



**FEMA**

March 27, 2023

Dawn Brantley, Acting Director  
Massachusetts Emergency Management Agency  
400 Worcester Road  
Framingham, Massachusetts 01702-5399

Acting Director Brantley:

The U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) Region I Mitigation Division has approved the City of Framingham, MA Hazard Mitigation Plan Update, effective **March 27, 2023** through **March 26, 2028** in accordance with the planning requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended, the National Flood Insurance Act of 1968, as amended, and Title 44 Code of Federal Regulations (CFR) Part 201.

With this plan approval, the jurisdiction is eligible to apply to the Massachusetts Emergency Management Agency for mitigation grants administered by FEMA. Requests for funding will be evaluated according to the eligibility requirements identified for each of these programs. A specific mitigation activity or project identified in this community's plan may not meet the eligibility requirements for FEMA funding; even eligible mitigation activities or projects are not automatically approved.

The plan must be updated and resubmitted to the FEMA Region I Mitigation Division for approval every five years to remain eligible for FEMA mitigation grant funding.

Thank you for your continued commitment and dedication to risk reduction demonstrated by preparing and adopting a strategy for reducing future disaster losses. Should you have any questions, please contact Brigitte Ndikum-Nyada at (617) 378-7951 or [brigitte.ndikum-nyada@fema.dhs.gov](mailto:brigitte.ndikum-nyada@fema.dhs.gov).

Sincerely,

Dean Savramis  
Mitigation Division Director  
DHS, FEMA Region I

DS: bnn

cc: Jeffrey Zukowski, Hazard Mitigation Planner, MEMA  
Marybeth Groff, CFM, Hazard Mitigation & Climate Adaptation Coordinator, MEMA  
Beth Dubrawski, Hazard Mitigation Contract Specialist, MEMA

# CITY OF FRAMINGHAM, MA HAZARD MITIGATION PLAN UPDATE JANUARY 2023

---



**City of Framingham**

150 Concord Street

Framingham, MA 01701

<https://www.framinghamma.gov>

# CITY OF FRAMINGHAM, MA HAZARD MITIGATION PLAN UPDATE

---

January 2023

City of Framingham

150 Concord Street

Framingham, MA 01701

<https://www.framinghamma.gov>

Prepared by:

**JAMIE CAPLAN CONSULTING LLC**  
Emergency Management Services

351 Pleasant Street, Suite B # 208 · Northampton, MA 01060

Phone: 413-586-0867 · Fax: 413-727-8282 · [www.jamiecaplan.com](http://www.jamiecaplan.com)

## Table of Contents

- Table of Contents ..... 1**
- Table of Figures ..... 3**
- Table of Tables ..... 4**
- Acknowledgements ..... 6**
- Local Adoption Resolution ..... 7**
- Record of Changes ..... 8**
- Chapter 1. Introduction ..... 9**
  - Purpose of the Plan .....9
  - Guiding principles for plan development .....10
  - Mitigation Strategy .....10
  - Plan Update and Changes.....12
    - Changes in Development .....13
    - Progress in Mitigation Efforts .....14
    - Changes in Priority Since 2017.....14
  - Authority and Assurances.....15
  - Plan Adoption .....15
  - Document Overview .....15
- Chapter 2: Planning Area Profile .....17**
  - History and Background .....17
  - Land Use and Development Trends.....18
  - Environmental Justice Populations.....20
  - Natural Resources .....22
    - Rivers .....22
    - Dams.....23
  - Infrastructure .....27
    - Water and Sewer Service.....27
    - Critical Transportation Infrastructure.....27
  - Critical Facilities.....28
  - Historic and Cultural Resources.....32

# City of Framingham, MA Hazard Mitigation Plan Update

- Chapter 3. Planning Process.....34**
  - Hazard Mitigation Working Group ..... 35
  - Public Outreach ..... 39
  - Review of Draft Plan ..... 46
- Chapter 4: Risk Assessment .....50**
  - Hazard Identification ..... 50
  - Hazard Profiles..... 51
    - Primary Climate Change Interaction: Changes in Precipitation..... 53
    - Primary Climate Change Interaction: Changing Temperatures ..... 76
    - Primary Climate Change Interaction: Extreme Weather Events..... 101
  - Non Climate-Induced Hazards ..... 121
  - National Flood Insurance Repetitive Loss Properties ..... 128
  - Hazard Ranking..... 128
  - Problem Statements ..... 130
- Chapter 5: Capability Assessment ..... 133**
  - Capability Assessment Purpose..... 133
  - Review and Incorporation of Existing Studies ..... 134
  - Planning and Regulatory Capabilities ..... 136
  - Administrative and Technical Capabilities..... 145
  - Financial Capabilities ..... 147
  - Education and Outreach Capabilities ..... 149
  - National Flood Insurance Program (NFIP) Participation and Compliance ..... 150
  - Conclusions..... 154
- Chapter 6. Mitigation Strategy.....159**
  - Mitigation Goals ..... 159
  - Comprehensive Range of Mitigation Actions ..... 193
  - Mitigation Action Plan ..... 194
  - System to Integrate this Plan with other Planning Mechanisms..... 213
  - Possible funding sources ..... 214
- Chapter 7. Plan Maintenance.....218**
  - Continued Public Participation ..... 218

# City of Framingham, MA Hazard Mitigation Plan Update

- Method and Schedule for Keeping the Plan Current..... 219
  - Process to Track Actions ..... 219
  - Process to Evaluate Effectiveness of the Plan ..... 219
  - Process to Update the Plan..... 220
- Responsible Parties for Plan Implementation and Maintenance ..... 222
- Appendix A. Planning Process Supporting Materials ..... 223**
  - Hazard Mitigation Working Group Meetings ..... 223
    - HMWG Meeting Participants..... 223
  - Public Meeting Outreach..... 224
    - Press Release #1 Public Meeting ..... 224
    - Flyer for #1 Public Meeting..... 225
    - News Article Following Public Meeting #1 ..... 226
    - Press Release #2 ..... 228
    - Public Meeting #2 Flyer ..... 231
    - News Article..... 232
    - Public Review Flyer ..... 234
- Appendix B. Critical Facilities ..... 235**
- Appendix C. Mitigation Actions..... 241**
  - Action Priority Ranking Consideration..... 241
  - Actions That Protect Critical Facilities ..... 249
- Appendix D. Plan Implementation and Review Supporting Materials..... 256**
  - Plan Update Evaluation Worksheet..... 256
  - Mitigation Action Progress Worksheet ..... 257
- Appendix E. Hazus Results ..... 258**

## Table of Figures

- Figure 1. Goal Statement..... 12
- Figure 2. Objectives..... 12
- Figure 3. Southeastern Census Block Groups in Framingham..... 22
- Figure 4. Objectives..... 39
- Figure 5. Example of slide in three languages..... 41
- Figure 6. Hazard Identification Question..... 42
- Figure 7. Mitigation Suggestions at Public Meeting, 1 of 2..... 43

# City of Framingham, MA Hazard Mitigation Plan Update

- Figure 8. Mitigation Suggestions at Public Meeting, 2 of 2..... 44
- Figure 9. City of Framingham Website Homepage Announcement..... 44
- Figure 10. Weather Related Hazards Word Cloud. .... 45
- Figure 11. Plan Review Announcement. .... 46
- Figure 13: Framingham Critical Facilities and 100-Year Floodplain..... 64
- Figure 14: Landslide Susceptibility Map ..... 75
- Figure 15. Annual Days with Maximum Temperature Above 90 (SHMCAP, 2018). .... 80
- Figure 16. Annual Days with Maximum Temperatures Below 32 (SHMCAP, 2018)..... 81
- Figure 17. Change in Number of Days Per Year Over 90 Degrees and 100 Degrees Compared to Current Climate (2022 Massachusetts Climate Change Assessment). .... 82
- Figure 18: Wildfire Burn Probability Map..... 90
- Figure 19. Hurricane Storm Tracks. .... 102
- Figure 20: 100-Year Windspeeds (ASCE 7-98) ..... 106
- Figure 21. Goal Statement Comparison Between 2017 and 2022. .... 160
- Figure 22. Objectives Comparison Between 2017 and 2022..... 160

## Table of Tables

- Table 1. Summary of Changes..... 8
- Table 2. Hazards Considered..... 10
- Table 3. Planning Process Timeline. .... 35
- Table 4. Hazard Mitigation Planning Working Group..... 36
- Table 5. City of Framingham Hazards..... 51
- Table 6. Hazard Characterization ..... 52
- Table 7. Buildings in 100-Year Floodplain ..... 61
- Table 8. Population Exposed to 100-Year Floodplain (2020 U.S. Census) ..... 61
- Table 9. Dams in Vicinity ..... 63
- Table 10. Building Loss for the 100-Year Flood Scenario ..... 65
- Table 11. Drought Events Listed by USDA..... 68
- Table 12. Buildings in Moderately Unstable Area ..... 75
- Table 13. Extreme Temperature Events Listed by USDA..... 78
- Table 14. Wildfire Events Listed By USDA. .... 87
- Table 15. Buildings in 0.03% Annual Chance Area ..... 89
- Table 16. Population Exposed to 0.03% Annual Chance Wildfire (2020 U.S. Census) ..... 89
- Table 17. Building Loss for a 0.03% Annual Chance Scenario ..... 91
- Table 18. Building Loss for a 500-Year Scenario ..... 107
- Table 19. Building Loss for a 1000-Year Scenario ..... 107
- Table 20. Severe Wind Events Listed by USDA..... 120
- Table 21. Modified Mercalli Intensity Scale. .... 124
- Table 22. Building Loss for a 1500-Year Scenario ..... 126

# City of Framingham, MA Hazard Mitigation Plan Update

- Table 23. Building Loss for a 2500-Year Scenario .....127
- Table 24. Hazard Ranking Criteria .....129
- Table 25. Final Hazard Ranking of Hazards for Framingham.....130
- Table 26. Capability Assessment Components.....133
- Table 27. Planning and Regulatory Findings.....137
- Table 28. Safe Growth Survey Results.....143
- Table 29. Administrative and Technical Findings .....145
- Table 30. Financial Findings.....147
- Table 31. Education and Outreach Findings.....149
- Table 32. NFIP Summary. ....150
- Table 33. Additional NFIP Participation and Compliance Information.....154
- Table 34. Status of Previous Mitigation Actions.....162
- Table 35. Status of MVP Recommendations. ....175
- Table 36. Types of Mitigation Actions. ....193
- Table 37. Priority Ranking System. ....195
- Table 38. Mitigation Actions. ....198
- Table 39. Schedule Associated with Plan Update and Implementation.....220
- Table 40. Critical Facilities. ....235
- Table 41. Priority Ranking Scoring.....241
- Table 42. Hazards Addressed, Type of Mitigation Action and Critical Facility Protection.....249

## Acknowledgements

The City of Framingham would like to thank the following people for supporting the development of this plan. This group was considered the Hazard Mitigation Working Group throughout the planning process.

- Sam Bade, Chair, Conservation Commission
- Bob Bois, Resident and Former Chair of the Conservation Commission, City of Framingham
- Alison Eliot, Senior Project Manager, City of Framingham
- Dana Haagensen, Director of Administration & Finance, City of Framingham Fire Department
- Ed Kross, Resident, City of Framingham
- Shawn Luz, Sustainability Coordinator, City of Framingham
- Robert McArthur, Former Conservation Agent, City of Framingham
- Shane O'Brien, Former Senior Planner, City of Framingham
- Kerry Reed, Former Senior Project Manager, City of Framingham
- Sarkis Sarkisian, Director of Planning, Community Development, and Conservation, City of Framingham
- Amanda Smith, Former Assistant Conservation Administrator, City of Framingham
- Ryan Sullivan, Deputy Fire Chief, City of Framingham
- Jeffrey Zukowski, Hazard Mitigation Planner, MA Emergency Management Agency

# City of Framingham, MA Hazard Mitigation Plan Update

E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))

## Local Adoption Resolution



**CITY OF FRAMINGHAM**  
OFFICE OF THE MAYOR

Charlie Sisitsky  
Mayor

o 508-532-5401  
e mayor@framinghamma.gov  
w www.framinghamma.gov

MEMORIAL BUILDING  
150 Concord Street, Room 213  
Framingham, MA 01702

CITY OF FRAMINGHAM, MASSACHUSETTS  
MAYOR'S OFFICE  
**A RESOLUTION ADOPTING THE**  
**CITY OF FRAMINGHAM, MA HAZARD MITIGATION PLAN UPDATE**

WHEREAS, the City of Framingham established a Working Group to prepare the CITY OF FRAMINGHAM, MA HAZARD MITIGATION PLAN UPDATE and

WHEREAS, the City of Framingham participated in the development of the CITY OF FRAMINGHAM, MA HAZARD MITIGATION PLAN UPDATE;

and WHEREAS, the City of Framingham, MA has identified potential future projects to mitigate potential impacts from natural hazards in the City of Framingham, and

WHEREAS, a duly noticed public meeting was held by the City of Framingham on December 19, 2022 for the public and municipality to review prior to consideration of this resolution; and

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

NOW, THEREFORE BE IT RESOLVED that the Mayor of the City of Framingham formally approves and adopts the CITY OF FRAMINGHAM, MA HAZARD MITIGATION PLAN UPDATE, in accordance with M.G.L. c. 40.

ADOPTED AND SIGNED by the Mayor of Framingham on this 3/24, 2023

  
\_\_\_\_\_  
Charlie Sisitsky, Mayor



## Chapter 1. Introduction

The Federal Emergency Management Agency (FEMA) defines hazard mitigation per the Code of Federal Regulations (CFR) 44 Section 201.2 as “any **sustained** action taken to reduce **or eliminate** the **long-term risk** to human life and property from hazards.”

“Disaster Mitigation Act (DMA) 2000 (Public Law 106-390)<sup>1</sup> provides the legal basis for FEMA mitigation planning requirements for State, local and Indian Tribal governments as a condition of mitigation grant assistance. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by repealing the previous mitigation planning provisions and replacing them with a new set of requirements that emphasize the need for State, local, and Indian Tribal entities to closely coordinate mitigation planning and implementation efforts.”<sup>2</sup>

The City of Framingham, Massachusetts created this plan as part of an ongoing effort to reduce the negative impacts and costs from damages associated with natural hazards, such as nor’easters, floods, and hurricanes. This plan meets the requirements of the Disaster Mitigation Act 2000. More importantly, the plan was created to reduce loss of life, land, and property due to natural hazards that affect the City of Framingham. It is difficult to predict when natural hazards will impact the planning area, but it is accurate to say that they will. By implementing the mitigation actions listed in this plan, the impact of natural hazards will be lessened.

Local Mitigation Plans must be updated at least once every five years to remain eligible for FEMA hazard mitigation project grants. A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five (5) years to continue to be eligible for mitigation project grants.

### Purpose of the Plan

The purpose of the Local Hazard Mitigation Plan is to provide the City of Framingham with a comprehensive examination of all natural hazards affecting the area, as well as a framework for informed decision-making regarding the selection of cost-effective mitigation actions. When implemented, these mitigation actions will reduce the City’s risk and vulnerability to natural hazards.

This plan is a result of a collaborative effort between the City of Framingham and the surrounding communities. Throughout the development of the plan, the Hazard Mitigation Working Group (HMWG) consulted the public and key stakeholders for input regarding identified goals, mitigation actions, risk assessment, and mitigation implementation strategy. A sample of key stakeholders who participated,

---

<sup>1</sup> Disaster Mitigation Act of 2000, Pub. L. 106-390, as amended

<sup>2</sup> Disaster Mitigation Act of 2000. <https://www.congress.gov/106/plaws/publ390/PLAW-106publ390.pdf>

# City of Framingham, MA Hazard Mitigation Plan Update

included the Metropolitan Area Planning Council, the Massachusetts Emergency Management Agency (MEMA), and the Department of Conservation and Recreation (DCR).

### Guiding principles for plan development

The HMWG adhered to the following guiding principles in the plan’s development.<sup>3</sup>

- Focus on mitigation strategy as the plan’s primary purpose. All other sections contribute to and inform the mitigation strategy and specific hazard mitigation actions.
- Process is as important as the plan itself. In mitigation planning, as with most other planning efforts, the plan is only as good as the process and people involved in its development. The plan should also serve as the documentation of the planning process.
- This is the community’s plan. To have value, the plan must represent the current needs and values of the community and be useful to local officials and stakeholders. Develop the mitigation plan in a way that best serves the community’s purpose and people.

### Mitigation Strategy

C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))

The HMWG identified the following list of hazards to profile. They are shown in order of climate change interaction for consistency with the State Hazard Mitigation and Climate Adaptation Plan (SHMCAP).

Table 2. Hazards Considered.

Primary Climate Change Interactions	Hazards
Changes in Precipitation	Flooding ( <i>including riverine, dam failures, ice jams, etc.</i> ) Drought Landslide Sinkholes
Rising Temperatures	Average/Extreme Temperatures Wildfires ( <i>including brush and mulch/peat fires</i> )

<sup>3</sup> Federal Emergency Management Agency. (2013). *Local Mitigation Planning Handbook*, p. 1-2.

# City of Framingham, MA Hazard Mitigation Plan Update

Primary Climate Change Interactions	Hazards
	Infectious Disease Invasive Species
<b>Extreme Weather</b>	Hurricanes/Tropical Storms Severe Winter Storm/Nor’easter ( <i>including blizzard, ice storm, etc.</i> ) Tornadoes Other Severe Weather ( <i>including thunderstorms, etc.</i> )
<b>Non-Climate Influenced Hazards</b>	Earthquake

The hazard mitigation strategy is the culmination of work presented in the planning area profile, risk assessment, and capability assessment. It is also the result of multiple meetings and sustained public outreach. The HMWG developed the goal and objectives shown below. The goals from the Town of Framingham Multiple Hazard Mitigation Plan 2017 Update were revised to develop this current list. Information about the goal development process is in Chapter 6: Mitigation Strategy. This goal and these objectives are considered “broad policy-type statements”<sup>4</sup> that represent the long-term vision for mitigating risk to natural hazards in the City of Framingham.

---

<sup>4</sup> Federal Emergency Management Agency. (2013). *Local Mitigation Planning Handbook*, p. 6.

Reduce the loss of life, property, infrastructure, and cultural and historic resources from natural disasters and climate change through an equitable hazard mitigation program that includes infrastructure improvements, capacity building, natural resources protection, and education with emphasis on supporting the community's vulnerable populations.

Figure 1. Goal Statement.

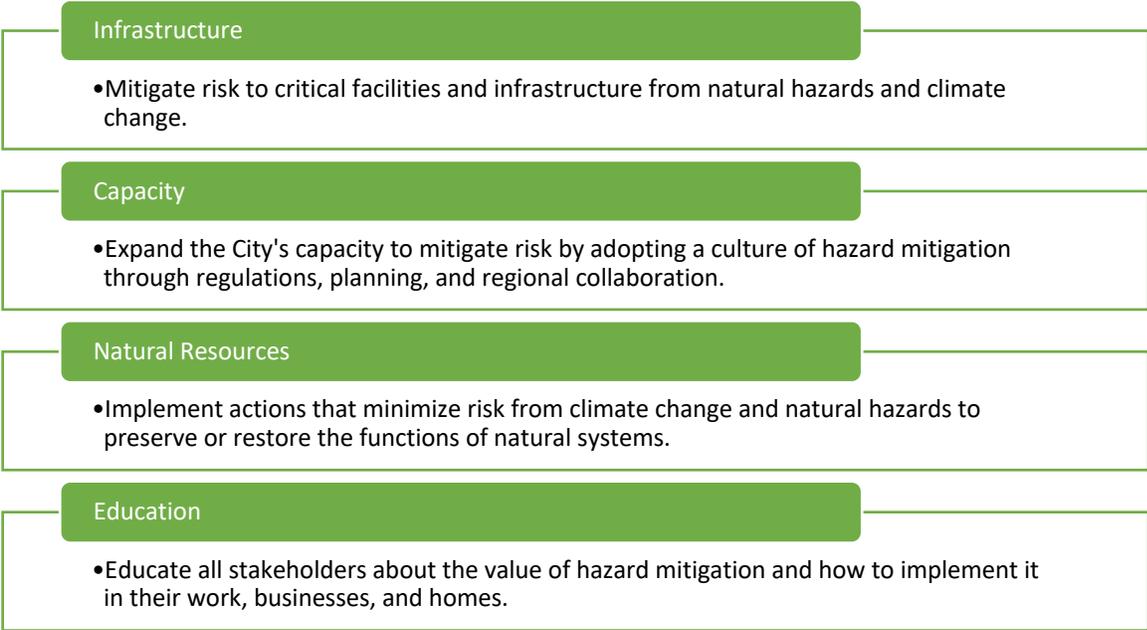


Figure 2. Objectives.

### Plan Update and Changes

This section details some of the changes incorporated into this plan based on development, status of mitigation actions, and current City priorities. This plan serves as a total revision and update to the Town of Framingham Multiple Hazard Mitigation Plan 2017 Update.

# City of Framingham, MA Hazard Mitigation Plan Update

## Changes in Development

D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))

Changes in development in the City of Framingham have decreased vulnerability to natural hazards and climate change. City policies include resilient land use practices through zoning, permitting, and historic preservation. The City Zoning Ordinance is an effective tool for managing growth and future development and includes floodplain and groundwater protection through overlay districts. The City does not have future development planned that would increase their risk to natural hazards such as flooding.

The Planning, Community Development & Conservation Division promotes the City's economic development and enhances the quality of life of Framingham residents. This Division undertakes many projects in support of the City's Master Plan. This Division works closely with other City Divisions and regional and local stakeholders to ensure comprehensive approaches to community and economic development. This includes planning, permitting, zoning, and historic preservation. Land use is a primary responsibility of the Division. This Division supports permitting through the Planning Board, Zoning Board of Appeals, Conservation Commission, Historical Commission, and Historic District Commission. The Planning, Community Development, and Conservation Division is responsible for the development of the Hazard Mitigation Plan with the support of other municipal departments.

The City of Framingham had a housing moratorium, originally planned for nine months, but extended to twelve months from September 2020-September 2021. In 2015 zoning regulations changed to allow for more density in the downtown area. This has led to growth of nearly one thousand new units. Many of these are rental units and there is a concern that occupants may be underinsured. In addition, the City added a green infrastructure bylaw and regulations. The City has implemented solar carports, impervious surfaces, and green building design in the last five years and have prioritized sustainable development. In addition to hosting a Municipal Vulnerability Preparedness Workshop in 2019 as part of its efforts to earn designation in the Commonwealth's Municipal Vulnerability Preparedness (MVP) communities, the City soon plans to begin work on its first Climate Action Plan.

Beyond the commitment to sustainable development, the City has made a direct connection to equity through hazard mitigation and land use. Framingham participated in the Metropolitan Area Planning Council (MAPC), the Government Alliance on Race and Equity, and the Federal Reserve Bank of Boston's Racial Equity Municipal Action Plan (REMAP) Program. All the public outreach for this plan included the three primary languages spoken in Framingham, English, Portuguese, and Spanish. In addition, outreach efforts were directed at public housing projects, small business associations, and the South Middlesex Opportunity Council (SMOC) for energy assistance. The City is advancing equity as a core focus of its efforts, collaborating with its neighboring municipalities and the MAPC on the MetroWest Climate

# City of Framingham, MA Hazard Mitigation Plan Update

Equity Project that it is utilizing as a framework for the engagement of Environmental Justice (EJ) populations throughout its neighborhoods.

Additional information regarding development, such as population changes and land use may be found in Chapter 2. Planning Area Profile. Additional information regarding vulnerability is included in Chapter 4. Risk Assessment. Finally, the HMWG did amend hazard mitigation actions to mitigate risk based on current and future development patterns, as well as consideration of equity.

## Progress in Mitigation Efforts

D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))

Chapter 6: Mitigation Strategy details the previously identified mitigation actions from the Town of Framingham Multiple Hazard Mitigation Plan 2017 Update and their status in 2022. Each of these actions is listed as completed, in progress, or delayed. A description of the status is given. The HMWG used this information to determine if the actions should now be considered capabilities of the City or if they should move forward into this new plan. The current mitigation action list represents present and future needs for the City of Framingham.

## Changes in Priority Since 2017

D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))

The biggest change in priority since the Town of Framingham Multiple Hazard Mitigation Plan 2017 Update is how the City understands the current and potential impacts of climate change, and their dedication to sustainable development. Framingham completed a Municipal Vulnerability Preparedness Plan in 2019 which identified climate change impacts and key climate change adaptation actions the City can take for improved resiliency.

Another significant change in priority was due to the COVID-19 pandemic. Like many communities nationwide, the COVID-19 pandemic impacted the operation of Framingham’s local government and public expectations for communications. To promote resident safety and avoid the spread of disease due to the pandemic, virtual engagement was the primary method of community participation utilized to develop this plan. The mitigation actions created include consideration of infectious disease risk and mitigation, primarily through citizen education and increased local government capacity.

The City’s commitment to equity and citizen participation is another significant priority. As previously identified, its involvement in initiatives such as a REMAP Program and the MetroWest Climate Equity

## City of Framingham, MA Hazard Mitigation Plan Update

Project reflect its desire to support the participation of all residents, especially its EJ populations and other members of the community that are most vulnerable to climate change.

The new list of objectives emphasizes the current priorities of enhancing the resilience of infrastructure, expanding capacity through regulations and regional collaboration, strengthening natural resource protection, and educating all stakeholders with a focus on equity. The priority that has not changed since 2017 is the City's priority to mitigate flood risk.

Following review by the HMWG, several priorities from the previous plan are no longer identified as priorities: participation in the Community Rating System, moving City-owned buildings out of the floodplain, and developing a stormwater utility. Each of these previously identified mitigation actions have been removed because they are not feasible for the City at this time.

### Authority and Assurances

The City of Framingham will continue to comply with all applicable Federal laws and regulations during the periods for which it receives grant funding, in compliance with 44 CFR 201.6. It will amend its plan whenever necessary to reflect changes in City, State or Federal laws and regulations, as required in 44 CFR 201.6.

The HMWG recognizes the following FEMA publications:

- Local Mitigation Planning Handbook (March 2013)
- Local Mitigation Plan Review Guide (October 2011)
- Demonstrating Good Practices Within Local Hazard Mitigation Plans (January 2017, FEMA Region 1)

### Plan Adoption

The City of Framingham will adopt the Plan when it has received “approved-pending adoption” status from the Federal Emergency Management Agency (FEMA). The Certificate of Adoption is included on page 7.

### Document Overview

Below is a summary of the City of Framingham, MA Hazard Mitigation Plan Update chapters, including appendices. The planning process closely adhered to FEMA guidelines and to the intent of those guidelines.

#### **Chapter 2: Planning Area Profile**

The Planning Area Profile chapter describes the City of Framingham, including history, population, government, and infrastructure.

# City of Framingham, MA Hazard Mitigation Plan Update

## **Chapter 3: Planning Process**

The Planning Process chapter documents the methodology and approach of the hazard mitigation planning process. The chapter summarizes the HMWG meetings and the public outreach process (including public meetings). This chapter guides the reader through the process of generating this plan and reflects its open and inclusive public involvement process.

## **Chapter 4: Risk Assessment**

The Risk Assessment identifies the natural hazard risks to the City of Framingham and its residents. The risk assessment looks at current and future vulnerabilities based on land use development including structures and infrastructure. Included in this chapter is a list of critical facilities identified by the HMWG.

## **Chapter 5: Capability Assessment**

The Capability Assessment looks at the City's ability to mitigate risk prior to and following disaster. This chapter is structured around the following four categories: planning and regulatory, administrative, and technical, financial, as well as education and outreach. The chapter concludes with information regarding the National Flood Insurance Program.

## **Chapter 6: Mitigation Strategy**

This chapter provides a blueprint for reducing losses identified in the Risk Assessment. The chapter presents the hazard mitigation goals and identifies mitigation actions in priority groupings. Each mitigation action includes essential details, such as City lead, potential funding sources, and implementation timeframe.

## **Chapter 7: Plan Implementation and Maintenance**

The Plan Implementation and Maintenance establishes a system and mechanism for periodically monitoring, evaluating, and updating the City of Framingham Hazard Mitigation Plan Update. It also includes a plan for continuing public outreach and monitoring the implementation of the identified mitigation actions.

## **Appendices**

The Appendices includes documentation regarding the planning process, the list of mitigation actions and the *Hazus* Reports.

## Chapter 2: Planning Area Profile

### History and Background

The City of Framingham, with a population of 72,846<sup>5</sup>, is located midway between Boston and Worcester and is the hub of the MetroWest region. Formerly a town, Framingham became a city in 2018 (after voting to become a city at a Town Meeting in 2017). Framingham has a Mayor and City Council. Framingham offers a unique blend of urban, suburban, and rural qualities. It is home to a vibrant regional retail area along Route 9 and a high technology oasis near quiet residential areas, working farms, and dynamic commercial centers like Framingham Centre with its small shops and historic buildings. The traditional strengths of the City include its residents, phenomenal location, and general accessibility.

Framingham was originally inhabited by the Nipmuc. They were a part of the Algonquin language group and were agriculturalists and hunters who lived by the streams and ponds of the area.<sup>6</sup> From its founding in 1700, Framingham has supported a variety of industries. The mills and factories that flourished in Framingham encouraged the growth of Saxonville in Northeast Framingham and the downtown in South Framingham. Currently, the major city employers are in the Business & Professional Services, Education & Health Services, Trade, Transportation & Utilities, and Manufacturing sectors.<sup>7</sup>

The total area of Framingham is approximately 26.4 square miles. Twenty-five square miles is made up of land area, while 1.3 square miles is water. As for the City's climate, some trends have emerged - the average high temperature in January is 35.0°F and the average low is 16.0°F while the average high temperature in July is 84.0°F and the average low is 63.0°F. The average annual precipitation is 45.9".<sup>8</sup> As we know with climate change, weather patterns will be changing, and many parts of Massachusetts will see warmer winters. Rainfall is also expected to increase in the spring and winter months with an increasing number of dry days in the summer and fall.<sup>9</sup>

Framingham's landscape is diverse, from rural farmlands to the urban cityscapes, from rivers and forests to hills and valleys. Topographical levels range from a low of 114 feet above sea level at the surface of the Sudbury River below the Saxonville Dam, to a high of 602' at the top of Nobscot Hill. The central section of the City is fairly flat with an elevation of about 200' above sea level. The Northwest region rises to an elevation of about 400' and is characterized by a combination of wetlands, steep slopes, and exposed bedrock.<sup>10</sup>

---

<sup>5</sup> "ACS Demographic and Housing 5-Year Estimates." (2020). U.S. Census Bureau.

<sup>6</sup> "Framingham Open Space and Recreation Plan." (2015). Framingham, Massachusetts.

<sup>7</sup> "Multiple Hazard Mitigation Plan 2022 Update Draft." (2022). Framingham, Massachusetts.

<sup>8</sup> "Climate Framingham - Massachusetts." (2022). U.S. Climate Data.

<sup>9</sup> "Massachusetts Climate Change Projections." (2018).

<sup>10</sup> "Multiple Hazard Mitigation Plan 2022 Update Draft." (2022). Framingham, Massachusetts.

## City of Framingham, MA Hazard Mitigation Plan Update

Sixty-eight percent of the population identifies as White, while 6.2% identify as Black or African American, and 8.5% identify as Asian. Sixteen- and one-half percent of Framingham’s population identifies as Hispanic or Latino (as compared to all other races).<sup>11</sup> The City is known for its multicultural communities, particularly immigrants from Brazil and other Latin American countries, though immigrants from Africa, Asia, and Europe are also growing, especially when compared to adjacent communities.<sup>12</sup> The mix of culture, heritage, language, and traditions, makes Framingham a cultural center and attraction. Festa Junina, or the “June Festival,” is one of the largest festivals in the region with thousands of people in attendance. The festival is a tradition that was introduced to Brazil by Portugal’s colonization as early as the year 1500. This Brazilian celebration features traditional music and dance, costumes, and barbecue as a celebration of culture, heritage, and history.<sup>13</sup>

### Land Use and Development Trends

The City of Framingham is home to a wide variety of land uses. The City's 26.4 square miles contain active agricultural areas, manufacturing and industrial areas, major retail developments, single-family and multi-family residences, office parks, and small business centers.<sup>14</sup>

Framingham has four major historic town centers: Saxonville, Framingham Centre, Downtown Framingham, and Nobscot. These areas developed at different times to accommodate changes in transportation mode and routes, as is common for many cities and towns. Smaller village nodes have since developed alongside secondary roads.<sup>15</sup>

As with many cities, the transportation network in Framingham has been impacted by changing patterns of development. Major population centers have clustered around highway and railway corridors. The two major corridors, State Route 9 and the Massachusetts Turnpike (Interstate 90), run east-to-west and bisect the City. Two Framingham interchanges, exits 12 and 14, provide direct access to I-90. A regional retail district, called “The Golden Triangle” is bordered by State Route 9, State Route 30, and Speen Street. Commercial development is also near Routes 126 and 135. Proximity to this transportation network allows for easy and direct access to commercial, retail, and industrial areas within the City and the region making it a helpful network.<sup>16</sup>

Though a large city, northwest Framingham gives way to rolling hills and fields with low-density suburban development, farms, and large tracts of open space, forests, and fields. The eastern half of the City is more densely developed. Northeastern Framingham is predominantly single-family residential

---

<sup>11</sup> “ACS Demographic and Housing 5-Year Estimates.” (2020). U.S. Census Bureau.

<sup>12</sup> “Framingham Open Space and Recreation Plan.” (2015). Framingham, Massachusetts.

<sup>13</sup> “Slideshow: Thousands Attend Festa Junina in Framingham” (2022). Framingham SOURCE.

<sup>14</sup> “Land Use & Zoning” (2022). City of Framingham, Massachusetts.

<sup>15</sup> “Framingham Open Space and Recreation Plan.” (2015). Framingham, Massachusetts.

<sup>16</sup> “Framingham Open Space and Recreation Plan.” (2015). Framingham, Massachusetts.

## City of Framingham, MA Hazard Mitigation Plan Update

homes on small lots. To the north, there is the old town center, Saxonville, and Nobscot. While the southeast holds Downtown Framingham and multi-family homes on smaller lots.<sup>17</sup> Framingham is also home to Shopper's World, a 778,342 square foot retail property located at Worcester Road and Shoppers World Drive in Framingham. Shoppers World is positioned in the center of the Golden Triangle, the largest retail destination in the Boston area. The center is situated near Natick Mall, a top regional draw, and the corporate headquarters of T.J. Maxx, Bose, Mathworks, and Staples. The center also contains AMC Theatres and is home to Logan Express public transportation. The diverse land use and development patterns allows Framingham to accommodate the needs of its residents, visitors, and businesses.

In 2015, new zoning regulations were passed allowing for more Transit Oriented Development (TOD) in Downtown Framingham to revitalize the area. This TOD aims to take advantage of the existing infrastructure of the downtown area while supporting multicultural businesses and the unique character of Framingham, promoting redevelopment and reinvestment in the housing stock, and providing increased tree canopy, green spaces, and links to natural resources.<sup>18</sup>

Recent development in the City includes the expansion of Framingham Tech Park. Sanofi is a global biopharmaceutical company that focuses on human health. Sanofi last fall received a MEPA certificate for a major future expansion in Framingham which will help lead the way in delivering the next generation of biologics manufacturing. Additionally, new housing developments such as the Alta Union House in 2019 and the development of Modera Framingham and Bancroft Building in 2021 added significant housing capacity to downtown near public transportation options such as the MBTA Commuter Rail and the MWRTA Bus Hub. Other new residential developments include "The Millwood Preserve" which is 75% complete, consisting of 127 units of new homes with sales over \$1 million.

Downtown Framingham is on the cusp of a major renaissance, with roughly 975 units of housing built in the last 5 years and an additional 900+ units of housing in the conceptual and permitting stage all within the core and walking distance to the commuter rail. In 2017, Framingham executed Tax Increment Financing (TIF) agreements with Wood Partners and Mill Creek Residential Trust, to encourage each project to move forward. These agreements are the first executed in Massachusetts under the new rules for the Urban Center Housing TIF (UCH-TIF) Program, set through Governor Charlie Baker's 2016 Economic Development bill. Framingham's intent was to use TIF support to encourage "first mover" TOD projects in the emerging Downtown market, by overcoming uncertainties for investors and addressing site-specific costs.

Further, Framingham's vision, "*Our Civic Plan*", is for the Downtown to become a regional economic hub to attract visitors from within and beyond city boundaries. However, even as TOD becomes a reality in Framingham, the surrounding area will remain very automobile dependent, and residents and visitors

---

<sup>17</sup> "Framingham Open Space and Recreation Plan." (2015). Framingham, Massachusetts.

<sup>18</sup> "Downtown Framingham Transit Oriented Development Action Plan." (2015). Framingham, Massachusetts.

## City of Framingham, MA Hazard Mitigation Plan Update

will need cars for certain needs. The City plans to make Downtown more of an attractive destination, which will require accommodating more trips, many of which will inevitably be in cars. The proposed project aims to build current and future parking needs in the right location by consolidating parking and building affordable housing. The overarching vision of this plan is to build on the current momentum of downtown revitalization through strategic public investments to cultivate a safe and vibrant downtown with strong and sustainable economic vitality. A revitalized downtown will provide an 18-hour live, work and play environment which will bring new opportunities to underperforming properties, will connect people and places, and capitalize on Framingham’s advantageous position in the MetroWest.

Framingham’s 2020 Master Plan Update lays out for a vision for the City as a community that is “culturally vibrant and provides members of the community access to affordable and diverse housing options, education opportunities for all, transportation that is efficient and easy to utilize, supportive of all businesses that choose to locate in Framingham, safe and attractive neighborhoods and villages, cultural and historical resources, and a community representing its people”<sup>19</sup>. The City continues to work in 2023 to support the revitalization of its downtown neighborhoods including the renovation of the Mary Dennison Park, recently-built and planned expansions to affordable housing, implementation and integration of the Bruce Freeman and Chris Walsh Memorial Trails, development of a parking garage that will support the local businesses, residents, and visitors, and the prospective development of a regional dispatch center for Police and Fire Department with neighboring MetroWest communities.

### Environmental Justice Populations

Framingham is considered an Environmental Justice (EJ) community due to its large low-income and minority populations. The EJ criterion includes Income, English Isolation, and Minority populations. This is especially prevalent in the densely populated south side of the City, which has Census tracts that meet all three environmental justice criteria.<sup>20</sup> The median household income for the city is \$86,322 and over 8% of Framingham’s population lives in poverty. Over 28% of the population is foreign-born as of 2020.<sup>21</sup> Ten- and one-half percent of the City’s total housing units are subsidized.<sup>22</sup> Over 87% of Framingham’s population are in EJ Block Groups.<sup>23</sup>

Low-income households, including the majority of Framingham’s immigrant and minority populations, are concentrated within downtown and southeast Framingham. These neighborhoods are home to two US Census tract blocks that meet all three of the Environmental Justice (EJ) Criteria. The EJ criterion include Income, English Isolation, and Minority Population. There are 38 Census tract blocks in total that meet at least one EJ criteria in the City.<sup>24</sup> Framingham’s percentages of minority, Hispanic, and Latino

---

<sup>19</sup> “City of Framingham Master Land Use Plan 2020 Update.” (2020). Framingham, Massachusetts.

<sup>20</sup> “Framingham Open Space and Recreation Plan.” (2015). Framingham, Massachusetts.

<sup>21</sup> “QuickFacts Framingham city, Massachusetts” (2020). U.S. Census Bureau.

<sup>22</sup> Department of Housing & Community Development. (2014).

<sup>23</sup> “2020 Environmental Justice Populations (November 2022 Update)” (2022), MA Executive Office of Energy and Environmental Affairs

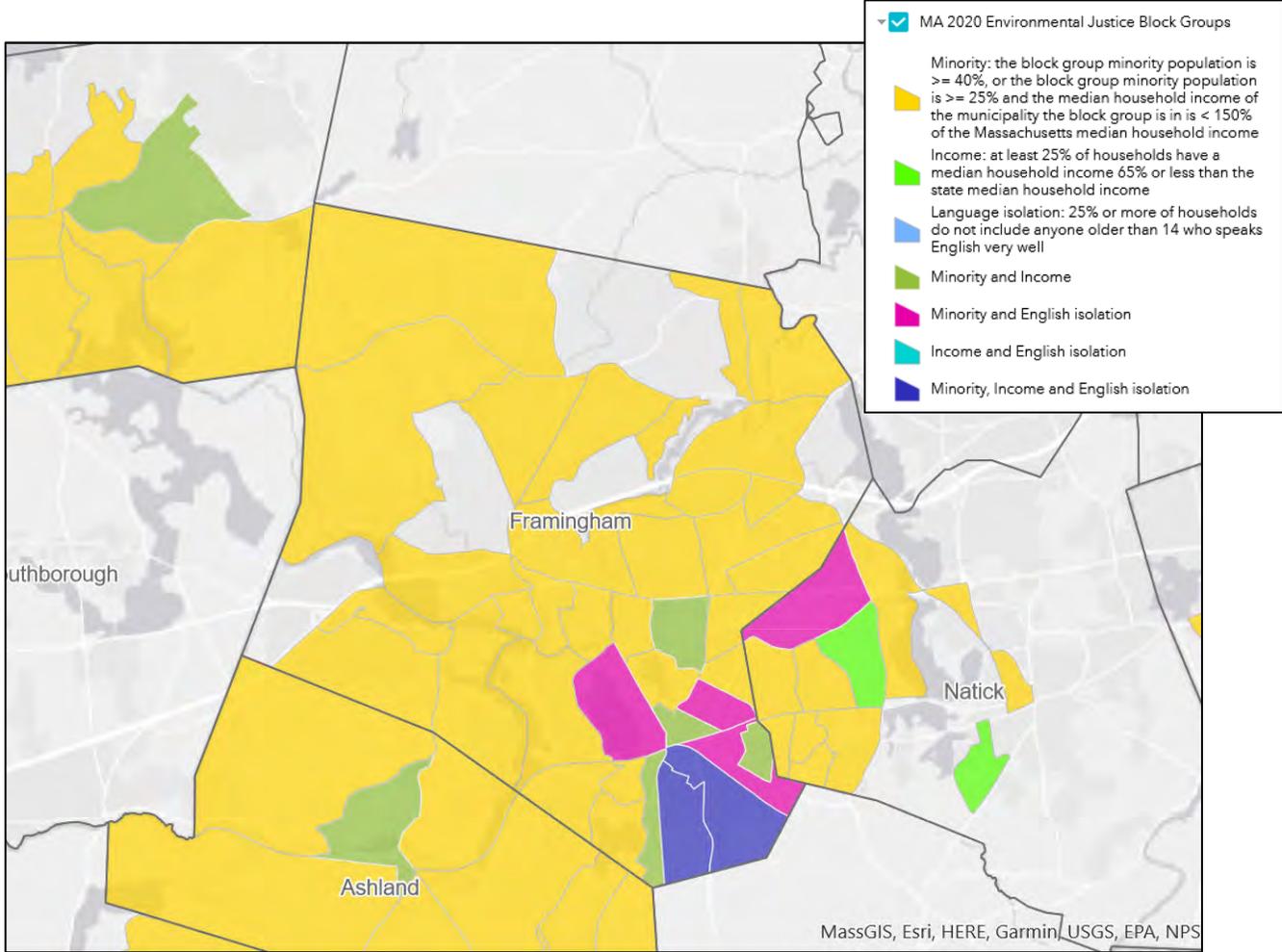
<sup>24</sup> “Massachusetts Cities & Towns with Environmental Justice Populations.” (2021). Executive Office of Energy and Environmental Affairs.

# City of Framingham, MA Hazard Mitigation Plan Update

populations are significantly higher than regional percentages.<sup>25</sup> This further highlights the need of the City to focus on these areas which are home to historically underrepresented and underserved populations.

The figure below, a map pulled from the Massachusetts 2020 EJ Communities Map Viewer, shows the location of EJ communities in Framingham.

Figure 1. Updated 2022 Massachusetts 2020 Environmental Justice Populations



The two census block groups located in the southeastern portion of the City that meet all three EJ criteria and can be seen in the figure below.

<sup>25</sup>“Framingham Open Space and Recreation Plan.” (2015). Framingham, Massachusetts.

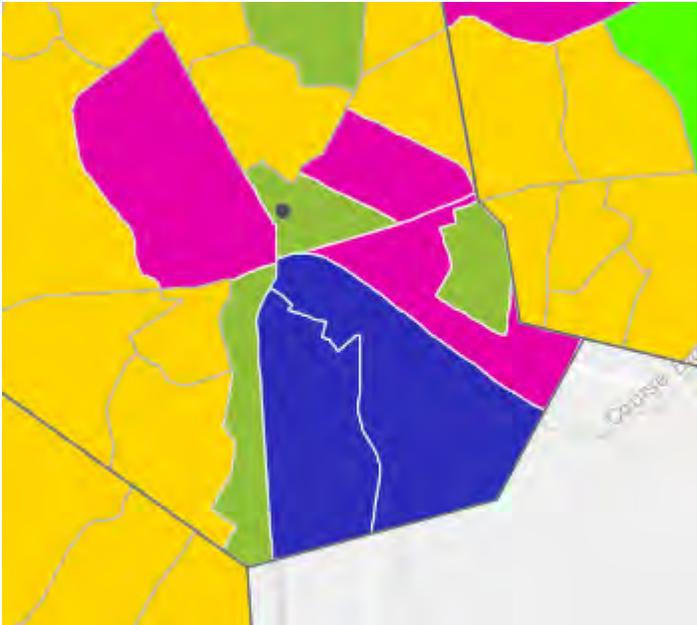


Figure 3. Southeastern Census Block Groups in Framingham.<sup>26</sup>

### Natural Resources

#### Rivers

##### Sudbury River

The City of Framingham is entirely within the drainage of the Sudbury River, Framingham’s major waterway. The Sudbury River headwaters form in Cedar Swamp, located west of Framingham in the Town of Westborough. The river flows easterly through Southborough and Ashland and then northerly into Framingham where it flows in a northeast direction to join the Assabet River in Concord. The Sudbury River passes through Massachusetts Water Resources Authority (MWRA) Reservoirs Numbers 1 and 2 as it flows through Framingham. The southern section of the river is barely thirty feet wide, but the river opens just above the Massachusetts Turnpike I-90 bridge and widens considerably to a width of 700 feet (the area known as Mill Pond) above the dam at the bend of the river in Saxonville. From an elevation of 146 feet above sea level just above the Saxonville dam, the river falls to 114 feet as it winds through Saxonville and north to the Great Meadows National Wildlife Refuge in Sudbury and Wayland.

Major tributaries to the Sudbury River in Framingham are Lake Cochituate, which flows through Cochituate Brook into the Sudbury River below the Concord Street bridge; Dunsdell Brook, which flows into the Sudbury River at the point where it runs alongside the MassPike; Farm Pond, which flows through Eames Brook into the Sudbury River at Mount Wayte; Sucker Brook, which flows south from Sucker Pond, to Fuller Middle School and is then largely culverted as it flows west to a wetland adjacent to Walnut Street and then north to the Sudbury River; and Birch Meadow and Baiting Brook, which flow

<sup>26</sup> “Massachusetts 2020 Environmental Justice Populations Map Viewer.” (2020). State of Massachusetts.

## City of Framingham, MA Hazard Mitigation Plan Update

into the Sudbury River just below the Reservoir outflow. Hop Brook flows north into Sudbury and eventually into the Sudbury River. The Sudbury River, in turn, feeds Stony Brook, which flows into Reservoir 3, which flows into Reservoir 1. Another large brook within the Sudbury River watershed is Beaver Dam Brook, which flows from Waushakum Pond through Framingham's southeast corner, then through Natick to Lake Cochituate.<sup>27</sup>

Over time, the Sudbury River's meandering has created wetland zones that integrate in small strips and patches. Despite its small size, the river represents the diversity of characteristics present in a typical river floodplain. The overall effect is one of considerable ecological diversity within a small area (Margolis, Fairbairn). One area is the oxbow, which is located near the Sudbury line and is a marshy wetland, only exposed to running water intermittently. The oxbow is a refuge for many water birds since it is too shallow and weed-grown to permit boating for most of the breeding season.<sup>28</sup>

Following a three-year study, the National Park Service, and a 13-member advisory committee, which included a representative from the then Town of Framingham, recommended that a 29-mile segment of the Sudbury, Assabet, and Concord (SuAsCo) Rivers be added to the National Wild and Scenic River System. Rivers designated as "Wild and Scenic" must possess at least one "outstanding remarkable resource value." The study found that the SuAsCo segment has five of these qualities: ecological; recreational; historical/archaeological; scenic; and literary (US Department of the Interior (DOI), 1995).<sup>29</sup>

At the conclusion of the study, all eight towns along the river segments (Framingham, Wayland, Sudbury, Lincoln, Concord, Bedford, Carlisle, and Billerica) voted at their 1995 spring town meetings to ask Congress for Wild and Scenic designation, which was awarded in 1999. The Sudbury River portion of the SuAsCo Wild and Scenic River begins in the Saxonville section of Framingham. Starting at the Danforth Street Bridge, the SuAsCo in Framingham includes the oxbow, and continues downstream into Wayland and Sudbury.

Section 7 of the Wild and Scenic Rivers Act restricts federal activities that have a direct and adverse effect on the values for which the river was designated. Each of the towns along the wild and scenic segment have also committed to work to protect the river resources. The Wild and Scenic River Stewardship Council, on which Framingham is represented, was created, and directed by legislation to work with DOI to ensure the long-term protection of these rivers.<sup>30</sup>

### Dams

There are 10 dams in Framingham which are summarized in Table 4.5. Massachusetts Department of Conservation and Recreation (DCR) owns many of the dams.

---

<sup>27</sup> "Multiple Hazard Mitigation Plan 2022 Update Draft." (2022). Framingham, Massachusetts.

<sup>28</sup> "Multiple Hazard Mitigation Plan 2022 Update Draft." (2022). Framingham, Massachusetts.

<sup>29</sup> "Multiple Hazard Mitigation Plan 2022 Update Draft." (2022). Framingham, Massachusetts.

<sup>30</sup> "Multiple Hazard Mitigation Plan 2022 Update Draft." (2022). Framingham, Massachusetts.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 4.5. Summary of Dams<sup>31</sup>

Dam Name	Impoundment	Receiving Waterbody	Owner
Central Street Dam	Saxonville Pond	Sudbury River	Private - Saxonville Realty Trust
Reservoir No. 1 Dam	Reservoir No. 1 (Stearns)	Sudbury River	DCR
Reservoir No. 2 Dam	Reservoir No. 2 (Bracket)	Reservoir #1	DCR
Reservoir No. 3 Dam	Reservoir No. 3 (Foss)	Reservoir #1	DCR
Lake Cochituate Dam	Lake Cochituate	Cochituate Brook	DCR
Constance M. Fiske Dam	PI566 Flood Control Site	Baiting Brook	DCR
Mt. Wayte Outlet Works	Farm Pond	Eames Brook	DCR
Packard Dam	Baiting Brook	Baiting Brook	Private - Sudbury Valley School
Fiddlers Green Dam	Sudbury River	Sudbury River	Private - Roger G. Patten
Landham Pond Dam	Landham Pond	Hop Brook	City of Framingham

Fiddlers Green Dam, Landham Pond Dam, and Packard Dam do not have federal or state requirements because they do not meet the official definition of a dam because of height or impounded capacity. The dams for the City’s Reservoirs were constructed in the late 1800s to provide Boston and the metropolitan area with public water. By the mid-1900s both the Stearns Reservoir and the Brackett Reservoir were discontinued due to the construction of the Quabbin Reservoir and finding extensive pollution in the Sudbury River sediment. The Foss Reservoir and the upstream Sudbury Reservoir are maintained as emergency backup water supplies.<sup>32</sup>

Below are brief descriptions of the high hazard dams that could potentially impact Framingham.

**The Central Street Dam** is located on the Sudbury River and impounds Saxonville Pond. The dam is owned by Saxonville Realty Trust and maintained in cooperation with the City of Framingham. The dam

<sup>31</sup> “Multiple Hazard Mitigation Plan 2017 Update.” (2017). Framingham, Massachusetts.

<sup>32</sup> “Framingham Open Space and Recreation Plan.” (2015). Framingham, Massachusetts.

## City of Framingham, MA Hazard Mitigation Plan Update

is a composite masonry and earth structure. Based on a hydraulic and hydrologic analysis completed by the Army Corps of Engineers included in the Phase I Inspection Report, the existing spillway of the dam appears to be adequately sized to pass the test flood outflow (10,000 cfs [cubic feet per second] = half of Probable Maximum Flood). The last inspection performed by the DCR Office of Dam Safety found that the dam was in fair condition and no evidence of apparent conditions requiring emergency actions was noted. The Massachusetts Department of Transportation began construction of the Central Street Bridge next to the dam in 2015 and completed construction in 2016. Recommended improvements to the bridge and surrounding infrastructure such as abutment repairs are included as part of the bridge project.

**Reservoir Number 1 (Stearns) Dam** is located on the Sudbury River near Winter Street. The Dam along with the related water storage and supply facilities is owned and operated by DCR. Water transmission into and from the reservoir for public use is accomplished by means of gates and conduits owned and operated by the MWRA (MDC 1995). The spillway discharge from the Reservoir Number 1 Dam is conveyed by the Sudbury River to Concord, where it joins the Assabet River. The dam consists of two earthen embankments separated by a stone masonry spillway and a gate house structure. The total length of the dam is approximately 800 feet. The overflow spillway crest is approximately 168 feet long and 9.5 feet lower than the top of the dam. The spillway was designed to operate with up to 1.75 feet of flashboards, which have not been used recently. A gatehouse structure is located to the right of the spillway. A 48-inch cast-iron supply pipe from upstream Reservoirs Number 2 and 3 enters the upstream side of the structure. The arrangement of ten gates and various chambers in the gate house is such that water from Reservoir Number 1 and/or the 48-inch pipe can be released to the Sudbury River or diverted into the Sudbury Aqueduct, a horseshoe-shaped water supply aqueduct that flows to the Chestnut Hill Reservoir in Brookline. Note that this aqueduct has not been utilized in many years and its structural integrity is unknown.

**Reservoir Number 2 (Brackett) Dam and Appurtenances** is located on the Sudbury River about one mile upstream of the Reservoir Number 1 Dam. The Dam along with the related water storage and supply facilities is owned and operated by DCR. Water transmission into and from the reservoir for public use is accomplished by means of gates and conduits owned and operated by the MWRA (MDC 1995).

The spillway from Reservoir Number 2 Dam discharges into Reservoir Number 1, an earth embankment structure with a stone masonry core, the dam is approximately 1,340 feet long. The dam impounds water in Reservoir Number 2; Reservoir Number 1 is immediately downstream of the dam.

The overflow spillway is a stone masonry structure approximately 186 feet long. There are training walls on either side and there is a cast-iron framework of an abandoned walkway on the crest. The walkway was used to provide access to the spillway for the installation and removal of flashboards. Both the flashboards and the walkway have been removed. A gatehouse is located on the right side of the spillway.

## City of Framingham, MA Hazard Mitigation Plan Update

**Reservoir Number 3 (Foss) Dam and Appurtenances** is located on Stony Brook about 0.8 miles upstream of its confluence with the Sudbury River. The Dam along with the related water storage and supply facilities is owned and operated by DCR. Water transmission into and from the reservoir for public use is accomplished by means of gates and conduits owned and operated by the MWRA (MDC 1995). The spillway from Reservoir Number 3 Dam discharges into Reservoir Number 1. The length of the dam is approximately 1,640 feet. The spillway is 100 feet long and has a narrow-crested stone masonry weir. There are no stop logs or flashboards on the crest of the spillway. The channel below the spillway is a 200-foot-wide pond that is part of Reservoir Number 1.

**Lake Cochituate Dam**, located on the western side of Lake Cochituate near the Natick town line, is owned, and operated by DCR. The channel below the dam is Cochituate Brook, which flows northwesterly into the Sudbury River (MDEM, 2002).

**Constance M. Fiske Dam**, located on the southern side of Callahan State Park, is owned, and operated by DCR. The Soil Conservation Service constructed the flood control project for the Baiting Brook watershed in the 1980s to reduce the severity of flooding along major portions of Baiting Brook and Birch Meadow Brook. The project includes 26 feet high, 690 feet long earthen dam on Baiting Brook. Maximum discharge is 818 cubic feet per second. Its capacity is 885-acre feet. Normal storage is 9-acre feet. It drains an area of 1.9 square miles.

**Mt. Wayte Outlet Works**, located at the end of Sherwin Terrace and adjacent to the Town's Recycling Drop-Off Center at 255 Mount Wayte Avenue, consists of an earthen berm, flood gate, and pump support structure. It was designed to control backflow from the Sudbury River into Farm Pond during high water conditions.

**Sudbury Reservoir**, located in the Town of Sudbury and built between 1894 and 1898, is by far the largest water body in the Framingham area. With a surface area of 1,292 acres (MDC 2002) it is well over twice the size of Framingham Reservoirs 1, 2, and 3 combined. The reservoir has a volume capacity of 7.254 billion gallons, which is more than 3.5 times more than the combined total of Framingham Reservoirs 1, 2, and 3.

The Sudbury Reservoir Dam is roughly 0.2 miles west of the Southborough/Framingham municipal line. The 2,000-foot-long dam (MDC 2002) along with the related water storage and supply facilities is owned and operated by DCR. Water transmission into and from the reservoir for public use is accomplished by MWRA-operated gates and conduits. Water from the Sudbury Reservoir (elevation 259 feet above sea level) flows over the dam into the Framingham Reservoir Number 3 (elevation 154 feet). Based on an analysis of 1876 to 1972 MDC flow data (MDM, 1997), an average of 21 MGD (million gallons per day) flow over the Sudbury Reservoir Dam.<sup>33</sup>

---

<sup>33</sup>"Multiple Hazard Mitigation Plan 2017 Update." (2017). Framingham, Massachusetts.

# City of Framingham, MA Hazard Mitigation Plan Update

## Infrastructure

### Water and Sewer Service

The City of Framingham Water Division is responsible for distributing public potable water supply and the provision of fire suppression service to 17,000 residential and commercial units. The infrastructure to provide this includes 288 miles of pipe, 17,000 service connections, 2,000 hydrants, 4,8000 gate valves, 22,000 meters, four pumping stations, three booster stations, and six above ground water tanks with storage capacities of nearly 9 million gallons.<sup>34</sup>

The City of Framingham Wastewater Division is responsible for the collection and transportation of 10 million gallons of sewerage daily for over 17,000 residential and commercial units. The sewerage is conveyed to the MWRA. The City's collection system has 231 miles of gravity mains, 18 miles of force mains, 43 pumping stations, 6,500 manholes, and over 40 miles of cross-country sewer-line easements.<sup>35</sup> The municipal sewage system serves about 95% of the population while the remaining 5%, primarily the northwest part of the City and near Salem End Road, have on-site disposal systems.<sup>36</sup>

Though the pandemic impacted the health and supply lines in 2021, MWRA's drinking water met all federal and state standards. There were some contaminants found in the drinking water in 2021 but were said to fall "well below" EPA standards. A full evaluation of contaminants, levels, and water maintenance can be found in the MWRA 2021 Drinking Water Test Results for their service region.<sup>37</sup>

### Critical Transportation Infrastructure

Framingham's location halfway between Worcester which is a major commercial area in Central Massachusetts, and Boston, New England's leading port and major metropolitan area, make it an excellent connector to these popular cities and surrounding communities particularly through its rail and highway facilities.<sup>38</sup>

The major highways are Interstate 90 (Massachusetts Turnpike) and State Route 9, which both run east-west across the state. Three additional State highways dissect Framingham: Routes 135 and 30 running east-west, and Route 126 running north-south.<sup>39</sup>

There is a direct rail service to Boston, New York, and all other points on the Amtrak network which is available through Framingham. The Massachusetts Bay Transportation Authority (MBTA) commuter rail service is available to travel to South Station and Back Bay Station in Boston. Travel time to Back Bay

---

<sup>34</sup> "Water Division." City of Framingham, Massachusetts.

<sup>35</sup> "Wastewater Division." City of Framingham, Massachusetts.

<sup>36</sup> "Framingham Open Space and Recreation Plan." (2015). Framingham, Massachusetts.

<sup>37</sup> "Massachusetts Water Resources Authority 2021 Drinking Water Test Results." (2021). MWRA.

<sup>38</sup> "Multiple Hazard Mitigation Plan 2022 Update Draft." (2022). Framingham, Massachusetts.

<sup>39</sup> "Multiple Hazard Mitigation Plan 2022 Update Draft." (2022). Framingham, Massachusetts.

## City of Framingham, MA Hazard Mitigation Plan Update

Station is about 42 to 45 minutes. The MBTA has low-cost parking adjacent to the Framingham Commuter Rail station. CSX Transportation provides freight rail service throughout the region and is active in South Framingham.<sup>40</sup>

Regarding public bus transit, Framingham is served by the MetroWest Regional Transit Authority (MWRTA). This service links Framingham and surrounding municipalities with regular bus service to major retail and employment destinations including Framingham’s Technology Park, Route 9, Framingham State University, other surrounding commuter rail stations, along with many of their downtowns and key residential areas. MWRTA also operates the MetroWest RIDE for the elderly and customers with disabilities in Framingham as well as its new curb-to-curb MicroTransit System.<sup>41</sup>

### Critical Facilities

To update the City’s Hazard Mitigation Plan, a list of critical facilities was identified. The complete list is in Appendix B. Critical facilities typically include important municipal structures, emergency service structures, locations of populations that may need special assistance, and critical infrastructure. The purpose of identifying a list of critical facilities and infrastructure is consider if these facilities are prone to damage from natural hazards, and if they are, how to mitigate those risks. The HMWG considered the list of facilities in the previous plan as well as those mentioned in the 2019 Municipal Vulnerability Preparedness report.

The City’s 2019 Municipal Vulnerability Preparedness report does not directly address critical facilities in the same way that a Hazard Mitigation Plan might typically address them. Below is content taken directly from the MVP including context and recommendations from the report:

- The City activates its Emergency Operation Center at the Police Department Headquarters during city-wide and large-scale emergencies. These facilities provide a place to run operations in case of an emergency and are equipped with backup power via a generator. In addition, the Massachusetts Emergency Management Agency and State Police headquarters are located along Route 9 in Framingham.
- As the City moves toward electric power for efficiency improvements (heat pumps, etc.), there is concern that electrical infrastructure is more vulnerable to hazards. In general, there is a desire to make facilities more energy independent. Critical facilities such as City Hall, school buildings, Housing Authority buildings, and the Callahan Senior Center are typically able to maintain power during a hazard-induced power outage due to their locations and electrical infrastructure. This allows many of these facilities to serve as warming/cooling centers. However, the Senior Center is unable to act as an official cooling center or shelter because its parking lot has only one egress route. The Senior Center parking lot has also historically been

---

<sup>40</sup>“Multiple Hazard Mitigation Plan 2022 Update Draft.” (2022). Framingham, Massachusetts.

<sup>41</sup>“Multiple Hazard Mitigation Plan 2022 Update Draft.” (2022). Framingham, Massachusetts.

## City of Framingham, MA Hazard Mitigation Plan Update

impacted by flooding, losing as many as 30 parking spaces to floodwaters. Snow loads on various public facilities, including the City Hall, are another topic of concern. The major facilities operated by the Housing Authority have back-up generators to maintain heating and cooling capabilities and keep elevators running for a temporary period but cannot operate on a prolonged, multi-day, 24-hour basis. In addition, 360 Housing Authority units on Arsenal Road have no cooling capabilities, making them subject to extra risk during extreme heat events.

- Severe storms bringing heavy precipitation can overwhelm the sewer system by inundating pipes and pump stations and causing inflow and infiltration in various areas of the City. The City has 43 sewer pump stations at various low points throughout the City, some of which are likely vulnerable to flooding. The City has an ongoing infiltration and inflow program and is systematically working to tighten up their system. Wastewater infrastructure is also vulnerable to power outages, which may result in backups and sewer overflows if pump stations are shut down. Maintenance and upgrades to Framingham's wastewater infrastructure are ongoing, including an inflow and infiltration study, but further safeguards are needed at pump stations located in low areas across the City in order to ensure back-up power, flow control, and protection from flooding.
- Framingham has strong public transportation assets, which are critical to mobility during hazard events. The City's proximity to Boston and Central Massachusetts is seen as critical to the City's future development. The MetroWest Regional Transit Authority (MWRTA) provides bus service and the majority of its users are transit-dependent. The MWRTA has a compressed natural gas (CNG) fueling station that can assist the region in improving vehicle fuel efficiency and diversification of fuel sources. Maintaining public transportation options during emergencies and extreme weather helps ensure that residents who do not drive or own a car can evacuate hazard areas, obtain necessary provisions, or access critical services and medical care. In addition to those critical, short-term objectives, the City also depends on its public transportation system to achieve long term objectives, such as allowing people to get to work and keeping businesses open whenever possible, despite hazardous weather. MWRTA operates an intermodal service hub to link bus service with MBTA commuter rail. Logan Express is also a key transportation service for the City's residents, but parking at the newly renovated Logan Express garage is already frequently exceeding capacity. There are plans to add an additional parking deck for increased service.
- Emergency shelters can be vital to public safety during hazard events, with both extreme temperatures and rising floodwaters being the typical drivers of shelter use (though charging stations for phones are increasingly important as well). The City is able to have a shelter open and fully staffed within an hour to an hour and a half, but shelters are very expensive to run and often underutilized. The serious flooding of 2005 was the last time that shelters received any heavy utilization. Emergency personnel typically coordinate the Council on Aging to determine whether the City's senior population will need shelters during any given event.

## City of Framingham, MA Hazard Mitigation Plan Update

- Framingham’s Fire, Police, and Public Works departments bear much of the burden of responding to the increased human threats that result from climate-induced hazards. An ever-larger percentage of the departments’ time and resources are being devoted to handling things like traffic accidents, clearing roads to maintain access and traffic flows, activities to protect property, ensuring residents’ safety, and aiding overall recovery efforts. The Fire and Police Departments know the City’s flood-prone areas and respond effectively. Coordinated emergency response between the Fire and Police departments and ambulance service was also described as strong. However, staffing and equipment needs exist among the departments. It was also acknowledged at the workshop that climate impacts may disproportionately impact low-income neighborhoods or homeless populations, with the potential to overwhelm support services. Municipal facilities need to be strengthened with critical communications technology to safeguard municipal communications between departments and with the public in an emergency event.
- Some of the City’s schools are also located in or near floodplains and are susceptible to flooding, including Fuller Middle School. Schools are increasingly forced to cancel classes due to snow and ice events or extreme cold that make it impossible to safely get the City’s students to and from school. This, in turn, extends the school year further into the summer, which exacerbates the risks that school will be in session during extreme heat events. As days above 90 degrees increase, heat stroke is a concern for the student population at those schools without air conditioning, and for student athletes practicing outdoors. The City is working to appropriate capital funds to implement air conditioning. At the high school alone, this is expected to cost approximately \$1.2 million. This would not only benefit students in class during the summer, but it would also potentially allow the City to offer more cooling centers for residents during heat waves, as these schools already act as emergency shelters.

Also, some strengths within the City related to critical facilities included:

- City Hall has a back-up generator to ensure that power to the City’s IT and 911 hubs housed there is uninterrupted during power outages.
- Framingham has five Fire Stations that are well-positioned to respond during hazard events, and coordination among emergency services is strong.
- The City has many portable generators that can be deployed at critical intersections and multiple buildings, including warming and cooling centers, during emergencies.
- The City operates a Rave Emergency Alert system that is used to share information relevant to short-term hazards or expected long-term hazards.

## City of Framingham, MA Hazard Mitigation Plan Update

- Framingham has a wide variety of emergency services equipment, including snow equipment, ATVs, signs, and a Storm Room.
- The Police Department Headquarters is home to the Emergency Operations Center.
- Several emergency shelters, including most schools, are available during hazard events and can be fully deployed within 1.5 hours of an event.
- Framingham is home to MetroWest Medical Center.
- Framingham Operation Center is ready for activation during City-wide or large-scale emergency events.
- The City's Housing Authority has back-up generators to power emergency lighting and elevators, and a community room with A/C.
- Framingham State University is a resource for training students and community members about sustainability and climate change through curricular activities. It adopted a Climate Action Plan in 2018 to reduce its greenhouse gas contributions.

Actions about critical facilities or facilities that could be critical facilities:

- Assess flood-proofing measures and flood storage to prevent future flooding at critical facilities, including the Callahan Senior Center and Fire Station #7.
- Perform a risk assessment of vulnerable pump stations and establish priority actions for reducing potential flooding impacts, including consideration of nature-based solutions or green infrastructure approaches. Establish emergency back-up plans for the pump stations. Continue to implement improvements to reduce infiltration and inflow.
- Evaluate satellite locations to supplement DPW operations center and salt storage in order to provide better support City-wide and reduce response times.
- Implement plans to install air conditioning in Framingham schools that currently lack A/C, with the high school as the most immediate priority. Include any necessary upgrades to the electrical infrastructure to allow for the additional capacity required to run air conditioning systems. This will also expand the number of public buildings available for cooling stations.
- Evaluate opportunities to provide emergency backup power to critical facilities, including feasibility of green power and battery storage. City-wide, there are a number of buildings and facilities (including substations, schools, Framingham Housing Authority properties, etc.) in need

## City of Framingham, MA Hazard Mitigation Plan Update

of backup power systems that could be tied to renewable or alternative energy sources to protect public buildings and infrastructure from freezing and improve services for residents who may lose power during emergencies or hazard events.

- Conduct a microgrid feasibility study to investigate the possibility of localized power for critical facilities and ensure that electrical services continue when the primary power grid is disrupted by a hazard event.
- Identify and implement measures to prepare municipal facilities and operations to be more energy independent, including repairing/replacing rooftops in order to support solar energy systems and adopting alternative fuel vehicles.
- Continue to support coordinated efforts to provide emergency shelters that effectively serve Framingham’s population during hazard events, including cooling and warming centers. Begin a City-wide discussion about informal sheltering to better understand how and when residents might use shelter services and redefine ‘sheltering’ to meet Framingham’s specific needs. For instance, if primary shelter use is for charging stations, develop locations where residents can meet this need during power outages without the expense of opening formal shelters. Consider how to support the use of informal sheltering locations where people already go in emergencies.

Chapter 4. Risk Assessment considers the impacts natural hazards may have on the identified critical facilities. Many of the recommendations from the MVP report were included in Chapter 6. *Mitigation Strategy*. It speaks to the validity of the plans and that findings and recommendations are consistent in each plan.

### Historic and Cultural Resources

The City of Framingham completed an updated Cultural Resource Inventory in 2018. The inventory includes 734 buildings, monuments, cemeteries, and other sites which contribute to the historical and architectural heritage of the City of Framingham. Of these, 475 are seen to be of special significance as having been listed in the National Register of Historic Places, the Historic Architectural Buildings Survey, and/or one or more local authorities of recognition.<sup>42</sup> To highlight just a few: the Framingham Railroad Station was built 1884 and is said to be one of the most famous buildings in the City; the First Baptist Church which is the oldest church building in operation in Framingham was built in 1825; and the Moses Ellis House, a historic residential building from 1868 built by Framingham’s well-known architect Alexander Rice Esty.<sup>43</sup>

---

<sup>42</sup> “Framingham Cultural Resource Inventory.” (2018). City of Framingham, Massachusetts.

<sup>43</sup> Town of Framingham Historic Preservation Plan.” (2016). Framingham, Massachusetts.

## City of Framingham, MA Hazard Mitigation Plan Update

In the first twenty years since the inventory was established, from 1980-2000, 27 properties/structures were lost to demolition, fire, etc. In the current period of 2000-2016, an additional 19 properties/structures were lost, while 20 were added.<sup>44</sup>

Framingham has seven National Register of Historic Places districts that cover multiple properties:

1. Framingham Centre Common (1990)
2. Concord Square (1983)
3. Irving Square (1982)
4. Saxonville (1992)
5. Sudbury Aqueduct Linear District (1990)\*
6. Sudbury Dam Historic District (1990)\*
7. Weston Aqueduct Linear District (1990)\*

\*Listed by the Metropolitan Water Resources Authority (MWRA)<sup>45</sup>

A list of cultural and recreation resources compiled by the City include:

- Danforth Museum of Art
- Framingham History Center
- The Will C. Curtis Garden in the Woods/New England Wildflower Society
- Amazing Things
- Performing Arts Center of MetroWest
- Fountain Street Studios
- Framingham Public Library
- Brazilian American Center
- Cochituate Rail Trail
- Danforth Gym & Recreation Hall
- Loring Skating Arena
- Weston Aqueduct Trail Segments
- Bowditch Field
- Callahan State Park
- Cushing Memorial Park
- Wittenborg Woods
- City-owned beaches: Learned Pond, Lake Cochituate (North Basin), Saxonville, Waushakum Pond

There are also many additional trails, fields, and playgrounds that encompass active and passive recreation resources for the community.<sup>46</sup>

---

<sup>44</sup> "Framingham Cultural Resource Inventory." (2018). City of Framingham, Massachusetts.

<sup>45</sup> "Town of Framingham Historic Preservation Plan." (2016). Framingham, Massachusetts.

<sup>46</sup> "Multiple Hazard Mitigation Plan 2022 Update Draft." (2022). Framingham, Massachusetts.

### Chapter 3. Planning Process

The planning process was developed in full compliance with the current planning requirements of the Federal Emergency Management Agency (FEMA) per the following rules and regulations:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended by the Disaster Mitigation Act of 2000
- Code of Federal Regulations – Title 44, Chapter 1, Part 201 (§201.6: Local Mitigation Plans)
- Federal Emergency Management Agency Local Mitigation Plan Review Guide (dated October 1, 2011)

The Federal Emergency Management Agency’s recently released; Local Mitigation Planning Policy Guide (Released April 19, 2022, Effective April 19, 2023) was considered but all requirements may not be included. In addition, the plan was prepared with the suggestions found in the Demonstrating Good Practices Within Local Hazard Mitigation Plans, FEMA Region 1, January 2017.

A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))

A priority through the planning process was equity, which FEMA defines as the “consistent and systematic fair, just and impartial treatment for all individuals.” This was a central theme through the planning process and effort was made to develop an inclusive planning process. The whole community (individuals, communities, private and nonprofit sectors, faith-based organizations, and all levels of government) were given an opportunity to participate.

The planning process for this updated mitigation plan began in March 2022 and concluded in December 2022 (this does not include the months of plan review and adoption). The table below illustrates the planning process. The city developed a Municipal Vulnerability Preparedness (MVP) Program summary of findings in 2019. This planning effort contributed to the update of the mitigation plan. Below is a graphical display of the plan development timeline. Due to staffing changes, the lead project contact on the HMWG shifted several times from the Senior Planner, to the Assistant Conservation Administrator, and finally to the Sustainability Coordinator who was actively involved in the plan update from the beginning. The lead contact facilitated all activities related to the mitigation plan update, including meeting logistics, data gathering, and public outreach.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 3. Planning Process Timeline.

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Task 1. Convene Local HMWG	HMWG Meeting		HMWG Meeting		HMWG Meeting & Public Meeting			HMWG Meeting		Public Meeting		
Task 2. Update Hazard Profiles												
Task 3. Update Critical Facility Inventory												
Task 4. Update Mitigation Goals												
Task 5. Update Mitigation Actions												
Task 6. Plan Review, Evaluation, and Implementation												
Task 7. Public Review of Draft												
Task 8. Review and Approval												

## Hazard Mitigation Working Group

The City of Framingham created a Multiple Hazard Mitigation Plan Working Group in 2006 to oversee the implementation and update of the Hazard Mitigation Plan. The Working Group has always consisted of staff and officials from key departments such as Police, Fire, Public Works (DPW), Capital Projects and Facilities Management, and Planning, Conservation, and Community Development. The Multiple Hazard Mitigation Plan Update Working Group met several times in the fall of 2021 to review the 2017 plan and begin updating it. They also conducted several public hearings during this time. Beginning in February

# City of Framingham, MA Hazard Mitigation Plan Update

2022, through a grant from the Massachusetts Emergency Management Agency (MEMA), the Jamie Caplan Consulting LLC team assumed leadership of the update process.

This Multiple Hazard Mitigation Plan Working Group was renamed the Hazard Mitigation Working Group (HMWG) and expanded to include additional stakeholders. A list of HMWG members is shown in the table below.

Table 4. Hazard Mitigation Planning Working Group.

Name		Title	Department	Organization
<b>Bob</b>	Bois	Resident	N/A	City of Framingham
<b>Sam</b>	Bade	Chair	Conservation Commission	City of Framingham
<b>Alison</b>	Eliot	Senior Project Manager	Department of Public Works	City of Framingham
<b>Dana</b>	Haagensen	Director of Administration & Finance	Fire Department	City of Framingham
<b>Ed</b>	Kross	Resident	N/A	City of Framingham
<b>Shawn</b>	Luz	Sustainability Coordinator	Capital Projects and Facilities Management	City of Framingham
<b>Robert</b>	McArthur	Conservation Agent (Former)	Planning, Conservation, and Community Development	City of Framingham
<b>Shane</b>	O'Brien	Senior Planner (Former)	Planning, Conservation, and Community Development	City of Framingham
<b>Kerry</b>	Reed	Senior Project Manager (Former)	Senior Project Manager	City of Framingham
<b>Sarkis</b>	Sarkisian	Director of Planning, Community Development, and Conservation	Planning, Conservation, and Community Development	City of Framingham

# City of Framingham, MA Hazard Mitigation Plan Update

Name		Title	Department	Organization
<b>Amanda</b>	Smith	Assistant Conservation Administrator (Former)	Planning, Conservation, and Community Development	City of Framingham
<b>Ryan</b>	Sullivan	Deputy Fire Chief	Fire Department	City of Framingham
<b>Jeffrey</b>	Zukowski	Hazard Mitigation Planner		MA Emergency Management Agency

The HMWG met four times, March 1, 2022, May 11, 2022, July 14, 2022, and October 18, 2022. All the meetings were conducted via Zoom due to the COVID-19 Pandemic. A list of participants at each of these meetings is included in Appendix A. The staff turn-over at the City was a potential limiting factor in the planning process, however, it did not limit the process.

The first HMWG meeting, March 1, 2022, was an opportunity for Shane O’Brien, Senior Planner, and the City of Framingham staff to meet the Consulting Team and share ideas about the project and expectations for the HMWG. These included providing supporting data, identifying, and prioritizing mitigation actions, conducting public outreach, and reviewing the draft and final mitigation plan. During this meeting the HMWG chose the hazards to include in the plan and chose to organize them by Primary Climate Change Interaction for consistency with the Massachusetts State Hazard Mitigation and Climate Adaptation Plan. They revised the list of hazards to include. All the hazards listed in the previous plan, except for urban fires, are included in addition invasive species and infectious disease were added to the list. The previous mitigation plan did not list critical facilities but did mention hospitals and nursing homes. The MVP plan included a long list of critical facilities. The consulting team offered suggestions about which facilities should be considered critical and included in the Hazard Mitigation Plan Update. Developing a final list will include multiple discussions.

During this first HMWG meeting, the City’s environmental justice populations were discussed. It is a priority of the City and MEMA that this population be given an opportunity to participate in the planning process and be considered when identifying mitigation actions. City representatives mentioned that the South-East side of the city has the largest environmental justice population.

The second HMWG meeting, May 11, 2022, provided an opportunity for the HMWG to discuss in detail the City’s critical facilities, public engagement, and capabilities to mitigate risk. Amanda Smith, Assistant Conservation Administrator, was the lead of the HMWG at this time. When discussing hazards, it was mentioned that many cellars in Framingham flood due to groundwater and the Fire Department responds by lending sump pumps to homeowners. A record of these occurrences could lead to identification of hazard areas that GIS analysis may not highlight. A discussion took place regarding flood

## City of Framingham, MA Hazard Mitigation Plan Update

insurance and a concern that overall City residents are underinsured. The Conservation Administrator added to this conversation a concern that the department is bombarded with permit requests and a potential lack of regulations. The concern is that hazard risk may increase if permits are granted for problem areas. Since 2014 two large subdivisions were built. The City is completely built out, so the majority of development is redevelopment, except in the northwest quadrant of the City where developers are attempting to adjust the topography and build near slopes. This development may raise the hazard risk due to land disturbance. The current stormwater bylaw may not be adequate to protect against the increased threat.

The third HMWG Meeting, July 14, 2022, included a discussion about the potential need to find a way to prevent building in floodplains. In Massachusetts, local governments may not independently update the building code, but they can make changes through zoning regulations. This was identified as an important consideration by the HMWG. A thorough review of previous and potential mitigation actions took place at this meeting. The HMWG determined that the cost range for mitigation actions should be the following:

- Low cost under \$10,000
- Medium cost \$10,000 - \$100,000
- High cost between \$100,000 - \$500,000
- Very high cost over \$500,000

The final HMWG Meeting, October 18, 2022, was an opportunity to discuss public outreach and engagement for the 2<sup>nd</sup> Public Meeting and for plan review. The HMWG made a list of stakeholders and systems for outreach for both the public meeting and plan review. They agreed that the Planning Board, Conservation Commission, and Zoning Board should be included, as well as the Metropolitan Area Planning Commission (MAPC), local nursing homes and care facilities, Environmental Justice community representatives, and others. Shawn Luz, Sustainability Coordinator, and lead of the HMWG said he would send an email blast to all boards and committees in the city. The meeting then turned to defining the plan goal, objectives and prioritizing the mitigation actions. Members of the HMWG identified the importance of ensuring that the goals and objectives identified reflected an emphasis on protecting the City's residents that are most vulnerable to climate change impacts, including EJ populations. Four objectives, shown below, were developed to elaborate on priorities named in the goal statement.

# City of Framingham, MA Hazard Mitigation Plan Update

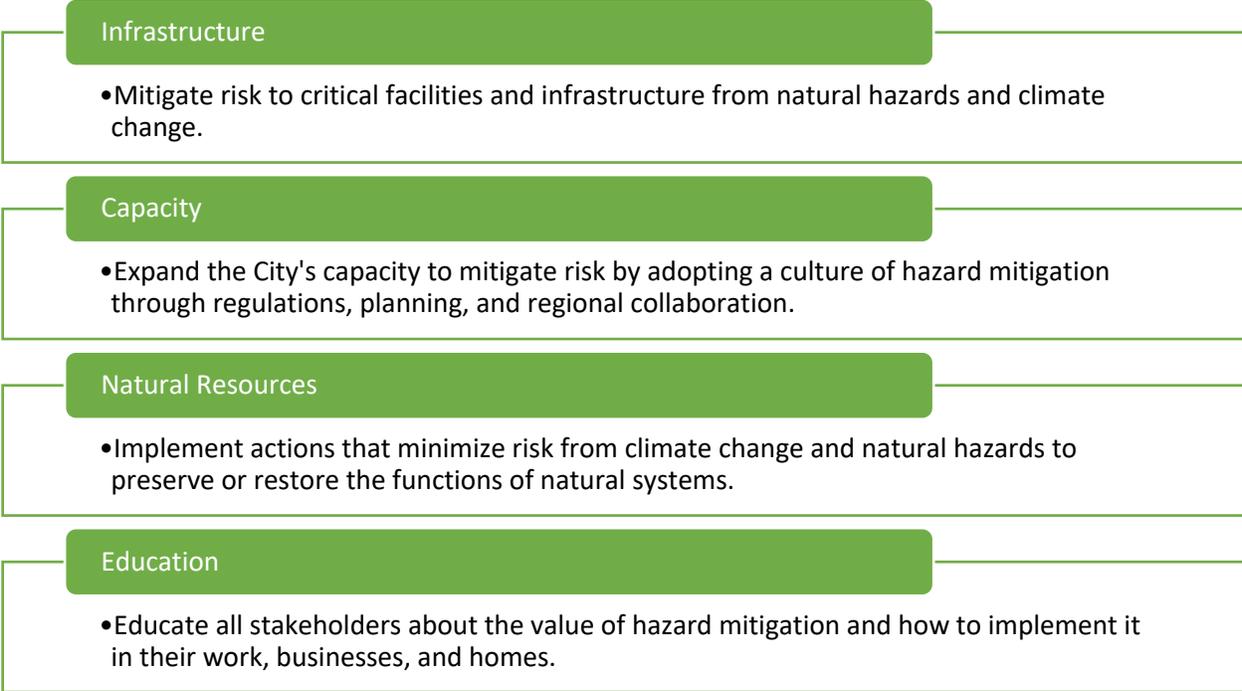


Figure 4. Objectives.

Members of the HMWG also participated in two public meetings, one on July 11, 2022, and one on December 19, 2022. These were also attended via Zoom. Leading up to the development of the draft of the Hazard Mitigation Plan Update, the project lead for the HMWG also held numerous individual meetings with departments and interested residents in development of prospective hazard mitigation actions. Finally, the HMWG reviewed the Draft City of Framingham, MA Hazard Mitigation Plan Update prior to sending it to the Massachusetts Emergency Management Agency (MEMA) for their review.

## Public Outreach

- A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))
- A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))

The Public Outreach Strategy was designed to involve the public in the mitigation planning process. The purpose of public outreach and stakeholder involvement was to:

- Generate public interest in mitigation planning
- Identify and accommodate special populations

## City of Framingham, MA Hazard Mitigation Plan Update

- Solicit public input
- Engage local stakeholders
- Create opportunities for public and local stakeholders to be actively involved in the mitigation planning process

The public outreach strategy included two public meetings, and an opportunity for the public to review the draft plan. The public outreach strategy created an opportunity for neighboring communities and regional organizations to participate in the planning process. They were notified of the opportunity to join public meetings and to review the draft plan through a press release and website notification. In addition, email invites were sent to Framingham State University, the South Middlesex Opportunity Council, Eversource, the Small Business Association, Massachusetts Water Resources Authority, MetroWest Regional Transportation Authority, and the sustainability coordinators for the towns of Natick and Ashland.

Both public meetings were hosted virtually due to the COVID-19 pandemic. Each meeting included a PowerPoint presentation in English, Spanish, and Portuguese, and plenty of opportunity for questions and discussion. In addition, the service *Mentimeter* was used to facilitate input from meeting participants. This has proven to be an effective tool when engaging people who may not be comfortable speaking up in a virtual meeting. The HMWG participated in each meeting. The meetings were advertised on the City website, by press release and through email blasts and phone calls to identified stakeholders and public representatives. The City of Framingham Mayor's Office assisted with distribution of the press release which was also hosted on the City's landing page for the Climate Change and Hazard Planning. Copies of all outreach materials are included in Appendix A.

The first public meeting occurred on July 11, 2022, and emphasized identification of hazards and critical facilities. Twenty-seven people participated in the meeting including a Spanish translator and a Portuguese translator. Participants gave feedback regarding what they have noticed in terms of climate change and how the City can address these changes. All questions were asked in three languages as seen on the figure below.

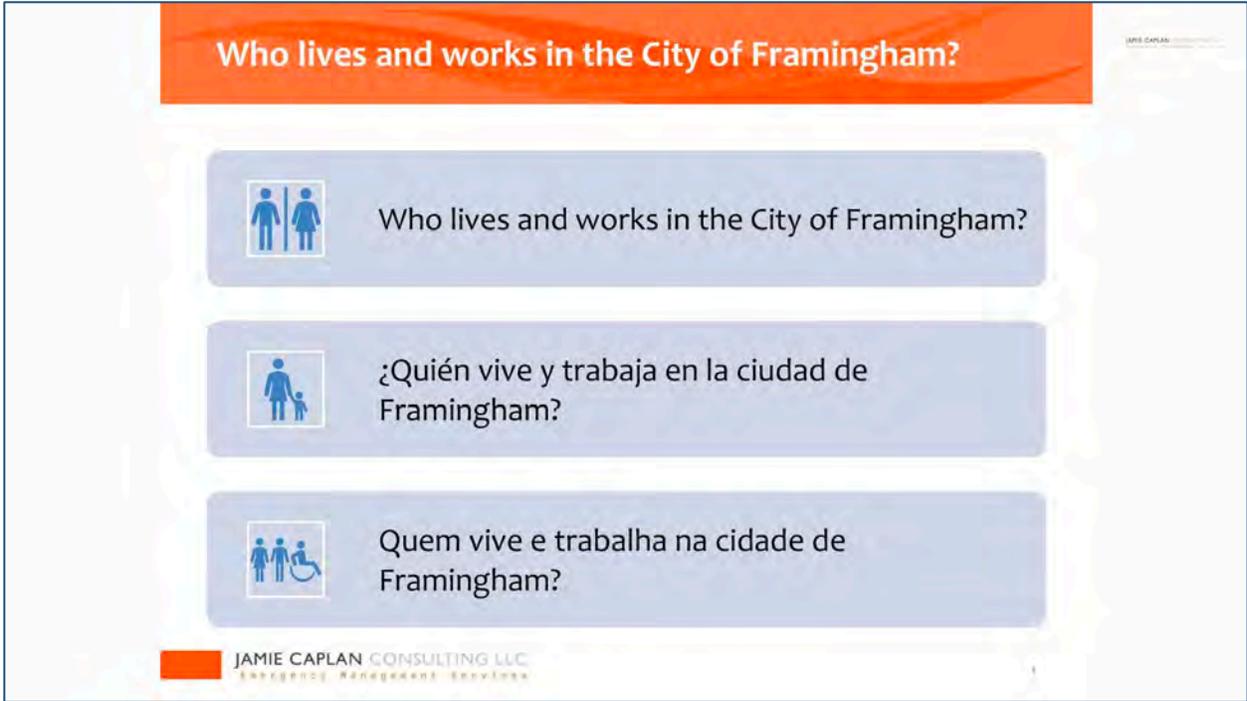


Figure 5. Example of slide in three languages.

When asked what buildings, organizations, and infrastructure the people in Framingham rely on, the following list indicates collected responses. This question is asked to help the audience understand the process of identifying critical facilities.

- Schools
- Senior Center
- Daniels Table
- Public Transportation
- Hospital
- Memorial Building
- City Offices
- Municipal Buildings
- Places to buy food
- Library
- Commuter Rail
- Beaches
- MEMA
- Shelters
- Lodging
- Gas Stations
- Mass Pike
- Conservation Commission
- Open Space

To identify weather related hazards and their impacts the question in the figure below was asked.



Figure 6. Hazard Identification Question.

Responses to this question, in alphabetical order included:

- Blizzards
- COVID-19
- Downed trees
- Drought
- Excessive Heat
- Flooding
- Humidity
- Hurricanes
- Ice
- Lightning
- Nor'easters
- Power Outages
- Rain
- Snowstorms

# City of Framingham, MA Hazard Mitigation Plan Update

To wrap up the public meeting, the audience was asked to consider what the City can do to lessen the impacts of the identified hazards, and how to protect people and property. The following figures are the responses collected.

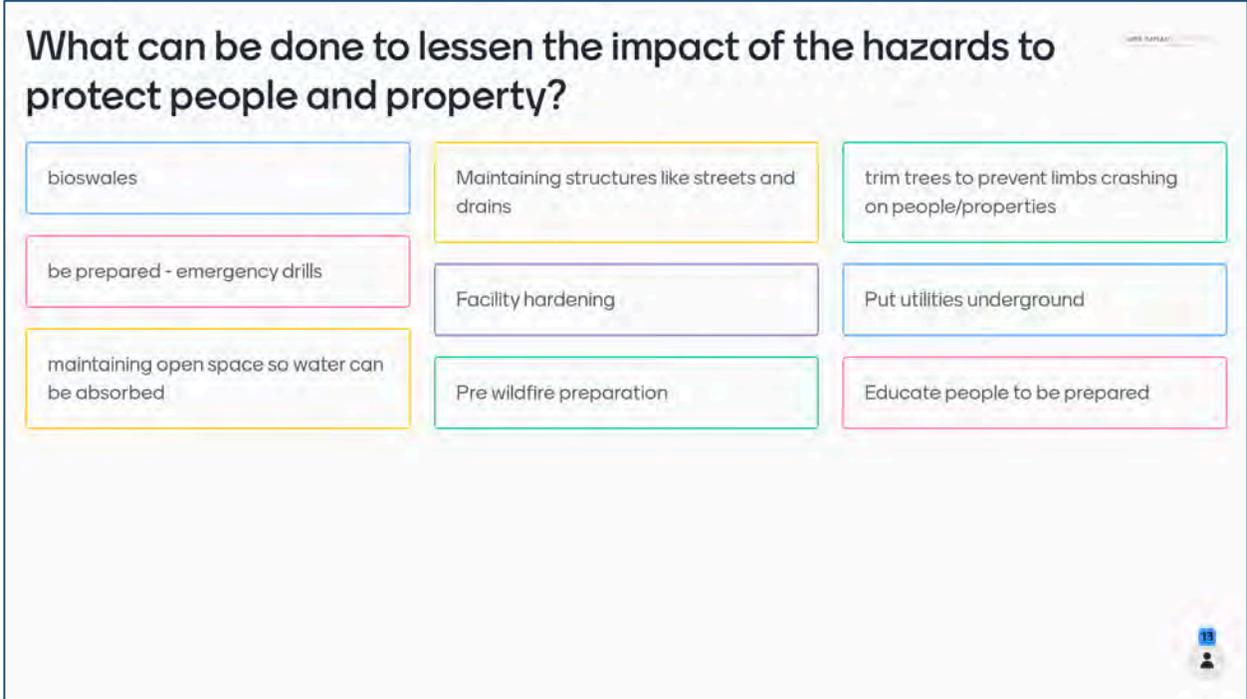


Figure 7. Mitigation Suggestions at Public Meeting, 1 of 2.

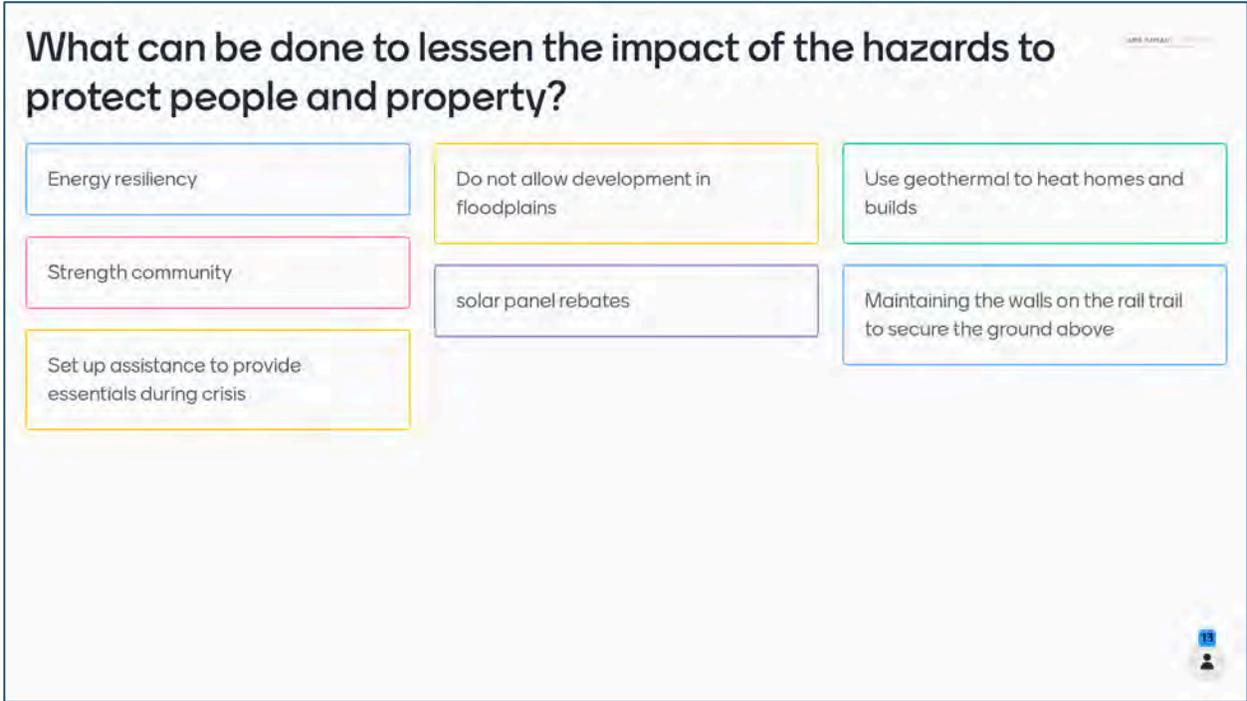


Figure 8. Mitigation Suggestions at Public Meeting, 2 of 2.

The second public meeting occurred on December 19, 2022 and included over twenty participants on Zoom. The meeting was similar in format to the first public meeting, held on zoom and using Mentimeter for participant interactions. Outreach for the meeting was also similar to that of the first public meeting. The Figure below is an example of an announcement on the City’s website.

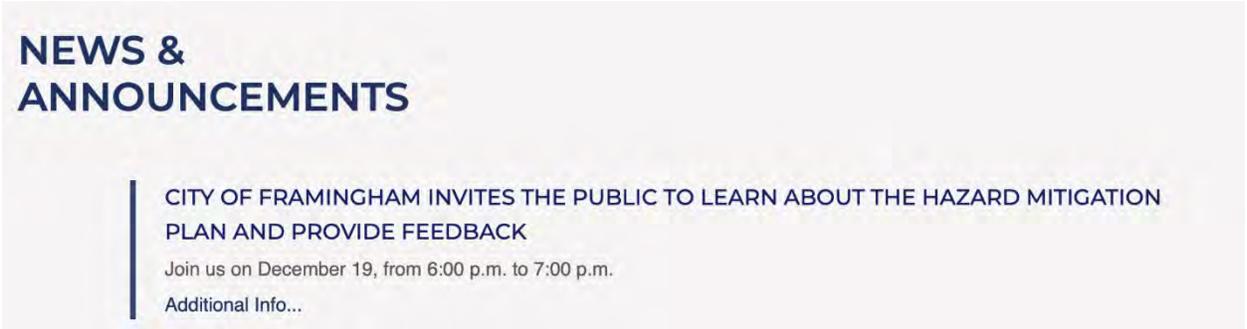


Figure 9. City of Framingham Website Homepage Announcement.<sup>47</sup>

Participants were asked about what weather-related hazards impact their community, and the results generated the word cloud in the figure below.

<sup>47</sup> <https://www.framinghamma.gov>

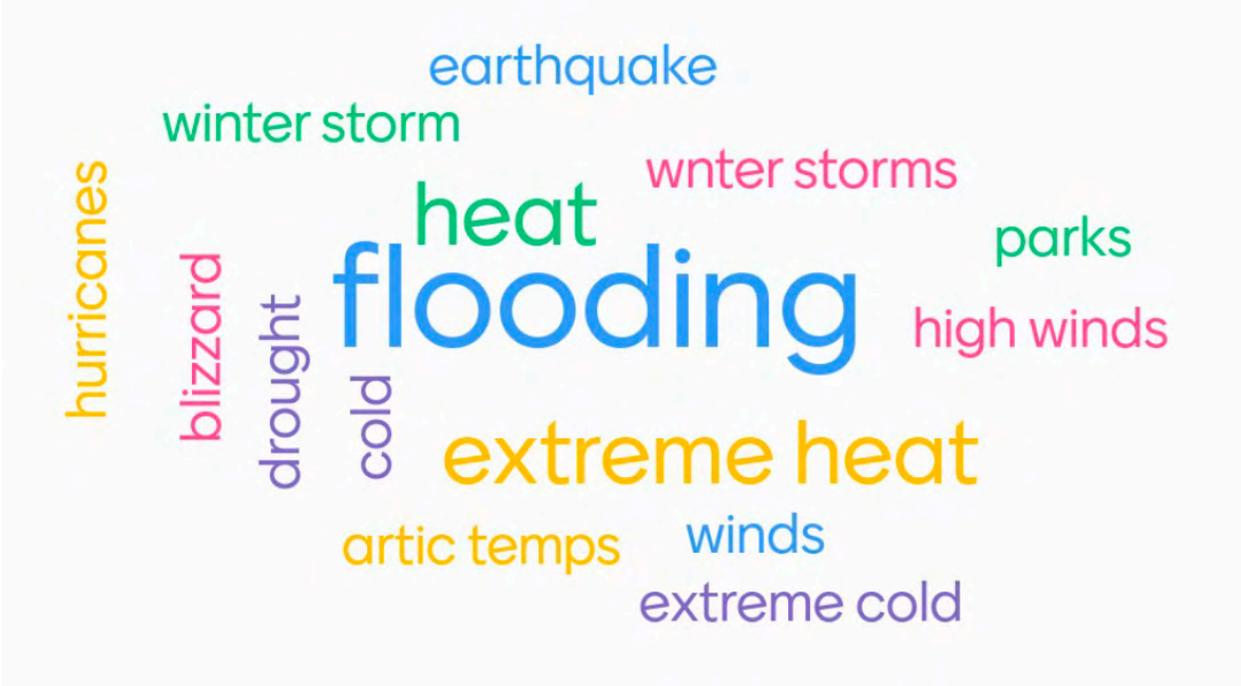


Figure 10. Weather Related Hazards Word Cloud.

These results were similar to the results from the first public meeting. Most beneficial to the planning process was the list of activities that participants identified to mitigate risk. These are shown below:

- Design infrastructure with consideration of natural resources.
- Alternative power sources in the event of electricity outages.
- Improved stormwater management.
- Sump pumps and drainage systems.
- Check health of large trees.
- Provide information to community.
- Zoning regulations to protect wetlands.
- Reduce heat islands.
- Preserve wetlands.
- Purchase open space and protect land.
- Design new buildings to meet higher standard for flood and stormwater.
- Improve energy resiliency of buildings.
- Encourage green energy use.

Many of the ideas listed above were also identified by the HMWG and ultimately included in the list of mitigation actions.

To give neighboring communities and regional agencies an opportunity to participate in the planning process, the HMWG sent personal invitations to their contacts in adjacent communities and local and regional representatives. This included invitations to City Council members, news media organizations,

# City of Framingham, MA Hazard Mitigation Plan Update

Framingham State University, the Framingham Housing Authority, Eversource, the Small Business Association, public housing project leads, assisted living facilities, sustainability staff in Natick and Ashland, and the MetroWest Regional Transit Authority.

## Review of Draft Plan

The City made the plan available for public review from January 23, 2023, to February 7, 2023. The plan was posted on the City’s website at <https://framinghamma.gov/hazardmitigation>. This was the landing page for hazard mitigation and included meeting announcements, past meeting slides and presentation recordings. The slides were posted in English, Portuguese, and Spanish. In addition, links and announcements were made on the City’s News Update. The plan was emailed directly to City Council members, to all boards and committees, and to people who were invited to public meetings and City staff. The same efforts mentioned above in the Public Outreach section were taken to make people aware of the opportunity to review the draft plan. Plan review outreach instructed people to submit comments to the Sustainability Coordinator. The figure below at right from the [www.framinghamma.gov](http://www.framinghamma.gov) website.

One person commented during this public review period. His comment included initial concern about the limited time allowed for public review, since the document is so large.

The point of his comment was an expression of concern that the plan does not adequately focus on mitigating risk to power outages. Below is direct text from the comments.

I think that far too little emphasis has been placed on the interaction of predictable weather events (hurricanes, mainly), the dramatic increase in Framingham residents’ reliance on electricity, and the parlous state of our electric grid.

Even today, we live and die by our electricity supply and an extended outage is a major issue. But everything points to a *dramatic* increase in electrification in the next 10-20 years:

- It seems clear that new residential heating will be moving fairly quickly towards electric-powered heat pumps.

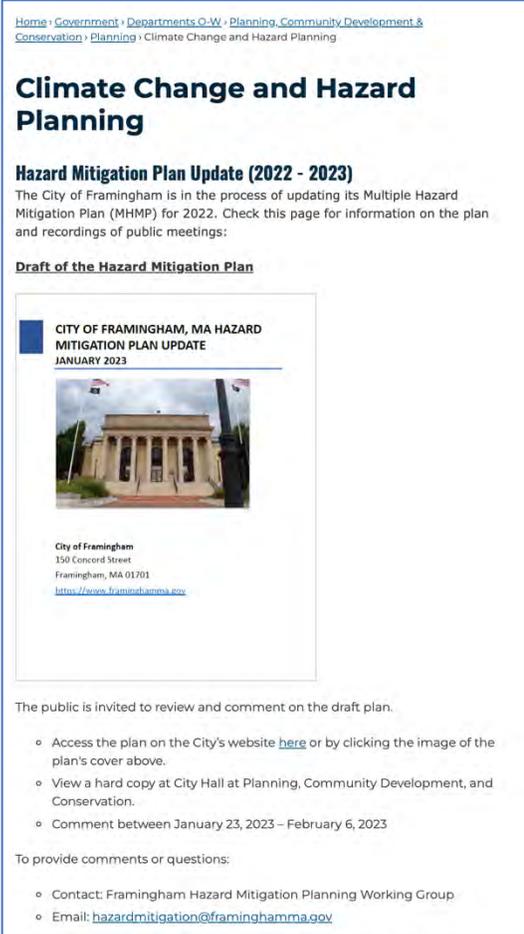


Figure 11. Plan Review Announcement.

## City of Framingham, MA Hazard Mitigation Plan Update

- Auto electrification has already begun and the projections I find most plausible have electric vehicles holding a majority of new car sales well within this time.
- Towards the end of this period, we need to be well on our way to actively decarbonizing existing housing.

All of this means we must plan for a major increase in Framingham residents' reliance on a reliable electricity supply.

Today, if a Nor'easter kills power a homeowner can count on power being restored in a few days at worst. This is hugely annoying but survivable. The key to this is that we normally lose power due to downed branches and occasional downed trees, but the extent of damage is usually much less than 1% of the trees. Our utilities have the crews, equipment and supplies to make rapid repairs on this scale.

They do not have the capacity to respond to 10x or 50x more downed trees, downed lines, and blocked roads. My main concern is the intersection of a dramatic increased reliance on electricity with our continuing vulnerability to widespread devastation from a hurricane such as a repeat of the Hurricane on '38. See the Wikipedia article [https://en.wikipedia.org/wiki/1938\\_New\\_England\\_hurricane](https://en.wikipedia.org/wiki/1938_New_England_hurricane). Here is an extract of the part most relevant to Framingham:

...[In New England] 20,000 electrical poles [were] toppled. The hurricane also devastated the forests of the Northeast, knocking down an estimated two billion trees in New York and New England...

Over 35% of New England's total forest area was affected... In many locations, roads from the fallen tree removal were visible decades later, and some became trails still used today...

[Yale](#) and [Harvard](#) both owned large forests managed by their forestry departments, but both forests were wiped out by the hurricane.

This hurricane knocked down a vast number of trees, and if it hit Framingham today, we would be looking at as much as 50% tree loss in the city – a disaster enough by itself – but in falling those trees would have taken down most of our low-voltage transmission lines and probably a lot of our high-voltage lines as well, and this would happen over an area a perhaps hundred miles wide and two or three times as long.

This widespread damage would mean that there would be little outside help to restore a dark City of Framingham. Recovery of power for a majority of residents would be on the order of months, not days.

## City of Framingham, MA Hazard Mitigation Plan Update

And note that this level of damage actually happened *right here*, due to a *real* hurricane, during the lifetime of some of our oldest residents. This is *not* a hypothetical disaster. (Hurricanes of similar intensity are seen somewhere in the US every few years.)

In the short term we can't make Framingham able to withstand a repeat of a hurricane like this, but we can make it more resilient by making its electric infrastructure more robust.

- Make burying electric lines a priority. This will not be cheap, but it is essential to any hope of resilience in the face of a repeat of '38.
- Welcome local large-scale electrical generation in Metrowest (I hate to rely on power coming from hundreds or thousands of miles away!)
- Look towards some sort of microgrid technology which would put electrical storage in most Framingham neighborhoods. This is still a rapidly evolving field, but Framingham should actively seek out and welcome medium-scale (10-500 MW-h sized storage) right here in town. (I do not see local *generation* to be an available option.)
- Continue to support home solar but insist on it including significant home energy storage.

Because this is an historical hazard with an impact greater than anything else under consideration, I believe that a significant increase in the resilience of our electric grid should be front in center in this report.

While these comments did not change the body of the report, they were shared with the HMWG and the Sustainability Coordinator sent an email message in response to the comments. Below is a piece of that response.

We would appreciate your continued engagement with us on these issues as we move forward review and continue to update the plan over time – let me know if you would be interested in staying connected in this regard.

To your comments on electrification: especially with the statewide push for electrification and our local efforts to help residents and businesses adopt more efficient heating and cooling technologies that align with climate goals, I completely agree that energy resilience is critical and that the vulnerabilities of our energy infrastructure can be complex and deepened by hazards like hurricanes and severe weather that strain widespread emergency response.

Building this perspective into the plan, there are multiple actions that relate to improving the resilience of electrical infrastructure and supporting the health of the grid. One of the plan's high priority actions is to explore the utilization of clean energy technologies like solar and battery storage in microgrids to protect critical facilities (Action 10, Page 200). This builds off of

## City of Framingham, MA Hazard Mitigation Plan Update

some recent studies that the City had conducted with the Massachusetts Clean Energy Center to study the development of microgrids in two Framingham neighborhoods to protect buildings like schools, emergency response facilities, critical infrastructure, and public housing. In addition to ongoing efforts to pursue funding to implement recommendations from these studies, we're looking for more opportunities to spur the development of energy resiliency systems across the community given the variety of environmental and economic benefits that they can provide. Related to this, the HMP Working Group also identified a priority for the City to implement emergency generators for traffic signals across the City using technologies like solar PV and batteries (Action 34, Page 208).

The plan also prioritizes community engagement efforts on energy efficiency and clean energy to support the implementation of these technologies across new and existing buildings in the community (Action 30, Page 206). On the energy efficiency side of things, this would involve maximizing the energy efficiency of our building stock with measures such as insulation and weatherization to help improve the passive survivability of homes and businesses for a longer period of time should there be an outage, particularly in preparation for periods of extreme heat and frigid temperatures, while also mitigating increasing demand on the grid with the rise of electrification. A related part of this measure also involves promoting the development of distributed energy resources like solar, continuing efforts such as our past [MetroWest Solar & Clean Heat Challenge](#) project to help residents adopt these technologies but moving forward there should also be an emphasis on the safe deployment of battery storage as you have recommended.

It is clear that to accomplish these measures, coordination with the utilities will also be a critical component of this work and the plan also includes a priority to continue to partner with the utility on climate resilient efforts regarding vulnerabilities in utility infrastructure, such as utility lines, and communications (Action 28, Page 206). The plan also includes a priority to develop a tree management plan partly to help mitigate the risk community-wide that severe winds or hurricanes can have on our critical infrastructure (Action 37, Page 209).

## Chapter 4: Risk Assessment

### Hazard Identification

The first step in the risk assessment was to revisit and evaluate the hazards identified for study and inclusion the City's previous hazard mitigation plan. This was a key topic of discussion at the first Hazard Mitigation Working Group (HMWG) meeting, along with the consideration of any additional hazards to include in the updated risk assessment. While only natural hazards are required to be addressed by FEMA, other hazards such as technological and human-caused hazards may be included if they are of significant concern to the community and determined to be a mitigation priority.

In completing the updated hazard identification process, the HMWG considered the results of the City's recent Municipal Vulnerability Preparedness (MVP) planning effort, as well as the 2018 State Hazard Mitigation and Adaptation Plan (SHMCAP).<sup>48</sup> As a result of this process, all hazards from the 2017 plan remain included in this updated risk assessment except for urban fires, which was considered a low-risk hazard and not profiled in the previous risk assessment. For this updated assessment, some hazards have been consolidated or renamed to be consistent with the SHMCAP, as further described below.

The top four natural hazards identified for the MVP effort are thoroughly covered in this assessment, which include flooding, severe weather, extreme temperatures, and drought. In addition, two new hazards have been identified and incorporated into the assessment, including infectious disease and invasive species. Infectious disease was added based on the local impacts of the COVID-19 pandemic as well the City's growing concern for the increased prevalence of vector-borne diseases. Invasive species was added to reflect the concern for this becoming a more prevalent hazard with projected climate changes and so that the risk assessment is aligned with the SHMCAP.

With the addition of invasive species, all relevant hazards as identified in the SHMCAP were considered and addressed in this risk assessment for Framingham. Due to the community's inland location, coastal hazards identified in the SHMCAP are not included (such as sea level rise, coastal flooding, coastal erosion, and tsunami).

To better reflect the relationship between natural hazards and changing climate and weather patterns, each of the individual hazards identified for the updated risk assessment have been reorganized and categorized according to their primary interaction with climate change. These new categories are consistent with the SHMCAP and include the following:

- Changes in Precipitation
- Rising Temperatures
- Extreme Weather

---

<sup>48</sup> [Massachusetts State Hazard Mitigation and Climate Adaptation Plan. 2018.](#)

# City of Framingham, MA Hazard Mitigation Plan Update

- Non-Climate Influenced Hazards

Individual hazards are also grouped within each category according to their primary hazard (for example, all flooding-related hazards are listed under “Flooding” in the Changes in Precipitation category). This includes specific hazards as identified in the City’s previous plan as shown in *italics* in Table 5 below. This new classification for identified hazards was done for the plan update to consolidate and be consistent with the state’s current hazard classification scheme per the SHMCAP.

Table 26 provides an abbreviated list of the 13 primary hazards included in the update risk assessment.

Table 5. City of Framingham Hazards.

Primary Climate Change Interactions	Hazards
<b>Changes in Precipitation</b>	Flooding ( <i>including riverine, dam failures, ice jams, etc.</i> ) Drought Landslide
<b>Rising Temperatures</b>	Average/Extreme Temperatures Wildfires ( <i>including brush and mulch/peat fires</i> ) Infectious Disease Invasive Species
<b>Extreme Weather</b>	Hurricanes/Tropical Storms Severe Winter Storm/Nor’easter ( <i>including blizzard, ice storm, etc.</i> ) Tornadoes Other Severe Weather ( <i>including thunderstorms, etc.</i> )
<b>Non-Climate Influenced Hazards</b>	Earthquake

## Hazard Profiles

B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))

# City of Framingham, MA Hazard Mitigation Plan Update

- B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))
- B3. Is there a description of each identified hazard’s impact on the community as well as an overall summary of the community’s vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))

The risk assessment for the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) describes the natural hazards that have the potential to impact the Commonwealth, providing the underlying narrative for this hazard profile for the City of Framingham. This section is organized by climate change interaction category, consistent with the SHMCAP. Because this section repeats information from the SHMCAP, some citations have been removed for brevity. The original citations can be found in the SHMCAP.

Profiles have been developed for each identified hazard, organized by primary climate change interaction. Hazard profiles include the following sections: Hazard Description, Location, Previous Occurrences, Extent, Probability of Future Events, and Vulnerability Assessment; these are described below.

Table 6. Hazard Characterization

Category/Method	Definition
<b>Description</b>	Description of hazard, its characteristics, and potential effects.
<b>Location</b>	Describes geographic areas within the City that are affected by the hazard
<b>Previous Occurrences</b>	Provides information on the history of previous hazard events for the region, including their impacts on people and property.
<b>Extent</b>	Describes potential strength or magnitude of a hazard. Where possible, extent is described using established scales.
<b>Probability of Future Events</b>	Describes likelihood of future hazard occurrences in the City based on best available and climate-informed science
<b>Vulnerability Assessment</b>	Describes potential impact on the community, including estimated potential losses and the anticipated effects of climate change

To describe previous occurrences, this plan update highlights major events from history but *relies primarily on a ten-year lookback (2012 through 2021)* ending with the date of plan development (2022). This helps maintain a concise narrative. Where applicable, narratives about warning times (i.e., floods, heat advisories, and wildfires) are incorporated into the “Extent” subsections.

The vulnerability assessment characterizes how hazards have impacted and may impact the different aspects of the community. In the vulnerability assessment sub-sections, the magnitude and likelihood of a hazard event are evaluated, and impacts are quantified using hazard models. Some hazards, like earthquakes and winter storms, will impact the entire community while other hazards, like floods and landslides, impact specific locations in the community. The areas that could be impacted are defined as the community's exposure. The results of the vulnerability assessment are used to help identify mitigation measures the community may take to lessen the impact and better understand their benefits.

### Primary Climate Change Interaction: Changes in Precipitation

#### ***Flooding Including Dam Failures and Ice Jams***

Nationally, flooding causes more damage annually than any other severe weather event. Flooding in Massachusetts is often the direct result of frequent weather events such as coastal storms, nor'easters, tropical storms, hurricanes, heavy rains, and snowmelt. In an inland community such as Framingham, flooding is the result of moderate precipitation over several days, intense precipitation over a short period, or melting snowpack. Increases in precipitation and extreme storm events will result in increased inland flooding. Common types of flooding are described below.

The City of Framingham Community Resilience Building Workshop Summary of Findings (2019) lists "Flooding" as one of the top four hazards of concern.

#### *Description*

Riverine Flooding: Riverine flooding often occurs after heavy rain. Areas of the state with high slopes and minimal soil cover (such as found in western Massachusetts) are particularly susceptible to flash flooding caused by rapid runoff that occurs in heavy precipitation events and in combination with spring snowmelt, which can contribute to riverine flooding. Frozen ground conditions can also contribute to low rainfall infiltration and high runoff events that may result in riverine flooding. Some of the worst riverine flooding in Massachusetts' history occurred as a result of strong nor'easters and tropical storms in which snowmelt was not a factor. Tropical storms can produce very high rainfall rates and volumes of rain that can generate high runoff when soil infiltration rates are exceeded.

Floodplains are the low, flat, and periodically flooded lands adjacent to rivers, lakes, and oceans. These areas are subject to geomorphic and hydrologic processes. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined. These areas form a complex physical and biological system that supports a variety of natural resources and flood storage.

Drainage-Related Flooding: Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent localized flooding on streets and adjacent properties. They make use of a conveyance system that channels water away from a developed area to surrounding streams, bypassing natural processes of water infiltration into the ground, groundwater storage, and

## City of Framingham, MA Hazard Mitigation Plan Update

evapotranspiration. Flooding from overwhelmed drainage entails floods caused by increased water runoff due to development and drainage systems that are not capable of conveying high flows. Since drainage systems reduce the amount of time the surface water takes to reach surrounding streams, flooding can occur more quickly and reach greater depths than if there were no urban development at all. In almost any community with some degree of development, basement, roadway, and infrastructure flooding can result in significant damage due to poor or insufficient stormwater drainage.

Ice Jam: An ice jam is an accumulation of ice that acts as a natural dam and restricts the flow of a body of water. A freeze-up jam usually occurs in early winter to midwinter during extremely cold weather when super-cooled water and ice formations extend to nearly the entire depth of the river channel. This type of jam can act as a dam and begin to back up the flowing water behind it. A breakup jam, forms as a result of the breakup of the ice cover at ice-out, causing large pieces of ice to move downstream, potentially piling up at culverts, around bridge abutments, and at curves in river channels. Breakup ice jams occur when warm temperatures and heavy rains cause rapid snowmelt. The melting snow, combined with the heavy rain, causes frozen rivers to swell. The rising water breaks the ice layers into large chunks, which float downstream and often pile up near narrow passages and obstructions (bridges and dams). Ice jams may build up to a thickness great enough to raise the water level and cause flooding upstream of the obstruction.

Dam Overtopping: Dam overtopping is caused by floods that exceed the capacity of the dam, and it can occur as a result of inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors. Overtopping accounts for one-third of all dam failures in the U.S. The two primary types of dam failure are catastrophic failure (characterized by the sudden, rapid, and uncontrolled release of impounded water) and design failure (which occurs as a result of minor overflow events).

There are a number of ways in which climate change could alter the flow behavior of a river, causing conditions to deviate from what the dam was designed to handle. For example, more extreme precipitation events could increase the frequency of intentional discharges. Many other climate impacts, including shifts in seasonal and geographic rainfall patterns, could also cause the flow behavior of rivers to deviate from previous hydrographs. When flows are greater than expected, spillway overflow events (often referred to as “design failures”) can occur. These overflows result in increased discharges downstream and increased flooding potential. Therefore, although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

Beaver Dams: Additional causes of flooding include beaver dams. Beaver dams obstruct the flow of water and cause water levels to rise. Significant downstream flooding can occur if beaver dams break.

Secondary Hazards: The most problematic secondary hazards for flooding are fluvial erosion, riverbank erosion, and landslides affecting infrastructure and other assets located within floodplains. Without the space required along river corridors for natural physical adjustment, such changes in rivers after flood events can be more harmful than the actual flooding. The impacts from these secondary hazards are

## City of Framingham, MA Hazard Mitigation Plan Update

especially prevalent in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging buildings, and structures closer to the river channel or cause them to fall in. Landslides can occur following flood events when high flows oversaturate soils on steep slopes, causing them to fail. These secondary hazards also affect infrastructure.

Roadways and bridges are impacted when floods undermine or wash out supporting structures. Dams may fail or be damaged, compounding the flood hazard for downstream communities. Failure of wastewater treatment plants from overflow or overtopping of hazardous material tanks and the dislodging of hazardous waste containers can occur during floods as well, releasing untreated wastewater or hazardous materials directly into storm sewers, rivers, or the ocean. Flooding can also impact public water supplies and the power grid in similar ways, through inundation and/or erosion.

### *Location*

Heavy rainfall events occur regularly in Massachusetts. As a result, riverine flooding and drainage-related flooding affect the majority of the communities in the Commonwealth, including Framingham. Dam failure has the potential to impact areas downstream of dams, including river corridors in Framingham. Ice jams, if they occurred, would be limited to segments of the rivers with more modest changes in grade.

### *Previous Occurrences*

The City's previous hazard mitigation plan notes that Framingham has experienced many flooding events. Some notable events described in the plan include:

- The storm in October of 2005 flooded the Sudbury River and Beaver Dam Brook. Beaver Street and Taralli Terrace were closed. Route 9 experienced severe flooding, especially at the intersection with Route 126.
- The "Mother's Day Storm" in May of 2006 flooded the Sudbury River and Beaver Dam Brook, making several roads impassable including Herbert Street, Taralli Terrace, Beaver Street, and Second Street. Homeowners were evacuated, sometimes using boats since roadways were flooded with up to 4 feet of water.
- A storm in July of 2009 dropped five inches of rain in three hours in the northern sections of the town. Hop Brook, Baiting Brook, and Angelica Brook overtopped their channels, causing flooding in many homes. Many roads were impassable due to street flooding, especially in the area of Hemenway Road, Gregory Road, and Sloane Drive but also including Wayside Inn Road, Edmands Road, and Lanewood Avenue/Angelica Drive.
- Two storms in March of 2010 flooded the Sudbury River to a record high level (13.99 feet according to the USGS gage at Saxonville) made several roads impassable, including Auburn Street, Auburn Street Extension, Beulah Street, Circle Drive, Taralli Terrace, Beaver Street, and Second Street. Homeowners were evacuated on Circle Drive. DPW staff mobilized to prepare to close the Concord

## City of Framingham, MA Hazard Mitigation Plan Update

Street Flood Gate for the Saxonville Levee on March 31, however the final flood elevation was 9 inches below the trigger to close the gates, and therefore closure was not required.

Flooding remains a major concern in Framingham. The City's MVP-funded CRB Workshop Summary of Findings (2019) notes that *"Flooding is a severe hazard that frequently affects Framingham. The City has been experiencing an increasing regularity of storms, with the so-called ten and one hundred-year storms now happening on an annual or near-annual basis. Intense storms occurring throughout the year are producing very high volumes of rain, causing rivers and streams to overflow their banks, putting significant pressure on dams, culverts, and other drainage infrastructure, and overwhelming the stormwater infrastructure system. Flooding frequently has City-wide impacts, including road closures at susceptible locations, such as the Route 9/126 intersection, where cars have been known to become stuck in floodwaters on many occasions (during one recent summer, workshop participants described that this happened three times in two weeks). Because of a high degree of impervious surfaces in the City, even moderate volumes of stormwater in Framingham can result in stormwater runoff that floods buildings and infrastructure. Around 2003 there was flooding that overtopped a headwall and caused damage to approximately a dozen homes. Certain neighborhoods are particularly susceptible to flooding and related power outages."*

The CRB Workshop Summary of Findings (2019) notes that "the last time the City's shelters were really utilized was during a flooding event in 2005 during which police and fire were using boats to rescue residents and many had to shelter for three to four days.

As noted earlier, this plan update relies primarily on a ten-year lookback (2012 through 2021) ending with the date of plan development. From 2012 through 2021, none of the disaster declarations in Massachusetts that cover Middlesex County were related to flood impacts in Middlesex County. The NOAA Storm Events database (<https://www.ncdc.noaa.gov/stormevents/>) lists the following flood events affecting Framingham in that timeframe.

- 6/18/13 – Flash Flood: A cold front moved across southern New England, igniting showers and thunderstorms. Some of these storms became severe. Heavy rain resulted in flash flooding across parts of the region. **Route 9 was closed at the Route 126 underpass due to flooding.**
- 9/1/13 – Flood and Flash Flood: An upper-level disturbance moved over southern New England bringing showers and thunderstorms to the region... bringing torrential rainfall and flash flooding. **Route 9 was flooded in both directions at Route 126, making Route 9 impassable. Speen Street at Cochituate Road was also flooded with a car stuck in the flood waters.** Damage figures of \$10,000 to \$30,000 were reported.
- 8/1/14 – Flash Flood: A few showers and thunderstorms developed with the help of an upper-level disturbance and afternoon heating. Two to four inches of rain fell in less than an hour in Framingham. **This rendered several streets flooded and impassable, including Route 9 westbound near Oakcrest Drive, portions of Concord, A, and School Street, Queens Way. Several cars became stuck in flood waters, in some cases trapping their occupants temporarily.** Damage of \$30,000 was reported.

## City of Framingham, MA Hazard Mitigation Plan Update

- 5/31/15 – Flood: A cold front moving across southern New England combined with high precipitable waters and weak flow aloft to initiate showers and thunderstorms that produced flooding and pockets of flash flooding. **In Framingham, the intersection of Routes 126 and 9 was flooded.**
- 8/15/2015 – Flood: A weak cold front moving through southern New England brought showers and thunderstorms to the region. These storms produced hail and damaging winds as well as some poor drainage street flooding. **Pearl, Sanger, Waverly, Beech, Henry and Thompson Streets and Union Avenue were all flooded and impassable. Waverly Street was closed near Marble Street where several cars were stuck. Cars were stuck in flood waters on Route 9, Union Avenue, Beech Street, and Henry Street. The intersection of Bishop Street and Lawrence Street was closed, and several cars were stuck in flood waters. Parts of Route 9 were flooded with four to five feet of water.** Damage of \$75,000 was reported.
- 9/30/2015 – Flood: A cold front moved across southern New England bringing heavy rain, strong winds, and periods of coastal flooding along the south coast. **Route 9 was closed due to flooding at Route 126.**
- 10/30/17 – Flood: The remnants of Tropical Storm Phillipe merged with a mid-latitude system approaching the U.S. East Coast. Tropical moisture flowing north ahead of the cold front contributed to heavy downpours with one to five inches of rain reported. **State Route 9 westbound in Framingham was flooded near Temple Road.**
- 11/3/2018 – Flood: Heavy rain occurred in the early morning hours, with generally 1.50 to 2.50 inches in eastern sections of southern New England and up to 3.66 inches in the slopes of the Berkshires. **In Framingham, Route 9 was closed at Oakcrest Drive due to flooding.**
- 7/6/19 – Flood: A cold front advanced into a very moist, almost tropical air mass in place across southern New England. This produced a line of thunderstorms, some with torrential downpours that caused flooding. **Route 30 (Cochituate Road) was flooded and impassable in Framingham.**
- 7/9/21 – Flood: Tropical Storm Elsa made landfall in Rhode Island on Friday morning before moving into the Gulf of Maine. It interacted with a stalled frontal boundary and brought widespread heavy rainfall of 2 to 3.5 inches. **In Framingham, Rt 9 (Worcester Rd) at Rt 126, as well as the ramps on Rt 126 were closed due to flooding. A car was stuck at this intersection. Also, Gates St at Parker Rd was impassable.**
- 11/12/21 – Flood: Strong southerly wind flow out ahead of an advancing cold front produced strong to damaging wind gusts and some heavy rain that caused some street and basement flooding. **In Framingham, there was a public report – location unspecified – of a river/creek overflowing with cropland/yard/basement flooding.** Damage of \$5,000 was reported.

According to the previous edition of this plan, dam failures and ice jams have not occurred in Framingham. Aside from potentially the Sudbury River, most rivers in Framingham likely do not have the characteristics necessary for ice jams.

### *Extent*

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) will be equaled or exceeded in a given year. Flood studies

## City of Framingham, MA Hazard Mitigation Plan Update

use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the “100-year discharge” has a 1 percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The 1% annual chance flood is the standard used by most federal and state agencies. It is used by the National Flood Insurance Program (NFIP) to guide floodplain management and determine the need for flood insurance. The extent of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood) is called the 100-year floodplain, which is used as the regulatory boundary by many agencies. Also referred to as the Special Flood Hazard Area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. The term “500-year flood” is the flood that has a 0.2% chance of being equaled or exceeded each year. Base flood elevations and the boundaries of the 1% annual chance (100-year) and the 0.2% annual chance (500-year) floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principal tools for identifying the extent and location of the flood hazard.

Both the 100-year and the 500-year floodplains are determined based on past events. As a result, the flood maps do not reflect projected changes in precipitation events.

Flooding in Massachusetts is forecast and classified by the NWS’s Northeast River Forecast Center as minor, moderate, or severe based upon the types of impacts that occur. Minor flooding is considered “disruptive” flooding that causes impacts such as road closures and flooding of recreational areas and farmland. Moderate flooding can involve land with structures becoming inundated. Major flooding is a widespread, life-threatening event. River forecasts are made at many locations in the state containing USGS river gauges with established flood elevations and levels that correspond to each of the degrees of flooding.

Due to the pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Flash flooding, which occurs when excessive water fills either normally dry creeks or riverbeds or dramatically increases the water surface elevation on currently flowing creeks and river, can be less predictable. However, potential hazard areas can be warned in advanced of potential flash-flooding danger. Flooding is more likely to occur due to a rainstorm when the soil is already wet and/or streams are already running high from recent previous rains. NOAA’s Northeast River Forecast Center provides flood warnings for Massachusetts, relying on monitoring data from the USGS stream gauge network. Notice of potential flood conditions is generally available several days in advance. State agency staff also monitor river, weather, and forecast conditions throughout the year. Notification of potential flooding is shared among state agency staff, including the Massachusetts Emergency Management Agency (MEMA) and the Office of Dam Safety. The NWS provides briefings to

## City of Framingham, MA Hazard Mitigation Plan Update

state and local emergency managers and provides notifications to the public via traditional media and social networking platforms.

Dams are a special consideration within the Extent characterization for floods. Many dams in Massachusetts were built in the 19th Century without the benefit of modern engineering design and construction oversight. Dams can fail because of structural problems due to age and/or lack of proper maintenance. Dam failure can also be the result of structural damage caused by an earthquake or flooding brought on by severe storm events. The Massachusetts Department of Conservation and Recreation (DCR) is the agency responsible for regulating dams in the state (M.G.L. Chapter 253, Section 44 and the implementing regulations 302 CMR 10.00). The DCR was also responsible for conducting dam inspections until 2002, when state law was changed to place the responsibility and cost of inspections on the owners of the dams. In accordance with the new regulations, which went into effect in 2005, dam owners must register, inspect, and maintain dams in good operating condition. Owners of High Hazard Potential dams and certain Significant Hazard Potential dams are also required to prepare, maintain, and update Emergency Action Plans. The state has three hazard classifications for dams:

- **High Hazard Potential:** Dams located where failure or improper operation will likely cause loss of life and serious damage to homes, industrial or commercial facilities, important public utilities, main highways, or railroads.
- **Significant Hazard Potential:** Dams located where failure or improper operation may cause loss of life and damage to homes, industrial or commercial facilities, secondary highways or railroads or cause interruption of use or service of relatively important facilities.
- **Low Hazard Potential:** Dams located where failure or improper operation may cause minimal property damage to others. Loss of life is not expected.

Owners of dams are required to hire a qualified engineer to inspect and report results using the following inspection schedule:

- High Hazard Potential dams – 2 years
- Significant Hazard Potential dams – 5 years
- Low Hazard Potential dams – 10 years

The time intervals represent the maximum time between inspections. More frequent inspections may be performed at the discretion of the state. Owners of High Hazard Potential dams and certain Significant Hazard Potential dams are also required to prepare, maintain and update Emergency Action Plans (EAPs). Dams and reservoirs licensed and subject to inspection by the Federal Energy Regulatory Commission (FERC) are excluded from the provisions of the state regulations provided that all FERC-approved periodic inspection reports are provided to the DCR. FERC inspections of high and significant hazard projects are conducted on a yearly basis. All other dams are subject to the regulations unless exempted in writing by DCR.

## City of Framingham, MA Hazard Mitigation Plan Update

### *Probability of Future Events*

The frequency of hazard events of disaster declaration proportions is defined by the number of federally declared disaster events for the Commonwealth over a specified period of time. The historical record indicates the Commonwealth has experienced 22 coastal and inland flood-related disaster declaration events from 1954 to 2017. In the northeast, precipitation has increased by 17% from the baseline level recorded in the period from 1901 to 1960 to present-day levels measured from 2011 to 2012. Therefore, based on these figures, the Commonwealth may experience a flood event of disaster declaration proportions approximately once every three years.

The 2022 Massachusetts Climate Change Assessment provides statements about the impacts of climate change in each of seven regions of Massachusetts. Framingham is in the “Eastern Inland” region. Eventually, these impacts will be incorporated into the SHMCAP update scheduled for release in late 2023. This new report explains that “forecasting precipitation under climate change is complex. In general, scientists expect that there could be more rain overall in Massachusetts, on an annual basis and in most years, as higher temperatures will mean the moisture holding capacity of the atmosphere increases.... In most locations the increase in annual precipitation is less than 8 percent per year, and in a few locations (shown in red) small decreases in annual precipitation of less than 4 percent are expected.” The new climate assessment also notes that “The greater intensity of rainfall on rainy days, on the other hand, can lead to flooding, stress on built infrastructure, and consequent impacts on human health.”

However, the frequency of flooding varies significantly based on watershed, riverine reach, and location along each reach. Additionally, it is important to note that floods of lesser magnitude occur at a much higher frequency. The SHMCAP notes that in the ten-year period 2007 to 2017, the NOAA Storm Events Database reports that there were 433 flood events in Massachusetts, which is an average of more than 43 floods per year. The City of Framingham should assume that the probability of future flood events is high, especially given the number of flood occurrences in the city during the last 20 years.

According to information from the MA DCR Office of Dam Safety, ten classified dams are located in Framingham. Of these, six are ranked as high hazard. The remainder are low or non-jurisdictional (the storage capacity of the impoundment and height of dam are such that they need not be regulated). Upstream of the City’s boundaries, numerous dams pose risks along the Sudbury River and its tributaries, including the Sudbury Reservoir in Southborough and Ashland Reservoir in Ashland. Failure of these highly regulated dams is believed to have a very low probability.

### *Vulnerability Assessment*

#### **Exposure**

In Framingham, the 1% annual chance floodplain (100-year floodplain) covers about 1,896 acres, or approximately 11 percent of the city. In addition to the 100- year floodplain, there is stormwater with the potential to cause localized flooding.

# City of Framingham, MA Hazard Mitigation Plan Update

There are critical facilities located in the 100- and 500-year floodplain. In the 100-year floodplain, there are two sewer pumping stations, the Callahan Senior Center, and Hemenway Elementary School. In the 500-year floodplain, there is an additional pump station and the Framingham Police Substation. There are 290 buildings in the 100-year floodplain and 857 buildings in the 500-year floodplain. For the 100-year floodplain, there are 192 buildings that are part of an environmental justice community. Table 7 shows the types of buildings exposed to the flood and their value. The number in parenthesis shows the total number of buildings and building values for the city.

Table 7. Buildings in 100-Year Floodplain

Building Type	Number of Buildings (Total in City)	Building Value (Total in City)
Single Family	182 (16,587)	\$75,571,306 (\$4,940,318,400)
Multi-Family	36 (2,663)	\$119,216,100 (\$4,699,362,900)
Commercial	44 (862)	\$59,667,800 (\$2,677,214,075)
Educational	1 (84)	\$609,700 (\$909,919,700)
Government	8 (392)	\$54,316,200 (\$3,716,865,600)
Religious/Non-Profit	5 (244)	\$2,878,400 (\$287,434,200)
Agriculture	6 (7)	\$201,240 (\$289,900)
<b>Total</b>	<b>290 (20,920)</b>	<b>\$315,540,386 (\$17,231,404,775)</b>

The population exposed to the 100-year floodplain is shown in Table 8. The column in the left shows the population in and around the floodplain (wherever the Census Block overlapped with the floodplain boundary) while the column on the right shows the total population numbers for the city. There is a large environmental justice community in the floodplain.

Table 8. Population Exposed to 100-Year Floodplain (2020 U.S. Census)

Demographics	Population in and Adjacent to Floodplain	Total Population
Population	19,003	72,362
Households	7,926	29,033
White	2,211 (56.3%)	40,685 (56.2%)
Black	33 (5.9%)	4,517 (6.2%)

# City of Framingham, MA Hazard Mitigation Plan Update

Demographics	Population in and Adjacent to Floodplain	Total Population
American Indian	5 (0.4%)	338 (0.5%)
Asian	217 (8.9%)	5,267 (7.3%)
Pacific Islander	3 (0.0%)	26 (0.1%)
Other Race	2,651 (14.0%)	11,603 (16.0%)
Two or More Races	2,516 (13.2%)	9,926 (13.7%)
Hispanic or Latino:	2,778 (14.6%)	12,171 (16.8%)
Population under 18:	3,902 (20.5%)	14,178 (19.6%)
Population over 64:	3,384 (17.8%)	11,679 (16.1%)
Annual Income < \$30K/year	1,111 (14.0%)	4,678 (16.1%)
Population in EJ Zone:	15,511 (81.6%)	63,150 (87.3%)

According to the last edition of this plan and recent updates, the DPW, Fire Department, and Police Department identified the following areas as having frequent flooding that may not be identified by FEMA:

- Lokerville Brook – Bishop Street Area
- Reservoir No. 3 – Vallaincourt Drive, Westgate Road
- Farm Pond –
  - Downtown, Park Street Area including Beech Street and the Common
  - Larrabee/Waverly
  - Union Ave/Henry St under CSX rail yard
- Dunsdell Brook – Brook Street, Scott Drive and McAdams Road
- Waushakum Pond – Berry Street and Gilbert Street
- Beaver Dam Brook –
  - Waverly Street, Beaver Court, Beaver Street, Second Street, Morton Street, Herbert Streets and Taralli Terrace
  - Arlington Street Neighborhood – Gordon Street - Waushakum Street
- Sudbury River –
  - Circle Drive, Trafton Road, Bare Hill Road and Maple Street
  - Edgell Road
  - 929/931 Old Connecticut Path, School Street & Concord Street, Fenwood Street

# City of Framingham, MA Hazard Mitigation Plan Update

- Baiting Brook – Wayside Inn Road
- Angelica Brook – Lanewood Drive and lower Angelica Drive
- Sucker Brook – Walnut Street residences (not including the roadway)
- Hop Brook – Gregory Road, Sloane Drive, and Hemenway Road, Landham Pond
- Cochituate Brook – Concord Street, Speen Street
- Edmands Road – water pooling across the road during extreme weather events
- Fairview Road
- Kendall/Freeman/Frederick/Howard

Although dams and their associated impoundments provide many benefits to a community, such as water supply, recreation, hydroelectric power generation, and flood control, they also pose a potential risk to lives and property. Dam failure is not a common occurrence, but dams do represent a potentially disastrous hazard. When a dam fails, the potential energy of the stored water behind the dam is instantly released, oftentimes with catastrophic consequences as the water rushes in a torrent downstream flooding an area known as an “inundation area.” The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area.

There are six high hazard dams in Framingham which may cause casualties and damage if breached. Table 9 identifies these dams. The Not Applicable (N/A) designation refers to dams with no hazard code. Non-jurisdictional dams do not have hazard codes except when owned and regulated by the Federal Government.

Table 9. Dams in Vicinity

Name	Ownership	Hazard Type
Central Street Dam	Private	High
Constance M. Fiske Dam	Public (State)	High
Framingham #1 Reservoir Dam	Public (State)	High
Framingham #2 Reservoir Dam	Public (State)	High
Framingham #3 Reservoir Dam	Public (State)	High
Lake Cochituate Dam	Public (State)	High
Mt. Wayte Outlet Works	Public (State)	Low
Packard Dam	Private	N/A

# City of Framingham, MA Hazard Mitigation Plan Update

Name	Ownership	Hazard Type
Fiddlers Green Dam	Private	N/A
Landham Pond Dam	Public (City)	N/A

The 100-year Floodplain (FEMA) with the city’s critical facilities is shown in Figure 12. There are two sewer pumping stations, Callahan Senior Center, and Hemenway Elementary School in the 100-year floodplain. Additionally, there is a nursing home (Edgell Rest Home), six day care facilities, two preschools in the 100-year floodplain too, and four tier 2 chemical facilities.

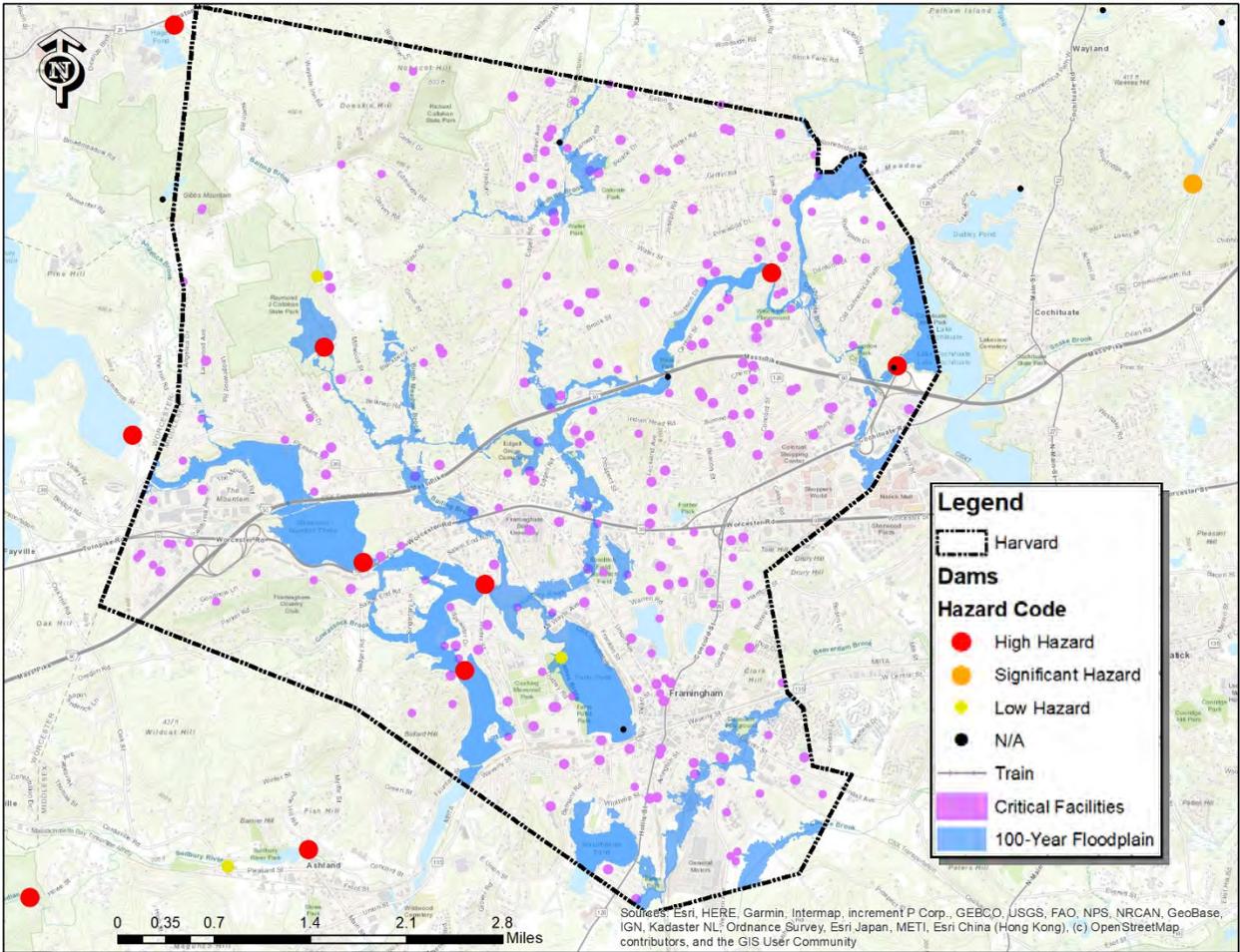


Figure 12: Framingham Critical Facilities and 100-Year Floodplain

## Built Environment Impacts

To identify built environment impacts to the city, FEMA’s risk assessment software, Hazus, was implemented. Building footprint data and parcel data was used to update the model while the latest floodplain was also integrated into the software. The economic loss results of the 100-year event are shown in Table 10. The city’s Average Annual Loss (AAL) is calculated to be \$2,274,600.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 10. Building Loss for the 100-Year Flood Scenario

Loss Type	Residential (\$Million)	Commercial (\$Million)	Other Occupancy (\$Million)	Total (\$Million)
Building Loss	46.96	12.55	6.46	<b>65.97</b>
Content Loss	24.74	30.90	17.76	<b>73.40</b>
Business Inventory Loss	0.00	0.51	1.55	<b>2.06</b>
Business Income Loss	0.66	21.44	1.94	<b>24.04</b>
Business Relocation Loss	9.89	6.81	0.94	<b>17.64</b>
Rental Income Loss	5.48	5.10	0.10	<b>10.68</b>
Wage Loss	1.57	23.95	8.15	<b>33.67</b>
<b>Total</b>	<b>89.30</b>	<b>101.25</b>	<b>36.90</b>	<b>227.46</b>

### Population Impacts

Senior and low-income segments of Framingham’s population may be more vulnerable to hazard events due to several factors. Senior and low-income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 8 shows the number of senior and low-income residents in Framingham. The potential needs of residents within these population segments in the event of a hazard occurrence are important to consider.

Using the Hazus software, the 100-year flood scenario results showed that there would be approximately than 700 to 900 displaced households and 100 to 150 people seeking public shelter needs.

### Environment Impacts

One of the major environmental impacts of a major flood would be the potential release of hazardous materials. There are four tier 2 facilities in the floodplain containing hazardous materials.

# City of Framingham, MA Hazard Mitigation Plan Update

## Droughts

Droughts are typically defined as periods of deficient precipitation. How this deficiency is experienced can depend on factors such as land use change, the existence of dams, and water supply withdrawals or diversions. Droughts can vary widely in duration, severity, and local impact.

### Description

The National Drought Mitigation Center references five common, conceptual definitions of drought:

- Meteorological drought is a measure of departure of precipitation from normal.
- Hydrological drought is related to the effects of precipitation shortfalls on stream flows and on reservoir and groundwater levels.
- Agricultural drought links various characteristics of meteorological and hydrological drought to agricultural impacts and occurs when there is not enough water available for a particular crop to grow at a particular time.
- Socioeconomic drought is associated with the supply and demand of economic goods with elements of meteorological, hydrological, and agricultural drought.
- Ecological drought is an episodic deficit in water availability that drives ecosystems beyond thresholds of vulnerability and impacts ecosystem services.

Drought conditions can cause a shortage of water for human consumption and reduce local firefighting capabilities. Public water suppliers may struggle to meet system demands while maintaining adequate pressure for fire suppression and meeting water quality standards. The Massachusetts DEP requires all PWSs to maintain an emergency preparedness plan.

Private well owners can be vulnerable to droughts. With declining groundwater levels, well owners may experience dry wells or sediment in their water due to the more intense pumping required to pull water from the bedrock or overburden aquifer. Wells may also develop a concentration of pollutants, which may include nitrates and heavy metals depending on local geology.

The loss of clean water for consumption and for sanitation may be a significant impact depending on the affected population’s ability to quickly drill a deeper or a new well or to relocate to unaffected areas. During a drought, dry soil and the increased prevalence of wildfires can increase the number of irritants (such as pollen or smoke) in the air. Reduced air quality can have widespread deleterious health impacts but is particularly significant to the health of individuals with pre-existing respiratory health conditions like asthma (CDC).

The City of Framingham Community Resilience Building Workshop Summary of Findings (2019) lists “Drought” as one of the top four hazards of concern.

## City of Framingham, MA Hazard Mitigation Plan Update

Lowered water levels can result in direct environmental health impacts, as the concentration of contaminants in swimmable bodies of water will increase when less water is present. Harmful algal blooms may occur, closing recreational areas.

One primary hazard in this plan that is commonly associated with drought is wildfire. A prolonged lack of precipitation dries out soil and vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. A drought may increase the probability of a wildfire occurring.

### *Location*

Parts of Massachusetts can experience significantly different weather patterns due to topography, distance from coastal influence, as well as a combination of regional, national, and global weather patterns. As a result, the Massachusetts Drought Management Plan (DMP) assesses drought conditions in six regions: Western, Connecticut River Valley, Central, Northeast, Southeast, and Cape and Islands. A regional approach allows customization of drought actions and conservation measures to address particular situations in each region; and allows for the determination of a drought on a watershed basis. Droughts have the potential to impact the entirety of Framingham.

### *Previous Occurrences*

The Commonwealth of Massachusetts has never received a Presidential Disaster Declaration for a drought-related disaster. However, several substantial droughts have occurred over the past 100 years. Massachusetts experienced its most significant drought on record in the 1960s. The severity and duration of the drought caused significant impacts on both water supplies and agriculture.

Although short or relatively minor droughts occurred over the 50 years following the drought of the 1960s, the next long-term event began in March 2015 when Massachusetts began experiencing widespread abnormally dry conditions. In July 2016, based on a recommendation from the Drought Management Task Force (DMTF), the Secretary of EOEEA declared a Drought Watch for Central and Northeast Massachusetts and a Drought Advisory for Southeast Massachusetts and the Connecticut River Valley. Drought warnings were issued in five out of six drought regions of the state. Many experts stated that this drought was the worst in more than 50 years. DMTF declared an end to the drought in May 2017 with a return to wetter-than-normal conditions.

The drought of 2015-2017 was also a significant disruption to the limited agricultural community in the northwestern section of the city. USDA declares agricultural disasters as needed for a variety of hazards. Information can be found at <https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index>. The events related to droughts in Middlesex County are listed below; this information does not include the drought of 2022 which is underway.

## City of Framingham, MA Hazard Mitigation Plan Update

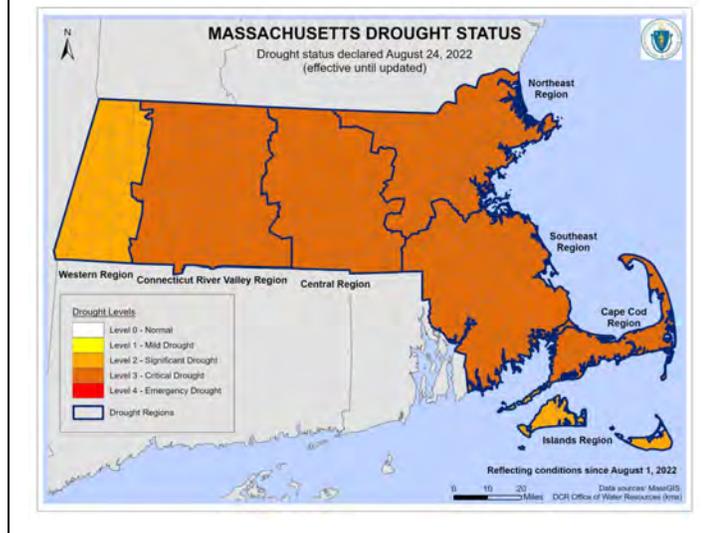
Table 11. Drought Events Listed by USDA.

Year	Event	Event "Begin Dates"
2020	Drought	8/18/2020, 9/29/2020
2018	Drought	7/15/2018, 7/17/2018
2016	Drought, wildfire, excessive heat, high winds, insects	8/16/2016
2016	Drought, wildfire, excessive heat, high winds, insects	7/5/2016
2015	Drought	2/1/2015

The drought of 2015-2017 is carried through several of the line items in the table above, with lingering impacts in 2018. The drought of 2020 was the so-called "flashy drought" that impacted southern New England. Flashy droughts are described below.

Applying the same ten-year lookback as the severe storms database review, USDA payments to Massachusetts agricultural sectors for drought impacts associated with events from 2012 through 2021 were reviewed. This timeframe includes the droughts of 2015-2017 and 2020. USDA payments in Framingham for these two droughts originated from the livestock forage program, non-insured assistance program, emergency conservation program; and totaled approximately \$50,000.

The drought of 2022 is ongoing as of the date of the development of this plan document, and its status as flashy vs. more significant is impossible to predict.



The severity of a drought depends on the degree of moisture deficiency, duration, spatial extent and location relative to resources or assets. The drought of the 1960s is the drought of record because duration, spatial extent, moisture deficiency, and impact all contributed to historic levels. In contrast, the severity of the 2016-2017 drought was due to impacts on natural resources (record low stream flows and groundwater levels), many water supplies, farms, and agriculture and to the swift onset of the drought.

## City of Framingham, MA Hazard Mitigation Plan Update

### *Extent*

Drought is defined by a combined look at several indices as detailed in the Massachusetts DMP (EOEEA and MEMA, 2013). The indices are:

- SPI for 3-, 6-, and 12-month time periods
- Precipitation as a percent of normal (or historic average) for 2-, 3-, 6-, and 12-month time periods
- Crop Moisture Index
- Keetch-Byram Drought Index
- Groundwater levels
- Stream flow
- Reservoir levels

These indices are analyzed on a monthly basis to generate hydrological conditions report and used to determine the onset, severity, and end of droughts. Five levels of increasing drought severity are defined in the DMP: *Normal*, *Advisory*, *Watch*, *Warning*, and *Emergency*. The drought levels are associated with actions outlined in the DMP. Recommendations of drought levels are made by the DMTF to the Secretary of the EOEEA, who then declares the drought level for each region of the state.

Other entities may measure drought conditions by these or other criteria more relevant to their operations. For example, water utilities may calculate the days of supply remaining. Farmers may assess soil moisture and calculate the water deficit for specific plants to determine irrigation needs or decide to change their crop based on the deficit or harvest early for non-irrigated crops.

The five drought levels in the 2013 DMP provide a basic framework for taking actions to assess, communicate, and respond to drought conditions. Under the “Normal” condition, data are routinely collected, assessed, and distributed. When drought conditions are identified, the four drought levels escalate moving to heightened action, which may include increased data collection and assessment, interagency communication, public education and messaging, recommendations for water conservation measures, and a state of emergency issued by the Governor. At the “Emergency” level, mandatory water conservation measures may be enacted. These regionally declared drought levels and associated state actions are intended to communicate and provide guidance to the public and stakeholders across industries to enable them to respond early and effectively and to reduce impacts. Individual public water suppliers may have their own drought management plan, drought levels, and associated actions, which they may follow at all levels except at the Emergency level when mandatory actions may be required.

Droughts develop over long periods of time relative to other hazards. However, flashy droughts are changing these norms (AMS, 2017). Flashy droughts may develop quickly or quickly intensify a developing or existing drought. The 2016-2017 drought is an example. Dry conditions from late 2015 lingered through the winter, with scattered groundwater levels reporting below normal and less than

# City of Framingham, MA Hazard Mitigation Plan Update

normal snowpack heading into spring 2016. Impacts were first seen in March 2016 in stream flows, groundwater levels, and reservoirs showing the long-term deficit. Then, as precipitation dramatically dropped below normal from June through September 2016, the entire state experienced record low stream flows and groundwater levels.

NOAA and others are advancing the science of early warning for droughts similar to the early warnings for floods and earthquakes to better project flashy droughts. Based on projected climate change, the distributions of precipitation events will continue to become more extreme, with periods of minimal rain alternating with extreme rain events. Therefore, developing ways to project and adapt to flash droughts may be critical for sectors such as agriculture and water supply.

The Massachusetts Water Resources Commission publishes the hydrologic condition report monthly, which includes the seven drought indices and the National Climate Prediction Center’s U.S. Monthly and Seasonal Drought Outlooks. The National Drought Mitigation Center produces a weekly Drought Monitor map. In accordance with the DMP, drought declarations are made on a monthly basis.

### *Probability of Future Events*

Using data collected since 1850, the probability of the precipitation index of the DMP exceeding the threshold at each drought level was calculated. On a monthly basis over the 162-year period of record from 1850 to 2012, there is a 2% chance of being in a drought warning level.

### Frequency of Drought Events Exceeding the Precipitation Index of the DMP

<b>Level</b>	<b>Frequency Since 1850</b>	<b>Probability in Any Given Month</b>
Emergency	5 occurrences	1% chance
Warning	5 occurrences	2% chance
Watch	46 occurrences	8% chance
Source: EOEEA and MEMA		

The likely range of consecutive dry days per year is projected to increase by up to nearly 20 days per year in 2090, compared to the annual statewide baseline of approximately 16 days per year from 1971 to 2001. Table 4-16 indicates the projected number of consecutive dry days according to the “high” and “low” limits of the Northeast Climate Adaptation Science Center (NE CASC) data.

### Projected Continuous Dry Days by Planning Year

<b>Planning Year</b>	<b>2030</b>	<b>2050</b>	<b>2070</b>	<b>2100</b>
Projected Range of Consecutive Dry Days	16.44-17.94	16.34-18.64	15.94-18.94	16.34-19.64
Source: resilient MA, 2018				

## City of Framingham, MA Hazard Mitigation Plan Update

These projections suggest that the average time between rain events is likely to remain fairly constant; however, individual drought events could still increase in frequency and severity. The incidence of droughts in 2015-2016, 2020, and 2022 certainly underscores that the probability of future droughts is high.

### *Vulnerability Assessment*

#### Exposure

Drought is a gradual phenomenon, and its condition occurs naturally in a broad geographic area. The entire city would be exposed to drought conditions.

#### Built Environment Impacts

Major water users are more susceptible to drought, and these include water utilities, farmers using irrigated agriculture, mining operations, and some commercial users. Like many communities, Framingham obtains water from the Massachusetts Water Resources Authority, and this is believed to provide a significant level of drought resilience. Over time, drought risks to the MWRA supplies will need to be evaluated by MWRA to determine if risk will be realized in individual communities that rely on this supply.

#### Population Impacts

Populations considered most vulnerable to drought impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard. Homeowners with a shallow well could also be more vulnerable to a drought. Table 8 summarizes the senior and low-income populations in Framingham. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the city should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Socioeconomic impacts of the drought may also include anxiety and depression about economic impact, health problems associated with poor water quality, fewer recreational activities, higher incidents of heat stroke, and even loss of human life.

#### Environment Impacts

Although agriculture is limited in the city, there are some natural areas including 400 acres which has been put into public conservation which may be adversely impacted by drought. Drought amplifies the risk of loss of biodiversity and affects animal and plant species. Economic impacts include higher food and lumber prices. Drought can shrink the food supplies of animals and plants dependent on water and damage their habitats. Sometimes the environmental damage caused by a drought is temporary, and other times it is irreversible.

## City of Framingham, MA Hazard Mitigation Plan Update

### ***Landslides***

The term “landslide” includes a wide range of ground movements such as rock falls, deep failure of slopes, and shallow debris flows. The most common types of landslides in Massachusetts include translational debris slides, rotational slides, and debris flows. Most of these events are caused by a combination of unfavorable geologic conditions (silty clay or clay layers contained in glaciomarine, glaciolacustrine, or thick till deposits), steep slopes, and/or excessive wetness leading to excess pore pressures in the subsurface.

### *Description*

Historical landslide data for the Commonwealth suggests that most landslides are preceded by higher-than-normal precipitation, followed by a single, high-intensity rainfall of several inches or more (Mabee and Duncan, 2013). This precipitation can cause slopes to become saturated. Landslides associated with slope saturation occur predominantly in areas with steep slopes underlain by glacial till or bedrock. Bedrock is relatively impermeable relative to the unconsolidated material that overlies it. Similarly, glacial till is less permeable than the soil that forms above it. Thus, there is a permeability contrast between the overlying soil and the underlying, and less permeable, unweathered till and/or bedrock. Water accumulates on this less permeable layer, increasing the pore pressure at the interface, leading to a failure or slide.

Occasionally, landslides occur because of geologic conditions and/or slope saturation. Adverse geologic conditions exist wherever there are lacustrine or marine clays, as clays have relatively low strength. These clays often formed in the deepest parts of the glacial lakes that existed in Massachusetts following the last glaciation. These lakes include Bascom, Hitchcock, Nashua, Sudbury, Concord, and Merrimack, among many other unnamed glacial lakes. When oversteepened or exposed in excavations, these vulnerable areas often produce classic rotational landslides.

Landslides can also be caused by external forces, including both undercutting (due to flooding or wave action) and construction. Undercutting of slopes during flooding or coastal storm events is a major cause of property damage. Streams and waves erode the base of the slopes, causing them to oversteepen and eventually collapse.

### *Location*

In 2013, the Massachusetts Geological Survey and University of Massachusetts Amherst published a Slope Stability Map of Massachusetts. This project, funded by the FEMA Hazard Mitigation Grant Program, was designed to provide statewide mapping and identification of landslide hazards that can be used for community level planning as well as prioritizing high-risk areas for mitigation. The maps produced from this project should be viewed as a first-order approximation of potential landslide hazards across the state.

## City of Framingham, MA Hazard Mitigation Plan Update

The Slope Stability Map categorizes areas of Massachusetts into stability zones, and the categorization is correlated to the probability of instability in each zone. The probability of instability metric indicates how likely each area is to be unstable, based on the parameters used in the analysis. According to the map, these unstable areas are located throughout the Commonwealth. Landslide risk is therefore assumed present in Framingham.

### *Previous Occurrences*

Nationwide, landslides constitute a major geologic hazard because they are widespread, occur in all 50 states, and cause approximately \$1 billion to \$2 billion in damages and more than 25 fatalities on average each year. In Massachusetts, landslides tend to be more isolated in size and pose threats to highways and structures that support fisheries, tourism, and general transportation.

Landslides commonly occur shortly after other major natural disasters, such as earthquakes and floods, which can exacerbate relief and reconstruction efforts. Many landslide events may have occurred in remote areas, causing their existence or impact to go unnoticed. Expanded development and other land uses may contribute to the increased number of landslide incidences and/or the increased number of reported events in the recent record. Notwithstanding these risks, very few landslides have been reported in Framingham.

### *Extent*

Variables that contribute to the extent of potential landslide activity in any area include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions. As a result, estimations of the potential severity of landslides are informed by previous occurrences as well as an examination of landslide susceptibility. Information about previous landslides, such as the information and images from landslides after T.S. Irene can provide insight as to both where landslides may occur and what types of damage may result. It is important to note, however, that landslide susceptibility identifies only areas potentially affected and does not imply a time frame when a landslide might occur. The distribution of susceptibility across the Commonwealth is depicted on the Slope Stability Map, with areas of higher slope instability considered to also be more susceptible to the landslide hazard.

Characterizing the warning time before landslides can be challenging. Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material, and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine the areas that are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis and respond after the event has occurred. Generally accepted warning signs for landslide activity include the following:

## City of Framingham, MA Hazard Mitigation Plan Update

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements, or sidewalks
- Soil moving away from foundations
- Ancillary structures, such as decks and patios, tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken waterlines and other underground utilities
- Leaning telephone poles, trees, retaining walls, or fences
- Offset fence lines
- Sunken or downdropped roadbeds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels even though rain is still falling or has just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together

### *Probability of Future Events*

The probability of future occurrences is defined by the number of events over a specified period of time. The SHMCAP notes that from 1996 to 2012, eight noteworthy events triggered one or more slides in the Commonwealth. However, because many landslides are minor and occur unobserved in remote areas, the true number of landslide events is probably higher. The SHMCAP estimated that about 30 or more landslide events occurred in the period between 1986 and 2006. This roughly equates to one to three landslide events each year in Massachusetts. Given this information, the probability of a landslide in Framingham is considered low.

### *Vulnerability Assessment*

#### Exposure

While landslides are rare, their impacts can be devastating, including loss of property, disruption to infrastructure, and injury and death. Continued development, particularly on steep slopes or unstable soils, increases the chances that landslides will be a danger. Other associated concerns are debris management issues including debris removal and identification of disposal sites.

To help identify potential landslide areas for the city, the slope stability index developed by the Massachusetts Geological Survey was used. The unstable and moderately unstable regions were queried out of the data and overlaid with the critical facilities and other buildings. There were no critical facilities found in the unstable or moderately unstable area.

The other building data was overlaid with the unstable and moderately unstable areas. Table 12 shows the result of this analysis. No buildings were found in the unstable area. Twenty-one buildings, including single-family and multi-family homes were found in the moderately unstable area.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 12. Buildings in Moderately Unstable Area

Building Type	Number of Buildings (Total in City)	Building Value (Total in City)
Single Family	14 (16,587)	\$3,785,000 (\$4,940,318,400)
Multi-Family	7 (2,663)	\$4,220,700 (\$4,699,362,900)

All of the buildings in the moderately unstable areas also have environmental justice concerns.

Figure 13 shows the landslide susceptibility map for the city. The red and pink areas are more susceptible to landslides.

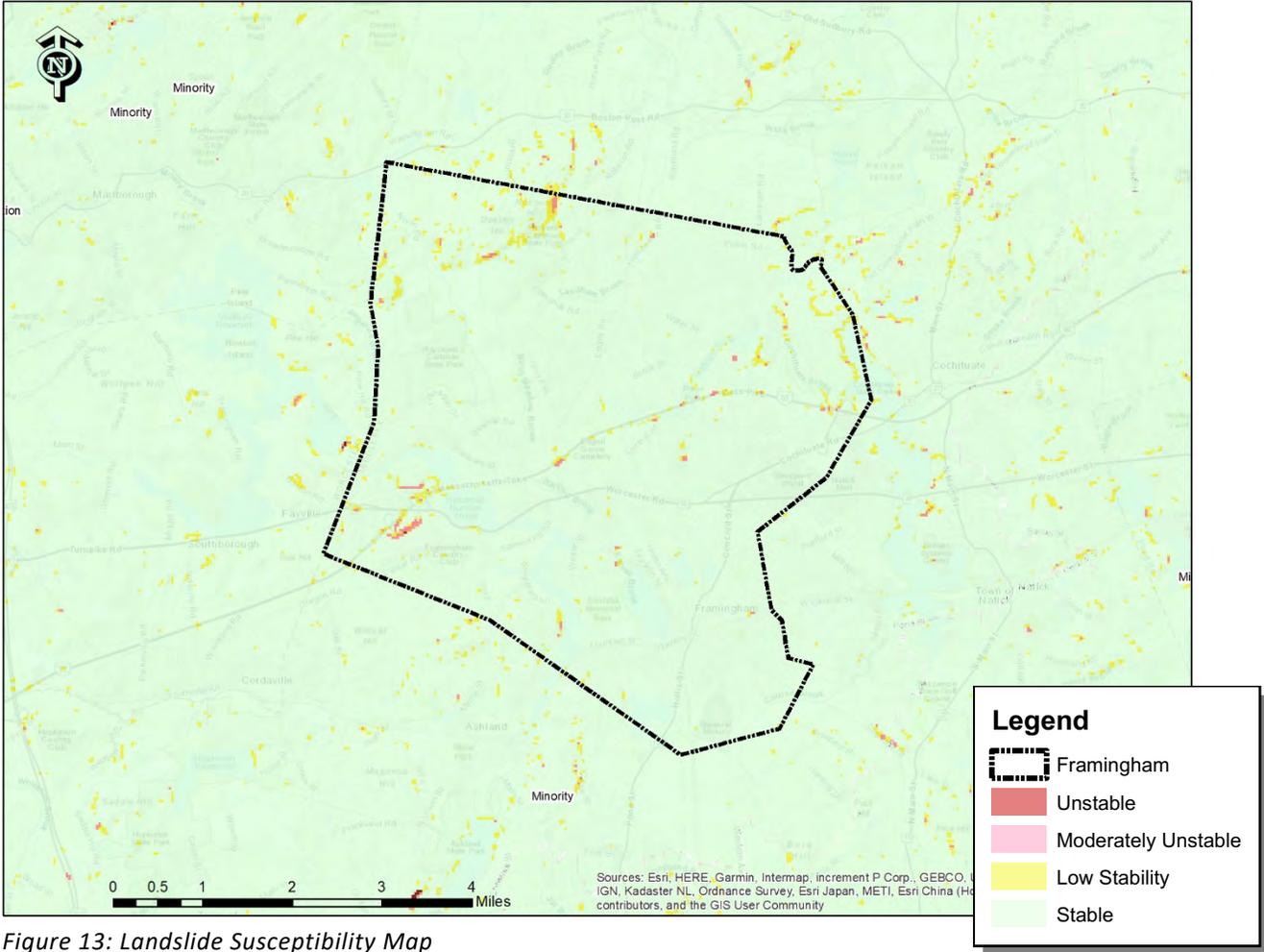


Figure 13: Landslide Susceptibility Map

# City of Framingham, MA Hazard Mitigation Plan Update

## Built Environment Impacts

Historic data for landslide events indicate that between 1993 and 2022, no landslide events were recorded in Framingham. Still, there is a likelihood even if it's slight. Reviewing the buildings at higher risk, they are fairly spread out across the city making an event damaging more than one property unlikely. We'll assume a total loss for a building due to a 100-year landslide event. The average value of a building in the moderately susceptible zone is \$381,223. This would result in an AAL of \$3,812.

## Population Impacts

Populations considered most vulnerable to landslide impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 8 summarizes the senior and low-income populations in Framingham. The potential needs of residents within these population segments in the event of a hazard occurrence is important to consider.

## Environment Impacts

There are unstable and moderately unstable areas around some transportation routes. These routes may be used to transport hazardous materials through the city.

## Primary Climate Change Interaction: Changing Temperatures

### **Extreme Temperatures**

According to the SHMCAP, extreme heat for Massachusetts is usually defined as a period of three or more consecutive days above 90 degrees Fahrenheit (°F), but more generally as a prolonged period of excessively hot weather which may be accompanied by high humidity. Extreme cold is also considered relative to the normal climatic lows in a region. Extreme cold temperatures are characterized by the ambient air temperature dropping to approximately 0°F or below.

The City of Framingham Community Resilience Building Workshop Summary of Findings (2019) lists "Extreme temperatures" as one of the top four hazards of concern.

### *Description*

Extreme cold is a dangerous situation that can result in health emergencies for susceptible or vulnerable people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. Extreme cold events are events when temperatures drop well below normal in an area. When winter temperatures drop significantly below normal, staying warm and safe can become a challenge. Extremely cold temperatures often accompany a winter storm, which may also cause power failures and icy roads. During cold months, carbon monoxide may be high in some areas because the colder weather makes it difficult for car emission control systems to operate effectively, and temperature inversions can trap the resulting pollutants closer to the ground.

## City of Framingham, MA Hazard Mitigation Plan Update

Likewise, extreme heat is a dangerous situation that can result in health emergencies for susceptible and vulnerable people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without adequate cooling.

A heat wave is defined as three or more days of temperatures of 90°F or above. A basic definition of a heat wave implies that it is an extended period of unusually high atmosphere-related heat stress, which causes temporary modifications in lifestyle, and which may have adverse health consequences for the affected population. Heat waves cause more fatalities in the U.S. than the total of all other meteorological events combined. According to the SHMCAP, more than 9,000 Americans have died from heat-related ailments (EPA, 2016) since the 1970s.

Heat impacts can be particularly significant in urban areas. Buildings, roads, and other infrastructure replace open land and vegetation. Dark-colored asphalt and roofs also absorb more of the sun's energy. These changes cause urban areas to become warmer than the surrounding areas. This forms "islands" of higher temperatures, often referred to as "heat islands." Heat islands can affect communities by increasing peak energy demand during the summer, air conditioning costs, air pollution and GHG emissions, heat-related illness and death, and water quality degradation (EPA).

Many conditions associated with heat waves or more severe events (including high temperatures, low precipitation, strong sunlight, and low wind speeds) contribute to a worsening of air quality in several ways. High temperatures can increase the production of ozone from volatile organic compounds and other aerosols. Weather patterns that bring high temperatures can also transport particulate matter air pollutants from other areas of the continent. Additionally, atmospheric inversions and low wind speeds allow polluted air to remain in one location for a prolonged period of time (UCI, 2017).

### *Location*

According to NOAA, Massachusetts is made up of three climate divisions: Western, Central, and Coastal. Average annual temperatures vary slightly over the divisions, with annual average temperatures of around 46°F in the Western division, 49°F in the Central division, and 50°F in the Coastal division. Framingham is located in the Central division. Because extreme temperature events occur more frequently and vary more in the inland regions where temperatures are not moderated by the ocean, Framingham is believed to be at risk.

### *Previous Occurrences*

Extreme Cold: The SHMCAP notes that since 1994, there have been 33 cold weather events within the Commonwealth, ranging from Cold/Wind Chill to Extreme Cold/Wind Chill events.

Extreme Heat: The SHMCAP notes that according to the NOAA's Storm Events Database (accessed in March 2018 for that planning process) there have been 43 warm weather events (ranging from Record Warmth/Heat to Excessive Heat events) since 1995. The most current event in the database occurred in

# City of Framingham, MA Hazard Mitigation Plan Update

July 2013. Excessive heat results from a combination of temperatures well above normal and high humidity. Whenever the heat index values meet or exceed locally or regionally established heat or excessive heat warning thresholds, an event is reported in the database.

In 2012, Massachusetts temperatures broke 27 heat records. Most of these records were broken between June 20 and June 22, 2012, during the first major heat wave of the summer to hit Massachusetts and the East Coast. In July 2013, a long period of hot and humid weather occurred throughout New England. One fatality occurred on July 6, when a postal worker collapsed as the Heat Index reached 100°F.

The NOAA Storm Events database (<https://www.ncdc.noaa.gov/stormevents/>) for Middlesex County lists the following extreme heat event for the Framingham area in the timeframe 2012-2021, matching the report above from the SHMCAP:

- 7/5/13 – Extreme Heat: A strong upper-level ridge over southern New England resulted in a long period of very hot and humid weather across the region. July 3rd through July 7th all had high temperatures above 90 degrees, constituting an official heat wave for the city of Boston. Despite the extended period of high heat and humidity, only one person succumbed to heat illness. That was a 45-year-old postal worker in the city of Medford who died on July 6th. The official cause of death for the postal worker was heat illness.

Several extreme heat events occurred in Framingham in July and August 2022. The City opened several cooling centers, and record temperatures were set elsewhere in Massachusetts. Official records will be compiled toward the end of 2022 and will be available for the next update of this plan.

Cold events are typically reported with winter storms and will be described in the winter storm section of this chapter.

USDA declares agricultural disasters as needed for a variety of hazards. Information can be found at <https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index>. The events related to extreme temperatures in Middlesex County are listed below.

Table 13. Extreme Temperature Events Listed by USDA.

Year	Event	Event “Begin Dates”
2020	Frost/freeze	5/6/2020
2019	Extreme cold, temperature fluctuations	12/1/2018
2016	Drought, wildfire, excessive heat, high winds, insects	8/16/2016

# City of Framingham, MA Hazard Mitigation Plan Update

Year	Event	Event “Begin Dates”
2016	Frost/freeze	2/14/2016
2016	Drought, wildfire, excessive heat, high winds, insects	7/5/2016
2016	Frost/freeze, unseasonably warm temps.	2/1/2016
2014	Frost/freeze, hail	5/22/2014
2014	Cold, frost/freeze	12/1/2013

### Extent

**Extreme Cold:** The extent (severity or magnitude) of extreme cold temperatures is generally measured through the Wind Chill Temperature Index. Wind Chill Temperature is the temperature that people and animals feel when they are outside, and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. As the wind increases, the body loses heat at a faster rate, causing the skin’s temperature to drop. The NWS issues a Wind Chill Advisory if the Wind Chill Index is forecast to dip to – 15°F to – 24°F for at least 3 hours, based on sustained winds (not gusts). The NWS issues a Wind Chill Warning if the Wind Chill Index is forecast to fall to –25°F or colder for at least 3 hours. On November 1, 2001, the NWS implemented a Wind Chill Temperature Index designed to more accurately calculate how cold air feels on human skin. Figure 4-42 shows the Wind Chill Temperature Index.

**Extreme Heat:** The NWS issues a Heat Advisory when the NWS Heat Index is forecast to reach 100 to 104°F for 2 or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105°F or higher for 2 or more hours. The NWS Heat Index is based both on temperature and relative humidity and describes a temperature equivalent to what a person would feel at a baseline humidity level. It is scaled to the ability of a person to lose heat to their environment. The relationship between these variables and the levels at which the NWS considers various health hazards to become relevant are shown in Figure 4-43. It is important to know that the heat index values are devised for shady, light wind conditions. Exposure to full sunshine can increase heat index values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can increase the risk of heat-related impacts.

### Probability of Future Events

The SHMCAP notes that Massachusetts averaged 2.4 declared cold weather events and 0.8 extreme cold weather events annually between January 2013 and October 2017. The year 2015 was a particularly notable one, with seven cold weather events, including three extreme cold/wind chill events, as compared to no cold weather events in 2012 and one in 2013. The SHMCAP notes that an average of between four and five heat waves occur annually in Massachusetts.

# City of Framingham, MA Hazard Mitigation Plan Update

There are a number of climatic phenomena that determine the number of extreme weather events in a specific year. However, there are significant long-term trends in the frequency of extreme hot and cold events. In the last decade, U.S. daily record high temperatures have occurred twice as often as record lows (as compared to a nearly 1:1 ratio in the 1950s). Models suggest that this ratio could climb to 20:1 by midcentury, if GHG emissions are not significantly reduced (C2ES, n.d.).

The NE CASC data support the trends of an increased frequency of extreme hot weather events and a decreased frequency of extreme cold weather events. High, low, and average temperatures in Massachusetts are all likely to increase significantly over the next century as a result of climate change. The graphics below (from resilient MA, 2018) show the projected annual days with maximum temperature above 90 degrees and projected annual days with minimum temperature below 32 degrees.

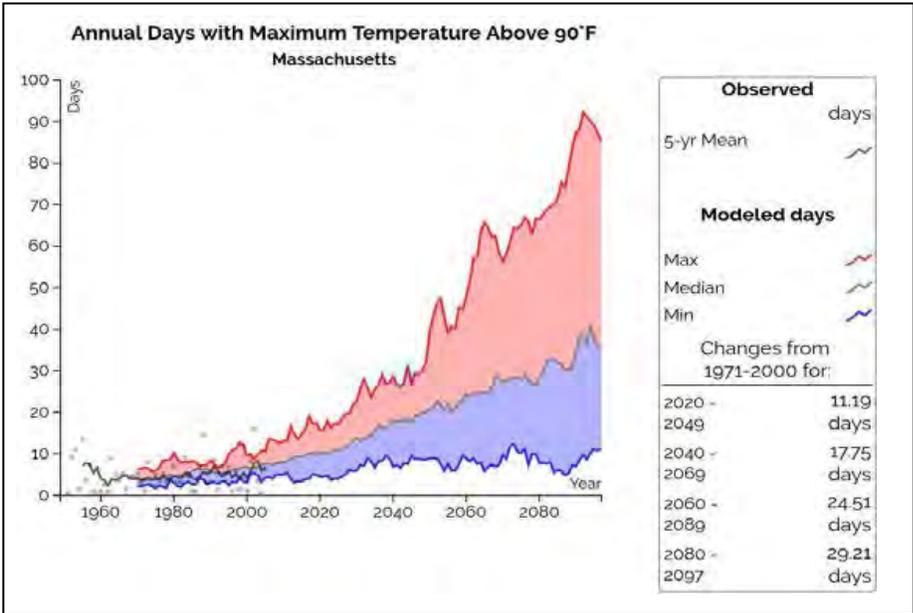


Figure 14. Annual Days with Maximum Temperature Above 90 (SHMCAP, 2018).

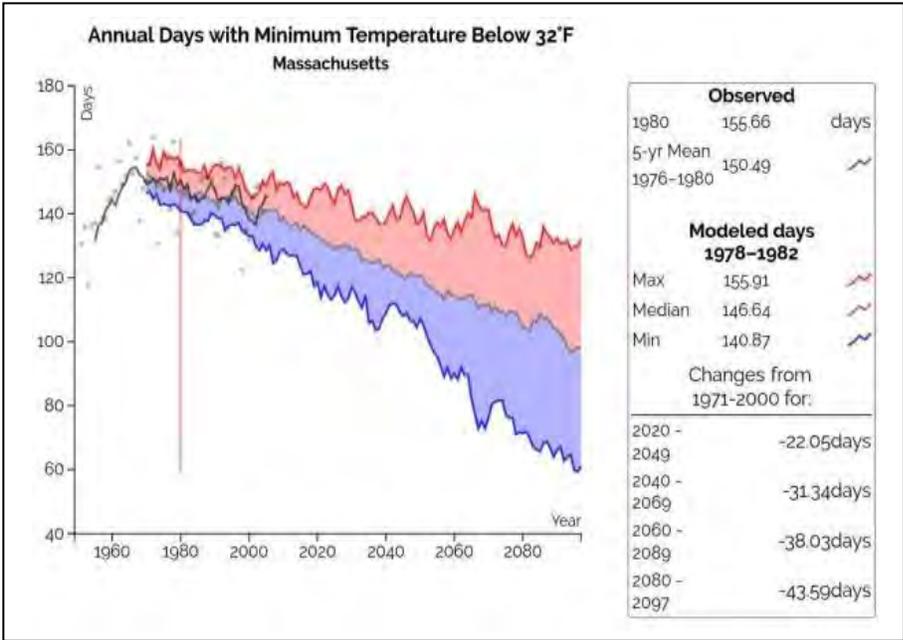


Figure 15. Annual Days with Maximum Temperatures Below 32 (SHMCAP, 2018).

Overall, the number of days of extreme heat will increase in Framingham, and the number of days of extreme cold will decrease. The 2022 Massachusetts Climate Change Assessment provide an update to the extreme heat projection relative to the number of days exceeding 90 degrees and 100 degrees, respectively:

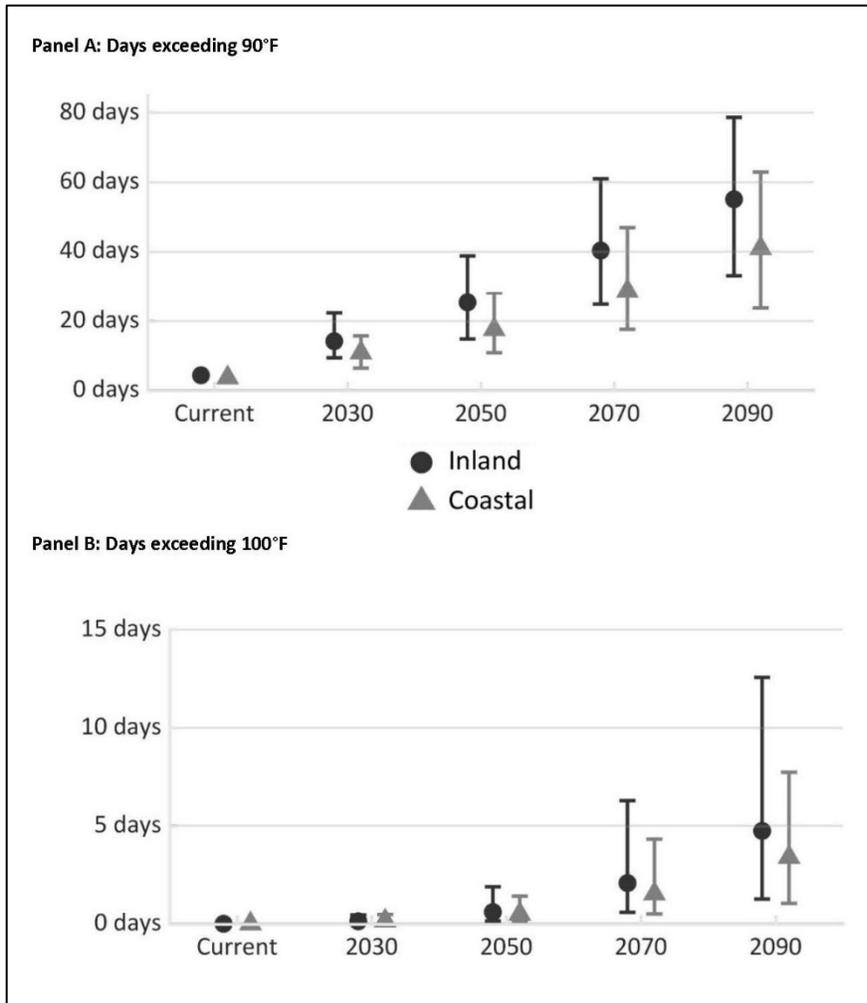


Figure 16. Change in Number of Days Per Year Over 90 Degrees and 100 Degrees Compared to Current Climate (2022 Massachusetts Climate Change Assessment).

Vulnerability Assessment

Exposure

Extreme temperatures are not a hazard with a defined geographic boundary. The entire city should be considered exposed to the hazard. Excessive heat can occur at any time during the year, but is most dangerous during the summer between June and August when average temperatures are at their highest.

Built Environment Impacts

The impact of excessive heat is most prevalent in developed areas, where the city lacks a tree canopy. Secondary impacts of excessive heat are severe strain on the electrical power system and potential brownouts or blackouts. Extreme heat can have a negative impact on transportation. Highways and roads are damaged by excessive heat as asphalt roads soften and concrete roads expand and can buckle, crack, or shatter. Moreover, concrete has been known to "explode," lifting chunks of concrete and

## City of Framingham, MA Hazard Mitigation Plan Update

putting those nearby at serious risk. Stress is also placed on automobile cooling systems, diesel trucks, and railroad locomotives which lead to an increase in mechanical failures. Steel rails are at risk of overheating and warping which can lead to train derailments.

Extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the heating system, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. Broken pipes may cause flooding in buildings, causing property damage and loss of utility service. Some of the secondary effects presented by extreme/excessive cold include dangerous conditions to livestock and pets.

### Population Impacts

Extreme cold events are predicted to decrease in the future, while extreme heat days, as well as average temperatures are projected to increase. The projected increase in extreme heat and heat waves is the source of one of the key health concerns related to climate change. Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat exhaustion, heat stroke, and death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. People who perform manual labor, particularly those who work outdoors, are at increased risk for heat-related illnesses. Prolonged heat exposure and the poor air quality and high humidity that often accompany heat waves can also exacerbate pre-existing conditions, including respiratory illnesses, cardiovascular disease, and mental illnesses.

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. Body temperatures that are too low affect the brain, making it difficult for the victim to think clearly or move well. This makes hypothermia particularly dangerous for those suffering from it, as they may not understand what is happening to them or what to do about it. Hypothermia is most likely at very cold temperatures but can occur at higher temperatures (above 40 degrees Fahrenheit) if the person exposed is also wet from rain, sweat, or submersion. Warning signs of hypothermia include shivering, exhaustion, confusion, fumbling hands, memory loss, slurred speech, or drowsiness. In infants, symptoms include bright red, cold skin and very low energy. A person with hypothermia should receive medical attention as soon as possible, as delays in medical treatment may result in death.

Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions. In Framingham, 16.1% of the population is over age 64. People who live in older housing stock and in housing without air conditioning have increased vulnerability to heat-related illnesses. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage. Heat impacts are more likely to be

## City of Framingham, MA Hazard Mitigation Plan Update

felt by residents without air conditioning, by those who work outdoors, and those with underlying health conditions.

Extreme heat can pose severe and life-threatening problems for people. According to the NWS, it is one of the leading weather-related killers in the United States, resulting in hundreds of fatalities each year and even more heat-related illnesses. Extreme heat has a special impact on the most vulnerable segments of the population - the elderly, young children and infants, impoverished individuals, and persons who are in poor health. The high-risk population groups with specific physical, social, and economic factors that make them vulnerable include:

- Older persons (age > 65)
- Infants (age < 1)
- Homeless population
- Very low- and low-income persons
- People who are socially isolated
- People with mobility restrictions or mental impairments
- People taking certain medications (e.g., for high blood pressure, depression, insomnia)
- People engaged in vigorous outdoor exercise or work or those under the influence of drugs or alcohol.

### Environment Impacts

There are several reservoirs in Framingham and having the water temperatures elevated over a longer period will increase the number of times the city will need to treat for algae blooms. More harmful blooms could result in more potential for injuries and death for swimmers and pets.

### **Wildfires**

A wildfire can be defined as any non-structure fire that occurs in vegetative wildland that contains grass, shrub, leaf litter, and forested tree fuels. Wildfires in Massachusetts are caused by natural events, human activity, or prescribed fire. Wildfires often begin unnoticed but spread quickly, igniting brush, trees, and potentially homes.

#### *Description*

The wildfire season in Massachusetts usually begins in late March and typically culminates in early June, corresponding with the driest live fuel moisture periods of the year. April is historically the month in which wildfire risk is the highest. Drought, snowpack level, and local weather conditions can impact the length of the fire season.

## City of Framingham, MA Hazard Mitigation Plan Update

According to the National Fire Protection Agency, several elements (known as the fire tetrahedron) must be present in order to have any type of fire:

- **Fuel:** Without fuel, a fire will stop. Fuel can be removed naturally (when the fire has consumed all burnable fuel) or manually by mechanically or chemically removing fuel from the fire. In structure fires, removal of fuel is not typically a viable method of fire suppression. Fuel separation is important in wildfire suppression and is the basis for controlling prescribed burns and suppressing other wildfires. The type of fuel present in an area can help determine overall susceptibility to wildfires. According to the Forest Encyclopedia Network, four types of fuel are present in wildfires:
  - Ground Fuels: organic soils, forest floor duff, stumps, dead roots, buried fuels
  - Surface Fuels: the litter layer, downed woody materials, dead and live plants to 2 meters tall
  - Ladder Fuels: vine and draped foliage fuels
  - Canopy Fuels: tree crowns
- **Heat:** Without sufficient heat, a fire cannot begin or continue. Heat can be removed through the application of a substance, such as water, powder, or certain gases, that reduces the amount of heat available to the fire. Scraping embers from a burning structure also removes the heat source.
- **Oxygen:** Without oxygen, a fire cannot begin or continue. In most wildland fires, this is commonly the most abundant element of the fire triangle and is therefore not a major factor in suppressing wildfires.
- **Uninhibited Chain Reaction:** The chain reaction is the feedback of heat to the fuel to produce the gaseous fuel used in the flame. In other words, the chain reaction provides the sustained heat necessary to maintain the fire. Fire suppression techniques, such as dry chemical extinguishers, break up the uninhibited chain reaction of combustion to stop a fire.

### *Location*

According to the SHMCAP, the ecosystems that are most susceptible to the wildfire hazard are pitch pine, scrub oak, and oak forests, as these areas contain the most flammable vegetative fuels. Other portions of the Commonwealth are also susceptible to wildfire, particularly at the urban-wildland interface.

The previous edition of this plan notes that northwest Framingham contains the largest contiguous area of forest and tree cover and is most susceptible to future wildfire events. This area is additionally at risk due to low density residential neighborhoods and winding rural roadways that make water and fire hydrant access more difficult compared to higher density neighborhoods with grid-like streets.

# City of Framingham, MA Hazard Mitigation Plan Update

## Previous Occurrences

Several notable wildfires have occurred in Massachusetts history, although none has ever resulted in a FEMA disaster declaration. Smaller fires such as brush fires are somewhat easier to characterize. According to statewide data sets (<https://www.mass.gov/service-details/fire-data-and-statistics>), the number of brush fire events per year from 2012 through 2019 ranged from about 3,000 in 2019 to almost 8,000 in the drought year of 2016.

Year	Total # of Events	Injuries/deaths (civilians and fire service)	Losses
2019	2,974	12/0	\$136,357
2018	3,253	1/5	\$493,145
2017	4,206	20/0	\$215,156
2016	7,834	40/0	\$1,526,654
2015	6,962	35/0	\$323,211
2014	4,627	25/0	\$209,857
2013	4,968	31/3	\$297,854
2012	5,857	38/0	\$705,457

The previous edition of this plan noted that Framingham experienced a total of 112 brush fire responses in 2015 which was a “significant increase from previous years.” At the time, local incident reporting data showed a ten-year historical average (2005 through 2015) of 62 brush fire responses each year. This contrasts only slightly with the statewide data sets referenced above for Massachusetts. According to this source, fire event counts back to 2012 were as follows for Framingham:

Year	Total Outdoor Fires	Total Fire Events	Reported Losses for Outdoor Fires
2019	55	582	\$113,052
2018	103	655	\$204,712
2017	88	574	\$283,493
2016	116	599	\$378,832
2015	121	632	\$373,271

# City of Framingham, MA Hazard Mitigation Plan Update

Year	Total Outdoor Fires	Total Fire Events	Reported Losses for Outdoor Fires
2014	66	494	\$110,155
2013	84	471	\$274,919
2012	50	481	\$203,492

USDA declares agricultural disasters as needed for a variety of hazards. Information can be found at <https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index>. The events related to wildfires in Middlesex County are listed below; these correspond to the drought of 2016.

Table 14. Wildfire Events Listed By USDA.

Year	Event	Event “Begin Dates”
2016	Drought, wildfire, excessive heat, high winds, insects	8/16/2016
2016	Drought, wildfire, excessive heat, high winds, insects	7/5/2016

The local planning committee noted that fires associated with mulch piles and mulch operations are a growing concern in Framingham, implying that prior occurrences have been recorded. The City will begin tracking these for future updates to this plan.

### Extent

Unfragmented and heavily forested areas of the state are vulnerable to wildfires, particularly during droughts. The greatest potential for significant damage to life and property from fire exists in areas designated as wildland-urban interface areas. A wildland-urban interface area defines the conditions where highly flammable vegetation is adjacent to developed areas.

Fires can be classified by physical parameters such as their fireline intensity, or Byram’s intensity, which is the rate of energy per unit length of the fire front (BTU [British thermal unit] per foot of fireline per second) (NPS, n.d.). Wildfires are also measured by their behavior, including total heat release during burnout of fuels (BTU per square foot) and whether they are crown-, ground-, or surface-burning fires. Following a fire event, the severity of the fire can be measured by the extent of mortality and survival of plant and animal life aboveground and belowground and by the loss of organic matter (NPS, n.d.).

The National Wildfire Coordinating Group defines seven classes of wildfires:

- Class A: 0.25 acre or less

## City of Framingham, MA Hazard Mitigation Plan Update

- Class B: more than 0.25 acre, but less than 10 acres
- Class C: 10 acres or more, but less than 100 acres
- Class D: 100 acres or more, but less than 300 acres
- Class E: 300 acres or more, but less than 1,000 acres
- Class F: 1,000 acres or more, but less than 5,000 acres
- Class G: 5,000 acres or more

Early detection of wildfires is a key part of the overall efforts of the Massachusetts Bureau of Fire Control. Early detection is achieved by trained Bureau observers who staff the statewide network of 42 operating fire towers. During periods of high fire danger, the Bureau conducts county-based fire patrols in forested areas. These patrols assist cities and towns in prevention efforts and allow for the quick deployment of mobile equipment for suppression of fires during their initial stage. If a fire breaks out and spreads rapidly, residents may need to evacuate within days or hours. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time.

### *Probability of Future Events*

It is difficult to predict the likelihood of wildfires in a probabilistic manner because a number of factors affect fire potential and because some conditions (e.g., ongoing land use development patterns, location, and fuel sources) exert changing pressure on the wildland-urban interface zone. The following discussion helps characterize the risk further for Framingham. Additionally, the concern related to mulch piles and mulching mentioned above could affect future wildfire probabilities.

### *Vulnerability Assessment*

#### Exposure

To help identify potential wildfire areas for Framingham, the U.S. Forest Service's Wildfire Risk to Communities spatial data was downloaded. This data was developed in 2020 using the vegetation and wildland fuels from the LANDFIRE 2014 model with the burn probability coming from the Forest Service Fire Simulation System (FSim). To create a product with a finer resolution, the data was upsampled to the native 30m resolution of the LANDFIRE fuel and vegetation data spreading the values of the modeled burn probability into developed areas represented in LANDFIRE fuels as non-burnable. The areas with a 0.03% probability of burning were identified and overlaid with the critical facilities and other buildings. There were no critical facilities found in the 0.03% burn probability areas, but 43 single-family homes are found there. Table 15 shows the result of this analysis.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 15. Buildings in 0.03% Annual Chance Area

Building Type	Number of Buildings (Total in City)	Building Value (Total in City)
Single Family	43 (16,587)	\$18,755,100 (\$4,940,318,400)

The population exposed to the 0.03% probability area is shown in Table 16. The column in the left shows the population in and around the 0.03% probability wildfire area (wherever the Census Block overlapped with the wildfire area) while the column on the right shows the total population numbers for the city. There is an older population exposed to the wildfire hazard with a lower annual income than the city average.

Table 16. Population Exposed to 0.03% Annual Chance Wildfire (2020 U.S. Census)

Demographics	Population in and Adjacent to 0.03% Wildfire Area	Total Population
Population	403	72,362
Households	148	29,033
White	365 (90.6%)	40,685 (56.2%)
Black	8 (2.0%)	4,517 (6.2%)
American Indian	0 (0.0%)	338 (0.5%)
Asian	11 (2.7%)	5,267 (7.3%)
Pacific Islander	0 (0.0%)	26 (0.1%)
Other Race	9 (2.2%)	11,603 (16.0%)
Two or More Races	10 (2.5%)	9,926 (13.7%)
Hispanic or Latino:	13 (3.2%)	12,171 (16.8%)
Population under 18:	85 (21.1%)	14,178 (19.6%)
Population over 64:	95 (23.6%)	11,679 (16.1%)
Annual Income < \$30K/year	44 (10.9%)	4,678 (16.1%)
Population in EJ Zone:	403 (100%)	63,150 (87.3%)

# City of Framingham, MA Hazard Mitigation Plan Update

Figure 17 shows the burn probability map from the USFS overlaid on the city.

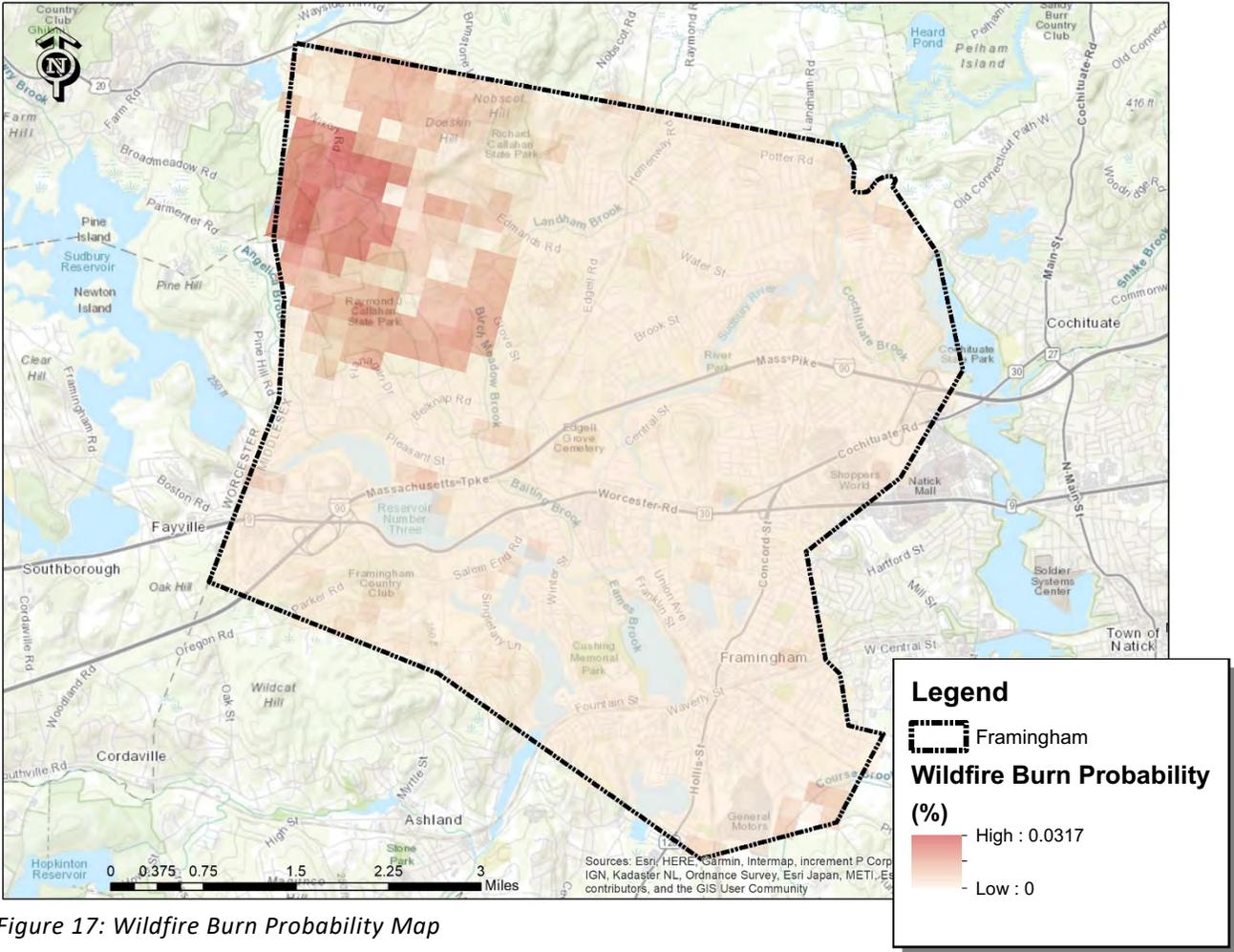


Figure 17: Wildfire Burn Probability Map

## Built Environment Impacts

A major out-of-control wildfire can damage property, utilities and forested land; create smoke that can cause breathing problems; and injure or kill people. Other associated concerns are debris management issues including debris removal and identification of disposal sites.

No property damage, injuries or deaths have been recorded for the reported brushfires in Framingham between 2004 and 2022. Using the wildfire probabilities and building values, a loss estimate was produced for the 0.03% scenario. The losses are shown in Table 17 and the AAL will be \$8,280.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 17. Building Loss for a 0.03% Annual Chance Scenario

Loss Type	Residential (\$Million)	Commercial (\$Million)	Other Occupancy (\$Million)	Total (\$Million)
Building Loss	\$18.4	\$0	\$0.0	\$18.4
Content Loss	\$9.2	\$0	\$0.0	\$9.2
<b>Total</b>	<b>\$27.6</b>	<b>\$0</b>	<b>\$0.0</b>	<b>\$27.6</b>

### Population Impacts

Populations considered most vulnerable to wildfire impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 8 summarizes the senior and low-income populations in Framingham. The city should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

### Environment Impacts

Many of the natural features in the city are susceptible to wildfire including the trees and parks.

### Infectious Diseases

The SHMCAP does not address infectious diseases as a profiled hazard. While major disease outbreaks are uncommon, public health emergencies can become standalone disasters that compound the threat of other natural hazards and exceed local and state capacity. Precedent for federal assistance due to public health emergencies has been set including West Nile Virus (2000), a mosquito-borne disease, for which a federal emergency declaration was made in New York and New Jersey; and the COVID-19 pandemic, which resulted in a major disaster declaration in all states, territories, and the District of Columbia. Given that COVID-19 has resulted in excessive public expenditures and resulted in a disaster declaration, and in light of heightened concerns about tick and mosquito-borne illnesses, this plan addresses infectious diseases.

### Description

Public health risks, such as those presented by infectious diseases and vector-borne illnesses, are present within every community. An infectious disease is one that is caused by micro-organisms, such as bacteria, viruses, and parasites. A vector-borne illness is an infectious disease that is transmitted to humans by blood-feeding arthropods, including ticks, mosquitoes, and fleas, or in some cases by

## City of Framingham, MA Hazard Mitigation Plan Update

mammals (e.g., rabies). Infectious diseases cause illness, suffering and even death, and place an enormous financial burden on society.

Most infectious diseases are caused by pathogens that can be spread, directly or indirectly, from person to person. Such diseases may be seasonal (seasonal influenza) or result, in the case of new diseases, result in a global pandemic. Infectious disease dynamics depend on a range of factors, including land use, human behavior, climate, efficacy of healthcare services, population dynamics of vectors, population dynamics of intermediate hosts and the evolution of the pathogens themselves. Many of these diseases require continuous monitoring, as they present seasonal threats to the general population.

In Massachusetts, state public health officials rely on local boards of health, healthcare providers, laboratories, and other public health personnel to report the occurrence of notifiable diseases as required by law. An epidemic emerges when an infectious disease occurs suddenly in numbers that are more than normal expectancy. Infectious disease outbreaks put a strain on the healthcare system and may cause continuity issues for local businesses. These outbreak incidents are a danger to emergency responders, healthcare providers, schools, and the public. This can include influenza (e.g., H1N1), pertussis, West Nile virus, and many other diseases. A pandemic is an epidemic that has spread over a large area, that is, it is prevalent throughout an entire country, continent, or the whole world.

On March 11, 2020, the World Health Organization (WHO) officially declared the Coronavirus disease 2019 (COVID-19) outbreak a pandemic due to the global spread and severity of the disease. COVID-19 is a respiratory illness that can spread from person to person. COVID-19 is a highly contagious, viral upper respiratory illness that was first detected in China in late 2019. The virus quickly spread throughout the world and has resulted in a global pandemic ongoing at the time of this plan. COVID-19 symptoms include cough, difficulty breathing, fever, muscle pain, and loss of taste or smell. Severe cases may result in death, especially in individuals over the age of 65 or with underlying medical conditions, such as diabetes, lung disease, asthma, obesity, or those who are immunocompromised. COVID-19 spreads from person to person through respiratory droplets in the air or on surfaces.

### *Location*

The entire Commonwealth of Massachusetts and City of Framingham are considered at risk to the infectious diseases addressed in this chapter.

### *Previous Occurrences*

Pandemic influenza episodes that were considered to be global outbreaks spread were observed in 1918, 1957, 1968, and in 2009 with the novel H1N1 strain. The 2009 H1N1 outbreak, though not considered a serious threat, still affected some residents in Massachusetts with nearly 2,000 confirmed cases and 33 deaths. The great influenza epidemic of 1918 killed millions worldwide and would likely cause hundreds to thousands of deaths in Massachusetts should a similar outbreak occur today. It is

# City of Framingham, MA Hazard Mitigation Plan Update

anticipated that a more serious strain of the usual flu will occur some year and that vaccines might not be ready in time to combat rapid spread.

The most significant recent occurrence of infectious disease for Framingham is that of COVID-19. Approximately 2 million cases and 21,000 deaths have been reported in Massachusetts. As of the end of August 2022, approximately 400,000 cases were reported for Middlesex County. The federal designation for the Massachusetts COVID-19 Pandemic is DR-4496-MA, with incident period January 20, 2020 and continuing. The Major Disaster Declaration was issued March 27, 2020.

Vector-borne diseases continue to pose a significant threat to communities across Massachusetts. Blacklegged (deer) ticks and dog ticks are found throughout Massachusetts and may spread different diseases. The most common tick-borne diseases in Massachusetts are Lyme Disease, Babesiosis, and Anaplasmosis. Other diseases that are rare, but still occur, are Tularemia, Rocky Mountain spotted fever, Borrelia miyamotoi, and Powassan virus. Tickborne figures for Middlesex County are available at <https://www.mass.gov/lists/monthly-tick-borne-disease-reports>; a summary for the last three calendar years is provided below.

Year	Emergency Department Visits	Number of Tick-Borne Disease Visits	Rate (per 10,000) of Tick-borne Disease Visits
2021	523,835	243	4.64
2020	457,499	206	4.5
2019	505,147	288	5.7

Mosquito-borne diseases are also a seasonal threat. West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE or “Triple E”) are viruses that occur in Massachusetts and can cause illness ranging from a mild fever to more serious disease like encephalitis or meningitis. Other diseases spread by mosquitoes may affect people when traveling in other regions of the world such as Zika virus, Dengue fever, and Chikungunya.

### Extent

Well-established scales for characterizing total impacts of infectious diseases are not present for applied uses such as a hazard mitigation plan. Nevertheless, commonly accepted methods are in place for characterizing active transmission, such as color scales (yellow, orange, red). Future editions of this plan will provide updates to measures of extent. Johns Hopkins continues to provide a very comprehensive dashboard of information for all regions of the U.S. including Massachusetts. County-level data can also be accessed (<https://coronavirus.jhu.edu/region/us/massachusetts>).

## City of Framingham, MA Hazard Mitigation Plan Update

### *Probability of Future Events*

Probability of infectious disease in the planning area is extremely variable. Many public health risks occur seasonally and are ongoing, such as the common cold and influenza. Major disease outbreaks such as the current COVID-19 pandemic are much less common but can last for long periods. Based on the information available regarding occurrences of greatest concern, the infectious disease hazard has been assigned a probability of likely for the foreseeable future.

The COVID-19 pandemic has the potential to continue to some degree over the next several years, even as vaccines continue to be developed and distributed. The City of Framingham is continually updating community mitigation measures and guidance in close consultation with Massachusetts Department of Public Health and based on new information from the CDC.

The effects of climate change will result in an increase in the probability and/or frequency of some infectious diseases. Those infectious diseases that are currently present in Massachusetts and which may be exacerbated by climate change are already exhibiting increased prevalence in New England. For example, with both temperature and precipitation expected to increase in Massachusetts, West Nile Virus mosquito vector activity will likely increase, as well as the vector's period of activity. Similarly, between 1964 and 2010, counts of Eastern Equine Encephalitis (EEE) have continued to rise in New England, though they remain constant in the southeastern states.

The United States is already seeing a significant increase in vector-borne infectious diseases. According to the CDC, the number of reported disease cases from mosquito, tick, and flea bites tripled from 2004 to 2016, and mosquito-borne disease epidemics are happening more frequently. Annual cases of Lyme disease have increased over the last decade, and with shrinking winters, the potential for infection through tick bite continues to grow. Given increasing trends for global travel, several other diseases not typically observed in Massachusetts could continue to make their way back to the state through infected travelers. COVID-19 is the most recent and severe example of this threat. Another example is the Zika virus, transmitted from infected mosquitoes to humans, which received international attention during an outbreak in 2015 and persists today.

*According to the MVP-funded CRB Workshop Summary of Findings (2019), "climate change is affecting pests and disease vectors both through changing precipitation conditions and changing temperature conditions. Warmer, wetter conditions lead to increased mosquito populations, while the absence of sufficient periods of cold means that pest populations that would historically have been killed off or reduced are able to survive the winter and emerge in greater numbers the following season. Further, as the Massachusetts climate begins to look more like that of the mid-Atlantic and southern states, we are seeing new types of diseases show up in existing pests (e.g. mosquitoes carrying West Nile Virus, Eastern Equine Encephalitis (EEE), or Zika and ticks carrying Rocky Mountain Spotted Fever). 2018 marked the Commonwealth's highest ever incidence of West Nile Virus diagnosis, which is a more urban vector-borne illness than EEE. These changes present a major public and animal health challenge in terms of*

## City of Framingham, MA Hazard Mitigation Plan Update

*education, prevention, and treatment. As Sam Wong, the City's Director of Public Health, noted during the workshop, 'I see ticks everywhere.' These pests are increasingly prevalent in the City's parks and trails, and complaints and reports of abnormal tick-borne diseases are on the rise in Framingham."*

### Vulnerability Assessment

#### Exposure

The risk associated with communicable disease in the region has not been formally quantified, due to the difficulty in predicting specific occurrences, and the lack of complete data on impacts. However, the potential risk and impact of communicable diseases is often presumed to be very high in the chaos that follows natural disasters (WHO, 2006).

Natural disasters, particularly meteorological and geological events such as hurricanes, floods and earthquakes, can bring about serious health consequences. These disasters can affect vector breeding sites and vector-borne disease transmission. In a flood hazard area, initial flooding may wash away existing mosquito breeding sites, but standing water caused by heavy rainfall or overflow of rivers can create new breeding sites. This can result (with typically some weeks delay) in an increase of the vector population and potential for disease transmission, depending on the local mosquito vector species and its preferred habitat. The crowding of infected and susceptible hosts, a weakened public health infrastructure and interruptions of ongoing control programs are all risk factors for vector-borne disease transmission.

The major causes of communicable disease from natural disasters can be categorized into four areas: Infections due to contaminated food and water, respiratory infections, vector, and insect borne diseases, and infections due to wounds and injuries. The most common causes of morbidity and mortality in this situation are diarrheal disease and acute respiratory infections.

- **Waterborne diseases:** Diarrheal disease outbreaks can arise subsequent to drinking water contamination, and have been reported after flooding and related movement. Hepatitis A and E have fecal-oral transmission in areas with poor water sanitation.
- **Diseases associated with crowding:** Acute respiratory infections are the main cause of morbidity and mortality among unsettled people and are seen predominantly in children less than 5 years old.
- **Vector-borne diseases:** The most common vector-borne diseases are carried by mosquitoes and ticks and include Lyme Disease, Rocky Mountain Spotted Fever, West Nile Virus, and Eastern equine encephalitis. Environmental changes after disaster could increase vector breeding sites and proliferation of disease vectors.
- **Infections due to wounds and injuries:** The potentially significant threats to persons suffering a wound are tetanus, staphylococci, and streptococci.

# City of Framingham, MA Hazard Mitigation Plan Update

## Built Environment Impacts

All human-occupied critical facilities are assumed to be at risk of contamination from a communicable disease. If facilities supporting emergency response lost their functionality because of contamination, delays in emergency services could result. Additionally, with a significant human disease outbreak, resources of health care systems such as ambulance services, hospitals, and medical clinics could quickly become overwhelmed. In most cases, critical infrastructure would not be affected by communicable disease. Scenarios that would affect infrastructure include the contamination of the water supplies and diseases that require special provisions in the treatment of wastewater. Should an epidemic necessitate quarantine or incapacitate a significant portion of the population, support of and physical repairs to infrastructure may be delayed, and services may be disrupted for a time due to limitations in getting affected employees to work.

## Population Impacts

High death counts during a natural disaster (either human or animal) can indicate an increased risk of outbreaks associated with the size, health status, and living conditions of the population displaced by the natural disaster. Crowding, inadequate water and sanitation, and poor access to health services, often characteristic of sudden population displacement, increase the risk of communicable disease transmission.

Populations that are vulnerable to communicable diseases include the economically disadvantaged, racial and ethnic minorities, the uninsured, low-income children, the elderly, the homeless, and those with other chronic health conditions, including severe mental illness. It may also include rural residents, who often encounter barriers to accessing healthcare services, transportations, or the internet.

## Environment Impacts

Infectious diseases can also impact livestock and other animals. Some of the most common communicable diseases include Eastern Equine Encephalitis, Equine Herpes Virus, West Nile Virus, and Avian Influenza. While Zoonotic diseases (those transmissible between humans and animals or via an animal vector) are also a concern for the region, those events are best addressed in a pandemic or contagious disease plan rather than this hazard mitigation plan.

## ***Invasive Species***

According to the SHMCAP, invasive species are defined as non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health (NISC 2006). The focus of this section is on invasive terrestrial plants, as this is the most studied and managed typed of invasive; information for invasive aquatic flora and fauna (including marine species) is also provided when relevant.

### *Description*

The Massachusetts Invasive Plant Advisory Group (MIPAG), a collaborative representing organizations and professionals concerned with the conservation of the Massachusetts landscape, is charged by

## City of Framingham, MA Hazard Mitigation Plan Update

EOEEA to provide recommendations to the Commonwealth to manage invasive species. MIPAG defines invasive plants as "non-native species that have spread into native or minimally managed plant systems in Massachusetts, causing economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems." These species have biological traits that provide them with competitive advantages over native species, particularly because in a new habitat they are not restricted by the biological controls of their native habitat. As a result, these invasive species can monopolize natural communities, displacing many native species and causing widespread economic and environmental damage.

MIPAG recognized 69 plant species as "Invasive," "Likely Invasive," or "Potentially Invasive." The criteria for an "Invasive" species are listed below; the other assigned categories are associated with lower scores on the criteria checklist. The criteria for invasive animal species are less well-defined, but many of the same characteristics (including a non-Massachusetts origin and the ability to out-compete native species) are similar. To be considered "Invasive" by MIPAG, a plant species must meet the following criteria:

- Be nonindigenous to Massachusetts.
- Have the biologic potential for rapid and widespread dispersion and establishment in minimally managed habitats.
- Have the biologic potential for dispersing over spatial gaps away from the site of introduction.
- Have the biologic potential for existing in high numbers away from intensively managed artificial habitats.
- Be naturalized in Massachusetts (persists without cultivation in Massachusetts).
- Be widespread in Massachusetts or at least common in a region or habitat in the state.
- Have many occurrences of numerous individuals in Massachusetts that have high numbers of individuals forming dense stands in minimally managed habitats.
- Be able to outcompete other species in the same natural plant community.
- Have the potential for rapid growth, for high seed or propagule production and dissemination, and for establishment in natural plant communities.

Some examples of invasive insect species include:

- Nantucket Pine Tip Moth (native pest) is a moth with heads, bodies, and appendages covered with gray scales with mottled rusty-red markings. Larvae causes damage to young trees (up to five years old) by feeding inside growing shoots, buds, and conelets. The preferred host is the loblolly pine.
- Bark Beetles (native pest) include more than 600 species of beetles which serve in important ecological roles in small numbers where they live in dead, weakened, and dying host conifer trees.
- Forest Tent Caterpillar (native pest) has the biggest footprint of any indigenous tent caterpillar in North America (Furniss and Carolin 1977) and is a major defoliator of a variety of deciduous hardwood trees. The caterpillars spin silken mats on the trunks and large branches of trees

## City of Framingham, MA Hazard Mitigation Plan Update

where they molt and feed. Forest Tent Caterpillars can reach outbreak proportions causing massive defoliation of host trees and becoming a nuisance to people

- Pine Reproduction Weevils (native pest) is a very dark, elongated, oval insect up to 1/2 inch long with indistinct to distinct gray or pale orange spots of scales on the wings and thorax. They feed at night on the conifer seedlings or near the tips of branches of larger plants. Females lay their eggs on the roots of these trees. The weevils breed in all species of pines, hemlocks, junipers, spruces, firs, and cedars.
- Hardwood Borers (native pest) usually attack hardwoods experiencing some kind of stress although the clear-wing moths attack healthy trees. These insects attack the tree year after year and may eventually weaken it enough that it is prone to wind breakage. Some borers develop in the root system damaging young trees.
- Hemlock Woolly and Balsam Woolly Adelgid (non-native pest) is a very small, invasive, aphid-like insect that attacks North American hemlocks (Hemlock Woolly) and firs (Balsam Woolly). They can be identified by the white woolly masses that form on the underside of branches at the base of the tree's needles. They stay at this location for the rest of their lives. Their feeding disrupts the flow of nutrients to the tree twigs and needles leading to a decline in tree health and mortality in 4 to 10 years.
- Gypsy Moth (non-native pest) is an insect which feeds on a large variety of tree leaves from oak, maple, apple, crabapple, hickory, basswood, aspen, willow, birch, pine, spruce, hemlock, and others. It does prefer oak tree leaves, however. Periodically, large populations can cause defoliation damaging and killing trees they are feeding on.
- Spotted Lanternfly (non-native pest) is an invasive insect first detected in the U.S. in 2014. It feeds on a variety of fruit, ornamental, and wood trees and could seriously impact the grape, orchard, and logging industries.

### *Location*

The damage rendered by invasive species is significant. Experts estimate that about 3 million acres within the U.S. are lost each year to invasive plants (Pulling Together, 1997, from Mass.gov "Invasive Plant Facts"). The massive scope of this hazard means that the entire Commonwealth experiences impacts from these species. Furthermore, the ability of invasive species to travel distances (either via natural mechanisms or accidental human interference) allows these species to propagate rapidly over a large geographic area. Similarly, in open freshwater and marine ecosystems, invasive species can quickly spread once introduced, as there are generally no physical barriers to prevent establishment, outside of physiological tolerances, and multiple opportunities for transport to new locations (by boats, for example). The entire geographic area of Framingham is believed at risk for invasive species propagation.

### *Previous Occurrences*

Invasive species do not represent a singular event but rather an ongoing or emerging problem, so it is difficult to measure the frequency of occurrences. Invasives of current concern to forest health

# City of Framingham, MA Hazard Mitigation Plan Update

(<https://www.mass.gov/service-details/current-forest-health-threats>) in Middlesex County are reportedly:

- Gypsy Moth
- Winter Moth
- Hemlock Woolly Adelgid
- Southern Pine Beetle
- Emerald Ash Borer
- White Pine Needlecast

The annual budget to address invasive species in Massachusetts has fluctuated over time but, in general, appears to have decreased. This likely implies a lack of resources rather than a decrease in risk. The following figures are from <https://budget.digital.mass.gov/summary/fy22/enacted/energy-and-environmental-affairs/environmental-affairs/20000100>.

FY Year	Budget
2022	\$277,838
2021	\$146,348
2020	\$4,150,000
2019	\$3,831,135
2018	\$4,347,000
2017	\$6,046,870

### Extent

The MIPAG has developed a list of Early Detection plant species according to an established set of criteria that includes MIPAG classification as an *invasive, likely invasive, or potentially invasive* ecological threat and one of these three criteria: *limited prevalence in Massachusetts, partial containment potential, or public health threat*. The Early Detection table includes the documented distribution of a species by county.

Once established, invasive species often escape notice for years or decades. Introduced species that initially escaped many decades ago are only now being recognized as invasives. Because these species can occur anywhere (on public or private property), new invasive species often escape notice until they are widespread and eradication is impractical. As a result, early and coordinated action between public and private landholders is critical to preventing widespread damage from an invasive species.

# City of Framingham, MA Hazard Mitigation Plan Update

## *Probability of Future Events*

The USDA Animal and Plant Health Inspection Service (APHIS) manages the Plant Protection and Quarantine (PPQ) Program which safeguards U.S. agriculture and natural resources from the introduction, establishment, and spread of plant pests and noxious weeds. PPQ is the lead federal agency for plant health emergencies and works closely with federal, state, and local agencies; universities; industries; and private entities in developing and implementing science-based framework designed to protect against invasive pests and diseases.

Massachusetts has a variety of laws and regulations in place that attempt to mitigate the impacts of these species. The Department of Agricultural Resources (DAR) maintains a list of prohibited plants for the state, which includes federally noxious weeds as well as invasive plants recommended by MIPAG and approved for listing by DAR. Species on the DAR list are regulated with prohibitions on importation, propagation, purchase, and sale in the Commonwealth. Additionally, the Massachusetts Wetlands Protection Act (310 CMR 10.00) includes language requiring all activities covered by the Act to account for, and take steps to prevent, the introduction or propagation of invasive species.

In 2000, Massachusetts passed an Aquatic Invasive Species Management Plan, making the Commonwealth eligible for federal funds to support and implement the plan through the federal Aquatic Nuisance Prevention and Control Act. MassDEP and CZM are part of the Northeast Aquatic Nuisance Species Panel, which was established under the federal Aquatic Nuisance Species Task Force. This panel allows managers and researchers to exchange information and coordinate efforts on the management of aquatic invasive species. The Commonwealth also has several resources pertaining to terrestrial invasive species, such as the Massachusetts Introduced Pest Outreach Project, although a strategic management plan has not yet been prepared for these species. All of these efforts are aimed at reducing the probability of future occurrences.

Notwithstanding the above efforts, the presence of invasive species is ongoing and it is difficult to quantify the future frequency of these occurrences. Increased rates of global trade and travel have created many new pathways for the dispersion of exotic species. As a result, the frequency with which these threats have been introduced has increased significantly. Increased international trade in ornamental plants is particularly concerning because many of the invasive plants species in the U.S. were originally imported as ornamentals. Furthermore, they are expected to be an increasing problem due to a changing climate and projected increases in non-native plant and animal infestations. For this reason and based on the fact invasive species are already an ongoing issue for the region, this hazard has been assigned a probability of highly likely.

## *Vulnerability Assessment*

### **Exposure**

The entire City of Framingham has the potential to be exposed to invasive pests. Climate change will make the area more attractive to pests who have not been found there traditionally.

# City of Framingham, MA Hazard Mitigation Plan Update

## Built Environment Impacts

Although the built environment is not as susceptible to pests as the natural environment, it can help spread the invasive species. This includes trains and vehicles that could move the species from one location to another. Trees, which are damaged or killed by invasive pests, can become hazards to people, property, utility lines, and roadways when they fall. Many dead trees in one area can also become fuel for wildfires interconnecting the two hazards.

## Population Impacts

The direct population impacts are minimal. However, the indirect impacts could destroy livelihoods.

## Environment Impacts

Most of the natural features in the city have some susceptible pests including the parks and other forested areas. Trees that have been damaged by other events such as fire, wind, flooding, and animal browsing are more susceptible to diseases and pests. Certain species of trees are more susceptible based on the need of the damaging organism.

## Primary Climate Change Interaction: Extreme Weather Events

### ***Hurricanes and Tropical Storms***

Flooding in Massachusetts is often the direct result of tropical storms and hurricanes. These powerful storms can also cause significant widespread damage due to high winds.

#### *Description*

Tropical cyclones (tropical depressions, tropical storms, and hurricanes) that affect New England form over the warm, moist waters of the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico.

Tropical systems customarily come from a southerly direction and when they accelerate up the East Coast of the U.S., most take on a distinct appearance that is different from a typical hurricane. Although rain is often limited in the areas south and east of the track of the storm, these areas can incur the worst winds and storm surge. Dangerous flooding occurs most often to the north and west of the track of the storm. An additional threat associated with a tropical system making landfall is the possibility of tornado generation. Tornadoes would generally occur in the outer bands to the north and east of the storm, a few hours to as much as 15 hours prior to landfall.

Hurricane season runs from June 1 to November 30. In New England, these storms are most likely to occur in August, September, and the first half of October. The SHMCAP notes that this is due in large part to the fact that it takes a considerable amount of time for the waters south of Long Island to warm to the temperature necessary to sustain the storms this far north. Also, as the region progresses into the fall months, the upper-level jet stream steering winds might flow from the Great Lakes southward to the

The City of Framingham Community Resilience Building Workshop Summary of Findings (2019) lists “Severe Weather” as one of the top four hazards of concern.

# City of Framingham, MA Hazard Mitigation Plan Update

Gulf States and then back northward up the eastern seaboard. This pattern is conducive for capturing a tropical system over the Bahamas and accelerating it northward.

### Location

Tropical storms and hurricanes can affect the entirety of Massachusetts, including the geographic extent of Framingham.

### Previous Occurrences

The SHMCAP notes that hurricanes and tropical storms occur somewhat regularly in Massachusetts. Historical tropical system tracks near and through Framingham are depicted on the following page. This mapping is available from NOAA and updated continuously.

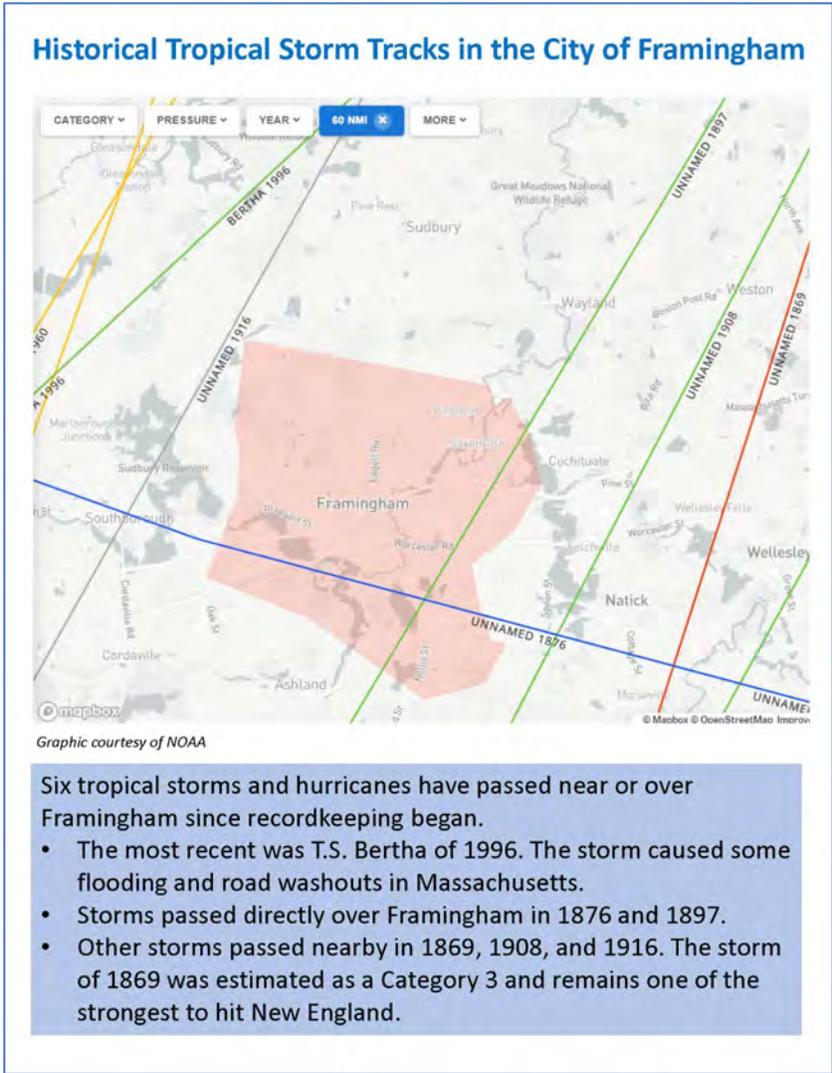


Figure 18. Hurricane Storm Tracks.

## City of Framingham, MA Hazard Mitigation Plan Update

As noted elsewhere, this plan update relies primarily on a ten-year lookback (2012 through 2021) ending with the date of plan development. During that ten-year period, only one declared disaster in Massachusetts (SuperStorm Sandy of October 2012) was associated with a tropical system, and the impacts to the Framingham region were minimal. Nevertheless, Framingham was impacted by the series of tropical and post-tropical storm systems that impacted Massachusetts in 2021. These storms occurred in July, August, and September 2021 as follows:

- T.S. Elsa - July 9, 2021
- T.S. Fred - August 19, 2021
- T.S. Henri - August 22-23, 2021
- T.D. Ida - September 1, 2021

Framingham suffered moderate impacts from at least two of these events (Elsa and Ida). The recorded precipitation associated with storm Elsa was 3.59 inches of rain according to the NWS; and T.S. Ida dropped 4.04 to 4.75 inches of rain on Framingham according to NBCBoston. Both storms were substantial rain events, although neither would have caused catastrophic flooding. The NOAA Storm Events database (<https://www.ncdc.noaa.gov/stormevents/>) for Middlesex County provided the following description of impacts in Framingham: *“Tropical Storm Elsa made landfall in Rhode Island on Friday morning before moving into the Gulf of Maine. It interacted with a stalled frontal boundary and brought widespread heavy rainfall of 2 to 3.5 inches and gusty winds along the south coast, which caused scattered tree damage. In Framingham, Rt 9 (Worcester Rd) at Rt 126, as well as the ramps on Rt 126 were closed due to flooding. A car was stuck at this intersection. Also, Gates St at Parker Rd was impassable.”*

In summary, a combination of the NOAA Storm Events database and precipitation records demonstrates that the 2021 storms adversely impacted Framingham. Even without the presence of a catastrophic hurricane striking Framingham in the last ten years, less severe tropical storms and remnants have created significant disruptions and necessitated public expenditures.

### *Extent*

Hurricanes are measured according to the Saffir-Simpson scale, which categorizes or rates hurricanes from 1 (minimal) to 5 (catastrophic) based on their intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, inherently leaving out any measure of precipitation and flooding.

### Saffir-Simpson Hurricane Wind Scale

Sustained Winds		Types of Damage Due to Hurricane Winds
1	74-95 mph	<b>Damaging winds will produce some damage:</b> Well-constructed framed homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap, and shallow-rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
	64-82 kt	
	119-153 km/h	
2	96-110 mph	<b>Very strong, damaging winds will cause widespread damage:</b> Well-constructed framed homes could sustain major roof and siding damage. Many shallow-rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
	83-95 kt	
	154-177 km/h	
3 (major)	111-129 mph	<b>Dangerous winds will cause extensive damage:</b> Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
	96-112 kt	
	178-208 km/h	
4 (major)	130-156 mph	<b>Extremely dangerous winds will cause devastating damage:</b> Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
	113-136 kt	
	209-251 km/h	
5 (major)	157 mph or higher	<b>Catastrophic damage will occur:</b> A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
	137 kt or higher	
	252 km/h or higher	

Source: National Hurricane Center, NOAA

Tropical storms and tropical depressions, while generally less dangerous than hurricanes, can be deadly. The winds of tropical depressions and tropical storms are usually not the greatest threat; rather, the rains, flooding, and severe weather associated with the tropical storms are what customarily cause more significant problems. Nevertheless, serious power outages can also be associated with these types of events:

- After T.S. Irene passed through the region in late August 2011, many areas of the Commonwealth were without power for more than five days.
- T.S. Isaias of August 2020 caused significant damage in Massachusetts and widespread outages in Connecticut.

## City of Framingham, MA Hazard Mitigation Plan Update

The NWS issues a hurricane warning when sustained winds of 74 mph or higher are expected in a specified area in association with a tropical, subtropical, or post-tropical cyclone. A warning is issued 36 hours in advance of the anticipated onset of tropical-storm-force winds. A hurricane watch is announced when sustained winds of 74 mph or higher are possible within the specified area in association with a tropical, subtropical, or post-tropical cyclone. A watch is issued 48 hours in advance of the anticipated onset of tropical-storm-force winds (NWS, 2013).

### *Probability of Future Events*

The SHMCAP notes that Massachusetts experiences an average of one storm every other year or 0.5 storms per year. Storms severe enough to receive FEMA disaster declarations are far rarer, occurring every 9 years on average. According to NOAA, a Category 1 hurricane can be expected to make landfall in/near southern New England once every 17 years. A Category 2 hurricane could be expected to make landfall once every 39 years, and a Category 3 hurricane has a calculated return period of 68 to 70 years.

Some researchers have suggested that the intensity of tropical cyclones has increased over the last 40 years, with some believing that there is a connection between this increase in intensity and climate change. While most climate simulations agree that greenhouse warming enhances the frequency and intensity of tropical storms, models of the climate system are still limited by resolution and computational ability. However, given the history of major storms and the possibility of increased frequency and intensity of tropical storms due to climate change, it is prudent to expect that there will be hurricanes impacting Framingham in the future that may be of greater frequency and intensity than in the past.

### *Vulnerability Assessment*

#### **Exposure**

High winds and heavy rain and/or hail associated with hurricanes and tropical storms can cause damage to utilities, structures, roads, trees (potentially causing vehicle accidents) and injuries and death. Other associated concerns are debris management issues including debris removal and identification of disposal sites. All assets in Framingham should be considered exposed to high winds. Figure 19 shows the 100-year windspeeds identified in the ASCE 7-98 publication.

# City of Framingham, MA Hazard Mitigation Plan Update

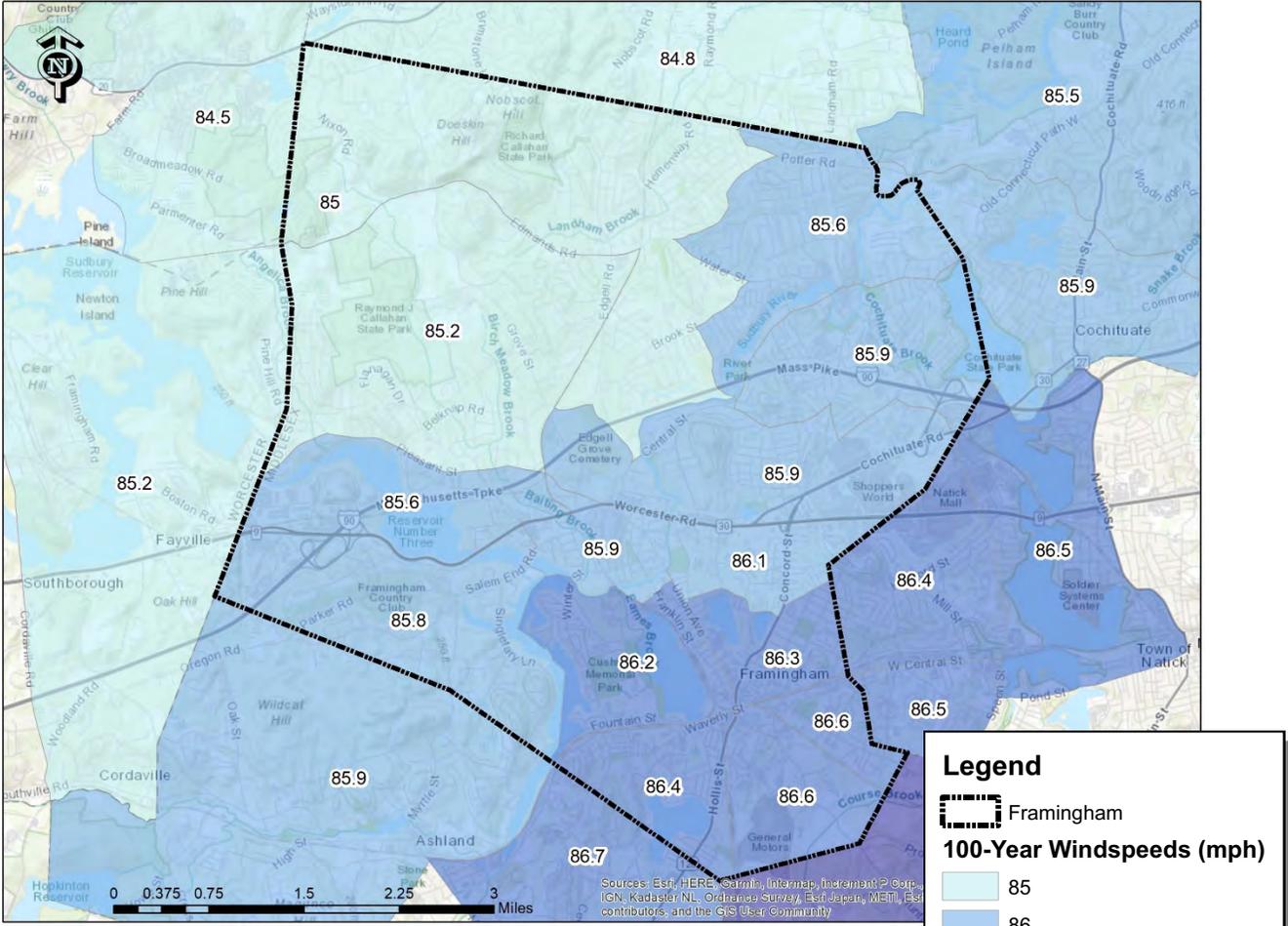


Figure 19: 100-Year Windspeeds (ASCE 7-98)

### Built Environment Impacts

To identify built environment impacts to the city, FEMA’s risk assessment software, Hazus, was implemented. The economic loss results of the 500-year event are shown in Table 18 while the results for the 1000-year event are shown in Table 19. The city’s Average Annual Loss (AAL) is calculated to be \$3,130,000.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 18. Building Loss for a 500-Year Scenario

Loss Type	Residential (\$Million)	Commercial (\$Million)	Other Occupancy (\$Million)	Total (\$Million)
Building Loss	172.6	13.3	5.3	<b>191.2</b>
Content Loss	58.4	3.5	2.4	<b>64.3</b>
Business Inventory Loss	0	0.1	0.2	<b>0.3</b>
Business Income Loss	0	1.6	0.3	<b>1.9</b>
Business Relocation Loss	5.7	2.2	0.6	<b>8.5</b>
Rental Income Loss	4.7	1.2	0.1	<b>6.0</b>
Wage Loss	0	1.6	2.1	<b>3.7</b>
<b>Total</b>	<b>241.4</b>	<b>23.5</b>	<b>11.0</b>	<b>275.9</b>

Table 19. Building Loss for a 1000-Year Scenario

Loss Type	Residential (\$Million)	Commercial (\$Million)	Other Occupancy (\$Million)	Total (\$Million)
Building Loss	283.8	28.3	12.0	<b>324.1</b>
Content Loss	100.9	9.5	6.4	<b>116.8</b>
Business Inventory Loss	0.0	0.2	0.6	<b>0.8</b>
Business Income Loss	0.0	2.3	0.4	<b>2.7</b>
Business Relocation Loss	13.4	4.9	0.8	<b>19.1</b>
Rental Income Loss	8.6	2.6	0.1	<b>11.3</b>
Wage Loss	0.0	2.4	3.3	<b>5.7</b>

# City of Framingham, MA Hazard Mitigation Plan Update

<b>Total</b>	<b>406.7</b>	<b>50.2</b>	<b>23.6</b>	<b>480.5</b>
--------------	--------------	-------------	-------------	--------------

### Population Impacts

Populations considered most vulnerable to hurricane and tropical storm impacts in Framingham are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. For high windspeeds, it’s important to maintain the building envelope during the event. If a window or door fails, damage to the structure will be much greater. Table 8 summarizes the senior and low-income populations in Framingham. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the city should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

For the 500-year event, Hazus predicts that there will be more than 500 displaced households with 150 to 200 people seeking public shelter from the high windspeeds alone. However, if the rainfall leads to flooding, families may be displaced (see flood section). For the 1000-year event, Hazus predicts nearly 600 displaced households with 350 people seeking public shelter.

### Environment Impacts

Hurricanes can cause damage to parks, and other, natural areas. Some areas of the city may be out of service until trees are removed.

### Severe Winter Storms

Severe winter storms include ice storms, nor’easters, heavy snow, blowing snow, and other extreme forms of winter precipitation. These are often accompanied by very low temperatures which were previously addressed.

#### Description

**Blizzard:** A blizzard is a winter snowstorm with sustained or frequent wind gusts to 35 mph or more, accompanied by blowing snow that reduces visibility to or below a quarter of a mile (NWS, 2018). These conditions must be the predominant condition over a 3-hour period.

Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. However, the hazard created by the combination of snow, wind, and low visibility increases significantly with temperatures below 20°F. A severe blizzard is categorized as having temperatures near or below 10°F, winds exceeding 45 mph, and visibility reduced by snow to near zero.

The City of Framingham Community Resilience Building Workshop Summary of Findings (2019) lists “Severe Weather” as one of the top four hazards of concern.

## City of Framingham, MA Hazard Mitigation Plan Update

Storm systems powerful enough to cause blizzards usually form when the jet stream dips far to the south, allowing cold air from the north to clash with warm air from the south. Blizzard conditions often develop on the northwest side of an intense storm system. The difference between the lower pressure in the storm and the higher pressure to the west creates a tight pressure gradient, resulting in strong winds and extreme conditions due to the blowing snow. Blowing snow is wind-driven snow that reduces visibility to 6 miles or less, causing significant drifting. Blowing snow may be snow that is falling and/or loose snow on the ground picked up by the wind.

Ice Storms: Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects, creating ice buildups of one-fourth of an inch or more. These can cause severe damage to vegetation, utilities, and structures. An ice storm warning, which is now included in the criteria for a winter storm warning, is issued when a half inch or more of accretion of freezing rain is expected. This may lead to dangerous walking or driving conditions and the pulling down of power lines and trees. Ice pellets are another form of freezing precipitation, formed when snowflakes melt into raindrops as they pass through a thin layer of warmer air. The raindrops then refreeze into particles of ice when they fall into a layer of subfreezing air near the surface of the earth. Finally, sleet occurs when raindrops fall into subfreezing air thick enough that the raindrops refreeze into ice before hitting the ground. The difference between sleet and hail is that sleet is a wintertime phenomenon whereas hail falls from convective clouds (usually thunderstorms), often during the warm spring and summer months.

Nor'easters: A nor'easter is a storm that occurs along the East Coast of North America. A nor'easter is characterized by a large counterclockwise wind circulation around a low-pressure center that often results in heavy snow, high winds, and rain. A nor'easter gets its name from its continuously strong northeasterly winds blowing in from the ocean ahead of the storm and over the coastal areas. Nor'easters are among winter's most ferocious storms. These winter weather events are notorious for producing heavy snow, rain, and oversized waves that crash onto Atlantic beaches, often causing beach erosion and structural damage. These storms occur most often in late fall and early winter. The storm radius is often as much as 100 miles, and nor'easters often sit stationary for several days, affecting multiple tide cycles and causing extended heavy precipitation. Sustained wind speeds of 20 to 40 mph are common during a nor'easter, with short-term wind speeds gusting up to 50 to 60 mph.

### *Location*

Although the entire Commonwealth may be considered at risk to the hazard of severe winter storms, higher snow accumulations appear to be prevalent at higher elevations in Western and Central Massachusetts, and along the coast where snowfall can be enhanced by additional ocean moisture. Ice storms occur most frequently in the higher-elevation portions of Western and Central Massachusetts. Overall, winter storms can affect the entirety of Massachusetts, including the geographic extent of Framingham.

## City of Framingham, MA Hazard Mitigation Plan Update

### *Previous Occurrences*

Winter storms occur somewhat regularly in Massachusetts. Although four of the disasters declared in Massachusetts from 2012 through 2021 were associated with winter storms, only three of the four covered Middlesex County and therefore the City of Framingham:

- Massachusetts Severe Winter Storm, Snowstorm, and Flooding (DR-4110-MA)  
Incident Period: February 8, 2013 - February 9, 2013  
Major Disaster Declaration declared on April 19, 2013  
***PA for entire state***
- Massachusetts Severe Winter Storm, Snowstorm, and Flooding (DR-4214-MA)  
Incident Period: January 26, 2015 - January 28, 2015  
Major Disaster Declaration declared on April 13, 2015  
***PA for Worcester County and eastward***
- Massachusetts Severe Winter Storm and Flooding (DR-4372-MA)  
Incident Period: March 2, 2018 - March 3, 2018  
Major Disaster Declaration declared on June 25, 2018  
***PA for Norfolk, Essex, Bristol, Plymouth, Cape and Islands***
- Massachusetts Severe Winter Storm and Snowstorm (DR-4379-MA)  
Incident Period: March 13, 2018 - March 14, 2018  
Major Disaster Declaration declared on July 19, 2018  
***PA for Worcester, Middlesex, Suffolk, Norfolk, Essex Counties***

The PA assistance reimbursements for the City associated with the winter storms of 2013, 2015, and 2018 were approximately \$1.4 million against a total cost of approximately \$1.9 million, indicating that severe winter storms comprise a substantial expenditure for Framingham over the course of a decade.

The NOAA Storm Events database (<https://www.ncdc.noaa.gov/stormevents/>) for Middlesex County lists a number of severe winter storm events impacting Framingham for the period 2012-2021:

- 3/7/18 – Winter Storm: A coastal storm moved up from the Carolinas, bringing snow and rain to Southern New England on March 7th and 8th. From eight to sixteen inches of snow fell on Western Middlesex County. At 12:21 AM EST on March 8, a large tree was down across Central Street at Hygate Road in Framingham. Also in Framingham, a tree was down on power lines along Pryor Drive, a tree and power lines were down on a car on Gleason Street, a tree was down on a house on Pleasant Street, and a tree was down on a power line on Roland Drive. Damage of \$25,000 was reported.
- 12/18/18 – Strong Wind: Departing coastal low pressure brought strong winds and scattered snow showers to Eastern Massachusetts. Most of the damage was concentrated in Middlesex County. At

## City of Framingham, MA Hazard Mitigation Plan Update

6:21 AM EST a tree was down on Badger Road in Framingham. Damage of \$14,000 was reported for all affected towns.

- 1/19/19 – Winter Storm: Low pressure from the Deep South moved along the South Coast of New England on January 20. Five to ten inches of snow fell on Western Middlesex County. Members of the general public in Carlisle and Framingham reported ice accumulation.
- 3/4/20 – Strong Wind: Low pressure over Maine strengthened into a powerful cyclone over the Canadian maritime provinces. Its cold front swept across New England, with strong west-northwest winds causing scattered damage in mainly northern and eastern Massachusetts. Peak winds included a report of 38 mph in Framingham. Damage of \$2,000 was reported for all affected towns.
- 12/16/20 – Heavy Snow: A storm system produced heavy snow, strong to damaging winds, and minor coastal flooding in southern New England. Heavy snow ranged from 9.0 to 15.2 inches across western Middlesex County. Some specific amounts included... 14.5 inches in Framingham (CoCoRaHS). Winds generally were gusting to 25 to 35 mph.
- 3/1/21 – High Wind: An arctic cold front moved through southern New England on the afternoon of March 1st. It was followed by very strong/damaging west-northwest winds, which continued through much of the night and into the early morning hours on March 2nd. There were many reports of downed trees and at one point, more than 60,000 customers were without power in Massachusetts. Winds generally gusting to 50 to 60 mph in western Middlesex County. In Framingham at 1215 AM EST on March 2, a large pine tree was down on Bethany Road. Damage of \$6,000 was reported for all affected towns.

### *Extent*

Snowfall is a component of multiple hazards, including nor'easters and severe winter storms. Two scores, the *Regional Snowfall Index (RSI)* and the *NESIS*, are described in this section.

Since 2005, the RSI has become the descriptor of choice for measuring winter events that impact the eastern two-thirds of the U.S. The RSI ranks snowstorm impacts on a scale system from 1 to 5 as depicted in Table 4-64. The RSI is similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes, except that it includes an additional variable: population. The RSI is based on the spatial extent of the storm, the amount of snowfall, and population (NOAA, n.d.).

The RSI is a regional index. Each of the six climate regions (identified by the NOAA National Centers for Environmental Information) in the eastern two-thirds of the nation has a separate index. The RSI incorporated region-specific parameters and thresholds for calculating the index. The RSI is important because, with it, a storm event and its societal impacts can be assessed within the context of a region's historical events. Snowfall thresholds in Massachusetts (in the Northeast region) are 4, 10, 20, and 30 inches of snowfall, while thresholds in the Southeast U.S. are 2, 5, 10, and 15 inches.

# City of Framingham, MA Hazard Mitigation Plan Update

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

Source: NOAA

Prior to the use of the RSI, the Northeast Snowfall Impact Scale, developed by Paul Kocin of The Weather Channel and Louis Uccellini of the NWS, was used to characterize and rank high- impact northeast snowstorms with large areas of 10-inch snowfall accumulations and greater. In contrast to the RSI, which is a regional index, NESIS is a quasi-national index that is calibrated to Northeast snowstorms. NESIS has five categories.

Meteorologists can often predict the likelihood of a severe storm or nor'easter. This can give several days of warning time. The NOAA's NWS monitors potential events and provides extensive forecasts and information several days in advance of a winter storm in order to help the state to prepare for the incident.

### *Probability of Future Events*

The SHMCAP notes that Massachusetts experiences high-impact snowstorms at approximately the rate of one per year, although there is significant interannual variability in the frequency and severity of winter storms. The City of Framingham should assume that winter storms are likely, even if the impacts of climate change will shift the timing to a shorter winter season. Heavy wet snowfall may be more common in the future.

### *Vulnerability Assessment*

#### **Exposure**

Heavy snowfall coupled with low temperatures often results in increases in traffic accidents; disruptions in transportation, commerce, government, and education; utility outages due to falling trees, branches, and other objects; personal injuries associated with slippery surfaces and freezing temperatures; and numerous other problems. Specific damages associated with severe winter storm (snow) events include:

- Injuries and fatalities associated with accidents, low temperatures, power loss, falling objects and accidents associated with frozen and slippery surfaces and snow accumulation
- Increases in the frequency and impact of traffic accidents, resulting in personal injuries

## City of Framingham, MA Hazard Mitigation Plan Update

- Ice-related damage to trees, building and infrastructure inventory, and utilities (power lines, bridges, substations, etc.)
- Roads damaged through freeze and thaw processes
- Stress on the local shelters and emergency response infrastructure
- Lost productivity that occurs when people cannot go to work, school, or stores due to inclement conditions

The entire city should be considered exposed to the severe winter storm hazard.

### Built Environment Impacts

The entire built environment of Framingham is vulnerable to a severe winter storm. New England's climate offers no immunity to the potential damaging effects of severe winter storms. Some minimum damage is anticipated annually, with potential extensive damage occurring about once every 10 years.

Since Hazus doesn't support severe winter storms and there aren't other readily available severe winter storm models, historical data was used to determine potential losses and probabilities. From 1996 until 2021, there was \$6.332M in property damage to Middlesex County. This equates to an AAL of \$243,538. To make this more relevant to the city itself, the population of Framingham (72,362) was divided by the population of Middlesex County (1,632,002) to create a population index (0.0443). That index is then multiplied by the county's AAL to get \$10,798, the city's AAL. This contrasts with the PA reimbursements described above for the three winter storm disaster declarations for Framingham, indicating that Framingham shoulders a disproportionate winter storm cost within Middlesex County.

### Population Impacts

As discussed above, some traffic accidents associated with storm events include injuries and in limited cases, deaths. However, the number of injuries and deaths reported for accidents is generally low. Populations considered most vulnerable to severe winter storm impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 8 summarizes the senior and low-income populations in Framingham. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the city should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

### Environment Impacts

Severe winter storms can cause damage to parks and other, natural areas. Some areas of the city may be out of service until roads are cleared and trees are removed.

**Tornadoes**

Tornadoes are a relatively infrequent occurrence but can be very destructive when they occur. While small tornadoes in outlying areas cause little to no damage, larger tornadoes in populated sections of Massachusetts have historically caused significant damage, injury, and death through the destruction of trees, buildings, vehicles, and power lines.

The City of Framingham Community Resilience Building Workshop Summary of Findings (2019) lists “Severe Weather” as one of the top four hazards of concern.

*Description*

A tornado is a narrow rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The observable aspect of a tornado is the rotating column of water droplets, dust, and debris caught in the column. Tornadoes are the most violent of all atmospheric storms.

Tornadoes can form from individual cells within severe thunderstorm squall lines. They can also form from an isolated supercell thunderstorm. They can be spawned by tropical cyclones or the remnants thereof, and weak tornadoes can even occur from little more than a rain shower if air is converging and spinning upward.

Most tornadoes occur in the late afternoon and evening hours when the heating is the greatest. The most common months for tornadoes to occur are June, July, and August, although the Great Barrington tornado (1995) occurred in May.

A waterspout is a rapidly rotating column of air extending from the cloud base (typically a cumulonimbus thunderstorm) to a water surface, such as a bay or the ocean. They can be formed in the same way as regular tornadoes or can form on a clear day with the right amount of instability and wind shear. Tornadic waterspouts can have wind speeds of 60 to 100 mph, but since they do not move very far, they can often be navigated around. They can become a threat to land if they drift onshore.

*Location*

The U.S. experiences an average of 1,253 tornadoes per year, more than any other country (NOAA, n.d.). Because Massachusetts experiences fewer tornadoes than other parts of the country, residents may be less prepared to react to a tornado. The SHMCAP notes that the area at greatest risk for a tornado touchdown runs from central to northeastern Massachusetts. Framingham is within this area.

*Previous Occurrences*

The most devastating tornado to occur in New England was the Worcester Tornado of July 9, 1953, a category F4 tornado. The tornado passed through Barre, Rutland, Holden, Worcester, Shrewsbury, Westborough, and Southborough causing 90 deaths and over 1,300 injured. Damage estimates were placed in excess of \$52 million. The National Storm Prediction Center has ranked this as one of the

# City of Framingham, MA Hazard Mitigation Plan Update

deadliest tornados in the nation's history. The most recent severe tornado to impact Massachusetts occurred June 1, 2011 affecting communities in Hampden and Worcester Counties. The EF3 tornado touched down in Westfield and traveled through West Springfield, Springfield, Wilbraham, Monson, Brimfield, and Sturbridge. The tornado caused extensive property damage and resulted in a FEMA disaster declaration.

Notwithstanding previous occurrences in Massachusetts, no known tornados have touched down in Framingham. The NOAA Storm Events database (<https://www.ncdc.noaa.gov/stormevents/>) for Middlesex County lists a variety of severe storms in Framingham from 2012 through 2021, but none were caused by or associated with tornados.

*Extent*

The NWS rates tornados using the Enhanced Fujita scale (EF scale), which does not directly measure wind speed but rather the amount of damage created. This scale derives 3-second gusts estimated at the point of damage based on the assignment of 1 out of 8 degrees of damage to a range of different structure types. These estimates vary with height and exposure. This method is considerably more sophisticated than the original Fujita scale, and it allows surveyors to create more precise assessments of tornado severity.

EF Rating	Wind Speeds	Expected Damage
<b>EF-0</b>	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled. 
<b>EF-1</b>	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged. 
<b>EF-2</b>	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed. 
<b>EF-3</b>	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark. 
<b>EF-4</b>	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse. 
<b>EF-5</b>	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped. 

Source: Weather.gov

## City of Framingham, MA Hazard Mitigation Plan Update

Tornado watches and warnings are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible.

### *Probability of Future Events*

According to the SHMCAP, the Commonwealth experienced 171 tornadoes from 1950 to 2017, or an average annual occurrence of 2.6 tornado events per year. In the last 20 years, the average frequency of these events has been 1.7 events per year (NOAA, 2018). Massachusetts experienced an average of 1.4 tornadoes per 10,000 square feet annually between 1991 and 2010, less than half of the national average of 3.5 tornadoes per 10,000 square feet per year (NOAA, n.d.). As highlighted in the National Climate Assessment, tornado activity in the U.S. has become more variable, and increasingly so in the last two decades. While the number of days per year that tornadoes occur has decreased, the number of tornadoes on these days has increased. Climate models show projections that the frequency and intensity of severe thunderstorms (which include tornadoes, hail, and winds) will increase (USGCRP, 2017).

### *Vulnerability Assessment*

#### Exposure

High winds, heavy rain, lightning and/or hail associated with tornados, thunderstorms and microbursts can cause damage to utilities, structures, roads, trees (potentially causing vehicle accidents) and injuries and death. The entire city should be considered exposed to the tornado hazard.

#### Built Environment Impacts

Since Hazus doesn't support tornadoes and there aren't other readily available tornado models, historical data will be used to determine potential losses and probabilities. From 1955 until 2021, there was \$4.891M in property damage to Middlesex County. This equates to an AAL of \$73,000. To make this more relevant to the city itself the population of Framingham (72,362) was divided by the population of Middlesex County (1,632,002) to create a population index (0.0443). That index is then multiplied by the county's AAL to get \$3,234, the city's AAL.

#### Population Impacts

Populations considered most vulnerable to tornado impacts in Framingham are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 8 summarizes the senior and low-income populations in Framingham. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the City should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

# City of Framingham, MA Hazard Mitigation Plan Update

## Environment Impacts

Tornadoes can cause damage to parks, and other, natural areas. Some areas of the city may be out of service until trees are removed.

### **Other Severe Weather**

Several frequent natural hazards in Massachusetts – particularly strong winds and extreme precipitation events – occur outside of notable storm events. This section discusses the nature and impacts of these hazards, as well as ways in which they are likely to respond to climate change.

#### *Description*

Thunderstorms: A thunderstorm is a storm originating in a cumulonimbus cloud. 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. Frequently during thunderstorm events, heavy rain and gusty winds are present. Less frequently, hail is present, which can become very large in size. Tornadoes can also be generated during these events. An average thunderstorm is 15 miles across and lasts 30 minutes, but severe thunderstorms can be much larger and longer.

Three basic components are required for a thunderstorm to form: moisture, rising unstable air, and a lifting mechanism. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise, it will continue to rise as long as it weighs less and stays warmer than the air around it. As the warm surface air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool, releasing the heat, and the vapor condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice, and some of it turns into water droplets. Both have electrical charges. When a sufficient charge builds up, the energy is discharged in a bolt of lightning, which causes the sound waves we hear as thunder.

Downbursts: A downburst is a severe localized wind blasting down from a thunderstorm. They are more common than tornadoes. Depending on the size and location of downburst events, the destruction to property may be significant. Downbursts fall into two categories:

- Microbursts affect an area less than 2.5 miles in diameter, last 5 to 15 minutes, and can cause damaging winds up to 168 mph.
- Macrobusts affect an area at least 2.5 miles in diameter, last 5 to 30 minutes, and can cause damaging winds up to 134 mph.

The City of Framingham Community Resilience Building Workshop Summary of Findings (2019) lists “Severe Weather” as one of the top four hazards of concern.

## City of Framingham, MA Hazard Mitigation Plan Update

An organized, fast-moving line of microbursts traveling across large areas is known as a “derecho.” These occasionally occur in Massachusetts. Downburst activity is, on occasion, mistaken for tornado activity. Both storms have very damaging winds (downburst wind speeds can exceed 165 mph) and are very loud. These “straight line” winds are distinguishable from tornadic activity by the pattern of destruction and debris such that the best way to determine the damage source is to fly over the area.

Hail: Hailstones are chunks of ice that grow as updrafts in thunderstorms keep them in the atmosphere. Most hailstones are smaller in diameter than a dime, but stones weighing more than 1.5 pounds have been recorded. NOAA has estimates of the velocity of falling hail ranging from 9 meters per second (m/s) (20 mph) for a 1-centimeter (cm)-diameter hailstone to 48 m/s (107 mph) for an 8 cm, 0.7-kilogram stone.

Lightning: Lightning is a discharge of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. According to NOAA, the creation of lightning during a storm is a complicated process that is not fully understood. In the initial stages of development, air acts as an insulator between the positive and negative charges. However, when the potential between the positive and negative charges becomes too great, a discharge of electricity (lightning) occurs. In-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom. Cloud-to-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom of a second cloud. Cloud-to-ground lightning is the most dangerous. In summertime, most cloud-to-ground lightning occurs between the negative charges near the bottom of the cloud and positive charges on the ground.

### *Location*

High wind events, thunderstorms, lightning, and hail can affect the entirety of Massachusetts, including the geographic extent of Framingham.

### *Previous Occurrences*

The NOAA Storm Events database (<https://www.ncdc.noaa.gov/stormevents/>) for Middlesex County lists a variety of severe storms affecting Framingham from 2012 through 2021. The individual damage figures for these events appear nominal but given the frequency of events, the overall losses from severe storms are striking.

- 1/11/14 – Lightning: An isolated lightning strike blew the chimney off a house on Cherry Street. Damage of \$3,000 was reported.
- 7/3/14 – Thunderstorm Wind: An approaching cold front, combined with tropical moisture in advance of Hurricane Arthur, produced two rounds of showers and thunderstorms during the afternoon and evening. Numerous trees and wires were downed from Metrowest to the immediate Boston area, including Holliston, Framingham, Natick, Newton, Waltham, Wakefield, Watertown, Somerville, and Malden. Damage of \$75,000 was reported (for all towns).

## City of Framingham, MA Hazard Mitigation Plan Update

- 8/4/15 – Hail: The second severe weather event for the day occurred north of the Massachusetts Turnpike. As these storms developed across western Massachusetts, they began to produce wind gusts of 50 to 60 mph. As they continued to move eastward, unusually large hail was the main event at several locations. Specific locations in Framingham were not noted.
- 8/15/2015 – Thunderstorm Wind: A weak cold front moving through southern New England brought showers and thunderstorms to the region. These storms produced hail and damaging winds as well as some poor drainage street flooding. A large tree was downed onto Winthrop Street at Bethany Road. Damage of \$5,000 was reported.
- 3/2/17 – High Wind: Low pressure moving up the St Lawrence Valley swept a cold front through Massachusetts early the morning of March 2. A tree fell on Coastal Railroad Line at mile 46.4 in Framingham. Damage of \$7,000 was reported for all affected towns.
- 3/22/17 – High Wind: Low pressure crossing Canada drew a cold front across New England the night of March 21. Brief snow squalls and strong gusty northwest winds followed. At 1208 PM EST amateur radio reported a tree down on Highgate Road in Framingham. Damage of \$10,000 was reported for all affected towns.
- 6/6/17 – Strong Wind: Coastal low pressure passed south of Southern New England and brought gusty northeast winds to Eastern Massachusetts. At 204 AM EST, winds brought a tree down on Pleasant Street in Framingham. Damage of \$5,000 was reported for all affected towns.
- 10/24/17 – High Wind: Low pressure moved north through the Great Lakes. The front stalled over the region during the 25th before moving off to the east on the 26th. Strong low-level winds brought a flow of tropical moisture ahead of the front. The strong winds aloft were brought to the surface in damaging wind gusts, with speeds reaching 45 to 55 mph. A tree was brought down on Maynard Road in Framingham. Damage of \$30,000 was reported for all affected towns.
- 11/3/2018 – High Wind: Low pressure over New York City early in the morning on November 3rd rapidly intensified as it moved northeastward across New England. A few severe thunderstorms moved from Rhode Island into eastern Massachusetts around daybreak. As the strong low passed to our north, strong to damaging westerly winds developed during the afternoon. In Framingham at 212 PM, a tree was down on Parmenter Road. Damage of \$16,500 was reported for all affected towns.
- 3/29/21 – High Wind: A cold front passed through southern New England on the evening of March 28th. Strong to damaging westerly winds generally gusted to 50 to 60 mph during the morning and early afternoon hours. Winds were generally gusting to 50 to 56 mph. In Framingham at 708 AM EST, a large tree and powerlines were down on a house on Janebar Circle. Damage of \$20,000 was reported for all affected towns.
- 7/27/21 – Thunderstorm Wind: A cold front entered a marginally unstable, but highly sheared environment during the late afternoon and evening hours. A broken line of severe thunderstorms moved across most of Massachusetts and a portion of northern Connecticut and northern Rhode Island. Specific locations of damage were not reported for Framingham. Damage of \$5,000 was reported for all affected towns.

USDA declares agricultural disasters as needed for a variety of hazards. Information can be found at <https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index>. The events related to severe winds and hail in Middlesex County are listed below.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 20. Severe Wind Events Listed by USDA.

Year	Event	Event “Begin Dates”
2016	Drought, wildfire, excessive heat, high winds, insects	8/16/2016
2016	Drought, wildfire, excessive heat, high winds, insects	7/5/2016
2014	Frost/freeze, hail	5/22/2014

*Extent*

The strength of thunderstorms is typically measured in terms of its effects, namely the speed of the wind, the presence of significant lightning, and the size of hail. High winds are defined by NWS 10-1605 as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (NCDC, 2018). A thunderstorm is classified as “severe” when it produces damaging wind gusts in excess of 58 mph (50 knots), hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

*Probability of Future Events*

According to the NWS, an average of 100,000 thunderstorms per year occur in the United States. The SHMCAP notes that over the ten-year period between January 1, 2008, and December 31, 2017, a total of 435 high wind events occurred in Massachusetts on 124 days, and an annual average of 43.5 events occurred per year. This is consistent with the figure from the SHMCAP that thunderstorms typically occur on 20 to 30 days each year in Massachusetts, which is a subset of the 43.5 high wind event days.

NOAA reports that there are 10 downburst reports for every tornado report in the United States. This implies that there are approximately 10,000 downbursts reported in the United States each year and further implies that downbursts occur in approximately 10% of all thunderstorms in the United States annually. This figure suggests that downbursts are a relatively uncommon yet persistent hazard.

An average of 33 people per year died from lightning strikes in the United States from 2004 to 2013. Most lightning deaths and injuries occur outdoors, with 45% of lightning casualties occurring in open fields and ballparks, 23% under trees, and 14% involving water activities. The SHMCAP notes that 8 fatalities and 145 injuries have occurred in Massachusetts as a result of lightning events between 1993 and 2017 (NCDC, 2017).

According to NOAA's National Weather Service, hail caused two deaths and an average of 27 injuries per year in the United States from 2004 to 2013.

## City of Framingham, MA Hazard Mitigation Plan Update

Climate models show projections that the frequency and intensity of severe thunderstorms (which include tornadoes, hail, and winds) will increase (USGCRP, 2017).

### *Vulnerability Assessment*

#### Exposure

The entire built environment of Framingham is vulnerable to the high winds and/or flooding from a severe weather event.

#### Built Environment Impacts

Severe thunderstorms, and their associated hail and lightning events, brought about property damage in Middlesex County in previous years. Thunderstorms and hail with associated wind damage, caused an average annual property loss of \$333K or \$6.651M over 20 years to Middlesex County. Using the population index, the Framingham AAL is \$14,732.

#### Population Impacts

Some traffic accidents associated with storm events include injuries and deaths. However, the number of injuries and deaths reported for accidents is generally low. Populations considered most vulnerable to tornado, microburst and thunderstorm impacts in Framingham are identified based on a number of factors including their physical and financial ability to react or respond during a hazard. Table 8 summarizes the senior and low-income populations in Framingham. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the city should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

#### Environment Impacts

Thunderstorms and microbursts can cause damage to parks and other, natural areas. Some areas of the city may be out of service until trees are removed.

### **Non Climate-Induced Hazards**

#### ***Earthquakes***

An earthquake is the vibration of the Earth's surface that follows a release of energy in the Earth's crust. New England experiences intraplate earthquakes because it is located within the interior of the North American plate. Although damaging earthquakes are rare in Massachusetts, low-magnitude earthquakes occur regularly in the state.

#### *Description*

An earthquake is a sudden rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes can cause buildings and bridges to collapse; disrupt gas, electric, and telephone lines; and often cause landslides, flash floods, fires, avalanches, and tsunamis. Earthquakes can occur at any time without warning.

## City of Framingham, MA Hazard Mitigation Plan Update

The underground point of origin of an earthquake is called its focus; the point on the surface directly above the focus is the epicenter. Earthquakes are described based on their magnitude and intensity as explained below under *Extent*.

New England's earthquakes appear to be the result of the cracking of the crustal rocks due to compression as the North American Plate is being very slowly squeezed by the global plate movements. As a result, New England epicenters do not follow the major mapped faults of the region, nor are they confined to particular geologic structures or terrains. Because earthquakes have been detected all over New England, seismologists suspect that a strong earthquake could be centered anywhere in the region. Furthermore, the mapped geologic faults of New England currently do not provide any indications detailing specific locations where strong earthquakes are most likely to be centered.

In addition to earthquakes occurring within the Commonwealth, earthquakes in other parts of New England can impact widespread areas. Large earthquakes in Canada, which is more seismically active than New England, can affect buildings Massachusetts. This is due in part to the fact that earthquakes in the eastern U.S. are felt over a larger area than those in the western U.S. The difference between seismic shaking in the East versus the West is primarily due to the geologic structure and rock properties that allow seismic waves to travel farther without weakening (USGS, 2012).

In some places in New England, including locations in Massachusetts, small earthquakes seem to occur with some regularity. For example, since 1985 there has been a small earthquake approximately every 2.5 years within a few miles of Littleton. It is not clear why some localities experience such clustering of earthquakes, but clusters may indicate locations where there is an increased likelihood of future earthquake activity.

### *Location*

Given the above discussion, the potential exists for earthquakes to occur within Framingham or to occur elsewhere and be felt anywhere in Framingham.

### *Previous Occurrences*

According to the previous edition of this plan, no documented earthquakes have been centered in the Town of Framingham. To determine whether earthquakes have occurred *recently* near or in Framingham, all events listed by Weston Observatory were reviewed for all towns in Massachusetts for a five-year lookback. Listed earthquakes above magnitude 2.0 include:

- 12/21/18 – 3 mk WSW of Gardner, 2.1/2.1 [Mn\*/Mc\*\*]
- 8/21/19 – 2 km SSE of Wareham, 1.7/2.4
- 12/3/19 – 4 km SSE of Plymouth, 1.6/2.2
- 11/8/20 – 11 mk SW of New Bedford, 3.8/3.4

## City of Framingham, MA Hazard Mitigation Plan Update

- 11/22/20 – 12 km WSW of New Bedford, 1.7/2.6
  - \*Mn is the Nuttli Magnitude (see *Extent* below)
  - \*\*Mc is the Coda Duration Magnitude (see *Extent* below)

These are very minor earthquakes.

On June 22, 2010, a magnitude 5.8 earthquake in Canada could be felt in Middlesex County. No damage was reported, but residents stated they felt the quake and were unnerved by the experience. On August 23, 2011, an earthquake measuring 5.8 on the Richter scale centered in Virginia was felt throughout the northeast, including in Framingham.

### *Extent*

Magnitude is an estimate of the relative size or strength of an earthquake and is related to the amount of seismic energy released at the hypocenter of the earthquake. It is based on the amplitude of earthquake waves recorded on instruments that have a common calibration. The magnitude of an earthquake is thus represented by a single instrumentally determined value recorded by a seismograph, which records the varying amplitude of ground oscillations.

The Richter scale was developed in 1935 and was used exclusively until the 1970s. It set the magnitude of an earthquake based on the logarithm of the amplitude of recorded waves. Being logarithmic, each whole number increase in magnitude represents a tenfold increase in measured strength. Earthquakes with a magnitude of about 2.0 or less are usually called "microearthquakes" and are generally only recorded locally. Earthquakes with magnitudes of 4.5 or greater are strong enough to be recorded by seismographs all over the world.

As more seismograph stations were installed around the world following the 1930s, it became apparent that the method developed by Richter was valid only for certain frequency and distance ranges, particularly in the southwestern United States. New magnitude scales that are an extension of Richter's original idea were developed for other areas. In particular, the Moment magnitude scale (Mw) was developed in the 1970s to replace the Richter scale and has been in official use by the USGS since 2002.

According to USGS, these multiple methods are used to estimate the magnitude of an earthquake because no single method is capable of accurately estimating the size of all earthquakes. Some magnitude types are calculated to provide a consistent comparison to past earthquakes, and these scales are calibrated to the original Richter scale. However, differences in magnitude of up to 0.5 can be calculated for the same earthquake through different techniques. In general, Moment magnitude provides an estimate of earthquake size that is valid over the complete range of magnitudes and so is commonly used today.

Although Moment magnitude is the most common measure of earthquake size for medium and larger earthquakes, the USGS does not calculate Mw for earthquakes with a magnitude of less than 3.5 which

# City of Framingham, MA Hazard Mitigation Plan Update

is the more common situation for Massachusetts. Localized Richter scales or other scales are used to calculate magnitudes for smaller earthquakes.

Regionally, the Weston Observatory utilizes two scales to track the magnitude of earthquakes. These include the Nuttli magnitude (Mn) for North America east of the Rocky Mountains and is more appropriate for the relatively harder continental crust in Connecticut compared to California. Weston Observatory also utilizes the Coda Duration magnitude (Mc), which is based on the duration of shaking at a particular station. The advantages of the Coda Duration magnitude is that this method can quickly estimate the magnitude before the exact location of the earthquake is known.

The effect of an earthquake on the earth's surface is called the intensity. The Modified Mercalli Intensity Scale consists of a series of key responses such as people awakening, movement of furniture, damage to chimneys, and total destruction. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It is an arbitrary ranking based on observed effects.

Table 21. Modified Mercalli Intensity Scale.

Modified Mercalli Intensity	Description
I	Not felt except by a very few under especially favorable conditions
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.

# City of Framingham, MA Hazard Mitigation Plan Update

VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry), structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown in the air.

Source: USGS

A comparison of Richter magnitude to typical Modified Mercalli intensity is presented below.

Moment Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 to 3.0	I
3.0 to 3.9	II to III
4.0 to 4.9	IV to V
5.0 to 5.9	VI to VII
6.0 to 6.9	VII to IX
7.0 and above	VIII or higher

Source: USGS

### Probability of Future Events

Earthquake location and magnitude probabilities are exceptionally difficult to predict in Massachusetts. Minor earthquakes are relatively common in New England, but damaging earthquakes are not. Therefore, USGS instead characterizes the probability of ground acceleration rather than estimating a probability of magnitude. The Seismic Hazard Map for the state of Massachusetts (USGS) shows a peak ground acceleration of 10% to 20% of gravity in Framingham having a 2% probability of being exceeded in 50 years.

# City of Framingham, MA Hazard Mitigation Plan Update

## Vulnerability Assessment

### Exposure

A major earthquake could cause severe damage to Framingham buildings, including older structures that were built before a 1975 law requiring new buildings to withstand earthquakes. Other associated concerns are debris management issues including debris removal and identification of disposal sites.

### Built Environment Impacts

Historic data for earthquake events indicate that between 1991 and 2022, no major (>5.0 magnitude) earthquakes were recorded in Middlesex County during this period, causing no damage to property. The entire built environment of Framingham is vulnerable to earthquakes. Older, unreinforced masonry buildings are very susceptible to earthquakes.

To identify built environment impacts to the city, FEMA’s risk assessment software, Hazus, was implemented. The economic loss results of the 1500-year event are shown in Table 22 while the results for the 2500-year event are shown in Table 23. The city’s Average Annual Loss (AAL) is modeled to be \$343,759.

Table 22. Building Loss for a 1500-Year Scenario

Loss Type	Residential (\$Million)	Commercial (\$Million)	Other Occupancy (\$Million)	Total (\$Million)
Building Loss	54.0	26.2	10.3	<b>90.5</b>
Content Loss	16.3	11.7	5.5	<b>33.5</b>
Business Inventory Loss	0.0	0.3	0.4	<b>0.7</b>
Business Income Loss	0.1	3.7	0.1	<b>3.9</b>
Business Relocation Loss	2.8	4.6	1.3	<b>8.7</b>
Rental Income Loss	2.4	3.2	0.2	<b>5.8</b>
Wage Loss	0.3	4.6	0.6	<b>5.5</b>
<b>Total</b>	<b>75.9</b>	<b>54.3</b>	<b>18.4</b>	<b>148.6</b>

# City of Framingham, MA Hazard Mitigation Plan Update

Table 23. Building Loss for a 2500-Year Scenario

Loss Type	Residential (\$Million)	Commercial (\$Million)	Other Occupancy (\$Million)	Total (\$Million)
Building Loss	102.2	48.7	19.3	<b>170.2</b>
Content Loss	33.1	22.0	10.2	<b>65.3</b>
Business Inventory Loss	0.0	0.6	0.8	<b>1.4</b>
Business Income Loss	0.3	7.0	0.2	<b>7.5</b>
Business Relocation Loss	5.1	8.6	2.5	<b>16.2</b>
Rental Income Loss	4.3	5.9	0.3	<b>10.5</b>
Wage Loss	0.7	8.6	1.2	<b>10.5</b>
<b>Total</b>	<b>145.7</b>	<b>101.4</b>	<b>34.5</b>	<b>281.6</b>

### Population Impacts

Populations considered most vulnerable to earthquake impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 8 summarizes the senior and low-income populations in Framingham. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the city should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Hazus was used to model injuries and fatalities for the 1500- and 2500-year events. For the 1500-year event, there are 20 to 30 minor injuries not requiring medical attention with up to 5 injuries requiring medical attention. For the 2500-year event there are 30 to 50 minor injuries not requiring medical attention with up to 10 injuries requiring medical attention.

### Environment Impacts

The environment may be impacted by cascading impacts from the earthquake, such as a train derailment caused by track damage, landslide, or dam breach. This could result in a hazardous material release.

### National Flood Insurance Repetitive Loss Properties

B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))

According to FEMA, repetitive loss properties are those for which two or more losses of at least \$1,000 each have been paid under the National Flood Insurance Program (NFIP) within any 10-year period since 1978. Severe repetitive loss properties are residential properties that have at least four NFIP payments over \$5,000 each and the cumulative amount of such claims exceeds \$20,000, or at least two separate claims payments with the cumulative amount exceeding the market value of the building.

According to data provided by MEMA, there are 16 repetitive loss facilities with \$337,138 total building payments and \$133,991 total content payments and 1 severe repetitive loss property with \$79,059 total building payments and \$18,573 total content payments. The repetitive loss properties include 8 single-family homes, 2 multi-family homes, 1 non-residential buildings, 3 other residential buildings, and 2 other non-residential buildings. The severe repetitive loss property is a single-family home. A summary of the Town’s participation and compliance with the NFIP, including current policy and historical claims statistics, is provided in Table 7 of Chapter 5 (Capability Assessment).

### Hazard Ranking

Ranking hazards helps the city set goals and mitigation priorities. To compare the risk of different hazards, and prioritize which are more significant, requires a scoring system for equalizing the units of analysis. As not all hazards assessed in this plan have precisely quantifiable probability or impact data, a scoring system based on multi-criteria decision analysis (MCDA) methodology was developed to rank all the hazards. This multi-criterion ranking analysis approach prioritizes hazard risk based on a blend of quantitative factors from the available data, such as historical data, local knowledge, public survey, and Hazus assessment. This hazard ranking analysis assigns varying degrees of risk to five categories for each of the hazards, including: probability (how often it can occur), impact (economic, social, and environmental loss), spatial extent (the size of the area affected), warning time (how long does a community have to prepare for the event), and duration. Each degree of risk was assigned a value ranging from 1 to 4. The weighting factor derived from a review of best practice plans. Some of these hazard characteristics, like probability and impact, are more important than others and are weighted more heavily.

To calculate a rank score value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories represents the final rank score, as demonstrated in the following equation:

# City of Framingham, MA Hazard Mitigation Plan Update

$$\text{Hazard Score Value} = [(\text{Probability} \times 30\%) + (\text{Impact} \times 30\%) + (\text{Spatial Extent} \times 20\%) + (\text{Warning Time} \times 10\%) + (\text{Duration} \times 10\%)]$$

Table 24 provides the hazard characteristic, level description, level criteria, level index value, and weighting value.

Table 24. Hazard Ranking Criteria

Hazard Characteristic	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	
Impact	Minor	Very few injuries, in any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	Long	More than 24 hours	1	10%
	Moderate	12 to 24 hours	2	
	Short	6 to 12 hours	3	
	Very short or no warning	less than 6 hours	4	
Duration	Very short	Less than 6 hours	1	10%
	Short	Less than 24 hours	2	
	Moderate	Less than one week	3	
	Long	More than one week	4	

Table 25 provides the final hazard ranking for Framingham. Each hazard characteristic is assigned a value between 1 (lowest value) and 4 (highest value). When the risk values were calculated, if the value was

# City of Framingham, MA Hazard Mitigation Plan Update

greater than 3, it was assigned as a high risk hazard. If the value was greater than 2 and less than or equal to 3, it was assigned as a moderate risk. If the value was less than or equal to 2, it was assigned as a low risk hazard. The flood, extreme temperatures, and severe winter storms hazards were ranked highest. The wildfires/brushfires, hurricanes/wind, thunderstorms, drought, infectious disease, invasive species, hazardous materials, and earthquakes are all ranked as moderate. The landslide and tornado hazards are ranked as low.

Table 25. Final Hazard Ranking of Hazards for Framingham

Hazards	Probability	Impact	Spatial Extent	Warning Time	Duration	Value	Rank
Flood	4	4	2	4	2	3.4	High
Landslide	1	2	1	4	1	1.6	Low
Wildfires/Brushfires	1	1	1	3	3	1.4	Low
Hurricanes/Wind	2	3	4	1	2	2.6	Mod .
Severe Winter Storms	4	2	4	1	3	3.0	High
Tornadoes	1	1	1	3	1	1.2	Low
Thunderstorms	4	2	4	2	1	2.9	Mod .
Earthquakes	1	3	4	4	1	2.5	Mod .
Drought	2	3	4	1	4	2.8	Mod .
Extreme Temperatures	4	2	4	1	2	2.9	Mod .
Infectious Disease	4	2	3	2	2	2.8	Mod .
Invasive Species	3	2	3	2	3	2.6	Mod .

## Problem Statements

As suggested in FEMA’s Local Mitigation Planning Handbook<sup>49</sup>, the following problem statements were developed upon the completion and review of all risk assessment tasks. These statements are designed to briefly summarize the key hazard risks and vulnerabilities to the community based on potential impacts and losses from future events. They are among the issues of greatest concern and were used to assist in the identification and analysis of potential mitigation actions for Chapter 6 (Mitigation

<sup>49</sup> Local Mitigation Planning Handbook. FEMA. March 2013. P. 5-2.

## City of Framingham, MA Hazard Mitigation Plan Update

Strategy). These problem statements will be reviewed and revised as needed during future plan updates to reflect the most current information resulting from the risk assessment.

### Primary Hazards of Concern (High Hazard Rankings)

- Flood
- Severe Winter Storm
- Extreme Temperatures

### Primary Impacts, Geographic Areas, and/or Vulnerable Assets of Concern

- **Riverine and Drainage-Related Flooding:** Flooding caused by excessive precipitation remains one of the most frequent and impactful hazards and is the City's primary concern due to the projected increase in extreme rainfall events under future climate conditions. Roadways are particularly susceptible with many areas of the community experiencing chronic and repeated flooding due to inadequate stormwater drainage (such as key intersections along Route 9, and especially at Route 126). Primary impacts are road closures, flooded or stranded vehicles, and other localized disruptions to transportation and commerce. Many other areas of the community are at risk to large storm events, including along Union Avenue and downtown, and especially along the Sudbury River, Beaver Dam Brook, and other tributaries as further described within this chapter.
- **Critical Facilities in High Risk Flood Zones:** Several of the City's critical facilities have been identified as vulnerable assets of concern due to their location in high risk flood areas, including but not limited to two sewer pump stations, the Callahan Senior Center, and Hemenway Elementary School (relocation and/or upgrades remain under consideration). Additionally, there is a nursing home (Edgell Rest Home), six day care facilities, two preschools in the 100-year floodplain too, and four Tier 2 chemical facilities.
- **Increased Stress on Aging Flood Control and Drainage Infrastructure:** More frequent and intense rainfall events, combined with the city's large amounts of impervious surface coverage, are placing additional pressure on local high hazard dams (including those upstream of Framingham), culverts, and other drainage infrastructure which were not designed and built to convey such large amounts of stormwater runoff. Future storm events are anticipated to continue overwhelming and potentially damaging local drainage systems as well as lead to increased flood risks for surrounding areas. This includes but extends well beyond the nearly 300 structures and critical facilities located in identified special flood hazard areas (i.e., 100-year floodplain) as identified earlier in this chapter.
- **Large-scale Power Outages:** The city's residents, services, and critical facilities are vulnerable to widespread power outages caused by severe winter storms that bring down trees and power lines. Power outages can be localized but still create extensive social and economic disruptions to the community, and they can also lead to additional life/safety threats and secondary hazard events that extend beyond the initial cause. The City should focus on both preventative mitigation techniques (such as expanding backup power capabilities for critical facilities, continued pruning and

## City of Framingham, MA Hazard Mitigation Plan Update

hazard tree management, undergrounding powerlines, and exploring the development of energy resiliency systems) as well as emergency response measures to expedite power restoration as much as possible. This is particularly true for the downtown power network for which many economic activities depend on, but also areas that are more remote and/or difficult to access during and immediately following a winter storm event, and/or with higher susceptibility to downed trees and powerlines.

- **Extreme Heat:** Extreme heat events are projected to become more frequent and severe under future climate conditions, with potentially major impacts to the community's more vulnerable populations (such as seniors, individuals with pre-existing health conditions, lower income residents, the homeless, and those without air conditioning), and particularly those living in more urbanized areas that are more susceptible to the heat island effect. Updated plans and procedures for the City's preparedness and response for these events are recommended along with multi-lingual public outreach materials that can be useful during summer months and in advance of forecasted heat waves (providing information on individual preparedness activities, cooling centers, etc.). Expanding the city's natural landscape/tree cover should also continue to be pursued along with implementing plans to install air conditioning in Framingham schools that currently lack A/C systems.

## Chapter 5: Capability Assessment

### Capability Assessment Purpose

The purpose of conducting a capability assessment is to determine the ability of a community to mitigate hazard risks and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs, or projects. As in any planning process, it is important to establish which goals or actions are feasible based on the organizational capacity of those agencies or departments tasked with their implementation. A capability assessment helps to determine which types of mitigation actions are practical and likely to be implemented over time based on a local jurisdiction’s existing authorities, policies, programs, and resources available to support such implementation. This analysis will identify any critical capability gaps or shortfalls, as well the key strengths or positive measures already in place and which should continue to be supported.

The capability assessment serves as the foundation for designing an effective mitigation strategy. It not only helps establish the goals and actions for the City of Framingham’s hazard mitigation plan, but it ensures that those goals and actions are realistically achievable under current local conditions. As highlighted in FEMA’s 2022 Local Mitigation Planning Policy Guide, *“describing the current capabilities provides a rationale for which mitigation projects can be undertaken to address the vulnerabilities identified in the Risk Assessment.”*<sup>50</sup>

The capability assessment for the City of Framingham includes a comprehensive examination of several components as summarized in Table 26.

Table 26. Capability Assessment Components

Components	Description
Planning and Regulatory Capabilities	Local plans, policies, codes, and ordinances that are relevant to reducing the potential impacts of hazards.
Administrative and Technical Capabilities	Local human resources and their skills/tools that can be used to support mitigation activities.
Financial Capabilities	Fiscal resources the community has access to for helping to fund hazard mitigation projects.
Education and Outreach Capabilities	Local programs and methods already in place that can be used to support mitigation activities.

<sup>50</sup> Local Mitigation Planning Policy Guide. FEMA. April 2022. P. 25.

# City of Framingham, MA Hazard Mitigation Plan Update

NFIP Participation and Compliance	Summary of information relevant to the community’s participation in the NFIP and continued compliance with NFIP requirements.
Capability Assessment Conclusions	A summary of capability findings.

## Review and Incorporation of Existing Studies

A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))

Many sources were used to develop this plan, including web-based resources, reports, and stakeholder engagement. Throughout the plan, these sources are cited within the text as footnotes. The Massachusetts State Hazard Mitigation and Climate Adaptation Plan, as well as several City of Framingham plans, were reviewed for consistency. The goal was to develop a plan that would easily integrate with the key aspects of plans in the City and State. This section reviews how the content of several key plans and studies influenced the development of this plan. The risk assessment also details resources used toward development of this mitigation plan update. A summary of the most relevant plans is provided below.

**State Hazard Mitigation and Climate Adaptation Plan (2018)**

The Commonwealth’s 2018 State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) is an innovative, first-of-its-kind statewide plan that fully integrates a traditional hazard mitigation plan with a climate change adaptation plan. The SHMCAP fulfills two important requirements, including (1) updating the 2013 State Hazard Mitigation Plan as required by Federal regulations (44 CFR Part 201.4); and (2) fulfilling requirements for a state climate adaptation plan per Massachusetts Executive Order 569. The SHMCAP has five goals as shown below:<sup>51</sup>

1. Enhance the Commonwealth’s resiliency to natural hazards and climate change by integrating programs and building institutional capacity.
2. Reduce the impacts of natural hazards and climate change with forward-looking policies, plans, and regulations.
3. Understand our vulnerabilities and risks and develop immediate and long-term risk reduction strategies for current and future conditions using the best available science.
4. Increase the resilience of State and local government, people, natural systems, the built environment, and the economy by investing in performance-based solutions.
5. Support implementation of this plan through increased education, awareness, and incentives for action for state agencies, local governments, private industry, non-profits, and the public.

---

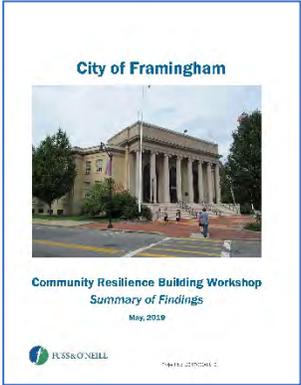
<sup>51</sup> Massachusetts State Hazard Mitigation and Climate Adaptation Plan. September 2018. P. 7-2.

# City of Framingham, MA Hazard Mitigation Plan Update

The City of Framingham’s Hazard Mitigation Plan is consistent and aligned with the SHMCAP. The goals in the following chapter include several of the themes shown in the State plan, including the integration of hazard mitigation and climate adaptation strategies in local policies, plans, and regulations; improving public education and awareness; building local capacity; and reducing risk to people, property, and infrastructure to natural hazards and climate change. In addition, as seen in Chapter 4, the risk assessment has been updated to be organized using the same hazard classification scheme as used for the SHMCAP.

## **City of Framingham Community Resilience Building Workshop – Summary of Findings (2019)**

The Commonwealth’s Municipal Vulnerability Preparedness (MVP) program provides support for cities and towns in Massachusetts to plan for resiliency and implement key climate change adaptation actions for resiliency. In 2018, Framingham was awarded an MVP Planning Grant to assess its vulnerability to and prepare for climate change impacts, build community resilience, and receive designation from the Executive Office of Energy and Environmental Affairs (EEA) as an MVP Community. Communities with this designation become eligible for MVP Action Grant funding and other opportunities to support the implementation of priority climate adaptation actions.



In completing the MVP planning process, the City of Framingham followed the Community Resilience Building (CRB) framework with technical assistance provided by a state-certified MVP Provider, Fuss & O’Neill. The CRB methodology is an “anywhere at any scale” format that draws on stakeholders’ wealth of information and experience to foster dialogue about a community’s strengths and vulnerabilities. A day long CRB Workshop was held on March 19, 2019, with the following central objectives:

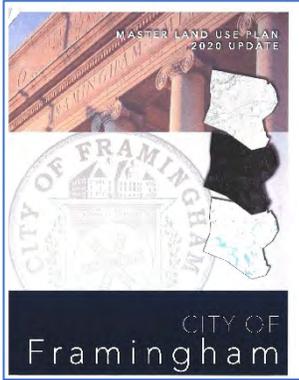
1. Define top local natural and climate-related hazards of concern.
2. Identify existing and future strengths and vulnerabilities.
3. Develop prioritized actions for Framingham.
4. Identify immediate opportunities to collaboratively advance actions to increase resilience.

The City’s resulting Summary of Findings Report and supporting materials served as a primary source of information and community-based inputs for the update to this plan update. These inputs include the identification of top climate-influenced hazards (flooding, severe weather, extreme temperatures, and drought) and vulnerable areas or community assets (infrastructural, societal, and environmental), current community concerns and challenges presented by these hazards, current strengths and assets, and specific, prioritized recommendations to improve resilience in Framingham.

# City of Framingham, MA Hazard Mitigation Plan Update

## **Master Land Use Plan (2020 Update)**

The City of Framingham’s Master Land Use Plan is a living, working document that is periodically amended' to remain up-to-date and current, while providing guidance to the municipality in all of its future endeavors. It is designed to help create a unified action agenda for municipal government and its partners, the Mayor, the City Council, the Conservation Commission, the Planning Board, the Zoning Board of Appeals (ZBA), and respective municipal staff. Last updated in 2020, the plan includes numerous goals, policies, and actions that are directly related to the mitigation of natural hazards and long-term risk reduction. It includes an explicit goal for “Creating a Sustainable and Resilient Community (4.2), and under this goal has established an objective to “adopt policies to make the community more resilient in the face of increasing severity of natural disasters and climate change” (4.2.1.h). Under its goal for “Sustainable Land Use and Development Review” (4.3), the City established objectives to “develop strategies to allow the City to respond quickly and efficiently to the impacts of natural hazards” (4.3.7.b) and for “preserving existing forests, floodplains, and wetlands” (4.3.7.i). More information on how the Master Plan relates to and/or addresses the mitigation of natural hazards is provided later in this section (see results of the *Safe Growth Survey*).



In addition to the above plans which were determined to be most relevant for the hazard mitigation plan update, the following plans, studies, reports, and other technical documents were reviewed to gain a clearer understanding of their existing or potential effects on hazard risk reduction. More information on each plan is provided in Table 26 in the next section.

- **Framingham Open Space and Recreation Plan (Draft, 2020)**
- **Stormwater Management Plan (2021)**
- **Transportation Master Plan – Phase II (2021)**
- **Historic Preservation Plan (2016)**

## Planning and Regulatory Capabilities

C1. Does the plan document each jurisdiction’s existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))

Table 27 is based off Worksheet 4.1 from FEMA’s *Local Mitigation Planning Handbook*. It was used by the HMWG to document and review the current planning and regulatory capabilities of the City including local plans, policies, codes, and ordinances that are relevant to reducing the potential impacts of hazards.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 27. Planning and Regulatory Findings

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
<b>Plans</b>		
Comprehensive/Master Plan	Planning Board/ Planning, Community Development, and Conservation	Last updated in 2020, the City’s Master Land Use Plan can be an effective tool for hazard risk reduction. It includes a specific goals, policies, and actions that are directly supportive of long-term hazard mitigation measures (as described in the previous section).
Community Resilience Building (CRB) Workshop Report	Planning, Community Development, and Conservation	Developed in 2019 to qualify as one of the Commonwealth’s Municipal Vulnerability Preparedness Communities. The workshop report represents a broad community effort to identify Framingham’s strengths, vulnerabilities, and opportunities to enhance resilience to climate change impacts.
Open Space & Recreation Plan	Planning, Community Development, and Conservation	Update in progress. Current draft plan (dated November 2020) addresses hazard risk reduction by recognizing and aiming to protect the natural and beneficial functions of floodplains and other natural features that help with flood control, stormwater management, and the prevention of storm-related damages. An established goal is to utilize management techniques to maximize ecological benefits and minimize risks to the community from flooding, extreme weather, etc. Among the prioritization criteria for protecting open space parcels are those identified to have a high value for mitigation toward climate change.
Housing Production Plan	Planning, Community Development, and Conservation	Draft plan completed but does not address hazards or hazard risk reduction.

City of Framingham, MA Hazard Mitigation Plan Update

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
Economic Development Plan	Planning, Community Development, and Conservation	Draft Economic Development Master Plan is still under development.
Capital Improvements Plan	All Departments	Each department contributes to a citywide Capital Improvement Plan, maintained by the City’s Finance Division, and many departments also develop and update their own CIP plans and projects lists for public facilities (i.e., Capital Projects and Facilities Management Department, DPW, Framingham Public Schools / Department of Buildings and Grounds, etc.). Through these efforts the City continues to manage extensive improvements of its critical assets and infrastructure systems that that are effective in reducing hazard risks (e.g., flood control and mitigation, stormwater management, etc.).
Emergency Operations Plan	Police Department	During all major incidents the City operates under the National Incident Management System (NIMS), utilizing the Incident Command System. All public safety personnel have been trained in Incident Command as required under Homeland Security Presidential Directive Number 5 and Number 8.
Continuity of Operations Plan (COOP)	Police Department	The COOP helps to assure that the capability exists to continue performing the City’s essential functions and services in response to a comprehensive array of potential emergencies or disasters, including natural hazards.
Transportation Plan	DPW	The focus areas for Transportation Master Plan (Phase II Report, dated December 2021) are on traffic management, multimodal corridor improvements, pedestrian and bicycle infrastructure, transportation demand management, and public transportation. The

City of Framingham, MA Hazard Mitigation Plan Update

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
		plan does not address hazards or hazard risk reduction.
Stormwater Management Plan	DPW	Updated in June 2021 to comply with latest EPA NPDES Phase II program requirements (MS4 Permit). Though focused on water quality the City’s SWMP is an effective tool for hazard risk reduction. It includes a stated goal to mitigation potential flooding, it requires the use of Best Management Practices (BMPs) for stormwater management and erosion/sedimentation control, and it supports the development of capital improvements for drainage infrastructure and other measures (such as automated stream gauges to help monitor and respond to flood conditions). It also includes a detailed report assessing local regulations regarding Low Impact Development (LID) and Green Infrastructure (prepared by Mass Audubon). The Stormwater Management Plan is updated annually as part of MS4 requirements.
Historic Preservation Plan	Planning, Community Development, and Conservation	The 2016 Historic Preservation Plan is focused on actions the City can take to further historic preservation efforts.
Rapid Recovery Plan	Planning, Community Development, and Conservation	Developed in 2021 in response to the impacts of the COVID-19 pandemic, the Rapid Recovery Plan for Framingham was created to help assess these impacts and develop actionable projects tailored to the City’s downtown. The plan is representative of the efforts the City will need to implement for other infectious disease events that may occur in the future.
Climate Action Plan	Capital Projects and	Currently in development, the Climate Action Plan will utilize community engagement and best practices to identify the critical measures Framingham should

City of Framingham, MA Hazard Mitigation Plan Update

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
	Facilities Management	adopt to improve its sustainability, reduce greenhouse gas emissions, and support local climate resiliency.
Other Plans <i>(e.g., brownfields redevelopment, disaster recovery, climate adaptation)</i>	Various Departments	The City has many other local plans that may not be as relevant for hazard mitigation purposes (Transit Oriented Development (TOD) Development Downtown, Bicycle and Pedestrian Plan, Southeast Framingham Brownfield Plan Study, etc.).
<b><i>Building Code, Permitting, and Inspections</i></b>		
Building Code	Inspectional Services Department (ISD)	Version/Year: The City enforces the most current version of the State Building Code (780 CMR), which includes numerous provisions for reducing risks posed by natural hazards (e.g., flood-resistant construction, seismic design standards, wind and snow load requirements, etc.).
ISO Fire Protection Rating	ISO/Verisk	Public Protection Classification: 3/3x
Site Plan Review Requirements	ISD and Planning	The City’s Site Plan Review process helps to ensure new development projects do not create adverse impacts to the health, safety, quality of life, and general welfare of the community. Among other stated intents, it encourages the use of LID and BMPs and seeks to establish and sustain a high-quality level of development through Framingham. Applicants for both major and minor projects must submit documentation that addresses stormwater management and demonstrates the project will not increase the potential for erosion, flooding, or sedimentation, either onsite or on neighboring properties; and shall not increase rates of runoff from the site.
<b><i>Zoning and Development Regulations</i></b>		

City of Framingham, MA Hazard Mitigation Plan Update

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
Zoning Ordinances	ISD	Very effective tool for hazard risk reduction through multiple regulatory standards and provisions for managing growth and future development. This includes overlay districts (i.e., floodplain, groundwater protection) and other regulations that establish type and use standards along with other conditions for new/improved construction.
Subdivision Regulations	Planning Board	Last adopted in November 2019 for the purposes of protecting the convenience, health, safety, morals, and welfare of Framingham residents and community. Among other stated intents, the regulations are designed to provide for the safety of all residents and the community at large in the event of fire, flood, panic, natural disaster, and/or other emergencies. They also promote the implementation of BMPs and LID for stormwater management and the protection of natural water resources and courses, flood control areas, wetland areas, and/or lands classified as Moderate Slopes.
Floodplain Regulations	Planning & Conservation Commission & ISD & DPW	Adopted as part of Zoning Ordinances (Section III, Overlay Districts) and in compliance with minimum State and Federal (NFIP) regulations at the time of adoption. The current FEMA Flood Insurance Rate Maps (FIRMs) for which the Floodplain District is based became effective on July 7, 2014.
Stormwater Management and Wetlands Protection Regulations		Section V. F Land Disturbance and Stormwater Management Ordinance.  The City recently strengthened its local wetlands and stormwater ordinance to provide additional protections to these sensitive environmental areas that play a crucial role in resiliency to climate impacts, particularly the effects of flooding. In particular, the City now maintains a 30-foot “no alteration” buffer, and a 50-foot “no build” buffer. The revised ordinance also gives the City more

# City of Framingham, MA Hazard Mitigation Plan Update

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
		authority for enforcement and requiring alternatives analyses.

**Safe Growth Survey**

As part of the assessment for planning and regulatory capabilities, the City’s Department of Planning, Community Development, and Conservation completed a *Safe Growth Survey*. This unique survey instrument was drawn from the Safe Growth Audit concept developed for the American Planning Association (APA) to help communities evaluate the extent to which they are positioned to grow safely relative to natural hazards. The survey covered six topic areas including the following:

- Land Use
- Transportation
- Environmental Management
- Public Safety, Zoning Ordinance
- Subdivision Regulations
- Capital Improvement Program and Infrastructure Policies

While somewhat of a subjective exercise, the Safe Growth Survey was used to provide some measure of how adequately existing planning mechanisms and tools for the City of Framingham were being used to address the notion of safe growth. In addition, the survey instrument was aimed at further integrating the subject of hazard risk management into the dialogue of local community planning and to possibly consider and identify new actions as it relates to those local planning policies or programs already in place or under development. It is anticipated that the Safe Growth Survey will be used again during future plan updates to help measure progress over time and to continue identifying possible mitigation actions as it relates to future growth and community development practices, and how such actions may better be incorporated into local planning mechanisms.

The results of the Safe Growth Survey are summarized in Table 28. This includes describing how strongly the City’s planning staff agrees or disagrees with 25 statements as they relate to Framingham’s current plans, policies, and programs for guiding future community growth and development, according to the following scale:

1=Strongly Disagree 2=Somewhat Disagree 3=Neutral 4=Somewhat Agree 5=Strongly Agree

# City of Framingham, MA Hazard Mitigation Plan Update

Table 28. Safe Growth Survey Results

COMPREHENSIVE/MASTER PLAN					
Land Use					
1. The comprehensive/master plan includes a future land use map that clearly identifies natural hazard areas.	1	2	3	4	5
2. Current land use policies discourage development and/or redevelopment within natural hazard areas.	1	2	3	4	5
3. The comprehensive/master plan provides adequate space for expected future growth in areas located outside of natural hazard areas.	1	2	3	4	5
Transportation					
4. The transportation element limits access to natural hazard areas.	1	2	3	4	5
5. Transportation policy is used to guide future growth and development to safe locations.	1	2	3	4	5
6. Transportation systems are designed to function under disaster conditions (e.g., evacuation, mobility for fire/rescue apparatus, etc.).	1	2	3	4	5
Environmental Management					
7. Environmental features that serve to protect development from hazards (e.g., wetlands, riparian buffers, etc.) are identified and mapped.	1	2	3	4	5
8. Environmental policies encourage the preservation and restoration of protective ecosystems.	1	2	3	4	5
9. Environmental policies provide incentives to development that is located outside of protective ecosystems.	1	2	3	4	5
Public Safety					
10. The goals and policies of the comprehensive/master plan are related to and consistent with those in the hazard mitigation plan.	1	2	3	4	5

City of Framingham, MA Hazard Mitigation Plan Update

11. Public safety is explicitly included in the comprehensive/master plan’s growth and development policies.	1	2	3	4	<b>5</b>
12. The monitoring and implementation section of the comprehensive/master plan covers safe growth objectives.	1	2	3	<b>4</b>	5
<b>ZONING BYLAWS</b>					
13. The zoning bylaws conform to the comprehensive/master plan in terms of discouraging development and/or redevelopment within natural hazard areas.	1	2	<b>3</b>	4	5
14. The bylaws contain natural hazard overlay zones that set conditions for land use within such zones.	1	2	3	<b>4</b>	5
15. Rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use.	1	2	3	<b>4</b>	5
16. The bylaws prohibit development within, or filling of, wetlands, floodways, and floodplains.	1	2	<b>3</b>	4	5
<b>SUBDIVISION REGULATIONS</b>					
17. The subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas.	1	2	3	<b>4</b>	5
18. The regulations provide for conservation subdivisions or cluster subdivisions to conserve environmental resources.	1	2	3	<b>4</b>	5
19. The regulations allow density transfers where hazard areas exist.	1	2	<b>3</b>	4	5
<b>CAPITAL IMPROVEMENT PROGRAM AND INFRASTRUCTURE POLICIES</b>					
20. The capital improvement program limits expenditures on projects that would encourage development and/or redevelopment in areas vulnerable to natural hazards.	1	2	<b>3</b>	4	5
21. Infrastructure policies limit the extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.	1	2	3	<b>4</b>	5

City of Framingham, MA Hazard Mitigation Plan Update

22. The capital improvements program provides funding for hazard mitigation projects identified in the hazard mitigation plan.	1	2	3	4	5
<b>OTHER</b>					
23. Small area or corridor plans recognize the need to avoid or mitigate natural hazards.	1	2	3	4	5
24. The building code contains provisions to strengthen or elevate new or substantially improved construction to withstand hazard forces.	1	2	3	4	5
25. Economic development and/or redevelopment strategies include provisions for mitigating natural hazards or otherwise enhancing social and economic resiliency to hazards.	1	2	3	4	5

Administrative and Technical Capabilities

Table 29 is based off Worksheet 4.1 from FEMA’s *Local Mitigation Planning Handbook*. It was used by the HMWG to document and review the current administrative and technical capabilities of the City. These include staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions.

Table 29. Administrative and Technical Findings

Administrative/Technical Resource	Full-time (FT) / Part-time (PT) / Volunteer (V)	General Description and Effectiveness for Hazard Risk Reduction
<b>Administration</b>		
Planning Board	FT (Staff)/V (Board)	Fully staffed, manages the Land Disturbance and Stormwater Management ordinance.
Conservation Commission	FT (Staff)/V (Board)	Staffed, coordination is considered effective.
Hazard Mitigation Working Group	FT (Staff)/V (Board)	Managed by the Sustainability Coordinator in partnership with the Planning, Conservation, and Community Development Department.
Maintenance Programs to Reduce Risk (e.g., tree trimming, drainage clearance)	FT (Staff)	DPW meets the needs of the community.

City of Framingham, MA Hazard Mitigation Plan Update

Administrative/Technical Resource	Full-time (FT) / Part-time (PT) / Volunteer (V)	General Description and Effectiveness for Hazard Risk Reduction
		The City has a robust maintenance program to maintain drainage system infrastructure (street sweeping, structure cleaning, pipe cleaning and TV, system inspections, capital improvement planning, MS4 compliance.)
Mutual Aid Agreements	FT (Staff)	Meets the needs of the community.
<b>Staff</b>		
Chief Building Official	FT (Staff)	Staffing is generally considered adequate to administer and/or enforce regulations, though as a result of staffing changes across departments, coordination can be improved to increase overall effectiveness for hazard risk reduction. Coordination is deemed effective for routine emergency management and public works/engineering activities.
Floodplain Administrator	FT (Staff)	
Emergency Manager	FT (Staff)	
Community Planner	FT (Staff)	
Civil Engineer	FT (Staff)	
GIS Coordinator	FT (Staff)	
Resource Development Staff or Grant Writers	FT (Staff)	
Public Information Officer	FT (Staff)	
<b>Technical</b>		
Staff with knowledge of land development and land management practices	FT (Staff)	Institutional knowledge in DPW, Conservation Commission, Fire, Capital Projects and Facilities Management, and Planning.
Staff trained in construction practices related to buildings and/or infrastructure	FT (Staff)	Institutional knowledge in DPW, Conservation Commission, Fire, Capital Projects and Facilities Management, and Planning.
Staff with an understanding of natural hazards and risk mitigation	FT (Staff)	Institutional knowledge in DPW, Conservation Commission, Fire, Capital Projects and Facilities Management, and Planning.

City of Framingham, MA Hazard Mitigation Plan Update

Administrative/Technical Resource	Full-time (FT) / Part-time (PT) / Volunteer (V)	General Description and Effectiveness for Hazard Risk Reduction
Hazards data and information	FT (Staff)	Institutional knowledge in DPW, Conservation Commission, Fire, Capital Projects and Facilities Management, and Planning. The utilization of tools such as GIS and other internal tracking methods helps the City manage hazards.
Warning systems/services (e.g., Reverse 911, outdoor warning signals, etc.)	FT (Staff)	Institutional knowledge in Police and Fire.

Financial Capabilities

Table 30 is based off Worksheet 4.1 from FEMA’s *Local Mitigation Planning Handbook*. It was used by the HMWG to identify the City’s eligibility and access to funding sources that can be used to support the implementation of hazard mitigation projects.

Table 30. Financial Findings

Financial Tool/Source	Accessible for Hazard Mitigation (Yes/No)	General Description and Effectiveness for Hazard Risk Reduction
General funds	Yes	Not done historically but possible in the future.
Capital Improvement Program (CIP) funding	Yes	Effective: Walnut Street Neighborhood Improvements can be seen as an example.
Special purpose taxes	No	N/A
Fees for water, sewer, gas, or electric services	Yes	N/A
Stormwater utility fee	No	The City has evaluated the feasibility of implementing a stormwater utility to provide sustainable stormwater management and funding, but this is currently not considered a near-term option (deferred for possible future implementation).

City of Framingham, MA Hazard Mitigation Plan Update

Financial Tool/Source	Accessible for Hazard Mitigation (Yes/No)	General Description and Effectiveness for Hazard Risk Reduction
Development impact fees	Yes	Primarily for large residential projects.
Incur debt through general obligation bonds and/or special tax bonds	Yes	Possible use for funding.
Incur debt through private activities	No	N/A
FEMA Hazard Mitigation Assistance (HMA)	Yes	Effective: The City has received HMA funds in the past for hazard mitigation activities and will continue to pursue. Completed projects include the A Street / Concord Street Culvert Upgrades (HMGP 4214) and the Walnut Street Flood Mitigation Study (FMA 18).
HUD Community Development Block Grant (CDBG)	Yes	Not done historically for hazard mitigation-focused projects but possible in the future.
Other federal funding programs	Yes	Effective: Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), and other federal agencies do make grant funding available for a variety of resilience-themed projects and initiatives that the City may be eligible to pursue in the future.
State funding programs	Yes	Effective: The City has received state funding for hazard mitigation activities in the past and will continue to pursue. The Commonwealth makes a variety of funding programs available on a routine basis to support local risk reduction projects. Some of the most applicable opportunities for the City include MVP Action Grants and other annual grant programs through MA Executive Office of Energy and Environmental Affairs (EEA), such as the Culvert Replacement Municipal Assistance Grant Program.

# City of Framingham, MA Hazard Mitigation Plan Update

## Education and Outreach Capabilities

Table 31 is based off Worksheet 4.1 from FEMA’s *Local Mitigation Planning Handbook*. It was used by the HMWG to identify education and outreach programs that can be used to support mitigation activities.

Table 31. Education and Outreach Findings

Program/Method	Yes/No	Description and Effectiveness for Hazard Risk Reduction
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Yes	Effective: Local sustainability organizations such as Energize Framingham, Keep Framingham Beautiful, and Mass Audubon.
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Yes	<p>Effective: The City sponsors a variety of school and community education outreach programs. DPW does a great job with this for information tailored for the public. A recent example is the flood gate mural completed this past year to increase awareness of the flood gate on Concord St (part of levee system). The City has also posted a “Framingham Flood Facts” brochure to its website that includes helpful information for the public to know before and during/following flood events.</p> <p>Additionally, multiple community engagement programs are underway regarding energy efficiency, resilience, and climate change to improve the capacity of municipal officials to support residents and directly benefit local residents.</p> <p>Framingham has resources available in multiple languages, including a multi-lingual City website, radio offerings in several languages, and translation capability available in the Mayor’s Office.</p>

City of Framingham, MA Hazard Mitigation Plan Update

Program/Method	Yes/No	Description and Effectiveness for Hazard Risk Reduction
Natural disaster or safety-related school programs	Yes	Effective: Framingham Public Schools and the Framingham Public Schools Committee is attentive to the health and safety of student and faculty.
StormReady certification	No	N/A
Firewise USA® certification	No	N/A
Public-private partnership initiatives addressing disaster-related issues	No	N/A

National Flood Insurance Program (NFIP) Participation and Compliance

C2. Does the Plan address each jurisdiction’s participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))

As summarized in Table 32, the HMWG used Worksheet 4.3 from FEMA’s *Local Mitigation Planning Handbook* to collect information regarding the City’s participation in and compliance with the NFIP. This worksheet, in addition to a separate *NFIP Survey* for the City’s Community Floodplain Administrator, helped the HMWG to identify areas for improvement and other ideas that could be potential mitigation actions. These actions, including those related to continued compliance with NFIP requirements, are identified and further discussed in Chapter 6 (Mitigation Strategy).

Table 32. NFIP Summary.

NFIP Topic	Source of Information	Comments
<b>Insurance Summary</b>		
How many NFIP policies are in the community? What is the total premium and coverage?	State NFIP Coordinator, FEMA (PIVOT)	As of May 6, 2022, a total of 556 NFIP policies are in force. The total premium is \$426,620 for a total of \$106,462,900 in coverage.
How many claims have been paid in the community?	State NFIP Coordinator,	There has been a total of 214 claims paid since 1978, totaling \$1,681,569 in losses. There has been one paid claim for substantial damage.

City of Framingham, MA Hazard Mitigation Plan Update

NFIP Topic	Source of Information	Comments
What is the total amount of paid claims? How many of the claims were for substantial damage?	FEMA (PIVOT, CIS)	
How many structures are exposed to flood risk within the community?	GIS analysis (FEMA FIRMs + building footprint data)	It has been estimated that 514 structures are at risk to the 1-percent annual chance flood, and 1,112 are at risk to the 0.2 percent annual chance flood for a combined total of 1,626 structures exposed to flood risk.
Describe any areas of flood risk with limited NFIP policy coverage	HMWG	No address-specific data has been made available by FEMA, but it is generally assumed that owners of property located in special flood hazard areas are underinsured when it comes to flood insurance coverage (based on only 556 current policies under the NFIP in comparison to more than 1,500 structures estimated to be exposed to moderate to high flood risk). City staff also noted that they often hear from property owners that they are “dropping” their flood insurance coverage when not required by mortgage lender (mostly because of perception it’s not worth keeping based on premiums vs. risk). Renters in flood hazard areas is another particular concern for the City.
<b>Staff Resources</b>		
Is the Community FPA or NFIP Coordinator certified?	Community FPA	No
Is floodplain management an auxiliary function?	Community FPA	Yes, for the Senior Stormwater and Environmental Engineer (by default)
Provide an explanation of NFIP administration services (e.g., permit review, GIS, education or outreach, inspections,	Community FPA	Plan reviews are conducted with input from various City Departments (Planning Board, Conservation, DPW, etc.); various education and outreach activities are implemented on a routine basis (including the provision of floodplain

City of Framingham, MA Hazard Mitigation Plan Update

NFIP Topic	Source of Information	Comments
engineering capability)		mapping and insurance information, etc.). Updated information is routinely posted to the City’s Stormwater website. Code Enforcement and utility inspections provided by City Departments (Building & DPW).
What are the barriers to running an effective NFIP program in the community, if any?	Community FPA	Staffing and budget.  Departmental coordination and enforcement.
<b>Compliance History</b>		
Is the community in good standing with the NFIP?	State NFIP Coordinator, FEMA	Yes
Are there any outstanding compliance issues (i.e., current violations)?	State NFIP Coordinator, FEMA	No
When was the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC)?	State NFIP Coordinator, FEMA (CIS)	Last CAC was 09/24/1993  Last CAV was 01/30/2020
Is a CAV or CAC scheduled or needed?	Community FPA	No
<b>Regulation</b>		
When did the community enter the NFIP?	State NFIP Coordinator, FEMA (CIS)	08/02/1974 (Emergency Entry)  02/03/1982 (Regular Entry)
Are the FIRMs digital or paper?	Community FPA	Digital (updated as of July 7, 2014)
Do floodplain development regulations meet or exceed FEMA or State minimum	Community FPA	Floodplain regulations are met by the Conservation Commission and Zoning Bylaws, which meet all current FEMA/NFIP requirements and State minimum requirements. These

City of Framingham, MA Hazard Mitigation Plan Update

NFIP Topic	Source of Information	Comments
requirements? If so, in what ways?		regulations will be routinely updated as necessary to maintain compliance with existing NFIP and State minimum standards for floodplain management.
Provide an explanation of the permitting process.	Community FPA, community records	As stated above, most activities are regulated through various local permitting procedures that involve multiple departments and commissions. The most significant factors are building location and loss of flood storage. These local regulations must meet NFIP and State minimum requirements as enforced through the City zoning bylaws, building codes, wetlands protection regulations, etc.). For more details see Framingham By-Law Section III (Overlay Districts, Floodplain districts, Section 3. Application procedures).
<b>Community Rating System (CRS)</b>		
Does the community participate in CRS?	Community FPA	No, however the City will continue to explore the benefits of CRS participation as Risk Rating 2.0 goes into effect and as updates to the CRS program are made by FEMA.
What is the community’s CRS Class Ranking?	N/A	N/A
What categories and activities provide CRS points and how can the class be improved?	N/A	N/A
Does the plan include CRS planning requirements	Yes	Yes, many of the planning requirements under CRS Activity 510 are included in the plan but will not be evaluated or scored for credit until the City decides to apply for CRS participation.

Table 33 provides some additional information in response to the updated requirements included in FEMA’s 2022 Local Mitigation Planning Policy Guide:<sup>52</sup>

<sup>52</sup> Local Mitigation Planning Policy Guide. FEMA. April 2022. P. 26.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 33. Additional NFIP Participation and Compliance Information

Required Information	Response
Adoption of NFIP minimum floodplain management criteria via local regulation.	City of Framingham Zoning By-Law  Section III. Overlay Districts, Section A Floodplain Districts. Adopted at Annual Town Meeting on April 29, 2014. §III.H. Floodplain Districts (edited), approved under Article 44, Zoning By-Law.
Adoption of the latest effective Flood Insurance Rate Map (FIRM), if applicable.	Same as above (2014).
Implementation and enforcement of local floodplain management regulations to regulate and permit development in SFHAs.	See explanation of the City’s permitting process provided in Table 27.
Appointment of a designee or agency to implement the addressed commitments and requirements of the NFIP.	The City has not formally appointed a designee or agency but will consider doing so upon adopting the MA 2020 State Model Floodplain Bylaw.
Description of how participants implement the substantial improvement/substantial damage provisions of their floodplain management regulations after an event.	The City implements the SI/SD provisions of its floodplain management regulations as required per the NFIP (CFR Title 44, Parts 59 thru 65) and Massachusetts State Building Code (780 CMR). The City will also coordinate with State Flood Hazard Management Program to assure that proper practices are followed and that a post-disaster plan will be in place to implement all SI/SD provisions.

## Conclusions

As exemplified by previous hazard mitigation, climate adaptation, and similar sustainability plans and initiatives, the City of Framingham is capable and committed building a resilient community in the face of increasing hazards and climate change. While some challenges remain, especially with regard to available funding and staffing for action implementation, several City departments have pursued and successfully implemented a variety of mitigation projects and activities that address multiple hazards. This includes a variety of planning and regulatory initiatives (i.e., MVP planning, enhanced regulations for wetlands protection and stormwater management, prioritizing open space/property acquisition for

## City of Framingham, MA Hazard Mitigation Plan Update

flood storage, etc.) as well as the City's success with grant applications and its own investment in resilience-themed projects.

Although Framingham is well-positioned to mitigate the natural hazard risks faced by the community, the City can expand and improve on the capabilities described in this chapter. Specific opportunities to address existing gaps or limitations in local capabilities to reduce risk have been identified for each capability type and are further described below. Each of these opportunities were then considered by the HMWG during the plan update process as potential new mitigation actions to be included in the Mitigation Strategy.

### **Opportunities to Expand and Improve on Capabilities to Reduce Risk**

#### **Planning and Regulatory Capabilities**

- Integrate plans (HMP, MVP, and other resilience-themed plans/reports) into a consolidated document, website, etc. This includes integrating future iterations of its MVP plans and reports (for example, under EEA's rollout of MVP Planning 2.0) into this Hazard Mitigation Plan through amendments or revisions that can occur before the next 5-year plan update.
- Conduct a detailed assessment of all relevant regulations and the City's permit review process to identify improvements to better address natural hazards, climate change, and projected future conditions (i.e., extreme heat, heavy downpour events, etc.). This includes the incorporation of Nature-based Solutions (NbS) into existing City ordinances where most appropriate.
- Review and update the existing Land Disturbance and Stormwater Management (LDSM) Ordinance to provide better protection for new development in areas of steep slopes, especially in the city's northwest quadrant.
- Evaluate the potential need and feasibility of updating the City's existing regulatory Floodplain District to incorporate projected future conditions (taking into account increased frequency and severity of heavy precipitation events, future land use/development trends, etc.).
- Increase the integration of hazard mitigation and climate resiliency into the City's existing CIP planning and project lists. Examples include (1) making resilience a key objective for the City's strategic, operational, and fiscal policies for municipal infrastructure and asset management; and (2) developing methods to help ensure the City limit expenditures on projects or infrastructure improvements that would encourage development and/or redevelopment in areas vulnerable to natural hazards. These measures should be promoted and administered by the City's Finance Division and across those City departments that develop and update their own CIP plans and projects lists for public facilities (i.e., Capital Projects and Facilities Management Department, DPW, Framingham Public Schools / Department of Buildings and Grounds, etc.).
- Be opportunistic with incorporating hazard mitigation and resilience into the City's economic development strategies and policies (draft plan update underway).

## City of Framingham, MA Hazard Mitigation Plan Update

- Research opportunities for the City to provide additional incentives for new development that is located outside of protective ecosystems or areas identified as at high risk to natural hazards.

### **Administrative and Technical Capabilities**

- Develop systems or practices that can help the City to better cope with staff turnover or other disruptions to routine government functions and duties that support risk reduction.
- Enhance communication and coordination between Administration (City Council, Office of the Mayor) and Departments.
- Develop central tracking system to facilitate improved coordination between departments on pre-disaster mitigation/resiliency-themed projects or routine maintenance activities, as well as emergency preparedness and response operations.
- Consolidate the City's various dispatch centers (EM, DPW, etc.) under one umbrella/organization to improve response and coordination between departments.
- Hire additional personnel and equipment as needed for maintenance of municipal stormwater drainage system, public water bodies, hazard trees, fire hazards (mulch/peat piles), etc.
- Continue with the Installation of additional stream gauges to help the City continually monitor and respond to real-time rainfall and rising surface water levels along local rivers and brooks. Explore the potential to expand this system into automated public warning and emergency notification systems.

### **Financial Capabilities**

- Maximize opportunities through the City's CIP process to help fund priority hazard mitigation and climate adaptation projects, particularly when combined with alternative/external grant funding sources when a local cost-share increases the City's chances for a grant award.
- Continue to coordinate with neighboring Metro West communities as it relates to positioning the City to pursue and capture future grant funding for regional hazard risk reduction projects. This is particularly true for federal mitigation grants available through FEMA's HMA grant programs (BRIC, HMGP, FMA) as well as MVP Action Grants through the Massachusetts MVP program.

### **Education and Outreach Capabilities**

- Conduct general and targeted outreach to owners and renters of properties located in special flood hazard areas to promote the availability of flood insurance. Emphasis should be placed on the relative affordability of renter's flood insurance policies given the high number of flood-prone structures in the city that are not owner-occupied. Existing resources from FEMA should be leveraged for conducting targeted outreach to renters, including social media postings, downloadable brochures, and other helpful materials (available at FloodSmart.gov).

## City of Framingham, MA Hazard Mitigation Plan Update

- Expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
- Increase use of the City’s website to support low-cost public education and outreach initiatives on building community resilience to hazards as well as individual mitigation actions for homeowners, business owners, etc.
- Leverage the use of the City’s Citizen Participation Officer position, additional support staff from across City Departments, and available outside resources to translate outreach materials into Spanish and Portuguese for all mitigation-themed outreach initiatives.
- Continue to address misinformation relating to the City’s drainage system through more focused public education and awareness initiatives (for example, building off DPW’s “Help Preserve Framingham Stormwater” video).
- Educate property owners about how to mitigate risk to their properties such as installing backflow valves, removing debris, and other low-cost and/or Do-It-Yourself projects for risk reduction.

### **Possible New Actions Related to NFIP Participation and Compliance**

- Identify team or specific staff position to be the Floodplain Administrator within the Planning, Conservation, and Community Development Department. This will ease coordination of bylaw enforcement.
- In coordination with the above, employ broader staffing to assist with NFIP participation and compliance. This includes designating departments/positions with specific NFIP-related roles and responsibilities, linking those staff with proper training and educational opportunities.
- Adopt the 2020 MA State Model Floodplain Bylaw to assure that the City’s current floodplain management regulations (Zoning Ordinances, Section 3, Overlay Districts)) contain the necessary and proper language for compliance with the NFIP and state requirements.
- Evaluate and consider the adoption of “higher standards” that are proven to reduce flood damage.
- To assist with implementing substantial damage provisions of the NFIP, develop a local post-disaster substantial damage plan in coordination with the State Flood Hazard Management Program and the *Massachusetts Local Guidance for NFIP Substantial Damage Planning*.
- Prohibit Special Permits for building in floodplain and make them only possible through a variance. Require certain thresholds for building in Floodplain with ZBA rather than leave basis up to Conservation Commission (example would be a ZBA project for Grattan Street).
- Evaluate permit application forms to determine possible modifications focused on flood hazard prevention.

## City of Framingham, MA Hazard Mitigation Plan Update

- Develop a checklist for review of building/development permit plans and for inspection of development in floodplains.
- Establish a goal to have each plan reviewer and building inspector attend a related training periodically (for example, ASFPM's Annual National Conference, chapter conferences, webinars, etc.).
- Maintain a map of areas that flood frequently (e.g., areas where repetitive loss properties are located) and prioritize those areas for inspection immediately after the next flood. If outside FEMA special flood hazard areas, consider requiring existing NFIP regulatory standards (compliance with existing ordinance) through overlay zoning, etc.
- Conduct a review of other regulatory programs and planning tools, such as the comprehensive plan and zoning ordinance, and report on opportunities to improve consistency with the objectives of floodplain management.

## Chapter 6. Mitigation Strategy

The hazard mitigation strategy is the culmination of work presented in the planning area profile, risk assessment and capability assessment. It is also the result of multiple meetings and thorough public outreach. The work of the HMWG was essential in developing the mitigation goals and actions included in this chapter. As described in Chapter 3 Planning Process, the HMWG worked in a consistent, coordinated manner to identify and prioritize the goals and mitigation actions for this Plan.

### Mitigation Goals

C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards?  
(Requirement §201.6(c)(3)(i))

Mitigation goals represent broad statements that are achieved through the implementation of more specific mitigation actions. These actions include both hazard mitigation policies (such as land use regulations) and hazard mitigation projects (such as structure or infrastructure projects). To develop goals for this City of Framingham, MA Hazard Mitigation Plan Update the HMWG reviewed the previous plan’s goal statements, the Municipal Vulnerability Preparedness (MVP) plan goal statements, and the goals of the State’s Hazard Mitigation and Climate Adaptation Plan.

The HMWG revised the 2017 City of Framingham Multi-Hazard Mitigation Plan goal statement and objectives. The goal statement was revised to include climate change and the objectives were revised to accurately reflect the ways the HMWG intends to implement the goal. The comparison of each is shown in the figures below.

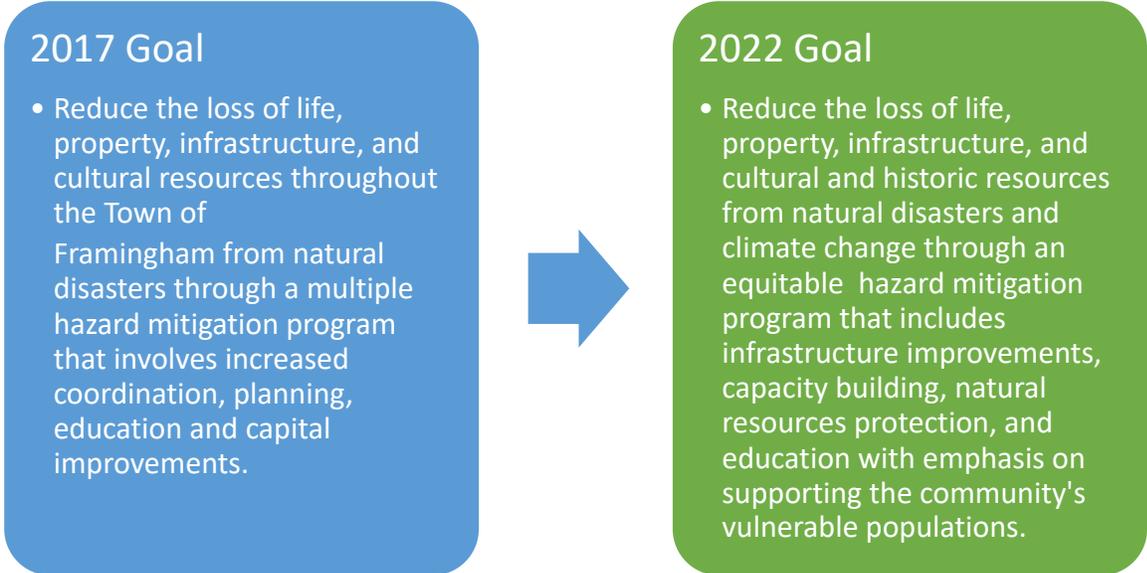


Figure 20. Goal Statement Comparison Between 2017 and 2022.

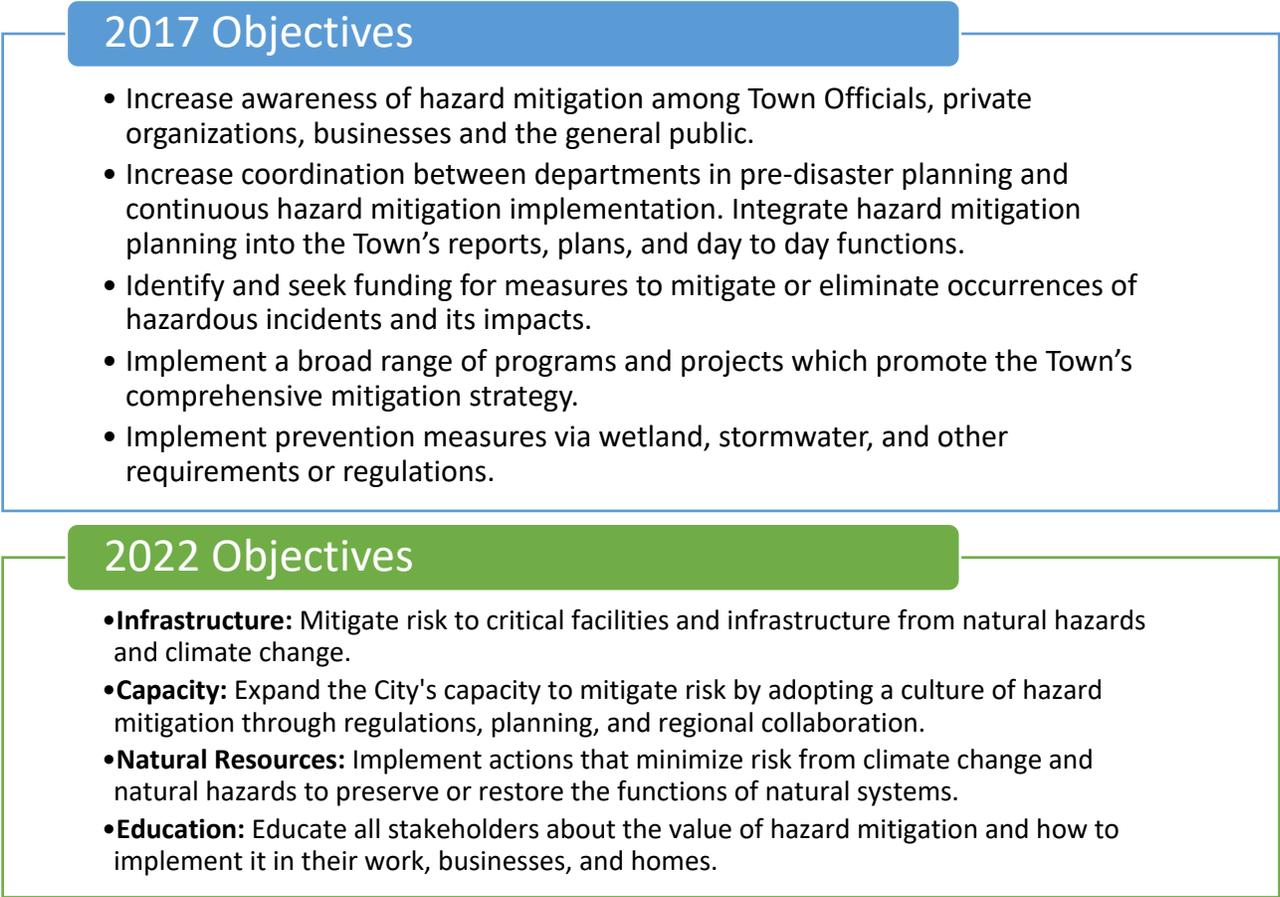


Figure 21. Objectives Comparison Between 2017 and 2022.

# City of Framingham, MA Hazard Mitigation Plan Update

The HMWG believes that four main areas of action listed in the goal and objective statements represent the approach necessary to mitigate natural hazard risk in the City of Framingham. All the hazards identified in this plan, while not named specifically in the goal or objectives, are implied and many are named specifically in the mitigation actions. When achieved by way of implementing the mitigation actions identified in this plan, the City will mitigate risk posed by all identified hazards.

The 2017 Town of Framingham Multi-Hazard Mitigation Plan included forty-five mitigation actions. For the purposes of this plan, all the actions were reviewed for their status and relevance. The following table shows the previous plan’s forty-five mitigation actions and the status of each. In addition to their status, if an action was moved forward to this plan the final column indicates the title of the new action.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 34. Status of Previous Mitigation Actions.

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
1	Evaluate current bylaws and regulations regarding floodplain development to ensure they are consistent and updated	Delayed	Due to limited staff capacity, this action has not progressed, however, this action remains a priority.	YES - updated/ revised description provided at right, if applicable	Renamed to "Evaluate and enhance current ordinances and regulations regarding floodplain development."
2	Purchase & install 4 automated weather stations	In Progress	This action has not been implemented due to a lack of funding, however, has been identified as supporting an important capability for the City.	YES - updated/ revised description provided at right, if applicable	Integrated into: "Purchase & install automated weather stations."
3	Integrate flood storage review into open space plan	In Progress	This action is identified in the 2020 OSRP but the OSRP has not been finalized at this time due to staffing constraints and high staff turnover.	YES - updated/ revised description provided at right, if applicable	Action carried directly into HMP Update.
4	Install additional stream gauges	In Progress	Ongoing as funding allows. The City has recently acquired new stream gauges. The selected locations have been revised. DPW replaced four existing stream gauges in July 2018 with upgraded technology with web portal.	YES - updated/ revised description provided at right, if applicable	Integrated into: "Purchase & install automated weather stations and additional pavement sensors."

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
5	Enhance current bylaws and regulations to prevent future development in the floodplain	In Progress	Due to limited staff capacity, this action has not progressed, however, this action remains a priority.	YES - updated/revised description provided at right, if applicable	Action carried directly into HMP Update.
6	Install additional pavement sensors	In Progress	DPW has installed additional sensors.	NO - explanation provided at left	Removed.
7	Develop stormwater bylaw & regulations	Completed	Action is complete; however, the City is exploring further improvements.	NO - explanation provided at left	Completed, not incorporated into update.
8	Develop green infrastructure bylaw & regulations	Completed	This is complete: current regulations were reviewed by VHB and Mass Audubon and subsequent bylaws have been updated (Subdivision Rules and Regs, Zoning Bylaw, etc.)	NO - explanation provided at left	Completed, not incorporated into update.
9	Emergency generators for traffic signals	Delayed	There are no updated regarding this measure.	YES - updated/revised description provided at right, if applicable	Carried directly into HMP Update.
10	Conduct a Climate Change Vulnerability Assessment	Completed, Additional Progress Underway	City was awarded funding under the MVP Program in 2018 and worked with Fuss & O’Neill to conduct a community resilience building workshop to	YES - updated/revised description provided at right, if applicable	Integrated into "Integrate relevant hazard mitigation plan priorities and actions into the City's forthcoming Climate Action Plan."

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
			assess the community’s vulnerabilities to climate change. The City is expanding on these efforts with the development of the Climate Action Plan.		
11	Culvert replacement at CSX crossing of Hop Brook	In Progress	DPW secured \$150K DER grant funding to study the replacement of the City-owned Colonial Drive culvert which is the last culvert downstream of the CSX culverts and will need to be upgraded before the CSX culverts can be upgraded.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Acquire the CSX Corridor and implement next steps to develop the Bruce Freeman Rail Trail."</i>
12	Prepare, adopt, implement, and update a comprehensive flood hazard mitigation plan	Delayed	Due to limited staff capacity, this action has not progressed, however, this action remains a priority.	YES - updated/ revised description provided at right, if applicable	Action carried directly into HMP Update.
13	Complete Stormwater Master Plan Phase IV	Delayed	Rather than Phase IV and V, there is a request for a Comprehensive Stormwater Master Plan that would incorporate Phases IV and V but also revisit Phases I-III for a comprehensive assessment of current conditions and recommended	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Develop a Comprehensive Stormwater Master Plan"</i> .

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
			actions/projects. The request for the Comprehensive Stormwater Master Plan has been deferred due to limited funding.		
14	Complete Stormwater Master Plan Phase V	Delayed	Rather than Phase IV and V, there is a request for a Comprehensive Stormwater Master Plan that would incorporate Phases IV and V but also revisit Phases I-III for a comprehensive assessment of current conditions and recommended actions/projects. The request for the Comprehensive Stormwater Master Plan has been deferred due to limited funding.	YES - updated/revised description provided at right, if applicable	Integrated into: <i>"Develop a Comprehensive Stormwater Master Plan"</i> .
15	Develop green infrastructure marketing/education program to business community	In Progress	This action is ongoing and requires additional funding and support.	YES - updated/revised description provided at right, if applicable	Integrated into HMP Update: <i>"Develop and implement a municipal program to promote the use of green infrastructure throughout the community."</i>
42	PILOT NEIGHBORHOOD PROJECT: Acquisition and Relocation or	In Progress	In August 2021, the City of Framingham received a \$269,030 Municipal Vulnerability	YES - updated/revised description provided at	Integrated into: <i>"Protect or acquire private property impacted by flooding in</i>

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
	flood protection of private properties with repetitive loss in Walnut Street neighborhood		Preparedness (MVP) Action Grant from the Baker-Polito Administration to support the project. In February 2020, the City received a \$206,850 MVP Action Grant from the Baker-Polito Administration to support the project.	right, if applicable	<i>repetitive loss neighborhoods</i> ".
<b>OTHER MITIGATION MEASURES FROM 2017 LIST (BUT NOT PRIORITIES, AND NOT PART OF 2017 ACTION PLAN):</b>					
16	Construct Walnut Street Sewer Pump Station	In Progress	The Walnut St. Pump Station construction was to replace the Worcester R. Pump Station. After analysis on constructing the Walnut St. Pump Station it was determined the more cost-effective approach was to rehabilitate the existing Worcester Rd. Pump Station in its existing location. The design is complete, and that project is scheduled to be put out to bid for construction.	YES - updated/revised description provided at right, if applicable	Integrated into: <i>"Complete rehabilitation of the Worcester Road Sewer Pump Station."</i>
17	Nobscott Fire Station Area Drainage Improvements	In Progress	Drainage improvements are in the process of being implemented as part of local development of the Nobscott Plaza. DPW also previously	YES - updated/revised description provided at right, if applicable	Integrated into: <i>"Implement drainage improvements to support transportation networks and associated properties."</i>

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
			made improvements to stormwater infrastructure for Fire Station #7.		
18	Web-based Public Portal for Stream Gauge Data	In Progress	DPW replaced four existing stream gauges in July 2018 with upgraded technology with web portal.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Install additional stream gauges and web-based public portal for stream gauge data."</i>
19	School Street Bridge Replacement	Delayed	Framingham anticipating pursuing grant funding for this measure. Currently highest priority bridge replacement project.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Replace the School Street, Taralli Terrace, and Second Street Bridges."</i>
20	CRS Program Assessment	Delayed	The City is not currently listed as a participating community in the CRS Program.	NO - explanation provided at left	Removed: lacking capacity to implement.
21	Fountain Street Drainage Improvement	In Progress	Comprehensive improvements to the Fountain Street intersection are underway. This project includes drainage improvements that will benefit the water quality of Farm Pond. Easement acquisitions will take place this year, along with utility pole installation and overhead wire transfers. Funding sources for the final	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Implement drainage improvements to support transportation networks and associated properties."</i>

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
			design and construction are being reviewed.		
22	Expand rain barrel program	Delayed	Rain barrel program was cancelled during the pandemic.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Reimplement residential rain barrel program."</i>
23	Taralli Terrace Bridge replacement	In Progress	Evaluation of bridge on CIP for 2025 request.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Replace the School Street, Taralli Terrace, and Second Street Bridges."</i>
24	Second Street Bridge replacement	In Progress	Evaluation of bridge on CIP for 2025 request.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Replace the School Street, Taralli Terrace, and Second Street Bridges."</i>
25	Replace Farm Pond outfall	Delayed	To be completed as part of <i>Fountain Street Drainage Improvement</i> .	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Implement drainage improvements to support transportation networks and associated properties."</i>
26	Culvert retrofit at Fuller School pedestrian path	Delayed	Stormwater improvements related to new school have significantly reduced impervious surface area in the neighborhood (a reduction of about 1/4 impervious surface). Several culvert retrofits included under this	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Retrofit, update, or replace undersized and unsafe culverts."</i>

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
			work and areas behind Fuller School with underground chambers for stormwater management. Drainage improvements at the site may have alleviated the issues here. Challenges with sewer infrastructure may complicate this project. Culvert and trench need to be evaluated for retrofit.		
27	Emergency generators for general store	Removed	Any progress that has been made has been community-driven as there is no municipal program to support this effort currently.	NO - explanation provided at left	Removed; organized through community.
28	Woodfield Playground infiltration system	Delayed	May be indirectly supported by prospective restoration work done as part of Rail Trail acquisition.	YES - updated/revised description provided at right, if applicable	Covered by: <i>"Acquire the CSX Corridor and implement next steps to develop the Bruce Freeman Rail Trail."</i>
29	Install green infrastructure in the vicinity of Butterworth Park	Delayed	No action has been taken on this measure.	YES - updated/revised description provided at right, if applicable	Integrated into: <i>"Deploy green infrastructure on municipal properties to improve stormwater management and reduce heat island impacts."</i>

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
30	Develop hazard mitigation incentive program	Delayed	No action has been taken on this measure.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Explore the development of a Hazard Mitigation Incentive Program."</i>
31	Constructed wetlands or wetlands restoration project	In Progress	City is pursuing conditions assessment and potential wetlands restoration to improve water quality at a Lake Waushakum outfall.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Protect and restore wetland areas, including around Lake Waushakum."</i>
32	Flood Protection of private property with flood loss in the Hemenway neighborhood	Delayed	Would be supported by MVP action regarding the removal of the Landham Pond Dam which is tied to acquisition of the rail trail property.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Protect or acquire private property impacted by flooding in repetitive loss neighborhoods."</i>
33	Flood Protection of private property with repetitive loss in the Auburn Street neighborhood	In Progress	In order to mitigate this problem, the City installed two backflow preventers, a component of which is a "duckbill" style check valve. 3 out of 4 duckbill devices were allowed for installation.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Protect or acquire private property impacted by flooding in repetitive loss neighborhoods."</i>
34	Flood Protection of private property with repetitive loss in the Circle Drive neighborhood	Delayed	Action has not been implemented.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Protect or acquire private property impacted by flooding in repetitive loss neighborhoods."</i>

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
35	Flood Protection of private property with repetitive loss in the Prescott St neighborhood	Delayed	Action has not been implemented.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Protect or acquire private property impacted by flooding in repetitive loss neighborhoods."</i>
36	Develop and implement a residential rain garden program	Delayed	No update currently, however, Framingham is participating in an MVP Project titled the Sudbury-Assabet-Concord Natural Climate Solutions Grant that may support nature-based solution projects.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Develop and implement a municipal program to promote the use of green infrastructure throughout the community"</i> .
37	Charlotte Dunning School green infrastructure	Completed	As part of parking lot project, the schools added a new drainage swale and catch basin.	NO - explanation provided at left	Completed, not incorporated into update.
38	Edmands Road culvert upgrade	In Progress	An emergency repair to the culvert was completed in 2021. Nobscott Intersection Project currently in progress with construction underway as of March.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Retrofit, update, or replace undersized and unsafe culverts."</i>
39	Install beaver deceivers near pedestrian bridge near high school	Delayed	No action taken.	NO - explanation provided at left	Removed; a more comprehensive exploration of solutions will be made through the development of a <i>Beaver Management Plan</i> .

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
40	Flood Protection of Town Buildings	In Progress	<p>Flood proofing has been done for facilities such as the Callahan Senior Center. Stormwater improvements have been implemented at Fire Station #7, but the facility is still vulnerable to flooding necessitating the use of sandbags near the entrance to the basement. Improvements to Station #7 have improved the situation, but the site is still vulnerable to severe storms. McCarthy experiences flooding from groundwater and the school has several sump pumps and a perimeter drainage system. Worcester Road Pumping Station rehabilitation will provide additional resiliency.</p>	YES - updated/ revised description provided at right, if applicable	Integrated in: <i>"Implement drainage improvements to support transportation networks and associated properties."</i>
41	Acquisition and Relocation or flood protection of private properties with repetitive loss in Beaver Dam Brook neighborhood	In Progress	See Action to Acquire 103 Guild Street Property. Also, 350 Irving Street project will result in dredging in Beaver Dam Brook that will alleviate flooding. City is pursuing	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Protect or acquire private property impacted by flooding in repetitive loss neighborhoods."</i>

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Action Title	Current Status	Status Description / Explanation	Incorporated into HMP Update?	Updated Action Title/Description (if applicable)
			opportunities through this to restore the floodplain.		
43	Rehabilitate flood control berm at Callahan Senior Center	Completed	Related work has been done in the Callahan Senior Center basement as of 2019 to mitigate flooding. The floor has been raised more than a foot to mitigate flooding issues.	NO - explanation provided at left	Removed: A flooding mitigation project in the basement of the Callahan Senior Center has been completed.
44	Acquisition and Relocation or flood protection of private properties with repetitive loss in Auburn Street neighborhood	Delayed	No update regarding this action.	YES - updated/ revised description provided at right, if applicable	Integrated into: <i>"Protect or acquire private property impacted by flooding in repetitive loss neighborhoods."</i>
45	Relocation of Town Buildings out of floodplain	Removed	Not feasible to implement, City will not pursue due to cost and space constraints.	NO - explanation provided at left	Removed.

# City of Framingham, MA Hazard Mitigation Plan Update

The City’s Municipal Vulnerability Preparedness (MVP) plan, titled the Community Resilience Building Workshop Summary of Findings, was developed in May 2019, and includes forty-two suggested actions. The MVP is part of a Massachusetts state-wide initiative through the Executive Office of Energy and Environmental Affairs (EEA) to provide support to cities and towns to plan for resiliency and implement climate change adaptation actions. The actions identified in Framingham’s MVP were reviewed and considered when developing mitigation actions for this plan update. Below is the status of each of the MVP actions as of the Fall of 2022. These recommendations are sorted by priority.

## City of Framingham, MA Hazard Mitigation Plan Update

Table 35. Status of MVP Recommendations.

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
	<b>Highest Priority</b>			
1	Conduct a field inventory of culverts and bridges to rank and prioritize projects for increased flooding resiliency and storm-hardening, followed by design and implementation of priority resizing or replacement projects. Green infrastructure, Low-Impact Design, and other nature-based solutions will be integrated with hard-infrastructure improvements to establish approaches that will be robust in the face of natural hazards and climate-change scenarios. Priority areas include the Route 9/126 intersection, the CSX culvert near Landham Pond Dam, and the Singletary Lane culvert.	Complete	Culvert assessment report has been completed.	Completed.
2	Conduct a flooding study of the Walnut Street neighborhood to assess flooding impacts in more detail and identify potential flood mitigation projects. Note that flooding in the Walnut Street neighborhood is connected to Route 9/126 flooding, so a larger watershed approach may be appropriate to best address these related issues.	Complete	Study Complete. Design of stream restoration and school path improvements is nearly complete. Application submitted for MVP grant to construct.	Completed.
3	Acquire the CSX corridor and implement next steps to develop the Bruce Freeman Rail Trail at the site. Address problems related to historically undersized culverts and neighborhood flooding. Partner with the Town of Sudbury to develop acquisition and trail development plans through a regional approach.	In Progress	As of December 2, the City finalized its purchase of the CSX Corridor. Additional improvements will follow acquisition of the site.	Carried directly into HMP Update.

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
4	Assess flood-proofing measures and flood storage to prevent future flooding at critical facilities, including the Callahan Senior Center and Fire Station #7.	In Progress	Floodproofing measures have been installed across facilities over time. At least several municipal facilities, such as the Callahan Senior Center and Fire Station #7 still experience flooding issues. Additional improvements associated with development of the area surrounding Fire Station #7 are anticipated to result in stormwater infrastructure improvements that will provide additional flooding relief.	Carried directly into HMP Update.
5	Perform a risk assessment of vulnerable pump stations and establish priority actions for reducing potential flooding impacts, including consideration of nature-based solutions or green infrastructure approaches. Establish emergency back-up plans for the pump stations. Continue to implement improvements to reduce infiltration and inflow.	In Progress	Inflow and infiltration is continuously being improved year after year with our pipe lining plan through the City's sewer defects capital appropriation as well as in house operations maintenance and repairs. As far as back up plans regarding flooding, more progress can be made. The City has backup plans for power outages and pump and equipment failures.	Removed: Assessed by DPW on a regular basis as part of their core efforts.
6	Assess drainage infrastructure and drainage-driven road flooding and develop green infrastructure solutions for	In Progress	DPW has been implementing green infrastructure to mitigate flooding	Integrated into: " <i>Develop green infrastructure on</i>

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
	stormwater management to be used in tandem with improvements to the outdated and undersized stormwater system to reduce road flooding and problems with ice slicks that make roads dangerous or impassable during hazard events. Develop a list of specific priorities, assess feasibility and cost, rank priority projects in terms of climate resilience potential, and develop concept designs for key projects. For linear projects along the City's roadways, consider utilizing green infrastructure design resources developed for other parts of the region, such as the Rhode Island Department of Transportation's Linear Stormwater Manual, released in 2019.		issues as opportunities arise with other site improvement projects. The City is also coordinating with MassDOT on drainage improvements that they are doing on Route 9, anticipated to be complete in 2022.	<i>municipal properties to improve stormwater management and reduce heat island impacts."</i>
7	Implement recommendations from the feasibility study for removal of Landham Pond Dam, including purchase of the rail corridor and removal or rehabilitation of existing culverts.	In Progress	Contingent upon acquisition of rail trail.	Carried directly into HMP Update.
8	Evaluate satellite locations to supplement DPW operations center and salt storage in order to provide better support City-wide and reduce response times.	No Update	Discussions have been underway over time, but there are is no current decision to supplement the DPW operations center and salt storage.	Carried directly into HMP Update.
9	Implement plans to install air conditioning in Framingham schools that currently lack A/C, with the high school as the most immediate priority. Include any necessary upgrades to the electrical infrastructure to allow for the additional capacity required to run air conditioning systems. This will	In Progress	AC deployment at FHS has been completed. AC deployment across other schools is currently underway starting with McCarthy Elementary School. FPS is working on assessing	Integrated into: " <i>Utilize clean energy technologies to provide efficient heating and cooling capacity to</i>

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
	also expand the number of public buildings available for cooling stations.		and upgrading electrical capacity across facilities and installing temporary cooling equipment for buildings that do not currently have cooling. Energy efficient heat pump equipment that provides electric heating and cooling has been prioritized for these replacements.	<i>municipal facilities and schools. "</i>
10	Plan and post neighborhood and regional evacuation routes, with particular attention to the needs of homeless and elderly populations and Environmental Justice communities. Consider feasibility of installing second parking lot entrance/exit from Callahan Senior Center to allow use as a warming/cooling center, including whether proximity of the lot to the nearby bridge will allow for this improvement.	In Progress	<p>A second entrance/exit to the Callahan Senior Center cannot be added.</p> <p>An exercise was completed to evaluate risk to low-lying properties from potential dam failures (3-4 years ago). Route-9 improvements with the MA DOT will help ensure that a critical roadway for evacuation is available that might otherwise be cut off due to severe flooding.</p>	Integrated into: " <i>Plan and post neighborhood and regional evacuation routes.</i> "
11	Evaluate opportunities to provide emergency backup power to critical facilities, including feasibility of green power and battery storage. City-wide, there are a number of buildings and facilities (including substations, schools, Framingham Housing Authority properties, etc.) in need of backup power systems that could be tied to renewable or	In Progress	Energy resiliency studies have been completed at multiple municipal sites including City Hall, the Police Department Headquarters, A Street Pumping Station, Framingham High School, Fuller Middle School,	Integrated into: " <i>Evaluate and pursue opportunities to use clean energy technologies, such as microgrids, to provide</i>

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
	alternative energy sources to protect public buildings and infrastructure from freezing and improve services for residents who may lose power during emergencies or hazard events.		McCarthy Elementary School, FHA properties, and the Farley Building. City is exploring how to procure clean energy resiliency assets for municipal facilities in connection with this work.	<i>enhanced backup power to municipal facilities."</i>
12	Assess additional mosquito/pest control options, including increased stormwater BMP maintenance, integrated pest management approaches, determination of future risks due to increase in type and quantity of pests/disease vectors due to climate change, and continued development and implementation of education and outreach programs.	In Progress	Many efforts delayed due to COVID-19 pandemic, last municipal efforts from MVP report. However, updated mosquito and tick information is provided on the municipal website.	Carried directly into HMP Update.
13	Conduct a feasibility study to evaluate development of a stormwater utility.	Removed	Not currently under consideration.	Removed.
14	Identify vulnerable populations and foster an improved communications network in advance of a hazard event to facilitate communication efforts and outreach to those most in need of information and assistance. Evaluate feasibility of a combined Fire/Police/DPW dispatch. Utilize networks of existing groups to encourage communication efforts led by churches, schools, social groups, or City agencies. Focus should be on populations that may be more vulnerable to climate-induced risks, such as extreme temperatures, may lack appropriate shelter during increasingly intense storms, or that may be unprepared if stranded or cut off from supplies due to flooding or storm	In Progress	Stronger community engagement is currently moving forward through the Metro West Climate Equity project which is supporting the City in building stronger relationships with EJ neighborhoods in Framingham. It is anticipated that the outreach strategies through this project will help inform community engagement strategies through other municipal projects.	Integrated into: " <i>Foster an improved communications network to better reach vulnerable populations and those most in need of information and assistance."</i>

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
	<p>events. Residents of South Framingham were a particular concern with regard to potential language barriers and ability to access transportation resources during hazards. Determine which other communities and populations are most likely to be impacted by different hazards and assess specific translation needs for messaging. Develop a plan to overcome internal communication barriers within City departments and between the City and community partners or residents. Improve outreach and education efforts to ensure City residents, especially vulnerable populations, and residents for whom English is not a first language, can access accurate and up-to-date emergency information, shelters, heating and cooling centers, evacuation routes, provisions and services during emergencies. Identifying opportunities to improve the resiliency of our communications networks, such as with local cell towers, will improve the effectiveness of outreach efforts in emergency events.</p>		<p>Evaluation of combined dispatch is underway. Fire Department moving forward on planning, identifying potential location and design. The City is targeting the next couple of years to find property and begin constructing the new combined dispatch center which may be regional in nature.</p> <p>Within the Fire Department, efforts are underway to support residents with disabilities in emergencies and the Department has conducted training, supported by the City's ADA Coordinator. Training occurred several months ago. The City uses reverse 911 system, implemented approximately 3-4 years ago. Residents can sign up for email and text notifications.</p> <p>A new radio system has also been implemented for Police, Fire, and Emergency (went into operation last year). There are plans to improve system in terms of coverage area and communications</p>	

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
			resilience. Recent upgrades have already improved coverage area for radio communication significantly.	
15	<p>Improve the resiliency and passive survivability of local buildings and facilities through energy efficiency and adoption of clean energy. Implement renewable/alternative energy technologies and energy efficiency measures in new and existing facilities across the public and private sectors to assist in reducing the impacts of extreme temperatures encountered in heatwaves and freezing periods, minimizing the strain on electric grid and other fuel sources during such hazards, improving the reliability energy-using equipment, and mitigating the local contribution to climate change and the prevalence of associated impacts.</p>	In Progress	<p>This work is underway, supported through both municipal-focused and community-focused programs. Municipal energy efficiency projects (such as insulation and weatherization projects) through the Green Communities program have helped to reduce municipal energy consumption. Programs have been developed to offer residents and businesses opportunities to improve their efficiency and to adopt renewable energy (including the City's participation in the Mass Save Municipal Partnership Program and the MetroWest Solar + Clean Heat Challenge it completed). Solar has been installed at the McAuliffe Library and Brophy Elementary School, and solar + battery storage is being installed at the Fuller Middle School. Additional efforts in this area are in development.</p>	<p>Integrated into: <i>"Evaluate and pursue opportunities to use clean energy technologies, such as microgrids, to provide enhanced backup power to municipal facilities"</i> and <i>"Continue community engagement efforts to maximize the adoption of energy efficiency and clean energy technologies at new and existing buildings."</i></p>

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
	<b>Moderate Priority</b>			
17	Develop and implement plans for ecological restoration at Beaver Dam Brook.	In Progress	The City is coordinating with Eversource on its extensive remediation project at 350 Irving Street. The City is advocating for ecological and wetlands restoration to be done as part of this remediation work. Eversource will be removing contaminated sediments and in this process will be remediating some wetlands property.	Integrated into: " <i>Protect and restore wetland areas and water bodies.</i> "
18	Conduct a study of flooding along Beaver Dam Brook, focusing in particular on the Second Street and Taralli Terrace Bridge area.	In Progress	Previously incorporated in Phase I Stormwater Master Plan 2008. Planned to be updated as part of Comprehensive Stormwater Master Plan. Both bridges are also targeted for replacement as part of the long-range capital plan.	Integrated into " <i>Develop a Comprehensive Stormwater Master Plan.</i> "
19	Design and implement flood mitigation and drainage improvements in the Hemenway neighborhood.	In Progress	A major component of this work is contingent upon acquisition of the rail trail.	Integrated into: " <i>Protect or acquire private property impacted by flooding in repetitive loss neighborhoods.</i> "

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
20	Assess levels and sources of stream contaminants in floodplain areas. Build on knowledge of existing problem areas (e.g., 350 Irving and General Chemical) and locate other above- and below-ground sources with potential to contaminate floodwaters.	In Progress	DPW is performing catchment and drainage inspections to identify potential contaminants in an effort to improve stormwater quality and compliance with MS4 permitting. Eversource's remediation project at 350 Irving Street will also support this measure. More contamination was found during the Beaver Street Bridge Replacement. Through the 350 Irving Street project, dredging will occur from Mary Dennison and all the way upstream to Irving Street. Excavation and restoration of wetlands will be occurring at 350 Irving Street. Eversource will also be performing subsurface remediation activities to limit the movement of contamination into the wetlands.	Removed: Progress is underway involving non-municipal projects as identified on the left.
21	Conduct a comprehensive assessment of water quality, supply, and infrastructure, including assessment of aging infrastructure, such as the MWRA aqueducts. Examine potential for incorporating homes with private wells (particularly in the northwest portion of the City) into the City water supply system. Explore means of mitigating climate-driven impacts on public water supply sources, such as harmful algal blooms or drought.	In Progress	Extending water mains to the northwest portion of the City - may not have been looked at in depth but would be a very costly project for the City to take on. Water & Sewer has prioritized aging infrastructure based on age, risk of failure, fire flow, and water quality	Integrated into: " <i>Explore intermunicipal connections with neighboring communities for water resources.</i> "

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
			to update our Capital plan for outyears. MWRA infrastructure is not assessed as it is understood that they do this on their own. Framingham does not have its own source of public water supply currently. All of the City's water comes from the MWRA so the MWRA would be primarily responsible for mitigating impacts on supply sources.	
22	Assess public and private dams and develop designs for improvements/replacement where necessary. Assessment should include updating information on ownership and gaining an understanding of condition, as well as determining risks and priority projects. Saxonville Dam, though privately owned by Saxonville Mills, was raised by workshop participants as a specific area of concern. Coordinate with private dam owners to determine where viable partnerships may exist that would provide important flood mitigation benefits to the City.	Delayed	The City owns two dams but does not have significant involvement with private dams throughout the City. No updates on this measure.	Integrated into: <i>"Assess City-owned dams and engage other public and private dam owners in Framingham on resilience."</i>
23	Develop a City-wide comprehensive tree and forest management program to identify, remove, and replace problem trees, preserve intact forests and street tree cover, provide guidance and resources for gradually moving toward more climate-resilient trees and forest communities (e.g. species that will tolerate warmer	Delayed	While no definitive plan is in place, the City is maintaining its current management of an estimated 12,000 street streets as well as other vegetation in the public right of way. These efforts include	Carried directly into HMP Update.

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
	temperatures) and develop guidelines to manage conversion of forest land and require shade tree plantings in new developments to promote erosion control and improved infiltration.		conducting hazardous tree assessments, prescribing treatment, and overseeing tree removals. Framingham’s 2020 Master Plan Update places priority on development of standards for green infrastructure as part of site and road improvements as well as other zoning criteria.	
24	Establish a water conservation program to reduce MWRA purchases and increase drought resilience for residents and the City.	In Progress	Progress has been made through public education of water conservation. DPW has been promoting water efficiency through its social media.	Integrated into: <i>“Conduct a community engagement campaign on water conservation.”</i>
25	Develop comprehensive plan for beaver management to mitigate against unpredictable flooding/impoundment impacts. Establish creative engineering solutions, identify suitable areas for beaver relocation or where beaver activity may be creating flood storage that contributes to resiliency, and consider the development of special legislation to give the City authority to address problematic beaver dams on private property. Evaluate permitting feasibility of beaver deceivers or other non-lethal methods to mitigating the flood impact of problem beavers in flood prone areas.	Delayed	Progress not started; City will be exploring potential solutions.	Carried directly into HMP Update.

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
26	Continue upgrading aging traffic control systems with more energy efficient and resilient options such as low voltage LED lights with back-up power supply to maintain normal traffic flow operations during power outages.	In Progress	Replacement of traffic lights with LEDs is nearly complete (estimated to be over 90%). City could expand upon this effort through the inclusion of battery backup.	Removed: Almost complete.
27	Develop a City-wide Business Resilience Plan to support local businesses and make the business community more resilient. Identify business development areas where impacts from climate hazards can be easily avoided or mitigated (e.g., by avoiding floodplains or areas of known drainage-related flooding) and targeted improvements, such as a microgrid and rooftop solar installations, employed to provide extra resilience to community businesses in the Downtown and I-90 Exits 12 and 13 areas. Evaluate feasibility of a carpool lane to these key exits.	Delayed	<p>A City-wide Business Resilience Plan centered on hazard mitigation is not underway, but a plan for COVID-19 recovery was recently completed.</p> <p>While not focused on local businesses, the City has developed energy resiliency studies of three locations in the community.</p> <p>The City is pursuing grant funding to implement a parking garage behind the City Hall. Implementation of a parking garage behind City Hall will provide additional resilience with the integration of EV charging stations. The parking garage could be paired with battery storage to provide resilient charging solutions. Implementation of the parking</p>	Carried directly into HMP Update.

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
			garage could also improve accessibility to the City Hall.	
28	Conduct a microgrid feasibility study to investigate the possibility of localized power for critical facilities and ensure that electrical services continue when the primary power grid is disrupted by a hazard event. Identify and implement measures to prepare municipal facilities and operations to be more energy independent, including repairing/replacing rooftops in order to support solar energy systems and adopting alternative fuel vehicles.	Complete	Three energy resiliency studies have been completed for different areas of the community, with more anticipated to be on the way. The City is continually working to identify and implement measures to municipal facilities and operations to be more energy independent.	Stated measure complete, expanded measure integrated into: <i>"Evaluate and pursue opportunities to use clean energy technologies, such as microgrids, to provide enhanced backup power to municipal facilities."</i>
29	Partner with electric and gas utility providers to identify and address vulnerabilities in utility infrastructure and enhance communication and cooperation between the City and private utilities. Continue to coordinate tree maintenance to increase resiliency to severe weather. Continue to utilize programs and resources offered by utilities and their associated service providers to improve energy resiliency for municipal facilities as well as residents and local businesses.	Continuous	The City has maintained consistent communication with the utilities on a variety of energy programs (Ex. Eversource Geothermal Pilot Program and Mass Save Community First Partnership Program)	Integrated into: <i>"Partner with the local utility on climate resilience efforts."</i>
30	Coordinate regional management efforts of Lake Cochituate, including studying ways to reduce pesticide and nutrient inputs from stormwater runoff. Efforts can include public outreach and education.	In Progress	Framingham is participating in an MVP Project titled the Sudbury-Assabet-Concord Natural Climate Solutions Grant that will support nature-based solutions.	Carried directly into HMP Update.

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
31	Update flood mapping throughout the City to ensure that residents and businesses have the most accurate information regarding risks and the need for potential mitigation strategies.	No Update	Flood maps are updated by FEMA, unclear of current flood map update status.	Removed.
32	Conduct robust transportation resiliency planning to ensure that access is maintained in and out of the City and throughout the Metro West region during hazard events. Focus on 1) facilitating emergency operations, 2) studying key junctions such as Exit 13, Exit 12, and the Route 9/126 intersection, and 3) considering approaches to improve and promote public transportation to help reduce cars on the road during inclement weather and reduce greenhouse gas emissions.	In Progress	Phase II of Transportation Master Plan completed in 2022. The City is also working on implementing public EV charging infrastructure to encourage residents to adopt electric vehicles. Implementation of a Downtown Parking Garage could support the community.	Integrated into: " <i>Conduct robust transportation resiliency planning.</i> "
33	Assess feasibility and funding options for property acquisitions along the Sudbury River and other flood-prone areas in the City with the intent of providing relief for property owners facing potential flood risks or repetitive losses and increasing available space for floodplain restoration to reduce flood impacts.	Delayed	Framingham is participating in an MVP Project titled the Sudbury-Assabet-Concord Natural Climate Solutions Grant that will support nature-based solutions. It is anticipated that this work could support the assessment of feasibility and funding options.	Integrated into: " <i>Protect or acquire private property impacted by flooding in repetitive loss neighborhoods.</i> "
34	Coordinate with Framingham State University, MassBay Community College, and local community organizations to develop educational messaging and/or programming to	Continuous	The City coordinates with Framingham State University (FSU) and Mass Bay Community College. For example, there is ongoing	Integrated into: " <i>Coordinate local community organizations to develop educational</i>

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
	transfer climate change risk and vulnerability knowledge to the general public, especially future generations.		collaboration between the Sustainability Coordinator and FSU on a student program to explore heat islands in Framingham. Coordination with local community organizations is in development. This measure is also supported by the MVP Climate Equity Project that Framingham is working on and will be further supported through the City's Climate Action Plan.	<i>messaging and/or programming to transfer climate change risk and vulnerability knowledge to the general public."</i>
	<b>Lower Priority</b>			
36	Continue to support coordinated efforts to provide emergency shelters that effectively serve Framingham's population during hazard events, including cooling and warming centers. Begin a City-wide discussion about informal sheltering to better understand how and when residents might use shelter services and redefine 'sheltering' to meet Framingham's specific needs. For instance, if primary shelter use is for charging stations, develop locations where residents can meet this need during power outages without the expense of opening formal shelters. Consider how to support the use of informal sheltering locations where people already go in emergencies.	In Progress	The City continues to provide emergency shelters for heating and cooling during severe weather in summer and winter months.	Carried directly into HMP Update.

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
37	Evaluate feasibility of City ordinance for private maintenance of problem trees. Such an ordinance can help increase utility resilience by reducing branch and tree falls during severe weather.	No Update	The City does not have an ordinance for the private maintenance of problem trees.	Integrated into: " <i>Develop a citywide comprehensive tree and forest management program.</i> "
38	Explore and evaluate means of improving resiliency at historic properties throughout the City.	In Progress	Improvements to municipal historical buildings, such as the Old Edgell Library, are currently in progress through capital projects. It is possible that the CPA may be able to provide additional support for local historic properties throughout the community.	Carried directly into HMP Update.
39	Identify financial and technical assistance for MS4 implementation, to support municipal departments in complying with the MS4 permit.	Ongoing	Framingham has submitted by three annual reports for MS4 regarding BMPs. Annual reports detail technical assistance that Framingham has received to support MS4 implementation. The City is continually looking for financial assistance to support compliance with the MS4 permits.	Removed: this action is integrated as part of general project development for each relevant measure.
40	Investigate potential for setting up and funding an emergency fund to support financially vulnerable	Removed	Framingham has implemented temporary financial assistance to families due to COVID-19,	Removed.

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
	populations during climate change related hazards and emergencies. This could include a surcharge on tax bills		supporting many residents that are also highly vulnerable to climate change impacts. There are no current plans for a long-standing emergency fund covered by tax bills.	
41	Collaborate with the state women’s prison, MCI-Framingham, to evaluate potential climate impacts related to hazard events such as flooding, drought, and extreme heat. Assess resiliency of the prison facility.	Removed	The State is currently evaluating the potential to replace MCI Framingham. All emergency plans of MCI-Framingham need to be approved by the Fire Chief annually. There is coordination with MCI Framingham on various issues.	Removed.
42	Coordinate with MWRTA and MBTA to assess resiliency of commuter transportation, with particular focus on minimizing susceptibility to climate hazards and ensuring continued operations. Incorporate assessment of increased ridership and expanded offerings that would better connect employees with key business centers.	Continuous	The City has been engaged with MWRTA in several recent planning processes to identify opportunities to support public transportation options, including the 2022 Transportation Master Plan. The Fire Department has maintained discussions with MWRTA for MWRTA to provide local transportation options in the event of an emergency.	Integrated into: " <i>Conduct robust transportation resiliency planning.</i> "

## City of Framingham, MA Hazard Mitigation Plan Update

#	MVP Recommendation	Current Status	Current Status Description/Explanation	Comments
43	Communicate with MEMA regarding the vulnerability of its command center and make efforts to increase the resiliency and safety of state emergency operations.	Removed	MEMA is resilient.	Removed.
44	Facilitate education for prospective homebuyers and realtors to address flood risks to make sure that buyers are aware of what it means to purchase a home that may be located in or near a floodplain and educate residents on protections such as flood insurance that can mitigate financial risks associated with climate hazards. Target landlord associations and realtors to encourage risk communication.	Delayed	The City is currently evaluating opportunities to educate property owners about this issue.	Carried directly into HMP Update.

Comprehensive Range of Mitigation Actions

C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))

Beyond reviewing the mitigation actions from previous plans, the HMWG considered a comprehensive range of mitigation actions. During each HMWG meeting, the group was educated on the possible range of mitigation actions. The Federal Emergency Management Agency’s online Mitigation Ideas publication was shared, and the following list of example actions was shared electronically with the HMWG.

Table 36. Types of Mitigation Actions.

Mitigation Action Category	Examples of Mitigation Actions
Local Plans and Regulations	<ul style="list-style-type: none"> <li>• Comprehensive plans</li> <li>• Land use ordinances</li> <li>• Subdivision regulations</li> <li>• Development review</li> <li>• Building codes and enforcement</li> <li>• NFIP Community Rating System</li> <li>• Capital improvement programs</li> <li>• Open space preservation</li> <li>• Stormwater management regulations and master plans</li> </ul>
Structure and Infrastructure Projects	<ul style="list-style-type: none"> <li>• Acquisitions and elevations of structures in flood-prone areas</li> <li>• Utility undergrounding</li> <li>• Structural retrofits</li> <li>• Floodwalls and retaining walls</li> <li>• Detention and retention structures</li> <li>• Culverts</li> </ul>

# City of Framingham, MA Hazard Mitigation Plan Update

Mitigation Action Category	Examples of Mitigation Actions
Natural Systems Protection	<ul style="list-style-type: none"> <li>• Sediment and erosion control</li> <li>• Stream corridor restoration</li> <li>• Forest management</li> <li>• Conservation easements</li> <li>• Wetland restoration and preservation</li> </ul>
Education and Awareness Programs	<ul style="list-style-type: none"> <li>• Radio or television spots</li> <li>• Websites with maps and information</li> <li>• Real estate disclosure</li> <li>• Presentations to school groups or neighborhood organizations</li> <li>• Mailings to residents in hazard-prone areas</li> </ul>

The HMWG considered previously identified actions, areas of weakness and mitigation opportunities identified in the risk assessment and capability assessment, as well as the possible types of mitigation actions when developing the action list for this plan update.

## Mitigation Action Plan

C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))

An online Mitigation Action Tracker was developed for the City to track the implementation of each mitigation action. The Mitigation Action Tracker was an online spreadsheet with separate tabs showing each action’s essential details. These column labels listed below are included to facilitate the City’s ability to sort through the actions as well as to apply for grant funding.

# City of Framingham, MA Hazard Mitigation Plan Update

- Action Title
- Action Description
- Implementation Timeline, When project will be completed
- Responsible Party and Department
- Supporting Agencies or Departments
- Potential Funding Sources
- Estimated Cost
- Hazard(s) Addressed
- Critical Facility Protection
- Type of Mitigation Action
- Priority

The priority order was chosen based on weighing costs versus benefits. It was imperative for the City to determine if the costs associated with an action were reasonable compared to those actions corresponding benefits. To do this, the HMWG developed a prioritization table that included eleven categories of criteria; these are detailed in the table below. Each category was assigned points with priority criteria given the highest points. The most points an action could earn is 29.

The City has 44 mitigation actions. They ranged in priority score from 12 – 23. The HMWG felt it necessary to associate a range of high, medium, or low for each action because it is not necessary to decide if one action is slightly higher priority than another and the three buckets of high, medium, and low is an effective and digestible way for the City to manage the list. Beyond the priority score, a quantitative analysis, the HMWG used a qualitative analysis to assist with where to breakdown the list into the high, medium, and low categories. Actions with a score between 21-23 were given a score of high priority, there are 18 high priority actions. Actions with a score between 18-20 were designated as medium priority, there are 16 medium priority actions. Actions with a score between 12-17 were designated low priority, there are 10 low priority actions.

Table 37. Priority Ranking System.

	Criteria Category	Description	Detailed Ranking and Associated Points
1	Hazards Addressed	What level of hazards does the measure provide protection against?	High (Flood, Severe Winter Storms, Extreme Temperatures) = 3  Medium (Hurricanes/Wind, Thunderstorms, Drought, Infectious Disease) = 2

City of Framingham, MA Hazard Mitigation Plan Update

	Criteria Category	Description	Detailed Ranking and Associated Points
			Low (Landslide, Wildfires, Tornadoes, Earthquakes, Invasive Species) = 1
2	Approximate Cost	How much will the measure cost to implement?	Low (Under \$10k) = 3 Medium (\$10k - \$100k) = 2 High (\$100k - \$500k) = 1 Very High (Over \$500k) = 0
3	Internal Capacity	Does the measure require a significant commitment of staff capacity or resources for operation and maintenance?	Low Resource Commitment= 2 Medium Resource Commitment= 1 High Resource Commitment = 0
4	Implementation Timeline	How long will it take for the measure to convey its benefits from the start of implementation efforts?	1-2 Years = 3 3-4 Years = 2 5 or More Years = 1
5	Equity Focus	Does the measure provide support to Environmental Justice (EJ) and other Vulnerable Populations?	Direct Support = 3 Indirect Support = 2 No Support = 0
6	Protection of Lives	How effective is the measure in protecting lives and mitigating injuries resulting from the targeted hazard(s)?	Direct Support = 3 Moderate Indirect Support = 2 Minor Indirect Support = 1 None = 0
7	Protection of Critical Facilities or Infrastructure	Does the measure provide protection of critical facilities and infrastructure?	Yes = 3 No = 0
8	Natural Resource Protection	Does the measure provide protection of critical facilities and infrastructure?	Yes = 2 No = 0
9	Alignment with Objectives	Does the measure align with the HMP objectives?	Yes =2 No =0

# City of Framingham, MA Hazard Mitigation Plan Update

	Criteria Category	Description	Detailed Ranking and Associated Points
10	Anticipated Scale of Impact	How significant is the impact of this measure to the community?	Large = 3 Medium = 2 Small = 1 Minor = 0
11	Public Support	Is there clear public support to implement and maintain the measure?	Broad Support = 2 Limited Support = 1 Controversial = 0

Details sorting the actions are included in Appendix C in the following tables.

- Priority Ranking Considerations
- Actions that Protect Critical Facilities

Below is the list of mitigation actions sorted by priority. The HMWG and the Mayor’s Office understand that mitigation actions may not be implemented in order of priority, they may be implemented in the order by which they receive funding. The actions are also included in Appendix C.

# City of Framingham, MA Hazard Mitigation Plan Update

Table 38. Mitigation Actions.

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
<b>HIGH PRIORITIIY ACTIONS</b>							
1	Complete rehabilitation of the Worcester Road Sewer Pump Station.	Structure & Infrastructure	<p>The Worcester Road Pumping Station is Framingham's second-largest wastewater station, responsible for collecting and pumping sewage for over 4,000 homes and more than 200 businesses. The station provides service to approximately 25% of the city.</p> <p>Originally constructed in 1963, the station's equipment is outdated, does not meet current DPW standards, does not have a full backup power supply, and is at the end of its reliable service life. The pump station also does not meet current building codes, and the superstructure, including the roof, has structural deficiencies and will need replacement to extend the building's life. Rehabilitation of the pump station will modernize the facility and ensure reliable operation in years ahead. This project is underway.</p>	2027	Director of Public Works	\$\$\$\$	Capital Budget, MassDEP State Revolving Loan Program
2	Regionalize emergency dispatch with neighboring communities to enhance and improve efficiency	Structure & Infrastructure	Combine and regionalize Police and Fire Dispatch. The City is currently pursuing the purchase of downtown property for use as a regional dispatch center that neighbors the Police Department Headquarters and City Hall.	2024	Director of Regional Dispatch	\$\$\$\$	Municipal Bonds, State 911 Department Grant

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
	of emergency response services.						
3	Acquire the 103 Guild Street property.	Natural Resources Protection	Acquire the 103 Guild Street property to secure valuable flood storage for the local neighborhood situated nearby Beaver Dam Brook. Property is located in an Environmental Justice Neighborhood.	2023	Director of Planning, Conservation, and Community Development	\$\$\$	SVT, CPA Funding
4	Acquire the CSX Corridor.	Natural Resources Protection	Purchase of the 3.2 mile segment of the railway track will enable the City to add to the Bruce Freeman Rail Trail as well as protect vital stormwater capacity in the downtown area through the replacement of the CSX Hop Brook culvert. Acquisition of the property and subsequent improvements will help address problems related to historically undersized culverts and neighborhood flooding. Framingham has signed an agreement to purchase the CSX property.	2023	Director of Planning, Conservation, and Community Development	\$\$\$\$	Mass Trails Grant
5	Retrofit, update, or replace undersized and unsafe culverts.	Structure & Infrastructure	Retrofit, update, or replace undersized and unsafe culverts to provide enhanced capacity to accommodate increased precipitation. Priority culverts include the Fuller Middle School Pedestrian Path Culvert, Edmands Road Culvert, and Colonial Drive Culvert.	2028	Director of Public Works	\$\$\$\$	Capital Budget; FEMA BRIC Grant; MA MVP Action Grants
6	Develop a <i>Beaver Management Plan</i> .	Local Plans & Regulations	Development of a plan to mitigate against unpredictable flooding/impoundment impacts. Establish creative engineering	2026	Director of Planning, Conservation,	\$\$	Capital Budget; MVP Grant

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
			solutions, identify suitable areas for beaver relocation or where beaver activity may be creating flood storage that contributes to resiliency, and consider the development of special legislation to give the City authority to address problematic beaver dams on private property. Evaluate permitting feasibility of beaver deceivers or other non-lethal methods to mitigating the flood impact of problem beavers in flood-prone areas.		and Community Development		
7	Protect or acquire private property impacted by flooding in repetitive loss neighborhoods and neighborhoods lacking infrastructure for future development.	Natural Resources Protection	Protect or acquire private properties experiencing severe and repetitive flooding to reduce future disaster losses and provide important flood storage for surrounding neighborhoods. The acquisition and/or protection of properties would be prioritized in neighborhoods such as Hemenway Road, Auburn Street, Beaver Dam Brook, Prescott Street, Nixon Road, and the Circle Drive neighborhood as well as along the Subury River	2030	Director of Planning, Conservation, and Community Development	\$\$\$\$	Capital Budget, MVP Action Grant
8	Integrate relevant hazard mitigation plan priorities and actions into the City's forthcoming <i>Climate Action Plan</i> .	Local Plans & Regulations	Integrate relevant HMP priorities and actions into the development of the City's Climate Action Plan (2023). Development of the City's first <i>Climate Action Plan</i> will be underway in 2022 and coordination with relevant items from the HMP plan will ensure expedient progress toward goals and generally support efforts to improve the resiliency of the community.	2023	Sustainability Coordinator	\$	Capital Budget, MAPC Technical Assistance, Executive Office of Energy and Environmental Affairs

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
							(EOEEA) Planning Assistance Grant
9	Protect and restore wetland areas and water bodies.	Natural Resources Protection	Complete wetlands construction projects and ecological restorations of existing wetlands to improve flood storage capacity and water quality. Coordinate regionally to reduce pesticide and nutrient inputs from stormwater runoff through public engagement and education. A priority area includes the City's conditions assessment and potential wetlands restoration to improve water quality at the Lake Waushakum outfall as well as regional coordination on the management of Lake Cochituate.	2026	Director of Planning, Conservation, and Community Development	\$\$\$	Capital Budget (ARPA), Regional MVP Action Grant
10	Evaluate and pursue opportunities to use clean energy technologies, such as microgrids, to provide enhanced backup power to municipal facilities.	Structure & Infrastructure	Explore the implementation of solar PV, battery storage, and other renewable energy technologies to provide clean energy resilience to critical municipal facilities as part of efforts to expand renewable energy technologies	2025	Sustainability Coordinator	\$\$\$	MassCEC CLEAR Grant, Capital Budget
11	Protect flood storage at Mary Dennison Park.	Natural Resources Protection	Utilize the redesign of the Mary Dennison Park as an opportunity to preserve existing flood storage capacity located at the back of the facility. Protection of this flood storage will improve the resilience of local	2026	Director of Parks and Recreation	\$\$\$\$	Mary Dennison Settlement and Town Meeting /

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
			infrastructure and community facilities, such as adjacent affordable housing, to flooding.				Capital Budget
12	Implement flood mitigation measures in the Walnut Street neighborhood.	Natural Resources Protection	Implement wetland, stream channel, and streambank restorations to reduce flooding and increase brook capacity in the Walnut Street/Sucker Brook Drainage Area as well as construction of an elevated walking path to restore hydraulic connectivity.	2025	Director of Public Works	\$\$\$\$	MVP Grant
13	Continue to support coordinated efforts to provide emergency shelters and evaluate the specific needs for enhanced capacity in areas of the community.	Structure & Infrastructure	Provide shelters that that effectively serve Framingham’s population during hazard events, including cooling and warming centers such as the Framingham Public Library branches and the Callahan Senior Center. Evaluate the necessity of locations over time to support vulnerable populations.	2023	Director of Emergency Management	\$	Operating Budget
14	Facilitate education for prospective homebuyers and realtors to address flood risks.	Outreach & Education	Provide education to make sure that buyers are aware of what it means to purchase a home that may be located in or near a floodplain and educate residents on protections such as flood insurance that can mitigate financial risks associated with climate hazards. Target landlord associations and realtors to encourage risk communication.	2023	Director of Public Works	\$	Operating Budget
15	Develop a <i>Comprehensive Stormwater Master Plan</i> .	Local Plans & Regulations	The Comprehensive Stormwater Master Plan will complete Phases IV and V of the City's study of the stormwater system which involve the study of ten sub-basins: North	2028	Director of Public Works	\$\$\$	Capital Budget, MVP

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
			and South Saxonville, Cherry Meadow Brook, Birch Meadow Brook, Baiting Brook, Wayside, Square Meadow Brook, Reservoir #1 and #2 South, Reservoir #3 North, and Willow Brook drainage sub-basins. It will also include updated analysis off flooding along Beaver Dam Brook.				Action Grant
16	Utilize clean energy technologies to provide efficient heating and cooling capacity to municipal facilities and schools.	Structure & Infrastructure	Implement heat pump systems to provide efficient relief to occupants of municipal facilities and schools from rising summer temperatures while enhancing efficiency of/and reducing reliance on natural gas-fired winter heating systems. Schools currently without full air conditioning solutions include Brophy Elementary School, Dunning Elementary School, Hemenway Elementary School, McCarthy Elementary School, Potter Road Elementary School, Stapleton Elementary School, and Walsh Middle School.	2027	Sustainability Coordinator	\$\$\$\$	Eversource, Green Communities Competitive Grants, Capital Budget, ARPA
17	Replace the School Street, Taralli Terrace, Potter Road, and Second Street Bridges.	Structure & Infrastructure	Replace outdated bridges and associated infrastructure that serve as critical links in the City's transportation network. Priority bridges for replacement include the School Street Bridge over Cochituate Brooks as well as the Taralli and Second Street Bridges where flooding has occurred in the past. Potter Road Bridge is also in need of replacement. Replacement of these bridges will better ensure their operational status in the event of a critical natural hazard.	2027	Director of Public Works	\$\$\$\$	Capital Budget

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
18	Plan and post neighborhood and regional evacuation routes.	Outreach & Education	Develop and publicize neighborhood and regional evacuation routes to support the safe evacuation of Framingham residents, with emphasis on vulnerable populations.	2024	Director of Emergency Management	\$\$	Operating Budget
<b>MEDIUM PRIORITY ACTIONS</b>							
19	Coordinate local community organizations to develop educational messaging and/or programming to transfer climate change risk and vulnerability knowledge to the general public.	Outreach & Education	Communicate with Framingham State University, Mass Bay Community College, and other local organizations to increase awareness of climate change risks.	2024	Sustainability Coordinator	\$	Operating Budget; MAPC Technical Assistance
20	Assess City-owned dams and engage other public and private dam owners in Framingham on resilience.	Outreach & Education	Evaluate the condition of two public dams owned by the City: the Landham Pond Dam and the Mt. Wayte Outlet Works. Coordinate with other public and private dam owners, such as Massachusetts Water Resources Authority (MWRA) and Massachusetts Department of Conservation and Recreation (DCR) and DCR to help support the health and resilience of this infrastructure.	2025	Director of Public Works	\$\$	Operating Budget; Administrative Resources
21	Purchase & install automated weather stations.	Structure & Infrastructure	Purchase and install 4 automated weather stations throughout the City, with web-based access. Weather stations will assist	2027	Director of Public Works	\$\$	Operating Budget;

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
			DPW personnel with assessing storms to improve response to extreme precipitation, high winds, and winter storms. They will also assist the Police Department & Fire Department with emergency response for storm events.				FEMA BRIC Grant
22	Develop and implement a municipal program to promote the use of green infrastructure.	Outreach & Education	Develop a green infrastructure marketing/education campaign focusing on businesses and large commercial developments to help mitigate stormwater runoff and the heat island effect, particularly in areas of downtown Framingham with high levels of impermeable surface and flooding risks. This program would support requirements of the City's NPDES MS4 permit.	2024	Sustainability Coordinator	\$	MAPC Accelerating Climate Resilience (ACR) Grant Program
23	Foster an improved communications network to better reach vulnerable populations and those most in need of information and assistance.	Outreach & Education	Identify vulnerable populations and foster an improved communications network in advance of hazard events to facilitate communication efforts and outreach to those most in need of information and assistance. Expand upon current efforts to strengthen relationships with Framingham's Environmental Justice neighborhoods.	2024	Sustainability Coordinator	\$\$	Operating Budget; MAPC Technical Assistance
24	Implement drainage improvements to support transportation networks and associated properties.	Structure & Infrastructure	Implement drainage improvements along roadways that reduce flooding and improve the resilience of transportation infrastructure. Priority areas for the implementation of drainage improvements include Fountain Street (currently undergoing a comprehensive capital project	2026	Director of Public Works	\$\$\$\$	Capital Budget

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
			that includes drainage improvements and replacement of the Farm Pond Outfall) and the Nobscott Area (for which drainage improvements are being implemented through development of the Nobscott Plaza).				
25	Develop green infrastructure on municipal properties to improve stormwater management and reduce heat island impacts.	Structure & Infrastructure	Assess drainage infrastructure and drainage-driven road flooding and develop green infrastructure solutions for stormwater management and urban heat island mitigation to be used in tandem with improvements to the outdated and undersized stormwater system to reduce road flooding and problems with ice slicks that make roads dangerous or impassable during hazard events. Develop a list of specific priorities, assess feasibility and cost, rank priority projects in terms of climate resilience potential, and develop concept designs for key projects. Projects in areas of the community with high proportions of impermeable surface area, such as downtown Framingham, shall be prioritized as well as facilities such as Butterworth park.	2029	Director of Public Works	\$\$\$	Capital Budget, MVP Action Grant, DCR Urban Forestry Challenge Grant
26	Develop standards to prioritize social equity in resilience project planning, design, and development.	Outreach & Education	Develop standards by which municipal departments can prioritize the equitable share of benefits from hazard mitigation actions to support Environmental Justice (EJ) and vulnerable populations in the community.	2025	Director of Planning, Conservation, and Community Development	\$	U.S. Department of Housing and Urban Development Technical

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
							Assistance, CBDG funds
27	Integrate flood storage review into <i>Open Space Plan</i> .	Local Plans & Regulations	Integrate flood storage capacity as a criterion in the City's Open Space Plan's priority list of open space parcels to protect from future development. Inclusion of this information in the analysis will help the City more clearly identify properties that would be prime candidates for increasing flood storage and mitigate flooding impacts.	2023	Director of Planning, Conservation, and Community Development	\$	Operating Budget
28	Partner with the local utility on climate resilience efforts.	Outreach & Education	Enhance coordination to identify and address vulnerabilities in utility infrastructure and enhance communication and cooperation between the City and private utilities.	2023	Sustainability Coordinator	\$	Operating Budget
29	Evaluate and enhance current ordinances and regulations regarding floodplain development.	Local Plans & Regulations	Review zoning ordinances, planning and wetlands regulations, building code, as well as health and safety regulations to ensure consistency across regulations and the collaborative mitigation of risks, such as avoiding development in floodplains.	2026	Director of Public Works	\$\$	Capital Budget
30	Continue community engagement efforts to maximize the adoption of energy efficiency and clean energy technologies	Outreach & Education	Improve the resilience of local buildings to extreme weather conditions through community engagement focused on advancing clean energy and energy efficiency development in new and existing buildings. Community engagement should leverage and coordinate technical and financial resources from the utility, state,	2024	Sustainability Coordinator	\$\$	Mass Save (Eversource), U.S. Department of Housing and Urban Development

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
	at new and existing buildings.		<p>and other entities, such as the Mass Save Program, to empower residents and businesses to implement energy efficiency improvements and install clean energy systems.</p> <p>The intensification of climate change impacts threatens critical local infrastructure including the electrical grid and powered devices. Energy efficient, well-insulated buildings can maintain habitable conditions for longer durations in the event of prolonged utility outages that may be caused by flooding, severe weather, and extreme heat. Enhanced local energy efficiency can also reduce stress on the local electrical grid during periods of peak demand, increasing system reliability for nearby facilities.</p>				nt Technical Assistance
31	Install additional stream gauges and web-based public portal for stream gauge data.	Structure & Infrastructure	Install additional automated stream gauges (surface water level sensors and communications equipment) at high risk areas, including Angelica Drive (Angelica Brook) Bates Rd (Beaver Dam Brook).	2027	Director of Public Works	\$\$\$	Capital Budget; FEMA BRIC Grant
32	Develop a citywide <i>Business Resilience Plan</i> .	Local Plans & Regulations	Develop plan to support local businesses and make the business community more resilient. Identify business development areas where impacts from climate hazards can be easily avoided or mitigated (e.g., by avoiding floodplains or areas of known drainage-related flooding) and targeted improvements, such as a microgrid and	2027	Director of Planning, Conservation, and Community Development	\$\$	Capital Budget

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
			rooftop solar installations, employed to provide extra resilience to community businesses in the Downtown and I-90 Exits 12 and 13 areas.				
<b>33</b>	Conduct robust transportation resiliency planning.	Local Plans & Regulations	Develop a plan or amendment to 2022 Transportation Master Plan to help safeguard transportation during natural hazard events with emphasis on facilitating emergency operations and ensure that access is maintained in and out of the City and throughout the MetroWest region during hazard events. The plan will study key junctions such as Exit 13, Exit 12, and the Route 9/126 intersection. Development of the plan will require coordination with the MWRTA and MBTA to assess the resiliency of commuter transportation.	2028	Director of Public Works	\$\$	Operating Budget; EEA Planning Assistance Grant
<b>34</b>	Implement emergency generators for traffic signals.	Structure & Infrastructure	Implement emergency backup power generation (such as solar PV and batteries) to power traffic signals in the event of power disruptions due to natural hazards (such as severe storms) and hazard-related events.  For example, during a 2013 storm event, power was lost at a major intersection's traffic signal for 6 days. Police details were required, pulling limited emergency personnel from other weather-related emergencies. Loss of power to traffic signals compounds hazardous travel conditions. Emergency, back-up generators for traffic	2028	Director of Public Works	\$\$\$	Capital Budget

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
			signals will help facilitate traffic flow and mitigate hazardous conditions.				
<b>LOW PRIORITY ACTIONS</b>							
35	Implement recommendations from the feasibility study for removal of the Landham Pond Dam.	Structure & Infrastructure	Implement flood and drainage mitigation measures in the Hemenway neighborhood associated with the removal of the Landham Pond Dam. The implementation of these measures is contingent on the acquisition of the CSX property associated with the Bruce Freeman Rail Trail.	2029	Director of Public Works	\$\$\$\$	FEMA BRIC Grant, Capital Budget
36	Conduct a power quality and surge protection study of critical municipal facilities.	Local Plans & Regulations	Conduct an analysis of critical municipal facilities for vulnerabilities and power quality needs to ensure the long-term reliability of electronics and other building-connected electrical equipment in an emergency situation such as a prolonged climatic hazard. The intensification of climate change impacts threatens critical local infrastructure including the electrical grid and powered devices. Disruptions to the electrical grid caused by outages (severe winds, snowstorms, flooding) and brownouts (stemming from excessive demand during extreme weather) can severely damage connected equipment and reduce or delay the ability of critical facilities to support the public.	2026	Sustainability Coordinator	\$\$	Capital Budget
37	Develop a citywide comprehensive tree and forest	Local Plans & Regulations	Development of a plan to identify, remove, and replace problem trees, preserve intact forests and street tree cover, provide	2025	Director of Public Works	\$\$	DCR Urban Forestry Grant;

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
	management program.		guidance and resources for gradually moving toward more climate-resilient trees and forest communities (e.g., species that will tolerate warmer temperatures) and develop guidelines to manage conversion of forest land and require shade tree plantings in new developments to promote erosion control and improved infiltration.				MAPC Accelerating Climate Resiliency Grant; Capital Budget
38	Explore the development of a Hazard Mitigation Incentive Program.	Local Plans & Regulations	Explore options for incentives which may include zoning amendments to encourage property owners to engage in mitigation.	2028	Director of Planning, Conservation, and Community Development	\$	CPA Funding
39	Evaluate satellite locations to supplement DPW operations center and salt storage.	Local Plans & Regulations	Evaluate an alternative location for salt storage that is currently located at the Henry Street Garage in order to provide better support citywide and reduce response times during severe winter weather and storms.	2030	Director of Public Works	\$\$	Operating Budget
40	Reimplement the residential rain barrel program.	Outreach & Education	Reimplement a residential rain barrel program to offer discounted rain barrels to help improve stormwater management, reducing the risk of flooding as well as enabling residents to mitigate the impact of droughts.	2023	Director of Public Works	\$	MassDEP Sustainable Materials Recovery Program (SMRP)
41	Conduct a community engagement campaign on water conservation.	Outreach & Education	Expand water conservation efforts for Framingham residents and businesses to mitigate consumption of MWRA and local well water to improve local resiliency to drought conditions.	2023	Director of Public Works	\$\$	Operating Budget

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Description	Implementation Timeline	Responsible Department Lead	Estimated Cost	Potential Funding Sources
42	Assess additional mosquito/pest control options, including increased stormwater BMP maintenance.	Outreach & Education	Determine future risks due to increase in type and quantity of pests/disease vectors due to climate change and develop education and outreach efforts as well as strategies to improve resilience.	2029	Director of Health Department	\$\$	Operating Budget
43	Explore intermunicipal connections with neighboring communities for water resources.	Local Plans & Regulations	Explore the potential for intermunicipal connections with other communities to access water resources that can safeguard against potential regional capacity risks through the MWRA in times of drought. This would include a high-level analysis of the major logistical, regulatory, financial, and health challenges involved with intermunicipal connection.	2025	Director of Public Works	\$\$	Capital Budget
44	Explore and evaluate means of improving resiliency at historic properties.	Structure & Infrastructure	Identify opportunities to improve the resilience of municipal and private historical facilities throughout the community to climate change impacts such as extreme heat, severe weather, and flooding.	2028	Sustainability Coordinator	\$\$	Operating Budget

## System to Integrate this Plan with other Planning Mechanisms

C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))

The City of Framingham has taken many steps to integrate their 2017 Multiple Hazard Mitigation Plan into policies, plans, and programs throughout city government. The 2019 Community Resilience Building Workshop Summary of Findings includes hazards consistent with those from the 2017 Multiple Hazard Mitigation Plan. It also included capabilities as strengths and weaknesses from the previous plan. Finally, many of the recommendations in the 2019 Community Resilience Building Workshop Summary of Findings are consistent with the identified mitigation actions in the previous plan. For instance, specific culvert replacements and flood protection measures. The 2020 City of Framingham Master Land Use Plan includes goals, policies, and land use actions consistent with the 2017 Multiple Hazard Mitigation Plan. For instance, the Zoning policies in the Master Land Use Plan that state “examine existing zoning ordinances, land use regulations, and zoning districts to determine their conformance with the Plan and amend accordingly,” is consistent with the highest priority mitigation measure from 2017, “evaluate current bylaws and regulations regarding floodplain development to ensure they are consistent and updated.”

For the City of Framingham to succeed in reducing hazard risks over the long term, the information, conclusions, and recommendations of this hazard mitigation plan should be integrated throughout government operations. Many other local plans and processes will present opportunities to address hazard mitigation in a way that can support multiple community objectives, so an important part of maintaining and implementing this hazard mitigation plan will be to identify and capitalize on these opportunities to leverage activities that have co-benefits (including but not limited to risk reduction).

The HMWG will remain tasked with helping to ensure that all new or updated local plan documents are informed by and consistent with the goals and actions of this hazard mitigation plan and will not contribute to increased hazard vulnerability in Framingham. Specifically, this includes but is not limited to the implementation or future updates to the following local plans as identified and further described in Chapter 5 (Capability Assessment):

- Municipal Vulnerability Plan
- Master Land Use Plan
- Open Space and Recreation Plan
- Stormwater Management Plan
- Transportation Master Plan
- Historic Preservation Plan

## City of Framingham, MA Hazard Mitigation Plan Update

- Climate Action Plan

Additional opportunities to integrate the requirements of this plan into other local planning mechanisms shall continue to be identified through future meetings of the HMWG and through the five-year review process described in Chapter 7. Other planning mechanisms include local regulations and existing code enforcement procedures (i.e., zoning bylaws, site plan review, etc.), internal municipal policies, special projects or initiatives, and other routine government or community decision-making activities such as capital improvement planning and the City's annual budget process. Emphasis for identifying these integration opportunities will be placed on those governance structures used to manage local land use and community development in both the pre-disaster and post-disaster environment. Also, as it relates to implementing specific mitigation actions identified in this plan, it will be the responsibility of each assigned lead department to determine additional measures that can support action completion or enhancement. This includes integrating mitigation actions from this plan into other local planning documents, processes, or mechanisms as deemed appropriate and most effective.

While it is recognized that there are many possible benefits to integrating components of this plan into other local planning mechanisms, the routine maintenance of this stand-alone plan is considered by the City to be the most effective and appropriate method to identify, prioritize, and implement local hazard mitigation actions. In moving forward, however, the City will consider the incorporation of some other plan documents into the hazard mitigation plan, such as any future iterations of the City's MVP Plan or related climate adaptation planning efforts.

### Possible funding sources

All the mitigation actions included in this plan have identified one or more potential funding sources. The HMWG focused on projects eligible for MVP Grant funding and FEMA BRIC funding. Below is a list of some of the federal and state funding mechanisms that may assist in implementing mitigation actions.

#### Federal Emergency Management Agency (FEMA) Mitigation Grants

The Federal Emergency Management Agency (FEMA) makes grant funding available for a range of mitigation activities via several Hazard Mitigation Assistance (HMA) programs. These grant programs provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages. They are not intended to fund repair, replacement, or deferred maintenance activities but are rather designed to assist in developing long-term, cost-effective improvements that will reduce risk to natural hazards.

- **Building Resilient Infrastructure and Communities (BRIC)**  
BRIC is a new FEMA hazard mitigation program designed to replace the agency's former HMA Pre-Disaster Mitigation (PDM) grant program, aiming to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. It is a result of recent amendments made to Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) by Section 1234 of the Disaster Recovery Reform Act of 2018 (DRRA). BRIC will support states, local communities,

## City of Framingham, MA Hazard Mitigation Plan Update

tribes, and territories as they undertake hazard mitigation projects reducing the risks they face from natural hazards. The BRIC program’s guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.

- **Hazard Mitigation Grant Program (HMGP)**

The HMGP is authorized under Section 404 of the Stafford Act. The HMGP provides grants to states, tribes, and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the HMGP is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not lost during the recovery and reconstruction process following a disaster. HMGP is typically available only in the months after a federal disaster declaration, as funding amounts are determined based on a percentage of the funds spent on FEMA’s Public and Individual Assistance programs.

- **Flood Mitigation Assistance (FMA) Program**

The FMA program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. FEMA provides FMA funds to assist states and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities. One limitation of the FMA program is that it is generally used to provide mitigation for structures that are insured or located in Special Flood Hazard Areas (SFHAs) as mapped by FEMA. Federal funding for this nationally competitive grant program is generally an annual allocation (subject to Congressional appropriation) and eligibility is linked to a community’s good standing in the NFIP.

### Municipal Vulnerability Preparedness Action Grants<sup>53</sup>

The MVP Action Grant offers financial resources to municipalities 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.

Responses to the RFR may be submitted by municipalities who have received designation from the Executive Office of Energy and Environmental Affairs (EEA) as a Climate Change Municipal Vulnerability Preparedness (MVP) Community, or “MVP Community.” All projects are required to provide monthly updates, project deliverables, a final project report, and a brief project summary communicating lessons learned. The municipality is also required to match 25% of total project cost using cash or in-kind contributions. All proposals must include the following:

---

<sup>53</sup> State of Massachusetts. *MVP Action Grant*. <https://www.mass.gov/service-details/mvp-action-grant>.

## City of Framingham, MA Hazard Mitigation Plan Update

- Completed application template
- Project budget and deliverables
- MVP yearly progress report describing any relevant work toward advancing community priorities since earning MVP designation
- Statement of match
- Letters of support from landowner (if applicable), partners, and the public

Project types include:

- **Detailed Vulnerability and Risk Assessment** – In-depth vulnerability or risk assessment of a particular sector, location, or other aspect of the municipality.
- **Public Education and Communication** – Projects that increase public understanding of climate change impacts within and beyond the community and foster effective partnerships to develop support.
- **Local Bylaws, Ordinances, Plans, and other Management Measures** – Projects to develop, amend, and implement local ordinances, bylaws, standards, plans, and other management measures to reduce risk and damages from extreme weather, heat, flooding, and other climate change impacts.
- **Redesigns and Retrofits** – Engineering and construction projects to redesign, plan, or retrofit vulnerable community facilities and infrastructure (e.g., wastewater treatment plants, culverts, and critical municipal roadways/evacuation routes) to function over the life of the infrastructure given projected climate change impacts.
- **Energy Resilience Strategies** — Projects that incorporate clean energy generation and that are paired with resilience enabling technology to maintain electrical and/or heating and cooling services at critical facilities.
- **Chemical Safety and Climate Vulnerabilities** — Projects that seek to engage the business and manufacturing community through assistance or training on identifying vulnerabilities to chemical releases due to severe weather events, reducing use of toxic or hazardous chemicals, outreach to improve operations and maintenance procedures to prevent chemical releases and accidents, outreach to improve emergency and contingency planning, and/or identifying existing contaminated sites that pose chemical dispersion risks during flood events.
- **Nature-Based Storm-Damage Protection, Drought Mitigation, Water Quality, and Water Infiltration Techniques** – Projects that utilize natural resources and pervious surfaces to manage

## City of Framingham, MA Hazard Mitigation Plan Update

coastal and inland flooding, erosion, and other storm damage, such as stormwater wetlands and bio-retention systems, and other Smart Growth and Low Impact Development techniques.

- ***Nature-Based, Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality*** – Projects that utilize natural resources, vegetation, and increasing pervious surface to reduce ambient temperatures, provide shade, increase evapotranspiration, improve local air quality, and otherwise provide cooling services within the municipality.
- ***Nature-Based Solutions to Reduce Vulnerability to other Climate Change Impacts*** – Nature-based projects that address other impacts of climate change such as extreme weather, damaging wind and power outages, and increased incidence of pests and vector-borne illnesses and other public health issues.
- ***Acquisition of Land to Achieve a Resiliency Objective*** — Land purchases are eligible for grant funding if the parcel has been identified through a climate vulnerability assessment as an appropriate location for a specific eligible adaptation activity to occur, such as accommodating an infrastructure or facility redesign or retrofit project, providing natural flood storage to reduce downstream flooding, or removal of pavement and planting of trees to reduce flooding and heat island effects.
- ***Ecological Restoration and Habitat Management to Increase Resiliency*** — Projects that repair or improve natural systems for community and ecosystem adaptation, such as right-sizing culverts, dam removal, restoration of coastal wetlands, etc.
- ***Subsidized Low Income Housing Resilience Strategies*** — Investments in resiliency measures for affordable housing to protect vulnerable populations that may not have the resources to recover from an extreme climate event.
- ***Mosquito Control Districts*** — Projects to reduce the risk to public health from mosquito-borne illness and to increase mosquito surveillance and control capacity by incentivizing municipalities not in an organized mosquito control project or district to form a new mosquito control district or join an existing mosquito control district. Also funding for municipalities currently in a mosquito control district for new or proactive mosquito control measures.

## Chapter 7. Plan Maintenance

The HMWG will implement the mitigation strategy and specific mitigation actions outlined in this plan, and update and maintain the plan according to the guidelines below. The HMWG includes key stakeholders in the City, who will use the plan’s goals, as well as continued analysis of hazard risks and capabilities, to weigh the available resources against the costs and benefits for each mitigation action. The City understands the value of this plan and its positive mitigation impact and intend to continue updating this plan and implementing the plan’s strategies. The Director of Planning, Community Development, and Conservation is the plan’s “champion” responsible for its implementation and maintenance. It is the City’s intent to never let the plan expire.

Interdepartmental collaboration was a strong component of the update to the plan and is anticipated to play an integral role for plan maintenance. While the HMWG faced a number of challenges over the course of the plan’s update related to staff turnover, coordination amongst existing staff members helped to maintain the momentum necessary to complete the plan. Moving forward, the collaboration of municipal departments will be critical to not only updating the plan, but in advancing mitigation actions and pursuing grant funding to complete these measures.

### Continued Public Participation

A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))

Public participation is an integral component of the mitigation planning process and will continue to be essential as this plan is implemented and updated over time. Based on the high level of interest in the mitigation planning process and in the Municipal Vulnerability Preparedness project, City residents and stakeholders are interested in hazard mitigation. The HMWG included several education and outreach mitigation actions designed to engage the public. The City intends to involve the public throughout the five-year implementation of this plan, as well as in the reviewing and updating process. The Director of Planning, Community Development, and Conservation will take the lead in soliciting participation from the public. This position will be well supported from members of this staff’s Department and the Sustainability Coordinator in the City. Equitable engagement is a priority for the City and the City will continue to conduct outreach and engagement in **English, Portuguese, and Spanish**.

This participation will take multiple forms, including all of those outlined in the Planning Process Chapter of this plan. Efforts to involve the public include:

- Posting plan updates and mitigation action updates on the City’s website, with announcements about new posts released via press release.
- Conducting outreach to regional and private industry stakeholders.

# City of Framingham, MA Hazard Mitigation Plan Update

- Digital copies of the plan will remain available on the City’s website. A hard copy will be kept in the office of the Sustainability Coordinator.

## Method and Schedule for Keeping the Plan Current

A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))

The HMWG and the City of Framingham recognize the importance of keeping the mitigation plan up to date. Keeping the plan current includes monitoring, evaluating, and updating the plan over a five-year period, a process that will be led by the Director of Planning, Community Development, and Conservation with support from their staff, the Sustainability Coordinator, and the HMWG.

### Process to Track Actions

Together the Director of Planning, Community Development, and Conservation and the HMWG will maintain the Mitigation Action Tracker (a tool to record the status of each mitigation action). The Director of Planning, Community Development, and Conservation will send a reminder email with a link to the web-based Mitigation Action Tracker on a semi-annual basis (June and December) to all Department Heads responsible for a mitigation action. They may also distribute the Mitigation Action Progress Worksheet (shown in Appendix D) for Department Heads who prefer a form over a digital spreadsheet.

If the City experiences a large-scale disaster, the Director of Planning, Community Development, and Conservation will assemble a HMWG meeting to update the list of mitigation actions and review their order based on current priorities.

In the past, it was challenging to maintain the status of the mitigation actions. Through the Hazard Mitigation Tracker, the HMWG has assigned a specific City position to be responsible for each action which is hoped to lead to even greater success in tracking hazard mitigation actions.

### Process to Evaluate Effectiveness of the Plan

The HMWG will work to identify the effectiveness of this plan. This includes meeting on a semi-annual basis to review the implementation of the mitigation strategy and mitigation actions. At the first meeting (June 2023), the HMWG will review the effectiveness of the planning process, public and stakeholder engagement, risk analysis, and the mitigation strategy, including its implementation. It is recommended that the HMWG use the worksheet provided in Appendix D. Beyond considering the planning process, the HMWG will seek to answer the following questions to determine if the plan is effective at mitigating risk to the City residents, the built environment, and the natural environment.

# City of Framingham, MA Hazard Mitigation Plan Update

- Can the HMWG identify success stories of losses avoided because of hazard mitigation measures implemented? Can the HMWG identify, political, social, and economic successes?
- Have the mitigation actions implemented achieved benefits beyond the cost of mitigation?
- Have the implemented mitigation actions saved lives or protected property?
- Does the list of mitigation actions jive with current City priorities? Do additional actions need to be added?

## Process to Update the Plan

At each semi-annual meeting, the HMWG will review the plan’s goal statement and objectives as well as mitigation action status. If necessary, the goal statement, objectives and mitigation actions may be revised to reflect current City priorities. In addition, the HMWG will discuss methods for continuing to integrate the mitigation plan with other plans, processes, and projects in the City.

They will prepare a one-page brief regarding each semi-annual HMWG meeting to share with the Mayor’s Office and to post on the City’s website. The HMWG recognizes the value in keeping the public and key stakeholders informed about the implementation and status of the mitigation plan.

HMWG members will continue to participate in regional and state-based meetings to stay current with best risk-mitigation practices. Such meetings may include the Massachusetts Emergency Management Agency (MEMA), the Metropolitan Area Planning Council (MAPC), and the MA Department of Conservation and Recreation.

The City of Framingham agrees to update and adopt this mitigation plan on a five-year basis. The update will include a comprehensive review and planning process like the one used to develop this mitigation plan update. It will update the mitigation action list, current land use practices, collecting and reviewing best available data, reviewing the capability assessment, and engaging the public and stakeholders. This process will occur according to FEMA guidelines. The HMWG will seek funding for the development of the plan update **two years** before the plan expires. The plan update process gives the City the chance to add and/or re-prioritize mitigation actions based on current risk, capabilities, and public/stakeholder suggestions. The Director of Planning, Conservation, and Community Development will serve as the Project Manager for the update process.

Table 39. Schedule Associated with Plan Update and Implementation.

Timeline	Activities
2023	<ul style="list-style-type: none"> <li>• HMWG Meetings in June and December Led by the Director of Planning, Community Development, and Conservation (Meeting includes monitoring the status of all mitigation actions through the Mitigation Action Tracker,</li> </ul>

# City of Framingham, MA Hazard Mitigation Plan Update

Timeline	Activities
	<p>evaluation of the effectiveness of the goal and objectives, development of a status report to share with the Mayor and post to the City’s website.)</p>
2024	<ul style="list-style-type: none"> <li>• HMWG Meetings in June and December Led by the Director of Planning, Community Development, and Conservation (Meeting includes monitoring the status of all mitigation actions through the Mitigation Action Tracker, evaluation of the effectiveness of the goal and objectives, development of a status report to share with the Mayor and post to the City’s website.)</li> </ul>
2025	<ul style="list-style-type: none"> <li>• HMWG Meetings in June and December Led by the Director of Planning, Community Development, and Conservation (Meeting includes monitoring the status of all mitigation actions through the Mitigation Action Tracker, evaluation of the effectiveness of the goal and objectives, development of a status report to share with the Mayor and post to the City’s website.)</li> <li>• Seek FEMA BRIC funding or other available funding for plan update.</li> </ul>
2026	<ul style="list-style-type: none"> <li>• HMWG Meetings in June and December Led by the Director of Planning, Community Development, and Conservation (Meeting includes monitoring the status of all mitigation actions through the Mitigation Action Tracker, evaluation of the effectiveness of the goal and objectives, development of a status report to share with the Mayor and post to the City’s website.)</li> </ul>
2027	<ul style="list-style-type: none"> <li>• HMWG Meetings in June and December Led by the Director of Planning, Community Development, and Conservation (Meeting includes monitoring the status of all mitigation actions through the Mitigation Action Tracker, evaluation of the effectiveness of the goal and objectives, development of a status report to share with the Mayor and post to the City’s website.)</li> </ul>

# City of Framingham, MA Hazard Mitigation Plan Update

## Responsible Parties for Plan Implementation and Maintenance

Sarkis Sarkisian, Director of Planning, Community Development, and Conservation

City of Framingham  
150 Concord Street  
Framingham, MA 01702  
Phone: 508-532-5455  
Email: [ssarkisian@framinghamma.gov](mailto:ssarkisian@framinghamma.gov)

For State resources:

Massachusetts Emergency Management Agency:  
Address: 400 Worcester Road, Framingham, MA 01702-5399  
Phone: 508-820-2000 (MEMA Headquarters and Communications Center)  
or 978-328-1500 (MEMA Region 1 Office)  
Website: <https://www.mass.gov/orgs/massachusetts-emergency-management-agency>

For Federal resources:

Federal Emergency Management Agency:  
Address: 99 High Street, Boston, MA 02110  
Phone: 877-336-2734  
Email: [fema-r1-info@fema.dhs.gov](mailto:fema-r1-info@fema.dhs.gov)  
Website: <https://www.fema.gov/region-i-ct-me-ma-nh-ri-vt>

Appendix A. Planning Process Supporting Materials

Hazard Mitigation Working Group Meetings

HMWG Meeting Participants

First Name	Last Name	Title	Department	Organization	HMWG #1 3/1/2022	HMWG #2 5/11/2022	HMWG #3 7/14/2022	HMWG #4 10/18/2022
Bob	Bois	Resident	N/A	City of Framingham	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Alison	Eliot	Senior Project Manager	Department of Public Works	City of Framingham	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Dana	Haagensen	Director of Administration & Finance	Fire Department	City of Framingham	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Ed	Kross	Resident	N/A	City of Framingham	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Shawn	Luz	Sustainability Coordinator	Capital Projects and Facilities Management	City of Framingham	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Robert	McCarthur	Conservation Agent	Planning, Conservation, and Community Development	City of Framingham	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shane	O'Brien	Senior Planner	Planning, Conservation, and Community Development	City of Framingham	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kerry	Reed	Senior Project Manager	Senior Project Manager	City of Framingham	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sarkis	Sarkisian	Director of Planning and Community Development	Planning, Conservation, and Community Development	City of Framingham	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Amanda	Smith	Assistant Conservation Administrator	Planning, Conservation, and Community Development	City of Framingham	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ryan	Sullivan	Deputy Fire Chief	Fire Department	City of Framingham	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Jeffrey	Zukowski	Hazard Mitigation Planner		MA Emergency Management Agency	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

# City of Framingham, MA Hazard Mitigation Plan Update

## Public Meeting Outreach

### Press Release #1 Public Meeting

PRESS RELEASE  
For Immediate Release  
June 24, 2022

Contact: Shawn Luz  
Sustainability Coordinator  
City of Framingham  
508-532-5652

### **City of Framingham Invites the Public to a Meeting to Learn About the Hazard Mitigation Plan Update**

The City of Framingham is developing a Hazard Mitigation Plan that identifies and prioritizes actions the Town can take to mitigate the impacts of natural hazards and climate change. Citizen participation is essential.

A virtual public meeting will be held on:

- Monday, July 11, 2022
- 6:00 pm – 7:00 pm

You can join the meeting on Zoom.

- [https://us02web.zoom.us/j/81302821517?pwd=TYlmXx\\_fi4tkKKosHi0FhTsk2yz3P7.1](https://us02web.zoom.us/j/81302821517?pwd=TYlmXx_fi4tkKKosHi0FhTsk2yz3P7.1)
- Meeting ID: 813 0282 1517
- Passcode: 145851

At the meeting, you will have an opportunity to contribute your ideas for making the City more resilient to natural hazards such as flooding, snowstorms, high winds, and extreme temperatures. This plan is being developed by a Hazard Mitigation Planning Committee comprised of City officials and local stakeholders. Jamie Caplan Consulting LLC, a Northampton, MA based firm, is leading this effort on behalf of the City and the Massachusetts Emergency Management Agency. Federal Emergency Management Agency (FEMA) approval, and City adoption, of the Hazard Mitigation Plan allows the City to apply for pre- and post-disaster hazard mitigation grant funds.

Framingham developed a Municipal Vulnerability Preparedness (MVP) plan in 2019 that also identified possible actions to mitigate risks to natural hazards and climate change. The Hazard Mitigation Plan will include all of those identified actions still relevant today.

For questions regarding this project, please contact Shawn Luz, Sustainability Coordinator, Phone: 508-532-5652, [sluz@framinghamma.gov](mailto:sluz@framinghamma.gov).

# City of Framingham, MA Hazard Mitigation Plan Update

## Flyer for #1 Public Meeting



**JULY 11, 2022  
PUBLIC MEETING ON ZOOM**

Framingham's Hazard Mitigation Planning Working Group is updating the City's Hazard Mitigation Plan. This plan serves as a strategy for reducing current and future risks of natural hazards and climate change.

The public is invited to learn about the Hazard Mitigation Plan and share their ideas for reducing impacts associated with natural hazards, such as flooding, winter storms and hurricanes. Approved by FEMA, the plan allows the City to apply for pre-disaster mitigation grant funding.



**Hazard Mitigation  
Public Meeting**

July 11, 2022

6:00pm - 7:00pm

For the Zoom Link Visit <http://www.framinghamma.gov/hazardmitigation>

Share your ideas to make the City more resilient to natural hazards such as floods, drought, high winds, and winter storms.

FOR MORE INFORMATION CONTACT  
Framingham Hazard Mitigation Planning Working Group  
[hazardmitigation@framinghamma.gov](mailto:hazardmitigation@framinghamma.gov)

## Social Media Graphic #1

**CITY OF FRAMINGHAM**  
**PUBLIC MEETING / Hazard Mitigation Plan**  
**HAZARD MITIGATION PLAN Update**



Please join the City virtually on **July 11th from 6:00 PM to 7:00 PM** for a public meeting on the hazard mitigation planning process. Members of the public can provide feedback during the zoom meeting using these details:

**ZOOM DETAILS:**  
<https://bit.ly/3u8tqAZ>  
**Meeting ID: 813 0282 1517**  
**Passcode: 145851**



News Article Following Public Meeting #1

NEWS

# Framingham hopes for public input in updating hazard mitigation plan

*Framingham is updating plan to head off disasters*



**Lillian Eden**  
MetroWest Daily News

Published 5:07 a.m. ET July 15, 2022

[View Comments](#)

FRAMINGHAM — Like those old TV ads for Fram oil filters, "Pay me now or pay me later," Framingham consumers can invest in a reliable product now or risk having to pay for expensive repairs down the line.

The product? A citywide action plan to reduce the risk of disasters in the coming years, be it from damaging ice storms or flooding.

Disasters are more expensive than hazards, but hazards can be fixed before they can cause disasters.

That’s according to Jamie Caplan, of Jamie Caplan Consulting, LLC, who spoke during in a virtual meeting Monday. Caplan is helping the city update its hazard mitigation plan, or things that can be done to avoid costly problems later.

“Hazard mitigation is considered any sustained action to reduce or eliminate risk to people and property from natural hazards and their effects,” he said.

Risk reduction could mean anything from updating building codes to retrofitting buildings and conserving wetlands.

That isn’t to say that things like winter storms and damaging, high winds aren’t going to happen, “but we don’t have to let those things turn into disasters,” Caplan said. “The actions we take to prevent the disasters are considered mitigation measures.”

Finding affordable ways of fixing problems that align with Framingham’s goals is part of Caplan’s job consulting with the city. Updating the risk-reduction plan will mean the municipality is also eligible for certain types of federal funding to help pay for upgrades and fixes.

According to the National Oceanographic and Atmospheric Administration, every dollar invested in preventing major problems saves an average of \$6 on future costs; For example, it is cheaper for the city to pour money into stormwater management than it is to repair streets and structures after a disastrous flood.

“We will identify cost-effective actions for the city to reduce risk,” Caplan said. “We’re looking for reasonable activities you can implement and we will focus resources on your greatest vulnerability.”

Caplan and Framingham Sustainability Coordinator Sean Luz said residents should feel free to reach out with their thoughts at future meetings or by contacting city officials, since the plan should include things people care about.

“If you wait for the disaster, it is much more expensive — financially, but also in terms of lives,” Caplan said. Also “the plan and planning process increases awareness of hazards and risks.”

Caplan said her team hopes to have a completed plan by the end of the year.

The hazards Framingham can anticipate include those caused by heavy rain: flooding, landslides and sinkholes, as well as extreme weather like hurricanes and ice storms. For this year’s plan — the last one was created in 2017 — invasive species and infectious disease have been added to the list of natural hazards facing the city.

Once the plan is completed and approved — which the Federal Emergency Management Agency requires every five years — the city can tap into FEMA funding, such as the Building Resilient Infrastructure and Communities program as well as technical assistance with mitigation projects. FEMA had \$1.16 billion available to distribute from fiscal 2021 for BRIC and flood assistance programs.

“If you implement this plan it will, in fact, save lives and money,” Caplan said. “That’s the biggest benefit to it, I think.”

# City of Framingham, MA Hazard Mitigation Plan Update

## Press Release #2



### CITY OF FRAMINGHAM OFFICE OF THE MAYOR

**Charlie Sisitsky**  
Mayor

o 508-532-5401  
e [mayor@framinghamma.gov](mailto:mayor@framinghamma.gov)  
w [www.framinghamma.gov](http://www.framinghamma.gov)

**MEMORIAL BUILDING**  
150 Concord Street, Room 121  
Framingham, MA 01702

**FOR IMMEDIATE RELEASE 12/02/2022**

#### **For further information, contact:**

Ryan Egan  
Public Information Officer  
[regan@framinghamma.gov](mailto:regan@framinghamma.gov)  
O (508) 532-5428 C (508) 782-8629

### **City of Framingham Invites the Public to Learn About the Hazard Mitigation Plan and Provide Feedback**

**FRAMINGHAM, MA** – The Framingham Hazard Mitigation Plan Working Group is developing a plan that identifies and prioritizes actions the City can take to mitigate the impacts of natural hazards and climate change. Citizen participation is essential to this planning process. The input of Framingham residents, business owners, civic organizations, and institutions will be critical to supporting the working group in analyzing local hazards and developing or updating possible actions to reduce their impact.

Please join the City virtually on **Monday, December 19 from 6:00 PM to 7:00 PM for a public meeting on the hazard mitigation planning process.** Members of the public can join the meeting on Zoom using these details:

<https://us02web.zoom.us/j/81652116657?pwd=ZzE0dCtiMlZybjdINU1relFvM0pmUT09>

Meeting ID: 816 5211 6657

Passcode: 819390

The draft plan will be presented at this meeting, with emphasis placed on the mitigation actions identified to mitigate risks to natural hazards throughout the City. Participants in the meeting will have an opportunity to learn and contribute ideas to make the City more resilient to natural hazards such as flooding, snowstorms, high winds, and extreme temperatures. The presentation will be made in English and presentation slides will be available in English, Spanish, and Portuguese.

This plan was developed by a Hazard Mitigation Working Group comprised of City officials and local stakeholders. Jamie Caplan Consulting LLC, a Northampton, MA based firm, led this effort on behalf of the City and the Massachusetts Emergency Management Agency. Federal Emergency Management Agency (FEMA) approval, and City adoption, of the Hazard Mitigation Plan allows the City to apply for pre- and post-disaster hazard mitigation grant funds. More information can be found at <https://www.framinghamma.gov/hazardmitigation>.

For questions regarding this project, please contact the Hazard Mitigation Plan Working Group at [hazardmitigation@framinghamma.gov](mailto:hazardmitigation@framinghamma.gov).

###

## EN ESPAÑOL

**La ciudad de Framingham invita al público a una reunión para**

**Obtenga información sobre la actualización del plan de mitigación de riesgos**

La Ciudad de Framingham está desarrollando un Plan de Mitigación de Peligros que identifica y prioriza las acciones que la Ciudad puede tomar para mitigar los impactos de los peligros naturales y el cambio climático. La participación ciudadana es esencial para este proceso y el aporte de los residentes de Framingham, dueños de negocios, organizaciones cívicas e instituciones será fundamental para apoyar al equipo del proyecto en el análisis de peligros locales y el desarrollo o actualización de posibles acciones para reducir su impacto.

**Únase a la Ciudad virtualmente el 19 de diciembre de 6:00 a 7:00 p. m. para una reunión pública sobre el proceso de planificación de mitigación de riesgos.** Los miembros del público pueden unirse a la reunión en Zoom usando estos detalles:

<https://us02web.zoom.us/j/81652116657?pwd=ZzE0dCtiMlZybjdINU1relFvM0pmUT09>

Identificación de la reunión: 816 5211 6657

Contraseña: 819390

En esta reunión se presentará el borrador del plan, con énfasis en las acciones de mitigación identificadas para mitigar los riesgos de desastres naturales en toda la ciudad. Los asistentes a la reunión tendrán la oportunidad de aprender y aportar ideas para hacer que la ciudad sea más resistente a los peligros naturales como inundaciones, tormentas de nieve, vientos fuertes y temperaturas extremas. La presentación será en inglés y las diapositivas de la presentación estarán disponibles en inglés, español y portugués.

Este plan fue desarrollado por un Grupo de Trabajo de Mitigación de Riesgos compuesto por funcionarios de la ciudad y partes interesadas locales. Jamie Caplan Consulting LLC, una empresa con sede en Northampton, MA, dirigió este esfuerzo en nombre de la ciudad y la Agencia de Manejo de Emergencias de Massachusetts. La aprobación de la Agencia Federal para el Manejo de Emergencias (FEMA) y la adopción por parte de la ciudad del Plan de Mitigación de Riesgos le permite a la ciudad solicitar fondos de subvención para la mitigación de riesgos antes y después del desastre. Se puede encontrar más información en

<https://www.framinghamma.gov/hazardmitigation>.

Si tiene preguntas sobre este proyecto, comuníquese con el Grupo de Trabajo del Plan de Mitigación de Riesgos al [hazardmitigation@framinghamma.gov](mailto:hazardmitigation@framinghamma.gov).

###

# City of Framingham, MA Hazard Mitigation Plan Update

## EM PORTUGUÊS

**A cidade de Framingham convida o público para uma reunião para saber mais sobre a atualização do plano de mitigação de perigos**

A cidade de Framingham está desenvolvendo um Plano de Mitigação de Perigos que identifica e prioriza as ações que a cidade pode tomar para mitigar os impactos de desastres naturais e mudanças climáticas. A participação do público é essencial para este processo e a contribuição dos moradores, empresários, organizações cívicas e instituições de Framingham será fundamental para apoiar a equipe do projeto na análise dos perigos locais e no desenvolvimento ou atualização de possíveis ações para reduzir seu impacto.

**Por favor, junte-se à cidade virtualmente no dia 19 de dezembro, das 18h às 19h, para uma reunião pública sobre o processo de planejamento de mitigação de riscos.** Membros do público podem participar da reunião no Zoom usando estes detalhes:

<https://us02web.zoom.us/j/81652116657?pwd=ZzE0dCtiMlZybjdlNU1relFvM0pmUT09>

ID da reunião: 816 5211 6657

Senha: 819390

Nesta reunião será apresentada a minuta do plano, com ênfase nas ações de mitigação identificadas para mitigar os riscos de desastres naturais em toda a cidade. Os participantes da reunião terão a oportunidade de aprender e contribuir com ideias para tornar a cidade mais resistente a riscos naturais, como inundações, tempestades de neve, ventos fortes e temperaturas extremas. A apresentação será feita em inglês e os slides da apresentação estarão disponíveis em inglês, espanhol e português.

Este plano foi desenvolvido por um Grupo de Trabalho de Mitigação de Riscos composto por funcionários da cidade e partes interessadas locais. Jamie Caplan Consulting LLC, uma empresa com sede em Northampton, MA, liderou esse esforço em nome da cidade e da Massachusetts Emergency Management Agency. A aprovação da Agência Federal de Gerenciamento de Emergências (FEMA) e a adoção pela cidade do Plano de Mitigação de Riscos permite que a cidade solicite fundos de subsídios de mitigação de riscos pré e pós-desastre. Mais informações podem ser encontradas em <https://www.framinghamma.gov/hazardmitigation>

Por perguntas sobre este projeto, entre em contato com o Grupo de Trabalho do Plano de Mitigação de Perigos em [hazardmitigation@framinghamma.gov](mailto:hazardmitigation@framinghamma.gov).

###

# City of Framingham, MA Hazard Mitigation Plan Update

## Public Meeting #2 Flyer



### DECEMBER 19, 2022 PUBLIC MEETING ON ZOOM

Framingham's Hazard Mitigation Planning Working Group has updated the City's Hazard Mitigation Plan. This plan serves as a strategy for reducing current and future risks of natural hazards and climate change.

The public is invited to learn about the Hazard Mitigation Plan and share their ideas for reducing impacts associated with natural hazards, such as flooding, winter storms and hurricanes. Approved by FEMA, the plan allows the City to apply for pre-disaster mitigation grant funding.



#### Hazard Mitigation Public Meeting

December 19, 2022

6:00pm - 7:00pm

For the Zoom Link Visit  
<https://www.framinghamma.gov/hazardmitigation>

Share your ideas to make the City more resilient to natural hazards such as floods, drought, high winds, and winter storms.



FOR MORE INFORMATION  
CONTACT  
Framingham Hazard  
Mitigation Planning Working  
Group  
[hazardmitigation@framinghamma.gov](mailto:hazardmitigation@framinghamma.gov)

## Social Media Graphic #2

**CITY OF FRAMINGHAM**  
**PUBLIC MEETING / Hazard Mitigation Plan**

**HAZARD MITIGATION PLAN**  
*Update*

Please join the City virtually on December 19th from 6:00 PM to 7:00 PM for a public meeting on the hazard mitigation planning process. Members of the public can provide feedback during the zoom meeting using these details:

**ZOOM DETAILS:**  
<https://bit.ly/3P3JYrG>  
**Meeting ID: 816 5211 6657**  
**Passcode: 819390**

## News Article

### Framingham's Hazard Mitigation Plan To Receive Public Input

A meeting will be held to hear what the public thinks about ways to protect the city from climate change, flooding and more.

 Montana Samuels, Patch Staff

Posted Wed, Dec 7, 2022 at 10:00 am ET

[Reply](#)



A virtual public meeting on the planning process is scheduled for Dec. 19 from 6 to 7 p.m. (Neal McNamara/Patch)

FRAMINGHAM, MA — The Framingham Hazard Mitigation Plan Working Group is developing a plan that identifies and prioritizes actions the city can take to mitigate the impacts of natural hazards and climate change.

As that plan continues to develop, city officials are looking for public input in the process.

"The input of Framingham residents, business owners, civic organizations, and institutions will be critical to supporting the working group in analyzing local hazards and developing or updating possible actions to reduce their impact," officials said, in a news release.

Newrez - NMLS #3013 | Featured Advertisement

**Is 2022 the year to buy your dream home?**

With competitive rates and a variety of home loans, your dream home is within reach!



A virtual public meeting on the planning process is scheduled for Dec. 19 from 6 to 7 p.m.

The draft plan will be presented at this meeting, with emphasis placed on the mitigation actions identified to mitigate risks to natural hazards throughout the city, officials said.

# City of Framingham, MA Hazard Mitigation Plan Update

Participants in the meeting will have an opportunity to learn and contribute ideas to make the city more resilient to those natural hazards, such as flooding, snowstorms, high winds, and extreme temperatures.

This plan was developed by a Hazard Mitigation Working Group comprised of city officials and local stakeholders.

Jamie Caplan Consulting LLC, a Northampton, MA-based firm, led this effort on behalf of the City and the Massachusetts Emergency Management Agency. Federal Emergency Management Agency (FEMA) approval, and city adoption, of the Hazard Mitigation Plan, allows the city to apply for pre- and post-disaster hazard mitigation grant funds.

*Get more local news delivered straight to your inbox. [Sign up for free Patch newsletters and alerts.](#)*

♥ Thank    ◻ Reply    ↗ Share



# DRAFT PLAN NEEDS PUBLIC REVIEW

Access the plan on the City's Website:  
<https://www.framinghamma.gov/2047/Climate-Change-and-Hazard-Planning>  
or View a Hard Copy at City Hall  
**Comment Period Ends 2/7/2023**

Framingham's Hazard Mitigation Planning Working Group has updated the City's hazard mitigation plan. This plan serves as a strategy for reducing current and future risks of natural hazards and climate change. Approved by FEMA, the plan allows the City to apply for pre-disaster mitigation grant funding.

CITY OF FRAMINGHAM, MA HAZARD  
MITIGATION PLAN UPDATE  
JANUARY 2023



City of Framingham  
10 Nicholas Road  
Framingham, MA 01701  
508-532-5652  
<https://www.framinghamma.gov>

**FOR MORE INFORMATION OR TO SHARE YOUR COMMENTS**

**Framingham Hazard Mitigation Planning Working Group**

Email: [hazardmitigation@framinghamma.gov](mailto:hazardmitigation@framinghamma.gov)

### Appendix B. Critical Facilities

The list below was developed by the HMWG. Some addresses and standby power status are purposely omitted.

Table 40. Critical Facilities.

Facility	Address	Identified as Having Standby Power?	Use or Comment
Memorial Building/City Hall	150 Concord St	Yes	
Framingham Public Library Main Branch	49 Lexington St	Yes	
Framingham Public Library McAuliffe Branch	746 Water Street	Yes	
Capital Projects and Facilities Management Storage	2 Watson Place		
Capital Projects and Facilities Management Headquarters	10 Nicholas Road	Yes	
Jonathan Maynard Building	14 Vernon St		
Loring Arena	165 Fountain St		
Parks and Recreation Building	475 Union Ave		
Animal Control	50 Western Ave		
atac	160 Hollis St		
Framingham Emergency Operations Center	1 William H Welch Way		
Framingham Fire Department Headquarters – Station 3	10 Loring Dr		
Framingham Fire Department Station 1	1055 Worcester Rd	Yes	
Framingham Fire Department Station 2	75 A St	Yes	
Framingham Fire Department Station 5	520 Concord St	Yes	

# City of Framingham, MA Hazard Mitigation Plan Update

Facility	Address	Identified as Having Standby Power?	Use or Comment
Framingham Fire Department Station 7	789 Water St	Yes	
Public Works Department	100 Western Ave	Yes	
Henry St. Public Works Yard	Henry St Ext		
Callahan Senior Center	535 Union Ave	Yes	
Framingham Police Headquarters	1 William H Welch Way	Yes	
Framingham Police Substation	160 Hollis St		
Framingham Police Substation	39B Beaver Park Rd		
Massachusetts Emergency Management Agency	400 Worcester Road	Yes	
State Police Headquarters	450 Worcester Road	Yes	
Framingham Housing Authority	Arsenal Road	Yes	
Framingham Housing Authority	Other locations		
Heritage at Framingham Assisted Living	747 Water Street		
Carmel Terrace Assisted Living	933 Central Street		
Brookdale Cushing Park	300 West Farm Pond Road		
MetroWest Medical Center	115 Lincoln St		
Bethany Skilled Nursing Facility	97 Bethany Road		
The Carlyle House	342 Winter Street		
Oak Knoll Health Care Center	9 Arbetter Drive		

# City of Framingham, MA Hazard Mitigation Plan Update

Facility	Address	Identified as Having Standby Power?	Use or Comment
Casa de Ramana	485 Franklin Street		
St. Patrick's Manor	863 Central Street		
Framingham State University	100 State Street		
Massachusetts Correctional Institution	30 Loring Dr		
Danforth Museum	121 Union Ave		
MWRTA CNG fueling station			
MWRTA Intermodal Service hub	15 Blandin Avenue		
Logan Express Garage	11 Burr Street		
Barbieri Elementary School	100 Dudley Road	Yes	
Walsh Middle School	301 Brook Street	Yes	
Dunning Elementary School	48 Frost Street	Yes	
Keefe Regional Technical School			
Brophy Elementary School	575 Pleasant St	Yes	
Harmony Grove Elementary School	169 Leland Street	Yes	
McCarthy Elementary School	8 Flagg Drive	Yes	
Fuller Middle School	31 Flagg Drive	Yes	
Juniper Hill Elementary School	29 Upper Joclyn Ave	Yes	
Stapleton Elementary School	25 Elm Street	Yes	
Hemenway School	729 Water Street	Yes	
Cameron School	215 Elm Street	Yes	

# City of Framingham, MA Hazard Mitigation Plan Update

Facility	Address	Identified as Having Standby Power?	Use or Comment
Framingham High School	115 A Street	Yes	
Potter Road Elementary School	492 Potter Road	Yes	
King Elementary School + Admin	454 Water Street	Yes	
Farley Building	19 Flagg Drive	Yes	
Thayer Campus	50 Lawrence St	Yes	
McAuliffe Charter School			
Temple Beth Am			
Temple Beth Sholom			
Brookdale	200 West Farm Pond Rd		
The Branches	518 Pleasant St		
Shillman House	49 Edmands Rd		
Encompass Rehab	125 Newbury St		
Ambulance Station	7 Main St		
Pelham Sub Station	95B Taralli Ter		
Tripoli Sub Station	904 Waverly St		
CSX Transportation			Listed because of potential hazardous materials at these facilities
Framingham POP (Sprint)			
General Chemical Corporation			
Mass Highway			
Qwest Communications			
Triram Corp			
United States Postal Service			

City of Framingham, MA Hazard Mitigation Plan Update

Facility	Address	Identified as Having Standby Power?	Use or Comment
Verizon MA565406			
Verizon MA565206			
Verizon MA565213			
Verizon MA565212			
National Guard Armory			
Framingham State University			Communications Tower
Brimstone Lane Communications Tower			Communications Tower
LZ1 Mass State Police Helipad	470 Worcester Rd		Helipad
LZ3 Farm Pond	N.E. Pond/S.W. Dudley Rd		Helipad
LZ4 Brophy School Soccer Field	575 Pleasant St		Helipad
LZ5 CSX Railyard	Hollis St.		Helipad
LZ6 Framingham High School at Ball Field	115 A Street		Helipad
LZ7 Potter Rd School at Soccer Field	492 Potter Rd		Helipad
Saxonville Levee Flood control system			
Central Street Dam – Sudbury River			
Reservoir No. 1 Dam – Sudbury River			
Reservoir No. 3 Dam – On Reservoir #1			

# City of Framingham, MA Hazard Mitigation Plan Update

Facility	Address	Identified as Having Standby Power?	Use or Comment
Reservoir No. 2 Dam – Direct to Reservoir #1 Da			
Lake Cochituate Dam – Lake Cochituate			
Merriam Hill Tank			Water infrastructure
Goodnow Tank			Water infrastructure
Indian Head Tank			Water infrastructure
Beebe Tank			Water infrastructure
Beebe Tank			Water infrastructure
Doeskin Tank			Water infrastructure
Duggan Drive P.S.			Water infrastructure
Goodnow P.S.			Water infrastructure
Crossing Blvd. P.S.			Water infrastructure
Grove Street P.S.			Water infrastructure
Edgell P.S.			Water infrastructure
Elm St. P.S.			Water infrastructure
Pleasant Street P.S.			Water infrastructure
Doeskin P.S.			Water infrastructure
Sewer Pumping Stations (total of 53)			Sewer infrastructure

Appendix C. Mitigation Actions.

Action Priority Ranking Consideration

Table 41. Priority Ranking Scoring.

Action #	Mitigation Measure	Hazards Addressed	Approximate Cost	Internal Capacity	Implementation Timeline	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Alignment with Objectives	Anticipated Scale of Impact	Anticipated Public Support	Total Score
1	Complete rehabilitation of the Worcester Road Sewer Pump Station.	3	0	1	2	3	3	3	2	2	3	1	23
2	Regionalize emergency dispatch with neighboring communities to enhance and improve efficiency of emergency response services.	3	0	1	3	3	3	3	0	2	3	2	23
3	Acquire the 103 Guild Street property.	3	1	2	3	3	1	0	2	2	3	2	22
4	Acquire the CSX Corridor.	3	0	1	3	3	1	3	2	2	2	2	22
5	Retrofit, update, or replace undersized and unsafe culverts.	3	0	0	1	3	3	3	2	2	3	2	22
6	Develop a <i>Beaver Management Plan</i> .	3	2	1	2	2	1	3	2	2	2	2	22

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Hazards Addressed	Approximate Cost	Internal Capacity	Implementation Timeline	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Alignment with Objectives	Anticipated Scale of Impact	Anticipated Public Support	Total Score
7	Protect or acquire private property impacted by flooding in repetitive loss neighborhoods and neighborhoods lacking infrastructure for future development.	3	0	1	1	3	3	3	2	2	3	1	22
8	Integrate relevant hazard mitigation plan priorities and actions into the City's forthcoming <i>Climate Action Plan</i> .	3	3	2	3	3	0	0	2	2	1	2	21
9	Protect and restore wetland areas and water bodies.	3	1	2	2	3	1	0	2	2	3	2	21
10	Evaluate and pursue opportunities to use clean energy technologies, such as microgrids, to provide enhanced backup power to municipal facilities.	3	1	1	2	3	2	3	0	2	2	2	21
11	Protect flood storage at Mary Dennison Park.	3	0	2	2	3	2	3	0	2	2	2	21

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Hazards Addressed	Approximate Cost	Internal Capacity	Implementation Timeline	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Alignment with Objectives	Anticipated Scale of Impact	Anticipated Public Support	Total Score
12	Implement flood mitigation measures in the Walnut Street neighborhood.	3	0	1	2	3	3	0	2	2	3	2	21
13	Continue to support coordinated efforts to provide emergency shelters and evaluate the specific needs for enhanced capacity in areas of the community.	3	3	1	3	3	3	0	0	2	1	2	21
14	Facilitate education for prospective homebuyers and realtors to address flood risks.	3	3	2	3	2	1	0	2	2	2	1	21
15	Develop a <i>Comprehensive Stormwater Master Plan</i> .	3	1	1	1	2	1	3	2	2	3	2	21
16	Utilize clean energy technologies to provide efficient heating and cooling capacity to municipal facilities and schools.	3	0	1	2	3	2	3	0	2	3	2	21
17	Replace the School Street, Taralli Terrace, Potter Road, and Second Street Bridges.	3	0	0	2	3	3	3	0	2	3	2	21

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Hazards Addressed	Approximate Cost	Internal Capacity	Implementation Timeline	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Alignment with Objectives	Anticipated Scale of Impact	Anticipated Public Support	Total Score
18	Plan and post neighborhood and regional evacuation routes.	3	2	1	3	3	3	0	0	2	2	2	21
19	Coordinate local community organizations to develop educational messaging and/or programming to transfer climate change risk and vulnerability knowledge to the general public.	3	3	2	3	3	1	0	0	2	1	2	20
20	Assess City-owned dams and engage other public and private dam owners in Framingham on resilience.	3	2	1	2	2	1	3	2	2	1	1	20
21	Purchase & install automated weather stations.	3	2	1	2	2	2	3	0	2	2	1	20
22	Develop and implement a municipal program to promote the use of green infrastructure.	3	3	1	3	2	1	0	2	2	2	1	20
23	Foster an improved communications network to better reach vulnerable populations and those most in	3	2	1	3	3	2	0	0	2	2	2	20

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Hazards Addressed	Approximate Cost	Internal Capacity	Implementation Timeline	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Alignment with Objectives	Anticipated Scale of Impact	Anticipated Public Support	Total Score
	need of information and assistance.												
24	Implement drainage improvements to support transportation networks and associated properties.	3	0	1	2	2	2	3	0	2	3	2	20
25	Develop green infrastructure on municipal properties to improve stormwater management and reduce heat island impacts.	3	1	2	1	2	1	3	2	2	1	1	19
26	Develop standards to prioritize social equity in resilience project planning, design, and development.	3	3	2	2	3	1	0	0	2	2	1	19
27	Integrate flood storage review into <i>Open Space Plan</i> .	3	3	1	3	2	1	0	2	2	1	1	19
28	Partner with the local utility on climate resilience efforts.	3	3	2	3	2	2	0	0	2	1	1	19
29	Evaluate and enhance current ordinances and regulations regarding floodplain development.	3	2	1	2	2	2	0	2	2	3	0	19

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Hazards Addressed	Approximate Cost	Internal Capacity	Implementation Timeline	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Alignment with Objectives	Anticipated Scale of Impact	Anticipated Public Support	Total Score
30	Continue community engagement efforts to maximize the adoption of energy efficiency and clean energy technologies at new and existing buildings.	3	2	1	3	3	1	0	0	2	2	2	19
31	Install additional stream gauges and web-based public portal for stream gauge data.	3	1	1	2	2	2	3	0	2	2	1	19
32	Develop a citywide <i>Business Resilience Plan</i> .	3	2	1	2	2	2	3	0	2	2	1	20
33	Conduct robust transportation resiliency planning.	3	2	0	1	2	2	3	0	2	2	1	18
34	Implement emergency generators for traffic signals.	3	1	1	1	2	2	3	0	2	2	1	18
35	Implement recommendations from the feasibility study for removal of the Landham Pond Dam.	3	0	1	1	2	2	0	2	2	3	1	17
36	Conduct a power quality and surge protection study of critical municipal facilities.	3	2	1	2	2	1	3	0	2	1	0	17

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Hazards Addressed	Approximate Cost	Internal Capacity	Implementation Timeline	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Alignment with Objectives	Anticipated Scale of Impact	Anticipated Public Support	Total Score
37	Develop a citywide comprehensive tree and forest management program.	3	2	0	2	2	1	0	2	2	2	1	17
38	Explore the development of a Hazard Mitigation Incentive Program.	3	3	0	1	2	1	0	2	2	2	0	16
39	Evaluate satellite locations to supplement DPW operations center and salt storage.	3	2	1	1	2	1	3	0	2	1	0	16
40	Reimplement the residential rain barrel program.	3	3	2	3	0	0	0	0	2	1	2	16
41	Conduct a community engagement campaign on water conservation.	2	2	2	3	2	0	0	2	2	0	1	16
42	Assess additional mosquito/pest control options, including increased stormwater BMP maintenance.	2	2	0	1	2	1	0	2	2	2	1	15
43	Explore intermunicipal connections with neighboring communities for water resources.	3	2	0	2	2	2	0	0	2	0	0	13

## City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Hazards Addressed	Approximate Cost	Internal Capacity	Implementation Timeline	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Alignment with Objectives	Anticipated Scale of Impact	Anticipated Public Support	Total Score
44	Explore and evaluate means of improving resiliency at historic properties.	3	2	2	1	0	1	0	0	2	0	1	12

# City of Framingham, MA Hazard Mitigation Plan Update

## Actions That Protect Critical Facilities

Table 42. Hazards Addressed, Type of Mitigation Action and Critical Facility Protection.

Action #	Mitigation Measure	Type of Mitigation Action	Hazards Addressed	Critical Facility Protection (Y/N)
1	Complete rehabilitation of the Worcester Road Sewer Pump Station.	Structure & Infrastructure	Flooding	Y
2	Regionalize emergency dispatch with neighboring communities to enhance and improve efficiency of emergency response services.	Structure & Infrastructure	Flooding, Severe Winter Storms, Extreme Temperatures, Hurricanes, Tornadoes	Y
3	Acquire the 103 Guild Street property.	Natural Resources Protection	Flooding	N
4	Acquire the CSX Corridor.	Natural Resources Protection	Flooding	Y
5	Retrofit, update, or replace undersized and unsafe culverts.	Structure & Infrastructure	Flooding	Y
6	Develop a <i>Beaver Management Plan</i> .	Local Plans & Regulations	Flooding, Severe Winter Storms	Y
7	Protect or acquire private property impacted by flooding in repetitive loss neighborhoods and neighborhoods lacking infrastructure for future development.	Natural Resources Protection	Flooding	Y
8	Integrate relevant hazard mitigation plan priorities and actions into the City's forthcoming <i>Climate Action Plan</i> .	Local Plans & Regulations	Extreme Temperatures, Flooding, Severe Winter Storms, Drought,	N

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Hazards Addressed	Critical Facility Protection (Y/N)
			Tornadoes, Hurricanes	
9	<b>Protect and restore wetland areas and water bodies.</b>	Natural Resources Protection	Flooding, Severe Winter Weather, Invasive Species	N
10	<b>Evaluate and pursue opportunities to use clean energy technologies, such as microgrids, to provide enhanced backup power to municipal facilities.</b>	Structure & Infrastructure	Severe Winter Storms, Flooding, Extreme Temperatures, Hurricanes, Thunderstorms	Y
11	<b>Protect flood storage at Mary Dennison Park.</b>	Natural Resources Protection	Flooding	Y
12	<b>Implement flood mitigation measures in the Walnut Street neighborhood.</b>	Natural Resources Protection	Flooding	N
13	<b>Continue to support coordinated efforts to provide emergency shelters and evaluate the specific needs for enhanced capacity in areas of the community.</b>	Structure & Infrastructure	Extreme Temperatures, Flooding, Severe Weather, Drought, Infectious Disease, Wildfires, Tornadoes, Earthquakes, Hurricanes	N
14	<b>Facilitate education for prospective homebuyers and realtors to address flood risks.</b>	Outreach & Education	Flooding	N

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Hazards Addressed	Critical Facility Protection (Y/N)
15	<b>Develop a <i>Comprehensive Stormwater Master Plan</i>.</b>	Local Plans & Regulations	Flooding, Severe Winter Storms	Y
16	<b>Utilize clean energy technologies to provide efficient heating and cooling capacity to municipal facilities and schools.</b>	Structure & Infrastructure	Extreme Temperatures	Y
17	<b>Replace the School Street, Taralli Terrace, Potter Road, and Second Street Bridges.</b>	Structure & Infrastructure	Flooding, Severe Winter Storms, Hurricanes, Tornadoes, Earthquakes	Y
18	<b>Plan and post neighborhood and regional evacuation routes.</b>	Outreach & Education	Extreme Temperatures, Flooding, Severe Weather, Tornadoes, Earthquakes, Hurricanes	N
19	<b>Coordinate local community organizations to develop educational messaging and/or programming to transfer climate change risk and vulnerability knowledge to the general public.</b>	Outreach & Education	Extreme Temperatures, Flooding, Severe Weather, Drought, Infectious Disease, Wildfires, Tornadoes, Earthquakes, Hurricanes	N
20	<b>Assess City-owned dams and engage other public and private dam owners in Framingham on resilience.</b>	Outreach & Education	Flooding, Severe Winter Storms, Hurricanes,	Y

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Hazards Addressed	Critical Facility Protection (Y/N)
			Tornadoes, Earthquakes	
21	<b>Purchase &amp; install automated weather stations.</b>	Structure & Infrastructure	Extreme Temperatures, Flooding, Severe Winter Storms, Drought	Y
22	<b>Develop and implement a municipal program to promote the use of green infrastructure.</b>	Outreach & Education	Flooding, Extreme Temperatures, Invasive Species	N
23	<b>Foster an improved communications network to better reach vulnerable populations and those most in need of information and assistance.</b>	Outreach & Education	Extreme Temperatures, Flooding, Severe Winter Storms, Drought, Wildfires, Tornadoes, Earthquakes	N
24	<b>Implement drainage improvements to support transportation networks and associated properties.</b>	Structure & Infrastructure	Flooding, Severe Winter Weather	Y
25	<b>Develop green infrastructure on municipal properties to improve stormwater management and reduce heat island impacts.</b>	Structure & Infrastructure	Flooding, Wildfires, Extreme Temperatures	Y
26	<b>Develop standards to prioritize social equity in resilience project planning, design, and development.</b>	Outreach & Education	Extreme Temperatures, Flooding, Severe Weather, Drought, Infectious Disease,	N

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Hazards Addressed	Critical Facility Protection (Y/N)
			Wildfires, Tornadoes, Earthquakes, Hurricanes	
27	Integrate flood storage review into <i>Open Space Plan</i> .	Local Plans & Regulations	Flooding	N
28	Partner with the local utility on climate resilience efforts.	Outreach & Education	Extreme Temperatures, Flooding, Severe Winter Weather	N
29	Evaluate and enhance current ordinances and regulations regarding floodplain development.	Local Plans & Regulations	Flooding, Severe Winter Storms	N
30	Continue community engagement efforts to maximize the adoption of energy efficiency and clean energy technologies at new and existing buildings.	Outreach & Education	Flooding, Severe Winter Storms, Extreme Temperatures, Hurricanes, Tornadoes, Thunderstorms, Earthquakes	N
31	Install additional stream gauges and web-based public portal for stream gauge data.	Structure & Infrastructure	Flooding, Drought	Y
32	Develop a citywide <i>Business Resilience Plan</i> .	Local Plans & Regulations	Extreme Temperatures, Flooding, Severe Winter Storms, Hurricanes, Infectious/Disease Drought	Y
33	Conduct robust transportation resiliency planning.	Local Plans & Regulations	Extreme Temperatures, Flooding,	Y

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Hazards Addressed	Critical Facility Protection (Y/N)
			Severe Winter Storms, Hurricanes, Infectious/Disease Drought	
34	Implement emergency generators for traffic signals.	Structure & Infrastructure	Severe Winter Storms, Flooding, Extreme Temperatures, Hurricanes, Thunderstorms	Y
35	Implement recommendations from the feasibility study for removal of the Landham Pond Dam.	Structure & Infrastructure	Flooding, Severe Winter Storms	N
36	Conduct a power quality and surge protection study of critical municipal facilities.	Local Plans & Regulations	Extreme Temperatures, Severe Winter Storms, Thunderstorms	Y
37	Develop a citywide comprehensive tree and forest management program.	Local Plans & Regulations	Flooding, Severe Winter Storms, Extreme Temperatures	N
38	Explore the development of a Hazard Mitigation Incentive Program.	Local Plans & Regulations	Flooding, Severe Winter Storms, Extreme Temperatures, Hurricanes, Drought, Tornadoes	N
39	Evaluate satellite locations to supplement DPW operations center and salt storage.	Local Plans & Regulations	Flooding, Severe Winter	Y

City of Framingham, MA Hazard Mitigation Plan Update

Action #	Mitigation Measure	Type of Mitigation Action	Hazards Addressed	Critical Facility Protection (Y/N)
			Storms, Hurricanes, Tornadoes, Earthquakes	
40	Reimplement the residential rain barrel program.	Outreach & Education	Flooding, Drought	N
41	Conduct a community engagement campaign on water conservation.	Outreach & Education	Drought	N
42	Assess additional mosquito/pest control options, including increased stormwater BMP maintenance.	Outreach & Education	Invasive Species, Infectious Disease	N
43	Explore intermunicipal connections with neighboring communities for water resources.	Local Plans & Regulations	Drought, Invasive Species	N
44	Explore and evaluate means of improving resiliency at historic properties.	Structure & Infrastructure	Flooding, Severe Winter Storms, Extreme Temperatures, Hurricanes, Tornadoes	N

Appendix D. Plan Implementation and Review Supporting Materials.

Plan Update Evaluation Worksheet

Plan Section	Considerations	Response
<b>Planning Process</b>	Should the town invite any additional stakeholders to participate in the planning process? What public outreach activities have occurred? How can public involvement be improved?	
<b>Risk Assessment</b>	What disasters has the town, or the region experienced? Should the list of hazards be modified? Are new data sources, maps, or studies available? If so, what have they revealed, and should the information be incorporated into the plan update? Has development in the region occurred and could it create or reduce risk?	
<b>Capability Assessment</b>	Has the town adopted new policies, plans, regulations, or reports that could be incorporated into this plan? Are there different or additional administrative, human, technical, and financial resources available for mitigation planning? Are there different or new education and outreach programs and resources available for mitigation activities?	
<b>Mitigation Strategy</b>	Is the mitigation strategy being implemented as anticipated?  Were the cost and timeline estimate accurate?  Should new mitigation actions be added to the Action Plan?  Should existing mitigation actions be revised or removed from the plan?  Are there new obstacles that were not anticipated in the plan that will need to be considered in the next plan update? Are there new funding sources to consider?  Have elements of the plan been incorporated into other planning mechanisms?	
<b>Implementation Plan</b>	Was the plan monitored and evaluated as anticipated?  What are needed improvements to the plan implementation procedures?	

# City of Framingham, MA Hazard Mitigation Plan Update

## Mitigation Action Progress Worksheet

Mitigation Action Progress Worksheet				
<b>Progress Report Period</b>		From Date	To Date	
Action/Project Title				
Responsible Department				
Contact Name				
Contact Phone/Email				
Project Description				
Project Goal				
Project Objective				
Project Cost				
Project Status				
Date of Project Approval	Date of Project Start	Anticipated Date of Completion	Project Canceled	Project Delayed
Explanation of Delay or Cost Overruns				
Project Report Summary				
What was accomplished for this project during this reporting period?				
What obstacles, problems, or delays did the project encounter?				
Plans for next reporting period.				

Appendix E. Hazus Results



# Hazus: Flood Global Risk Report

**Region Name:** FraminghamFL

**Flood Scenario:** 100year

**Print Date:** Thursday, August 25, 2022

**Disclaimer:**

*This version of Hazus utilizes 2010 Census Data.*

*Totals only reflect data for those census tracts/blocks included in the user's study region.*

*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 Flood. These results can be improved by using enhanced inventory data and flood hazard information.*



**FEMA**

**RiskMAP**  
Increasing Resilience Together



## Table of Contents

Section	Page #
<b>General Description of the Region</b>	<b>3</b>
<b>Building Inventory</b>	
General Building Stock	4
Essential Facility Inventory	5
<b>Flood Scenario Parameters</b>	<b>6</b>
<b>Building Damage</b>	
General Building Stock	7
Essential Facilities Damage	9
<b>Induced Flood Damage</b>	<b>10</b>
Debris Generation	
<b>Social Impact</b>	<b>10</b>
Shelter Requirements	
<b>Economic Loss</b>	<b>12</b>
Building-Related Losses	
<b>Appendix A: County Listing for the Region</b>	<b>15</b>
<b>Appendix B: Regional Population and Building Value Data</b>	<b>16</b>



**FEMA**

**RiskMAP**  
Increasing Resilience Together



## General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Massachusetts

Note:

Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is approximately 27 square miles and contains 1,145 census blocks. The region contains over 26 thousand households and has a total population of 68,318 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B .

There are an estimated 19,056 buildings in the region with a total building replacement value (excluding contents) of 10,661 million dollars. Approximately 87.58% of the buildings (and 71.18% of the building value) are associated with residential housing.



**FEMA**

**RiskMAP**  
Increasing Resilience Together



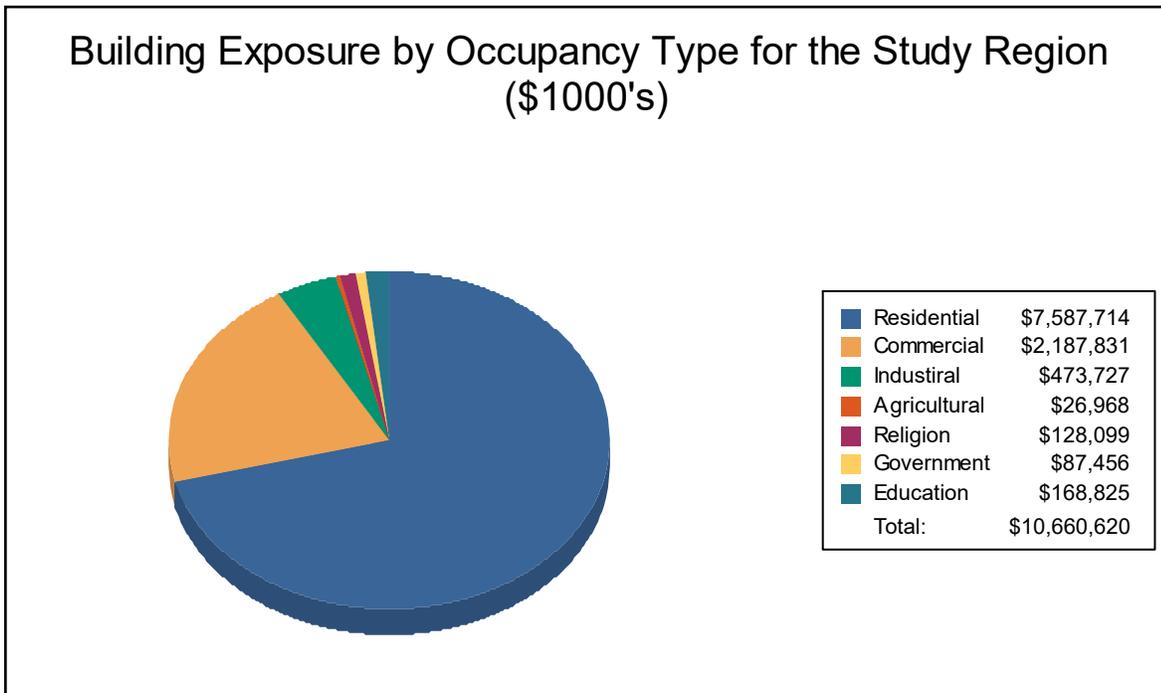
## Building Inventory

### General Building Stock

Hazus estimates that there are 19,056 buildings in the region which have an aggregate total replacement value of 10,661 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

**Table 1**  
**Building Exposure by Occupancy Type for the Study Region**

Occupancy	Exposure (\$1000)	Percent of Total
Residential	7,587,714	71.2%
Commercial	2,187,831	20.5%
Industrial	473,727	4.4%
Agricultural	26,968	0.3%
Religion	128,099	1.2%
Government	87,456	0.8%
Education	168,825	1.6%
<b>Total</b>	<b>10,660,620</b>	<b>100%</b>



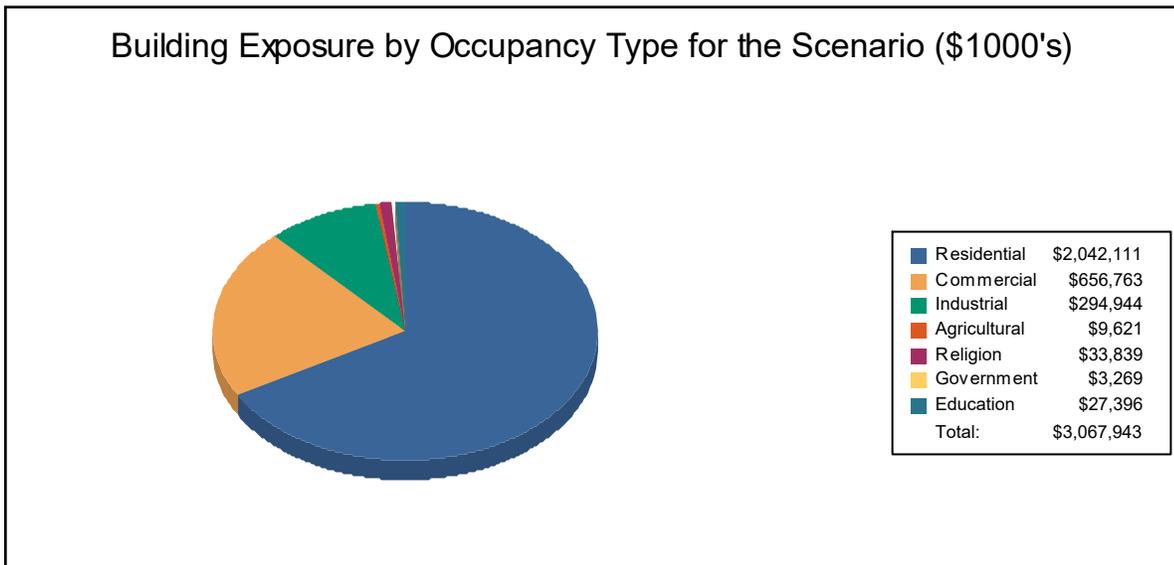
FEMA

**RiskMAP**  
 Increasing Resilience Together



**Table 2**  
**Building Exposure by Occupancy Type for the Scenario**

<b>Occupancy</b>	<b>Exposure (\$1000)</b>	<b>Percent of Total</b>
Residential	2,042,111	66.6%
Commercial	656,763	21.4%
Industrial	294,944	9.6%
Agricultural	9,621	0.3%
Religion	33,839	1.1%
Government	3,269	0.1%
Education	27,396	0.9%
<b>Total</b>	<b>3,067,943</b>	<b>100%</b>



**Essential Facility Inventory**

For essential facilities, there are 2 hospitals in the region with a total bed capacity of 155 beds. There are 29 schools, 5 fire stations, 6 police stations and 2 emergency operation centers.



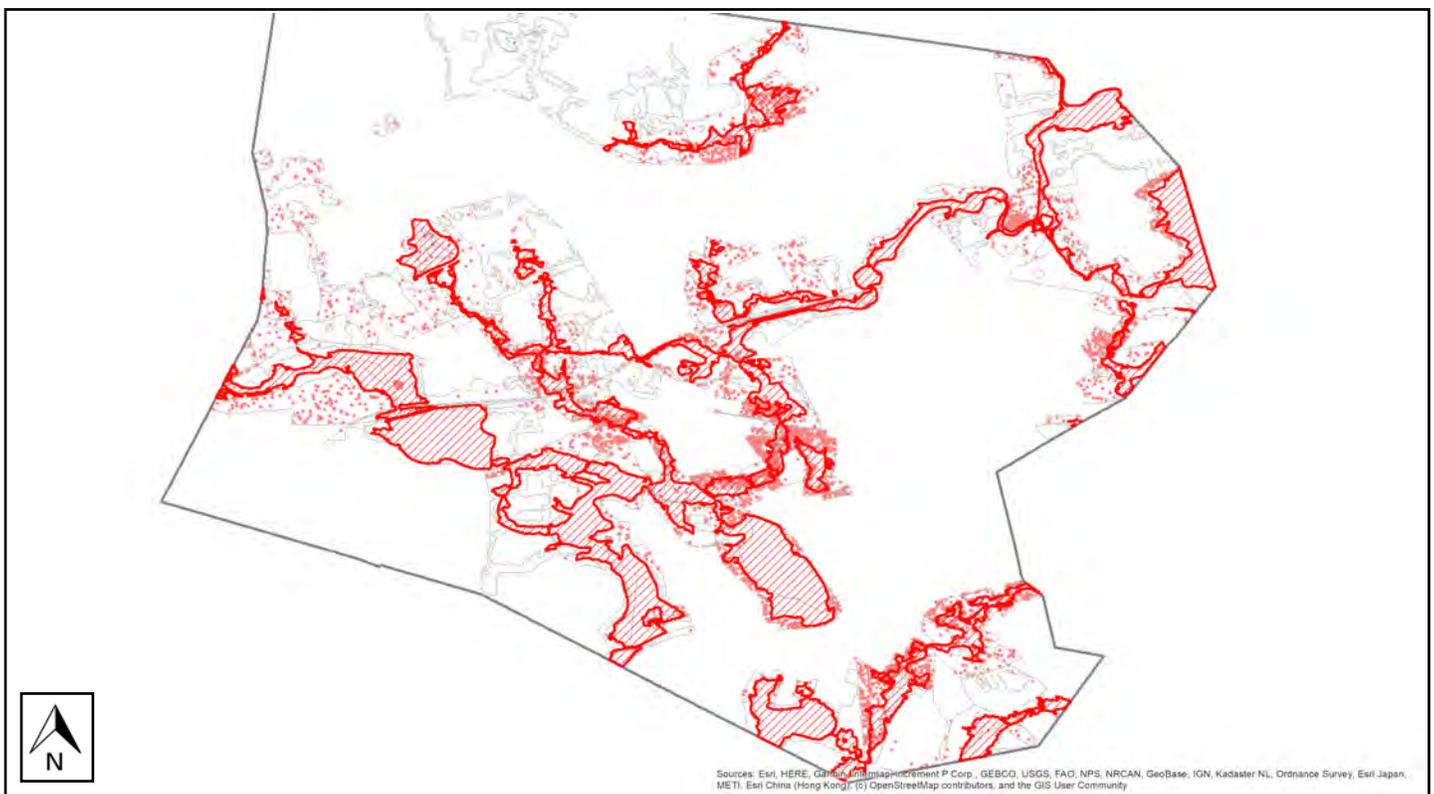


## Building Damage

### General Building Stock Damage

Hazus estimates that about 169 buildings will be at least moderately damaged. This is over 80% of the total number of buildings in the scenario. There are an estimated 6 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

**Total Economic Loss (1 dot = \$300K) Overview Map**



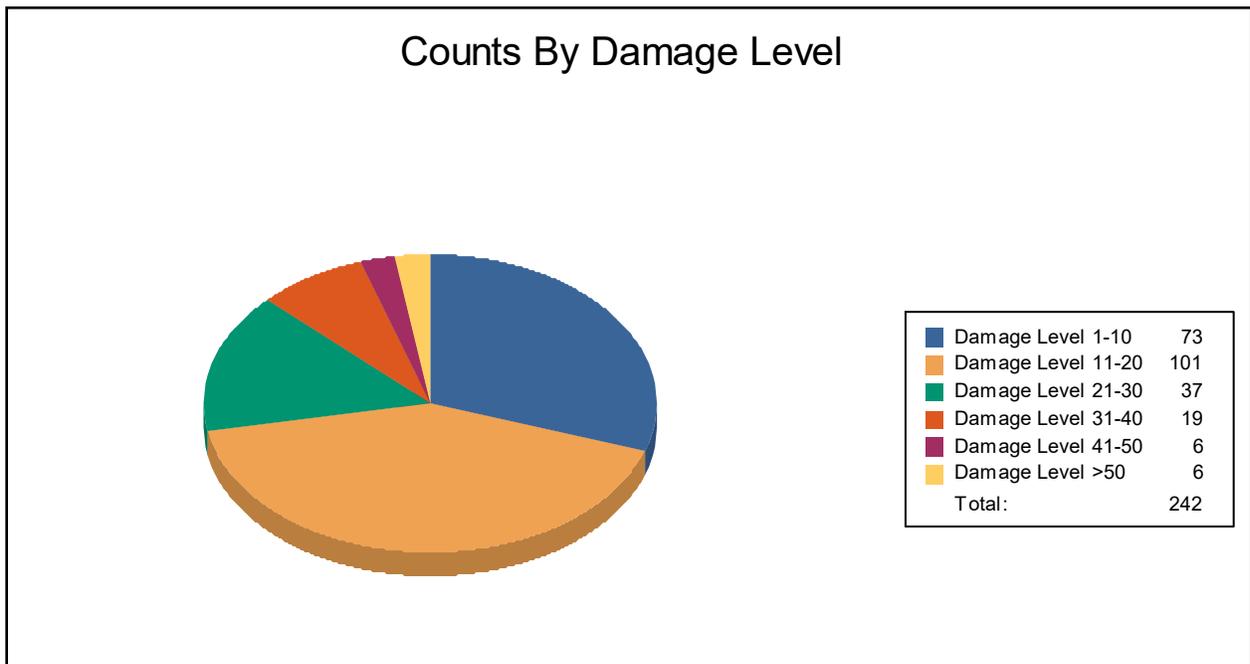
FEMA

**RiskMAP**  
Increasing Resilience Together



**Table 3: Expected Building Damage by Occupancy**

Occupancy	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	1	100	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	73	30	100	41	37	15	19	8	6	2	6	2
<b>Total</b>	<b>73</b>		<b>101</b>		<b>37</b>		<b>19</b>		<b>6</b>		<b>6</b>	





**Table 4: Expected Building Damage by Building Type**

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)										
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	1	33	2	67	0	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	72	30	99	41	37	15	19	8	6	3	6	3



**FEMA**

**RiskMAP**  
Increasing Resilience Together



## Essential Facility Damage

Before the flood analyzed in this scenario, the region had 155 hospital beds available for use. On the day of the scenario flood event, the model estimates that 155 hospital beds are available in the region.

**Table 5: Expected Damage to Essential Facilities**

Classification	# Facilities			
	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	2	0	0	0
Fire Stations	5	0	0	0
Hospitals	2	0	0	0
Police Stations	6	0	0	0
Schools	29	1	0	1

If this report displays all zeros or is blank, two possibilities can explain this.

- (1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.
- (2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.



## Induced Flood Damage

### Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

**Analysis has not been performed for this Scenario.**



**FEMA**

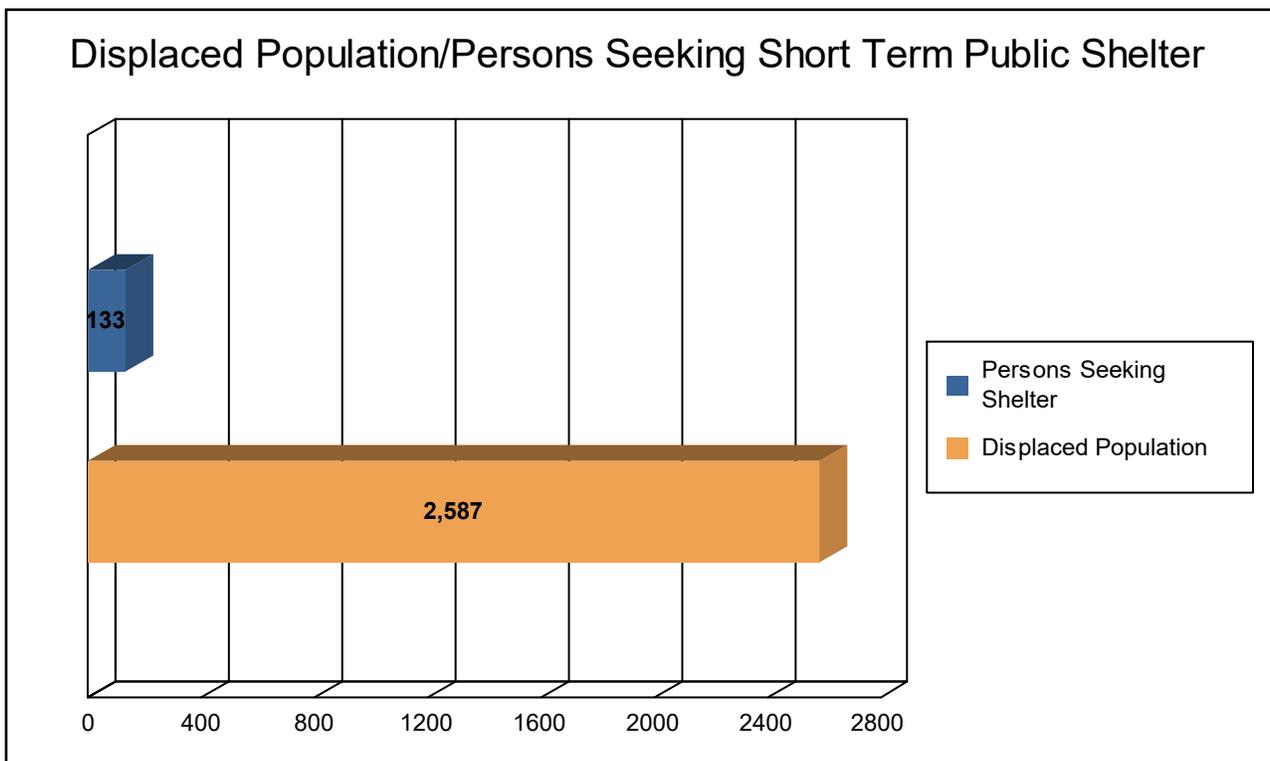
**RiskMAP**  
Increasing Resilience Together



## Social Impact

### Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 862 households (or 2,587 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 133 people (out of a total population of 68,318) will seek temporary shelter in public shelters.



FEMA

RiskMAP  
Increasing Resilience Together



## Economic Loss

The total economic loss estimated for the flood is 223.46 million dollars, which represents 7.28 % of the total replacement value of the scenario buildings.

### **Building-Related Losses**

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 140.43 million dollars. 37% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 39.96% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.



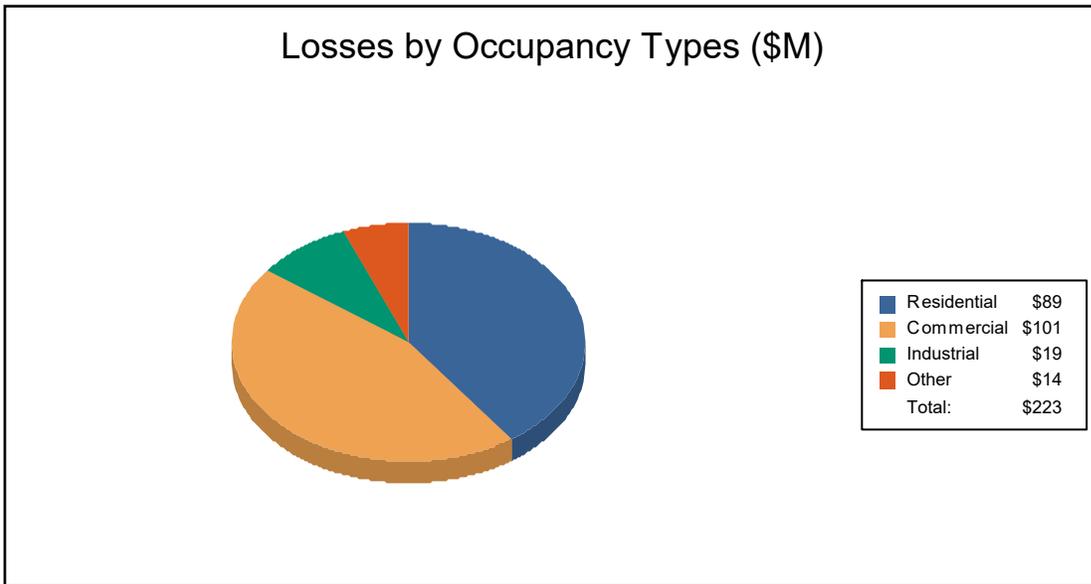
**FEMA**

**RiskMAP**  
Increasing Resilience Together



**Table 6: Building-Related Economic Loss Estimates**  
(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Building Loss</u>						
	Building	46.96	12.55	5.38	1.08	65.97
	Content	24.74	30.90	11.17	5.59	72.40
	Inventory	0.00	0.51	1.52	0.03	2.06
	<b>Subtotal</b>	<b>71.70</b>	<b>43.96</b>	<b>18.07</b>	<b>6.70</b>	<b>140.43</b>
<u>Business Interruption</u>						
	Income	0.66	21.44	0.27	1.67	24.04
	Relocation	9.89	6.81	0.34	0.60	17.64
	Rental Income	5.48	5.10	0.06	0.04	10.68
	Wage	1.57	23.95	0.48	4.67	30.68
	<b>Subtotal</b>	<b>17.61</b>	<b>57.30</b>	<b>1.15</b>	<b>6.98</b>	<b>83.03</b>
<b>ALL</b>	<b>Total</b>	<b>89.30</b>	<b>101.25</b>	<b>19.22</b>	<b>13.69</b>	<b>223.46</b>





## **Appendix A: County Listing for the Region**

Massachusetts

- Middlesex



**FEMA**

**RiskMAP**  
Increasing Resilience Together



**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
<b>Massachusetts</b>				
Middlesex	68,318	7,587,714	3,072,906	10,660,620
<b>Total</b>	<b>68,318</b>	<b>7,587,714</b>	<b>3,072,906</b>	<b>10,660,620</b>
<b>Total Study Region</b>	<b>68,318</b>	<b>7,587,714</b>	<b>3,072,906</b>	<b>10,660,620</b>



FEMA

**RiskMAP**  
Increasing Resilience Together

## Hazus: Hurricane Global Risk Report

**Region Name:** Framingham\_Wind

**Hurricane Scenario:** Probabilistic 500-year Return Period

**Print Date:** Thursday, August 25, 2022

**Disclaimer:**

*This version of Hazus utilizes 2010 Census Data.*

*Totals only reflect data for those census tracts/blocks included in the user's study region.*

*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 Hurricane. These results can be improved by using enhanced inventory data.*



## Table of Contents

<b>Section</b>	<b>Page #</b>
General Description of the Region	3
Building Inventory	4
General Building Stock	
Essential Facility Inventory	
Hurricane Scenario Parameters	5
Building Damage	6
General Building Stock	
Essential Facilities Damage	
Induced Hurricane Damage	8
Debris Generation	
Social Impact	8
Shelter Requirements	
Economic Loss	9
Building Losses	
Appendix A: County Listing for the Region	10
Appendix B: Regional Population and Building Value Data	11



## General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Massachusetts

Note:

Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is 33.35 square miles and contains 15 census tracts. There are over 27 thousand households in the region and a total population of 72,638 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B .

There are an estimated 20 thousand buildings in the region with a total building replacement value (excluding contents) of 11,624 million dollars (2014 dollars). Approximately 87% of the buildings (and 71% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

Hazus estimates that there are 20,603 buildings in the region which have an aggregate total replacement value of 11,624 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

### Building Exposure by Occupancy Type

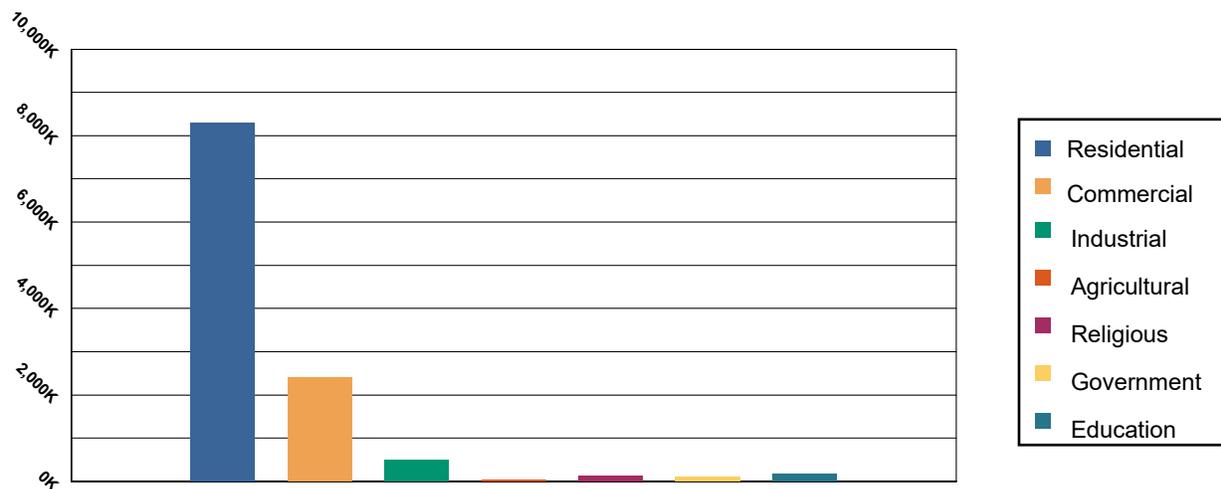


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure (\$1000)	Percent of Tot
Residential	8,290,487	71.32%
Commercial	2,413,041	20.76%
Industrial	491,919	4.23%
Agricultural	32,577	0.28%
Religious	135,461	1.17%
Government	91,096	0.78%
Education	169,371	1.46%
<b>Total</b>	<b>11,623,952</b>	<b>100.00%</b>

### Essential Facility Inventory

For essential facilities, there are 2 hospitals in the region with a total bed capacity of 155 beds. There are 30 schools, 6 fire stations, 7 police stations and 2 emergency operation facilities.



FEMA

## Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

**Scenario Name:** Probabilistic

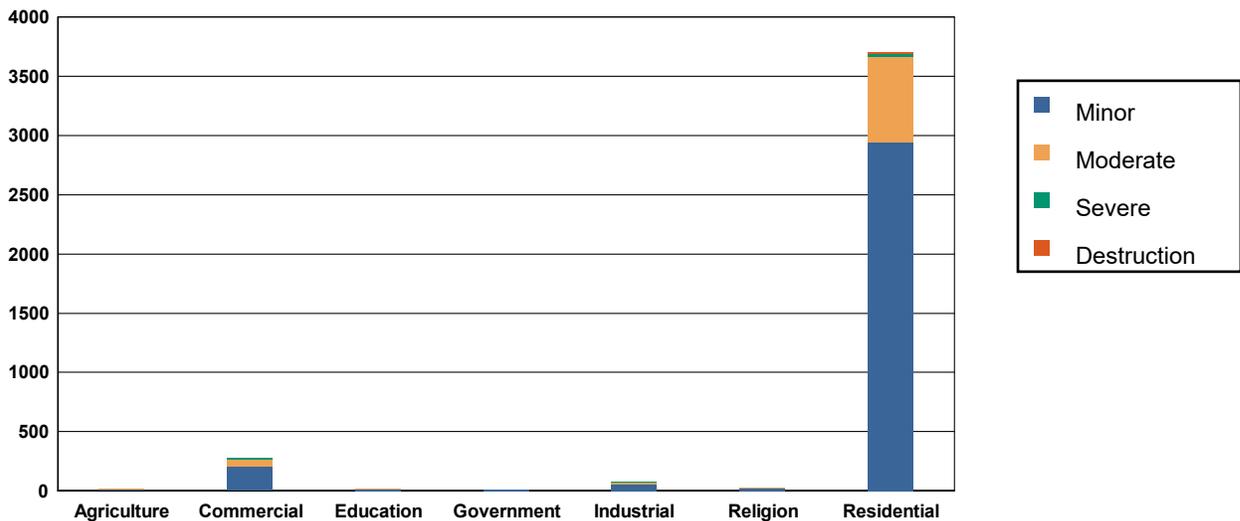
**Type:** Probabilistic

## Building Damage

### General Building Stock Damage

Hazus estimates that about 851 buildings will be at least moderately damaged. This is over 4% of the total number of buildings in the region. There are an estimated 10 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

### Expected Building Damage by Occupancy



**Table 2: Expected Building Damage by Occupancy : 500 - year Event**

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	77.22	81.29	12.77	13.44	3.29	3.46	1.56	1.64	0.16	0.17
Commercial	1,476.47	84.47	207.81	11.89	55.74	3.19	7.94	0.45	0.04	0.00
Education	68.44	85.54	9.41	11.76	2.03	2.54	0.13	0.16	0.00	0.00
Government	47.85	85.44	6.56	11.71	1.51	2.69	0.09	0.17	0.00	0.00
Industrial	399.33	84.78	53.72	11.41	14.67	3.12	3.06	0.65	0.22	0.05
Religion	113.24	84.51	17.49	13.05	3.08	2.30	0.20	0.15	0.00	0.00
Residential	14,320.31	79.47	2,941.47	16.32	725.75	4.03	21.70	0.12	9.78	0.05
<b>Total</b>	<b>16,502.86</b>		<b>3,249.22</b>		<b>806.07</b>		<b>34.67</b>		<b>10.19</b>	



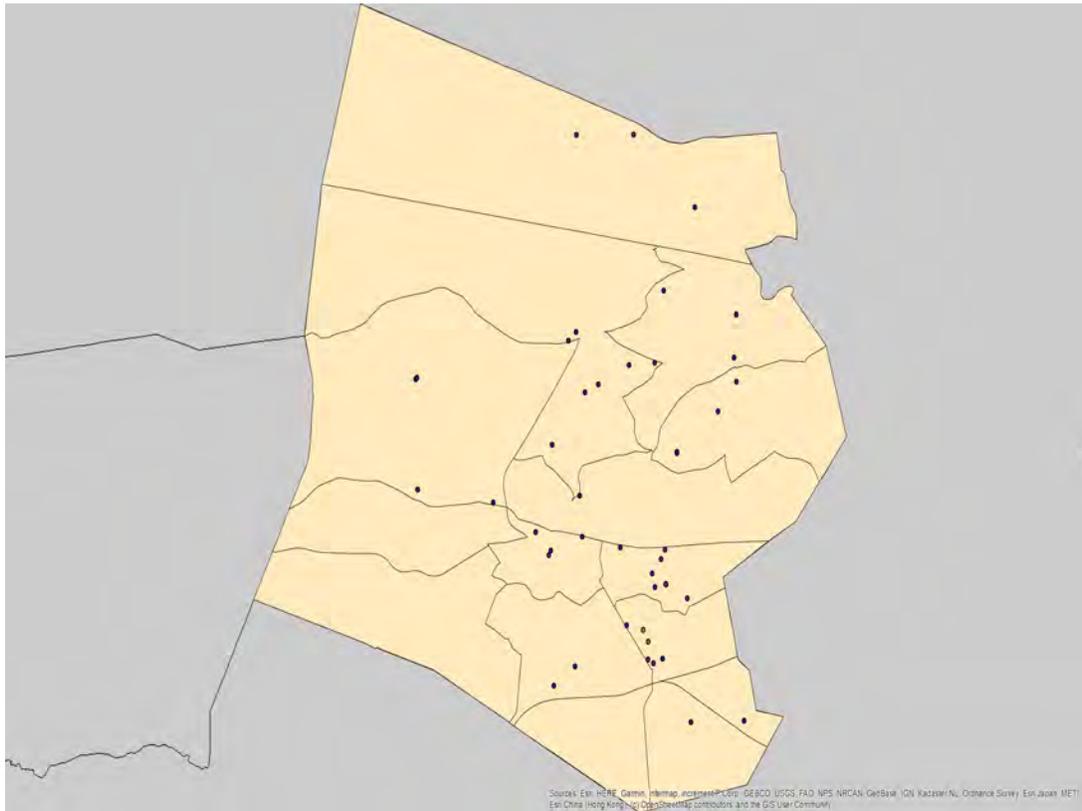
**Table 3: Expected Building Damage by Building Type : 500 - year Event**

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	284	80.79	51	14.55	16	4.54	0	0.12	0	0.00
Masonry	1,503	74.67	297	14.76	206	10.21	7	0.33	1	0.03
MH	19	93.69	1	3.83	0	1.78	0	0.04	0	0.65
Steel	1,045	84.59	137	11.12	45	3.66	8	0.63	0	0.00
Wood	13,917	81.92	2,721	16.02	321	1.89	21	0.12	9	0.05

### Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 155 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

**Thematic Map of Essential Facilities with greater than 50% moderate**



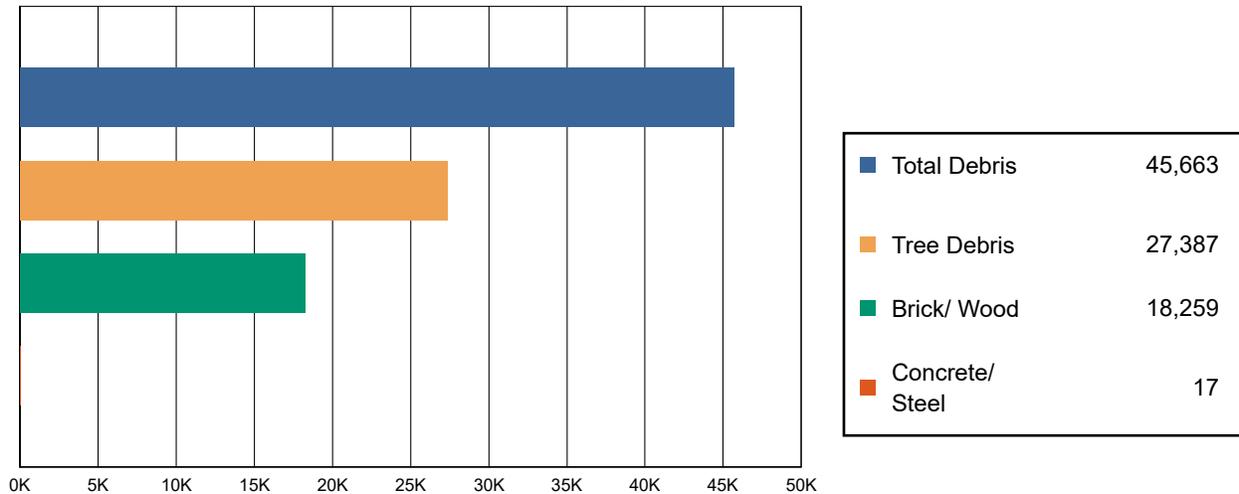
**Table 4: Expected Damage to Essential Facilities**

Classification	Total	# Facilities		
		Probability of at Least Moderate	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
EOCs	2	0	0	2
Fire Stations	6	0	0	6
Hospitals	2	0	0	2
Police Stations	7	0	0	7
Schools	30	0	0	17

## Induced Hurricane Damage

### Debris Generation

**Estimated Debris (Tons)**

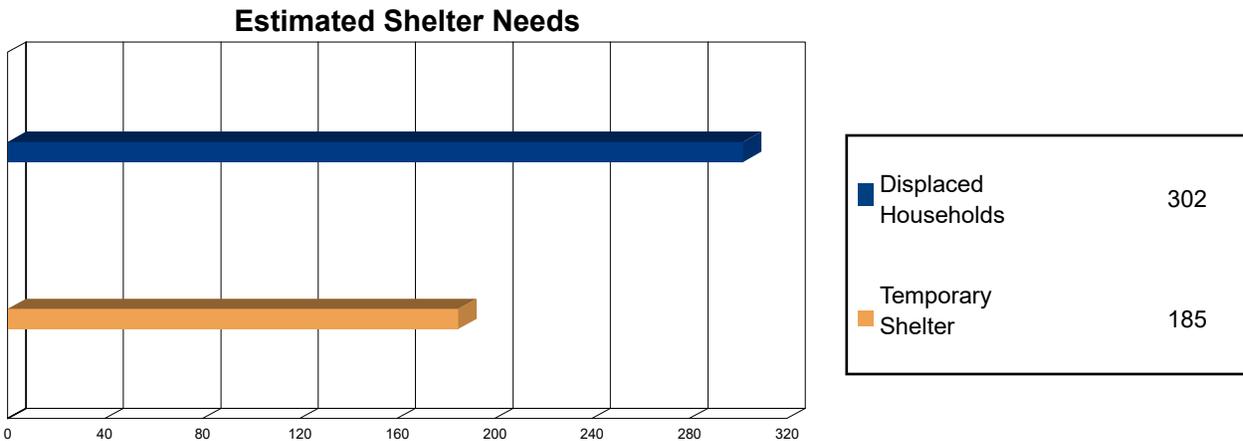


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 45,663 tons of debris will be generated. Of the total amount, 13,291 tons (29%) is Other Tree Debris. Of the remaining 32,372 tons, Brick/Wood comprises 56% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 731 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 14,096 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

## Social Impact

### Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 302 households to be displaced due to the hurricane. Of these, 185 people (out of a total population of 72,638) will seek temporary shelter in public shelters.



## Economic Loss

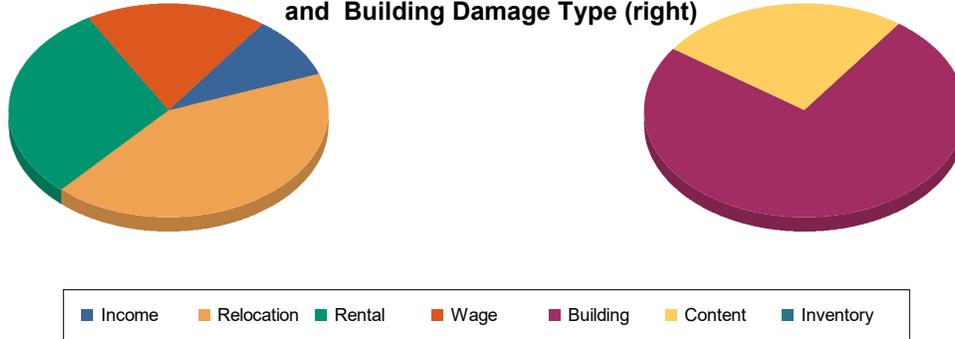
The total economic loss estimated for the hurricane is 275.9 million dollars, which represents 2.37 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 276 million dollars. 7% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 88% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

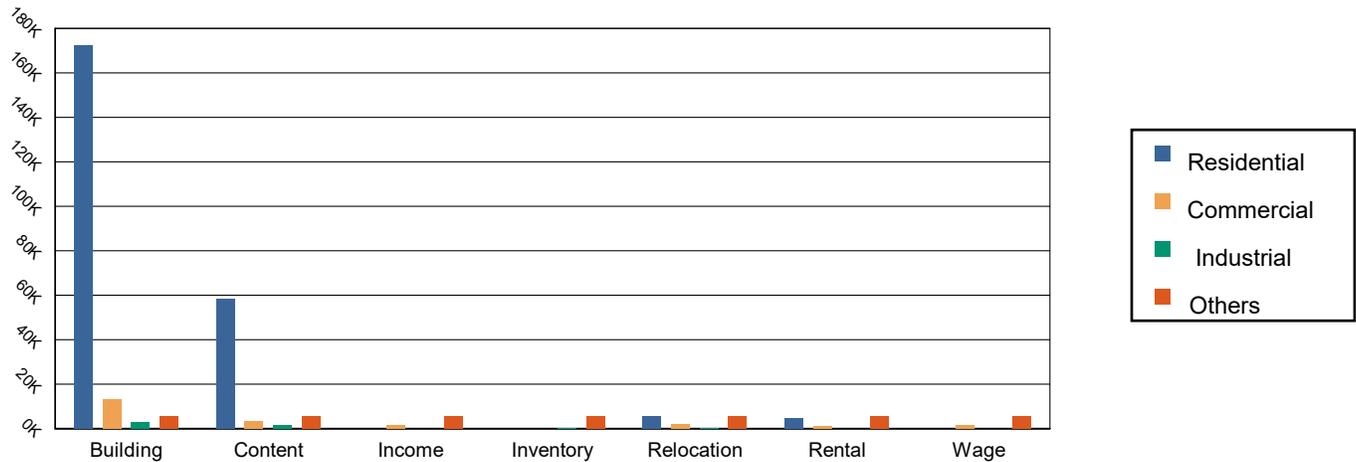


Table 5: Building-Related Economic Loss Estimates  
(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<b>Property Damage</b>						
	Building	172,627.74	13,259.50	3,089.35	2,232.28	191,208.87
	Content	58,428.07	3,476.80	1,813.52	598.45	64,316.84
	Inventory	0.00	88.57	213.31	12.36	314.24
	<b>Subtotal</b>	<b>231,055.81</b>	<b>16,824.87</b>	<b>5,116.18</b>	<b>2,843.09</b>	<b>255,839.95</b>
<b>Business Interruption Loss</b>						
	Income	0.00	1,613.66	36.17	219.63	1,869.47
	Relocation	5,732.22	2,195.21	206.09	360.74	8,494.26
	Rental	4,727.56	1,228.84	31.49	29.83	6,017.71
	Wage	0.00	1,559.44	60.58	2,075.79	3,695.82
	<b>Subtotal</b>	<b>10,459.78</b>	<b>6,597.15</b>	<b>334.33</b>	<b>2,685.99</b>	<b>20,077.26</b>



FEMA

---

Total

---

Total	241,515.60	23,422.02	5,450.51	5,529.08	275,917.21
-------	------------	-----------	----------	----------	------------

---



FEMA

---

**Appendix A: County Listing for the Region**

Massachusetts  
- Middlesex



**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
<b>Massachusetts</b>				
Middlesex	72,638	8,290,487	3,333,465	11,623,952
<b>Total</b>	<b>72,638</b>	<b>8,290,487</b>	<b>3,333,465</b>	<b>11,623,952</b>
<b>Study Region Total</b>	<b>72,638</b>	<b>8,290,487</b>	<b>3,333,465</b>	<b>11,623,952</b>



FEMA

**RiskMAP**  
Increasing Resilience Together

## Hazus: Hurricane Global Risk Report

**Region Name:** Framingham\_Wind

**Hurricane Scenario:** Probabilistic 1000-year Return Period

**Print Date:** Thursday, August 25, 2022

**Disclaimer:**

*This version of Hazus utilizes 2010 Census Data.*

*Totals only reflect data for those census tracts/blocks included in the user's study region.*

*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 Hurricane. These results can be improved by using enhanced inventory data.*



## Table of Contents

<b>Section</b>	<b>Page #</b>
General Description of the Region	3
Building Inventory	4
General Building Stock	
Essential Facility Inventory	
Hurricane Scenario Parameters	5
Building Damage	6
General Building Stock	
Essential Facilities Damage	
Induced Hurricane Damage	8
Debris Generation	
Social Impact	8
Shelter Requirements	
Economic Loss	9
Building Losses	
Appendix A: County Listing for the Region	10
Appendix B: Regional Population and Building Value Data	11



## General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Massachusetts

Note:

Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is 33.35 square miles and contains 15 census tracts. There are over 27 thousand households in the region and a total population of 72,638 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B .

There are an estimated 20 thousand buildings in the region with a total building replacement value (excluding contents) of 11,624 million dollars (2014 dollars). Approximately 87% of the buildings (and 71% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

Hazus estimates that there are 20,603 buildings in the region which have an aggregate total replacement value of 11,624 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

### Building Exposure by Occupancy Type

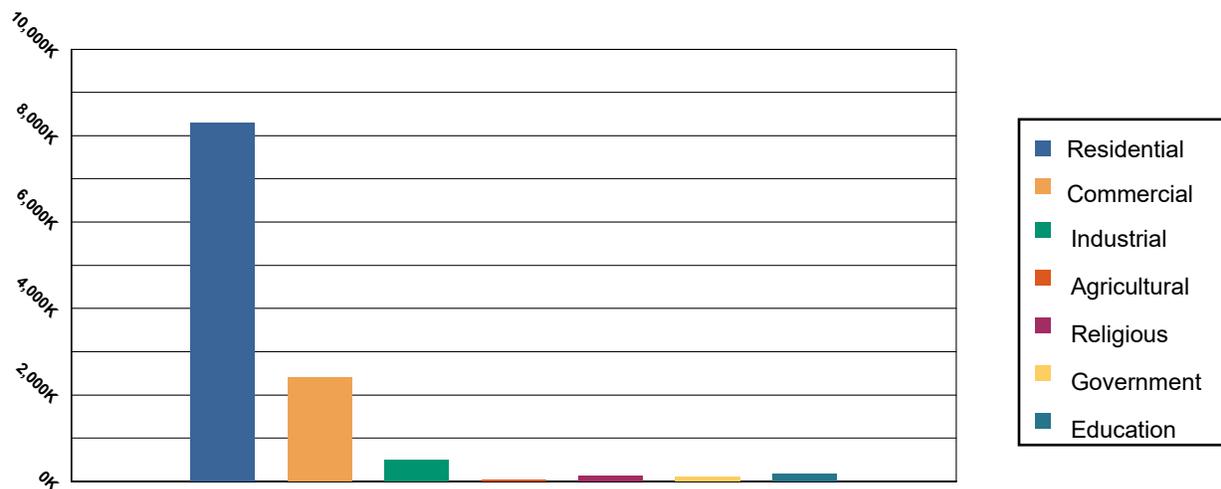


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure (\$1000)	Percent of Tot
Residential	8,290,487	71.32%
Commercial	2,413,041	20.76%
Industrial	491,919	4.23%
Agricultural	32,577	0.28%
Religious	135,461	1.17%
Government	91,096	0.78%
Education	169,371	1.46%
<b>Total</b>	<b>11,623,952</b>	<b>100.00%</b>

### Essential Facility Inventory

For essential facilities, there are 2 hospitals in the region with a total bed capacity of 155 beds. There are 30 schools, 6 fire stations, 7 police stations and 2 emergency operation facilities.



FEMA

## Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

**Scenario Name:** Probabilistic

**Type:** Probabilistic

## Building Damage

### General Building Stock Damage

Hazus estimates that about 1,727 buildings will be at least moderately damaged. This is over 8% of the total number of buildings in the region. There are an estimated 38 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

### Expected Building Damage by Occupancy

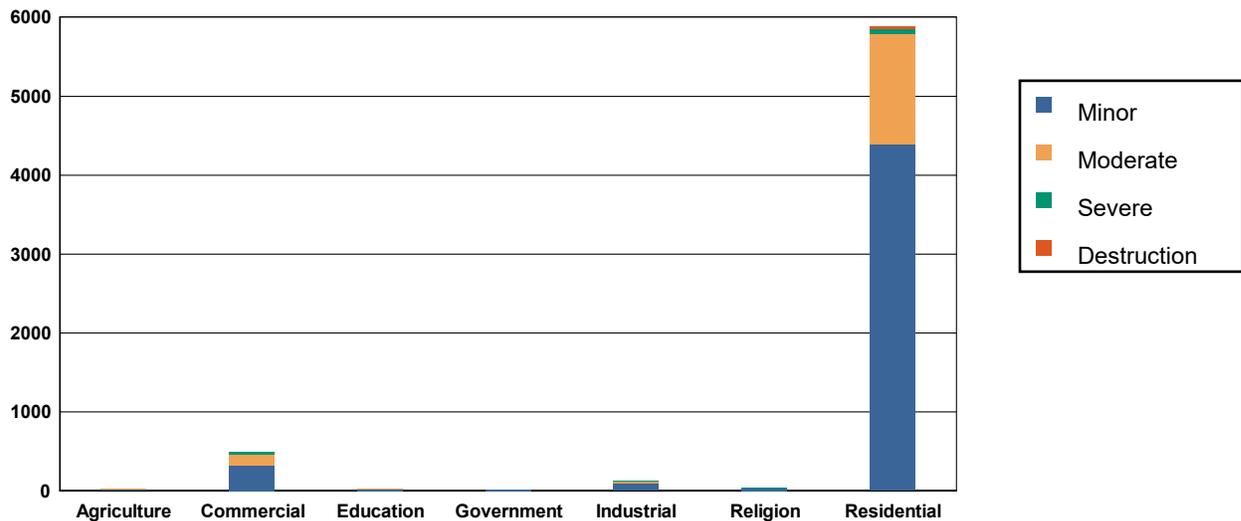


Table 2: Expected Building Damage by Occupancy : 1000 - year Event

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	65.24	68.67	19.62	20.65	6.53	6.87	3.17	3.33	0.45	0.47
Commercial	1,266.99	72.48	326.53	18.68	131.51	7.52	22.79	1.30	0.17	0.01
Education	58.90	73.62	14.96	18.70	5.54	6.93	0.60	0.75	0.00	0.00
Government	40.96	73.14	10.44	18.64	4.15	7.40	0.46	0.82	0.00	0.00
Industrial	342.29	72.67	83.66	17.76	36.11	7.67	8.31	1.76	0.64	0.14
Religion	96.81	72.25	28.02	20.91	8.31	6.20	0.85	0.63	0.00	0.00
Residential	12,129.30	67.31	4,392.33	24.38	1,388.21	7.70	72.04	0.40	37.11	0.21
<b>Total</b>	<b>14,000.49</b>		<b>4,875.57</b>		<b>1,580.37</b>		<b>108.21</b>		<b>38.37</b>	



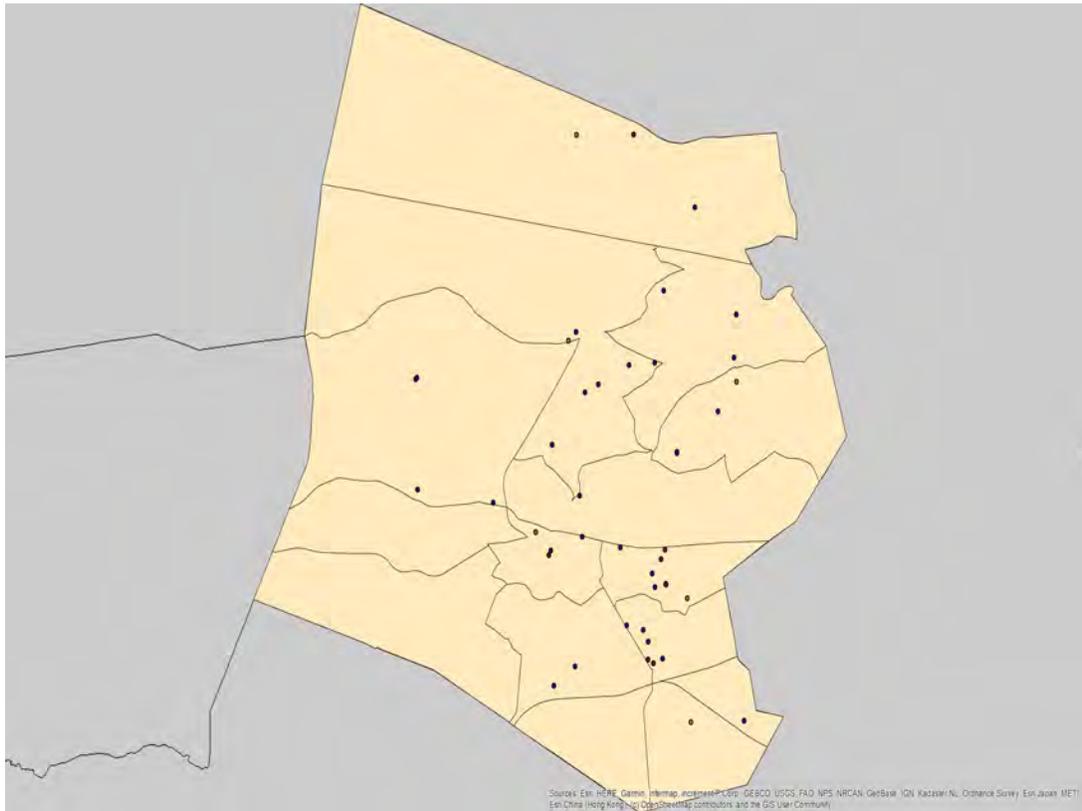
**Table 3: Expected Building Damage by Building Type : 1000 - year Event**

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	236	66.91	74	21.10	40	11.37	2	0.62	0	0.00
Masonry	1,242	61.69	402	19.96	350	17.38	18	0.88	2	0.09
MH	17	85.72	1	7.42	1	4.79	0	0.25	0	1.82
Steel	895	72.38	212	17.15	107	8.68	22	1.78	0	0.02
Wood	11,914	70.13	4,228	24.89	744	4.38	66	0.39	36	0.21

### Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 155 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

**Thematic Map of Essential Facilities with greater than 50% moderate**



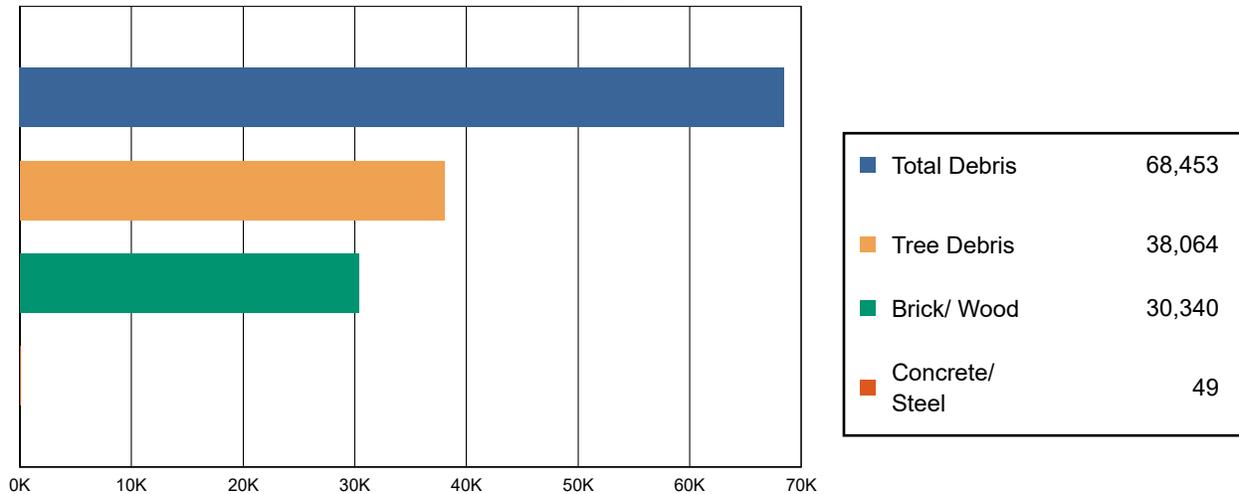
**Table 4: Expected Damage to Essential Facilities**

Classification	Total	# Facilities		
		Probability of at Least Moderate	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
EOCs	2	0	0	2
Fire Stations	6	0	0	6
Hospitals	2	0	0	2
Police Stations	7	0	0	7
Schools	30	2	0	5

## Induced Hurricane Damage

### Debris Generation

**Estimated Debris (Tons)**

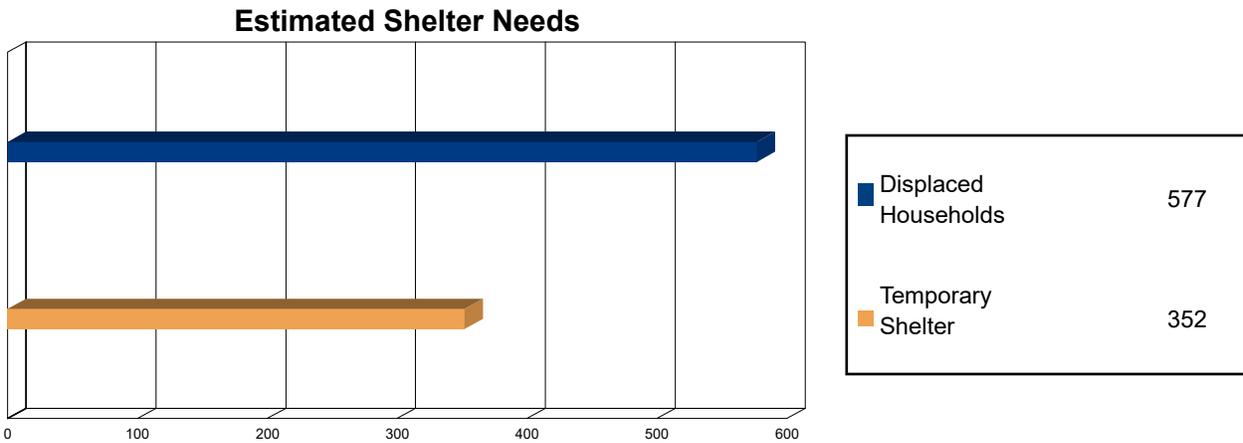


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 68,453 tons of debris will be generated. Of the total amount, 18,467 tons (27%) is Other Tree Debris. Of the remaining 49,986 tons, Brick/Wood comprises 61% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 1216 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 19,597 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

## Social Impact

### Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 577 households to be displaced due to the hurricane. Of these, 352 people (out of a total population of 72,638) will seek temporary shelter in public shelters.



## Economic Loss

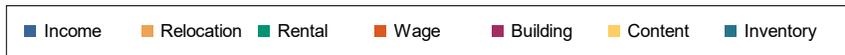
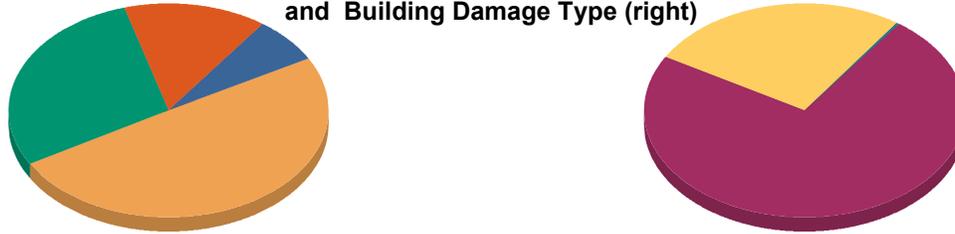
The total economic loss estimated for the hurricane is 481.3 million dollars, which represents 4.14 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 481 million dollars. 8% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 84% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

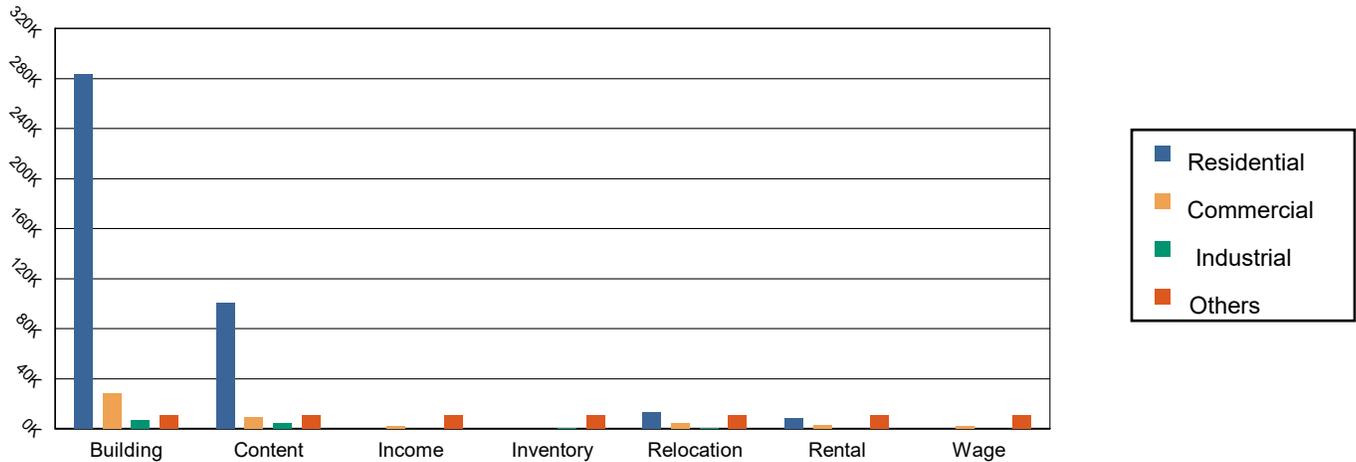


Table 5: Building-Related Economic Loss Estimates  
(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<b>Property Damage</b>						
	Building	283,795.81	28,284.78	7,108.17	4,967.90	324,156.66
	Content	100,867.55	9,520.56	4,723.49	1,708.17	116,819.76
	Inventory	0.00	243.83	543.94	28.55	816.33
	<b>Subtotal</b>	<b>384,663.36</b>	<b>38,049.17</b>	<b>12,375.60</b>	<b>6,704.62</b>	<b>441,792.74</b>
<b>Business Interruption Loss</b>						
	Income	0.00	2,337.01	68.91	327.16	2,733.09
	Relocation	13,375.83	4,891.75	509.68	836.17	19,613.43
	Rental	8,635.32	2,640.87	72.36	66.63	11,415.18
	Wage	0.01	2,382.17	115.37	3,225.30	5,722.86
	<b>Subtotal</b>	<b>22,011.17</b>	<b>12,251.80</b>	<b>766.32</b>	<b>4,455.25</b>	<b>39,484.55</b>



FEMA

---

Total

---

Total	406,674.53	50,300.97	13,141.92	11,159.87	481,277.29
-------	------------	-----------	-----------	-----------	------------

---



FEMA

---

**Appendix A: County Listing for the Region**

Massachusetts  
- Middlesex



**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
<b>Massachusetts</b>				
Middlesex	72,638	8,290,487	3,333,465	11,623,952
<b>Total</b>	<b>72,638</b>	<b>8,290,487</b>	<b>3,333,465</b>	<b>11,623,952</b>
<b>Study Region Total</b>	<b>72,638</b>	<b>8,290,487</b>	<b>3,333,465</b>	<b>11,623,952</b>



FEMA

**RiskMAP**  
Increasing Resilience Together

---

## Hazus: Earthquake Global Risk Report

---

**Region Name:** FraminghamEQ

**Earthquake Scenario:** 1500year

**Print Date:** August 25, 2022

**Disclaimer:**

*This version of Hazus utilizes 2010 Census Data.  
Totals only reflect data for those census tracts/blocks included in the user's study region.*

*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.*



FEMA

## Table of Contents

Section	Page #
General Description of the Region	3
Building and Lifeline Inventory	4
Building Inventory	
Critical Facility Inventory	
Transportation and Utility Lifeline Inventory	
Earthquake Scenario Parameters	7
Direct Earthquake Damage	8
Buildings Damage	
Essential Facilities Damage	
Transportation and Utility Lifeline Damage	
Induced Earthquake Damage	14
Fire Following Earthquake	
Debris Generation	
Social Impact	15
Shelter Requirements	
Casualties	
Economic Loss	17
Building Related Losses	
Transportation and Utility Lifeline Losses	

Appendix A: County Listing for the Region

Appendix B: Regional Population and Building Value Data

## General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Massachusetts

**Note:**

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 26.49 square miles and contains 14 census tracts. There are over 26 thousand households in the region which has a total population of 68,318 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 10,660 (millions of dollars). Approximately 88.00 % of the buildings (and 71.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,079 and 247 (millions of dollars) , respectively.



FEMA

---

## Building and Lifeline Inventory

### **Building Inventory**

Hazus estimates that there are 19 thousand buildings in the region which have an aggregate total replacement value of 10,660 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 82% of the building inventory. The remaining percentage is distributed between the other general building types.

### **Critical Facility Inventory**

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 2 hospitals in the region with a total bed capacity of 155 beds. There are 29 schools, 5 fire stations, 6 police stations and 2 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 10 hazardous material sites, no military installations and no nuclear power plants.

### **Transportation and Utility Lifeline Inventory**

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 1,326.00 (millions of dollars). This inventory includes over 68.97 miles of highways, 50 bridges, 889.18 miles of pipes.

**Table 1: Transportation System Lifeline Inventory**

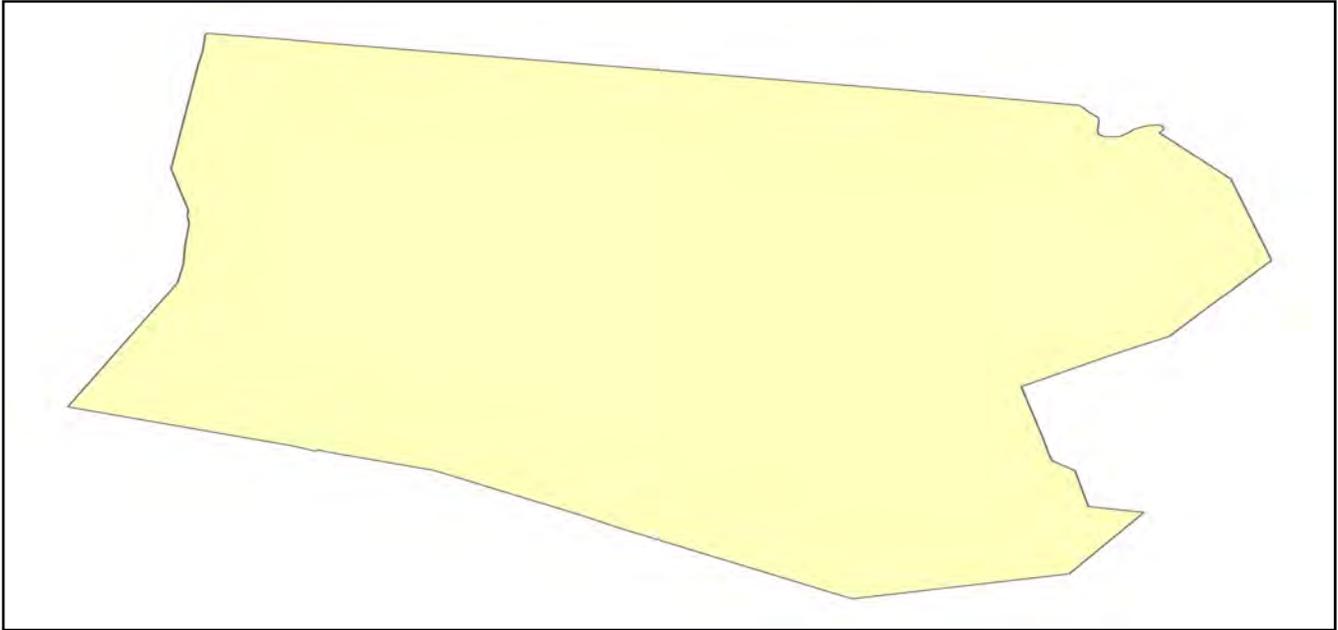
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
<b>Highway</b>	Bridges	50	203.1945
	Segments	48	742.4826
	Tunnels	0	0.0000
		<b>Subtotal</b>	<b>945.6771</b>
<b>Railways</b>	Bridges	8	42.8857
	Facilities	1	2.6630
	Segments	28	57.7630
	Tunnels	0	0.0000
		<b>Subtotal</b>	<b>103.3117</b>
<b>Light Rail</b>	Bridges	0	0.0000
	Facilities	1	3.4308
	Segments	4	25.3014
	Tunnels	0	0.0000
		<b>Subtotal</b>	<b>28.7322</b>
<b>Bus</b>	Facilities	1	1.7154
		<b>Subtotal</b>	<b>1.7154</b>
<b>Ferry</b>	Facilities	0	0.0000
		<b>Subtotal</b>	<b>0.0000</b>
<b>Port</b>	Facilities	0	0.0000
		<b>Subtotal</b>	<b>0.0000</b>
<b>Airport</b>	Facilities	0	0.0000
	Runways	0	0.0000
		<b>Subtotal</b>	<b>0.0000</b>
		<b>Total</b>	<b>1,079.40</b>

**Table 2: Utility System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations / Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Potable Water</b>	Distribution Lines	NA	17.4657
	Facilities	0	0.0000
	Pipelines	0	0.0000
	<b>Subtotal</b>		<b>17.4657</b>
<b>Waste Water</b>	Distribution Lines	NA	10.4794
	Facilities	0	0.0000
	Pipelines	0	0.0000
	<b>Subtotal</b>		<b>10.4794</b>
<b>Natural Gas</b>	Distribution Lines	NA	6.9863
	Facilities	0	0.0000
	Pipelines	3	25.1269
	<b>Subtotal</b>		<b>32.1132</b>
<b>Oil Systems</b>	Facilities	0	0.0000
	Pipelines	0	0.0000
	<b>Subtotal</b>		<b>0.0000</b>
<b>Electrical Power</b>	Facilities	1	186.5528
	<b>Subtotal</b>		<b>186.5528</b>
<b>Communication</b>	Facilities	4	0.4640
	<b>Subtotal</b>		<b>0.4640</b>
	<b>Total</b>		<b>247.10</b>

## Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



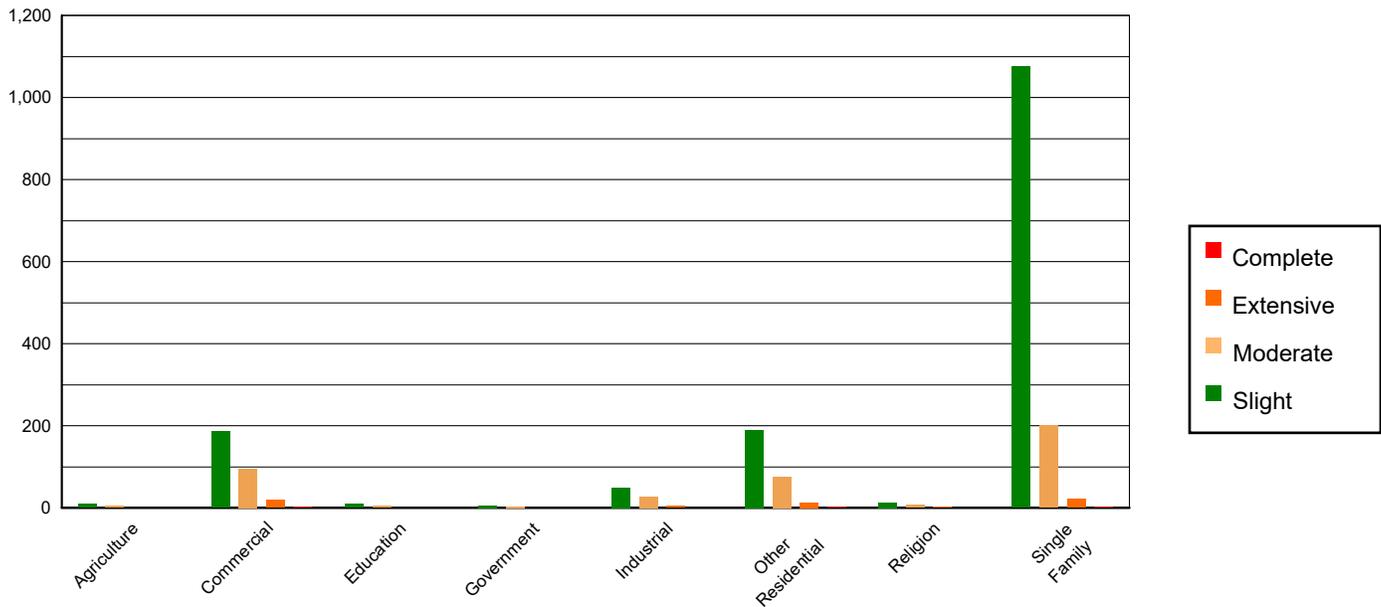
<b>Scenario Name</b>	1500year
<b>Type of Earthquake</b>	Probabilistic
<b>Fault Name</b>	NA
<b>Historical Epicenter ID #</b>	NA
<b>Probabilistic Return Period</b>	1,500.00
<b>Longitude of Epicenter</b>	NA
<b>Latitude of Epicenter</b>	NA
<b>Earthquake Magnitude</b>	6.50
<b>Depth (km)</b>	NA
<b>Rupture Length (Km)</b>	NA
<b>Rupture Orientation (degrees)</b>	NA
<b>Attenuation Function</b>	NA

## Direct Earthquake Damage

### Building Damage

Hazus estimates that about 485 buildings will be at least moderately damaged. This is over 3.00 % of the buildings in the region. There are an estimated 5 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

### Damage Categories by General Occupancy Type



**Table 3: Expected Building Damage by Occupancy**

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Agriculture</b>	66.45	0.39	9.71	0.63	4.02	0.96	0.76	1.24	0.05	0.91
<b>Commercial</b>	1284.28	7.54	186.37	12.11	95.87	22.87	17.86	29.29	1.62	28.30
<b>Education</b>	64.65	0.38	8.96	0.58	4.57	1.09	0.74	1.21	0.08	1.47
<b>Government</b>	40.97	0.24	6.04	0.39	3.37	0.80	0.56	0.92	0.05	0.88
<b>Industrial</b>	364.01	2.14	49.43	3.21	27.33	6.52	4.85	7.96	0.38	6.66
<b>Other Residential</b>	1803.36	10.59	189.72	12.33	76.89	18.34	13.52	22.16	1.52	26.51
<b>Religion</b>	102.34	0.60	12.87	0.84	6.35	1.51	1.29	2.12	0.15	2.71
<b>Single Family</b>	13305.15	78.12	1075.83	69.91	200.77	47.90	21.40	35.10	1.86	32.56
<b>Total</b>	<b>17,031</b>		<b>1,539</b>		<b>419</b>		<b>61</b>		<b>6</b>	

**Table 4: Expected Building Damage by Building Type (All Design Levels)**

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Wood</b>	14376.68	84.41	1127.63	73.27	172.00	41.03	10.47	17.17	0.02	0.37
<b>Steel</b>	933.73	5.48	120.40	7.82	69.93	16.68	10.76	17.65	0.60	10.50
<b>Concrete</b>	197.50	1.16	28.79	1.87	17.20	4.10	1.78	2.93	0.12	2.04
<b>Precast</b>	63.97	0.38	9.00	0.59	8.17	1.95	2.27	3.73	0.05	0.85
<b>RM</b>	319.98	1.88	28.36	1.84	21.10	5.03	4.45	7.30	0.03	0.59
<b>URM</b>	1126.45	6.61	220.89	14.35	127.81	30.49	30.97	50.78	4.88	85.44
<b>MH</b>	12.89	0.08	3.87	0.25	2.96	0.71	0.26	0.43	0.01	0.20
<b>Total</b>	<b>17,031</b>		<b>1,539</b>		<b>419</b>		<b>61</b>		<b>6</b>	

\*Note:

- RM     Reinforced Masonry
- URM    Unreinforced Masonry
- MH     Manufactured Housing

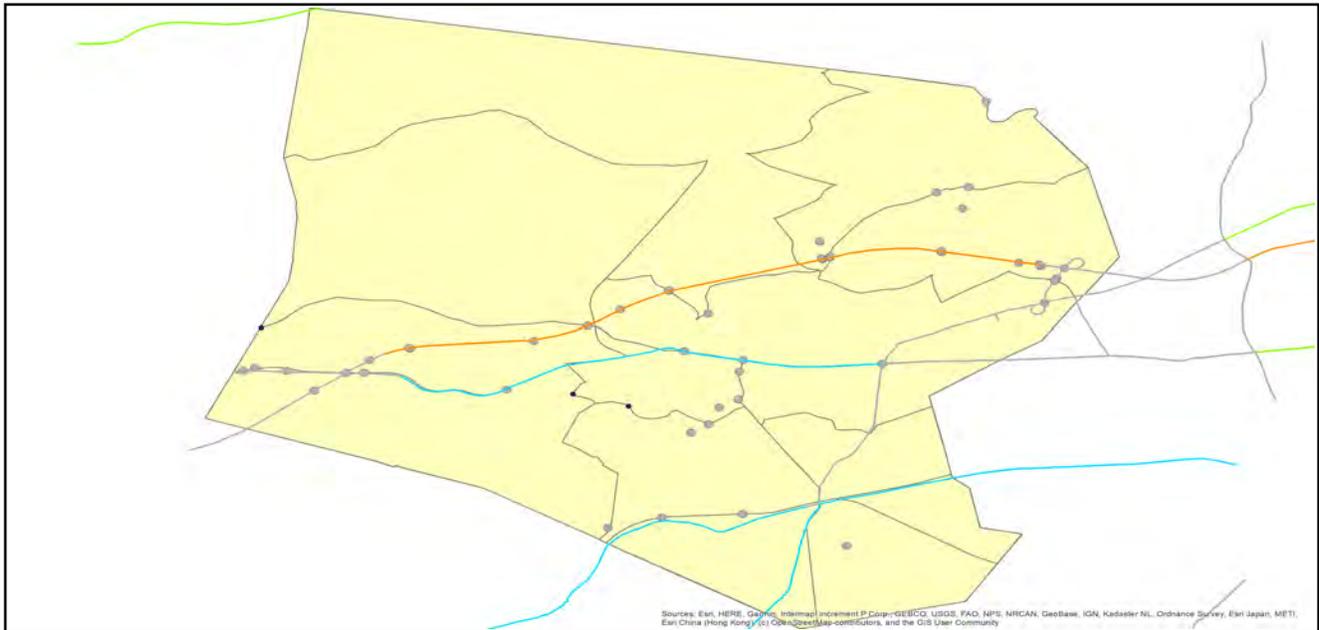
### **Essential Facility Damage**

Before the earthquake, the region had 155 hospital beds available for use. On the day of the earthquake, the model estimates that only 116 hospital beds (75.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 89.00% of the beds will be back in service. By 30 days, 98.00% will be operational.

**Table 5: Expected Damage to Essential Facilities**

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	2	0	0	2
Schools	29	0	0	29
EOCs	2	0	0	2
PoliceStations	6	0	0	6
FireStations	5	0	0	5

**Transportation Lifeline Damage**



**Table 6: Expected Damage to the Transportation Systems**

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	48	0	0	48	48
	Bridges	50	0	0	50	50
	Tunnels	0	0	0	0	0
Railways	Segments	28	0	0	28	28
	Bridges	8	0	0	8	8
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
Light Rail	Segments	4	0	0	3	3
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

**Table 7 : Expected Utility System Facility Damage**

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	1	1
Communication	4	0	0	4	4

**Table 8 : Expected Utility System Pipeline Damage (Site Specific)**

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	543	6	1
Waste Water	326	3	1
Natural Gas	21	0	0
Oil	0	0	0

**Table 9: Expected Potable Water and Electric Power System Performance**

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	26,173	0	0	0	0	0
Electric Power		0	0	0	0	0

## Induced Earthquake Damage

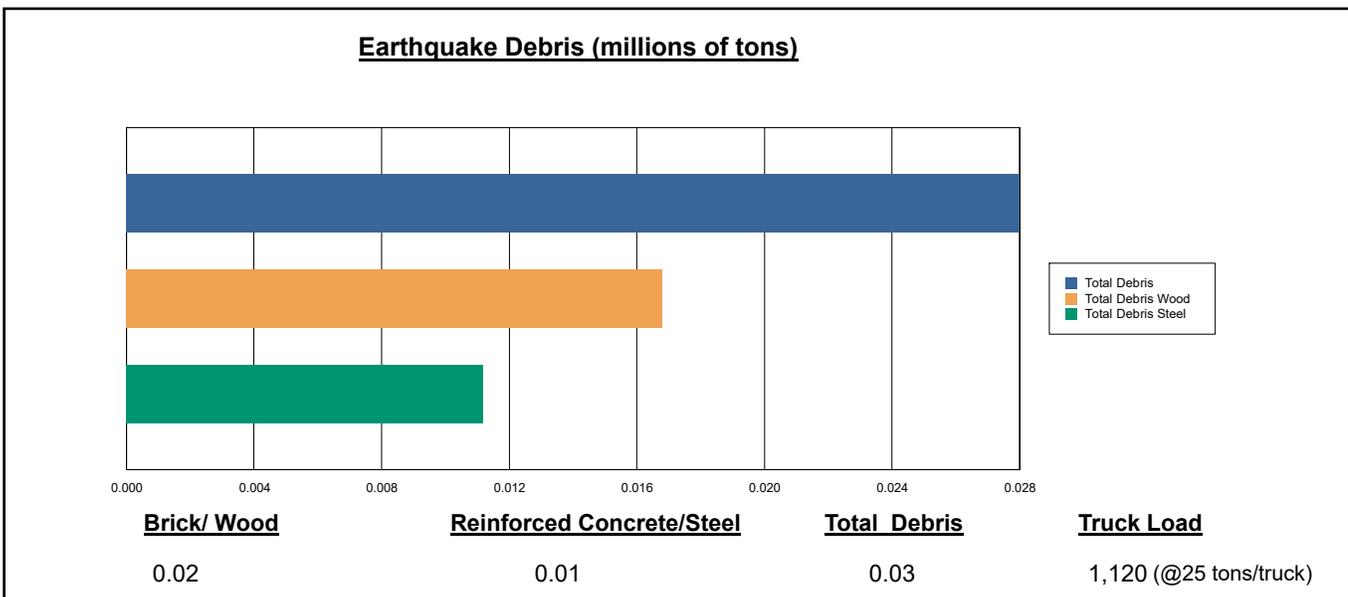
### Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

### Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

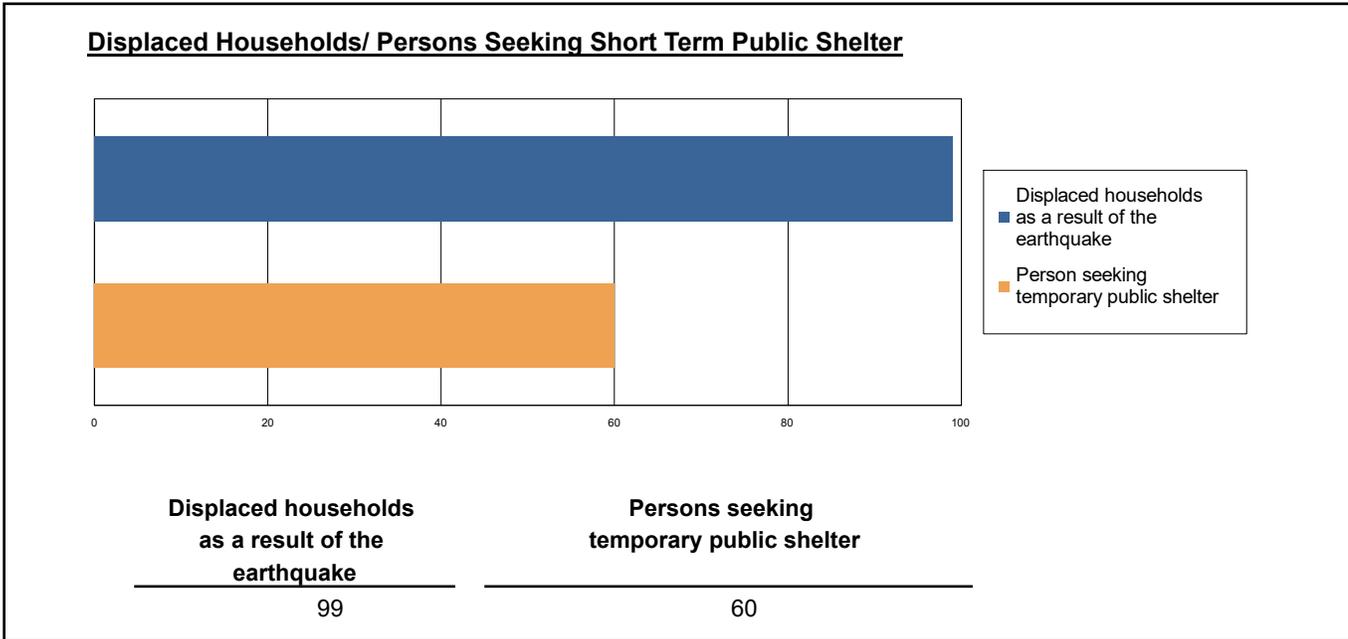
The model estimates that a total of 28,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 60.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 1,120 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.



## Social Impact

### Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 99 households to be displaced due to the earthquake. Of these, 60 people (out of a total population of 68,318) will seek temporary shelter in public shelters.



### Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

**Table 10: Casualty Estimates**

		Level 1	Level 2	Level 3	Level 4
<b>2 AM</b>	Commercial	0.29	0.04	0.00	0.01
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.23	0.03	0.00	0.01
	Other-Residential	10.22	1.61	0.16	0.32
	Single Family	4.41	0.49	0.04	0.08
	<b>Total</b>	<b>15</b>	<b>2</b>	<b>0</b>	<b>0</b>
<b>2 PM</b>	Commercial	16.12	2.45	0.23	0.44
	Commuting	0.00	0.00	0.00	0.00
	Educational	4.58	0.72	0.07	0.14
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1.72	0.25	0.02	0.04
	Other-Residential	1.92	0.31	0.03	0.06
	Single Family	0.79	0.09	0.01	0.01
	<b>Total</b>	<b>25</b>	<b>4</b>	<b>0</b>	<b>1</b>
<b>5 PM</b>	Commercial	11.02	1.69	0.16	0.31
	Commuting	0.00	0.00	0.01	0.00
	Educational	0.82	0.13	0.01	0.03
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1.08	0.16	0.01	0.03
	Other-Residential	4.05	0.66	0.07	0.13
	Single Family	1.70	0.20	0.02	0.03
	<b>Total</b>	<b>19</b>	<b>3</b>	<b>0</b>	<b>1</b>



FEMA

---

## Economic Loss

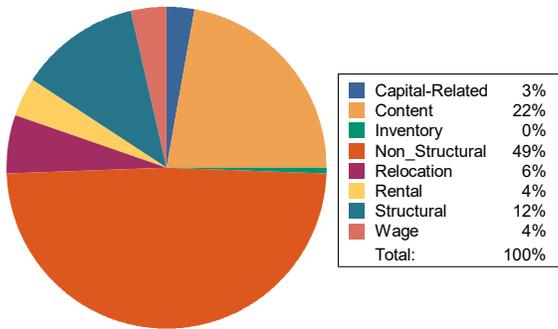
The total economic loss estimated for the earthquake is 154.96 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

### Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 149.36 (millions of dollars); 16 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 51 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type (\$ millions)



Earthquake Losses by Occupancy Type (\$ millions)

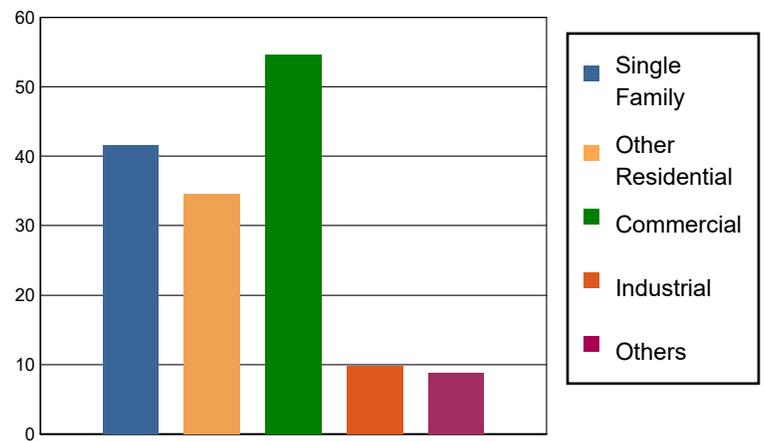


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
<b>Income Losses</b>							
	Wage	0.0000	0.3403	4.6029	0.1310	0.5167	5.5909
	Capital-Related	0.0000	0.1445	3.7070	0.0775	0.0555	3.9845
	Rental	0.4410	1.9615	3.2325	0.0712	0.0965	5.8027
	Relocation	1.4768	1.3080	4.6144	0.4379	0.9069	8.7440
	<b>Subtotal</b>	<b>1.9178</b>	<b>3.7543</b>	<b>16.1568</b>	<b>0.7176</b>	<b>1.5756</b>	<b>24.1221</b>
<b>Capital Stock Losses</b>							
	Structural	4.4142	4.0922	7.0726	1.1553	1.1759	17.9102
	Non_Structural	25.0502	20.5975	19.2242	4.4754	3.6749	73.0222
	Content	10.2416	6.0752	11.7486	3.1350	2.3607	33.5611
	Inventory	0.0000	0.0000	0.3280	0.3966	0.0159	0.7405
	<b>Subtotal</b>	<b>39.7060</b>	<b>30.7649</b>	<b>38.3734</b>	<b>9.1623</b>	<b>7.2274</b>	<b>125.2340</b>
	<b>Total</b>	<b>41.62</b>	<b>34.52</b>	<b>54.53</b>	<b>9.88</b>	<b>8.80</b>	<b>149.36</b>

### Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

**Table 12: Transportation System Economic Losses**  
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	742.4826	0.0000	0.00
	Bridges	203.1945	0.0537	0.03
	Tunnels	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>945.6771</b>	<b>0.0537</b>	
Railways	Segments	57.7630	0.0000	0.00
	Bridges	42.8857	0.0002	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	2.6630	0.2822	10.60
	<b>Subtotal</b>	<b>103.3117</b>	<b>0.2824</b>	
Light Rail	Segments	25.3014	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	3.4308	0.3635	10.60
	<b>Subtotal</b>	<b>28.7322</b>	<b>0.3635</b>	
Bus	Facilities	1.7154	0.1818	10.60
	<b>Subtotal</b>	<b>1.7154</b>	<b>0.1818</b>	
Ferry	Facilities	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>0.0000</b>	<b>0.0000</b>	
Port	Facilities	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>0.0000</b>	<b>0.0000</b>	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>0.0000</b>	<b>0.0000</b>	
<b>Total</b>		<b>1,079.44</b>	<b>0.88</b>	

**Table 13: Utility System Economic Losses**  
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	17.4657	0.0263	0.15
	<b>Subtotal</b>	<b>17.4657</b>	<b>0.0263</b>	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	10.4794	0.0132	0.13
	<b>Subtotal</b>	<b>10.4794</b>	<b>0.0132</b>	
Natural Gas	Pipelines	25.1269	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	6.9863	0.0045	0.06
	<b>Subtotal</b>	<b>32.1132</b>	<b>0.0045</b>	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>0.0000</b>	<b>0.0000</b>	
Electrical Power	Facilities	186.5528	4.6545	2.50
	<b>Subtotal</b>	<b>186.5528</b>	<b>4.6545</b>	
Communication	Facilities	0.4640	0.0211	4.55
	<b>Subtotal</b>	<b>0.4640</b>	<b>0.0211</b>	
	<b>Total</b>	<b>247.08</b>	<b>4.72</b>	



FEMA

---

**Appendix A: County Listing for the Region**

Middlesex, MA

**Appendix B: Regional Population and Building Value Data**

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
<b>Massachusetts</b>	Middlesex	68,318	7,587	3,072	10,660
<b>Total Region</b>		<b>68,318</b>	<b>7,587</b>	<b>3,072</b>	<b>10,660</b>



FEMA

**RiskMAP**  
Increasing Resilience Together

---

## Hazus: Earthquake Global Risk Report

---

**Region Name:** FraminghamEQ

**Earthquake Scenario:** 2500year

**Print Date:** August 25, 2022

**Disclaimer:**

*This version of Hazus utilizes 2010 Census Data.  
Totals only reflect data for those census tracts/blocks included in the user's study region.*

*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.*



FEMA

## Table of Contents

Section	Page #
General Description of the Region	3
Building and Lifeline Inventory	4
Building Inventory	
Critical Facility Inventory	
Transportation and Utility Lifeline Inventory	
Earthquake Scenario Parameters	7
Direct Earthquake Damage	8
Buildings Damage	
Essential Facilities Damage	
Transportation and Utility Lifeline Damage	
Induced Earthquake Damage	14
Fire Following Earthquake	
Debris Generation	
Social Impact	15
Shelter Requirements	
Casualties	
Economic Loss	17
Building Related Losses	
Transportation and Utility Lifeline Losses	
Appendix A: County Listing for the Region	
Appendix B: Regional Population and Building Value Data	



FEMA

## General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Massachusetts

**Note:**

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 26.49 square miles and contains 14 census tracts. There are over 26 thousand households in the region which has a total population of 68,318 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 10,660 (millions of dollars). Approximately 88.00 % of the buildings (and 71.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,079 and 247 (millions of dollars) , respectively.

---

## **Building and Lifeline Inventory**

### **Building Inventory**

Hazus estimates that there are 19 thousand buildings in the region which have an aggregate total replacement value of 10,660 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 82% of the building inventory. The remaining percentage is distributed between the other general building types.

### **Critical Facility Inventory**

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 2 hospitals in the region with a total bed capacity of 155 beds. There are 29 schools, 5 fire stations, 6 police stations and 2 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 10 hazardous material sites, no military installations and no nuclear power plants.

### **Transportation and Utility Lifeline Inventory**

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 1,326.00 (millions of dollars). This inventory includes over 68.97 miles of highways, 50 bridges, 889.18 miles of pipes.

**Table 1: Transportation System Lifeline Inventory**

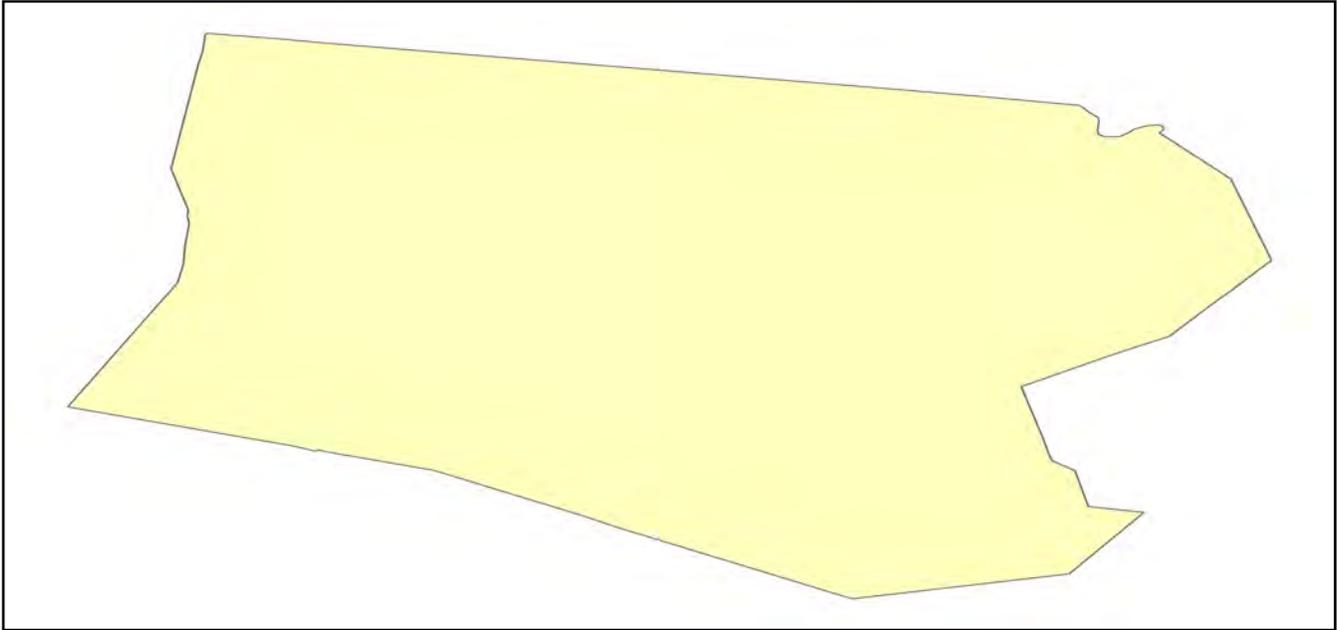
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
<b>Highway</b>	Bridges	50	203.1945
	Segments	48	742.4826
	Tunnels	0	0.0000
	<b>Subtotal</b>		<b>945.6771</b>
<b>Railways</b>	Bridges	8	42.8857
	Facilities	1	2.6630
	Segments	28	57.7630
	Tunnels	0	0.0000
	<b>Subtotal</b>		<b>103.3117</b>
<b>Light Rail</b>	Bridges	0	0.0000
	Facilities	1	3.4308
	Segments	4	25.3014
	Tunnels	0	0.0000
	<b>Subtotal</b>		<b>28.7322</b>
<b>Bus</b>	Facilities	1	1.7154
	<b>Subtotal</b>		<b>1.7154</b>
<b>Ferry</b>	Facilities	0	0.0000
	<b>Subtotal</b>		<b>0.0000</b>
<b>Port</b>	Facilities	0	0.0000
	<b>Subtotal</b>		<b>0.0000</b>
<b>Airport</b>	Facilities	0	0.0000
	Runways	0	0.0000
	<b>Subtotal</b>		<b>0.0000</b>
		<b>Total</b>	<b>1,079.40</b>

**Table 2: Utility System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations / Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Potable Water</b>	Distribution Lines	NA	17.4657
	Facilities	0	0.0000
	Pipelines	0	0.0000
	<b>Subtotal</b>		<b>17.4657</b>
<b>Waste Water</b>	Distribution Lines	NA	10.4794
	Facilities	0	0.0000
	Pipelines	0	0.0000
	<b>Subtotal</b>		<b>10.4794</b>
<b>Natural Gas</b>	Distribution Lines	NA	6.9863
	Facilities	0	0.0000
	Pipelines	3	25.1269
	<b>Subtotal</b>		<b>32.1132</b>
<b>Oil Systems</b>	Facilities	0	0.0000
	Pipelines	0	0.0000
	<b>Subtotal</b>		<b>0.0000</b>
<b>Electrical Power</b>	Facilities	1	186.5528
	<b>Subtotal</b>		<b>186.5528</b>
<b>Communication</b>	Facilities	4	0.4640
	<b>Subtotal</b>		<b>0.4640</b>
	<b>Total</b>		<b>247.10</b>

## Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



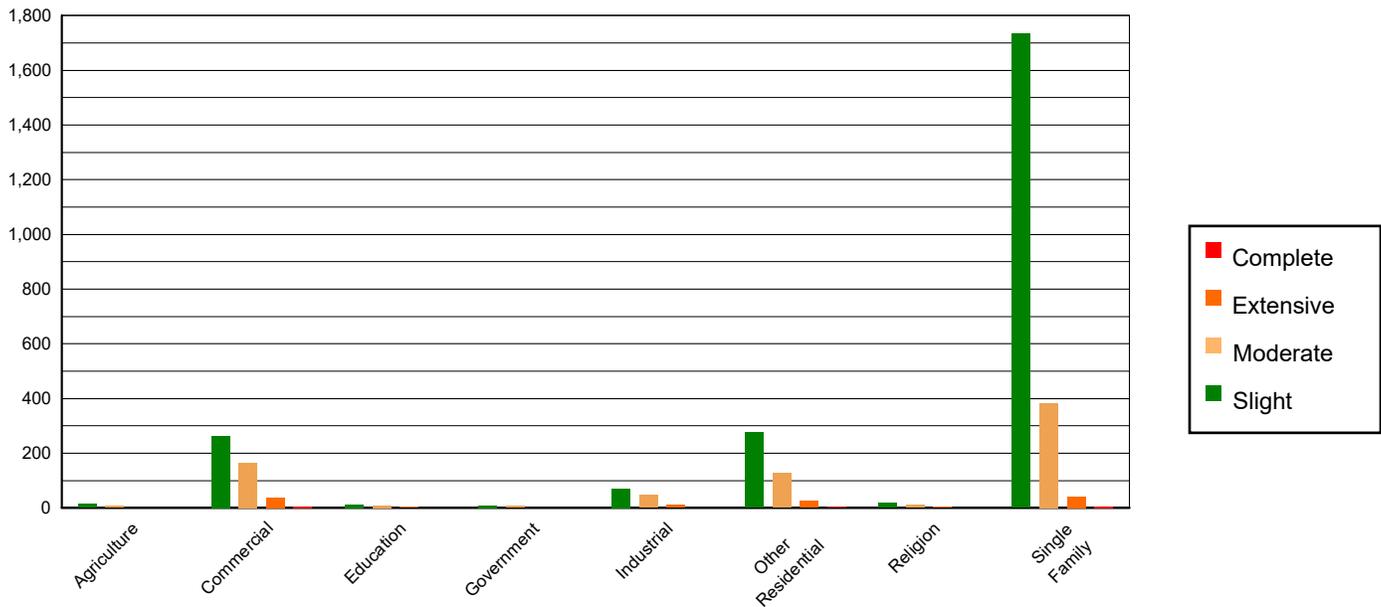
<b>Scenario Name</b>	2500year
<b>Type of Earthquake</b>	Probabilistic
<b>Fault Name</b>	NA
<b>Historical Epicenter ID #</b>	NA
<b>Probabilistic Return Period</b>	2,500.00
<b>Longitude of Epicenter</b>	NA
<b>Latitude of Epicenter</b>	NA
<b>Earthquake Magnitude</b>	7.00
<b>Depth (km)</b>	NA
<b>Rupture Length (Km)</b>	NA
<b>Rupture Orientation (degrees)</b>	NA
<b>Attenuation Function</b>	NA

## Direct Earthquake Damage

### Building Damage

Hazus estimates that about 892 buildings will be at least moderately damaged. This is over 5.00 % of the buildings in the region. There are an estimated 13 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

### Damage Categories by General Occupancy Type



**Table 3: Expected Building Damage by Occupancy**

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Agriculture</b>	57.66	0.37	14.42	0.60	7.26	0.96	1.53	1.25	0.13	0.99
<b>Commercial</b>	1115.70	7.08	263.52	11.00	165.88	21.92	36.99	30.22	3.92	28.82
<b>Education</b>	56.34	0.36	12.72	0.53	8.12	1.07	1.63	1.33	0.20	1.47
<b>Government</b>	35.13	0.22	8.45	0.35	6.00	0.79	1.29	1.05	0.13	0.97
<b>Industrial</b>	317.30	2.01	69.32	2.89	47.83	6.32	10.56	8.63	0.99	7.25
<b>Other Residential</b>	1652.56	10.48	275.79	11.51	127.13	16.80	26.24	21.43	3.28	24.17
<b>Religion</b>	92.17	0.58	17.83	0.74	10.20	1.35	2.47	2.01	0.33	2.44
<b>Single Family</b>	12440.59	78.90	1733.87	72.37	384.22	50.78	41.72	34.08	4.61	33.89
<b>Total</b>	<b>15,767</b>		<b>2,396</b>		<b>757</b>		<b>122</b>		<b>14</b>	

**Table 4: Expected Building Damage by Building Type (All Design Levels)**

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Wood</b>	13445.50	85.27	1854.39	77.40	361.65	47.80	24.27	19.82	1.00	7.36
<b>Steel</b>	811.96	5.15	169.54	7.08	126.50	16.72	25.44	20.78	1.99	14.64
<b>Concrete</b>	168.93	1.07	39.77	1.66	31.37	4.15	4.95	4.04	0.37	2.74
<b>Precast</b>	53.46	0.34	11.73	0.49	13.24	1.75	4.84	3.95	0.19	1.39
<b>RM</b>	285.46	1.81	40.44	1.69	37.42	4.95	10.45	8.54	0.15	1.07
<b>URM</b>	991.62	6.29	275.51	11.50	182.14	24.07	51.87	42.37	9.86	72.54
<b>MH</b>	10.50	0.07	4.54	0.19	4.31	0.57	0.61	0.50	0.04	0.26
<b>Total</b>	<b>15,767</b>		<b>2,396</b>		<b>757</b>		<b>122</b>		<b>14</b>	

\*Note:

- RM Reinforced Masonry
- URM Unreinforced Masonry
- MH Manufactured Housing

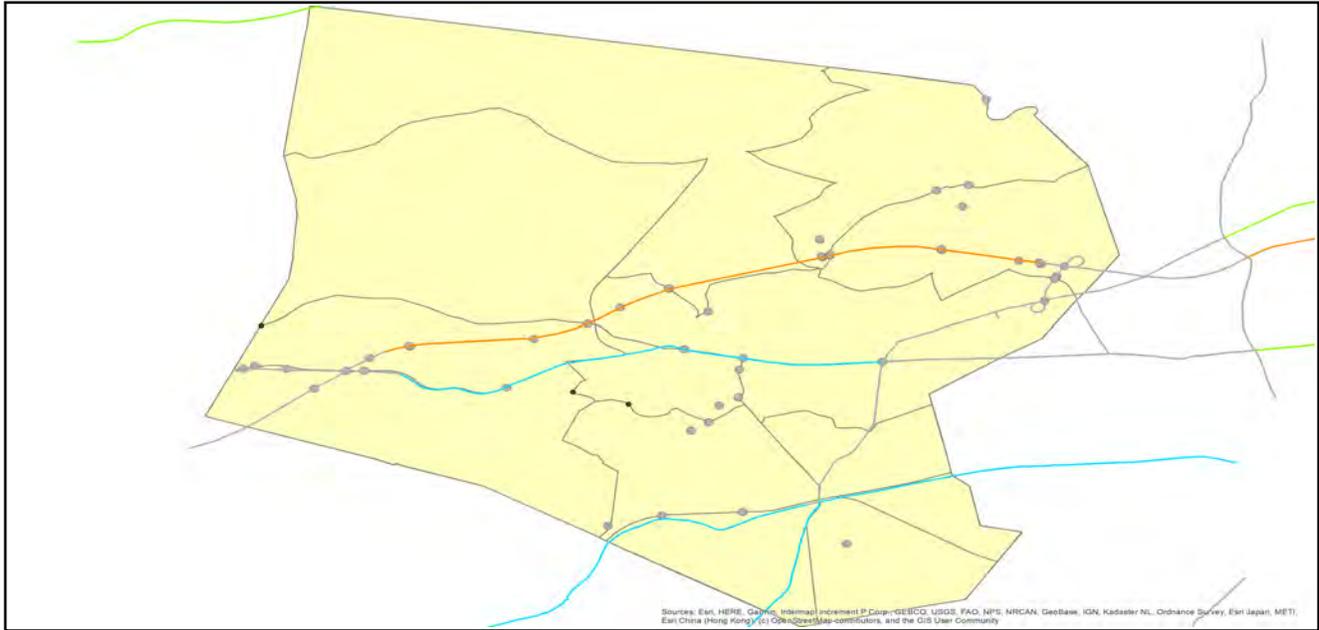
### **Essential Facility Damage**

Before the earthquake, the region had 155 hospital beds available for use. On the day of the earthquake, the model estimates that only 101 hospital beds (66.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 84.00% of the beds will be back in service. By 30 days, 96.00% will be operational.

**Table 5: Expected Damage to Essential Facilities**

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	2	0	0	2
Schools	29	0	0	29
EOCs	2	0	0	2
PoliceStations	6	0	0	6
FireStations	5	0	0	5

**Transportation Lifeline Damage**



**Table 6: Expected Damage to the Transportation Systems**

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	48	0	0	48	48
	Bridges	50	0	0	50	50
	Tunnels	0	0	0	0	0
Railways	Segments	28	0	0	28	28
	Bridges	8	0	0	8	8
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
Light Rail	Segments	4	0	0	3	3
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

**Table 7 : Expected Utility System Facility Damage**

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	1	1
Communication	4	0	0	4	4

**Table 8 : Expected Utility System Pipeline Damage (Site Specific)**

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	543	11	3
Waste Water	326	5	1
Natural Gas	21	0	0
Oil	0	0	0

**Table 9: Expected Potable Water and Electric Power System Performance**

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	26,173	0	0	0	0	0
Electric Power		0	0	0	0	0

## Induced Earthquake Damage

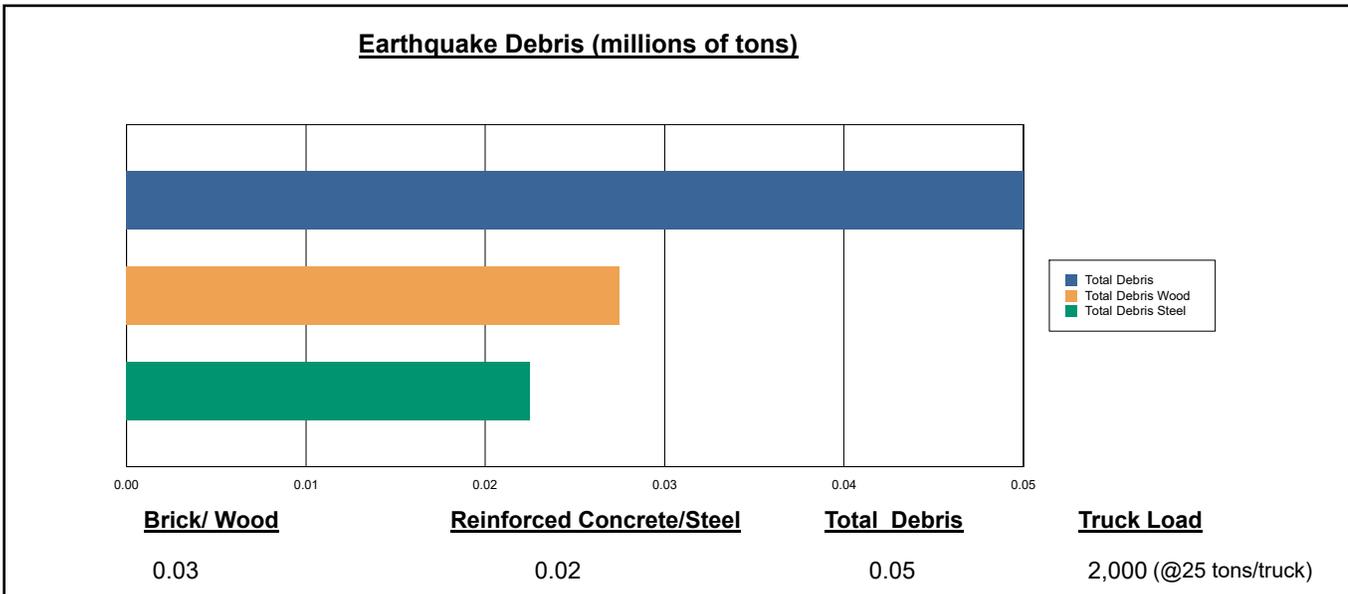
### Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

### Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

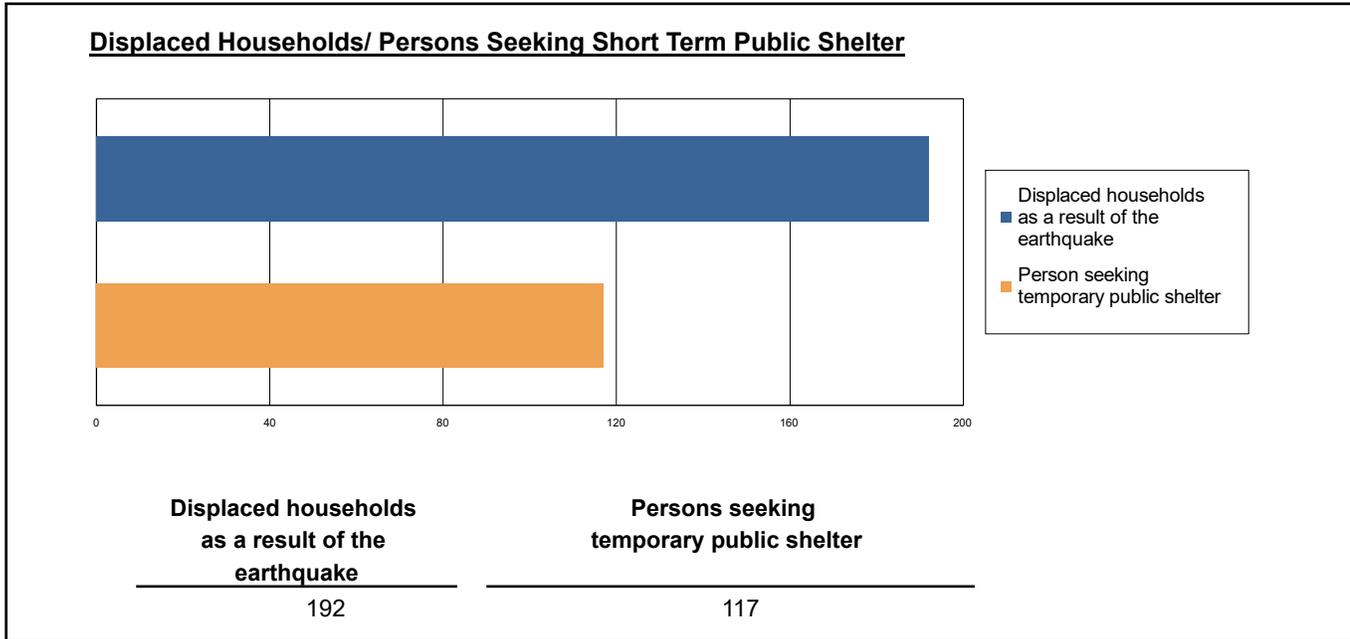
The model estimates that a total of 50,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 55.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 2,000 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.



## Social Impact

### Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 192 households to be displaced due to the earthquake. Of these, 117 people (out of a total population of 68,318) will seek temporary shelter in public shelters.



### Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

**Table 10: Casualty Estimates**

		Level 1	Level 2	Level 3	Level 4
<b>2 AM</b>	Commercial	0.55	0.09	0.01	0.02
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.45	0.07	0.01	0.01
	Other-Residential	18.46	3.15	0.34	0.67
	Single Family	8.11	0.98	0.08	0.16
	<b>Total</b>	<b>28</b>	<b>4</b>	<b>0</b>	<b>1</b>
<b>2 PM</b>	Commercial	30.31	5.02	0.51	0.99
	Commuting	0.00	0.00	0.00	0.00
	Educational	8.78	1.51	0.16	0.31
	Hotels	0.00	0.00	0.00	0.00
	Industrial	3.33	0.53	0.05	0.10
	Other-Residential	3.46	0.61	0.07	0.13
	Single Family	1.45	0.18	0.02	0.03
	<b>Total</b>	<b>47</b>	<b>8</b>	<b>1</b>	<b>2</b>
<b>5 PM</b>	Commercial	20.73	3.47	0.36	0.68
	Commuting	0.01	0.02	0.03	0.01
	Educational	1.59	0.28	0.03	0.06
	Hotels	0.00	0.00	0.00	0.00
	Industrial	2.08	0.33	0.03	0.06
	Other-Residential	7.31	1.28	0.15	0.27
	Single Family	3.13	0.40	0.04	0.07
	<b>Total</b>	<b>35</b>	<b>6</b>	<b>1</b>	<b>1</b>



FEMA

---

## Economic Loss

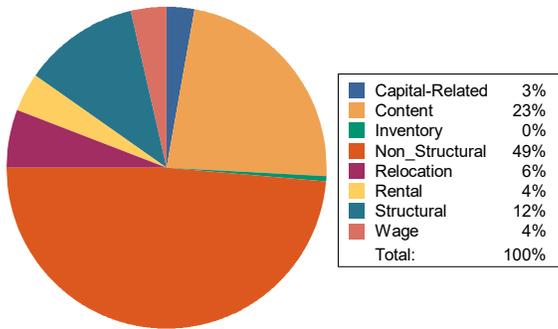
The total economic loss estimated for the earthquake is 292.83 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

### Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 282.00 (millions of dollars); 16 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 52 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type (\$ millions)



Earthquake Losses by Occupancy Type (\$ millions)

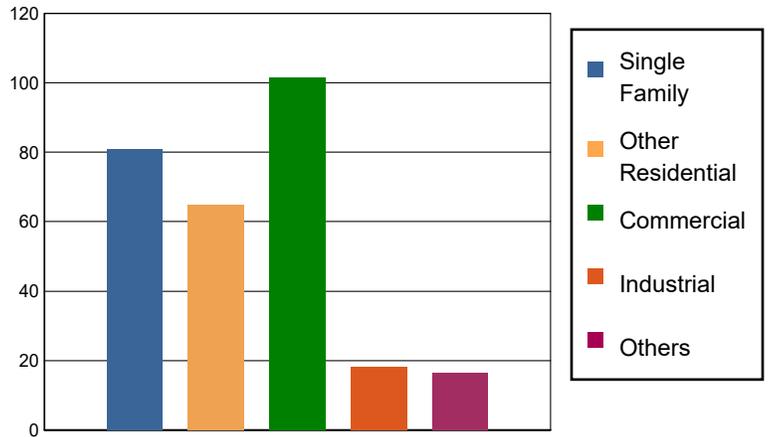


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
<b>Income Losses</b>							
	Wage	0.0000	0.6818	8.5609	0.2504	0.9277	10.4208
	Capital-Related	0.0000	0.2895	6.9572	0.1481	0.1003	7.4951
	Rental	0.8370	3.5123	5.8808	0.1301	0.1829	10.5431
	Relocation	2.8642	2.2960	8.6476	0.8049	1.7187	16.3314
	<b>Subtotal</b>	<b>3.7012</b>	<b>6.7796</b>	<b>30.0465</b>	<b>1.3335</b>	<b>2.9296</b>	<b>44.7904</b>
<b>Capital Stock Losses</b>							
	Structural	8.0073	7.2693	13.2836	2.1597	2.1971	32.9170
	Non_Structural	48.1585	38.7879	35.5785	8.1749	6.8351	137.5349
	Content	21.0624	12.0346	21.9695	5.8523	4.4574	65.3762
	Inventory	0.0000	0.0000	0.6102	0.7421	0.0298	1.3821
	<b>Subtotal</b>	<b>77.2282</b>	<b>58.0918</b>	<b>71.4418</b>	<b>16.9290</b>	<b>13.5194</b>	<b>237.2102</b>
	<b>Total</b>	<b>80.93</b>	<b>64.87</b>	<b>101.49</b>	<b>18.26</b>	<b>16.45</b>	<b>282.00</b>

### Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

**Table 12: Transportation System Economic Losses**  
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	742.4826	0.0000	0.00
	Bridges	203.1945	0.1641	0.08
	Tunnels	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>945.6771</b>	<b>0.1641</b>	
Railways	Segments	57.7630	0.0000	0.00
	Bridges	42.8857	0.0011	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	2.6630	0.4139	15.54
	<b>Subtotal</b>	<b>103.3117</b>	<b>0.4150</b>	
Light Rail	Segments	25.3014	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	3.4308	0.5332	15.54
	<b>Subtotal</b>	<b>28.7322</b>	<b>0.5332</b>	
Bus	Facilities	1.7154	0.2666	15.54
	<b>Subtotal</b>	<b>1.7154</b>	<b>0.2666</b>	
Ferry	Facilities	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>0.0000</b>	<b>0.0000</b>	
Port	Facilities	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>0.0000</b>	<b>0.0000</b>	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>0.0000</b>	<b>0.0000</b>	
<b>Total</b>		<b>1,079.44</b>	<b>1.38</b>	

**Table 13: Utility System Economic Losses**  
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	17.4657	0.0476	0.27
	<b>Subtotal</b>	<b>17.4657</b>	<b>0.0476</b>	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	10.4794	0.0239	0.23
	<b>Subtotal</b>	<b>10.4794</b>	<b>0.0239</b>	
Natural Gas	Pipelines	25.1269	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	6.9863	0.0082	0.12
	<b>Subtotal</b>	<b>32.1132</b>	<b>0.0082</b>	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	<b>Subtotal</b>	<b>0.0000</b>	<b>0.0000</b>	
Electrical Power	Facilities	186.5528	9.3351	5.00
	<b>Subtotal</b>	<b>186.5528</b>	<b>9.3351</b>	
Communication	Facilities	0.4640	0.0378	8.15
	<b>Subtotal</b>	<b>0.4640</b>	<b>0.0378</b>	
	<b>Total</b>	<b>247.08</b>	<b>9.45</b>	



FEMA

---

**Appendix A: County Listing for the Region**

Middlesex, MA

**Appendix B: Regional Population and Building Value Data**

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
<b>Massachusetts</b>	Middlesex	68,318	7,587	3,072	10,660
<b>Total Region</b>		<b>68,318</b>	<b>7,587</b>	<b>3,072</b>	<b>10,660</b>

# LOCAL MITIGATION PLAN REVIEW TOOL – Final

## City of Framingham, MA

---

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

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

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

<b>Jurisdiction:</b> City of Framingham, MA	<b>Title of Plan:</b> City of Framingham, MA Hazard Mitigation Plan Update	<b>Date of Plan:</b> January 2023 <b>Resubmit:</b> 3/23/2023
<b>Single or Multi-jurisdiction plan?</b> Single	<b>New Plan or Plan Update?</b> Update	
<b>Regional Point of Contact:</b> N/A <b>Title:</b> <b>Agency/Address:</b>  <b>Phone Number:</b> <b>E-Mail:</b>	<b>Local Point of Contact/Title:</b> Shawn Luz, Sustainability Coordinator City of Framingham, Capital Projects & Facilities Management The City of Framingham 150 Concord Street Framingham, MA 01701 508-532-5652 <a href="mailto:sluz@framinghamma.gov">sluz@framinghamma.gov</a>	

<b>State Reviewer:</b> Jeffrey Zukowski	<b>Title:</b> Hazard Mitigation Planner	<b>Date:</b> 2/21/2023; 3/23/2023 & 3/24/2023
--	--	--

<b>FEMA Reviewer:</b> Dylan Burkett Brigitte Ndikum-Nyada	<b>Title:</b> CERC Hazard Mitigation Planner Community Planner	<b>Date:</b> 3/6/2023 3/16 – 3/22/23; 3/23/23; 3/27-3/28/2023
<b>Date Received in FEMA Region I</b>	02/21/2023; 3/23/2023 & 3/24/2023	
<b>Plan Not Approved</b>	03/22/2023 Requires revisions	
<b>Plan Approvable Pending Adoption</b>	3/23/2023	
<b>Plan Adopted</b>	3/24/2023	
<b>Plan Approved</b>	<b>3/27/2023</b>	
<i>Next plan will expire 5yrs after FA date above</i>		

**SECTION 1:  
REGULATION CHECKLIST**

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

<b>1. REGULATION CHECKLIST</b>	<b>Location in Plan (section and/or page number)</b>	<b>Met</b>	<b>Not Met</b>
<b>Regulation (44 CFR 201.6 Local Mitigation Plans)</b>			
<b>ELEMENT A. PLANNING PROCESS</b>			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Ack. p. 6; Ch. 3, pp. 34-39; App. A, p. 224	X	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Ch. 3, pp. 39-46	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Ch. 3, pp. 39-49; App. A, pp. 225-235	X	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Ch. 5, pp. 135-137; Footnotes & references included thru-out the plan	X	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Ch. 7, pp. 219-220	X	
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	p. 8; Ch. 7, pp. 220-223; App. D	X	
<b>ELEMENT A: REQUIRED REVISIONS</b>			
<b>ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT</b>			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Ch. 1, pp. 10-11; Ch. 4, pp. 50-133; App. E	X	

<b>1. REGULATION CHECKLIST</b>		<b>Location in Plan (section and/or page number)</b>	<b>Met</b>	<b>Not Met</b>
<b>Regulation (44 CFR 201.6 Local Mitigation Plans)</b>				
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6©(2)(i))	Ch. 4, pp. 55-133	X		
B3. Is there a description of each identified hazard’s impact on the community as well as an overall summary of the community’s vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Ch. 2, pp. 28-33; Ch. 4, pp. 55-133; App. B; App. E	X		
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Ch. 4, p. 128	X		
<b><u>ELEMENT B: REQUIRED REVISIONS</u></b>				
<b>ELEMENT C. MITIGATION STRATEGY</b>				
C1. Does the plan document each jurisdiction’s existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Ch. 5, pp. 134-135, 137-159	X		
C2. Does the Plan address each jurisdiction’s participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Ch. 5, pp. 151-155	X		
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Ch. 1, p. 12; Ch. 6, pp. 160-162	X		
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Ch. 6, pp. 199-213; App. C, pp. 250-256	X		
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Ch. 6, pp. 196-213; App. C, pp. 242-249	X		
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Ch.5, pp. 137-159; Ch. 6, pp. 214-215	X		
<b><u>ELEMENT C: REQUIRED REVISIONS</u></b>				
<b>ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION</b> (applicable to plan updates only)				
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Ch. 1, pp. 13-14; Ch. 2, pp. 17-33	X		
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Ch. 1, p. 14; Ch. 6, pp. 163-193	X		
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Ch. 1, pp. 14-15; Ch. 3, p. 37; Ch. 6, p. 161	X		

<b>1. REGULATION CHECKLIST</b>		<b>Location in Plan</b> (section and/or page number)	<b>Met</b>	<b>Not Met</b>
<b>Regulation (44 CFR 201.6 Local Mitigation Plans)</b>				
<b><u>ELEMENT D: REQUIRED REVISIONS</u></b>				
<b>ELEMENT E. PLAN ADOPTION</b>				
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Signed Adoption Certificate if on file. Formal Approval is <b>3/27/2023</b>	X		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))				
<b><u>ELEMENT E: REQUIRED REVISIONS</u></b>				
<b>ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)</b>				
F1.				
F2.				
<b><u>ELEMENT F: REQUIRED REVISIONS</u></b>				

**SECTION 2:  
PLAN ASSESSMENT**

**A. Plan Strengths and Opportunities for Improvement**

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

**Recommended Corrections:**

- None.

**Element A: Planning Process**

**Strengths:**

- The planning process is well-documented. It includes a detailed schedule of events and meetings that were part of the plan’s development.
- The planning process is well-detailed. The inclusion of meeting materials will help guide future updates.
- A range of existing studies, reports and plans was reviewed and incorporated. The result is a plan that is comprehensive and current.
- The outreach strategy was comprehensive. It gave the public a variety of opportunities to participate.
- It is quite commended to observe that this Framingham HMP update referenced this new report: *The 2022 Massachusetts Climate Change Assessment provides statements about the impacts of climate change in each of seven regions of Massachusetts. Framingham is in the “Eastern Inland” region.*

**Opportunities for Improvement:**

- Consider explaining whether the previous maintenance strategy was successful in the next plan update. Were there any obstacles in monitoring/evaluation/updating efforts?
- Prepare for the next plan update to be evaluated under the updated planning policy. Build on the equitable planning approach used for this plan across the next five years.
- Consider expanding public engagement in the planning process for future updates. Other communities have found success offering periodic presentations, distributing questionnaires or surveys, conducting public meetings, and posting on social media and interactive websites.

**Element B: Hazard Identification and Risk Assessment**

**Strengths:**

- The plan gives good reasons for why certain hazards were omitted from analysis.
- Hazard profiles are well-defined. There is detailed information about the context of the hazard and the risk it presents to the community.
- The plan does an excellent job of showing how the probability or severity of future hazard events may change due to changes in climate, population, or land use. FEMA will require this in subsequent plan updates.

- The plan incorporates 500-year floodplain data into the flood profile. While not regulatory, it is a great planning tool for future development.
- The plan includes problem statements for hazards. While not required, this is good practice and can help readers understand the risks the community faces.
- The resubmitted revised 2<sup>nd</sup> draft HMP addressed these deficiencies: *B4-a. The plan must describe the types (residential, commercial, institutional, etc.) and estimate the numbers of repetitive loss properties located in identified flood hazard areas. (page 128)*
- The plan identifies the number of repetitive and severe repetitive loss properties; however, it must describe the type of each property. Please provide the land use designation or structure type of these properties.

**Opportunities for Improvement:**

- Include the date of the data that explains the number of repetitive loss properties within Framingham.
- Indicate the location of Framingham on all state, regional and county maps included in the risk assessment.
- Include the original Fujita scale, as tornados before 2007 were measured with this and it may be a helpful reference.

**Element C: Mitigation Strategy**

**Strengths:**

- The plan gives a comprehensive and detailed description of the community’s existing programs, plans and policies that relate to mitigation.
- The plan evaluates existing capabilities. It also looks at how they could be expanded further to reduce risk.
- The plan includes a variety of mitigation actions (local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs).
- The resubmitted revised 2<sup>nd</sup> draft HMP addressed these deficiencies: *C5-a. The plan identifies the process for prioritizing actions well. However, it does not discuss the methods used to determine which scores lead to a “low,” “medium,” or “high” determination. Please add a discussion of priority descriptors that links the terms to a range of points. (page 195).*

**Opportunities for Improvement:**

- Include projects that would be possible if additional funding became available, such as during long-term recovery from a major disaster.
- Adding lessons learned about implementing mitigation actions would strengthen the plan, as would a short narrative on some “success stories.”

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

**Strengths:**

- The plan clearly describes development changes since the last update.
- Progress on mitigation actions is clear and comprehensive.

- Priorities are clearly stated and reflect climate change and equity, both of which will be required elements in subsequent updates.

***Opportunities for Improvement:***

- Describe general land use changes in neighboring areas that may affect the community's risk.

## B. Resources for Implementing Your Approved Plan

Refer to the [Massachusetts Integrated State Hazard Mitigation and Climate Action Plan](#), [Resilient MA Climate Clearinghouse](#), and State's [Climate Action Page](#) to learn about hazards relevant to Massachusetts and the State's efforts and action plan.

### Technical Assistance:

#### FEMA

- [Climate Resilience in Action | FEMA.gov](#): This page showcases efforts happening across the country, every day, to strengthen our communities. Together, we can build a climate resilient nation.
- [FEMA Climate Change](#): Provides resources that address climate change.
- [FEMA Hazard Mitigation Planning Online Bibliography](#): This compilation of government and private online sites is a useful source of information for developing and implementing hazard mitigation programs and plans in New England.
- [FEMA Library](#): FEMA publications can be downloaded from the library website. These resources may be especially useful in public information and outreach programs. Topics include building and construction techniques, NFIP policies, and integrating historic preservation and cultural resource protection with mitigation.
- [FEMA RiskMAP](#): Technical assistance is available through RiskMAP to assist communities in identifying, selecting, and implementing activities to support mitigation planning and risk reduction. Attend RiskMAP discovery meetings that may be scheduled in the state, especially any in neighboring communities with shared watersheds boundaries.

#### Other Federal

- [EPA Resilience and Adaptation in New England \(RAINE\)](#): A collection of vulnerability, resilience and adaptation reports, plans, and webpages at the state, regional, and community levels. Communities can use the RAINE database to learn from nearby communities about building resiliency and adapting to climate change.
- [EPA Soak Up the Rain](#): Soak Up the Rain is a public outreach campaign focused on stormwater quality and flooding. The website contains helpful resources for public outreach and easy implementation projects for individuals and communities.
- [NOAA C-CAP Land Cover Atlas](#): This interactive mapping tool allows communities to see their land uses, how they have changed over time, and what impact those changes may be having on resilience.
- [NOAA Sea Grant](#): Sea Grant's mission is to provide integrated research, communication, education, extension and legal programs to coastal communities that lead to the responsible use of the nation's ocean, coastal and Great Lakes resources through informed personal, policy and management decisions. Examples of the resources available help communities plan, adapt, and recovery are the Community Resilience Map of Projects and the National Sea Grant Resilience Toolkit
- [NOAA Sea Level Rise Viewer](#) and [Union for Concerned Scientists Inundation Mapper](#): These interactive mapping tools help coastal communities understand how their hazard risks may be changing. The "Preparing for Impacts" section of the inundation mapper addresses policy responses to protect communities.
- [NOAA U.S. Climate Resilience Toolkit](#): This resource provides scientific tools, information, and expertise to help manage climate-related risks and improve resilience to extreme events. The "[Steps to Resilience](#)" tool may be especially helpful in mitigation planning and implementation.

## State

- [Massachusetts Emergency Management Agency](#): The Massachusetts State Hazard Mitigation Officer (SHMO) and State Mitigation Planner(s) can provide guidance regarding grants, technical assistance, available publications, and training opportunities.
- Massachusetts Departments of [Conservation and Recreation](#) and [Environmental Protection](#) can provide technical assistance and resources to communities seeking to implement their hazard mitigation plans.
- [MA Mapping Portal](#): Interactive mapping tool with downloadable data

## Not for Profit

- [Kresge Foundation Online Library](#): Reports and documents on increasing urban resilience, among other topics.
- [Naturally Resilient Communities](#): A collaboration of organizations put together this guide to nature-based solutions and case studies so that communities can learn which nature-based solutions can work for them.
- [Rockefeller Foundation Resilient Cities](#): Helping cities, organizations, and communities better prepare for, respond to, and transform from disruption.

## Funding Sources:

- [Massachusetts Coastal Resilience Grant Program](#): Funding for coastal communities to address coastal flooding, erosion, and sea level rise.
- [Massachusetts Municipal Vulnerability Preparedness](#) program: Provides support for communities to plan for climate change and resilience and implement priority projects.
- [Massachusetts Water Quality Grants](#): Clean water grants that can be used for river restoration or other kinds of hazard mitigation implementation projects.
- [Federal Grants Resource Center](#) and [Grants.gov](#): Lists of grant opportunities from federal agencies (HUD, DOT/FHWA, EPA, etc.) to support rural development, sustainable communities and smart growth, climate change and adaptation, historic preservation, risk analyses, wildfire mitigation, conservation, Federal Highways pilot projects, etc.
- [FEMA Hazard Mitigation Assistance](#) (HMA): FEMA's Hazard Mitigation Assistance provides funding for projects under the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA). States, federally recognized tribes, local governments, and some not for profit organizations are eligible applicants.
- [GrantWatch](#): The website posts current foundation, local, state, and federal grants on one website, making it easy to consider a variety of sources for grants, guidance, and partnerships. Grants listed include The Partnership for Resilient Communities, the Institute for Sustainable Communities, the Rockefeller Foundation Resilience, The Nature Conservancy, The Kresge Climate-Resilient Initiative, the Threshold Foundation's Thriving Resilient Communities funding, the RAND Corporation, and ICLEI Local Governments for Sustainability.
- USDA [Natural Resource Conservation Service](#) (NRCS) and [Rural Development Grants](#): NRCS provides conservation technical assistance, financial assistance, and conservation innovation grants. USDA Rural Development operates over fifty financial assistance programs for a variety of rural applications.