. **Implement Local Hazard Mitigation Plan**. The City will monitor and evaluate progress in addressing action items in this Plan and include those accomplishments in its annual report to the City.	High	Low	2022 to 2027	Low	High	Leominster Department of Public Works (DPW) and Office of Emergency Management (OEM)	Leominster Operating Budgets (OB), Other Programs (OP)
Action 2. **Use Capital Improvement Program (CIP) to set aside funds for infrastructure improvements** to reduce loss of life and property during natural hazard (NH) events.	High	Low	2022 to 2027	Low	High	Leominster Mayor's Office, City Council (MO/CC)	Leominster OB and OP; Federal Emergency Management Agency (FEMA)
Action 3. **Prepare a Grant Application and Administration Plan (GAAP).** Prepare detailed application plan for grant opportunities, including FEMA Hazard Mitigation Grant, USACE, NOAA, HUD, CIRCA, DOT, DECD and EPA programs & benefit-cost analysis for each opportunity. As a part of the plan development, identify and Prioritize Physical Improvement Projects.	High	Low	2022 to 2027	Medium	High	Leominster DPW, OEM, MO	FEMA HMGP, BRIC and FMA HUD CDBG-Disaster Recovery Funds NOAA
Action 4. 5**-Year Review & Update of Natural Hazard Mitigation Plan**. The Planning Commission will reconvene its multi-agency Committee every 5 years to update the Plan.	High	Low	2026 to 2027	Low	High	Leominster MO, DPW, OEM and supporting agencies/departments	FEMA Building Resilient Communities and Infrastructure (BRIC) Grant MEMA
Action 5. **Maintain and upgrade as necessary all facility mechanicals, such as generators,** in municipal and other **critical facilities**.	High	Low	2022 to 2027	Low to High	High	All departments, MO / CC	FEMA HMGP and BRIC MEMA
Action 6. **Update City-wide evacuation plan** (Including vulnerable populations and that includes a plan for evacuation public housing, assisted-living facilities, schools). See State Evacuation Plan.	Medium	Low	2022 to 2024	Low	Medium	Leominster MO, OEM, PD, FD	MEMA FEMA Leominster OB, CIP
Action 7. Continue to **jointly work with neighboring jurisdictions on ongoing emergency Management planning.**	High	Low	2022 to 2027	Low	High	Leominster OEM, MO, PD, FD	Leominster OB MEMA FEMA EMGP

Table 6: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
MULTIPLE HAZARDS (cont.)							
Action 8. **Increase hazard education and risk awareness** to public by Collecting, Updating, and Disseminating Information on Local Radio/TV Stations to educate the public & alert them of emergency information including shelter locations and other instructions related to all natural hazards.	High	Low	2022 to 2026	Low	High	Leominster MO, OEM, DPW	Leominster OB and OP FEMA HMGP and BRIC MEMA
Action 9. **Ensure that all identified shelters have sufficient back-up utility service** in the event of a primary power failure to eliminate or reduce risk to human life.	High	Low	2022 to 2026	Low to High	High	Leominster OEM and DPW	Leominster OB and OP FEMA HMGP and BRIC MEMA
Action 10. **Implement recommendations** regarding natural hazard mitigation **in existing planning documents** including the five year action plan of the open space and recreation plan and the emergency evacuation plan	High	Low	2022 to 2026	Low	High	Leominster OEM, CC, MO and FA	Leominster OB and OP FEMA EMPG MEMA
Action 11. **Utilize interactive mapping application prepared by MRPC/CMRPC** to update critical infrastructure and simulate real time evacuation scenarios to mitigate hazards to the public.	High	Low	2022 to 2026	Low	High	Leominster OEM and DPW	Leominster OB and OP FEMA HMGP and BRIC MEMA
Action 12. **Communications & Database**: **Create a multi-lingual education system** to enhance emergency preparedness for residents and visitors. Create a database for all residents in the City and provide a multi-lingual document for procedures during a shelter in place, emergency evacuations, and extreme weather events.	High	Low to Medium	2023-2024	Low to Medium	Medium	Leominster OEM, MO, CC	FEMA EMPG
Action 13. **Evaluate the City's backup generator network** to ensure enough power will be provided to critical buildings during emergency conditions.	High	Low	2022 to 2026	Low to High	High	Leominster all departments, CC/FA	FEMA HMGP and BRIC MEMA
Action 14. **Conduct Natural Hazard Mitigation Training on an annual basis**.	High	Low	2022 to 2026	Low	High	Leominster OEM and DPW	Leominster OB and OP FEMA HMGP and BRIC MEMA

Table 6 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
MULTIPLE HAZARDS (cont.)							
Action 15. **Public Infrastructure Evaluation**: Evaluate public infrastructure upgraded on grandfathered developments. Provide ongoing routine maintenance to public infrastructure to proactively address issues associated with natural/climate-related hazards. Identify potential retro-fit locations where impervious areas and ambient temperatures can be reduced & where greenspaces & stormwater treatment can be increased.	High	Medium to High	2022—2024	High	Medium	Leominster DPW, OEM, MO/CC	Leominster CIP, OB and OP FEMA EMPG, HMGP MEMA
Action 16. **Conduct a municipal buildings capabilities assessment**. The purpose of the assessment will be to identify buildings for future investment for renovation or new construction to ensure the candidate buildings are in compliance with standards for use as a shelter.	High	Medium to High	2022—2027	High	Medium	Leominster OEM, DPW, MO/CC	Leominster CIP FEMA EMPG
Action 17. **Expand and bolster the community emergency response team** including increasing funding for emergency services.	High	Low to Medium	2022—2027	Low to Medium	Medium	Leominster OEM, PD, FD, DPW, MO/CC	Leominster OB and OP FEMA EMPG MEMA
Action 18. **Continue to maintain an effective evacuation route and plan** for use during an emergency (natural event or chemical spill).	High	Low to Medium	2022—2027	Low to Medium	Medium	Leominster OEM, PD, FD, DPW, MO/CC	Leominster OB and OP FEMA EMPG MEMA
Action 19. **Recovery and Reconstruction Plan**: Prepare a post-disaster recovery and reconstruction plan to re-establish infrastructure and public services, etc. damaged or destroyed by any NH event.	High	Low to Medium	2022—2027	Low to Medium	High	Leominster OEM, DPW, MO/CC	FEMA HMGP, FMA, BRIC EEA MVP Grants
Action 20. **Tenant Notification**: Update mechanism for tenants to register for disaster notifications.	High	Low to Medium	2022—2027	Low to Medium	Medium	Leominster OEM, MO	Leominster OB and OP FEMA EMPG MEMA
Action 21. **Immobile Evacuees Planning:** Review annually the program to evacuate persons without means of transportation, including registration and house numbering.	High	Low to Medium	2022—2027	Low to Medium	Medium	Leominster OEM, MO	Leominster OB and OP FEMA EMPG MEMA

Table 6 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
Action 22. Evaluate the gas infrastructure in the City and improve communications with private partners to ensure the safety of the community and acceptable performance of the infrastructure	High	Low	2022—2026	Low	High	Leominster DPW, OEM	Leominster OB FEMA MEMA/DCR
Action 23. **Maintain Disaster Recovery and Rainy Day Fund** to supplement federal disaster assistance.	High	Low	2022—2027	Medium	High	Leominster MO/CC, OEM, DPW	Leominster
FLOOD HAZARDS							
Action 24. **Continue to participate in National Flood Insurance Program** (NFIP) to enable property owners to purchase insurance protection against flood losses and complete NFIP (or other) training offered by the State and/or FEMA that addresses flood hazard planning & management.	High	Low	2022—2027	Low	High	Leominster P&D, PB, DPW, ZBA	Leominster OB FEMA MEMA/DCR
Action 25. Continue to participate in **reviews of regulatory floodplain maps updates** and revisions.	High	Medium to High	2022—2026	Low	High	Leominster P&D, PB, DPW, ZBA	Leominster OB MEMA/DCR FEMA
Action 26. **Culverts: Create a city-wide program to assess, prioritize, and repair/replace culverts**. Program would include structural and hydraulic capacity assessment, identification of deficient culverts and recommended improvements. As a part of this effort develop a priority list and possibly seek funding through the HMGP for the replacement of undersized culverts throughout City to reduce or eliminate flooding risk.	High	Medium to High	2022—2024	High	Medium	Leominster DPW, OEM, MO/CC	Leominster CIP, OB and OP FEMA EMPG, HMGP MEMA
Action 27. **Evaluate and relocate valuable and historical items and furnaces**, Water heaters, and electrical equipment in any municipal owned buildings that might be located in areas prone to flooding to reduce flood damage.	High	Medium to High	2022—2026	High	Medium	Leominster DPW, OEM, MO/CC	Leominster CIP, OB and OP FEMA EMPG, HMGP MEMA
Action 28. **Amend the Special Permit and Site Plan Approval Provisions** in the Zoning Bylaw adding more specific requirements **to address flooding.**	High	Low	2022—2026	Low	High	Leominster P&D, PB, DPW, ZBA	Leominster OB MEMA/DCR

Table 6 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
FLOOD HAZARDS (cont.)							
Action 29. Continue to **educate property owners regarding options for mitigating their properties from flooding** through outreach programs that address measures that residents can take (i.e., installing backflow valves, securing debris, etc.)	High	Low	2022—2026	Low	Medium	Leominster DPW, OEM, MO/CC	Leominster CIP, OB and OP FEMA EMPG, HMGP MEMA
Action 30. **Increase Stormwater Capacity:** Consider an analysis of the entire drainage system to calculate the capacity of system and detect locations where flooding is likely to occur as a result of increased storm intensity and frequency due to climate change. Identify locations where stormwater capacity could be increased in the City to improve the functionality of the stormwater drainage system.	High	Medium to High	2022—2026	High	Medium	Leominster DPW, OEM, MO/CC	Leominster CIP, OB and OP FEMA EMPG, HMGP MEMA EEA MVP
Action 31. **Restore & Increase Wetland Areas**: To address and improve water quality through an increase of nutrient removal, identify locations where wetlands have previously been lost and restore if feasible, ideally in locations that are currently impervious. Identify locations where new wetlands could be created to mitigate the impact of previously lost wetlands and provide flood storage to retain increased stormwater runoff anticipated as a result of climate change.	High	Medium	2022-2026	Medium to High	High	Leominster DPW, TE, MO/CC	FEMA HMGP, BRIC EEA MVP Leominster OP, OB, CIP
Action 32. **Road Evaluation**: Continue to evaluate roads to develop plans for improvement or elevation for emergency access and evacuation	High	Medium	2022—2026	Low	High	Leominster DPW, TE, MO/CC	Leominster OP, OB, CIP RTP
Action 33. **Stream Bank Stabilization**: Design, permit, and implement stabilization of eroding stream banks located on the **Monoosnoc Brook, the Nashua River along Route 2, and the North Nashua River behind the Wastewater Treatment Facility**.	High	Medium	2022-2026	Medium to High	High	Leominster DPW, TE, MO/CC	FEMA HMGP, BRIC EEA MVP Leominster OP, OB, CIP

Table 6 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
FLOOD HAZARDS (cont.)							
Action 34. **Stream Bank Stabilization**: Assess, inventory, & prioritize, locations where stream bank stabilization is needed because of erosion. Design, permit, & implement stabilization of eroding stream banks based on the assessment.	High	Low	2022—2026	Low	High	Leominster DPW, MO/CC	Leominster OB FEMA MEMA/DCR
Action 35. **Obtain updated aerial imagery** and planimetric data in order to allow for assessment of such factors as extent of damage from NHs, compliance with building standards, identification of shoreline hardening & erosion/accretion.	High	Low to Medium	2022—2026	Low to Medium	Medium	Leominster DPW, GIS	FEMA HMA grants Leominster OP, OB, CIP
Action 36. Install "**beaver diverters**" and water control devices to mitigate flooding caused by beaver dams. Hire trapper for removal of beavers to mitigate flooding caused by beaver dams.	High	Medium	2022—2026	Medium	High	Leominster DPW, MO/CC	Leominster OP, OB, CIP
Action 37. **Identify the equipment needed to continue running an effective MS4 program,** identify locations of illicit discharges, and protect the City's water supply.	High	Low	2022—2026	Low	High	Leominster DPW, MO/CC	Leominster OB EPA MEMA/DCR
Action 38. Perform study to increase the capacity of the City's reservoirs to adequately handle excess runoff produced during storm events.	High	Low	2022—2026	Low	High	Leominster DPW, MO/CC	Leominster OB MEMA/DCR
Action 39. **Encourage Repetitive Loss Property Owners to pursue flood mitigation funding** for actions such as elevation or acquisition of structures where appropriate on a voluntary basis	High	Medium to High	2022—2027	Low	High	Leominster DPW, TE	FEMA HMA grants Leominster OP, OB, CIP
Action 40: **HISTORIC PROPERTIES.** The City should provide flood mitigation guidance to property owners that is consistent with Historic District Regulations.	High	Low to Medium	2022—2026	Low	High	Leominster HC, OEM, MO/CC	FEMA HMA grants Leominster OP, OB, CIP
Action 41. **Purchase equipment to block streets in case of flood hazard** to reduce or eliminate the risk to human life.	High	Medium to High	2022—2024	High	Medium	Leominster DPW, OEM, MO/CC	Leominster CIP, OB and OP FEMA EMPG, HMGP MEMA

Table 6 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
SECONDARY HAZARDS: DAM FAILURE							
Action 42. **Dam** Owners responsible for review and update of **Emergency Action Plans** (EAP) and **Maintenance and Operations Plans** for the High Hazard Dams per state requirements to ensure the plans are up to date & have protocols in place to maintain safe operations of the Dams.	High	Low	2022—2027	Low	High	DAM OWNERS DCR	FEMA MA DCR DAM OWNERS
Action 43. **Continue to assess downstream risks due to catastrophic failure** per the EM emergency operations plan.	High	Medium	2022—2025	Low to Medium	High	Leominster OEM, DPW, MP/CC/ DCR	MA DCR Leominster OP, CIP
Action 44. **Dam Repair & Maintenance**: Complete assessment to identify dams in need of repair or maintenance, prioritize repair and/or maintenance of specific publicly owned dams. Require repair and maintenance of privately owned dams in the City.	High	Medium	2022—2025	Low to Medium	High	OEM, DPW, MP/CC/ DCR	DCR Leominster OP, CIP
CLIMATE RELATED HAZARDS: Drought							
Action 45. Conduct a **City-wide study of ground and surface water capacity** as it relates to planning for droughts.	High	Medium	2022—2025	Low to Medium	High	CC, FD, Fire Marshall (FM)	Leominster OP, CIP
Action 46. Continue to coordinate with the MEMA/ EEA on **public education and public service announcements in anticipation of and during times of drought**.	High	Low	2022—2027	Low	High	CC, FD, FM	Leominster OP, CIP
Action 47. **Identify locations where water storage tanks need rehabilitation** (Legate Hill) to ensure the City is maximizing its ability to maintain water supply for fire protection and domestic supply in the event of an emergency.	High	Low	2022—2027	Low	High	CC, FD, FM	Leominster OP, CIP
Action 48. Continue to implement a **water conservation program to ration water in instances of extreme heat or drought**.	High	Low	2022—2027	Low	High	FD, FM, DPW, CC/ MO	Leominster OP, CIP

Table 6 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Project Costs	Priority	Responsible Agencies	Potential Funding Sources
CLIMATE RELATED HAZARDS: Wildfire							
Action 49. **Wildfire Management Plan**. Evaluate and consider development a wildfire management plan and protocol.	High	Low to Medium	2022—2027	Low	Medium	Leominster FD, Fire Marshall (FM), MO/CC	FEMA EMPG, HMGP, BRIC Leominster OP, CIP
Action 50. **Firefighting Infrastructure Analysis**: Continue to evaluate existing firefighting infrastructure to identify needs for improvement to cover gaps in availability.	High	Low	2022-2025	Low	High	Leominster FD, Fire Marshall (FM), MO/CC	FEMA EMPG, HMGP, BRIC Leominster OP, CIP
Action 51. **Forest Management Plans**. Include provisions in existing and future forest management plans to provide emergency access to fire-fighters in the event of wildfires in City-owned Open Space	High	Low	2022—2027	Low	High	Leominster FD, FM, MO/CC	FEMA EMPG, HMGP, BRIC Leominster OP, CIP
Action 52. Increase awareness by educating property owners on actions that they can take to reduce risk to property by hosting an Open House at the Fire Department. Revise & continue to distribute an **Educational Pamphlet on Fire Safety and Prevention** (SAFE PROGRAM) & wildfire prevention.	High	Low	2022—2027	Low	High	Leominster FD, FM, MO/CC	FEMA EMPG, Leominster OP, CIP
Action 53. Improvements to and clearing of trail network, specifically the fire road system, to maintain emergency responder access to the trail network when necessary.	High	Low to Medium	2022—2027	Low	High	Leominster FD, FM, DPW, MO/CC	FEMA EMPG, Leominster OP, CIP
SEVERE WEATHER: WIND HAZARDS							
Action 54. **Debris Management Plan**. Continue to facilitate and coordinate the removal, collection, and disposal of debris following a disaster, to mitigate against any potential threat to the health, safety, and welfare of the impacted citizens, expedite recovery efforts in the impacted area, and address any threat of significant damage to improved public or private property.	High	Low	2022—2027	Low	High	Leominster MO, OEM, PD, FD	MEMA FEMA Leominster OB, CIP
Action 55. Continue to enforce state building codes related to design loads to include wind effects generated from wind related hazards.	High	Low	2022—2027	Low	High	Leominster ZBA, MO/CC	Leominster OB, CIP

Table 6 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

Section 6: Regional and Inter-community Relationships

SECTION 6 - REGIONAL AND INTERCOMMUNITY 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 issues that involve cooperation between two or more municipalities. There is a third level of mitigation which is regional; involving a state, regional or federal agency or an issue that involves three or more municipalities.

The Leominster Planning Board is the primary City agency responsible for regulating development in City. Feedback to the Planning Board was ensured through the participation of the Planning and Development Director on the local hazard planning team. In addition, MRPC, the State-designated regional planning authority for Leominster works with agencies that regulate development in its region including the Leominster Planning Board and Conservation Commission and state entities such as the Massachusetts Department of Conservation and Recreation (DCR), Massachusetts Department of Transportation (MassDOT).

As a part of developing this updated natural hazards mitigation plan, the City coordinated with FEMA to update pertinent repetitive loss property and NFIP claims related details for the City. Local, regional and state entities were provided an opportunity to provide input at two public meetings in May and August of 2022. The City will continue to collaborate with local, regional and state agencies as a part of the implementation of actions outlined in this plan. Below is a more detailed overview of the regional and intercommunity considerations for this plan.

REGIONAL PARTNERS

In many communities, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems and embankment structures that serve these communities include a complex system of storm drains, outfalls, roadway drainage structures, dams and levees, bridges, and other facilities owned and operated by a wide array of agencies including but not limited to the City of Leominster, DCR, MassDOT, and the U.S. Army Corps of Engineers. The planning, construction, operations and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered as 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. **Section 5** of the Plan Update includes several mitigation actions where several of these agencies will participate in moving hazard mitigation efforts forward in collaboration with the City of Leominster. Implementation of these actions will require that all parties work together to develop solutions.

REGIONAL FACILITIES WITHIN LEOMINSTER

Major facilities owned, operated and maintained by federal, state, regional, local or private entities in Leominster include: I-190 and State Routes 2 (George Stanton HWY), 12 (Central Street), 13 (Main Street) and 117 (Lancaster Street / New Lancaster Road), MBTA Fitchburg Branch Commuter Rail Line, UMass Memorial HealthAlliance– Clinton Hospital, 24 assisted living and long-term care facilities, and the Litchfield Street and Prospect Street substations in Leominster..

INTERCOMMUNITY CONSIDERATIONS

Many areas in Leominster, as well as some surrounding communities are close to build-out, but some parcels may undergo significant re-development in the future. To avoid impacts from any residential and commercial development, communication between Leominster and surrounding communities, including input in the review processes, is vital.

Section 7: Plan Adoption and Implementation

SECTION 7- PLAN ADOPTION AND IMPLEMENTATION

Adopting, implementing, monitoring, evaluating, and updating the City's Local Natural Hazard Mitigation Plan are necessary steps to sustaining a viable plan that will assist the community in becoming more resilient to natural hazards long into the future. An overview of how the City will carry out each of these tasks is outlined in the following sections.

PLAN ADOPTION

The Draft Plan was provided to the City on July 19, 2022 for review and distribution to the public, and local, regional and state stakeholders. The City posted the Draft Plan on the City website on August 15, 2022 for public review and input. A public meeting was held on August 29 2022 at the Leominster Office of Emergency Management (OEM) to: 1) present the Draft Plan and 2) solicit input and feedback on the Draft Plan from the public. Based on feedback provided at the public meeting and received from the public online, the Draft Plan was revised on September 7, 2022**.** The City then submitted the Draft Plan Update to the MEMA and the FEMA for review. Upon receiving conditional approval of the plan by FEMA, the plan was presented and approved by the Leominster City Council on **ADD MONTH XX, 2022.** A copy of the plan adoption letter is included in the front of this plan.

PLAN IMPLEMENTATION

The implementation of the Plan commences upon its formal adoption by the City Council and official approval by MEMA and FEMA. **Section 5** details the mitigation strategy that prioritizes the various actions identified to reduce the impacts from future natural hazards. A local hazard mitigation working group (including the LPT) will be responsible for overseeing the implementation of the plan.

In addition, the Local Planning Team (LPT), that includes City officials as presented in Section 2, will identify existing planning documents and regulations where relevant policies and actions outlined in this Plan may be incorporated to improve the potential for the implementation of mitigation actions across related programs and agencies. Relevant programs, policies, and/or regulations may include updates to existing polices and regulations, or those to be developed, such as the following:

- Updates to the Local Building Code based on changes outlined in the new 9th Edition of the Massachusetts Building Code
- Zoning By-Laws, 2022
- Subdivision Regulations, 2012
- MVP Plan 2020
- Continuity of Operations Plan

PLAN MONITORING AND EVALUATION

The City of Leominster has taken steps to implement findings from the 2015 Hazard Mitigation Plan into the following policy, programmatic areas and plans: the update to the City Flood plain Bylaw, development of local evacuation routes, updates to mutual aid agreements, and addressing emergency shelter needs.

Over the 5 years after plan adoption, the LPT led by the Mayor's Office, will monitor and review the Plan progress using a an excel spreadsheet tracking system that includes the 55 actions outlined in Table 6. This monitoring tracking system will include an evaluation of hazard mitigation activities such as ongoing projects, changes in developing new mitigation actions resulting from a natural disaster event, changes in local, State and federal regulations that may impact the implementation of future projects, and modification of existing actions. As a part of this process, the LPT will evaluate and assess the effectiveness the action items outlined in the plan and will post the Plan Update on the City website to gather public input on the progress of the Plan. This will also provide the public with the opportunity to provide additional mitigation activities for the LPT's consideration.

A review, evaluation and update of the City's Plan will be conducted on a 5-year basis in compliance with the 2000 Disaster Mitigation Act and Part 201.6 of 44 Code of Federal Regulations (CFR). The City's Department of Public Works (DPW) will initiate the planning process for updating the City's plan in 2025. The DPW will lead the plan update from 2025 until plan adoption in 2027following the planning process outlined in Section 2 of this plan update that will include:

1. Organize the Planning Process and Resources
2. Assess Natural Hazard Risks
3. Develop Mitigation Strategies
4. Adopt and Implement the Plan

In the event of a major disaster event impacting the City of Leominster, the City may update the plan at that time with actions to address unexpected impacts resulting from the damages to the community, if needed.

FEDERAL AND STATE FUNDING SOURCES

Several of the proposed hazard mitigation projects and actions may be eligible activities for funding under the three FEMA Hazard Mitigation Assistance (HMA) Grant Programs. The FEMA HMA Grant Programs include two non-disaster mitigation grant programs that include the Flood Mitigation Assistance (FMA) grant and the Building Resilient Infrastructure and Communities (BRIC) grant programs, and one post-disaster mitigation grant program that is the Hazard Mitigation Grant Program (HMGP). State and federal Funding source details are presented in **Attachment 5.**

Attachment 1: Community Profile

Attachment 1: Community Profile

Community Profile Overview

This section of the Plan presents details about the City assets which categorically include:

- People
- Support, High Occupancy and Vulnerable Population facilities;
- Essential Facilities including emergency response, police, fire, hospitals, etc.;
- Lifeline Systems including water, wastewater, electrical power, etc.;
- High Potential Loss Facilities, including high hazard dams; and
- Transportation Infrastructure.

Demographic Overview

Per the U.S. Census Bureau Decennial Census (2020) and American Community Survey 5-year estimates (2019):

Age and Sex:

Population:	43,782
Population change since 2010*:	3,023 (+ 7.4%)
**Leominster population of 40,759 from 2010 Decennial Census*	
Percent female/male:	52.5%/47.5%
Age:	
persons <18 years:	21.7%
persons 18 to 64:	62.4%
persons ≥ 65 years:	15.9%

Race:

White alone:	67.7%
Black or African Amer. alone:	7%
Amer. Indian or Alaska Native alone:	0.3%
Asian alone:	3.2%
Two or more races:	12.4%
Hispanic or Latino:	18.9%
White alone, not Hispanic or Latino:	64%

Education:

High school graduate or higher:	79.3%
Bachelor's degree or higher:	14.5%

Economy:

In civilian labor force, total, greater 16 years: (2012 to 2016)	63.9%
In civilian labor force, female, greater 16 years: (2012 to 2016)	73.5%

Income and Poverty:

Median household income:	$61,825
Per capita income:	$33,676
Persons in poverty:	12.6%

Family and Living Arrangements:

Households:	16,830
Persons per Household:	2.45
Language spoken at home other than English, greater than 5 years:	26.2%
Median house cost:	$241,800
Percent owner-occupied:	57.8%

Population Density: 1,474/sq. mile

The City has a total area of 29.7 square miles that includes 28.8 square miles of land and 0.9 square miles of water. It is located about 20 miles north of Worcester, 41 miles northwest of Boston, has a residential community, manufacturing center, and a Historic Downtown area.

Demographics

Based on the U.S. Census Bureau (2020) Census estimates, the population per square mile varies with census tract, and range from as low as 354.2 to as high as 5,010.5 (**Figure 1-1**) The average population density for the entire city is 1,474 population per square mile. This is greater than the average for Massachusetts as a whole (901.2) and Worcester County (570.7).

The number of residents has increased from 40,759 in the 2010 US Census to 43,782 in 2020. Leominster includes a largely white population, representing about 67.7% of all residents. Hispanics or Latinos make up the largest single minority group at 18.9% of all residents. The black population represents 7% of the population, and Asians make up 3.2%. 12.4% of residents are two or more races.

The population includes 21.7% of residents under the age of 62.4% between the ages of 18 to 64, and 15.9% who are 65 years or older.

There are 16,830 households, with an average household size of 2.45.Leominster has 4.58% of its housing units classified as vacant, which is slightly less than the percentage in Worcester County (5.68%). A housing unit is classified as vacant by the U.S. Census if no one is living in it at the time of the interview, or if the unit is entirely occupied by persons who have a usual residence elsewhere (seasonal housing units).

The median household income in Leominster was $61,825, which is below the median averages of $81,215 for the Commonwealth and $74.679 for Worcester County. Poverty is at 12.6% which is slightly higher than the Commonwealth rate of 10.3% and the County rate of 10.1%.

Housing costs are $241,800 for the median value, owner-occupied housing unit compared to the Commonwealth at $381,600 and Worcester County at $280,600. 57.8% of the housing units are owner-occupied compared to 62.4% for Massachusetts and 65.1% for Worcester County.

Social Vulnerability

The term Social Vulnerability describes how resilient a community is to external stresses, such as natural hazards, on human health. The Social Vulnerability Index (SVI) employs U.S. Census Bureau variables to identify neighborhoods that may need additional support in preparing for hazards or recovering from disasters, and is a useful tool for emergency response planners and

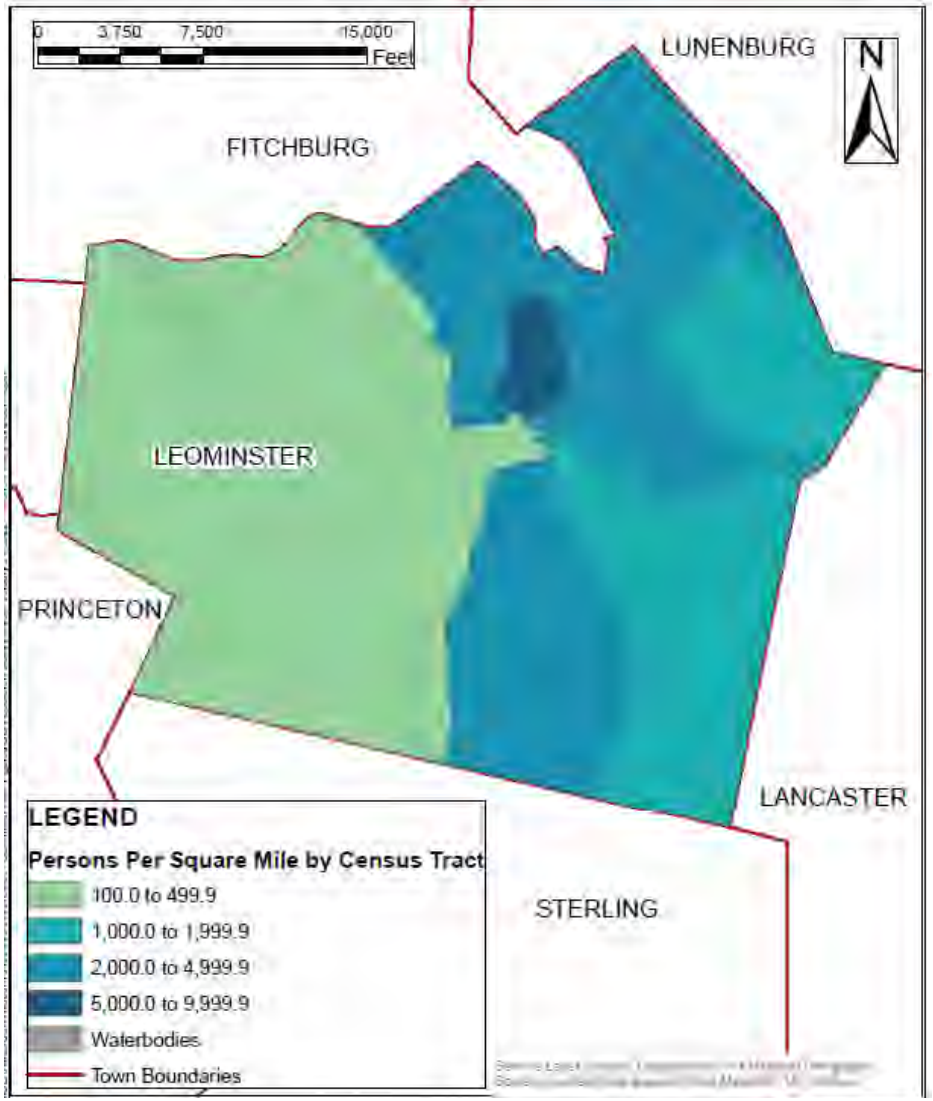


Figure 1-1: Population Density

on 15 social factors, including poverty, lack of vehicle access, and crowded housing, and groups them into four related themes: 1) Socioeconomic status; 2) Household Composition/Disability; 3) Minority status and language; and 4) English language proficiency, housing, and transportation. Each tract receives a separate ranking for each of the four themes, as well as an overall ranking.

Leominster consists of nine (9) Census Tracts: 7091, 7092.01, 7092.02, 7094, 7095.01, 7095.02, 7096, 7097.01, 7097.02.

The City contains census tracts that range in overall SVI across each category, from lowest vulnerability to highest vulnerability, as shown in **Figure 1-2**.

The ranking for each of the four themes listed above was identified using the SVI Interactive Map for SVI Year 2018 (https://svi.cdc.gov/map.html) for each of the census tracts. The rankings are summarized in **Table 1-1**.

The scale for each of the themes is consistent with the scale for overall SVI shown in **Figure 1-2.**

Census Tract	Socio-economic	Household Composition/ Disability	Minority/ Language	Housing/ Transportation	Overall SVI
7091	0.44	0.40	0.34	0.47	0.47
7092.01	0.27	0.68	0.56	0.77	0.56
7092.02	0.74	0.75	0.76	0.90	0.87
7094	0.89	0.86	0.80	0.82	0.93
7095.01	0.14	0.11	0.34	0.09	0.06
7095.02	0.27	0.40	0.62	0.77	0.51
7096	0.83	0.85	0.80	0.78	0.90
7097.01	0.49	0.57	0.58	0.86	0.68
7097.02	0.46	0.63	0.39	0.67	0.55

Table 1-1: Leominster Social Vulnerability Profile Analysis

Centers for Disease Control and Prevention/ Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. Social Vulnerability Index 2018 Database Massachusetts. Accessed on 2/23/2022.

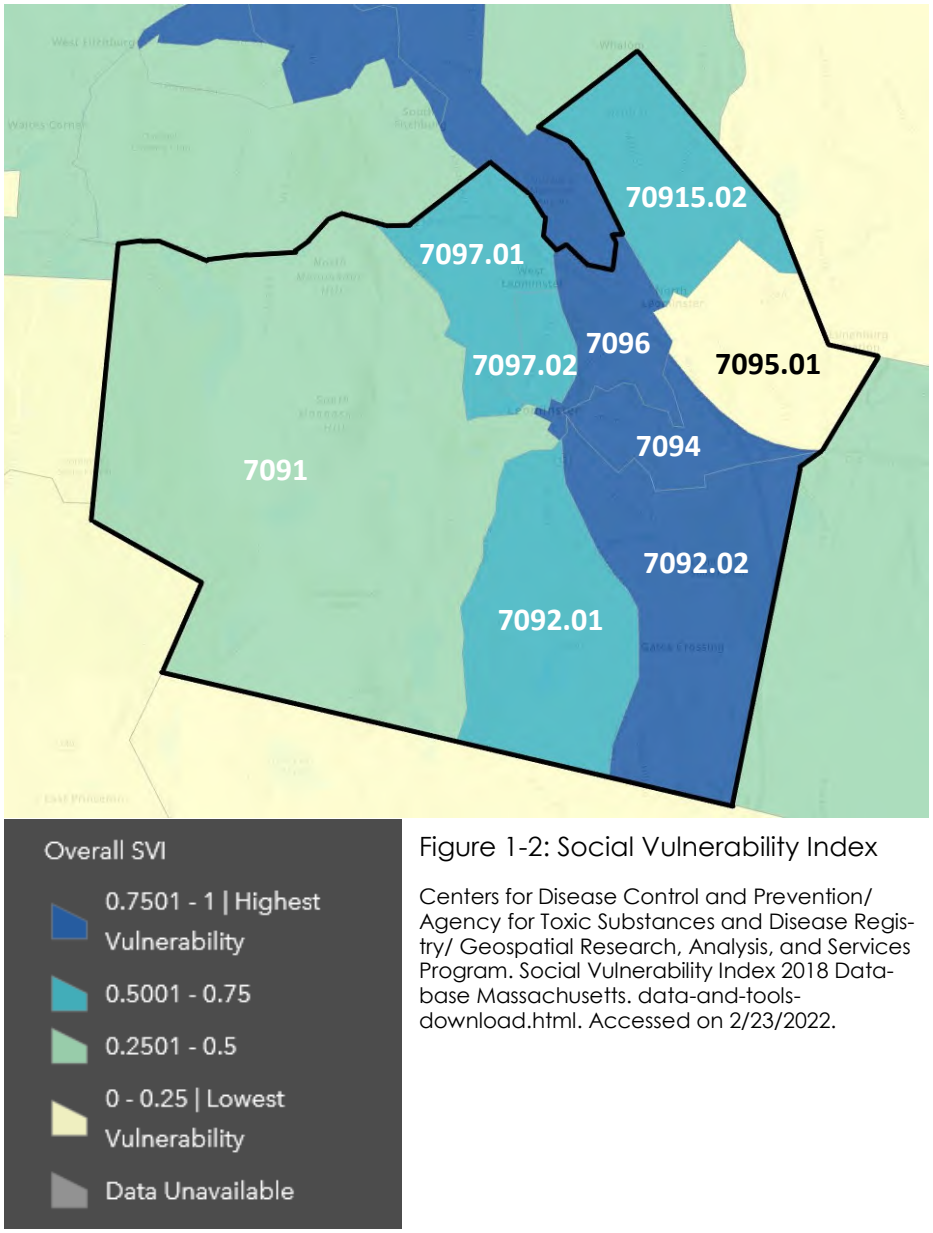


Figure 1-2: Social Vulnerability Index

Centers for Disease Control and Prevention/ Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. Social Vulnerability Index 2018 Database Massachusetts. data-and-tools-download.html. Accessed on 2/23/2022.

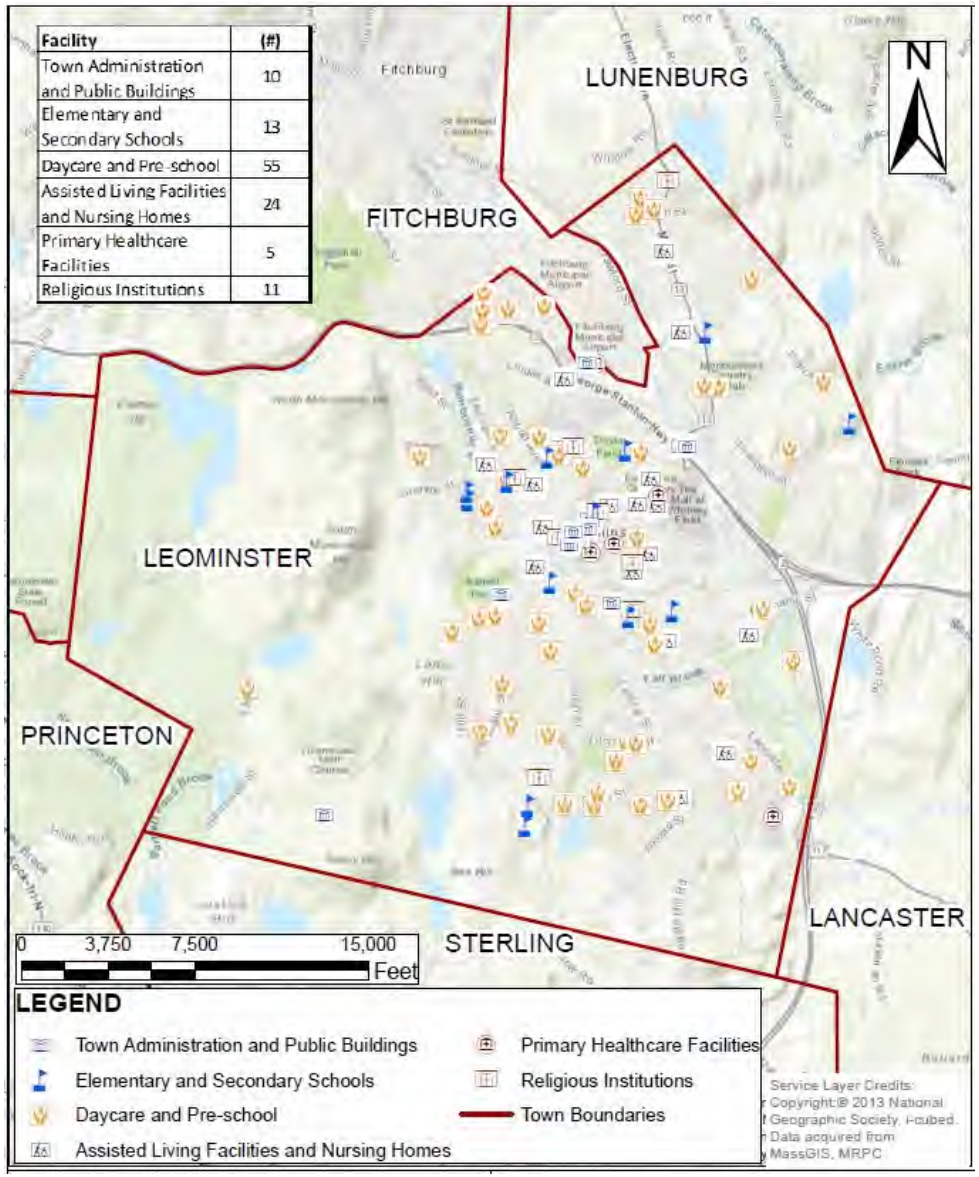


Figure 1-3: Support, High Occupancy and Vulnerable Population Facilities

Support, High Occupancy and Vulnerable Populations

There are several Support, High Occupancy, and Vulnerable Populations facilities in Leominster . There are 55 daycare and pre-school facilities and 13 elementary and secondary schools in the City as shown on **Figure 1-3**. There are five (5) primary healthcare facilities not having surgery of emergency treatment capabilities, in addition to the hospitals in the area. Elderly housing and long-term care facilities are located throughout the City; 24 in total. Additionally, there are 11 religious institutions in Leominster, consisting of churches and a synagogue.

Land Use (Existing)

According to MassGIS data, Leominster has 18,994 acres of land, broken down by general land use category as shown in **Table 1-2** and presented in **Figure 1-4**. About 8.4% (by area) of land in the City is identified as residential. About 3.67% and 3.4% (by area) of land is identified as commercial and industrial, respectively. The largest portions of land cover in Leominster are deciduous and evergreen forest, covering about 33.9% and 18.3% (by area) respectively. Additionally, forested wetlands cover approximately 7.1% of the area. Most of the development is in the central to easter portion of the City, with the majority of western Leominster undeveloped: a combination of evergreen and deciduous forest, wetlands, and surface water.

Open Space: The majority of open space lands in the City are municipal lands, owned by the City of Leominster, as shown on **Figure 1-5**. The City owns the Notown Reservoir and surrounding watershed area, an 889.4- acre area, which is the largest municipal area. The City also owns the Haynes Reservoir and watershed area, and the Nashua Valley Conservation Area, 321.6 and 322 acres, respectively. The largest single open space in the City is Leominster State Forest, 1394.6 acres owned by MA DCR– Division of State Parks and Recreation.

The open space and recreational lands within the City of Leominster are presented on **Table 1-3**. The larger sites are shown in the table, along with the remaining acreage of open space lands.

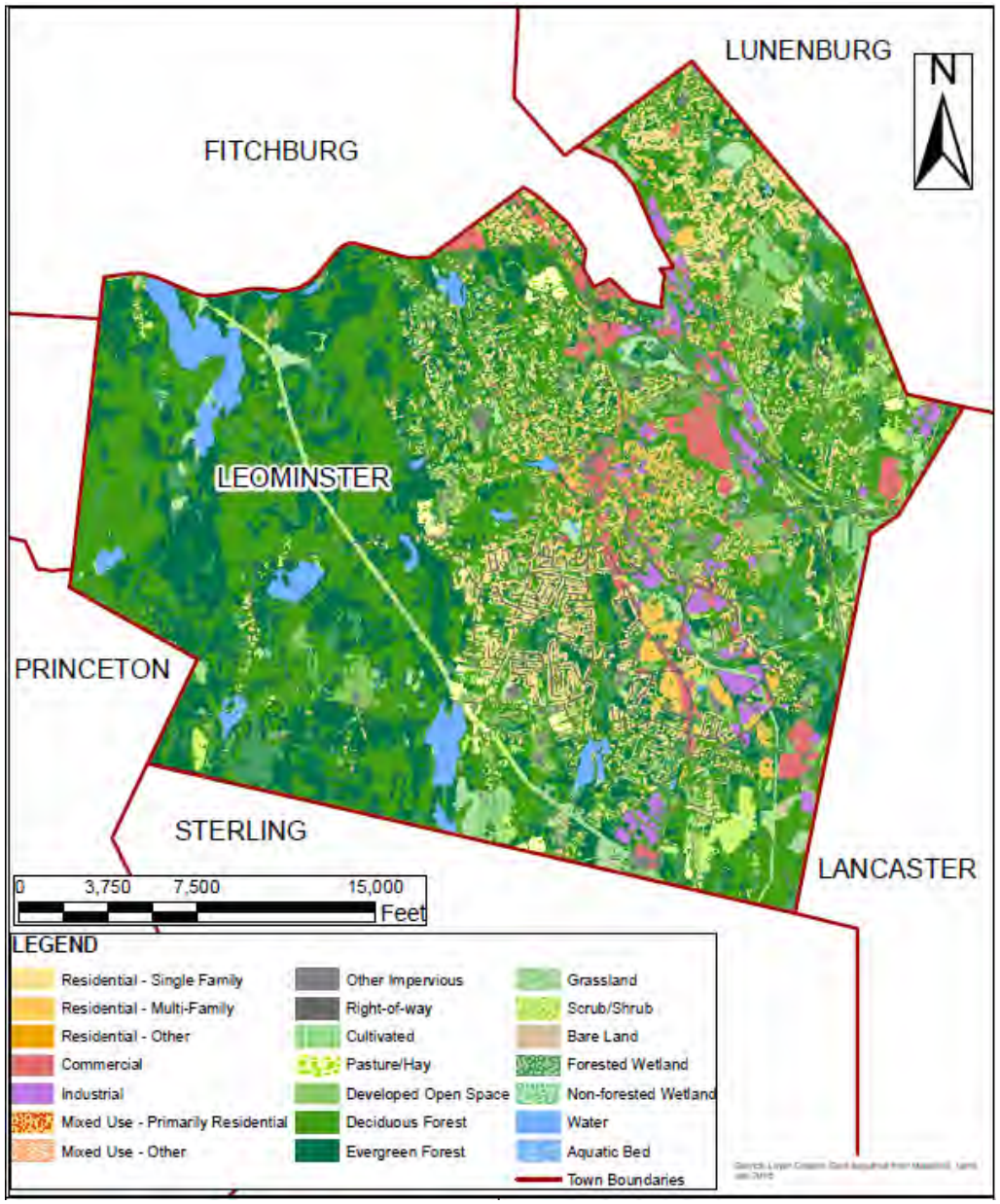


Figure 1-4: Existing Land Use

Land Use / Land Cover	Acres Total	Acres (%)
Residential:		
Single-Family	1243	6.55%
Multi-Family	355	1.87%
Other Residential	4	0.02%
Commercial	697	3.67%
Industrial	645	3.40%
Mixed Use—Primarily Residential	46	0.24%
Mixed Use—Other	0.49	0.003%
Other Impervious	490	2.58%
Right-of-Way	1645	8.66%
Cultivated	169	0.89%
Pasture/ Hay	155	0.82%
Developed Open Space	366	1.92%
Forest:		
Deciduous Forest	6438	33.89%
Evergreen Forest	3478	18.31%
Forested Wetland	1347	7.09%
Vacant Land:		
Grassland	444	2.34%
Scrub/Shrub	503	2.65%
Bare Land	95	0.50%
Non-forested Wetland	299	1.57%
Water	551	2.90%
Aquatic Bed	23	0.12%
TOTAL	18,994	100.0%

Table 1-2 Land Use / Land Cover (MassGIS)

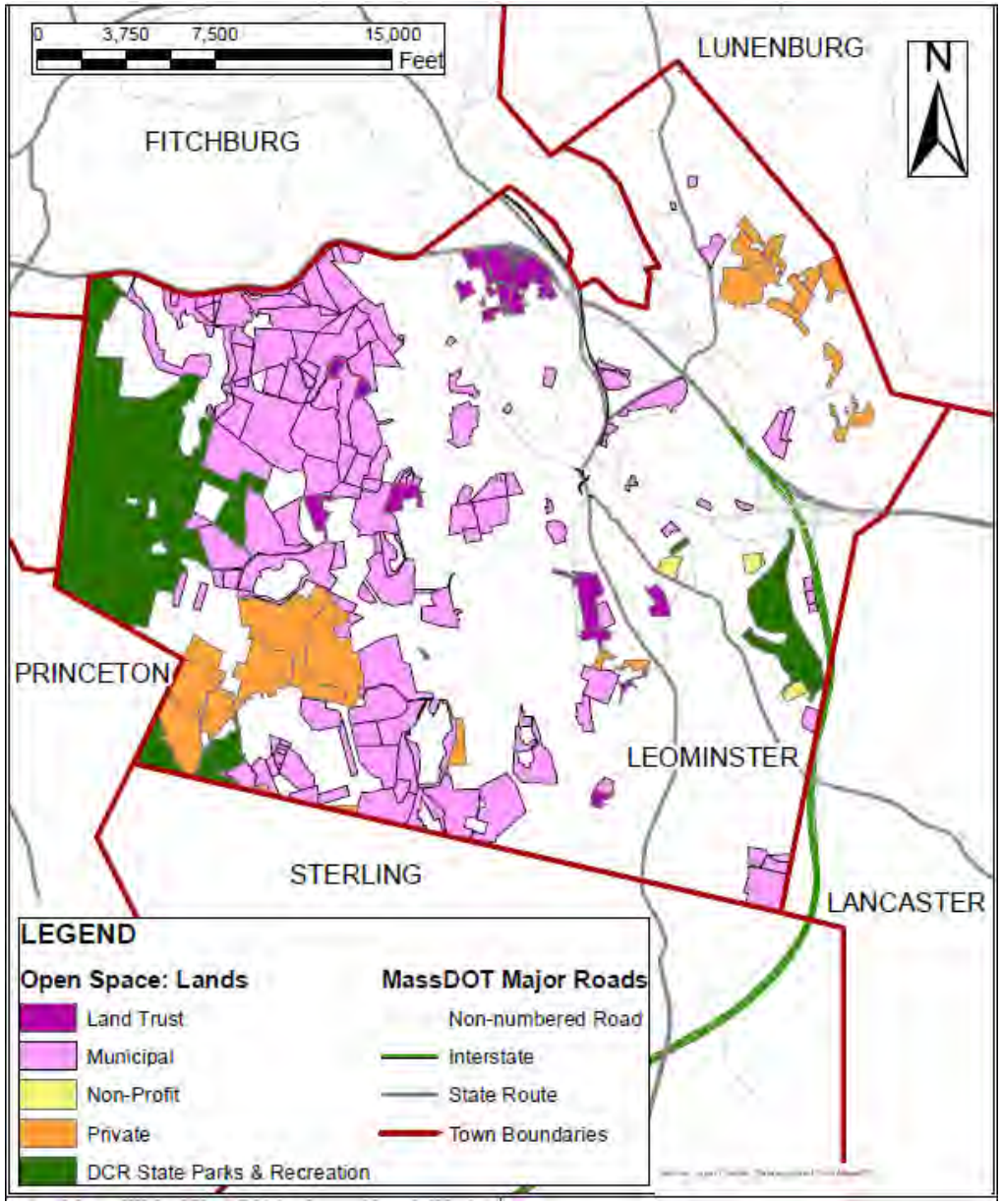


Figure 1-5: Open Space

Site	Acres	Owner Type
Leominster State Forest	1394.6	DCR - Division of State Parks and Recreation
Johnny Appleseed State Park	204.7	DCR - Division of State Parks and Recreation
Leominster Sportsmen's Club	250.9	Private
Grandview Country Club	343.9	Private
Barrett Park	75.9	Municipal
Bartlett Swamp	158.8	Municipal
Nashua Valley Conservation Area	322	Municipal
Notown Reservoir/ Watershed	889.4	Municipal
Haynes Reservoir/ Watershed	321.6	Municipal
Doyle Community Park and Center	150.7	Land Trust
Other Land Trust Space	170.3	Land Trust
Other Municipal Space	1696.1	Municipal
Other Non-Profit Space	42.5	Non-Profit
Other Private Space	404.4	Private
Other DCR Space	76.5	DCR - Division of State Parks and Recreation
Total	6502.3	

Table 1-3 Open Space /Recreational Lands in Leominster (MassGIS Protected and Recreational OpenSpace 2021)

Zoning

The City of Leominster's zoning includes the following eleven (11) underlying zoning districts, as shown on **Figure 1-6a**.

- Rural Residence and Agriculture (RR)
- Residence A (RA)
- Residence B (RB)
- Residence C (RC)
- Business A (BA)
- Business B (BB)
- Commercial (C)
- Industrial (I)
- Multi-Use 1 (MU1)
- Multi-Use 2 (MU2)
- Village (V)

The City's zoning also includes the following six (6) overlay districts as shown on **Figure 1-6b**.

- Downtown (DO)
- Mechanic Street (MS)
- Urban Corridor (UCO)
- Health Care / Development Envelope #1 (HCO)
- Health Care / Development Envelope #2 (DE2)
- Health Care / Multi-Use Area (MUA)

The Floodplain District is a special district that includes those areas designated as a flood way and all special flood hazard areas designated as either Zone A or Zone A-I through A-30 Zone on the on the Leominster, Massachusetts Flood Boundary and Floodway Map (the "FBFM"), Community Panel Numbers 250314-0001-0010, effective September 16, 1982.

Land Use and Growth (Future)

Unlike many communities in the Montachusett Region, the City of Leominster does not have a community master plan or comprehensive plan that provides a plan for future land uses and growth within the City. However, The Montachusett Regional Planning Council (MRPC) prepared plans that included an evaluation of potential future growth in the Montachusett Region including in Leominster that serve as the basis for future land use and growth. Based on the 2011 Montachusett Regional Strategic Framework Plan, projects that the City's population will increase to approximately 45,270 residents by 2035 which will result in a population growth of 3.3% . The 2011 Montachusett Plan also forecasts that employment growth will increase by about 1,500 employees by 2035. Based on a review of the City's EO Community Development Plan, the 2011 Montachusett Plan identified the following Housing and Economic Development Priority Areas.

Housing Priority Areas

- Carter and Second Street Housing Areas
- Second Street Housing Area
- Area around Tucker Drive
- All projects listed in the Affordable Housing/ Rockwell Village Revitalization Initiative
- Accessory apartments should be promoted throughout the community
- Multi-family housing though adaptive reuse in RC and RB Zones

Economic Development Priority Areas

- Central Business District
- Area along State Route 117/Lancaster Street between Pioneer Drive and Harvard Street
- Development and redevelopment in commercial, industrial zones and brownfield sites

There has been some new development that occurred in hazard prone areas since the adoption of the 2015 HMP in the areas outlined above; however it's important to note that this development took place in previously developed areas. The City implemented applicable regulatory measures as presented in **Table 4** of Section 5 for new development in these hazard prone areas. These measures helped to make sure that new buildings and structures were built safely and to the state building code standards for including hazard mitigation regarding wind loads, earthquake resistant design, flood resistant design, floodproofing and snow loads. Therefore, by requiring higher building standards for new development resulted in a slight decrease of the overall impact on the City's vulnerability since the adoption of the 2015 Plan Update.

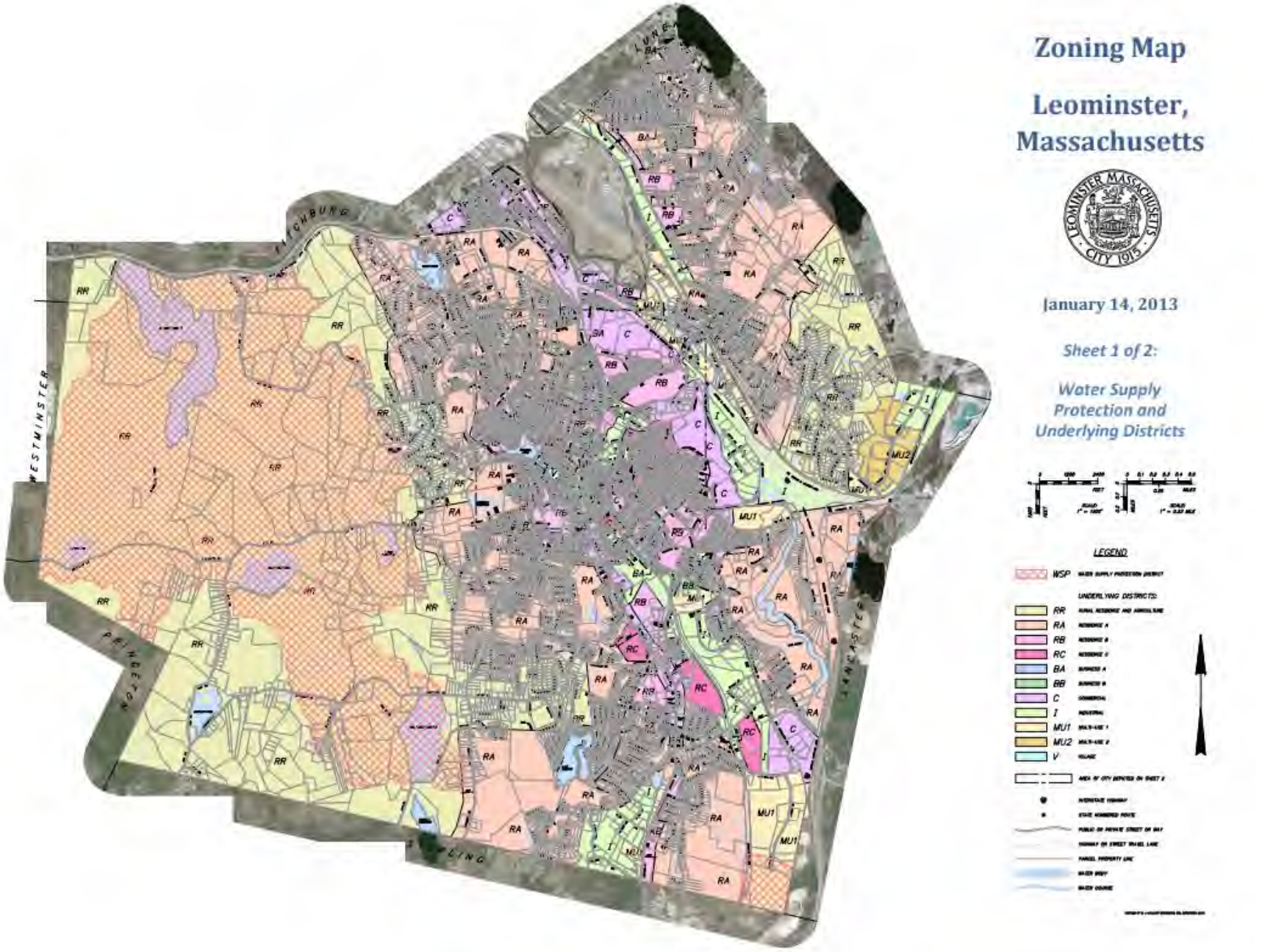


Figure 1-6a: Zoning Map—Underlying Zoning Districts (Source: City of Leominster 2013)

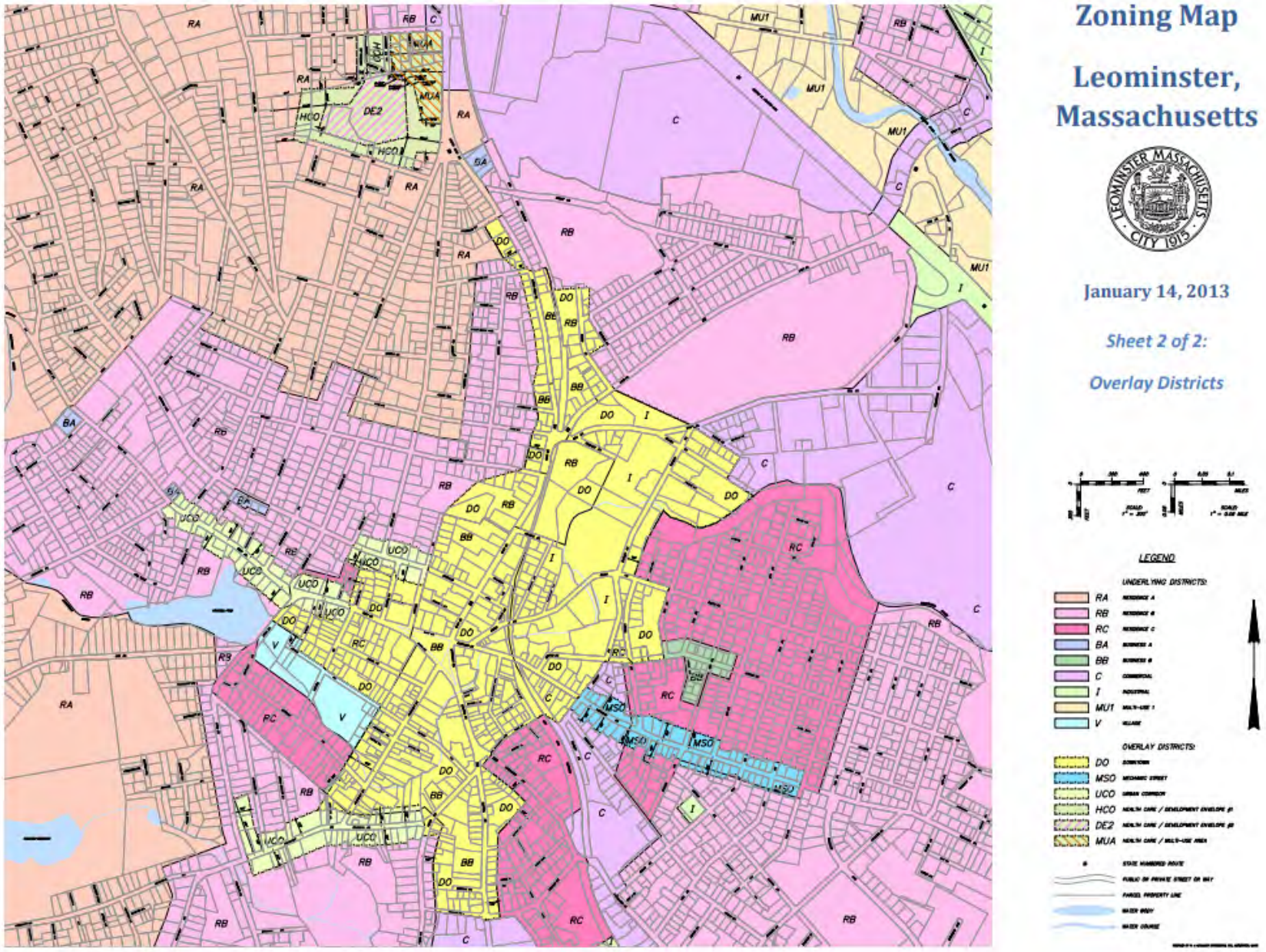


Figure 1-6b: Zoning Map—Overlay Districts (Source: City of Leominster 2013)

Transportation Infrastructure

Interstate Route 190 is the main roadway entering Leominster from the South. It meets Route 2, the main east-west route, which travels across the northern region of Massachusetts. There are several other main roadways, including the north-south Route 12, Route 117, and Route 13. All are in the east-central portion of the City. There are no major roadways that service the west-central portion of Leominster south of Route 2.

According to the MassDOT Road Inventory Municipal Data Viewer, there are 186.13 miles of roads in Leominster, with 163.40 miles (87.8%) under the jurisdiction of the City. The remaining roadways are either unaccepted (9.52 miles), or under the jurisdiction of MassDOT (12.12).

The Montachusett Regional Transit Authority (MART) bus routes service Leominster and the neighboring Town of Fitchburg and nearby Gardner .

There are no airports located within the city, however the Fitchburg Municipal Airport is very nearby, and the larger Worcester Regional Airport is located South in the County. There is a privately owned Sterling Airport in south-neighboring Sterling, and the next two closest airports are Gardner Municipal Airport to the west and Stow-Minuteman Airfield to the east. The nearest international airport is Logan International Airport in Boston.

Numerous bridges and culvert crossings are located within Leominster, as shown on **Figure 1-7**. The number of major MassDOT bridges and municipal bridges, as well as culverts are listed as follows in **Table 1-4**.

Transportation Infrastructure	(#)
MassDOT Bridges	27
Municipal Bridges	24
Culverts	12

Table 1-4 Bridges and Culverts in Leominster

The Massachusetts Bay Transportation Authority (MBTA) Fitchburg Branch line runs through the City, and provides commuter service to Boston. The North Leominster train station provides access to this railroad. rail systems currently provide commuter or other types of freight service to Leominster. There is a CSX commercial/ industrial rail line that runs north-south through eastern Leominster.

Bus service in Leominster is provided by Montachusett Regional Transit Authority. There are three local routes within the City, and two regional routes that connect Leominster to the surrounding Towns of Fitchburg, Westminster, Gardner, Templeton, Phillipston, and Athol (Montachusett Regional Planning Commission).

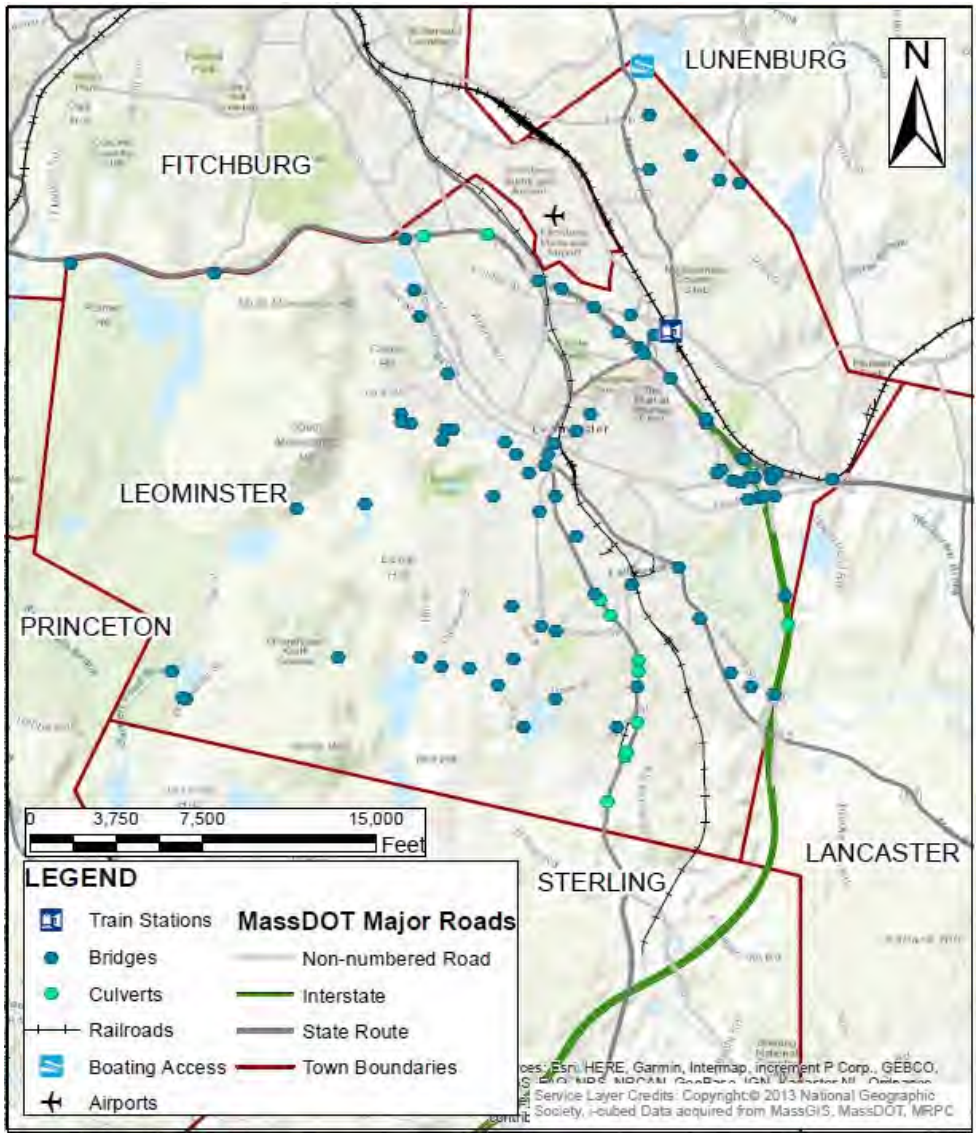


Figure 1-7: Transportation Infrastructure

Essential Facilities

Essential Facilities in Leominster are presented in **Figure 1-8**. Essential facilities include facilities that provide critical services including public safety (e.g. police, fire, emergency shelters), health care, and City and regional services necessary for response during and after natural disasters. More information about these services are described below. Lifeline Systems include power generation and transmission, communication systems, potable water supply and sanitary wastewater treatment.

Public Safety and Health Care

Public safety within the City of Leominster is the responsibility of the local Police Department, Fire Department, Emergency Management, and Highway Department. The Leominster Police Department is located at 29 Church Street. The Fire Department Headquarters is located at 210 Lancaster Street, and Fire Stations 1, 2 and 3 are located at 19 Church Street, 598 Central Street and 524 Main Street, respectively. The Department of Public Works is located at 109 Graham Street.

The Police Department consists of over 500 eligible police officers, plus the Police Chief. The Fire Department in Leominster has 80 full-time staff supporting the City including the Fire Chief. The Department is tasked with providing fire protection (fire prevention and fire extinguishing), emergency medical response, search and rescue, fire education and a host of other services. The department has 8 engine trucks, 2 ladder trucks, 4 ambulances, 1 rescue truck, several 4 x 4 vehicles, and all terrain vehicles.

There are two hospitals in Leominster. The main hospital is UMass Memorial HealthAlliance– Clinton Hospital, Leominster Campus is located at 60 Hospital Road, and there is a satellite of UMass Memorial-Health Alliance Hospital, Physical Therapy Plus at Whitney Field, located at 21 Cinema Boulevard.

There are two Emergency Operations Centers in the City, one at the Leominster Office of Emergency Management located at 37 Carter Street, and the other is City Hall, located at 25 West Street. There are 11 Designated Emergency Shelters in Leominster, which are located at various schools in the area.

The Department of Public Works is responsible for maintaining the City's roadways, culverts, utilities, facilities, parks, and City cemeteries. The Highway Department also maintains sewer mains and stormwater drainage.

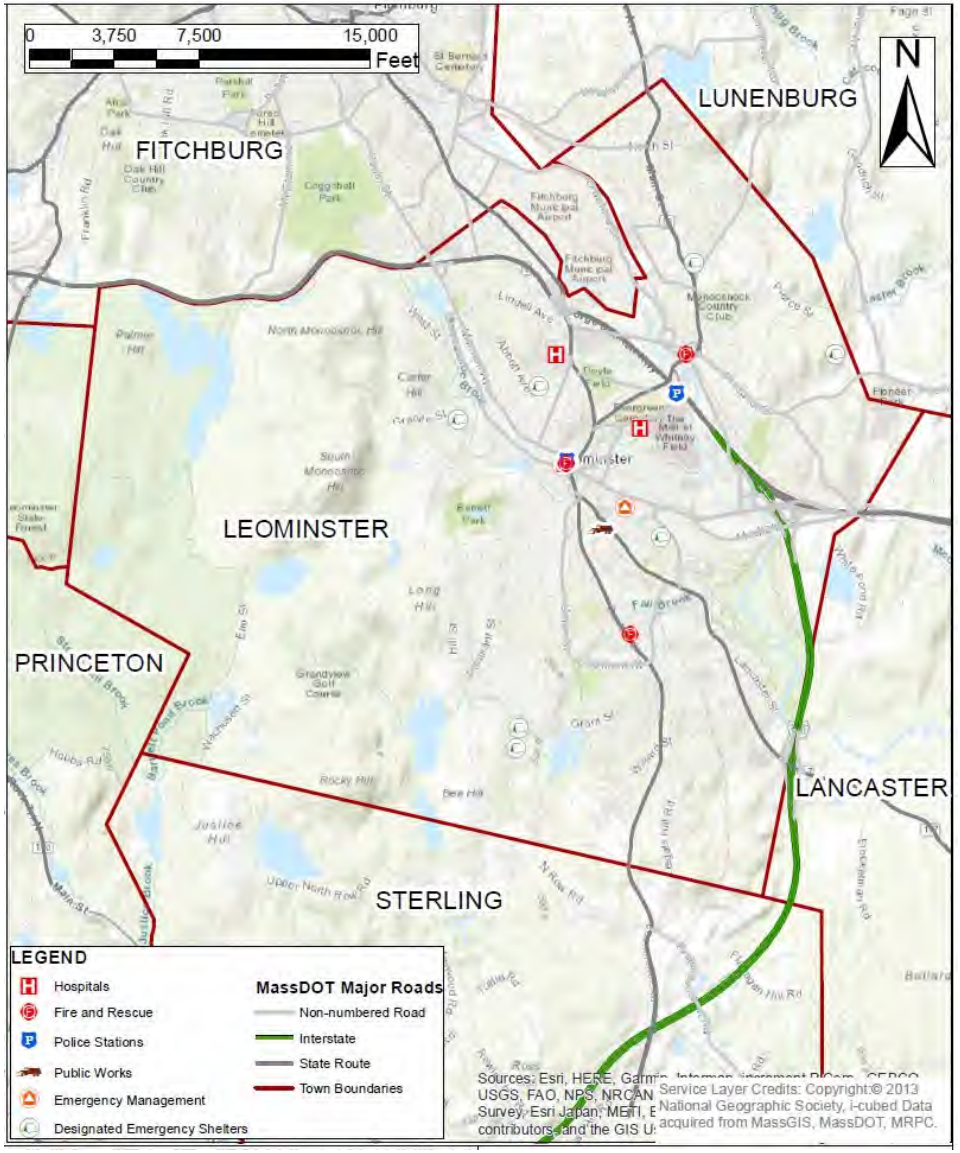


Figure 1-8: Essential Facilities and Lifeline Systems

Lifeline Systems

Utilities

Gas service in Leominster is provided by National Grid (Boston Gas). There is a major gas service pipeline that briefly enters the City from the east to provide service to Leominster (See **Figure 1-9**). Cell phone service is available in Leominster, and there is a cellular tower located in the southwestern area of the City. National Grid is also the electric provider in Leominster. Cable and internet service are provided by Xfinity via cable, as well as by Verizon via fiber optic cable. There are other cable and internet providers available in the City that provide service via satellite. Telephone service is also provided by Verizon.

There are multiple powerlines that transverse the City (See **Figure 1-9**). One crosses the southwestern portion of Leominster, and there are other powerlines in the southeastern region.

Water Supply

The City of Leominster Water Department provides water to its municipal customers. The 2015 Montachusett Region Natural Hazard Mitigation Plan 2015 Update identified 11 public water supplies in the City, which consist of the South East Well Field (three wells), and eight (8) surface water supplies. The main reservoirs in the system are the Haynes, Morse, Fallbrook, and Notown Reservoirs.

There are four (4) Potable Water Treatment Plants in Leominster. One is located near the South East Well Field located at 1000 Jungle Road. The other three facilities are at the surface supplies of Distribution Reservoir, Notown Reservoir, and Fallbrook Reservoir, located at 300 Exchange Road, Route 2 East, and 100 Wachusett Street, respectively.

Water Pollution Control

Wastewater from residential and City properties in Leominster is also managed by the City of Leominster Water Department. The Leominster Wastewater Treatment Facility is located at 436 Mechanic Street. According to an EPA Study on Leominster's Wastewater Treatment Plant (EPA, March 1972), the facility has the capacity to treat approximately 16.5 million gallons per day (MGD) of sewage.

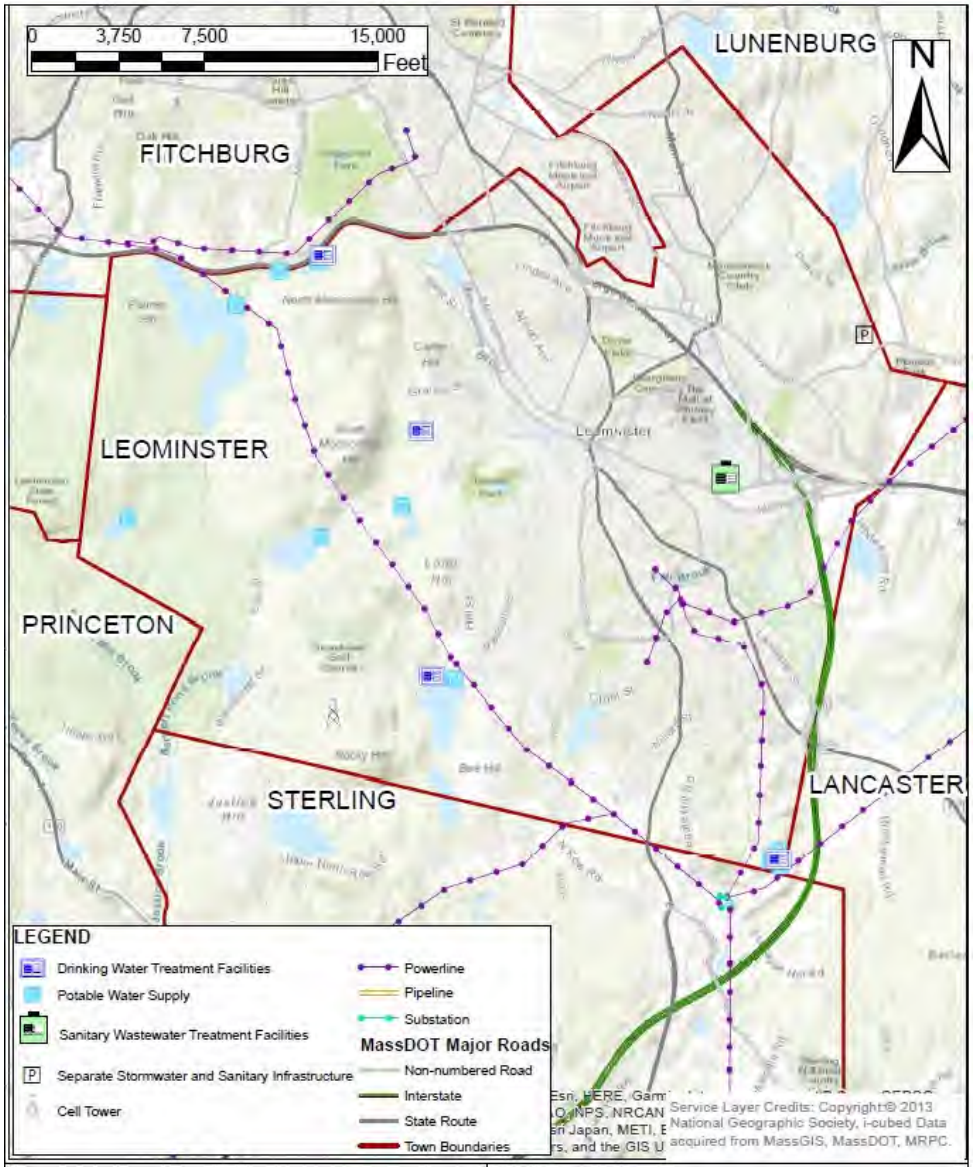


Figure 1-9: Lifeline Systems

High Potential Loss Facilities: Dams

There are a total of 24 dams located within Leominster. The dams are classified as either high, significant, or low hazard (**Figure 1-10**). The dams listed as N/A are non-jurisdictional and do not have a hazard classification. There are six (6) high hazard dams in the City.

Fall Brook Reservoir Dam and Dike: Fall Brook Reservoir is impounded by a dam and a dike. Both structures are located in south central part of the City. The dam is located south of Wachusett Street off of Pleasant Street. These structures are owned by the City of Leominster

Rockwell Pond Dam: Rockwell Pond Dam is located in the center of Leominster. Pond Street, between West Street and Elm Street is located on the crest of the dam. This dam is owned by the City of Leominster.

Pierce Pond Dam: This dam is located in the north-central area of the City, north of Lindell Ave off of Merriam Ave. This dam is privately owned.

Lake Samoset Dam: A fourth, High Hazard dam, is located in the south-eastern area of the City, off of Lincoln Drive between Lake Shore Drive and Grant Street. This dam is privately owned.

Notown Reservoir Dam: Notown Reservoir is impounded by a dam and a dike. Notown reservoir (pictured below) is the largest surface waterbody in Leominster and has a surface area of 238 acres. The dam is located in the western area of the city west of Mt Elam Road off of Route 2. This dam is owned by the City of Leominster.

Notown Reservoir Dike: The dike is located east of Palmer Road off of Route 2. This dike is also owned by the City of Leominster.

Notown Reservoir and Dam and Dike (in red)

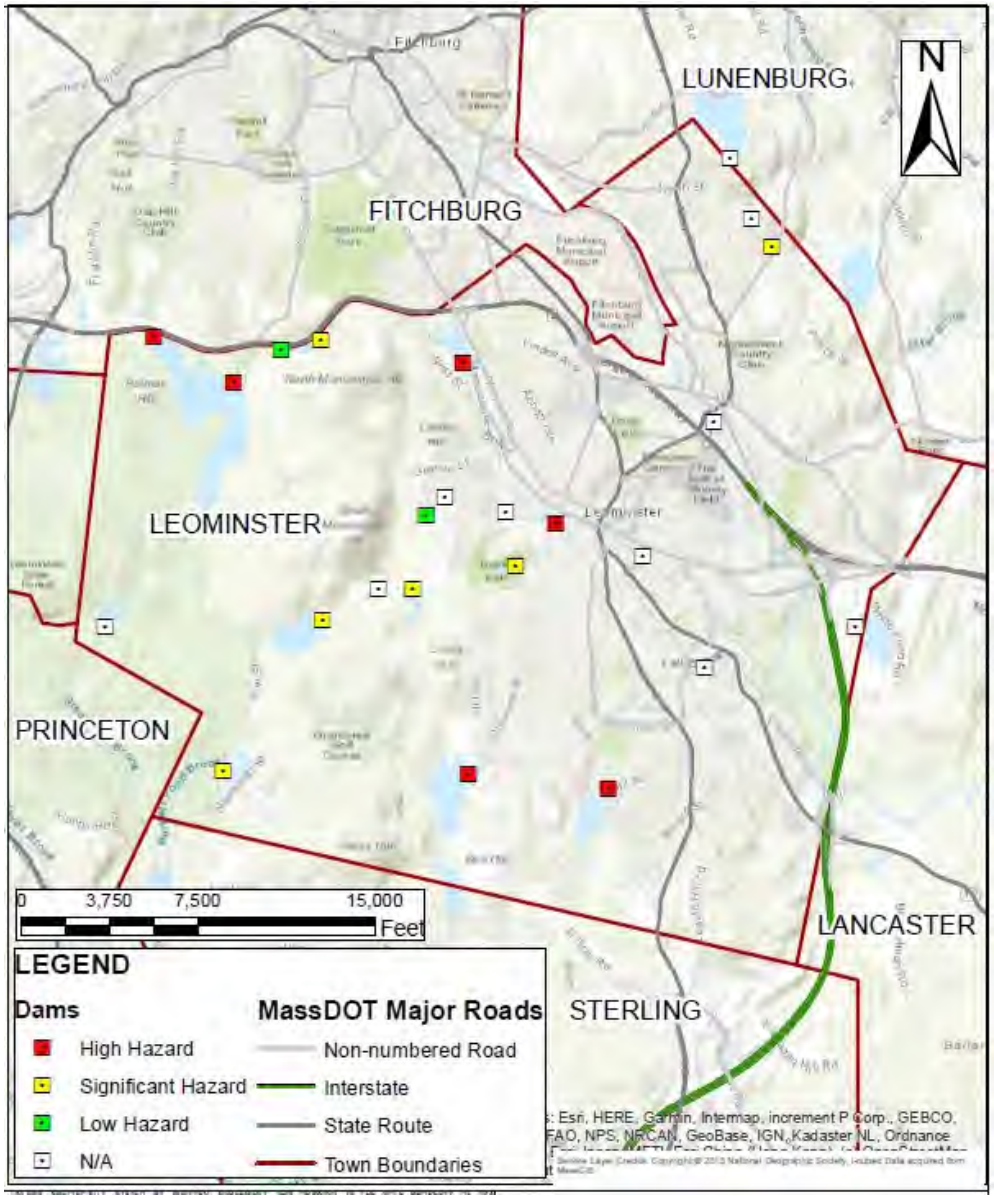


Figure 1-10: Dams in Leominster

Stormwater Management

The City of Leominster Department of Public Works maintains a separate stormwater system to collect and convey stormwater runoff from municipal roadways and properties. The DPW regularly cleans catch basins, storm drains, and culverts. The City has a Stormwater Committee dedicated to maintaining stormwater management standards, and a stormwater ordinance was passed in 2015, requiring most new construction projects to have a stormwater permit.

Hazardous Materials Facilities and Landfills

There are 39 HazMat sites located in Leominster as shown in **Figure 1-11.** The sites are a variety of Tier 2 Facilities, water treatment facilities, hospitals, electric substations, and other sites. There are no active landfills located in the City.

Natural Resources

Leominster lies within the Nashua River watershed (see **Figure 1-12**). The Nashua River is the major river that flows through the City, flowing south to north in the eastern region. Other streams include Monoosnoc Brook, Fall Brook, Reservoir Brook, and Bartlett Pond Brook. The water bodies include Notown Reservoir Fall Brook Reservoir, Haynes Reservoir, Lake Samoset, Pierce Pond, Morse Reservoir, Colbburns Reservoir, Distributing Reservoir, Rockwell Pond, Bartlett Pond, Rocky Pond, and a portion of Heywood Reservoir (MA DEP).

Endangered and Priority Habitats associated with the Massachusetts Natural Heritage and Endangered Species Program (MA NHESP) are associated primarily with areas around Notown Reservoir, Haynes Reservoir, Fall Brook Reservoir, and Lake Samoset, as shown on **Figure 1-13**. Priority Habitat is based on the known geographical extent of habitat for all state-listed rare species, both plants and animals, and is codified under the Massachusetts Endangered Species Act (MESA). Habitat alteration within Priority Habitats may result in a take of a state -listed species and is subject to regulatory review by the Natural Heritage & Endangered Species Program. Estimated Habitats are a sub-set of the Priority Habitats, are based on the geographical extent of habitat of state-listed rare wetlands wildlife and is codified under the Wetlands Protection Act (WPA), which does not protect plants. State-listed wetland wildlife species are protected under the Massachusetts Endangered Species Act as well as the Wetlands Protection Act.

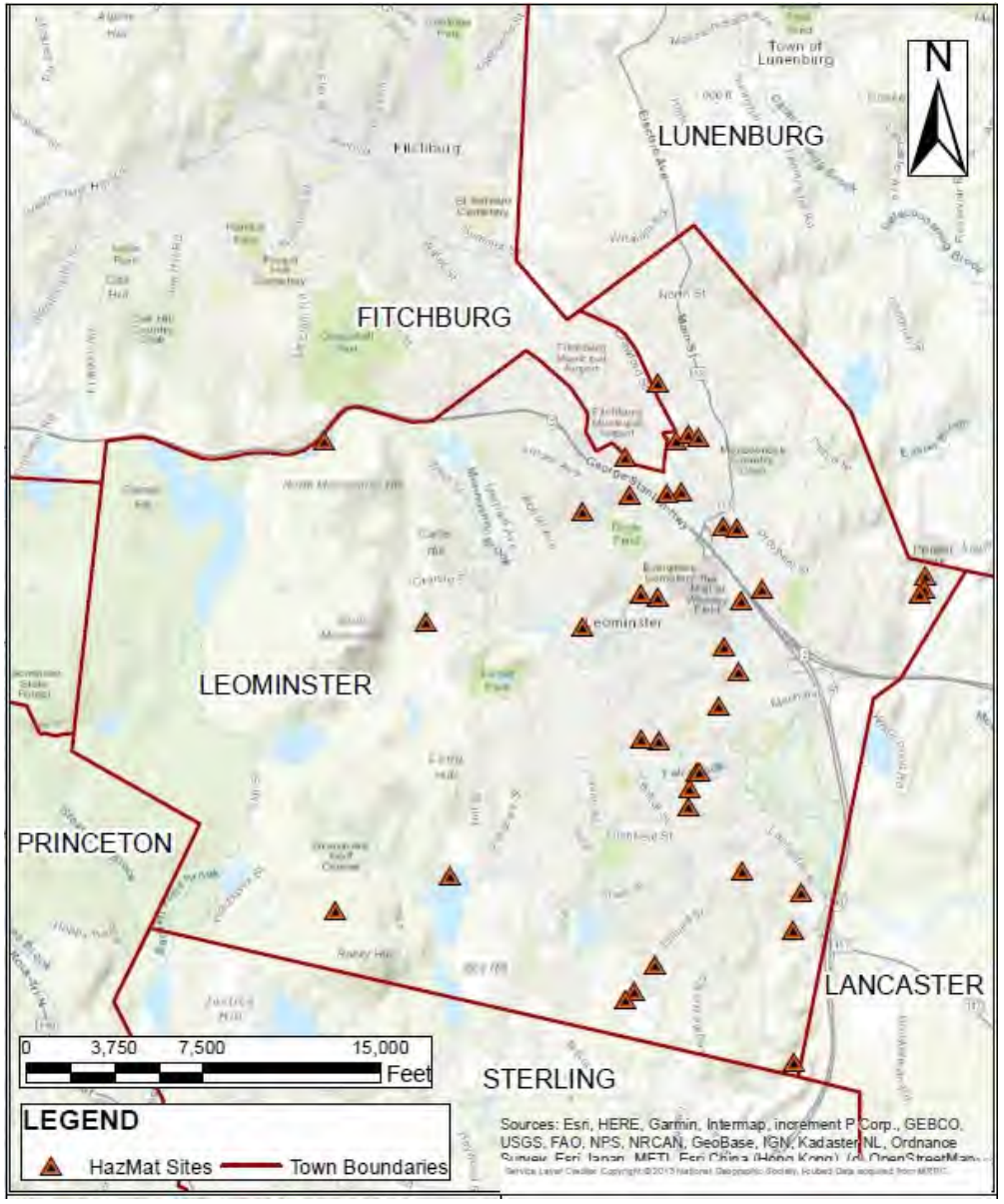


Figure 1-11: Hazardous Materials Facilities and Landfills

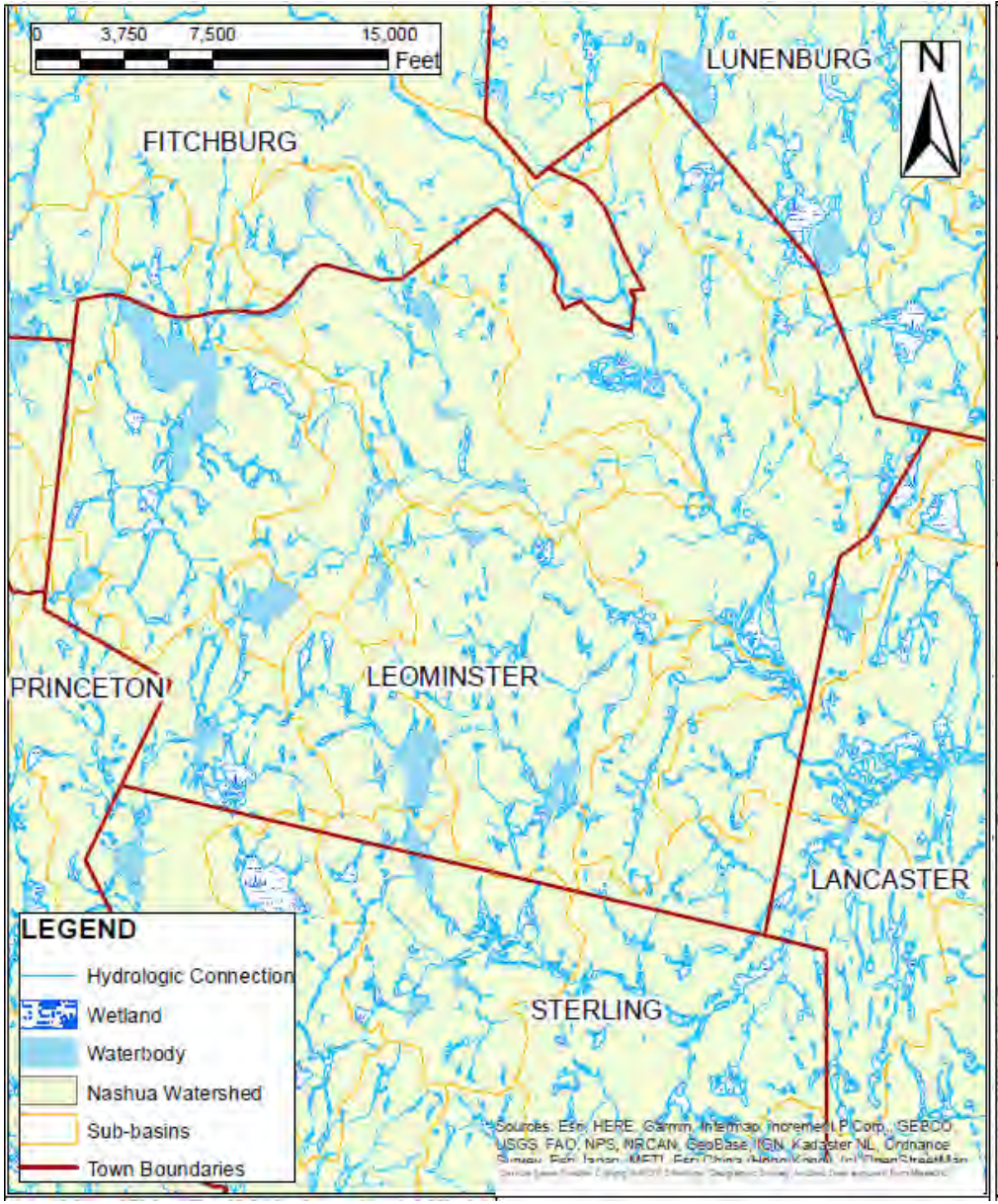


Figure 1-12: Water Resources

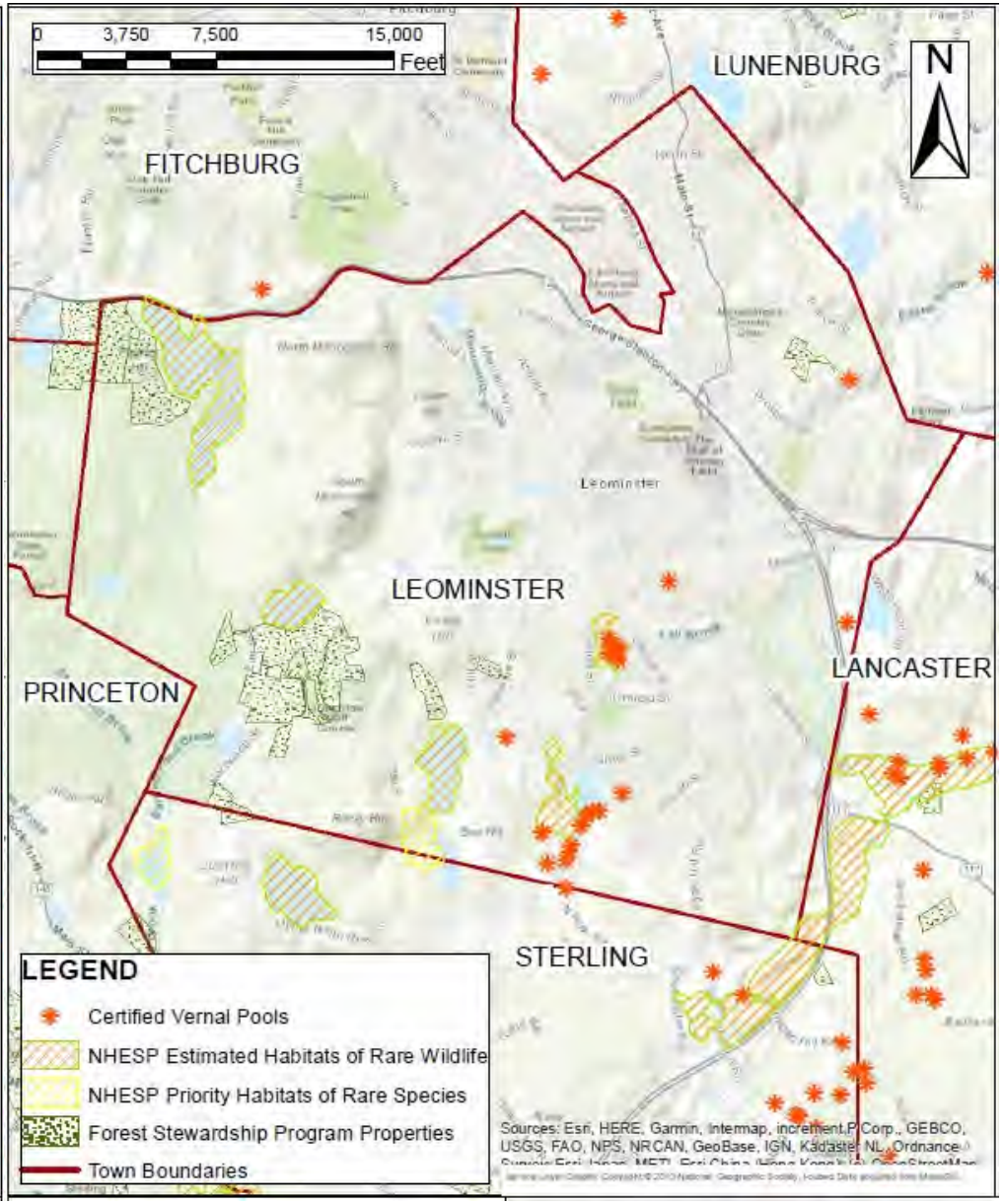


Figure 1-13: Natural Resources/Endangered Species

Cultural and Historic Sites

The Frances H. and Jonathan Drake House, Cluett Peabody & Company, Wachusett Shirt Company, Whitney & Company, and Wellington Piano Case Company Building are listed on the National Register of Historic Places, as shown on **Figure 1-14**. These properties are located at 21 Franklin Street, 123 1st Street, 97-100 Water Street, 142 Water Street, and 54 Green, respectively. Additionally the areas of Monument Square Historic District, which encompasses portions of Main and Water Streets and Grove Ave, Whitney, F.A., Carriage Company Complex Historic District, off of 124 Water Street, and the Pine Grove Cemetery, between Tremain & Main Streets are listed on the National Register of Historic Places.

The shirt industry was a major economy in Leominster in the late 1800s to early 1990s. The Wachusett Shirt Company was a leading employer of the area until it eventually went out of business in the 1930s. Cluett Peabody & Company, another shirt manufacturer, expanded to the Leominster building location in the early 1900s. They were best know for their Arrow brand shirts.

Monument Square Historic District is located within the City's traditional town square. There are several monuments within this space, including a firefighter's memorial, a Native American mortar, a monument marking the town's meeting house from 1775-1824, and veterans' memorials.

Monument Square Historic District, *Photo courtesy of Wikipedia Commons*

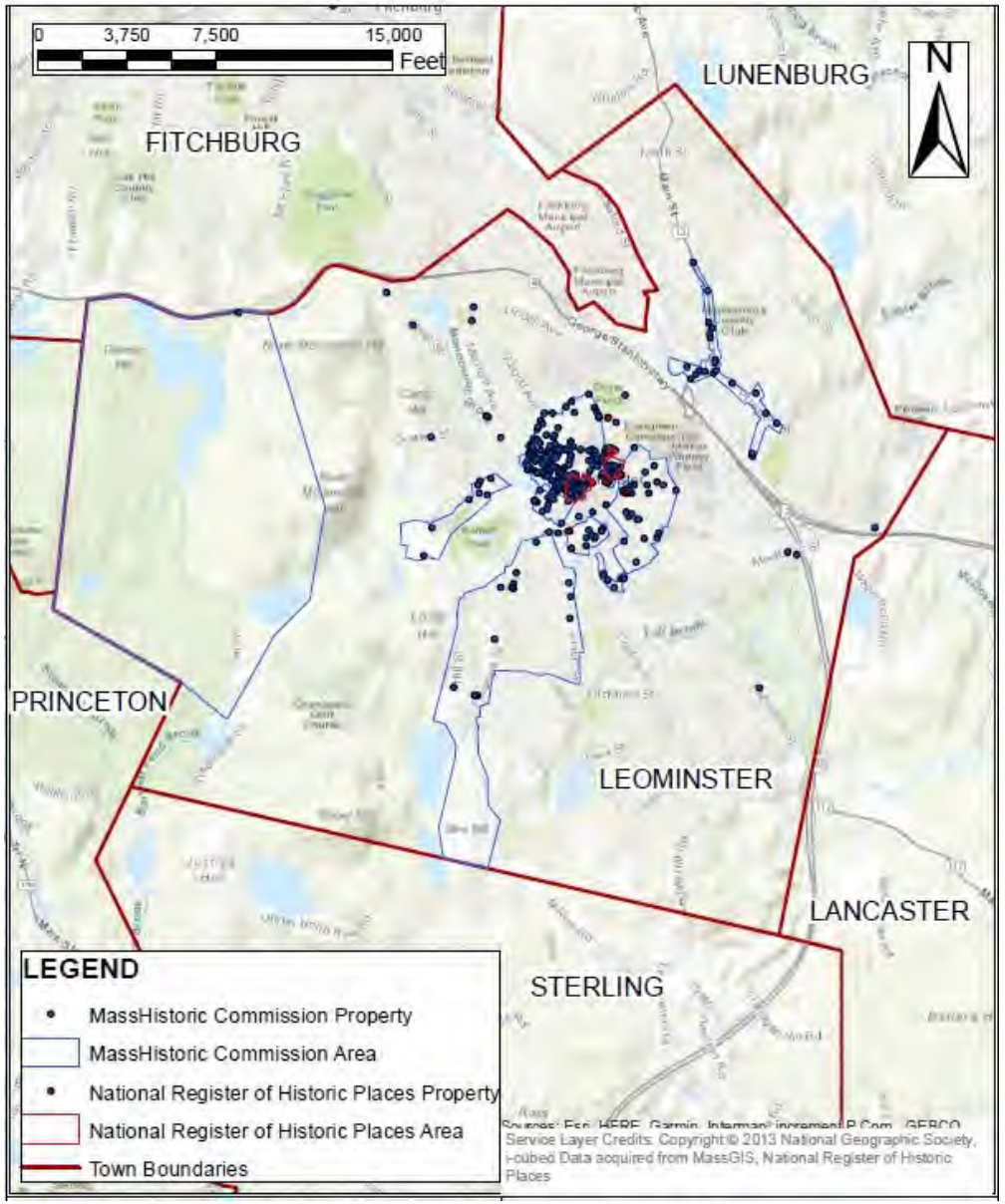


Figure 1-14: Historic Resources

Attachment 2: Natural Hazards

NATURAL HAZARDS OVERVIEW

Natural hazards are **natural events** that threaten lives, property, and other assets. Within Massachusetts, natural hazards typically include:

- Severe Weather Hazards such as Hurricanes and Tropical Storms, Nor'easters, Lightning, Intense Rainfall, Hail, Heavy Snowfall and Ice Storms.
- Climate-Related Hazards such as extreme heat and cold, drought and wildfire.
- Geologic Hazards such as earthquakes, landslides and tsunamis.

Severe weather hazards, including hurricanes, tropical storms and nor'easters can result in high winds and flooding. These floods will become worse in the future due to climate-related changes to storm frequency and intensity. Flooding can result in the secondary hazards of erosion and scour, leading to bridge or culvert failure. Severe weather hazards can also result in high winds, lightning, hail, intense rainfall and tornadoes.

Localized intense rainfall can result in urban flooding where existing stormwater management capacity is exceeded. It can also result in flash flooding of streams and rivers.

Hazard Probability

Natural hazards can often be predicted, including estimating their likelihood of occurrence. The probability of a specific natural hazard occurring is typically defined in terms of its annual exceedance probability (AEP). This refers to the probability that a hazard condition will be met or exceeded in any given year. In lieu of the AEP, the term recurrence interval (in years) is often used.

Climate Change

Climate change is likely to significantly influence certain natural hazards. Storm intensity may increase, resulting in increased flood elevations. There is high scientific confidence that climate change will result in increased rainfall intensity within Massachusetts as well as increased frequency of extreme rainfall events. There is also scientific consensus that climate change will result in extended periods of extreme heat (heat waves).

LEOMINSTER NATURAL HAZARDS

GZA performed an analysis of multiple natural hazards and identified those hazards that are relevant to the City of Leominster. These are presented in **Table 2-1**. These hazards are characterized in detail in the following pages.

Severe Weather Hazards:
Severe Wind:
Hurricanes/Tropical Storms
Thunderstorms
Tornadoes
Lightning
Intense Rainfall
Hail
Flood:
Riverine/Overbank Flooding
Dam Failure/Beaver Dams
Poor Drainage Flooding
Severe Winter Weather:
Snowfall
Ice Storms
Climate-Related Hazards:
Extreme Temperature:
Extreme Heat
Extreme Cold
Drought
Wildfire
Geologic Hazards:
Earthquake

Table 2-1: Natural Hazards applicable to Leominster

Severe Weather Hazards: Severe Wind

SEVERE WIND 

Severe wind (including high to extreme wind) will typically occur in the City as a result of: 1) tropical storms and hurricanes; 2) extratropical nor'easters; 3) severe thunderstorms; and 4) tornadoes. Severe thunderstorms and tornadoes are convective weather events. Extreme "straight line" convective wind events include microbursts, macrobursts and derechos. Derechos are widespread, long-lived, and violent convectively-induced "straight-line" windstorms associated with a fast moving band of severe thunderstorms,. "Thunderstorm winds", arising from convection are winds with speeds greater than 58 mph or winds of any speed producing, damage, injury or fatality.

Severe wind poses a threat to life, building structures, and essential facilities (e.g., electrical utilities) due to the effects of wind loads, flying debris, and/or downed trees and power lines. Severe wind will typically cause the greatest damage to lightly-constructed structures, in particular manufactured homes. Downed tree limbs can also cause property and vehicle damage, impact roadways, and in rare instances, cause loss of life. These storms may be accompanied by lightning, which can spark fires. During hurricanes and tropical storms, high winds can also occur coincident with intense rainfall and during nor'easters, high winds can occur coincident with snow (blizzards), rain and a snow/rain mix.

Wind speeds are categorized by the National Weather Service (NWS) based on potential for structure damage and public health risk, with a distinction between sustained (1-minute duration) wind speeds and gust (3 second duration) wind speeds:

- Wind Advisory: 1) sustained winds of 31 to 39 mph for an hour or more; and/or 2) wind gusts of 46 to 57 mph for any duration.
- High Wind Watch/Warning: 1) sustained winds of 40 mph for one hour or more; or 2) wind gusts of 58 mph or higher for any duration.
- Hurricane Warning: sustained winds of 74 mph or higher or frequent (for more than 2 hours) gusts of 74 mph or greater associated with a tropical cyclone.
- Extreme Wind: 1) surface winds of 115 mph or greater associated with a derecho or sustained hurricane winds.
- Severe Thunderstorm Watch/Warning: winds of 58 mph or higher and/or hail 1-inch in diameter or larger.

The 9th edition of the Massachusetts State Building Code (using ASCE 7-10) utilizes wind gusts as the basis for structure design (**Table 2-2**).

Design Wind Speeds for Buildings and Other Structures

The 9th edition of the Massachusetts State Building Code wind speed design requirements (in terms of 3-second gust) are:

- Risk Category I: 126 mph - 300 year recurrence interval;
- Risk Category II: 136 mph - 700 year recurrence interval; and

Mean Recurrence Interval (yrs)	3-second Gust (mph)
10	80
25	91
50	100
100	110
300	126
700	136
1,700	147

Table 2-2: ASCE 7-10 Wind speed Mean Recurrence Intervals (3-second peak gust in mph)

- Risk Categories III-IV: 147 mph - 1,700 year recurrence interval.

Historical Occurrence at Leominster and Vicinity

During 1996 through 2021, Worcester County experienced 54 days of High Wind events with estimated gusts of about 40 to 75 mph resulting in 4 injuries, 1 death, and about $1.288M in property damage. Between 1950 and 2021, Worcester County had 223 days with Thunderstorm (convective) winds resulting in 4 deaths, 68 injuries and $14.39M damage. (Source: NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/)

Estimated Probability of Occurrence at and near Leominster

The results indicate the following High Winds probability at and near Leominster:

- High Winds within Worcester County: 85% AEP or minimum of 1-year to 2-year recurrence interval (22 years with 1 or more events over 26 years)

Climate Change Effects and Severe Wind Occurrence

The attribution of high wind events to climate change is uncertain. There is moderate scientific confidence, that the intensity and frequency of intense hurricanes could increase within southern New England due primarily to the increase in sea water temperature along the East Coast. There is lower confidence, and less understanding, in the attribution of increased extratropical nor'easters and thunderstorms frequency and intensity to climate change.

HURRICANES

Hurricanes, tropical storms and tropical depressions are tropical cyclones - rotating low pressure weather systems that have organized thunderstorms but no pressure fronts (a boundary separating two air masses of different densities). Tropical cyclones with maximum sustained surface winds of less than 39 miles per hour (mph) are called tropical depressions. Those with maximum sustained winds between 39 mph and 73 mph are tropical storms. Hurricanes are tropical cyclones with sustained wind speeds of 74 mph or higher.

East Coast hurricanes originate in the Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. A six-year rotating list of names, updated and maintained by the World Meteorological Organization, is used to identify these storms. "Hurricane Season" begins on June 1 and ends on November 30, although hurricanes can, and have, occurred outside of this time frame (NOAA National Ocean Service).

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating, or category (as shown in the table on p. 2-6), based on a hurricane's maximum sustained winds. The higher the category, the greater the hurricane's potential for property damage (NOAA National Ocean Service). A major hurricane (Categories 3, 4 and 5) has sustained wind speeds of 111 mph or higher on the Saffir-Simpson Hurricane Wind Scale.

Historic hurricane and tropical storm tracks which have passed within 100 nautical miles of Leominster are presented in **Figures 2-1**. Historic hurricane tracks which have passed within 100 nautical miles of Leominster are presented in **Figure 2-2**. The unnamed tropical storm of 1894 was a Tropical Storm with wind speeds of about 50 to 65 mph as it tracked through Massachusetts. Hurricane Carol in 1954 also tracked very closely to Leominster and caused notable damage with wind speeds of about 90-115 mph. Damages left most of eastern Massachusetts without power, thousands of homes were damaged, and there were at least 15 deaths reported in the state. 18 hurricanes or tropical storms have tracked within 100 nautical miles of Leominster, including the following with more notable intensity:

Gloria, 1995; Cat 4 at landfall	Donna, 1960; Cat 4 at landfall
Unnamed, 1945: Cat 4 at landfall	Bob, 1991; Cat 3 at landfall
Carol, 1954; Cat 3 at landfall	Unnamed, 1876 and 1894; Cat 3 at landfall

Table 2-3: Notable hurricane tracks within 100 miles of Leominster

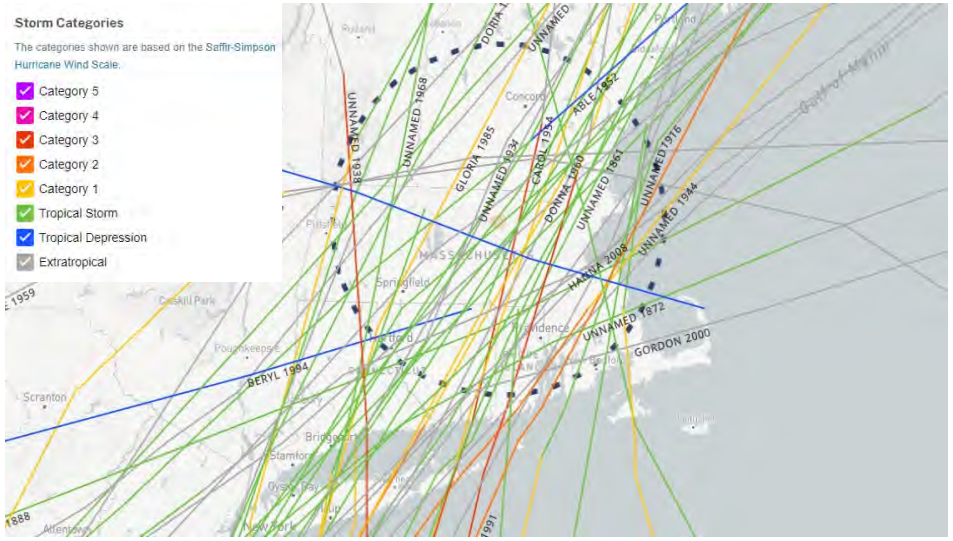


Figure 2-1: Hurricanes and Tropical Storms within 100 nautical miles of Leominster (Source: NOAA Historical Hurricane Tracks mapping tool https://oceanservice.noaa.gov/news/historical-hurricanes/)

Figure 2-2: Hurricanes within 100 nautical miles of Leominster

Hurricane recurrence intervals reflect the frequency at which hurricanes can be expected to occur within a given distance of a given location. The total number of "major" hurricane strikes along the southern New England coastline between 1900 and 2010 is 2 to 3 (**Figure 2-3**). **Figures 2-4 and 2-5** shows hurricane recurrence intervals (aka return periods) for hurricanes passing within 50 miles of various locations. In the vicinity of Leominster, the hurricane passing recurrence interval is about 17 years. In simpler terms, this means that a hurricane is likely to pass near Leominster, on average, about 6 times per 100 years. In the vicinity of Leominster, the recurrence interval for major hurricanes striking or passing near (Cat 3 and above) is about 50 to 60 years. **Figure 2-6** shows the zones of origin and tracks for different months during the hurricane season. These figures depict average conditions. Hurricanes can originate in different locations and travel much different paths from the average. Regardless, they provide a good sense of the general pattern of hurricane tracks. The likelihood of a hurricane tracking near Leominster is much greater during the months of August through October.

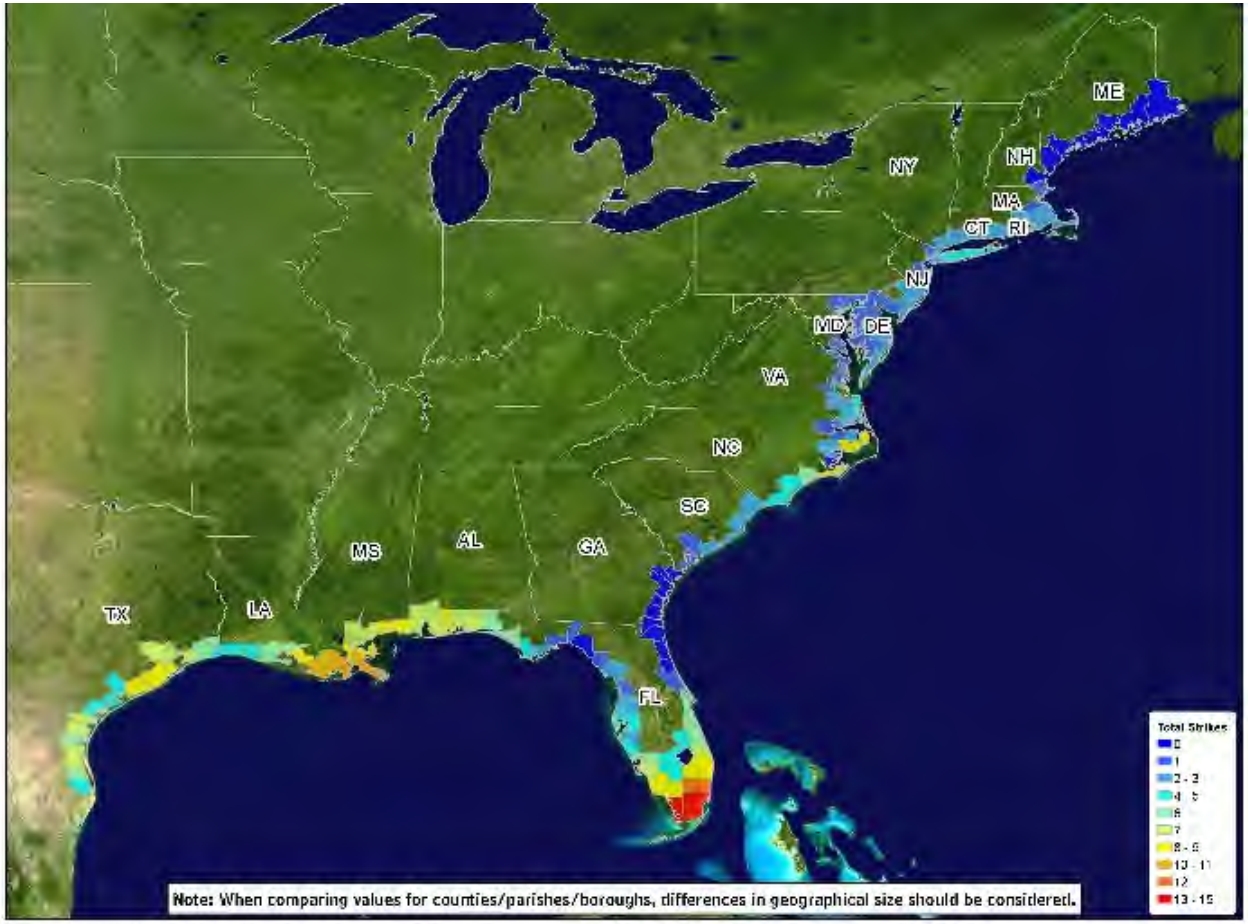
Historical Occurrence at Leominster and Vicinity

The recurrence interval of a hurricane passing in the vicinity of Leominster is about 17 years, for hurricanes that might strike between New Jersey and Massachusetts, based on Figure 2-5. In the vicinity of Leominster, the recurrence interval for major hurricanes (Cat 3 and above) is about 50 to 60 years, for hurricanes that might strike between New Jersey and Massachusetts, based on Figure 2-5.

Estimated Probability of Occurrence at and near Leominster

The results indicate the following hurricane strike probability at and near Leominster:

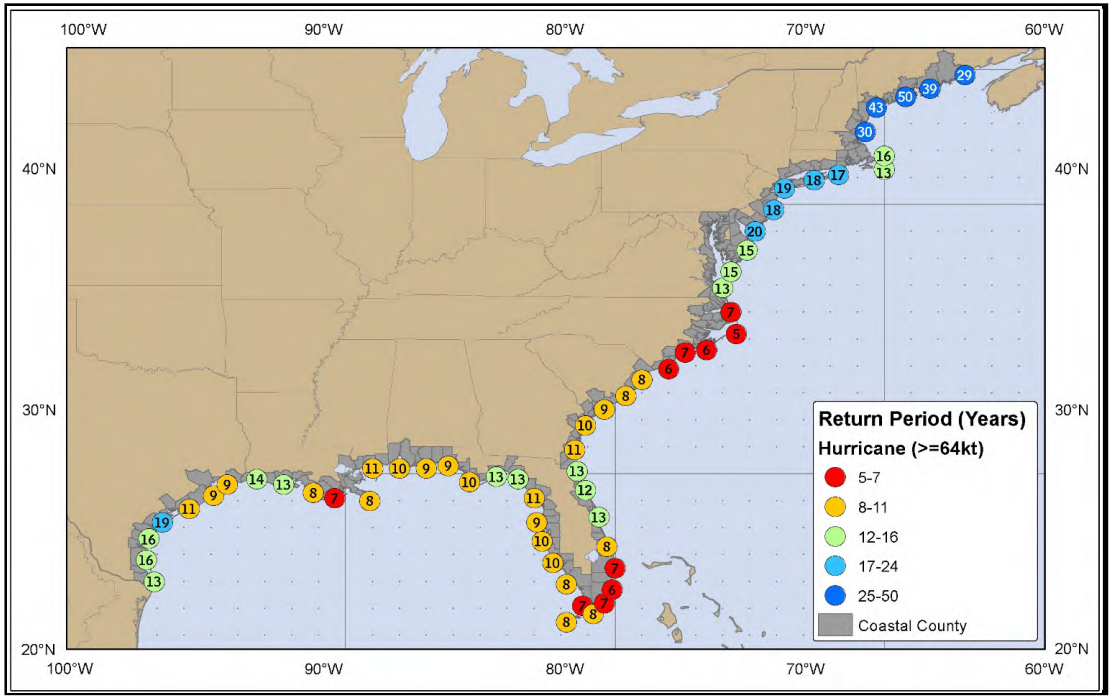
- All Hurricanes: 6% AEP or 17-year recurrence interval
- Major (≥ Cat 3) Hurricanes: 1.6% or 60-year recurrence period

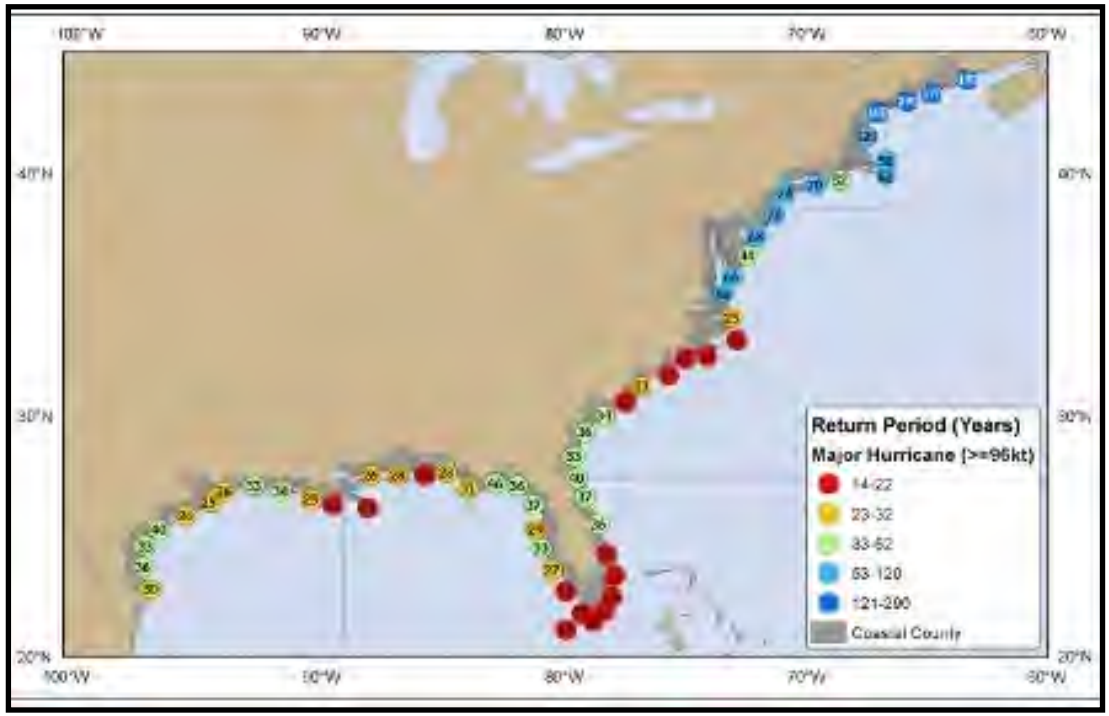


Total number of major hurricane strikes by counties/parishes/boroughs, 1900-2010

Figure 2-3: Hurricane Strikes (source - NOAA)

Saffir-Simpson Hurricane Scale		
Category	Wind Speed	
	mph	knots
5	≥156	≥135
4	131-155	114-134
3	111-130	96-113
2	96-110	84-95
1	74-95	65-83





Figures 2-4 and 2-5: Hurricane Recurrence Interval (all hurricanes - top and major hurricanes - bottom)
(Source: https://www.nhc.noaa.gov/climo/#bac)

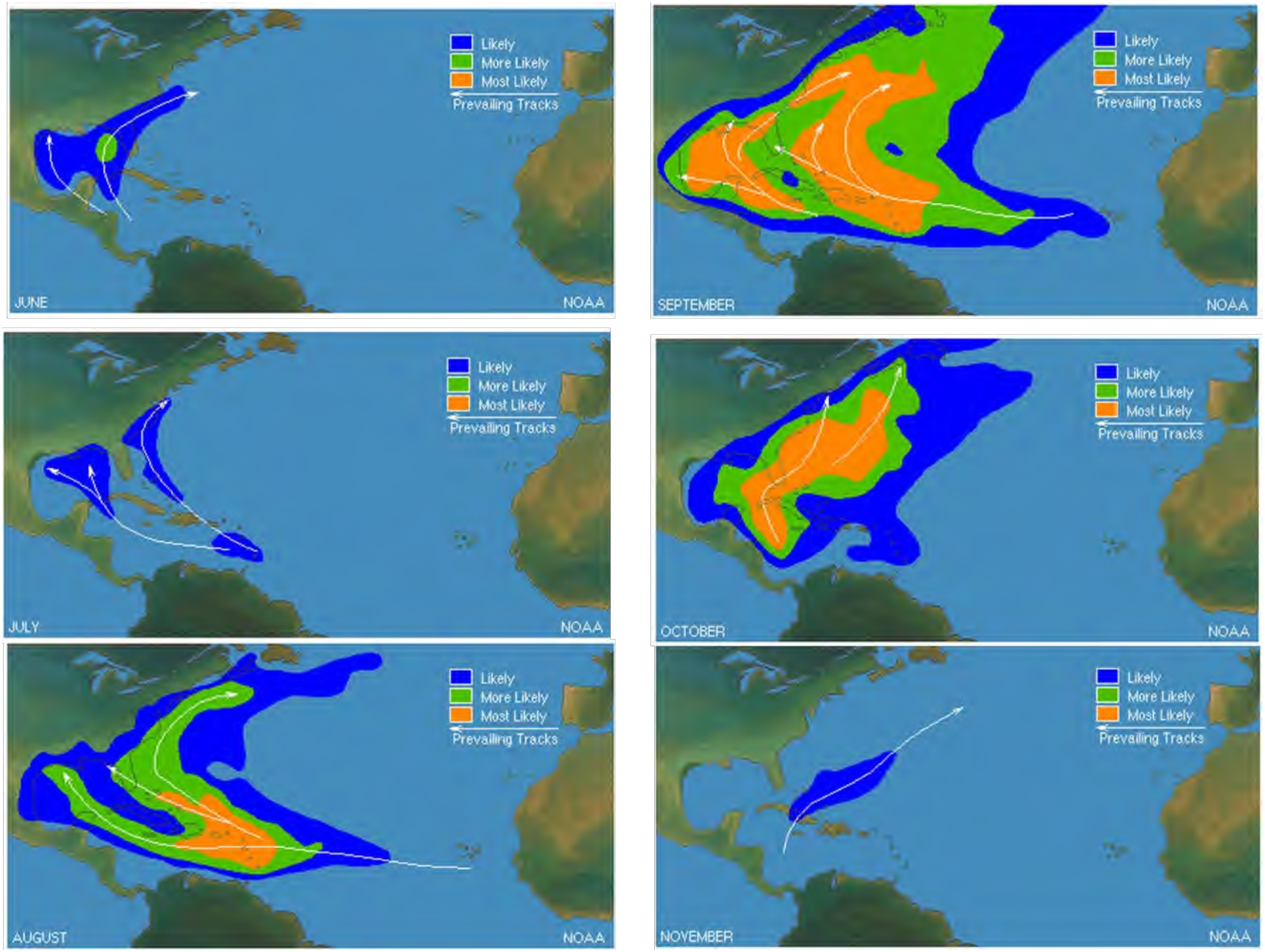


Figure 2-6: Hurricane Origin and Track Probability by Month

THUNDERSTORMS

A thunderstorm is characterized by lightning and thunder and usually produces gusty winds, heavy rain, and sometimes hail. Cumulonimbus clouds produce lightning, which locally heats the air to 50,000 degrees Celsius, which in turn produces an audible shock wave, known as thunder. Tornadoes can also be generated during these events. Three basic ingredients are required for a thunderstorm to form: moisture, rising unstable air (air that keeps rising when given a nudge), and a lifting mechanism. Every thunderstorm has an updraft (rising air) and a downdraft (sinking air). Sometimes strong downdrafts known as downbursts can cause tremendous wind damage, similar to that of a tornado. A small (< 2.5-mile path) downburst is known as a "microburst" and a larger downburst is called a "macroburst."

The peak season for severe thunderstorms in the Northeast U.S. is June through August, although thunderstorms also occur in the Spring and Fall, and thunder can occur during winter snow storms. Hazards from thunderstorms include high to extreme winds, lightning, torrential downpours, and hail. Thunderstorms can spawn tornadoes and cause flash floods, downed trees and power lines, power outages, and mudslides. Roads may become impassable due to flooding, downed trees, or a landslide. Power lines may be downed due to high winds, and services such as water or phone may not be able to operate without power. Lightning can cause severe damage and injury. Fatalities are uncommon, but can occur.

Lightning strikes primarily occur during the summer months. There were 10 lightning deaths in the U.S. in 2021, none of which occurred in Massachusetts (https://www.weather.gov/safety/lightning-fatalities).

Figure 2-7 shows the average number of thunderstorm days throughout the U.S. Massachusetts, including Worcester County, experiences between 20 and 30 thunderstorm days each year.

An average thunderstorm is 15 miles across and lasts 30 minutes; severe thunderstorms can be much larger and longer. According to the National Weather Service:

- a severe thunderstorm is a thunderstorm that produces a tornado, winds of at least 58 mph (50 knots or ~93 km/h), and/or hail at least 1" in diameter; and
- An approaching severe thunderstorm is a thunderstorm with winds equal to or greater than 40 mph (35 knots or ~64 km/h) and/or hail of at least ½"

Observed structural wind damage may imply the occurrence of a severe thunderstorm. Hail of 1" or greater can damage property such as plants, roofs and vehicles. http://www.weather.gov/bgm/severedefinitions

Derechos: Based on climatology, Massachusetts is located in a zone where derechos are predicted to occur about 1 every four years (typically during April to August).

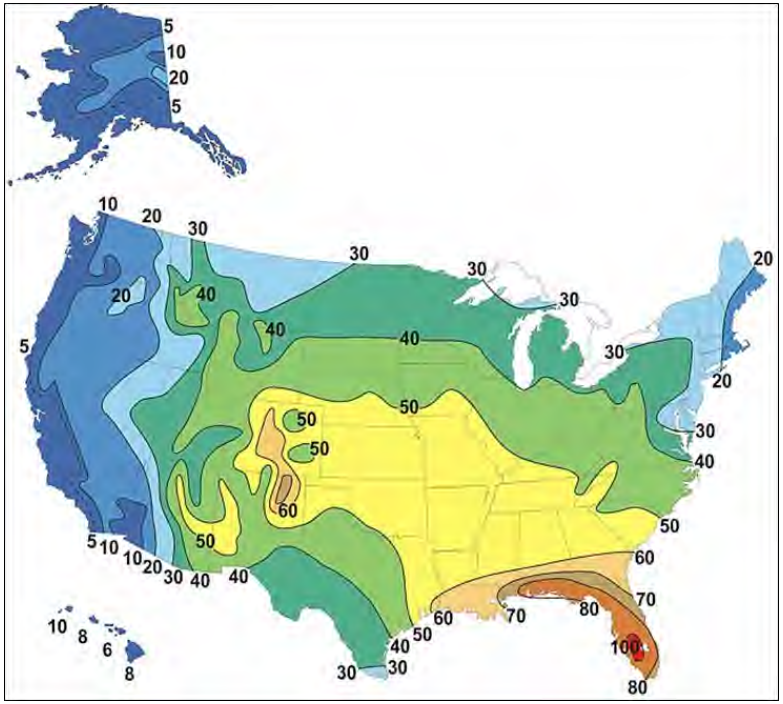


Figure 2-7: Average Annual Number of Thunderstorms in U.S.
(Source: http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.html)

Historical Occurrence at Leominster and Vicinity

Between 1950 and 2021, Worcester County had 223 days with Thunderstorm (convective) winds resulting in 4 deaths, 8 injuries and $14.39M damage.

132 of these events resulted in damage and 7 events resulted in death or injury. Of these, 10 thunderstorm events impacted the City of Leominster, in May 1998, June 2000, July 2004, August 2004, June 2005, July 2005, July 2007, August 2007, May 2010, and October 2013. None of these storms resulted in injuries or deaths, but there was $70,000 of damage. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/ For this database, thunderstorm winds are defined as speeds of at least 58 mph or of any speed producing a fatality, injury or damage.

Estimated Probability of Occurrence at and near Leominster

The results indicate the following thunderstorm wind probability at and near Leominster (within Worcester County):

- Thunderstorm Winds within Worcester County: 77% AEP or minimum of 1-year to 2-year recurrence interval (51 years with 1 or more events over 66 years)

TORNADOES

A tornado is a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. The destruction caused by tornadoes ranges from light to catastrophic depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings and particularly manufactured homes. Tornadoes are more likely to occur during the months of March through May and tend to form in the late afternoon and early evening.

Since 2007, tornadoes have been categorized according to the Enhanced Fujita scale:

Scale	Wind speed estimate		Potential damage
	mph	km/h	
EF0	65–85	105–137	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86–110	138–177	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111–135	178–217	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136–165	218–266	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations are badly damaged.
EF4	166–200	267–322	Devastating damage. Well-constructed and whole frame houses completely leveled; cars and other large objects thrown and small missiles generated.
EF5	>200	>322	Incredible damage. Strong-framed, well-built houses leveled off foundations are swept away; steel-reinforced concrete structures are critically damaged; tall buildings collapse or have severe structural deformations; some cars, trucks, and train cars can be thrown approximately 1 mile (1.6 km).

Table 2-4: Enhance Fujita Scale for Tornadoes

Prior to 2007, tornadoes were categorized according to the Fujita Tornado Intensity Scale:

Scale	Wind Speed Estimate (mph)	Potential Damage
Category F0:	Gale tornado (40-72 mph)	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
Category F1	Moderate tornado (73-112 mph)	Moderate damage. The lower limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads.
Category F2	Significant tornado (113-157 mph)	Considerable damage. roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
Category F3	Severe tornado (158-206 mph)	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.
Category F4	Devastating tornado (207-260 mph)	Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
Category F5	Incredible tornado (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile sized missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

Table 2-5: Original Fujita Tornado Intensity Scale

Tornadoes can also occur anywhere in Massachusetts, although relatively infrequently. Between 1950 and 2021, there were 190 tornado events within Massachusetts including 114 days with damage, 24 days with injury or death and 8 days with deaths, resulting in $544M damages. The data for this period for the State is presented below:

Magnitude	No of Days with Event	No. of Injuries	No. of Deaths	Property Damage
F0/EF0	38	6	1	$500,300
F1/EF1	62	38	1	$16,692,000
F2/EF2	27	9	2	$16,043,000
F3/EF3	5	221	4	$235,900,000
F4/E4	3	1288	97	$275,000,000

Magnitude	Avg. No of Events/year	Avg. No. of Injuries/Event	Avg. No. of Deaths/Event	Avg. Property Damage/ Event
All	1.87	11.6	0.78	$4,030,631
F0/EF0	0.53	0.16	0.026	$13,165
F1/EF1	0.86	0.61	0.016	$269,226
F2/EF2	0.4	0.3	0.07	$594,185
F3/EF3	0.07	44.2	0.8	$47,180,000
F4/E4	0.04	429.3	32.3	$91,666,667

Table 2-6: Massachusetts Tornado Data for the period of 1950 to 2021

Tornado risk is calculated from the destruction path that has occurred within 30 miles of the location. Details for tornadoes of magnitude F2 or more severe in Worcester County are presented in **Table 2-6.** Over half of he tornadoes were generally weak (F0 or F1). The 1953, 1972, 1979, and 1981 tornadoes, however, were severe and of relatively long duration, and had injuries or deaths occur. A total of 35 days with tornadoes were reported in Worcester County for the period of record between 1950 and 2021, according to the NOAA Storm Events Database. **Figure 2-8** shows the start and end points and tracks of the Worcester County tornadoes in the vicinity of Leominster. These tornadoes ranged in severity from F0 to F4, with more recent tornadoes rated under the EF scale at EF0 to EF3. These tornadoes occurred between the months of May and November.

Date	Location	Fujita	Fatalities	Injuries	Damages ($)
6/9/1953	Worcester County, Massachusetts	F4	90	1228	250.000M
6/9/1953	Worcester County, Massachusetts	F3	0	1	2.500M
11/21/1956	Worcester County, Massachusetts	F2	0	0	2.500M
7/5/1957	Worcester County, Massachusetts	F2	0	0	2.50K
10/12/1962	Worcester County, Massachusetts	F2	0	0	25.00K
5/20/1963	Worcester County, Massachusetts	F2	0	0	25.00K
5/20/1963	Worcester County, Massachusetts	F2	0	0	25.00K
5/20/1963	Worcester County, Massachusetts	F2	0	0	2.50K
8/31/1966	Worcester County, Massachusetts	F2	0	0	0.00K
10/3/1970	Worcester County, Massachusetts	F3	0	0	250.00K
8/9/1972	Worcester County, Massachusetts	F2	0	1	25.00K
8/10/1979	Worcester County, Massachusetts	F2	2	2	2.500M
6/22/1981	Worcester County, Massachusetts	F3	0	3	25.00K
6/1/2011	Worcester County, Massachusetts	EF3	0	0	0.00K

Table 2-7: Worcester County, Massachusetts Tornado Data (F2 or more severe) for the period of 1950 to 2021

Historical Occurrence at Leominster and Vicinity

Of the 47 tornadoes in Worcester County, the tornadoes during June, 1953 and August, 1979 resulted in the largest degree of damages at $250 Million and $2.5 Million, respectively. The June 1953 (F4) tornado resulted in 90 deaths and 1228 injuries. The F2 tornado in August, 1979 resulted in 2 deaths and 2 injuries. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Leominster

The results indicate the following tornado probability at and near Leominster (within Worcester County):

- Tornadoes within Worcester County: 39% AEP or 2-year to 3-year recurrence interval (27 years with 1 or more events over 69 years)
- Major tornado (EF4 and larger) within Worcester County: 1% AEP or 69-year recurrence interval

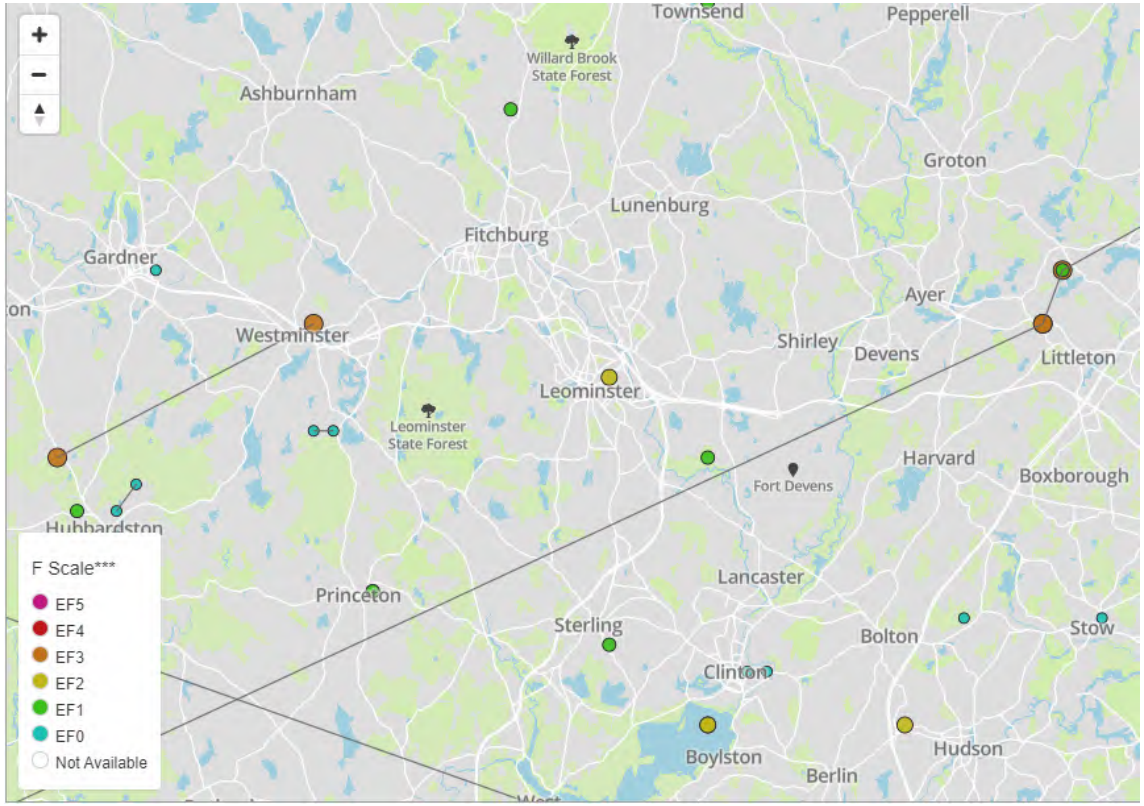


Figure 2-8: Location of Worcester County Tornadoes in the vicinity of Leominster https://data.burlingtonfreepress.com/tornado-archive/massachusetts/

Severe Weather Hazards: Lightning

LIGHTNING

Lightning is the second most common storm-related killer in the United States. It causes several billion dollars in property damage each year and kills several dozen people. It is a frequent cause of wildfires and costs airlines billions of dollars per year in extra operating expenses.

Lightning is a giant spark of electricity in the atmosphere between clouds, the air, or the ground. In the early stages of development, air acts as an insulator between the positive and negative charges in the cloud and between the cloud and the ground. When the opposite charges builds up enough, this insulating capacity of the air breaks down and there is a rapid discharge of electricity that we know as lightning. The flash of lightning temporarily equalizes the charged regions in the atmosphere until the opposite charges build up again. Lightning can occur between opposite charges within the thunderstorm cloud (intra-cloud lightning) or between opposite charges in the cloud and on the ground (cloud-to-ground lightning).

Massachusetts, including Worcester County, has a moderate risk associated with Lightning strikes relative to other states. **Figures 2-9** and **2-10** show the number of fatalities and relative fatality rates by state. In Massachusetts, there have been 6 Lightning fatalities during the period of 2005 and 2014 (an average of less than 1 per year).

Historical Occurrence at Leominster and Vicinity

Since 1996, Worcester County has experienced 67 Lightning events and 57 days with Lightning resulting in about $2.077M in property damage, 29 injuries and no deaths. 3 events were reported within Leominster in July 1999, July 2004, and May 2007.

NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Leominster

The results indicate the following Lightning probability at and near Leominster (within Worcester County):

- Lightning Events resulting in fatality, injury and/or damage within Worcester County: 88% AEP or 1.1-year recurrence interval (23 years with 1 or more events over 26 years)

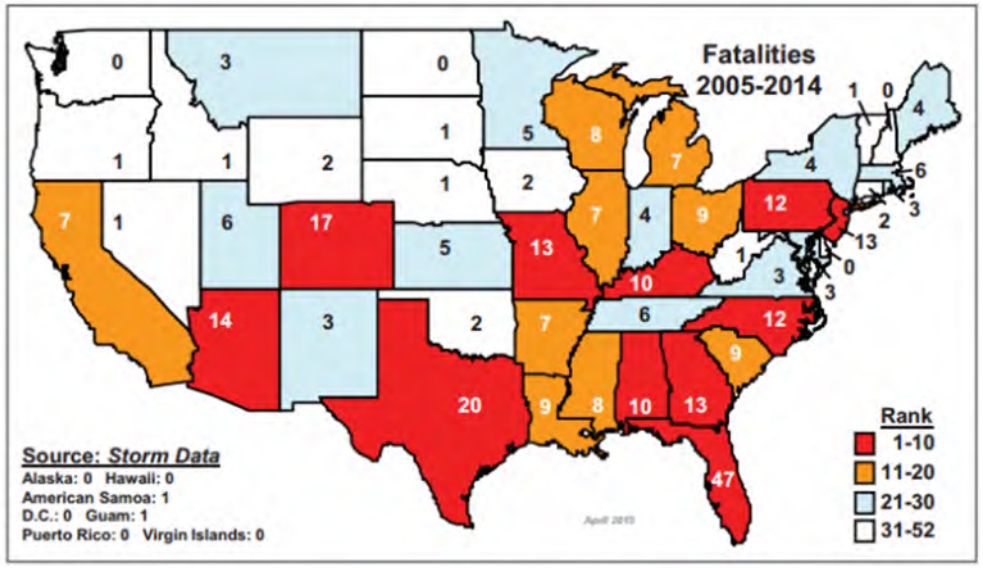


Figure 2-9: Lightning Fatalities by State, 2005-2014; (Source: Vaisala)

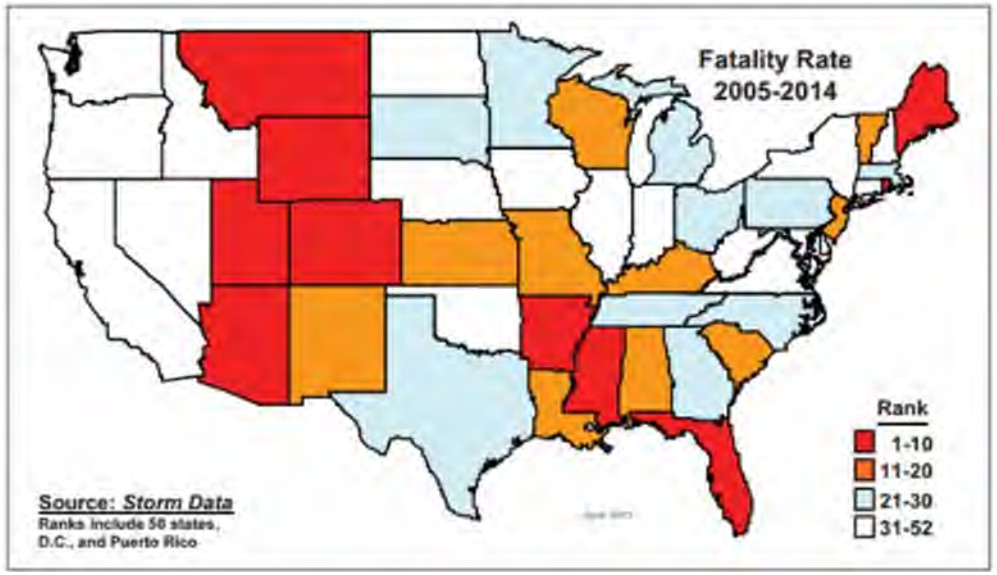


Figure 2-10: Lightning Fatalities Weighted by Population, 2005-2014; (Source: Vaisala)

Severe Weather Hazards: Intense Rainfall

INTENSE RAINFALL

Intense, heavy rainfall can result in localized flooding including flash flood events. Several factors contribute to intense precipitation flooding including rainfall intensity and duration. Other factors include the presence of streams and rivers, soil type, ground cover, drainage and the capacity of stormwater infrastructure. **Table 2-8** presents precipitation projections for Leominster developed by NOAA Atlas 14 Precipitation Frequency Data Server (https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html).

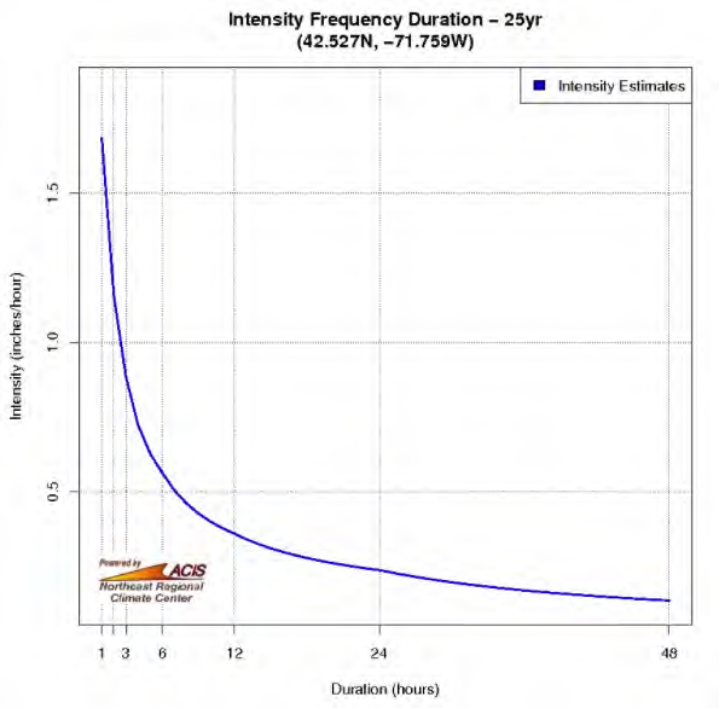


Figure 2-11: Massachusetts Rainfall Intensity-Duration for the 25-year Recurrence Interval Rainfall

PRECIPITATION FREQUENCY ESTIMATES (rainfall in inches)										
by duration for ARI (years):	1	2	5	10	25	50	100	200	500	1000
5-min:	0.335	0.394	0.49	0.57	0.68	0.763	0.849	0.942	1.07	1.17
10-min:	0.475	0.556	0.694	0.807	0.963	1.08	1.2	1.33	1.52	1.66
15-min:	0.559	0.657	0.817	0.95	1.13	1.27	1.42	1.57	1.79	1.96
30-min:	0.744	0.875	1.09	1.27	1.51	1.7	1.89	2.1	2.38	2.61
60-min:	0.929	1.09	1.35	1.58	1.88	2.12	2.35	2.62	2.98	3.26
2-hr:	1.16	1.38	1.76	2.07	2.5	2.82	3.17	3.58	4.2	4.72
3-hr:	1.31	1.59	2.04	2.42	2.93	3.31	3.73	4.24	5.03	5.71
6-hr:	1.67	2.04	2.63	3.12	3.79	4.29	4.83	5.5	6.56	7.47
12-hr:	2.14	2.59	3.33	3.93	4.77	5.39	6.07	6.88	8.13	9.2
24-hr:	2.69	3.33	4.01	4.74	5.75	6.5	7.3	8.26	9.71	10.9
2-day:	2.96	3.56	4.61	5.46	6.64	7.52	8.46	9.58	11.3	12.7
3-day:	3.21	3.89	5	5.92	7.18	8.13	9.15	10.4	12.2	13.7
4-day:	3.45	4.16	5.32	6.29	7.61	8.6	9.66	10.9	12.8	14.4
7-day:	4.11	4.97	6.31	7.45	8.97	9.83	10.8	12.1	14	15.6
10-day:	4.76	5.56	6.88	7.9	9.37	10.5	11.6	12.9	14.8	16.3
20-day:	6.81	7.64	9	10.1	11.7	12.9	14.1	15.3	16.9	18.1
30-day:	8.53	9.39	10.8	12	13.6	14.8	16.1	17.2	18.7	19.7
45-day:	10.7	11.6	13	14.3	16	17.3	18.6	19.7	21	21.8
60-day:	12.4	13.4	14.9	16.2	18	19.4	20.7	21.8	23	23.8

ARI= Annual Recurrence Interval

Table 2-8: Predicted Rainfall Intensity by Duration and Recurrence Interval for Leominster

While there is no specific, single set of criteria that defines "intense rainfall", the rainfall intensities associated with a 25-year recurrence interval are a reasonable benchmark (a 1 in 4 chance of being met or exceeded in any given year). These are presented for Massachusetts including Worcester County in **Figure 2-11** (Ref Northeast Regional Climate Center (NRCC) http://precip.eas.cornell.edu/). This figure indicates short duration intensities on the order of 1.5 to 2 inches per hour and longer duration intensities on the order of an average 0.25 inch per hour over 24 hours (one and two day total rainfall amounts of about 11 and 16 inches, respectively).

Historical Occurrence at Leominster and Vicinity

During the period between 1996 and 2021, Worcester County experienced 25 days with Heavy Rain events, an average of about 1 event every 1.04 years, with no documented property damages, injuries or death. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Leominster

The results indicate the following intense rainfall probability at and near Leominster (within Worcester County):

- Intense Rainfall within Worcester County: 4% AEP or 25-year recurrence

Severe Weather Hazards: Hail

HAIL

Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Hailstorms frequently accompany thunderstorms, so their locations and spatial extents overlap. Large hail (greater than 1 inch in diameter) can be destructive. Hail can cause substantial damage to vehicles, roofs, landscaping, and other areas of the built environment. U.S. agriculture is typically the resource most affected by hail storms, which cause severe crop damage even during minor events. A recent risk, due to the widespread use of solar panels, is hail-related damage to solar panels.

Hail storms are fairly common in Massachusetts, including Leominster. For this period of 1990 to 2021, Massachusetts hail data indicates:

- 1990-2004: 127 days (an average of 8 event per year), with 0 injuries, 0 deaths and $222K property damage (average property damage of $1,800 per event)
- 2005-2009: 78 days (an average of 16 events per year), with 0 injuries, 0 deaths and $269K property damage (average property damage of $3,500 per event)
- 2010-2021: 114 days (an average of 9.5 events per year), with 0 injuries, 0 deaths and $3.035M property damage (average property damage of $26,600 per event)

Per HomeAdvisor.com, the average per building cost, nationally, to repair hail, wind or storm damage is $10,265 ranging from $350 to $55,000.

The Hail Risk Score (**Table 2-9**) provides a short-to-medium term view of future hail risk based on the last 10 years of ultra-high resolution radar data. The score is based on a scale of 1 to 10, with the lowest score of 1 representing Very Low hail risk (damaging hail unlikely in the next 5-10 years) and the highest score of 10 representing Extreme hail risk (damaging hail very likely every year).

The Hail Risk Score for Leominster (reference stormersite.com) is 1.

Hail Risk Score	Hail Risk	Hail Risk Guidance
1	Very low	Damaging Hail unlikely in next 5-10 years
2	Very Low to Low	Damaging Hail likely every 5 years
3	Low	Damaging Hail likely every 2-4 years
4	Low to Moderate	Damaging Hail likely every 2-3 years
5	Moderate	Damaging Hail likely every other year
6	Moderate	Damaging Hail very likely every other year
7	Moderate to High	Damaging Hail likely every 1-2 years
8	High	Damaging Hail very likely every 1-2 years
9	Very High	Damaging Hail likely every year
10	Extreme	Damaging Hail very likely every year

Table 2-9: Hail Risk Score Classifications

Historical Occurrence at Leominster and Vicinity

For the period of 1956 to 2021, there have been 252 hail events in Worcester County including 4 hail days with damage (resulting in $125K property damage; average property damage of about $31,250 per event) and two (2) injuries. Two (2) of these events occurred in Leominster, but there was no property damage or injury. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Leominster

The results indicate the following hail probability at and near Leominster (within Worcester County):

- 70% AEP or 1.4 year recurrence interval (46 years with 1 or more events over 66 years)

Severe Weather Hazards: Flood

FLOOD

A flood is the partial or complete inundation of normally dry land. The various types of flooding include riverine flooding, coastal flooding, and shallow flooding. Common impacts of flooding include damage to personal property, buildings and infrastructure; bridge and road closures; service disruptions; and injuries or even fatalities.

The City is vulnerable to:

- **Riverine flooding**. There are many inland wetlands and streams within Leominster. The Nashua River, Fall Brook, Monoosnoc Brook, and Reservoir Brook have a FEMA-mapped floodplain of Zone A (1% annual chance of flooding).
- **Rainfall events.** Inland (poor drainage) flooding associated with large rainfall events, in particular within areas with impervious surfaces, poor drainage and inadequate stormwater management.
- **Beaver dams**. Many localized flooding issues are associated with beaver dams blocking culverts. There is a risk of flooding that could be caused by the failure of beaver dams, causing ponded water to flood downstream areas.

The City is not vulnerable to other types of flooding including:

- **Coastal Flooding.** Leominster is not located near the coast.

Riverine Flooding

Riverine flooding includes flooding caused by river flows which overtop the riverbanks and spread into the surrounding floodplain or other low-lying areas. Flooding is often caused by heavy rains resulting from thunderstorms, nor'easters, tropical storms, and hurricanes. In addition, the spring rainy season is a particularly hazardous time, as runoff from winter snowfalls can saturate wetlands and fill the streams and brooks. A heavy or severe rain event at this time of year can often overwhelm natural flood storage areas and create flood hazards on streets and around residential areas.

The second most costly flood in Worcester County occurred in Leominster during March of 2010 when a stacked low pressure system moved southeast of Nantucket, spreading rain across Southern New England. This resulted in rainfall totals on the order of three to six inches across Worcester County. This resulted in the flooding of the Nashua River along with several smaller brooks and streams overflowing their banks, which led to basements, parking lots, and yards flooding in Leominster, Clinton, and Westminster. Two vehicles were submerged in Leominster when the Monoosnoc Brook overflowed its banks. The combined damages of the flooding totaled $2.7M. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/.

FEMA Flood Hazard Determination

Through FEMA's flood hazard mapping program, Risk Mapping, Assessment and Planning (MAP), FEMA identifies flood hazards, assesses flood risks and partners with states and communities to provide accurate flood hazard and risk data to guide them to mitigation actions. Flood hazard mapping is an important part of the National Flood Insurance Program (NFIP), as it is the basis of the NFIP regulations and flood insurance requirements. FEMA maintains and updates data through Flood Insurance Rate Maps (FIRMs) and risk assessments. In Leominster, the Flood Insurance Study (FIS) for the City was last revised in 1989. There is a preliminary FIS for Worcester County that was last revised in 2021, along with preliminary FIRMs. The Special Flood Hazard Areas (shaded areas) shown on the FIRM are designated Zone A and all other (unshaded) areas are designated Zone X. Zone A is the flood having a one percent chance of being equaled or exceeded in any given year. This is the regulatory standard also referred to as the "100-year flood". These areas within Leominster are associated with the Nashua River, Fall Brook, Monoosnoc Brook, and Reservoir Brook. The Zone A areas in Leominster have Base Flood Elevations (BFEs) of 462 ft, NAVD88 on the Monoosnoc Brook, downstream of Pierce Pond, 300.8 ft, NAVD88 on the Nashua River, near the Interstate 190– Route 2 Interchange, and 353 ft, NAVD88 on Fall Brook, just upstream of its confluence with Reservoir Brook.

Historical Occurrence at Leominster and Vicinity

For the period of 1996 to 2021, there have been 71 days with flood events in Worcester County, including 42 days with property damage (resulting in $11.441M of damage), no injuries and no deaths. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/ .

Estimated Probability of Occurrence at and near Leominster

The results indicate the following flood probability at and near Leominster (within Berkshire County):

- 85% AEP or 1.2 year recurrence interval (22 years with 1 or more events over 26 years)

Climate Change Effects and Riverine Flood Occurrence

There is high confidence, within the scientific community, that the frequency and severity of riverine flooding will increase within southern New England due primarily to the increase in precipitation frequency and intensity.

Intense Rainfall and Poor Drainage Flooding

Intense, heavy rainfall can result in localized flooding including flash flood events. Risks due to intense rainfall are predominantly associated with flash flooding and are typically related to the capacity of the existing stormwater infrastructure to manage stormwater run-off. High velocity stormwater flow can also occur during these events. Damages can include localized flooding, damage to property and vehicles and potentially safety risk to the public.

Historical Occurrence at Leominster and Vicinity

- During the period between 1996 and 2021, Worcester County experienced 25 days with Heavy Rain events, an average of about 1 event day per year, with no documented property damages, injuries or death. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/
- During the period between 1996 and 2021, Worcester County experienced 35 days with Flash Flood events, an average of about 1.3 event days per year. 19 event days included property damage at a total cost of $1.456M. There were no injuries or death. There were four (4) Flash Flood events were reported in Leominster, resulting in $85k in property damage. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Leominster

The results indicate the following flash flooding probability at and near Leominster (within Worcester County):

- Flash Flooding due to Intense Rainfall within Worcester County: 77% AEP or 1.3-year recurrence interval (20 years with 1 or more events over 26 years)

Effects of Climate Change

The attribution of rainfall intensity and frequency has high confidence. Average annual precipitation in the Northeast increased 10 percent from 1895 to 2011, and precipitation from extremely heavy storms has increased 70 percent since 1958. During this century, average annual precipitation and the frequency of heavy downpours are likely to keep rising. Average precipitation is likely to increase during winter and spring, but not change significantly during summer and fall.

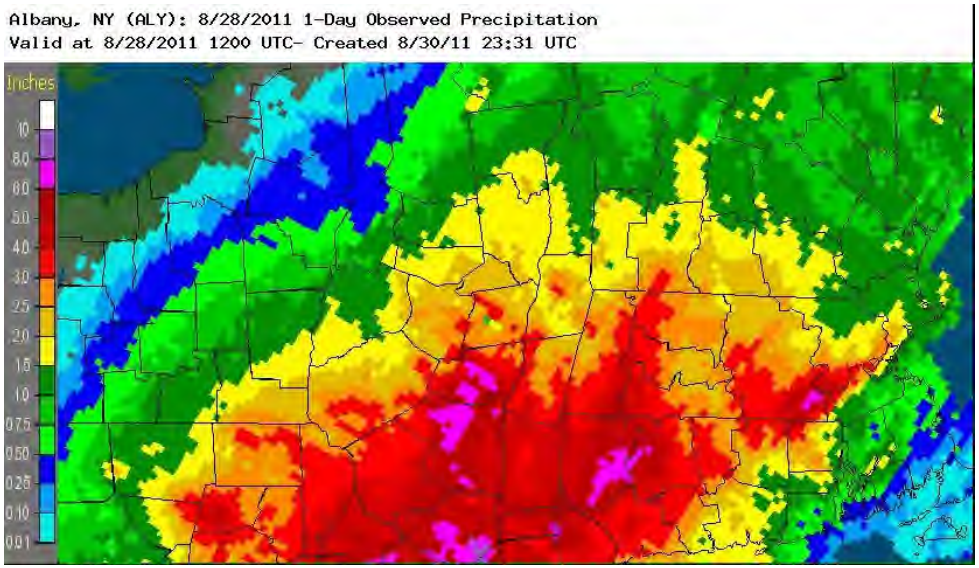


Figure 2-12: August 28, 2011 (Tropical Storm Irene) 1-Day Total Rainfall (weather.gov)

Beaver Dam Related Flooding

From the Montachusett Region Natural Hazard Mitigation Plan 2015 Update:

In all of the communities of the Montachusett Region beavers have been a concern. It takes a great deal of time and expense to control their activities. During most of the Hazard Identification meetings, time was spent on beaver related issues. These hazards of course relate directly to other hazards such as rain storms, hurricanes, floods, and winter related storms.

The beaver is a valuable component of Massachusetts' fauna. Beavers have played an active role in New England's ecology for thousands of years. Beavers are natural "engineers" of the land, they are agents of change, creating wetlands out of uplands and streams, and providing habitat for a variety of plants and animals. However, not long ago the beaver was absent from the Montachusett Region. In fact, it was absent from the late 1700s to the early 1900s. Intensive unregulated hunting and trapping, combined with deforestation to clear land for agriculture, led to the disappearance of beaver habitat and the beaver. In the early 1900's, forested habitat started to recover when many farmers abandoned their farms in order to take jobs in cities or to start new farms in the more fertile Midwestern United States. With the forests able to retake the landscape, the beaver was able to return and an important component of the Montachusett Region's native ecosystems was restored. However, beavers returned to a landscape that had been substantially altered by people.

When beavers in the Montachusett Region build their dams in areas where there is increased residential development, roads and agricultural use of the land, the flooding that results can cause serious public and private property damage, often threatening homes, septic systems, low-lying roadways, and other public infrastructure. It was stated at all of the Montachusett Region individual Hazard and Vulnerability Sessions that beavers continue to pose a significant problem. The state and local governments have responded to this crisis with a complex regulatory process. The process places its highest priority on protecting in-ground septic systems and road networks. Most of the regulatory process has been developed to respond to threats to the public health and safety.

Beaver activity will most certainly continue to persist throughout the Montachusett Region, as the factors that have allowed them to expand their range (increase in suitable habitat, wetland protection, and a decrease in hunting and trapping) are expected to remain constant over the next decade. Probability of future events falls under the definition of probability as Highly Likely.

Historical Occurrence at Leominster and Vicinity

The Montachusett Region Natural Hazard Mitigation Plan 2015 Update noted several locations within Leominster impacted by beavers, as follows:

- Public Water Supplies: beaver activity is present at each of the public water supplies in the city: Fall Brook Reservoir, Simonds Pond Reservoir, Distributing Reservoir, Notown Reservoir, Goodfellow Pond, Haynes Reservoir, Morse Reservoir, and Rocky Pond.
- Beaver activity has the potential to significantly impact the public water supplies, posing public health concerns.
- There is a beaver dam on the brook between the Wastewater Treatment Facility and north of Leominster Connector, which has flooded the surrounding area
- There are beaver dams on the Nashua River north of the Wastewater Treatment Facility, which has flooded the surrounding area
- Although there have been reports of beaver activity in the area Plan update, there have been no documented beaver dam related flooding events since the adoption of the 2015.

Estimated Probability of Occurrence at and near Leominster

It is highly likely that beaver activity will continue to persist in Leominster, as suitable habitat, wetland protection, and a decrease in hunting and trapping are expected to remain relatively constant over the next decade.

Severe Weather Hazards: Winter Weather

SEVERE WINTER WEATHER: SNOWFALL

Severe winter weather includes large snow events, blizzards and ice storms. As defined by the National Weather Service, a blizzard is a snowstorm with sustained winds or frequent gusts of 35 miles an hour or greater and considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than a quarter of a mile) for a period of 3 hours or longer. NOAA's National Centers for Environmental Information produces the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two thirds of the U.S. The RSI ranks snowstorm impacts on a scale from 1 to 5, as shown in **Table 2-10**. RSI is based on the spatial extent of the storm, the amount of snowfall, and the juxtaposition of these elements with population density and societal impacts. Currently, the index uses population data based on the 2000 Census. A similar storm index is the Northeast Snowfall Impact Scale (NESIS), also shown below. Reference NOAA; https://www.ncdc.noaa.gov/snow-and-ice/rsi/

Severe winter weather in Massachusetts is almost always associated with nor'easters. **Table 2-11** summarizes the major nor'easters that occurred between the 1880's and now in the Northeast U.S. and includes RIS and NESI values (if available). Ref. https://gis.ncdc.noaa.gov/maps/ncei/rsi

Figure 2-13 indicates the average annual snowfall amounts for the Northeast U.S. The average snowfall per year near Leominster is 50 to 75 inches per year .

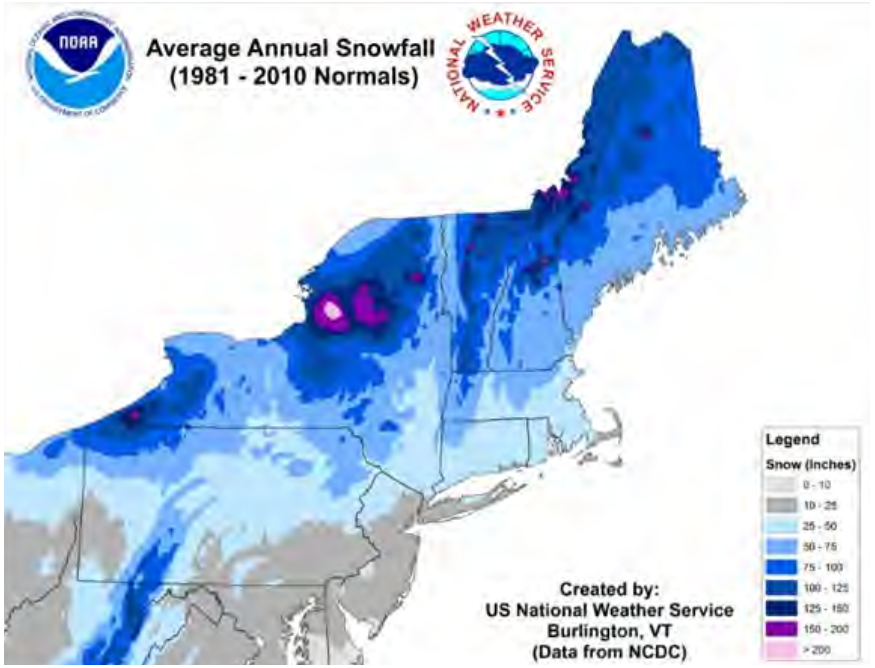


Figure 2-13: Average Annual Snowfall (http://www.weather.gov/btv/winter)

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

Category	NESIS Value	Description
1	1-2.5	Notable
2	2.5-4	Significant
3	4-6	Major
4	6-10	Crippling
5	10+	Extreme

Table 2-10: Regional Snowfall Index (RSI) and Northeast Snowfall Impact Scale

Table 2-11: Major Historical Nor'easters in the New England Region

Event	Northeast Category/RSI Value	Date	Description
Great Blizzard of 1888	NA	March 11-14, 1888	One of the worst blizzards in U.S. history. Dropped 40–50 inches (100–130 cm) of snow, killed 400 people, mostly in New York.
Great Appalachian Storm of November 1950	4/14.5	November 24-30, 1950	A very severe storm that dumped more than 30 inches (76 cm) of snow in many major metropolitan areas along the eastern United States, record breaking temperatures, and hurricane-force winds. The storm killed 353 people.
The Blizzard of'58	3/7.9	February 16-17, 1958	This coastal storm brought heavy snow and strong winds to the Northeast and resulted in 19.4 inches of snow in Boston.
	0/0	March 3-5, 1960	This wind-driven snowstorm brought whirling snow from Virginia to New York, before blowing into New England. Left 19.8 inches of
Ash Wednesday Storm of 1962	1/1.8	March 5-9, 1962	Caused severe tidal flooding and blizzard conditions from the Mid-Atlantic to New England, killed 40 people.
February Blizzard	5/34.0	February 24-27, 1969	This storm lasted several days and left 26.3 inches of snow in Boston.
Eastern Canadian Blizzard of March 1971	4/10.8	March 3-5, 1971	Dropped over 32 inches (81 cm) of snow over areas of eastern Canada, killed at least 30 people.
Groundhog Day Gale of 1976	NA	February 1-5, 1976	Caused blizzard conditions for much of New England and eastern Canada, dropping a maximum of 56 inches (140 cm) of snow.
January Blizzard	2/5.4	January 20-21, 1978	The January blizzard occurred just a couple of weeks before the infamous Blizzard of '78 and left 21.4 inches of snow in Boston.
Northeastern United States blizzard of 1978	5/18.4	February 5-7, 1978	A catastrophic storm, which dropped over 27 inches (69 cm) of snow in areas of New England, killed a total of 100 people, mainly people trapped in their cars on metropolitan Boston's inner beltway
1991 Storm (the "Perfect Storm," combined Nor'easter/hurricane)	0/0	October 28-November 2, 1991	Very unusual storm which evolved into a hurricane, tidal surge caused severe damage to coastal areas, especially Massachusetts,
December 1992 nor'easter	2/4.7	December 10-12, 1992	A powerful storm which caused severe coastal flooding throughout much of the northeastern United States.
1993 Storm of the Century	5/22.1	March 12-15, 1993	The Superstorm of 1993 which affected the entire eastern U.S., parts of eastern Canada and Cuba. It caused 6.65 billion (2008 USD) in damage, and killed 310 people.
Christmas 1994 nor'easter	NA	December 22-26, 1994	An intense storm which affected the east coast of the U.S., and exhibited traits of a tropical cyclone.
North American Blizzard of 1996	5/21.8	January 6-10, 1996	Severe snowstorm which brought up to 4 feet (120 cm) of snow to areas of the mid-Atlantic and northeastern U.S.
April Fools Storm	2/4.7	March 31-April 1, 1997	This April Fools storm dropped more than 2 feet of snow in Boston.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
North American Blizzard of 2003	4/14.7	February 14-22, 2003	Dropped over 2 feet (61 cm) of snow in several major cities, including Boston, and New York City, affected large areas of the Northeastern and Mid-Atlantic U.S., and killed a total of 27 people.
North American Blizzard of 2005	NA	January 20-23, 2005	Brought blizzard conditions to southern New England and dropped over 40 inches (100 cm) of snow in areas of Massachusetts.
North American Blizzard of 2006	2/5.0	February 11-13, 2006	A powerful storm that developed a hurricane-like eye when off the coast of New Jersey. It brought over 30 inches (76 cm) of snow in some areas and killed 3 people.
April 2007 nor'easter	0/1.0	April 13-17, 2007	An unusually late storm that dumped heavy snow in parts of Northern New England and Canada and heavy rains elsewhere. The storm caused a total of 18 fatalities.
November 2009 nor'easter	0/0	November 11-17, 2009	Formed from the remnants of Hurricane Ida, produced moderate storm surge, strong winds and very heavy rainfall throughout the mid-Atlantic region. It caused US$300 million (2009) in damage, and killed six people.
December 2009 North American blizzard	1/2.8	December 16-20, 2009	A major blizzard which affected large metropolitan areas, including New York City, Philadelphia, Providence, and Boston. In some of these areas, the storm brought up to 2 feet (61 cm) of snow.
March 2010 nor'easter	0/0.3	March 12-16, 2010	A slow-moving nor'easter that devastated the Northeastern United States. Winds of up to 70 miles per hour (110 km/h) snapped trees and power lines, resulting in over 1 million homes and businesses left without electricity. The storm produced over 10 inches (25 cm) of rain in New England, causing widespread flooding of urban and low-lying areas. The storm also caused extensive coastal flooding and beach erosion.
December 2010 North American blizzard	2/3.4	December 5, 2010-January 15, 2011	A severe and long-lasting blizzard which dropped up to 36 inches (91 cm) of snow throughout much of the eastern United States.
January 8–13, 2011 North American blizzard and January 25–27, 2011 North American blizzard	2/3.4	January 8-13 and January 25-27, 2011	In January 2011, two nor'easters struck the East Coast of the United States just two weeks apart and severely crippled New England and the Mid-Atlantic. During the first of the two storms, a record of 40 inches (100 cm) was recorded in Savoy, Massachusetts. Two people were killed.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
2011 Halloween nor'easter	1/2.6	October 28-November 1, 2011	A rare, historic nor'easter, which produced record breaking snowfall for October in many areas of the Northeastern U.S., especially New England. The storm produced a maximum of 32 inches (81 cm) of snow in Peru, Massachusetts, and killed 39 people. After the storm, the rest of the winter for New England remained very quiet, with much less than average snowfall and no other significant storms to strike the region for the rest of the season.
November 2012 nor'easter	0/0.3	November 7-10, 2012	A moderately strong nor'easter that struck the same regions that were impacted by Hurricane Sandy a week earlier. The storm exacerbated the problems left behind by Sandy, knocking down trees that were weakened by Sandy. It also left several residents in the Northeast without power again after their power was restored following Hurricane Sandy. Highest snowfall total from the storm was 13 inches (33 cm), recorded in Clintonville, Connecticut.
Late December 2012 North American storm complex	3/9.2	December 17-31, 2012	A major nor'easter that was known for its tornado outbreak across the Gulf Coast states on Christmas day as well as giving areas such as northeastern Texas a white Christmas. The low underwent secondary cyclogenesis near the coast of North Carolina and dumped a swath of heavy snow across northern New England and New York, caused blizzard conditions across the Ohio Valley, as well as an ice storm in the mountains of the Virginia and West Virginia.
Early February 2013 North American blizzard	3/NA	February 7-18, 2013	An extremely powerful and historic nor'easter that dumped heavy snow and unleashed hurricane-force wind gusts across New England. Many areas received well over 2 feet (61 cm) of snow, especially eastern Massachusetts, Connecticut, and Rhode Island. The highest amount recorded was 40 inches (100 cm) in Hamden, Connecticut, and Gorham, Maine, received a record 35.5 inches (90 cm). Over 700,000 people were left without power and travel in the region came to a complete standstill. The storm killed 18 people. Left 24.9 inches of snow in Boston and 22.8 inches in Providence.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
March 2013 nor'easter	1/1.6	March 1-21, 2013	A large and powerful nor'easter that ended up stalling along the eastern seaboard due to a blocking ridge of high pressure in Newfoundland and pivoted back heavy snow and strong winds into the Northeast United States for a period of 2 to 3 days. Many officials and residents were caught off guard as local weather stations predicted only a few inches (several centimeters) of snow with a change to mostly rain. Contrary to local forecasts, many areas received over one foot (30 cm) of snow, with the highest amount being 29 inches (74 cm) in Milton, Massachusetts. Several schools across the region, particularly in the Boston, Massachusetts, metropolitan area, remained in session during the height of the storm, not knowing the severity of the situation. Rough surf and rip currents were felt all the way southwards towards Florida's east coast.
January 2015 North American Blizzard	3/6.2	January 23-31, 2015	Unlike recent historical winter storms, there was no indication that a storm of this magnitude was coming until about 3 days in advance. The Blizzard began as an Alberta Clipper in the Midwestern States, which was forecast to transfer its energy to a new, secondary Low Pressure off the coast of the Mid Atlantic and move northeastward and pass to the south and east of New England. Several reports of over 30 inches (76 cm) across the State of Massachusetts, breaking many records. A maximum of 36 inches (91 cm) was recorded in at least four towns across Worcester County in Massachusetts and the city of Worcester itself received 34.5 inches (88 cm), marking the city's largest storm snowfall accumulation on record. The city of Boston recorded 24.6 inches (62 cm), making it the largest storm snowfall accumulation during the month of January and the city's sixth largest storm snowfall accumulation on record. On the coast of Massachusetts, Hurricane Force gusts up to around 80 mph (130 km/h) along with sustained winds between 50 and 55 mph (80 and 89 km/h) at times, were reported. The storm also caused severe coastal flooding and storm surge. The storm bottomed out to a central pressure of 970 mb (970 hPa). By January 28, the storm began to pull away from the area.
October 2015 North American storm complex	0/0	September 29-October 2, 2015	In early October, a low pressure system formed in the Atlantic, Tapping into moisture from Hurricane Joaquin, the storm dumped a huge amount of rain, mostly in South Carolina.

Table 2-11: Major Historical Nor'easters in the New England Area cont.

Event	Northeast RSI/ NESIS Category	Date	Description
January 2016 United States blizzard (also known as Winter Storm Jonas, Snowzilla, or The Blizzard of 2016 by media outlets)	4	January 19-29, 2016	This system dumped 2 to 3 feet (61 to 91 cm) of snow in the East Coast of the United States. States of Emergencies were declared in 12 States in advance of the storm as well as by the Mayor of Washington D.C. The blizzard also caused significant storm surge in New Jersey and Delaware that was equal to or worse than Hurricane Sandy. Sustained damaging winds over 50 mph (80 km/h) were recorded in many coastal communities, with a maximum gust to 85 mph (137 km/h) on Assateague Island, Virginia. A total of 55 people died due to the storm.
February 2017 United States blizzard (also known as Winter Storm Niko and The Blizzard of 2017 by media outlets)	4.17.8	February 6-11, 2017	Forming as an Alberta clipper in the northern United States on February 6, the system initially produced light snowfall from the Midwest to the Ohio Valley as it tracked southeastwards. It eventually reached the East Coast of the United States on February 9 and began to rapidly grow into a powerful nor'easter, dumping 1 to 2 feet (30 to 61 cm) across the Northeast Megapolis. The storm also produced prolific thunder and lightning across Southern New England. Prior to the blizzard, unprecedented and record-breaking warmth had enveloped the region, with record highs of above 60 °F (16 °C) recorded in several areas, including Central Park in New York City. Some were caught off guard by the warmth and had little time to
October 2017 nor'easter	0/0	October 28-31, 2017	An extratropical storm absorbed the remnants of Tropical Storm Philippe. The combined systems became an extremely powerful nor'easter that wreaked havoc across the Northeastern United States and Eastern Canada. The storm produced sustained tropical storm force winds along with hurricane force wind gusts. The highest wind gust recorded was 93 mph (150 km/h) in Popponesset, Massachusetts. The storm caused over 1,400,000 power outages. Damage across New England, especially in Massachusetts, Connecticut, and Rhode Island, was extreme. This was due to the combination of the high winds, heavy rainfall, saturated ground, and most trees still being fully leaved. Some residents in Connecticut were without power for nearly a week following the storm. Heavy rain in Quebec and Eastern Ontario, with up to 98 mm (3.9 in) in the Canadian capital region of Ottawa, greatly interfered with transportation.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
January 2018 North American blizzard	4/17.8	January 2-6, 2018	A powerful blizzard that caused severe disruption along the East Coast of the United States and Canada. It dumped snow and ice in places that rarely receive wintry precipitation, even in the winter, such as Florida and Georgia, and produced snowfall accumulations of over 2 feet (61 cm) in the Mid-Atlantic states, New England, and Atlantic Canada. The storm originated on January 3 as an area of low pressure off the coast of the Southeast. Moving swiftly to the northeast, the storm explosively deepened while moving parallel to the Eastern Seaboard, causing significant snowfall accumulations. The storm received various unofficial names, such as Winter Storm Grayson, Blizzard of 2018 and Storm Brody. The storm was also dubbed a "historic bomb cyclone".
March 1-3, 2018 nor'easter (also known as Winter Storm Riley or False Tropical Storm Riley by media outlets)	2/4.4	March 1-5, 2018	A very powerful nor'easter that caused major impacts in the Northeastern, Mid-Atlantic and Southeastern United States. It originated as the northernmost low of a stationary front over the Midwest on March 1, which moved eastward into the Northeast later that night. A new low pressure system rapidly formed off the coast on March 2 as it slowly meandered near the coastline. It peaked later that day and began to gradually move out to sea by March 3. Producing over 2 feet (24 in) of snow in some areas, it was one of the most significant March snowstorms in many areas, particularly in Upstate New York. In other areas, it challenged storm surge records set by other significant storms, such as Hurricane Sandy. It also produced widespread damaging winds, with gusts well over Hurricane force strength in some areas across Eastern New England as well as on the back side in the Mid-Atlantic via a sting jet. Over 2.2 million customers were left without power.
March 6-8, 2018 nor'easter (also known as Winter Storm Quinn by media outlets)	1/2.2	March 2-9, 2018	A powerful nor'easter that affected the Northeast United States. It came just days after another nor'easter devastated much of the Northeast. Frequent cloud to ground Thundersnow as well as snowfall rates of up to 3 inches (7.6 cm) an hour were reported in areas around the Tri-State Area, signaling the rapid intensification of the storm. Late in the afternoon, an eye-like feature was spotted near the center of the storm. It dumped over 2 feet of snow in many areas across the Northeast, including many areas in New England where the predominant precipitation type was rain for the previous storm. Over 1 million power outages were reported at the height of the storm due to the weight of the heavy, wet snow on trees and power lines. Many people who lost power in the previous storm found themselves in the dark again.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
March 12-14, 2018 nor'easter (also known as Winter Storm Skylar by media outlets)	1/2.2	March 11-14, 2018	A powerful nor'easter that affected portions of the Northeast United States. The storm underwent rapid intensification with a central millibaric pressure dropping down from 1001 mb to 974 mb in just 24 hours. This was the third major storm to strike the area within a period of 11 days. The storm dumped over up 2 feet of snow and brought Hurricane force wind gusts to portions of Eastern New England. Hundreds of public school districts including, Boston, Hartford, and Providence were closed on Tuesday, March 13.
March 20–22, 2018 nor'easter (also known as Winter Storm Toby by media outlets)	1/1.6	March 20-22, 2018	A powerful nor'easter that became the fourth major nor'easter to affect the Northeast United States in a period of less than three weeks. It caused a severe weather outbreak over the Southern United States on March 19th before moving off of the North Carolina coast on March 20th and spreading freezing rain and snow into the Mid-Atlantic States after shortly dissipating later that night. A new low pressure center then formed off of Chesapeake Bay on March 21st and then became the primary nor'easter. Dry air prevented most of the precipitation from reaching the ground in areas in New England such as Boston, Hartford, and Providence, all of which received little to no accumulation, in contrast with what local forecasts had originally predicted. In Islip, New York at the height of the storm, snowfall rates of up to 5 inches per hour were reported. 8 inches was reported at Central Park and over 12 inches was reported in many locations on Long Island as well in and around New York City and in parts of New Jersey.
Early December 2020 nor'easter		December 4-6, 2020	Brought up to 18 inches of snow in northern New England
Mid-December 2020 nor'easter	2/5.6	December 14-18, 2020	The nor'easter brought significant snowfall to metropolitan areas such as New York City, Philadelphia, and Washington, D.C., which eclipsed the entire snowfall total from the previous winter season, as well as Boston and Portland that saw over a foot of snow from the storm. It killed at least 7 people.
January 30– February 3, 2021 nor'easter	3/6.2	January 30– February 3, 2021	

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
April 2021 nor'easter (also known as 2021 Spring nor'easter by media outlets)		April 15-17, 2021	
Late October 2021 nor'easter		October 25-28, 2021	A powerful early-season nor'easter that struck the Northeastern United States in late October 2021. The system subsequently moved out to sea and later became Tropical Storm Wanda. Over 607,000 customers lost power during the storm, with the majority of them in Massachusetts.

Historical Occurrence at Leominster and Vicinity

Between 1996 and 2020, there were a total of 88 Heavy Snow event days in Worcester County, with 12 days with property damage ($5.485M) and no injuries or fatalities. Heavy Snow in the NOAA database is defined as snow accumulation meeting or exceeding locally/regionally 12 and/or 24 hour warning criteria: typically 4, 6 or 8 inches or more within 12 hours or 6, 8 or 10 inches or more in 24 hours. Storms including strong winds or other types of precipitation are classified as Winter Storms instead of Heavy Snow events. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/ .

Estimated Probability of Occurrence at and near Leominster

The results indicate the following Heavy Snowfall probability at and near Leominster:

- Average annual snowfall of 50 to 75 inches
- Heavy Snowfall within Worcester County: 96% AEP or 1.04 year recurrence interval (25 years with 1 or more events over 26 years)

Effects of Climate Change

The attribution of Heavy Snowfall events to climate change and understanding is moderate. High sea surface temperatures, increased atmospheric moisture and polar vortex conditions may result in an increased frequency of Heavy Snowfall.

SEVERE WINTER WEATHER: ICE STORMS

Ice storms are an occasional component of severe winter weather. Rain that falls and freezes on contact with cold surfaces is called freezing rain, while sleet is precipitation that freezes in the air before hitting the ground in the form of ice pellets. Heavy accumulations of ice can bring down trees or tree branches that may damage utility wires, causing power and communications outages, which may take days to repair. Ice can increase the weight of branches by 30 times. A 1/2-inch accumulation on power lines can add 500 lbs. of weight. Even slight accumulations of ice result in slippery conditions for motorists and pedestrians.

The National Weather Service issues:

- an Ice Storm Warning for a quarter-inch or more of ice accumulation
- a Freezing Rain Advisory for ice accumulation of less than one quarter-inch

Ice storms are relatively rare events in Massachusetts, including Leominster.

Historical Occurrence at Leominster and Vicinity

There were five (5) Ice Storm event days recorded in the NOAA Storm Events Database for Worcester County between 1998 and 2021, with one (1) injury and $23.33M property damage. Between 1998 and 2021, there were a total eight (8) days with ice storm events in Massachusetts (an average of 0.33 event per year), resulting in 1 injury and $45.4M property damage.

Estimated Probability of Occurrence at and near Leominster

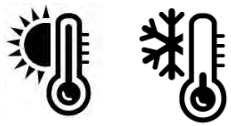
The results indicate the following Ice Storm probability at and near Leominster:

- Ice Storms within Worcester County: 17% AEP or 6 year recurrence interval (4 years with 1 or more events over 24 years)

Effects of Climate Change

The attribution of Ice Storm events to climate change and understanding is low to moderate. High sea surface temperatures, increased atmospheric moisture and polar vortex conditions may result in an increased frequency of Ice Storms.

Extreme Temperatures



EXTREME TEMPERATURE: HEAT

The National Weather Service in Albany, NY issues:

- Excessive Heat Warnings when the daytime heat indices reach 105° F or greater for 2 or more hours
- A Heat Advisory is issued when the daytime heat indices reach 100-104°F for 2 or more hours
- A Heat Wave is defined as 3 or more days of temperatures of 90° F or above.

Heat Index

The Heat Index, also known as the Apparent Temperature, is a subjective measure of what it feels like to the human body when relative humidity is factored into the actual air temperature. Relative humidity is a measure of the amount of water in the air compared with the amount of water that air can hold at the current temperature. The body cools itself through the evaporation of perspiration or sweat. However, when the relative humidity is high, the increased moisture content in the air decreases the evaporation of perspiration or sweat. For example, a hot and very humid air mass with a temperature of 94 degrees and a relative humidity of 45 percent yields an apparent temperature of 100° F. Holding the temperature constant and increasing the relative humidity to 60 percent yields an apparent temperature of 110° F.

The National Weather Service will initiate alert procedures when the Heat Index is expected to exceed 100° F to 104° F (depending on local climate). Under these conditions, sunstroke and heat exhaustion are likely, and physical activity or being outside for long periods is risky, potentially leading to heat stroke.

These dangerous heat days pose the greatest threat to children and the elderly, and to people who don't have easy access to air conditioning. The Heat Index values were derived for shady, light wind conditions, and exposure to full sunshine can increase heat index values by up to 15°F. (http://www.nws.noaa.gov/om/heat/heat_index.shtml).

From 1979-2016, more than 9,000 Americans have died in the United States from heat related ailments (EPA, 2016). During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

The highest temperature recorded in Massachusetts was 107°F on August 2, 1975, in Chester and New Bedford. According to the 2018 State Hazard Mitigation and Climate Adaptation Plan, there have been 43 warm weather events since 1995, ranging from Record Warmth/Heat to Excessive Heat events. During the period from 1985 to 2016, the heat-related mortality rate was about 2.9 per 100,000 people in Boston (Climate Ready Boston Executive Summary, December 2016).

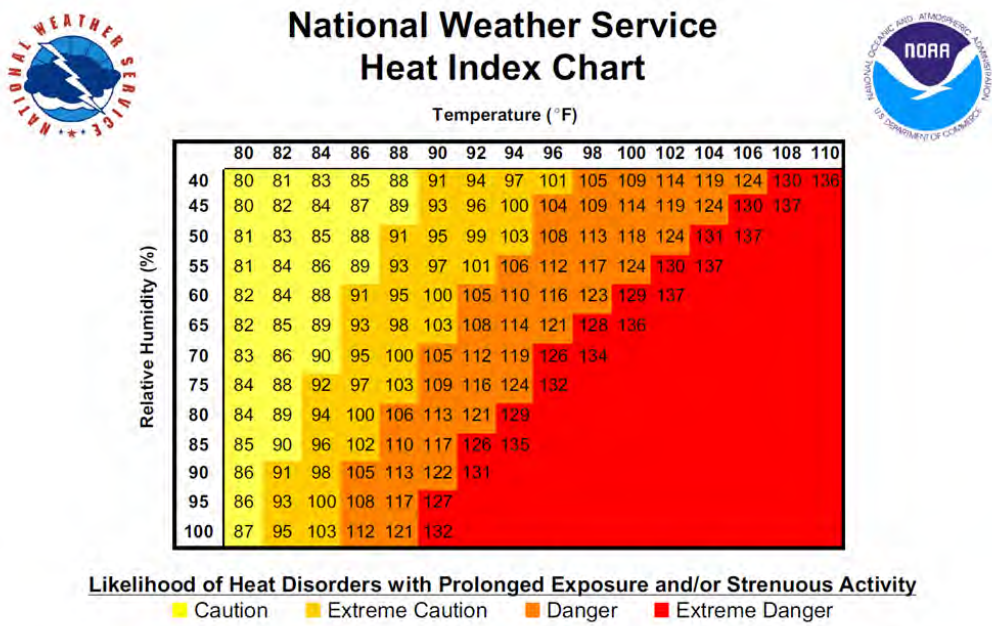


Figure 2-14: Heat Index Chart

Historical Occurrence at Leominster and Vicinity

Between 2001 and 2021, there were a total of 3 events with Excessive Heat in Worcester County and no fatalities or injuries. These included April 24, 2001 and May 2 and 3, 2001. The event on April 24 had a high temperature of 80° F, which broke the previous record of 79° F set in 1942. The May events of 2 and 3 had temperatures of 87° F, which broke and tied record highs set in 1930 and 1942, respectively. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Leominster

The results indicate that the probability of Excessive Heat near Leominster (Worcester County) is:

- Excessive Heat within Worcester County: 4.8% AEP or minimum of 21-year recurrence interval (1 year with 1 or more events of 21 years)

Additional Heat Effects

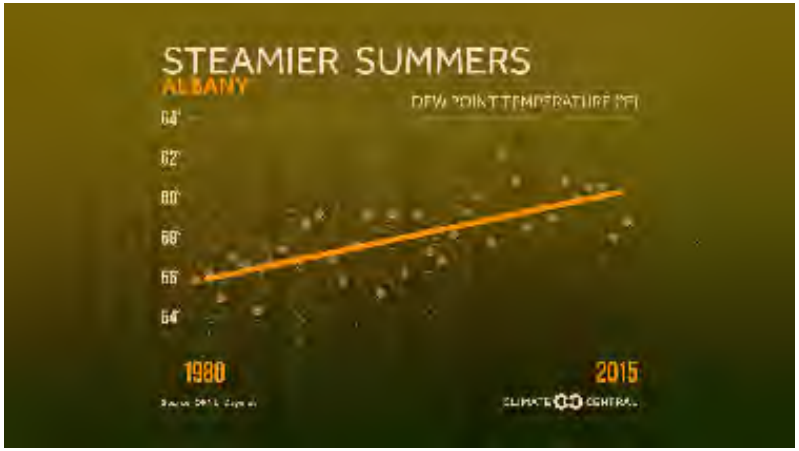
In addition to the Heat Index, air quality is a significant issue related to extreme temperature. Summers in the U.S. bring more than just searing, dangerously hot days. When the air is stagnant and there is little air circulation, hot weather can trigger high levels of air pollution that can have health consequences. High temperatures on sunny days make ground-level ozone (a major component of smog) form much more readily. An EPA study looking at more than 20 years of measurements across most of the rural areas in the eastern U.S. found that harmful ozone concentrations increased nearly linearly as temperatures increased and named the effect the "climate penalty on ozone."

Effects of Climate Change

The confidence of attribution of Excessive Heat to climate change, and understanding, is high. High global temperatures are effecting temperatures at the local level, including Leominster.

Massachusetts currently experiences between 5 and 8 days per year when the Heat Index is expected to exceed 105° F. By 2050, that number could grow to 16 days per year. The number of Heat Wave days in Massachusetts is expected to increase from about 11 to 30 days per year (the period of 2000 to 2030) to about 40 days per year by the year 2050. **Figure 2-15** shows the increase in days above 90° F for Albany, NY. **Figure 2-16** shows the predicted range of days above 105° F for Albany through 2050.

As summers get hotter from the increase in greenhouse gases, they are also getting stickier. More evaporation occurs in a warming atmosphere, and on a world where water covers nearly three-quarters of the surface, it means an increase in water vapor in the air. During the period of 1980 to 2015, the dew point temperature increased from about 59 ° F to 62 ° F. as presented on **Figure 2-17.**



Figures 2-15 through 2-17: Days Above 90 degrees (top); Days with Heat Index above 105 degrees (middle); Dew Point Temperature

Effects of Climate Change

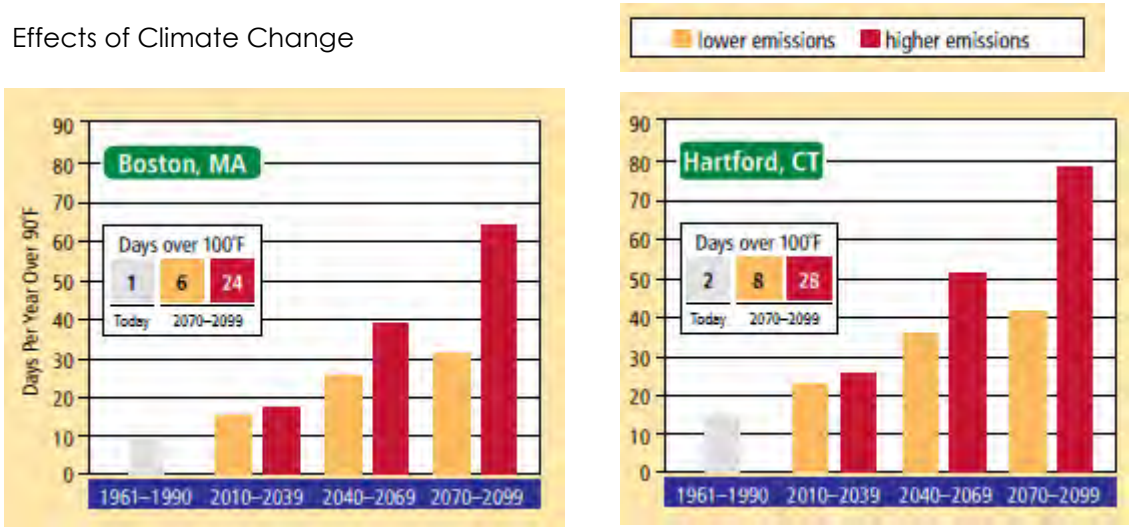


Figure 2-18: Predicted Days above 90° F and 100° F (source Union of Concerned Scientists)

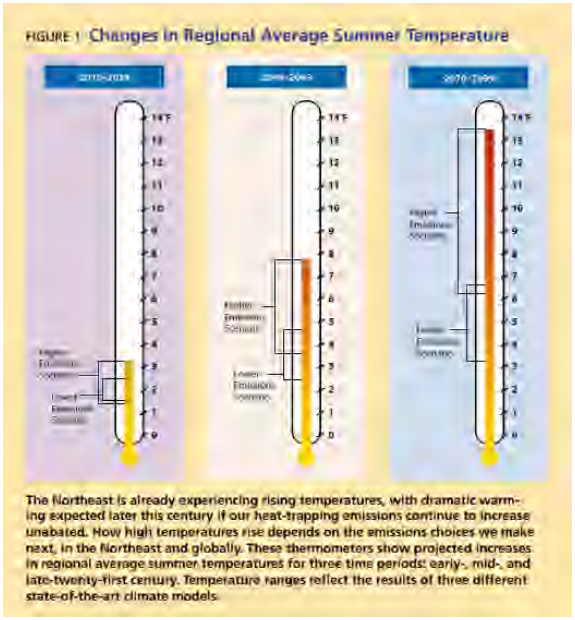


Figure 2-19: Predicted Rise in Average Northeast U.S. Temperatures (source Union of Concerned Scientists)

In addition to the effect of climate change on extreme heat events, the overall increase in global and local temperature averages will significantly change climate patterns within the Northeast U.S., including Leominster. Spring will arrive sooner, summers are growing hotter, and the weather is becoming more extreme with swings between above-average winter temperatures to extreme cold with large snowfall events. Per the Union of Concerned Scientists summary reports, if global greenhouse gas emissions continue, the Northeast can expect dramatic temperature increases and other climate changes within the next several decades. Recent observations indicate that these effects are already underway, including within Massachusetts. Average summer temperatures may increase between 6° F and 14° F by 2100 (see **Figure 2-19**). The overall effect will be a shift in the Massachusetts climate equivalent to that historically experienced in lower latitudes, ranging between the Chesapeake Bay area to South Carolina (see **Figure 2-20**).

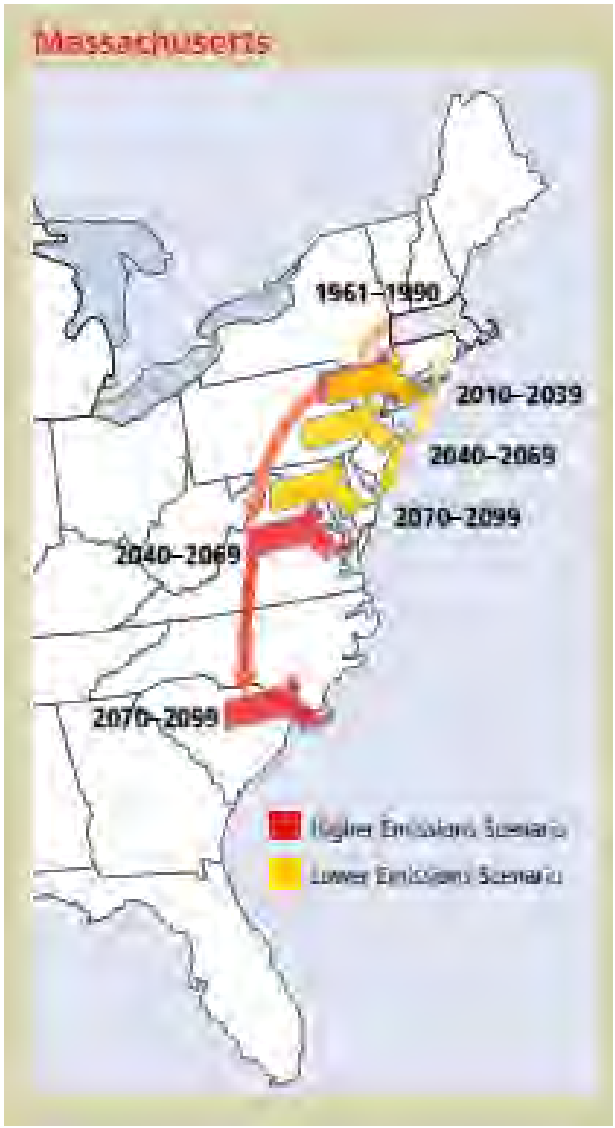


Figure 2-20: Latitudinal Changes in Regional Climate (source Union of Concerned Scientists)

EXTREME TEMPERATURE: COLD

Extreme cold events are generally defined as a prolonged period of excessively cold weather. Extreme cold conditions are often, but not always, part of winter storms. Winter in Massachusetts almost always includes periods of extreme cold weather. Exposure to cold can cause frostbite or hypothermia and has the potential to become life-threatening. Although anyone can suffer from cold-related health issues, some people are at greater risk than others, such as:

- Older adults
- Young children
- Those who are sick; and
- Those without adequate shelter.

Heating sources can be impacted by power failures due to winter storms. Infants and the elderly are more at risk of serious or life-threatening health problems from extreme cold. Secondary hazards may include risk of fires or carbon monoxide poisoning from space heaters, generators, inadequately cleaned or vented fireplaces, or use of candles.

The following extreme cold warnings and advisories are issued by the National Weather Service (NWS):

- Freezing Warning – When minimum shelter temperature drops to 32° F or lower during the growing season.
- Frost Advisory – Issued under clear, light wind conditions with forecast minimum shelter temperature at 33-36° F during the growing season.
- Wind Chill Warning – Wind chill index is -25° F or lower for at least three hours using only sustained wind.
- Wind Chill Advisory - Wind chill index is between -15° F and -24° F for at least three hours using only sustained wind.

The National Weather Service Wind Chill Chart indicates the amount of time in which frostbite may occur on exposed skin based on temperature and wind speed. The National Weather Service maintains a Wind Chill Calculator, which calculated wind chill based on temperature and wind speed, as a period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria (typical value around -35° F or colder). Ref. http://www.wpc.ncep.noaa.gov/html/windchill.shtml.

The lowest temperature recorded in Massachusetts was -35° F on January 5, 1904 in Taunton, February 15, 1943 in Coldbrook, and January 12, 1981 in Chester, according to NOAA (https://www.ncdc.noaa.gov/extremes/scec/records).

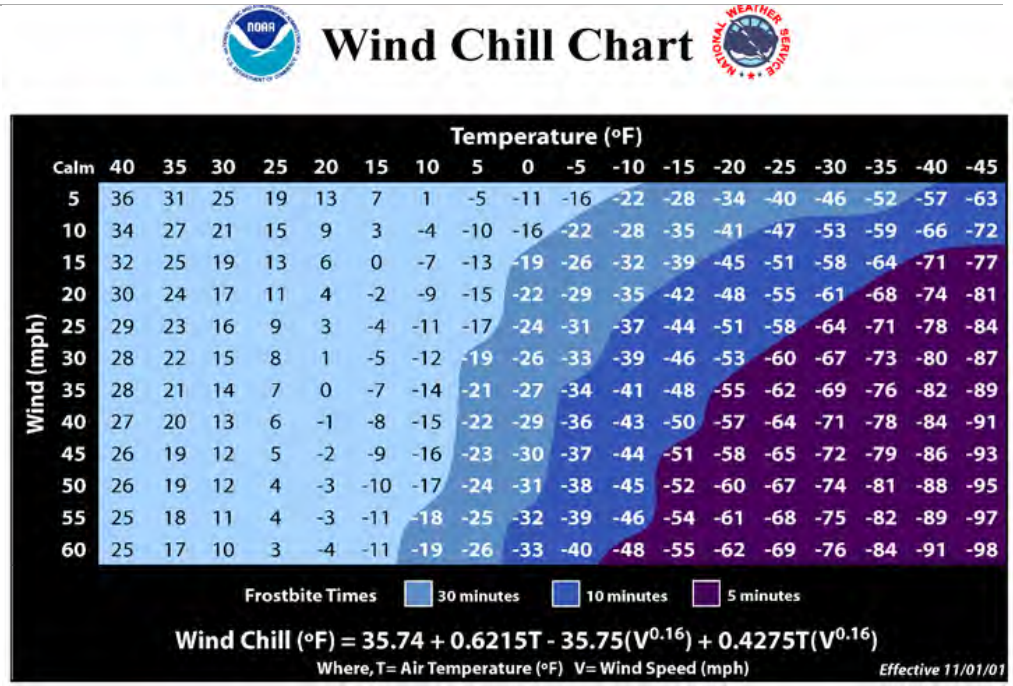


Figure 2-21: Wind Chill Chart

Nationally, there have been 972 recorded cold fatalities since 1988, with a 10 year average of 30 fatalities/year. (Ref. National Weather Service (NWS) https://www.weather.gov/hazstat/)

Historical Occurrence at Leominster and Vicinity

Between 2000 and 2021, Worcester County has experienced 2 event days with an Extreme Cold/Wind Chill event resulting in no fatalities or injuries. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Leominster

The results indicate the following Extreme Cold/Wind Chill probability at and near Leominster:

- Extreme Cold/ Wind Chill within Worcester County: 4.5% AEP or 22 year recurrence interval (1 year with 1 or more events over 22 years)

Effects of Climate Change

The confidence of attribution of Extreme Cold to climate change, and understanding, is moderate. It appears that warming trends have weakened polar vortex winds resulted in meandering of these winds. This condition allows cold Arctic air to dip further south, resulting in a variable New England winter with temperatures varying from above-average warm to periods of extreme cold.

Drought

DROUGHT

Droughts occur when there has not been enough rainfall and water levels get low, in particular when precipitation and other water resources fall below expectations but the demand for water remains. They can happen anywhere in the United States, and droughts increase the risk of other hazards like wildfires, flash floods, and possible landslides or debris flows. Drought is a slow-onset hazard that can last for months or years. Droughts are generally classified into different types including:

- meteorological drought - lack of precipitation
- agricultural drought - lack of soil moisture
- hydrologic drought - reduced streamflow or groundwater levels.

As a hazard, it has the potential to impact many aspects of life, including two of our most important needs: drinking water and food. Because of the long duration of droughts, the impacts can last for years and can ripple through a community over time.

Drought is an important issue in Massachusetts and the City due to effects on agricultural and water resources. City residents obtain their drinking water from surface water supplies, which can be affected by drought.

Massachusetts maintains a Drought Management Plan and five levels of drought are used to characterize drought severity and response: Normal; Advisory; Watch; Warning; and Emergency. A determination of drought level in Massachusetts is based on seven indices: Standardized Precipitation Index (SPI); Crop Moisture Index; Keetch-Byram Drought Index (KBDI); Precipitation Index; Groundwater Level Index; Stream Flow Index; and Reservoir Index. Additional climatological indices used nationally include: Standardized Precipitation-Evapotranspiration Index (SPEI), Palmer Drought Severity Index (PDSI) and Rainfall Deciles are standard climatological drought indices. Drought levels are declared on a regional basis. Massachusetts has identified six state-wide drought regions. The City is located within the Central Region.

During the summer of 2002, one-third of the U.S., including Massachusetts, experienced drought conditions. Based on historical Palmer Drought Severity Indices, Massachusetts has experienced multi-year drought periods in 1879-83, 1910-19, 1928-39, 1964-69, and 1985-95. The most severe drought on record in the northeastern United States was during 1961-69. For the period of 1895 to 1995, Massachusetts experienced low PDSIs (indicating drought conditions) about 6 to 10 percent of the time, indicating the relative probability of drought. Water supplies and agriculture were affected because of the severity and long duration of the drought. Precipitation was less than average beginning in 1960 in western Massachusetts and beginning in 1962 in eastern Massachusetts.

Historical Occurrence at Leominster and Vicinity

There was one event day for April 1999. The total monthly precipitation at Worcester Municipal Airport was 0.92 inches, which was the second driest April on record. There were two (2) event days in 2012 in April and May. The U.S. Drought Monitor declared a severe drought across the eastern half of Massachusetts.

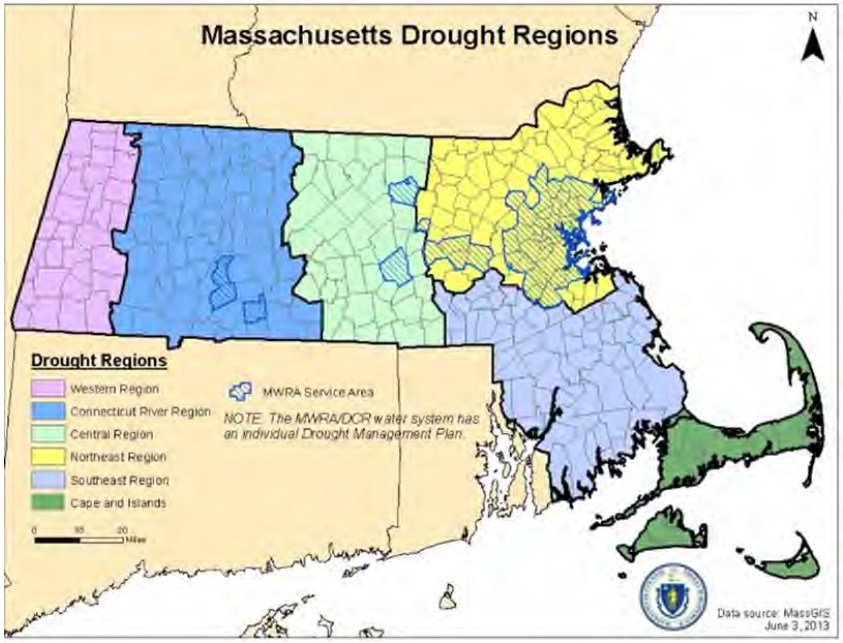


Figure 2-22: Massachusetts Drought Regions

This was declared as a hydrologic draft, as precipitation totals from January– April 2012 were approximately one half of normal levels. There were 11 event days between July 2016 and April 2017. This was caused by well below normal precipitation in the area during that time period. Ref. NOAA Storm Events Database.

Estimated Probability of Occurrence at and near Leominster

Based on recent drought history (1999 to 2020), Worcester County has been impacted by drought four times in in 21 years. Based on this limited data:

- The probability of Drought within Worcester County is 13% AEP or minimum of 7 to 8-year recurrence interval (3 years with 1 or more events over 19 years).
- Note: The drought between 2016-2017 was only counted as one (1) event
- Massachusetts experiences extended, multi-year droughts about every 20 years

Effects of Climate Change

The confidence of attribution of Drought to climate change is moderate. Increased air temperatures and evapotranspiration can increase drought potential. In the Northeast U.S, the relationship between increased rainfall intensity and drought is uncertain.

Wildfire

WILDFIRE

A wildfire is a non-structure/vehicle fire that occurs in undeveloped, wildland vegetated areas, including grass, brush/shrub, and forested areas. Wildfires occur when natural vegetation is ignited naturally, such as by lightning, or by human activity. Sometimes, wildfires are set intentionally for management of vegetation or to limit accidental fire risk. Wildfires may be unnoticed at first. Unnoticed fires often can spread to the urban-wildland interface and threaten developed areas.

Leominster is 52% forest, which presents potential area for wildfires to occur. However, according to the Wildfire Hazard Potential (WHP), developed by the U.S. Forest Service (**Figure 2-23**), there is generally low WHP in Leominster. The eastern portion of the City is more developed, and contains mostly non-burnable area. The western portion of the City, although largely forested, presents a very low to low WHP.

In Leominster, there have been no reports of significant property damage or deaths related to brush fires or wildfire.

Historical Occurrence at Leominster and Vicinity

The most recent wildfire in Massachusetts occurred on May 14, 2021 in the Clarksburg State Forest in Berkshire County, according to the NOAA Storm Events Database. The fire burned 947 acres before it was contained on May 18, 2021. It was the largest wildfire in Massachusetts since 1999.

The NOAA Storm Events database lists one (1) wildfire as having occurred in Worcester County between 1950 and 2021. This wildfire occurred in meadowlands in Dedham April 19, 2012, caused by above normal temperatures, low relative humidity levels, and gusty winds. There were no property damages, injuries, or deaths reported.

Estimated Probability of Occurrence at and near Leominster

The historical data indicates that the probability of wildfire within Leominster is low. The Wildfire Hazard Potential Index, developed by the U.S. Forest Service, (**Figure 2-23**) indicates that there is low to very low wildfire hazard potential in Leominster.

Effects of Climate Change

The confidence of attribution of Wildfire to climate change is low. Increased air temperatures and evapotranspiration, as well as increases in drought, can increase Wildfire potential.

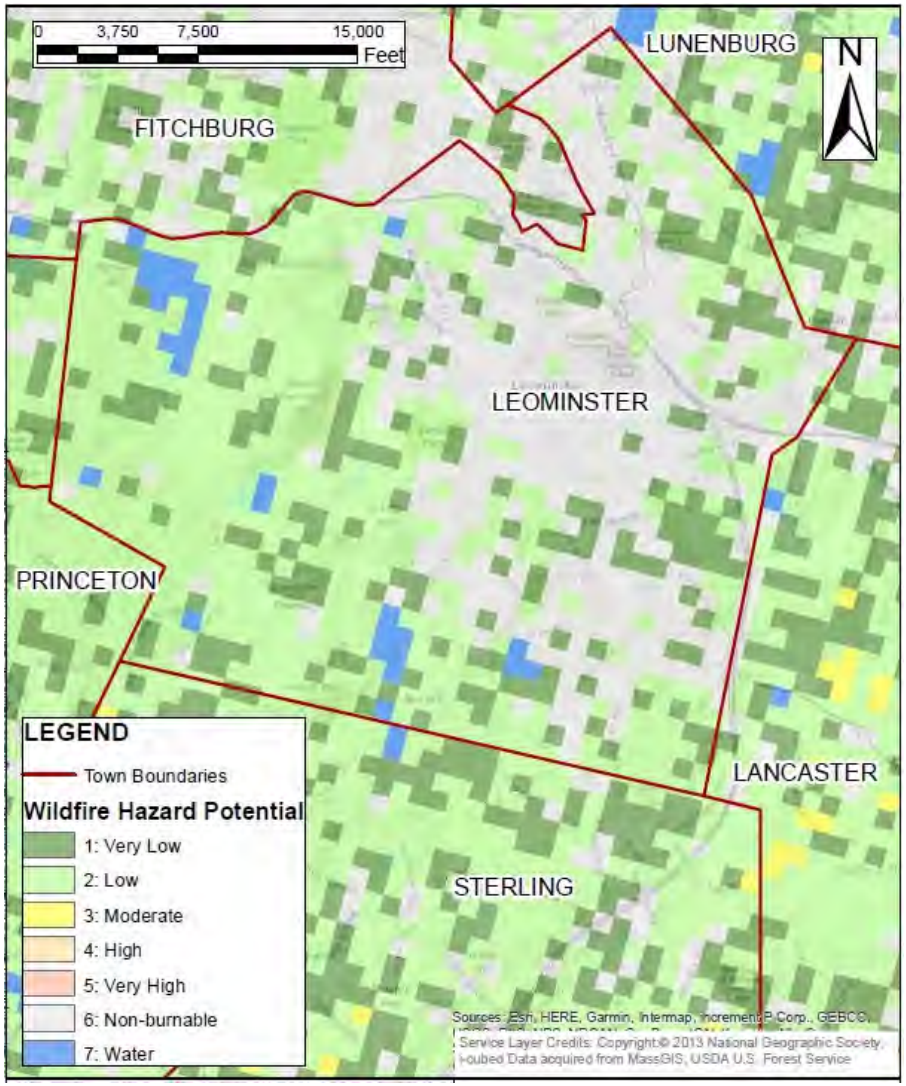


Figure 2-23: This map layer portrays the Wildfire Hazard Potential (WHP), developed by the U.S. Forest Service's (USFS) Fire Modeling Institute to help inform assessments of wildfire risk or prioritization of fuels management needs across large landscapes.

Earthquake

EARTHQUAKE

Earthquakes occur as the result tectonic activity. An earthquake is sudden ground motion or trembling caused by an abrupt release of accumulated strain acting on the tectonic plates that comprise the Earth's crust along faults. Although earthquakes have caused much less economic loss annually in the United States than other hazards such as floods, they have the potential for causing great and sudden loss. Within 1 to 2 minutes, an earthquake can devastate part of an area through ground-shaking, surface fault ruptures, and ground failures. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth. The focal depth of an earthquake is the depth from the surface to the region where the earthquake's energy originates (the focus). The epicenter of an earthquake is the point on the Earth's surface directly above the focus. The effects of earthquakes are: 1) ground shaking; 2) ground displacement; and 3) loss of soil strength (liquefaction). Ground shaking is represented by the Peak Ground Acceleration (PGA) and spectral acceleration (SA) response. The PGA reflects the ground acceleration at the top of bedrock. Thick deposits of soil over bedrock will modify (typically increase) the acceleration, resulting in ground surface accelerations that are greater than the PGA. Liquefaction is a function of soil type and density. Earthquake intensity is characterized by: 1) the Richter Scale; and 2) the Modified Mercalli Scale. Seismic hazards include damage to structures and infrastructure, landslides and tsunamis.

The National Seismic Hazard Maps (NSHM) (and the hazard model from which they are derived) are used by engineers who construct buildings to determine how strongly a particular site might be shaken by earthquakes. The NSHMs compile known earthquake sources, their distance from the site in question, and other seismological and geological information to project potential maximum expected ground motions at a site over a particular period of time (50 years).

Soil deposits above bedrock are classified based on shear wave velocity according to Site Class. Site Class Definitions are presented in **Table 2-13**. The geologic data indicates that the majority of Leominster consists of shallow glacial till or bedrock with sand and floodplain alluvium along the Hop Brook valley.

Figure 2-24 presents the significant earthquakes in New England. **Figure 2-25** presents the 2% probability of exceedance in 50 years PGA. The 2% in 50 years PGA in the vicinity of Leominster is 0.17g, where g is the acceleration of gravity (32.2 ft/sec^2).

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

Table 2-12: Richter Scale

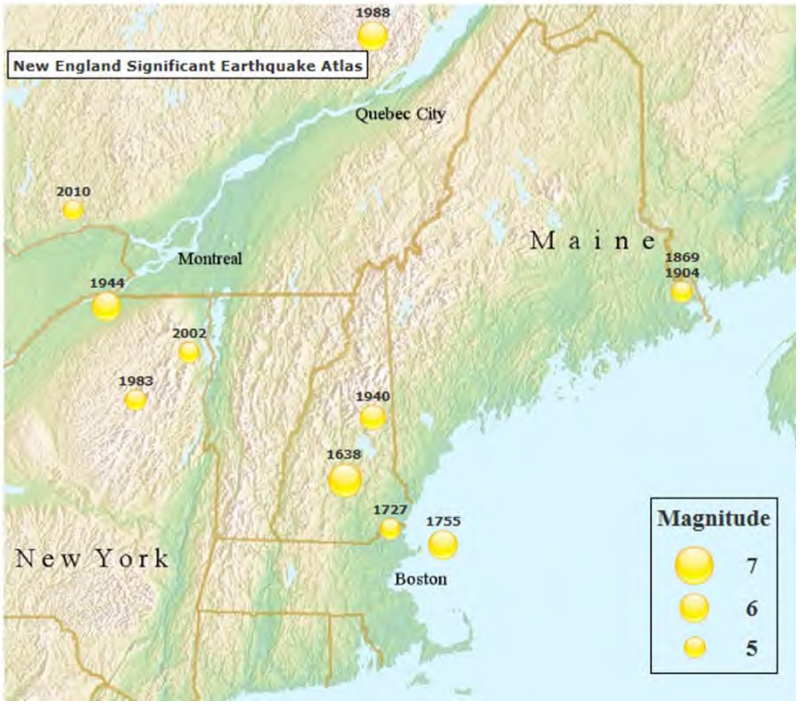


Figure 2-24: Significant Earthquakes in New England http://aki.bc.edu/quakes_historical.htm

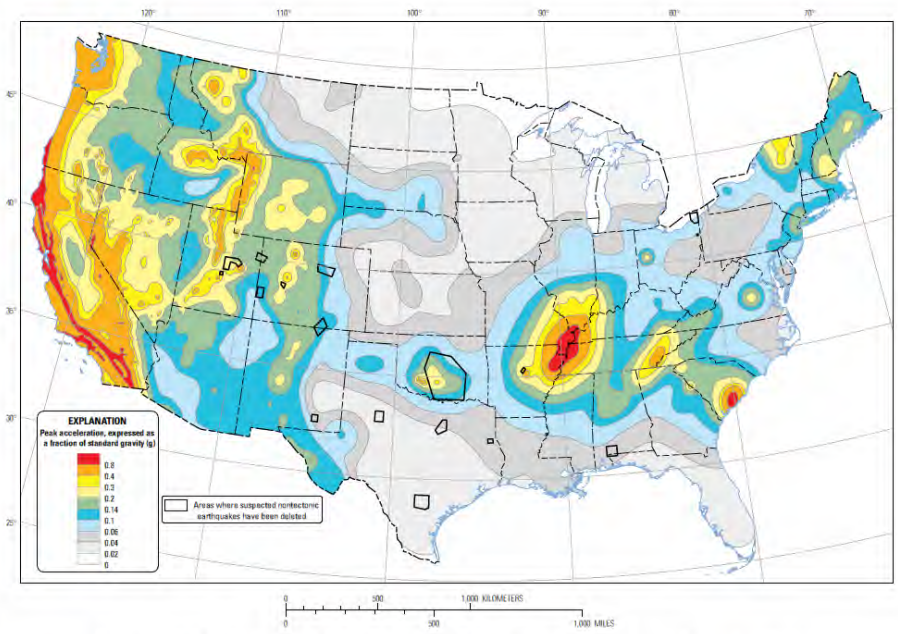


Figure 2-25: 2% probability of exceedance in 50 years Map of Peak Ground Acceleration

2010 ASCE-7 Standard – Table 20.3-1
SITE CLASS DEFINITIONS

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content w ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response	See Section 20.3.1		

Table 2-13: Site Class Definitions

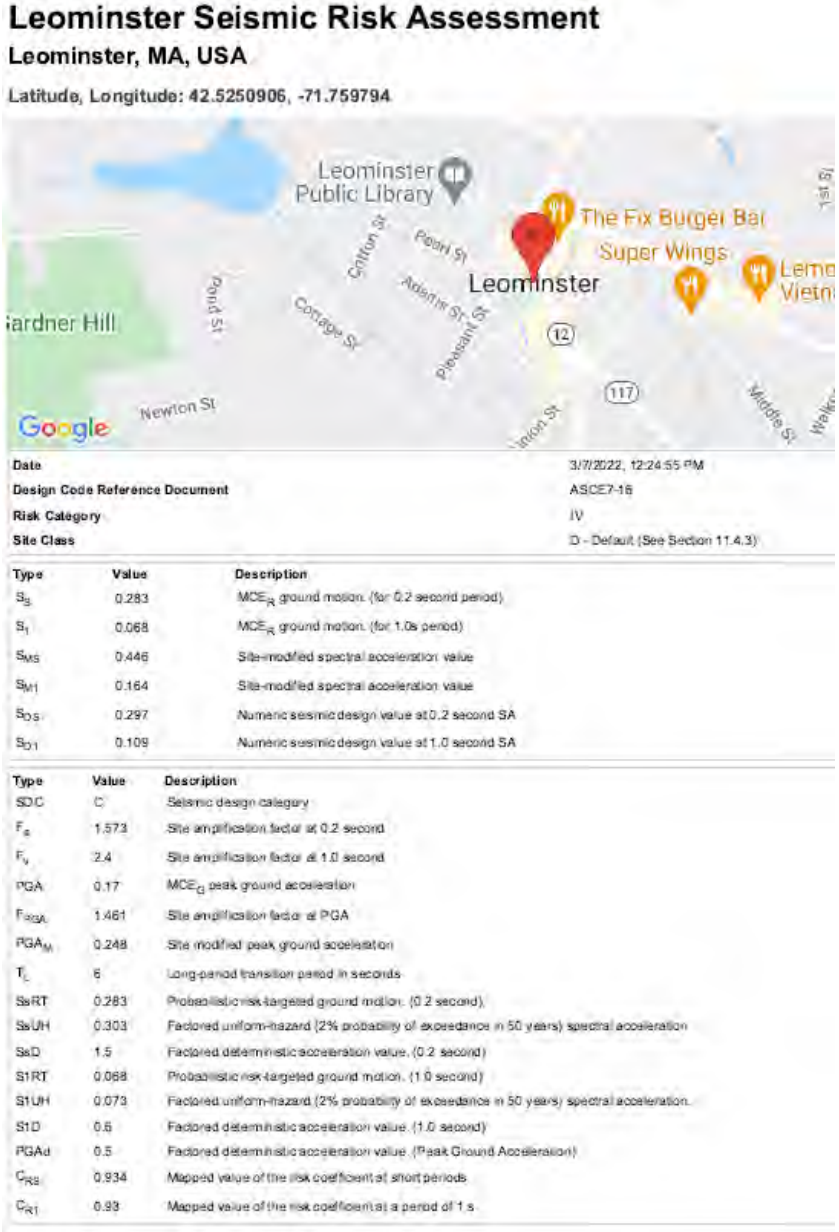


Figure 2-26: USGS Seismic Hazard Report for Leominster (https://seismicmaps.org/)

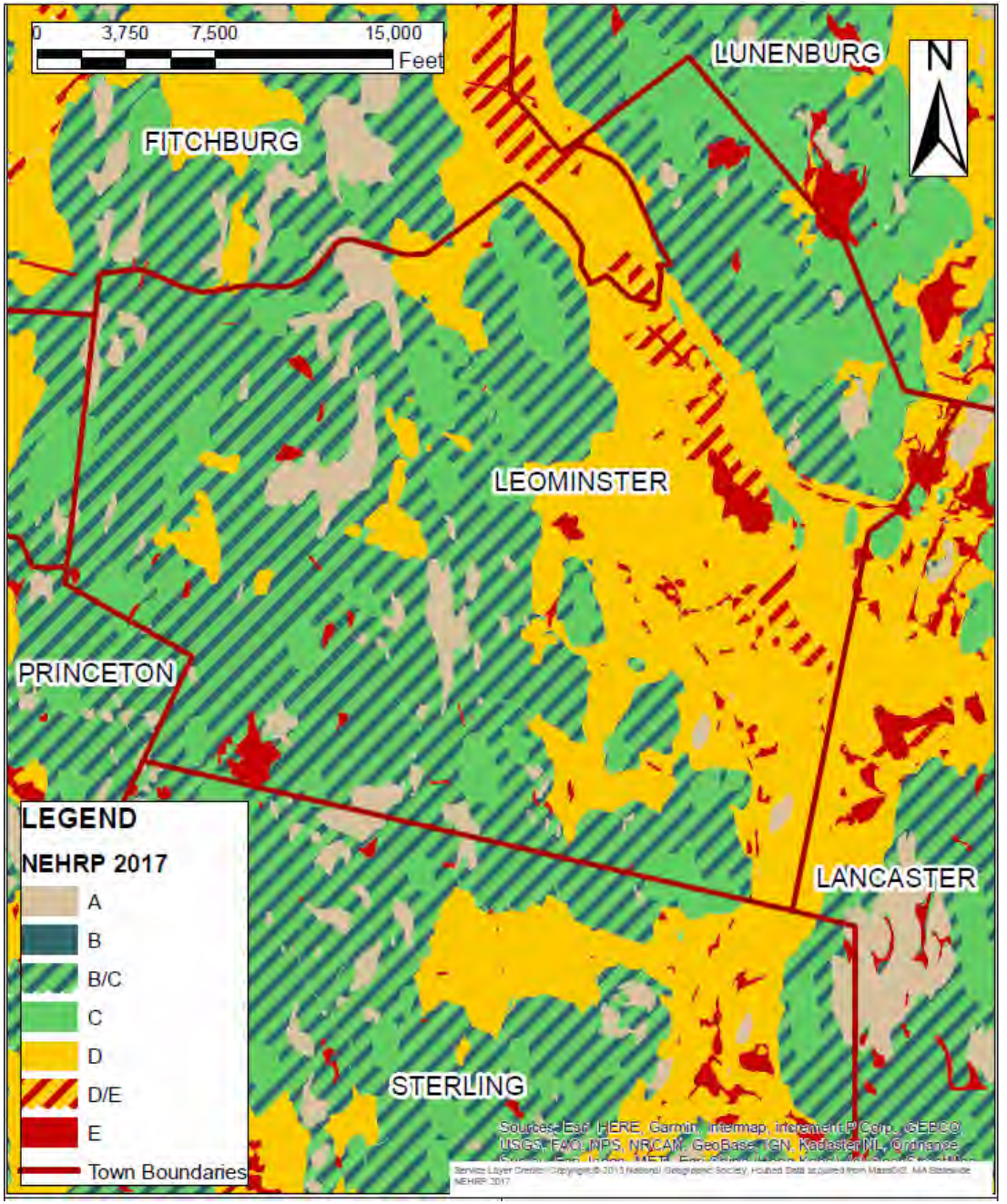


Figure 2-27: NEHRP 2017 Soil Site Classes at Leominster

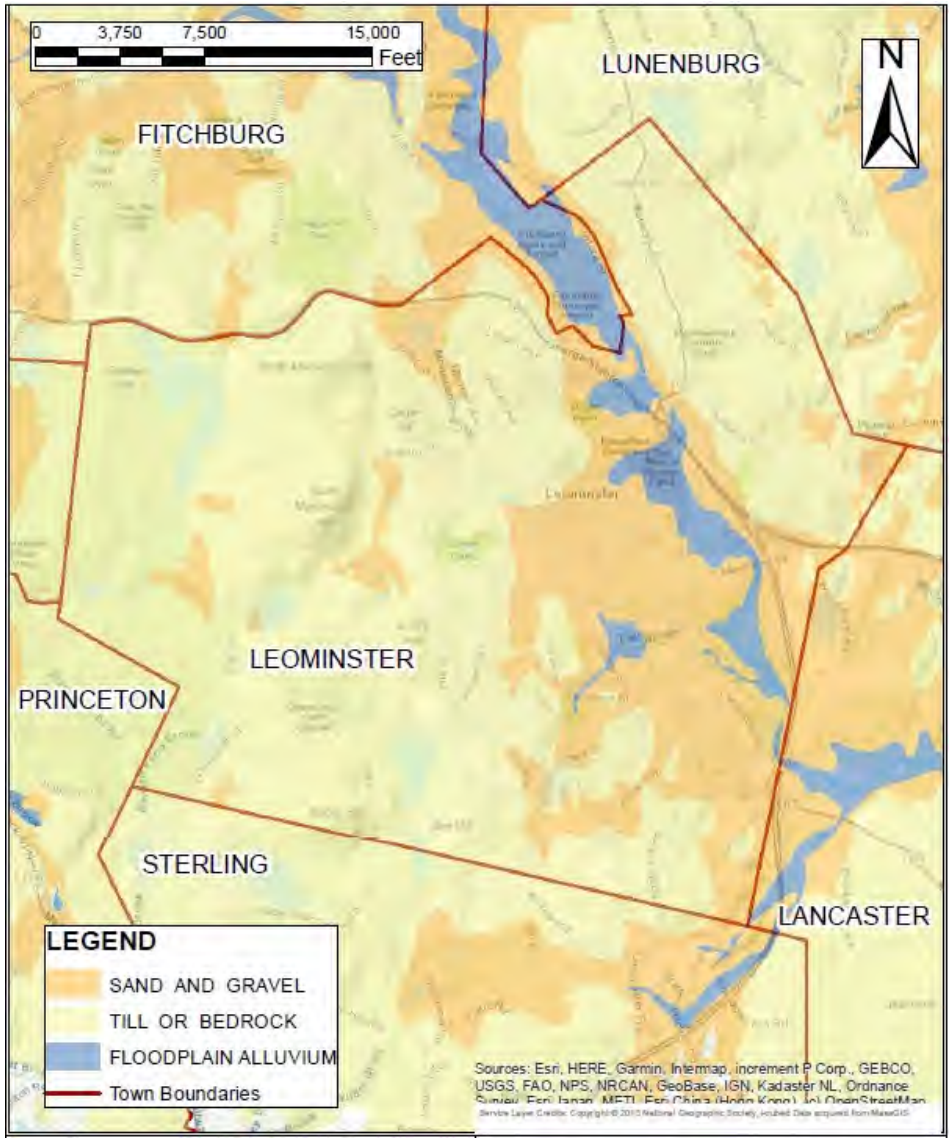


Figure 2-28: Surficial Geology of Leominster

Historical Occurrence at Leominster and Vicinity

According to the USGS Earthquake Catalog data search, there have been 21 earthquakes of magnitude 2.5 or greater which have occurred in Massachusetts or off the coast since 1974. The largest was a magnitude 3.7 which occurred near the Quabbin Reservoir in 1994. There was one aftershock of magnitude 3.3 associated with this earthquake. The second largest occurred in 2020 near Bliss Corner, and had a magnitude of 3.6. (https://earthquake.usgs.gov/earthquakes/search/ As show in **Figure 2-29**, there have historically been significant (Richter magnitudes between 5 and 7) earthquakes in the vicinity of Massachusetts.

Estimated Probability of Occurrence at and near Leominster

- The occurrence of historic earthquakes, PGA, and Site Class indicate that the seismic risk at Leominster is low. Amplified ground motion may occur within localized areas within Leominster classified as Site Classes D and E. These areas my also be susceptible to liquefaction.

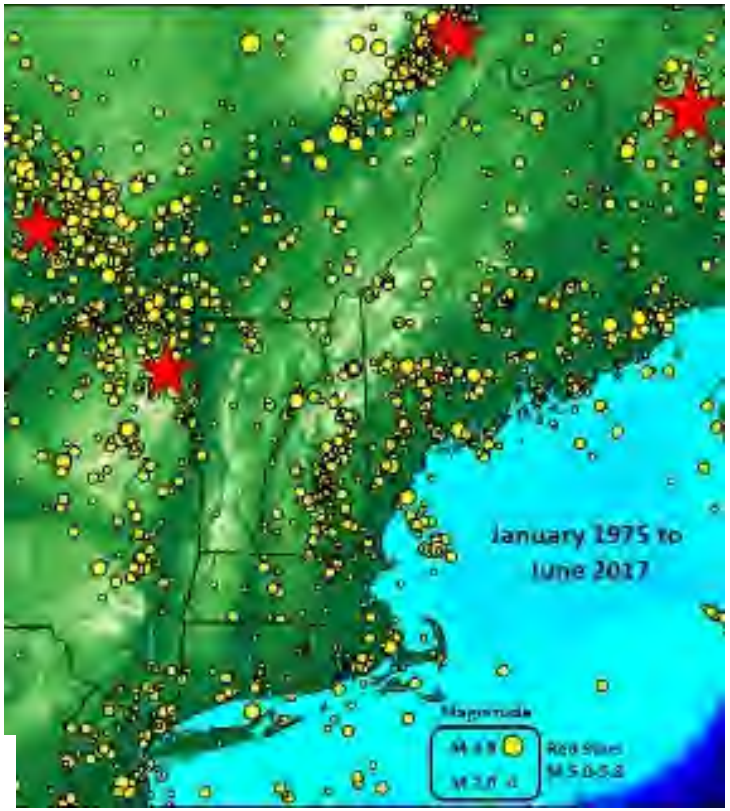


Figure 2-29: Area Earthquakes during January 1975 and June 2017

Attachment 3: Natural Hazard Risk

Attachment 3: Natural Hazard Risk

Overview

A Natural Hazard Risk Assessment was conducted by GZA to evaluate the potential consequences of natural hazards to the people, economy, and built and natural environments of the City of Leominster. The risk assessment was performed based on guidance provided by the FEMA Local Mitigation Planning Handbook, and included the Local Planning Team (LPT). Three planning meetings were held on March 15, 2022, May 25, 2022, and ADD, 2022.

The Natural Hazard Risk Assessment evaluates the effects of the relevant natural hazards (described in Attachment 2) on the community assets (identified in Attachment 1). The methodology assesses risk in terms of: 1) the likelihood (i.e., frequency) of the natural hazard occurring; 2) the predicted effects (damages, losses, etc.); and 3) the consequences (e.g., costs) associated with those effects.

A vulnerability analysis was performed based on historical data and by spatially comparing the hazard data to the community assets. In particular, the vulnerability of the City to flooding was assessed by identifying which assets are located within the FEMA flood zones (Special Flood Hazard Areas).

The FEMA Multi-Hazard MH-HAZUS program was used to evaluate losses due to flood hazards. The FEMA National Risk Index was used to score all other hazards. The hazard index is a function of the exposure, annualized frequency, and historic loss ratio for a hazard, as well as the social vulnerability and community resilience for the community. The scoring process and results were reviewed by the LPT to assess the City's current "perceived" risk.

Historical Hazard Events

Previous federal Presidential Disaster Declarations in Massachusetts and in Worcester County were reviewed. FEMA Repetitive Loss Property data within the City was also evaluated.

Presidential Disaster Declarations:

Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. §§ 5121-5207 (the Stafford Act), a Governor of a State affected by an emergency or a disaster can submit a request for a declaration by the President of the United States that a major disaster exists. The President can declare a major disaster for any natural event, including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought, or, regardless of cause, fire, flood, or explosion, that the President determines has caused damage of such severity that it is beyond the combined capabilities of state and local governments to respond.

A major disaster declaration provides a wide range of federal assistance programs for individuals and public infrastructure, including funds for both emergency and permanent work (FEMA, "The Disaster Declaration Process", https://www.fema.gov/disaster-declaration-process).

Disaster	Declaration Date
COVID-19 Pandemic (DR-4496)	March 27, 2020
Severe Winter Storm & Snowstorm (DR-4379)	July 19, 2018
Severe Winter Storm, Snowstorm & Flooding (DR-4214)	April 13, 2015
Severe Winter Storm, Snowstorm & Flooding (DR-4110)	April 17, 2013
Severe Storm & Snowstorm (DR-4051)	January 6, 2012
Severe Storms & Tornadoes (DR-1994)	June 15, 2011
Severe Storm & Flooding (DR-1895)	March 29, 2010
Sever Winter Storm & Flooding (DR-1813)	January 5, 2009
Severe Storms & Flooding (DR-1614)	November 10, 2005
Flooding (DR-1512)	April 21, 2004
Severe Storms & Flooding (DR-1364)	April 10, 2001
Heavy Rain, Flooding (DR-1224)	June 23, 1998
Blizzard of 96 (DR-1090)	January 24, 1996
Winter Coastal Storm (DR–975)	December 21, 1992
Hurricane Bob (DR-914)	August 26, 1991

Table 3-1: Disaster Declarations in Massachusetts 1991 to 2022

Table 3-1 presents disaster declarations which have been made since 1991 in Massachusetts (current through April 01, 2022). These disaster declarations included Worcester County. Based on the occurrence rate, the expected frequency of disaster declarations is about 1 every 2 years. Based on past declarations, the most common natural disasters were Severe Weather Hazards, including flooding, winter storms, snowstorms; and hurricanes and tropical storms.

Ranking Hazards

The natural hazards were ranked according to the FEMA National Risk Index (FEMA, 2021). The National Risk index is a dataset and online tool that utilizes available natural hazard and community risk factors data to develop a relative risk measurement for counties and census tracts. Its intended use is to help planners and emergency managers at the local, regional, state, and federal level better understand the natural hazard risk of their communities.

Risk is driven by loss due to natural hazard, social vulnerability, and community resilience. Risk is calculated using the following equation:

$$\text{Risk} = \frac{\text{Expected Annual Loss} \times \text{Social Vulnerability}}{\text{Community Resilience}}$$

The risk index scores are calculated for each natural hazard. The social vulnerability and community resilience scores remain the same for each hazard, while the expected annual loss (EAL) varies by hazard. Social vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards. The score is a relative score, and indicates the relative level of a community's social vulnerability compared to other communities at the same level. Community resilience is the ability of a community to prepare for a natural disaster, adapt to changing conditions, and withstand and recover rapidly from disruptions. Similar to social vulnerability, it is a relative score, and represents the community's relative level compared to other communities at the same level. The EAL represents the average economic loss in dollars resulting from a certain natural hazard each year. The EAL for each hazard is calculated as the product of exposure, annualized frequency, and historic loss ratio. Exposure represents the value of buildings, population, or agriculture potentially exposed to a natural hazard occurrence. Annualized frequency represents the expected frequency or probability of a natural hazard occurrence per year. Historic loss ratio represents the estimated percentage of the exposed building value, population, or agriculture value expected to be lost due to a natural hazard occurrence.

The FEMA National Risk Index provides risk index scores at county and census tract levels. As shown in **Figure 3-1**, each census tract in Leominster is ranked as "Very Low" for the overall risk index. Further breakdown of the risk index for each hazard is presented in **Table 3-2**. In order to determine an overall risk index score for the entire City for each hazard, the average of all census tracts was taken for each hazard.

There are qualitative ratings associated with each numerical score, ranging from "Very Low" to "Very High". There are no specific numeric values that determine the rating since the scores are relative to other communities at the same level. Numeric scores range from 1-100.

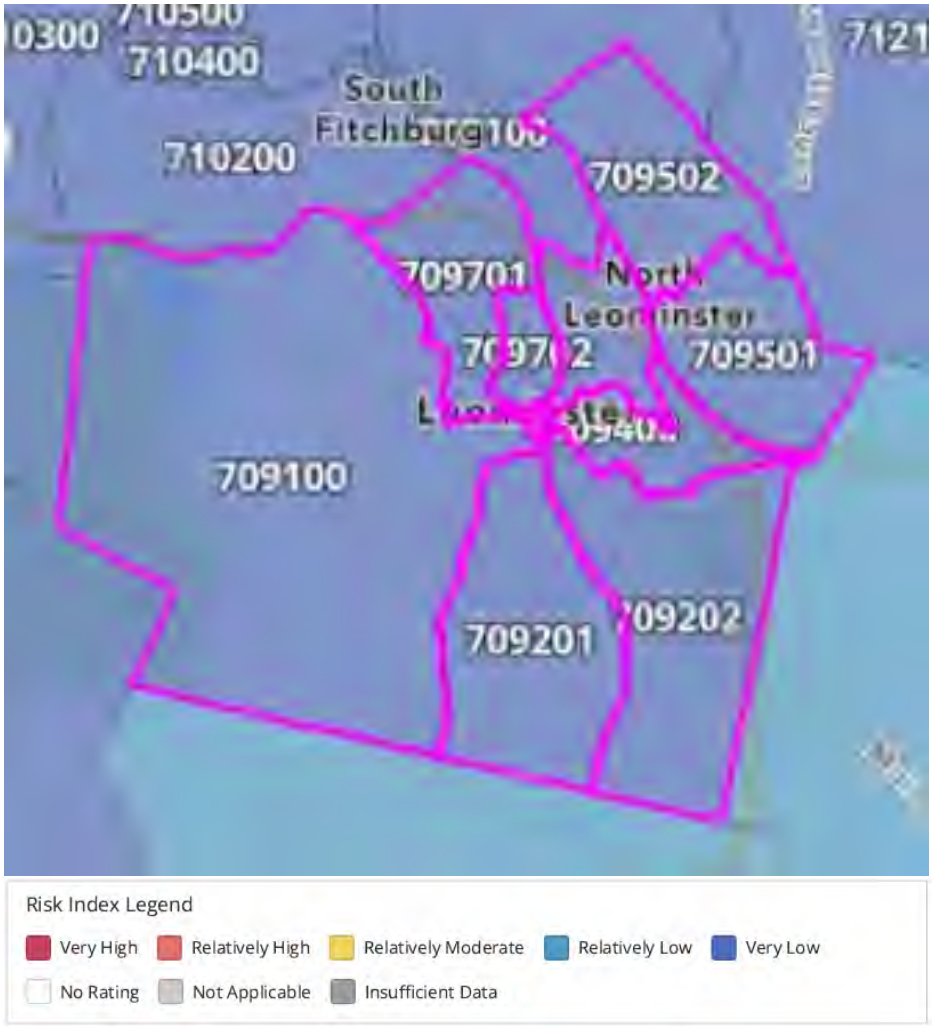


Figure 3-1: FEMA National Risk Index for Census Tracts within Leominster

Severe Weather Hazards:	Hazard Index
Strong Wind	11.94
Tornadoes	16.55
Hurricanes/ Tropical Storms	3.98
Lightning	19.66
Hail	2.79
Flooding	-
Severe Winter Weather	7.83
Ice Storms	18.49
Climate-Related Hazards:	
Heat Wave	5.20
Cold Wave	7.11
Drought	3.58
Wildfire	1.55
Geologic Hazards:	
Earthquake	9.69
Landslides	3.00
Secondary Hazard:	
Dam Failure	-

Table 3-2: Natural Hazard Ranking Results for Leominster

Table 3-2 presents the results of the hazard ranking for the City. The top ranked hazards include: 1) riverine/overbank flooding and flooding caused by intense precipitation or beaver dams; 2) strong wind caused by tornadoes, hurricanes/tropical storms, and thunderstorms; and 3) severe winter weather (large snowfall events and ice storms).

Although the extent of riverine/overbank flooding is limited to the areas along the Nashua River, Monoosnoc Brook, and Fall Brook, it is a highly ranked hazard due to: 1) flood inundation impacts to buildings including lifeline facilities (e.g., wastewater treatment buildings); and 2) impacts to transportation infrastructure including key roadways.

Strong wind and related damages during tornadoes is also ranked highly due to its relatively high frequency and its potential for wide-spread damage. In particular, a tornado strike at or near Leominster with a magnitude of EF4 or larger would be catastrophic (similar to the 1953 tornado).

Severe winter weather (including greater than 10-inches snowfall and ice storms) most frequently occur during Nor'easters, coincident with high winds, cold temperatures and blizzard conditions. They present risks due to transportation impacts (limited use of roadways), cold temperatures (including wind chill) and the potential for structure damage (roof failures). Its relative high probability of occurrence makes severe winter weather as a high ranked hazard.

Failure of the six high-hazard dams due to a dam breach is a medium ranked hazard due to the unlikelihood of occurrence, and lesser potential extent of flood inundation, despite the potential loss of life.

Other hazards currently rank less than the above hazards, but are expected to become more impactful in the future due to climate change. In particular, these include:

- Extreme temperatures. The frequency and intensity of heat waves is expected to increase in the future. Eastern Leominster is largely developed environment, and does not benefit from tree cover. Additionally, it sits at a generally low elevation. Overall warming will also increase the northern migration of disease vectors such as West Nile Virus and increase the duration and intensity of tick-borne diseases such as Lyme's Disease.
- Drought. Droughts could increase in duration and intensity in the future with potential impacts to the City's surface water supplies.

For comparison of Leominster's hazard ranking with the Commonwealth, all of the census blocks within the city have an overall risk index rating that is lower than the Commonwealth's average.

Hazard Vulnerability Assessment

As indicated by the past Presidential Disaster Declarations (**Table 3-1**), Leominster (like most of Worcester County and much of Massachusetts) is principally vulnerable to the following frequent severe weather hazards: 1) flooding that occurs during hurricanes, tropical storms and nor'easters; 2) severe winds due to tornadoes, thunderstorms, and hurricanes, which can occur coincident with flooding; and 3) heavy snowfall during winter nor'easters. Climate change has the potential to amplify the intensity and frequency of each of these hazards.

Although less frequent (or effecting less area), Leominster is also vulnerable to: 1) heat waves; and 2) drought. Climate change is expected to increase the severity of these hazards. The frequency and intensity of heat waves is expected to increase in the future. Droughts could increase in duration and intensity in the future with potential impacts to the City's surface water supplies.

The Fall Brook Reservoir Dam and Dike, Notown Reservoir Dam and Dike, Rockwell Pond, Pierce Pond, and Lake Samoset Dams are high hazard dams and present a dam failure hazard.

Flood Vulnerability

The City is vulnerable to riverine flood events. There are many surface waters throughout Leominster that present flooding potential; however, FEMA-mapped floodplain areas are limited to the Nashua River, Monoosnoc Brook, and Fall Brook. **Attachment 2** presents details about Leominster's flood hazards. **Figure 3-1** presents the FEMA preliminary special flood hazard areas (SFHA) within Leominster.

A screening level assessment of flood vulnerability relative to the FEMA 100-year (1% AEP) SFHAs indicates:

Essential Facilities:

- Police: Not Vulnerable
- Fire and First Responders: Not Vulnerable
- Emergency Operations Centers: Not Vulnerable
- Highway Department: Not Vulnerable
- City Offices: Not Vulnerable

Lifeline Systems:

- Sanitary Wastewater Treatment Facilities: Vulnerable (Multiple buildings located north and east of the wastewater treatment tanks are in the FEMA mapped floodplains)
- Drinking Water Treatment Facilities: Leominster Water Treatment–South East Well Field is vulnerable
- Potable Water Supply: Not Vulnerable
- Separate Stormwater and Sanitary Infrastructure: Not vulnerable

Transportation Infrastructure:

- Airports: None present
- Public Transit Stations: Not Vulnerable
- Roads and Bridges: Vulnerable (Certain structures. See below)

Based on the preliminary FEMA Flood Insurance Rate Map (FIRM), certain City roads are vulnerable to flooding, including:

- George Stanton Highway
- Lancaster Street
- Commercial Road
- Sack Boulevard
- Adams Street
- Union Street
- Pleasant Street
- Nashua Street
- Mohawk Drive
- Lock Drive
- Whitney Street

Based on the preliminary FEMA Flood Insurance Rate Map (FIRM), certain bridges are vulnerable to flooding, including:

- Lakeview Dr over Fall Brook
- Lancaster Stover Fall Brook
- Mechanic St over Nashua River
- Nashua St over Nashua River
- Route 12 over Nashua River
- Hamilton St over Nashua River
- Water St over Monoosnoc Brook
- Adams St over Monoosnoc Brook
- Pleasant St over Monoosnoc Brook
- Cotton St over Monoosnoc Brook
- Exchange St over Monoosnoc Brook
- Revolution Dr over Monoosnoc Brook

Support, High Occupancy, and Vulnerable Population Facilities

- Elementary and Secondary Schools: Not Vulnerable
- Daycare and Pre-schools: Not Vulnerable
- Assisted Living Facilities and Nursing Homes: Not Vulnerable
- Primary Healthcare Facilities: Not Vulnerable

High Potential Loss Facilities:

- Fall Brook Reservoir Dam and Dike, Notown Reservoir Dam and Dike, Rockwell Pond, Pierce Pond, and Lake Samoset Dams: Not vulnerable to flooding; dam failure risk discussed in separate section of plan

Historical Resources:

- MassHistoric Commission Property: Four properties vulnerable

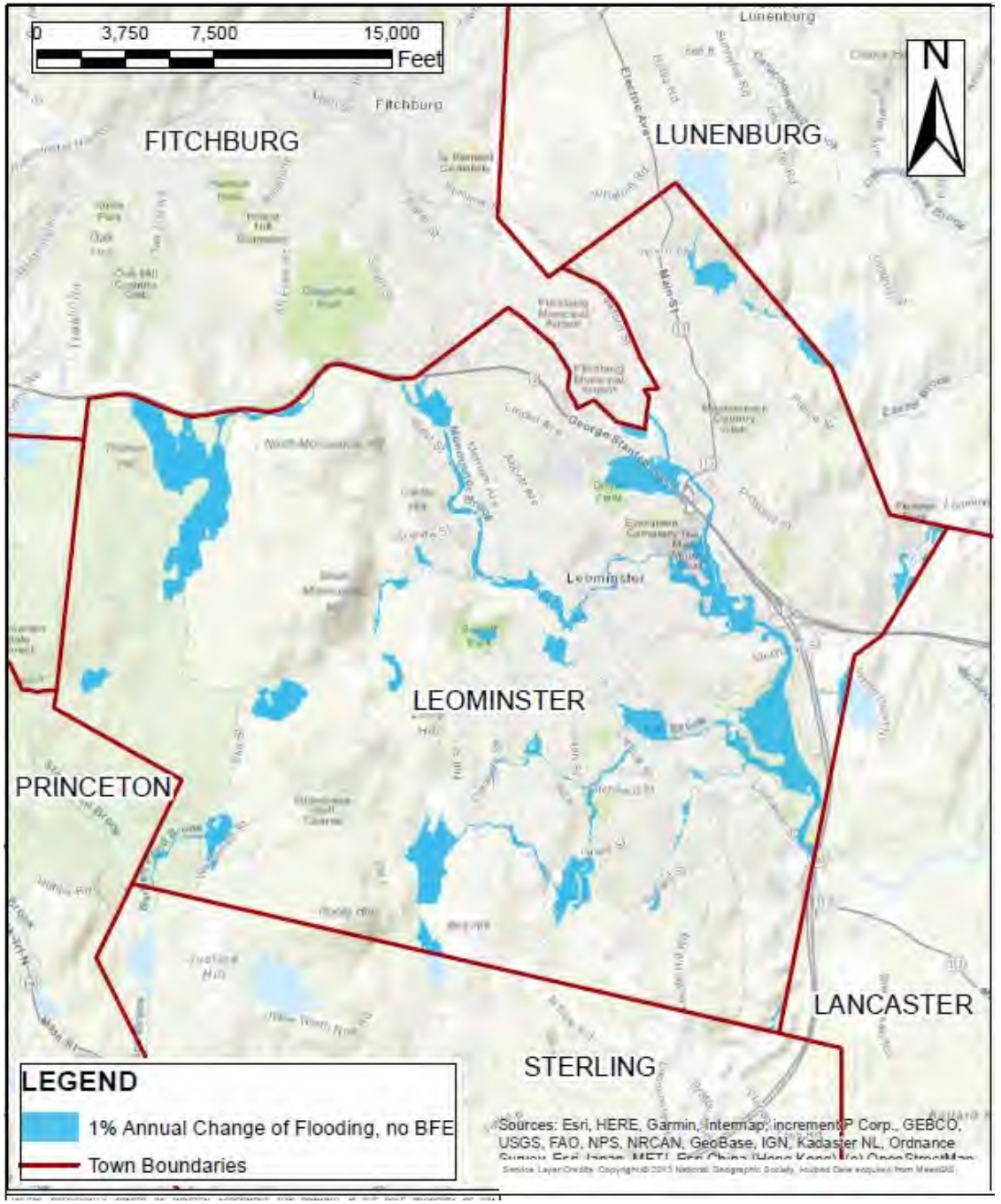


Figure 3-2: FEMA Special Flood Hazard Areas (SFHAs)

Legend: Blue shaded areas indicates preliminary FEMA Base Flood inundation area (100-year recurrence interval)

National Flood Insurance Program (NFIP) Repetitive Losses

According to the FEMA Flood Insurance Manual, Effective April 1, 2020, a Repetitive Loss Structure is defined as a National Flood Insurance Program (NFIP)-insured structure that has had at least 2 paid flood losses of more than $1,000 each in any 10-year period since 1978, and a Severe Repetitive Loss Building is any building that:

1. Is covered under a Standard Flood Insurance Policy made available under this title;
2. Has incurred flood damage for which:
    - 4 or more separate claim payments have been made under a Standard Flood Insurance Policy issued pursuant to this title, with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or
    - At least 2 separate claims payments have been made under a Standard Flood Insurance Policy, with the cumulative amount of such claim payments exceed the fair market value of the insured building on the day before each loss.

Since the start of the NFIP, there have been 25 flood insurance claims made in the City of Leominster totaling $98,076.97 in payments. There are four (4) repetitive loss properties in Leominster totaling $38,274.40 in claims which accounts for approximately 40% of the total claims made in the City. There are 108 flood insurance policies in force. These results are based on data from the NFIP BureauNet as presented in the 2015 NHP Update.

The City requested updated NFIP data from FEMA Region 1 Floodplain Management & Insurance Branch in coordination with MEMA on July 11, 2022; however, FEMA Region 1 was unable to provide the data because of an issue with producing the data report requested from the PIVOT system. FEMA Region 1 noted in an email on Monday August 8, 2022 that no timeframe was provided for correcting this issue. The City will incorporate the updated NFIP data into this plan upon receipt from FEMA.

Flood Risk Summary

As presented on the previous pages, although there are no essential services or lifeline systems located within the FEMA 100-year flood zone, there are several buildings and potential associated losses located within the 100 and 500-year floodplain. These are a result of the HAZUS analysis described below and in Attachment 4.

Likelihood/Frequency:

While flooding can occur more frequently at Leominster, significant flood events are associated with the 1% AEP.

Severity/Magnitude

As part of the Plan preparation, GZA completed a Level 1 HAZUS-MH damage analysis for flood scenario (based on FEMA flood hazard delineation). The results are presented at the end of this Attachment. The results predict about $89M to $148M building and content damage for the 1% AEP (100-year recurrence interval) and the 0.2% (500-year recurrence interval flood, respectively.

Flooding is a top-ranked hazard due to: 1) potential flood impacts to the City's buildings and high associated economic losses; and impacts to transportation infrastructure.

The Level 1 HAZUS scenario analyses identified 65 and 89 buildings vulnerable to flood damage (ranging from slight to substantial) for the 1% AEP and 0.2% AEP floods, respectively. Substantial damage will trigger specific flood regulations within the State Building Code, requiring that building repair or replacement be in compliance with current flood regulation.

Impact Area:

- 65 buildings are predicted to be impacted during the 1% and 89 buildings are predicted to be impacted during the 0.2% AEP floods. This number represents 0.5% and 0.7% of the total number of Leominster buildings, respectively.

Table 3-3: Leominster Flood Insurance Policies and Claims

Strong Winds/ Tornadoes

Leominster is vulnerable to severe wind events due to hurricanes and tropical storms, nor'easters, thunderstorms and tornadoes. **Attachment 2** presents details about Leominster's wind hazards. Severe winds at Leominster occur most frequently due to hurricanes and tropical storms which can occur coincident with heavy precipitation and flooding. Severe winds can also occur at Leominster during tornadoes and more frequently during severe thunderstorms. High winds can also occur, frequently, during nor'easters (along with heavy rain and snow). The risk score and rating for Tornadoes is presented in **Table 3-4** for the census tracts within Leominster. Additionally, **Table 3-4** presents the Estimate Annual Loss (EAL) score and rating that corresponds to the risk score and rating.

Likelihood/Frequency

The annual exceedance probability of experiencing High Winds within Worcester County is 85% AEP or minimum of 1-year to 2-year recurrence interval.

The annual exceedance probability of experiencing a Tornado within Worcester County is 39% AEP or minimum of 2-year to 3-year recurrence interval.

Severity/Magnitude

Damages due to severe winds include: 1) damage to trees, often resulting in power outages and also potentially fatal accidents related to treefalls; 2) structure damage. **Table 3-5** presents the typical physical effects associated with different wind speeds. As shown on **Table 3-5**, significant, widespread damage can be expected due to sustained wind speeds of about 74 mph or greater.

As discussed in **Attachment 2**, During 1996 through 2021, Worcester County experienced 54 days of High Wind events with estimated gusts of about 40 to 75 mph resulting in about $1.288M in property damage, 4 injuries, and 1 death.

Census Tract	Expected Annual Loss Score	Expected Annual Loss Rating	Risk Score	Risk Rating
709201	17.97	Relatively Low	18.43	Relatively Low
709202	17.95	Relatively Low	18.37	Relatively Low
709502	17.32	Relatively Low	18.24	Relatively Low
709701	16.53	Relatively Low	18.15	Relatively Low
709400	15.28	Relatively Low	17.96	Relatively Low
709100	14.92	Relatively Low	15.96	Very Low
709600	14.92	Relatively Low	15.66	Very Low
709702	13.978	Very Low	14.09	Very Low
709501	13.23	Very Low	12.12	Very Low

Table 3-4: Tornado EAL and Risk Score and Rating by Census Tract

Sustained Wind Speed	Annual Recurrence Interval (years)	Physical Effects
6-38 kts (30-44 mph)	<1	Trees in motion. Light-weight loose objects (e.g., lawn furniture) tossed or toppled.
39-49 kts (45-57 mph)	2 to 10	Large trees bend; twigs, small limbs break, and a few larger dead or weak branches may break. Old/weak structures (e.g., sheds, barns) may sustain minor damage (roof, doors). Building partially under construction may be damaged. A few loose shingles removed from houses. Carports may be uplifted; minor cosmetic damage to mobile homes and pool lanai cages.
50-64 kts (58-74 mph)	10 to 70	Large limbs break; shallow rooted trees pushed over. Semi-trucks overturned. More significant damage to old/weak structures. Shingles, awnings removed from houses; damage to chimneys and antennas; mobile homes, carports incur minor structural damage; large billboard signs may be toppled
65-77 kts (75-89 mph)	70 to 300	Widespread damage to trees with trees broken/uprooted. Mobile homes may incur more significant structural damage; be pushed off foundations or overturned. Roof may be partially peeled off industrial/commercial/warehouse buildings. Some minor roof damage to homes. Weak structures (e.g., farm buildings, airplane hangars) may be severely damaged.
78+ kts (90+ mph)	>300	Many large trees broken and uprooted. Mobile homes severely damaged; moderate roof damage to homes. Roofs partially peeled off homes and buildings. Moving automobiles pushed off dry roads. Barns, sheds demolished.

Table 3-5: Physical Effects associated with different wind speeds

Dam Failure

There are 6 high hazard dams within the City of Leominster, including 4 owned by the City itself. The dams function as water supply and/or recreation sources. High hazard dams will likely cause loss of life and serious damage to homes, businesses and major roadways in the event of dam failure.

Both high and significant hazard dams are required by the Massachusetts Office of Dam Safety to have Emergency Action Plans (EAPs) to assist public safety personnel before, during, and after an uncontrolled release of water at the dams. High hazard dams are also required to have a Phase I Dam Inspection and Report prepared every two years.

The EAP establishes the guidelines and procedures for addressing emergency conditions identified at the dam in time to take mitigative action such as notifying the appropriate emergency management officials of potential, impending, or active failing of the dam. Emergency conditions are generally identified by dam inspections (formal or casual) or triggered by unusual rainfall events or an earthquake. Identification of hazardous condition should be reported to the dam owner or to public safety personnel via 911 to initiate the notification process based on the Notification Flowchart (NFC) listing the personnel to be called and their phone numbers in case of emergency. The reader is referred to each dam's EAP for detailed information regarding these procedures.

Each EAP contains a Notification Flowchart (NFC) and Emergency Level Determination: The NFC indicates the chain of communication to be followed in the event of an emergency. The NFC indicates a Phase I and Phase II type of notification to be implemented depending on the emergency classification level (Condition I or II) as determined necessary based on the judgment of the personnel monitoring the emergency condition at the dam. The two emergency conditions outlined in the EAP are as follows:

- Condition I: "Potential failure situation is developing": This is a situation where a failure may eventually occur if left unattended. This situation will require Phase I response with continuous monitoring.
- Condition II: "Failure is imminent or has occurred": This is a situation where a failure has occurred, is occurring, or is just about to occur. This situation will require Phase I and II responses that will proceed with evacuation procedures.

General Responsibilities: The EAP includes specific emergency response actions for each Emergency Condition to be carried out by the responsible local and state authorities. Decisions that are made should be made in accordance with the Incident Command Structure outlined in the EAP. Notification of local authorities is primarily the responsibility of the dam owner, depending on the identified Emergency Condition as outlined in Section 5 of the EAP.

Evacuation Lists: The EAP includes a list of property lots and coordinates that would be notified in the event of an emergency.

Preparedness: The most important part of the EAP is the identification of a problem at the dam. The EAP notes that problem identification will be much easier if the dam is monitored closely by knowledgeable personnel. Maintenance District personnel must continue to monitor the dam on a regular basis. This is especially important during high rainfall events and during spring conditions when a large amount of snow melting occurs.

Each EAP also contains inundation mapping displaying the anticipated area subject to flooding in the event of dam failure. The inundation maps may consist of an overall index map and finer-scale resolution maps such as the map presented below (see **Figure 3-3**), for Notown Reservoir Dam.

The dam failure inundation areas often include separate areas for failure during a flood and failure during a sunny day. Generally, the inundation areas close to the dam are larger than FEMA's Base Flood. Dam failure is often considered a potential low probability, high consequence type event. The reader is referred to each dam's EAP for more information.

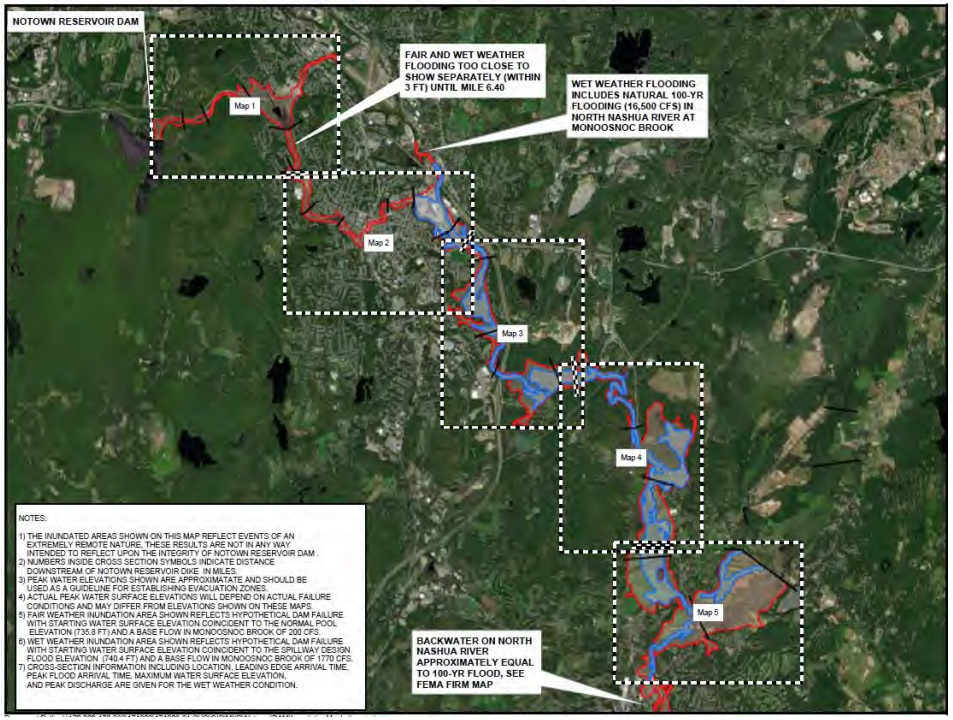


Figure 3-3: Notown Reservoir Dam Failure Inundation Map

Severe Winter Weather

Leominster is vulnerable to frequent snowstorms, usually associated with nor'easters. The U.S. Northeast annually experiences about 20 to 40 nor'easters. Beginning in October and ending in April, the nor'easter season runs for seven months. Out of the 20 to 40 annual storms, at least two are likely to be severe. **Attachment 2** presents details about Leominster's severe winter weather hazards. The risk score and rating as well as the EAL score and rating for Ice Storms is presented in **Table 3-6** for the census tracts within Leominster.

Damages due to severe winter weather include: 1) damage to trees, often resulting in power outages and also potentially fatal accidents related to treefalls; 2) structure damage, including roof collapse; and 3) roadway issues including access limitations and vehicular accidents.

Likelihood/Frequency

Between 1996 and 2021, there were a total of 88 Heavy Snow event days in Worcester County, with 12 days with property damage ($5.485M) and no injuries or fatalities. Estimated Leominster snowfall frequency:

- Average annual snowfall of 50 to 75 inches
- 96% AEP or 1.04 year recurrence interval Heavy Snowfall (25 years with 1 or more events over 26 years)

Severity/Magnitude

The severity/magnitude of severe winter weather is a function of the type of vulnerability. Snowfall vulnerabilities generally include: 1) building damage (e.g., roof collapse) due to snow weight; 2) branch fall and power line failure due to snow and ice weight and wind; and 3) snow roadway clearance capabilities relative to snow fall rates.

Building Damage: The Massachusetts State Building Code requires that structures be constructed in Leominster, at a minimum, to snow loads of 30 pounds per square foot (psf). The relationship of snow load to snow depth is a function of the water content of the snow (i.e., wet snow is heavier) and can be variable. In general, 30 psf snow loads correlates to about 24 inches of snow. For weight snow events (saturated snow = +/- 2 pcf), 30 psf correlates to about 15 inches of snow. During periods of cold, snow will not melt on roofs and will accumulate due to multiple snowfall events. Ref. https://www.mutualbenefitgroup.com/insurance-101/storm-center/prevent-roof-collapse-on-your-home/

Tree and Powerline Damage: 1/2" of ice can add 500 pounds load on power lines and trees, resulting in extensive damage. Similarly, greater than 6 to 8 inches of heavy snow accumulation on tree branches can result in significant tree damage.

Other Severe Winter Weather Events: Ice Storms

Other Leominster severe winter events include ice storms. **Attachment 2** presents details for this hazard. The risk score and rating as well as the EAL score and rating for Ice Storms is presented in **Table 3-6** for the census tracts within Leominster.

Leominster's vulnerability to ice storms is primarily loss of power and tree fall. The probability of damaging ice storms is high.

Likelihood/Frequency

Between 1996 and 2021, there were a total of five (5) Ice Storm event days in Worcester County, with one (1) injury and $5.485M property damage. Estimated Leominster ice storm frequency:

- 17% AEP or 6 year recurrence interval Heavy Snowfall (4 years with 1 or more events over 26 years)

Census Tract	Expected Annual Loss Score		Expected Annual Loss Rating		Risk Score		Risk Rating	
	Winter Weather	Ice Storm	Winter Weather	Ice Storm	Winter Weather	Ice Storm	Winter Weather	Ice Storm
709201	17.97	28.69	Relatively Low	Relatively Moderate	9.22	20.52	Relatively Low	Relatively Moderate
709202	17.95	28.68	Relatively Low	Relatively Moderate	8.96	20.32	Relatively Low	Relatively Moderate
709502	17.32	27.77	Relatively Low	Relatively Moderate	8.92	20.29	Relatively Low	Relatively Moderate
709701	16.53	26.30	Relatively Low	Relatively Moderate	8.72	20.23	Relatively Low	Relatively Moderate
709400	15.28	24.24	Relatively Low	Relatively Moderate	8.59	19.98	Relatively Low	Relatively Moderate
709100	14.92	24.19	Relatively Low	Relatively Moderate	7.05	18.03	Relatively Low	Relatively Moderate
709600	14.92	23.78	Relatively Low	Relatively Moderate	6.9	17.7	Relatively Low	Relatively Moderate
709702	13.978	22.64	Relatively Low	Relatively Moderate	6.62	15.66	Relatively Low	Relatively Low
709501	13.23	21.38	Relatively Low	Relatively Moderate	5.48	13.65	Relatively Low	Relatively Low

Table 3-6: Winter Weather and Ice Storm EAL and Risk Score and Rating by Census Tract

Attachment 4: FEMA HAZUS-MH Simulation Results

FEMA HAZUS-FLOOD HAZARD SCENARIO ANALYSES

Scenario analyses predict the impacts of an event or particular type of an event. This level of analysis considers potential impacts to infrastructure, people, and cost, as well as likelihood or frequency of the event. Scenario analyses were performed using the FEMA Multi-Hazard HAZUS-MH software.

Level 1 HAZUS analyses were performed using the HAZUS Flood module. The earthquake, wind, and tsunami modules were not used, as the FEMA National Risk Index provided risk characterizations for those hazards. A Level 1 HAZUS analysis calculates basic estimates of flood losses based on national databases and expert -based analysis parameters included in the HAZUS software. The data used for this analysis included the HAZUS "default" data included in the HAZUS software and 2010 US Census Data. Level 1 analyses are appropriate for initial loss estimation at the planning level, and is not intended for establishing the flood, earthquake, or hurricane related risk of any specific parcel or property.

Potential losses estimated by HAZUS include:

- **Physical damage,** to residential and commercial buildings, schools, critical facilities, and infrastructure;
- **Economic loss**, including lost jobs, business interruptions, repair, and reconstruction costs;
- **Social impacts**, including estimates of shelter requirements, displaced households, and population exposed to scenario floods, earthquakes, and hurricanes

https://www.fema.gov/HAZUS

There are 12,956 buildings in Leominster, with a total building replacement value (excluding contents) of $5.601 billion (2010 dollars; HAZUS). **Table 4-1** presents the total building value in Leominster. Approximately 89.13% of the buildings (representing about 71.93% of the total value) are residential. **Table 4-2** provides an overview of the expected damage and loss categories that will be the focus of this scenario analysis based on the results generated from the Flood HAZUS module runs.

Occupancy	Exposure ($1000)	Percent of Total
Residential	4,028,575	71.9%
Commercial	829,302	14.8%
Industrial	594,609	10.6%
Agricultural	18,887	0.3%
Religion	60,951	1.1%
Government	22,408	0.4%
Education	46,123	0.8%
Total	5,600,855	100%

Table 4-1: Leominster Building Exposure and Occupancy Type

DIRECT DAMAGE
General Building Stock
Essential Facilities
DIRECT LOSSES
Shelter Needs
INDIRECT LOSSES
Economic Loss
Property Damage Business Interruption

Table 4-2: Damage and Loss Categories

Flood Scenario

The City is vulnerable to riverine flooding. The flood scenario analysis used the default building stock from HAZUS as presented categorically in **Table 4-2** and the FEMA-defined flood hazard zones. **Table 4-3** presents the estimated damages and losses for the 100-year (1%), and 500-year (0.2%) floods for: 1) buildings; 2) essential facilities; 3) displaced people and sheltering; and 4) Economic Losses.

Building Damages

About 33 Leominster buildings would experience at least moderate damage from a 100-year recurrence interval flood and 45 would experience at least moderate damage from a 500-year recurrence interval flood . No buildings are predicted to experience substantial damage.

The associated economic losses (including business interruption) range from $89 million (100-year event) to $148 million (500-year event).

Essential Facilities

Based on the HAZUS flood analysis, zero (0) essential facilities are expected to be impacted or lose functionality during either the 100-year or 500-year recurrence interval floods.

Sheltering Requirements

Based on the HAZUS flood analysis, 314 households would be displaced and 238 people would require shelter for the 100-year flood and 428 households would be displaced and 271 people would require shelter for the 500-year flood.

	100-Yr	**500-Yr**
Building Damages (# of Buildings)		
# of Buildings with Slight Damage (1-10%)	32	44
# of Buildings with Moderate Damage (11-50%)	33	45
# of Buildings with Substantial Damage (>50%)	0	0
TOTAL	**65**	**89**
Essential Facilities Building Damages (Lose of Use > 1 Day)	100-Yr	500-Yr
Emergency Operations Center	0	0
Fire	0	0
Hospitals	0	0
Police	0	0
Schools	0	0
TOTAL	**0**	**0**
Sheltering Requirements	100-Yr	500-Yr
Displaced Households (# Households)	314	428
Short-Term Shelter (# People)	238	271
Economic Losses (in millions of dollars)	100-Yr	500-Yr
Residential Property - Building Loss	$13.21	$18.92
Total Property - Building Loss	$37.76	$67.98
Business Interruption	$51.29	$80.16
Total	**$89.04M**	**$148M**

Table 4-3: HAZUS Flood Scenario Results

Hurricane Wind Scenario

The City is vulnerable to hurricane wind events. The hurricane wind scenario analysis used the default building stock from HAZUS as presented categorically in **Table 4-2**. **Table 4-4** presents the estimated damages and losses for the 100-year (1%), and 500-year (0.2%) hurricane wind events for: 1) buildings; 2) essential facilities; 3) displaced people and sheltering; and 4) Economic Losses.

Building Damages

About 20 Leominster buildings would experience at least moderate damage from a 100-year recurrence interval wind event and 226 would experience at least moderate damage from a 500-year recurrence interval wind event.

The associated economic losses (including business interruption) range from $17.67 million (100-year event) to $79.73 million (500-year event).

Essential Facilities

Based on the HAZUS hurricane wind analysis, zero (0) essential facilities are expected to be impacted or lose functionality during either the 100-year or 500-year recurrence interval wind events.

Sheltering Requirements

Based on the HAZUS wind analysis, 4 households would be displaced and 3 people would require shelter for the 100-year wind event and 87 households would be displaced and 51 people would require shelter for the 500-year wind event.

Uncertainty

Loss estimations using HAZUS are highly uncertain, in particular relative to the predicted damage and resulting economic loss. The analysis is sensitive to wind damages and makes assumptions relative to: building floor elevations and percent damage (using generic depth-damage relationships). It also estimates loss based on a census block scale (i.e., not a building scale). HAZUS reasonably predicts the number of structures impacted. Significant uncertainty with economic loss analyses is also due to the uncertainty related to hurricane– wind probability. Uncertainty can be reduced by performing more site-specific analysis (i.e., Level 2 and 3 analyses, using building scale analyses). Uncertainty can also be reduced by comparing results to observed impact and losses. Unfortunately, there is limited historical loss data that is relevant to low probability storms (i.e. 50-year, 100-year and 500-year recurrence hurricane-wind events) in Massachusetts.

	100-Yr	**500-Yr**
Building Damages (# of Buildings)		
# of Buildings with Slight Damage (1-10%)	161	1,240
# of Buildings with Moderate Damage (11-50%)	19	226
# of Buildings with Substantial Damage (>50%)	1	9
TOTAL	**181**	**89**
Essential Facilities Building Damages (Lose of Use > 1 Day)	100-Yr	500-Yr
Emergency Operations Center	0	0
Fire	0	0
Hospitals	0	0
Police	0	0
Schools	0	0
TOTAL	**0**	**0**
Sheltering Requirements	100-Yr	500-Yr
Displaced Households (# Households)	4	87
Short-Term Shelter (# People)	3	51
Economic Losses (in millions of dollars)	100-Yr	500-Yr
Residential Property - Building Loss	$16.85	$69.58
Total Property - Building Loss	$17.33	$75.15
Business Interruption	$0.34	$4.58
Total	**$17.67M**	**$79.73M**

Table 4-4: HAZUS HW Scenario Results

Earthquake Scenario

The City is vulnerable to earthquake events. The earthquake scenario analysis used the default building stock from HAZUS as presented categorically in **Table 4-2**. **Table 4-5** presents the estimated damages and losses for the 1,000-year (0.1%), and 2,500-year (0.04%) earthquake events for: 1) buildings; 2) essential facilities; 3) displaced people and sheltering; and 4) Economic Losses.

Building Damages

About 133 Leominster buildings would experience at least moderate damage from a 1,000-year recurrence interval earthquake event and 399 would experience at least moderate damage from a 2,500-year recurrence interval earthquake event.

The associated economic losses (including business interruption) range from $31.07 million (1,000-year event) to $112.22 million (2,500-year event).

Essential Facilities

Based on the HAZUS earthquake analysis, zero (0) essential facilities are expected to be impacted or lose functionality during either the 1,000-year or 2,500-year recurrence interval earthquake events.

Sheltering Requirements

Based on the HAZUS earthquake analysis, 89 households would be displaced and 51 people would require shelter for the 1,000-year earthquake event and 89 households would be displaced and 51 people would require shelter for the 2,500-year earthquake event.

Uncertainty

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

	1,000-Yr	**2,500-Yr**
Building Damages (# of Buildings)		
# of Buildings with Slight Damage (1-10%)	557	1,393
# of Buildings with Moderate Damage (11-50%)	133	399
# of Buildings with Substantial Damage (>50%)	16	60
TOTAL	**706**	**1,852**
Essential Facilities Building Damages (Lose of Use > 1 Day)	1,000-Yr	2,500-Yr
Emergency Operations Center	0	0
Fire	0	0
Hospitals	0	0
Police	0	0
Schools	0	0
TOTAL	**0**	**0**
Sheltering Requirements	1,000-Yr	2,500-Yr
Displaced Households (# Households)	89	89
Short-Term Shelter (# People)	51	51
Economic Losses (in millions of dollars)	1,000-Yr	2,500-Yr
Residential Property - Building Loss	$15.03	$58.86
Total Property - Building Loss	$26.37	$98.81
Business Interruption	$4.70	$13.41
Total	**$31.07M**	**$112.22M**

Table 4-5: HAZUS Earthquake Scenario Results

Attachment 5: Potential State and Federal Funding Sources

Attachment 5: Potential State and Federal Funding Sources

Several of the proposed hazard mitigation projects and actions may be eligible activities for funding under the FEMA Hazard Mitigation Assistance (HMA) Grant Programs. The FEMA HMA Grant Programs include two non-disaster mitigation grant programs that include the BRIC and Flood Mitigation Assistance grant programs, and one disaster mitigation grant program that is the Hazard Mitigation Grant Program. An overview of each program is outlined as follows.

Building Resilient Infrastructure and Communities (BRIC)

BRIC is a new FEMA pre-disaster hazard mitigation program that replaces the existing Pre-Disaster Mitigation (PDM) program. On an annual basis FEMA will set aside up to 6% of the annual Disaster Recovery Fund for proactive mitigation and community capacity building planning projects. For Fiscal Year (FY) 2021 BRIC grant applications were due to FEMA on January 28, 2022 with $1 billion available in funds. For FY 2021, FEMA increased its allocations by S400,000 to $1 million to the Commonwealth of Massachusetts for Capability- and Capacity-Building (C&CB) activities. Additionally, this change includes an increase to mitigation planning and planning-related activities of $500,000 per applicant. C&CB activities enhance the knowledge, skills, expertise, etc., of the current workforce to expand or improve the administration of mitigation assistance. This includes activities in the following subcategories: building codes activities, partnerships, project scoping, mitigation planning and planning-related activities, and other activities. $919,000,000 was also available for applicants (i.e., States, District of Columbia, U.S. territories, and Indian tribal governments (federally recognized)) through a national competition for BRIC grants for proactive large and small mitigation projects (with a new focus on lifeline facilities, natural and nature-based features, innovative projects, and large projects).

The BRIC program guiding principles are supporting communities through capability - and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency. The Mitigation Action Portfolio is an online resource that introduces the BRIC grant program with many project case history examples of eligible hazard mitigation activities, the community lifelines involved, and the funding partners involved around the country. BRIC's final Policy will be published soon in Federal Register. These grants will require a national disaster declaration within the past seven years, which includes the Whole of America COVID-19 Pandemic Emergency Declaration. In FY 2021, $1 Billion was available for the BRIC grant program. Applications were due to FEMA on January 28, 2022. The City of Leominster will be eligible as a sub-applicant to the Massachusetts Emergency Management Agency (MEMA) for BRIC funding for FY 2022. For more detailed program information on the BRIC program please go to Building Resilient Infrastructure and Communities | FEMA.gov .(06/20/22)

Flood Mitigation Assistance (FMA)

The purpose of the FMA program is to reduce or eliminate the risk of repetitive flood damage to buildings and structures insured under the National Flood Insurance Program (NFIP). The FMA Program makes federal funds available to state, local, tribal, and territorial governments available for: 1) Project Scoping (previously Advance Assistance); 2) Community Flood Mitigation Projects; 3) Technical Assistance; 4) Flood Hazard Mitigation Planning; and Individual Flood Mitigation Projects.

FEMA Funding for BRIC and FMA is appropriated by Congress annually and awarded on a nationally competitive basis. FY 2021, $160 Million was available for the FMA grant program. Applications were due to FEMA on January 28, 2022. The City of Leominster will be eligible as a sub-applicant to the MEMA for FMA funding for FY 2022. For more detailed program information on the FMA program please go to Flood Mitigation Assistance (FMA) Grant | FEMA.gov .(06/20/22)

Hazard Mitigation Grant Program (HMGP)

The HMGP provides funds to states, territories, tribal governments, and other communities after a disaster, to reduce or eliminate future risk to lives and property from natural hazards. The funding for FEMA's HMGP is 15% of the total assessed damages for a given disaster for states that meet FEMA's standard Mitigation Plan requirements, which applies to the Commonwealth of Massachusetts. The HMGP application period is open for one year from the disaster declaration date.

The federal share of HMGP assistance is not less than 75 percent of the eligible cost. The HMGP requires a 25% local match for traditional Hazard Mitigation Assistance (HMA) projects. On March 13, 2020, the United States declared a nationwide emergency from the COVID-19 global pandemic which is still ongoing. On Aug. 8, 2021, an additional 3.46 billion in mitigation funding was announced for 59 major disaster declarations for COVID-19 global pandemic. The most recent open disaster was announced on August 12, 2021 - Massachusetts Covid-19 Pandemic (FEMA-4496-DR-MA HMGP) and the final State deadline for this disaster is October 9, 2022. $110,760,576 is available statewide. FEMA increased the federal cost share under FEMA-4496-DR-MA HMGP to no less than 90% (see MEMA Notice of Funding Opportunity FEMA-4496-DR-MA-HMGP and/or https://www.fema.gov/hazard-mitigation-grant-program . (06/20/22)

MEMA manages the HMGP application process by providing a state application that eligible entities complete and submit to MEMA electronically. Note that the application process for BRIC and FMA is conducted through FEMA's Grants Outcome (GO) online application process system (see https://www.fema.gov/grants/guidance-tools/fema-go). The application period for FEMA-4496-DR-MA HMGP is October 9, 2022.

All three HMA programs are managed by the MEMA with support from Department of Conservation and Recreation (DCR) and Executive Office of Energy and Environmental Affairs (EOEEA). Contact MEMA at (508) 820-1443 for more information on each of these HMA grant programs.

Public Assistance (PA)

FEMA's Public Assistance (PA) grant program provides federal assistance to governmental organizations and certain private nonprofit (PNP) organizations following a Presidential disaster declaration. Through the program, FEMA provides supplemental federal disaster grant assistance for debris removal, life-saving emergency protective measures, and the repair, replacement, or restoration of disaster-damaged publicly-owned facilities, and the facilities of certain PNP organizations.

The PA program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process. The federal share of assistance is not less than 75 percent of the eligible cost. The Recipient (usually the state) determines how the non-federal share (up to 25 percent) is split with the subrecipients (eligible applicants). https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

HUD Disaster Recovery and Resiliency Grants

Community Development Block Grant – Disaster Recovery (CDBG-DR)

Similar to FEMA's HMGP, HUD provides disaster recovery grants to help municipalities like Leominster and the State recover from Presidentially-declared disasters, especially in low-income areas. The goal of these grants is to rebuild the impacted areas and provide critical funding to start the recovery process. The CDBG-DR program allows for the funding of a wide range of recovery activities including planning activities that aide communities and neighborhoods that may otherwise not recover because of a lack of resources.

US Department of Agriculture's (USDA) and other Federal Grants

Natural Resources Conservation Services (NRCS)

The NRCS is the US Department of Agriculture's (USDA) leading agency providing voluntary technical and financial assistance to conservation districts, private landowners, tribal governments, and other organizations to help sustainably manage, conserve and improve natural resources at the local level. Two financial programs that offer funding support in response to natural hazards are outlined as follows.

Emergency Watershed Protection Program (EWP)

Congress established the EWP to assist public and private landowners in response to emergencies resulting from natural hazards including riverine flooding and storms. The mission of the EWP program is to assist people and conserve natural resources by reducing the future impacts to public safety and property caused by floods, storms and other natural hazards. The NRCS is the managing agency for the EWP program that includes two focus areas which are: EWP-Recovery and EWP-Floodplain Easement (FPE).

The EWP-Recovery provides recovery assistance to public and private landowners as a result of a natural disaster that requires a 25% local match with the NRCS providing a 75% match for the construction cost for emergency measures. The EWP-FPE provides assistance to privately-owned lands or lands owned by a local or state government that have been damaged by flooding at least once within the previous calendar year or have been subject to flood damage at least twice within the previous ten years.

Watershed & Flood Prevention Operations (WFPO) Program

The Watershed Protection and Flood Prevention Act of 1954 authorizes the NRCS to provide technical and financial assistance to states, local and tribal governments (project sponsors) for the planning and implementation of approved watershed plans. The NRCS works with local sponsors to protect and restore watersheds from damage caused by erosion, floodwater and sediment, to conserve and develop water and land resources, and to solve natural resource and related economic problems on a watershed basis. In Massachusetts, the project sponsor for watershed projects is the Massachusetts Department of Conservation and Recreation (MA DCR). The MA DCR provides assistance for the implementation of measures outlined in approved plans, and is focusing their efforts on reducing flood damages.

U.S. Department of Commerce Economic Development Administration Disaster Recovery Grants

The Economic Development Administration (EDA) often releases a Disaster Recovery Supplemental grant program to address economic development challenges caused by a disaster. For example, in June 2019, Congress passed the Additional Supplemental Appropriations for Disaster Relief Act, 2019 providing EDA with $600 million in additional Economic Adjustment Assistance (EAA) Program funds for necessary expenses related to flood mitigation, disaster relief, long-term recovery, and restoration of infrastructure in areas impacted by Hurricanes Florence, Michael, Lane, Typhoons Yutu and Mangkhut, wildfires, volcanic eruptions, earthquakes and other calendar year 2018 disasters under the Stafford Act and tornadoes and floods in calendar year 2019. Of the total available funding $50 million is open for states including Massachusetts.

EAA funds can be awarded to assist a wide variety of activities related to disaster recovery focused on economic development, including economic recovery strategic planning grants and construction assistance. Through this program, EDA can support both the development of disaster recovery strategies and the implementation of recovery projects identified with those strategies, including construction activities, capitalizing revolving loan funds (RLFs), and a variety of others. Disaster recovery project activities that can be eligible for Disaster Supplemental grants include, but are not limited to, economic recovery and resiliency projects that:

- Support the creation of new businesses and jobs in a variety of industry sectors, including, but not limited to advanced manufacturing, agriculture, energy, information technology, health care, telecommunications, tourism and recreation, transportation, and cultural and natural assets.
- Implement local and regional job creation and growth and economic diversification strategies targeted towards affected workers and businesses.
- Construction activities, including the restoration of damaged infrastructure, infrastructure enhancement, building new infrastructure including high performance and resilient infrastructure.
- Strengthening or developing existing or emerging industry clusters.

- Resiliency projects to increase the ability of a community or region to anticipate, withstand, and bounce back from future economic injuries and disasters. This may include: ensuring redundancy in telecommunications and broadband networks; promoting business continuity and preparedness; industrial diversification; employing safe development practices in business districts and surrounding communities; conducting disaster recovery planning with key stakeholders; and other methods that strengthen local and regional capacity to troubleshoot and address vulnerabilities within the regional economy.

- Developing business incubator programs.

- Enhancing access to and use of broadband services to support job growth through business creation and expansion.

- The development of economic development diversification strategies in accordance with EDA CEDS recommendations.

- Facilitating access to private capital investment and providing related capacity building and technical assistance, such as effective utilization of capital investment for business development and job creation.

- Facilitating and promoting market access for goods and services.

https://www.eda.gov/disaster-recovery/ (02/22/2021)

Commonwealth of Massachusetts Grants

Dams and Seawall Repair or Removal Program

The Dam and Seawall Repair or Removal Program offers financial resources to qualified applicants for projects that share our mission to enhance, preserve, and protect the natural resources and the scenic, historic and aesthetic qualities of the Commonwealth of Massachusetts.

The Dam and Seawall Repair or Removal Fund was established in 2013 by the Massachusetts Legislature to promote public health, public safety, and ecological restoration. Additional funds have also been supplemented the program with monies authorized in the EEA Environmental Bond.

The grant application for the Dam and Seawall Program is now closed. Please check back in fall, 2022 for the next open application period. For more information contact William Hinkley at617.626.1177 or by email at william.hinkley@mass.gov

Municipal Vulnerability Preparedness (MVP) Grant Programs

The Municipal Vulnerability Preparedness (MVP) Grant Program provides direct funding and support to cities and towns to complete a community-driven process that will bring together climate change information and local knowledge to identify top hazards, current challenges, and community strengths and then to develop priority actions to improve the municipality's resilience to all natural and climate-related hazards using a flexible, tested approach called the Community Resilience Building (CRB) workshop guide. The program provides access to a pool of state-certified MVP providers, a standardized toolkit for assessing climate change vulnerability and developing strategies, and access to the best available statewide climate projections and data.

Upon successful completion of the CRB process, municipalities will be designated as a "Municipal Vulnerability Preparedness (MVP) program community," or an "MVP Community" which enables communities to participate in the MVP Action Grants for program implementation, leads to increased standing in future state funding opportunities and indicates the community's commitment to preparing for climate change. Completion of the program will ensure that as municipalities make investments, set policy, and implement climate change adaptation projects they have a thorough understanding of their risk and vulnerabilities from climate change impacts and how these impacts specifically affect their residents, community, local economy and natural resources.

https://www.mass.gov/municipal-vulnerability-preparedness-mvp-program

MVP Planning Grants

Funding is to support municipalities who are completing climate change vulnerability assessments and resiliency planning using the Community Resilience Building workshop guide, and to allow them to procure an MVP certified provider (chosen from a list provided by the Commonwealth), to assess vulnerability to a full range of climate change impacts, including temperature changes, extreme weather, sea level rise, inland flooding, changes in precipitation, and other impacts, across multiple sectors of the municipality.

MVP Action Grants

The MVP Action Grant offers financial resources to municipalities that are seeking to advance priority climate adaptation actions to address climate change impacts resulting from extreme weather, sea level rise, inland and coastal flooding, severe heat, and other climate impacts. To discuss potential actions contact the MVP Coordinator for the Central Region, Hillary King at hillary.king@mass.gov. For more information on MVP Action Grants refer to https://www.mass.gov/s.rvice-details/mvp-action-grant. (06/24/2022)

Attachment 6: Public Review Documentation

Attachment 7: References and Resources

Attachment 7: References and Resources

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Attachment 8: Key Contacts

KEY CONTACTS

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MEMA Region I Office
978-328-1500

MEMA Region II Office
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MEMA Region III & IV Office
413-750-1400

MEMA Training & Exercise
508-820-1408

https://www.mass.gov/orgs/massachusetts-emergency-management-agency\
https://www.mass.gov/topics/mema-resources-for-public-officials

CITY OF LEOMINSTER EMERGENCY MANAGEMENT

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978-534-7580

Administrative Assistant: Ms. Debbie Bottalico
978-534-7580

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  978-534-7541
- Police Department
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  978-534-7560
- Department of Public Works
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  Leominster, MA 01453
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911

KEY CONTACTS

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DEPARTMENT OF CONSERVATION AND RECREATION (DCR)

DCR Office of Water Resources (OWR)

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SALVATION ARMY

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