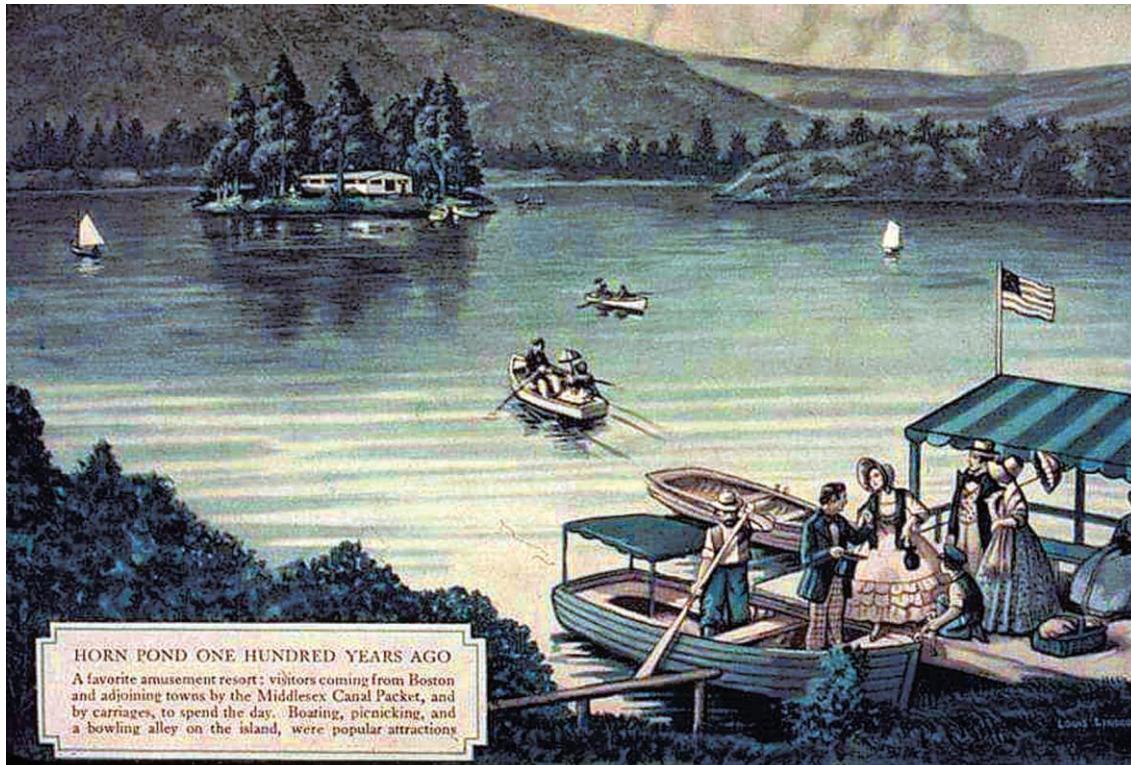


CITY OF WOBURN HAZARD MITIGATION PLAN 2021 UPDATE



Horn Pond
Louis Linscott illustration from the Horn Pond Facebook page



Draft Plan for MEMA and FEMA Review
August 23, 2021

ACKNOWLEDGEMENTS & CREDITS

This plan was prepared for the City of Woburn by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the City of Woburn.

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS & CREDITS	II
TABLE OF CONTENTS	III
LIST OF TABLES & FIGURES.....	IV
SECTION 1: EXECUTIVE SUMMARY	6
SECTION 2: INTRODUCTION	10
SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION	14
SECTION 4: RISK ASSESSMENT.....	20
SECTION 5: HAZARD MITIGATION GOALS	71
SECTION 6: EXISTING MITIGATION MEASURES	72
SECTION 7: MITIGATION MEASURES FROM PREVIOUS PLAN	77
SECTION 8: HAZARD MITIGATION STRATEGY	79
SECTION 9: PLAN ADOPTION & MAINTENANCE.....	88
SECTION 10: LIST OF REFERENCES	90
APPENDIX A: MEETING AGENDAS.....	91
APPENDIX B: HAZARD MAPPING	95
APPENDIX C: PUBLIC MEETINGS	105
APPENDIX D: PLAN ADOPTION	112
APPENDIX E: MVP WORKSHOP RESULTS	114

LIST OF TABLES & FIGURES

TABLES

Table 1: Plan Review and Update Process	8
Table 2: Presidential Declared Disasters 1991-2018.....	10
Table 3: Woburn Characteristics.....	12
Table 4: Woburn Public Meetings.....	17
Table 5: Climate Change and Natural Hazards.....	26
Table 6: Hazards Risk Summary.....	27
Table 7: Middlesex County Flood Events, 2010 through 2020	29
Table 8: Locally Identified Areas of Flooding	32
Table 9: Summary of Repetitive Losses and Claims.....	33
Table 10: Frequency of Massachusetts Drought Levels	34
Table 11: Middlesex County Extreme Cold and Winch Chill Occurrences 2011 through 2020....	37
Table 12: Middlesex County Extreme Heat Occurrences 2010 through 2020.....	38
Table 13: Locally Identified Areas of Brushfire Risk.....	40
Table 14: Hurricane Records for Massachusetts 1938-2018	42
Table 15: Saffir/Simpson Scale	43
Table 16: Regional Snowfall Index	44
Table 17: Severe Weather Major Disaster Declarations in Eastern MA	44
Table 18: Heavy Snow Events and Impacts in Middlesex County, 2010 through 2020	46
Table 19: Hail Size Comparisons	47
Table 20: Middlesex County Hail Events, 2010 through 2020.....	47
Table 21: Enhanced Fujita Scale	49
Table 22: Tornado Records for Middlesex County.....	50
Table 23: Middlesex County Thunderstorm Events, 2015 through 2020	51
Table 24: Richter Scale and Effects.....	53
Table 25: Historic Earthquakes in Massachusetts or Surrounding Area	53
Table 26: City of Woburn 2016 Land Use	56
Table 27: Summary of Woburn Developments, 2016-2021	57
Table 28: Relationship of Development to Hazard Areas	57
Table 29: Critical Facilities and Relationship to Hazard Areas.....	59
Table 30: Estimated Damages from Hurricanes	66
Table 31: Estimated Damages from Earthquakes.....	67
Table 32: Estimated Damages from Flooding	67
Table 33: Existing Natural Hazard Mitigation Measures in Woburn.....	75
Table 34: Mitigation Measures from the 2016 Plan	77
Table 35: Mitigation Measures Prioritization.....	84

FIGURES

Figure 1: Six-Step Planning Process.....	14
Figure 2: Observed Increase in Temperature	21
Figure 3: Projected Increase in Annual Days Over 90 Degrees F	22
Figure 4: Observed Change in Total Annual Precipitation Falling in the Heaviest 1% of Events ...	23
Figure 5: Projected Change in Total Annual Precipitation Falling.....	24
Figure 6: Observed Increase in Sea Level Rise	24
Figure 7: Recent and Projected Increase in Sea Level Rise	25
Figure 8: March 2010 USGS Aberjona River Gage	29
Figure 9: Weeks of Severe Drought (2001-2017).....	35
Figure 10 Wind Chill Temperature Index and Frostbite Risk.....	37
Figure 11: Heat Index Chart	38
Figure 12: Wildfire Risk Areas	41
Figure 13: State of Massachusetts Earthquake Probability Map.....	55

SECTION 1: EXECUTIVE SUMMARY

Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events. In the communities of the Boston region of Massachusetts, hazard mitigation planning tends to focus most on flooding, the most likely natural hazard to impact these communities. This plan considers how our warming climate will affect natural hazards. Warming temperatures will fuel changing precipitation patterns, sea level rise, and an increasing frequency and intensity of severe storms. The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five-year intervals.

PLANNING PROCESS

Planning for the Hazard Mitigation Plan update was led by the Woburn Local Hazard Mitigation Planning Team, composed of staff from a number of different city departments. The team met on March 16, 2021, April 22, 2021, and July 13, 2021, and discussed where the impacts of natural hazards most affect the city, the effects of climate change, goals for addressing these impacts, updates to the City's existing mitigation measures, and new or revised hazard mitigation measures that would benefit the city.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the city takes to mitigate them. The City's Local Hazard Mitigation Planning Team hosted two public meetings. The first meeting was held via Zoom on June 3, 2021. The second meeting on July 27, 2021, was held before the Planning Board via Zoom and the draft plan update was posted on the City's website for public review. Key city stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments.

RISK ASSESSMENT

The Woburn Hazard Mitigation Plan assesses the potential impacts to the city from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, drought, and invasive species. For each risk, the assessment identifies the projected impacts of a warming climate. These are shown in the map series in Appendix B. The Woburn Local Hazard Mitigation Planning Team identified 166 Critical Facilities. These are also shown on the map series and listed in Table 29, identifying which facilities are located within the mapped hazard zones.

Hazards U.S. – Multihazards (HAZUS-MH) is a standardized methodology developed by FEMA that utilizes Geographic Information Systems (GIS) to estimate physical, economic, and social impacts of disasters. The HAZUS-MH analysis for Woburn estimates property damages from Hurricanes of category 2 and 4 (\$25 million to \$103 million), earthquakes of magnitudes 5 and 7 (\$756 million to \$6.9 billion), and the 1% and .2% chance of flooding (\$31 to \$41 million).

HAZARD MITIGATION GOALS

The Woburn Local Multiple Hazard Community Planning Team endorsed the following ten hazard mitigation goals at the April 22, 2021, team meeting. The team added a tenth goal focused on incorporating future climate change projections.

1. Prevent and reduce the loss of life, injury and property damages resulting from all major natural hazards.
2. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
3. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees, and boards.
 - Ensure that the Planning Department considers hazard mitigation in its review and permitting of new development.
 - Review zoning regulations to ensure that the ordinance incorporates all reasonable hazard mitigation provisions.
 - Ensure that all relevant municipal departments have the resources to continue to enforce codes and regulations related to hazard mitigation.
4. Prevent and reduce the damage to public infrastructure resulting from all hazards.
 - Begin to assess the vulnerability of municipal buildings and infrastructure to damage from an earthquake.
 - Maintain existing mitigation infrastructure in good condition.
5. Encourage the business community, major institutions, and non-profits to work with the city to develop, review, and implement the hazard mitigation plan.
6. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
 - Continue to participate in the Mystic Region REPC and Region IV A (Board of Health).
7. Ensure that future development meets federal, state, and local standards for preventing and reducing the impacts of natural hazards.
8. Educate the public about natural hazards and mitigation measures that can be undertaken by property-owners.
 - Provide information on hazard mitigation activities in the languages most frequently spoken in Woburn.
9. Take maximum advantage of resources from FEMA and MEMA to educate City staff and the public about hazard mitigation.
10. Consider the potential impacts of future climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning.

HAZARD MITIGATION STRATEGY

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

PLAN REVIEW & UPDATE PROCESS

The process for developing Woburn's Hazard Mitigation Plan 2021 Update is summarized in Table 1.

Table 1: Plan Review and Update Process

Section	Reviews and Updates
Section 3: Public Participation	The Local Hazard Mitigation Planning Team placed an emphasis on public participation for the update of the Hazard Mitigation Plan, discussing strategies to enhance participation opportunities at the first local committee meeting. During plan development, the plan was discussed at two public meetings hosted by the Hazard Mitigation Team and the Planning Board. The plan was also available on the City's website for public comment. See Public Comments for feedback.
Section 4: Risk Assessment	MAPC gathered the most recently available climate, hazard and land use data and met with city staff to identify changes in local hazard areas and development trends. City staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. The Risk Assessment integrates projected climate impacts. MAPC also used the most recently available version of HAZUS and assessed the potential impacts of flooding using the latest data.
Section 5: Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Woburn Local Hazard Mitigation Planning Team.
Section 6: Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the city.
Sections 7 and 8: Hazard Mitigation Strategy	Mitigation measures from the 2016 plan were reviewed and assessed as to whether they were completed, in progress, or deferred. The Local Hazard Mitigation Planning Team determined whether to carry forward measures into the 2021 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2016 plan. The Local Hazard

	Mitigation Team prioritized all of these measures based on current conditions.
Section 9: Plan Adoption & Maintenance	This section of the plan was updated with a new on-going plan implementation review and five-year update process that will assist the City in incorporating hazard mitigation issues into other City planning and regulatory review processes and better prepare the City for the next comprehensive plan update.

As indicated in Table 34, Woburn made good progress implementing mitigation measures identified in the 2016 Hazard Mitigation Plan. Considerable work has been done to address drainage problems citywide. Three drainage projects were completed, and progress was made to reduce flooding on four additional projects. Progress was also made on stream, culvert and catch basin maintenance. A number of projects that were partially completed or not initiated have been continued into this plan update. The city also did outreach regarding heat risks and evaluated snow loads for some of its buildings.

Overall, fifteen mitigation measures from the 2016 plan will be continued in the plan update. Most retain the same priority in this 2021 Update. Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the City's decision-making processes. As in the past, the city will document any actions taken within this iteration of the Hazard Mitigation Plan on challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Woburn Hazard Mitigation Implementation Team, as described in Section 9 Plan Adoption and Maintenance.

SECTION 2: INTRODUCTION

PLANNING REQUIREMENTS UNDER THE FEDERAL DISASTER MITIGATION ACT

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

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

The City of Woburn contracted with the Metropolitan Area Planning Council (MAPC), to assist the City in updating its third local Hazard Mitigation Plan, which was first adopted in 2007 as a multijurisdictional plan and updated as a single municipality plan in 2016.

WHAT IS A HAZARD MITIGATION PLAN?

Natural hazard mitigation planning is the process of determining how to systematically reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities. This plan incorporates consideration of future risks due to projections for the increased frequency and severity of extreme weather fueled by a warming planet.

PREVIOUS FEDERAL/STATE DISASTERS

Since 1991, there have been 24 natural hazard events that triggered federal or state disaster declarations that included Middlesex County. These are listed in Table 2 below. The majority of these events involved flooding, while others were due to hurricanes or nor'easters, and severe winter weather.

Table 2: Presidentally Declared Disasters 1991-2018

Disaster Name	Date of Event	Declared Areas
Hurricane Bob	August 1991	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Severe Coastal Storm No Name Storm	October 1991	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk

Disaster Name	Date of Event	Declared Areas
Blizzard	March 1993	Statewide
Blizzard	January 1996	Statewide
Severe Storms, Flood	October 1996	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
Heavy Rain, Flood	June 1998	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Severe Storms, Flood	March 2001	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Snowstorm	March 2001	Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, Worcester
Snowstorm	February 2003	Statewide
Snowstorm	December 2003	Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, Worcester
Flooding	April 2004	Essex, Middlesex, Norfolk, Suffolk, Worcester
Snow	January 2005	Statewide
Hurricane Katrina	August 2005	Statewide
Severe Storms, Flooding	October 2005	Statewide
Severe Storms, Flooding	May 2006	Statewide
Severe Storm, Inland, Coastal Flooding	April 2007	Statewide
Severe Winter Storm	December 2008	Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Suffolk, Worcester
Severe Storms, Flooding	December 2008	Statewide
Severe Storms, Flooding	March/April 2010	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
Severe Winter Storm, Snowstorm	January 2011	Berkshire, Essex, Hampden, Hampshire, Middlesex, Norfolk, Suffolk
Severe Storm, Snowstorm	October 2011	Berkshire, Franklin, Hampden, Hampshire, Middlesex, Worcester
Severe Winter Storm, Snowstorm and Flooding	February, 2013	Statewide
Severe winter storm, snowstorm, and flooding	April 2015	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester

Disaster Name	Date of Event	Declared Areas
Severe winter storm and Snowstorm	March 2018	Essex, Middlesex, Norfolk, Suffolk, Worcester

Source: MA Hazard Mitigation and Climate Adaptation Plan, 2018

FEMA FUNDED MITIGATION PROJECTS

The city has not received funding from FEMA mitigation grants.

COMMUNITY PROFILE

The City of Woburn occupies 13.1 miles of the Fells Upland and is a suburban industrial city located along the upper Mystic Valley. Incorporated in 1642, Woburn became an early manufacturing center, tanning leather and making shoes. Production was large enough so that during the King Philip's Wars, town taxes were partially paid in shoes. The smallpox epidemic of 1675 cut deeply into the town's population. The Middlesex Canal from Boston opened in 1803 and the Boston and Lowell Railroad in 1835. Woburn continued to make boots and shoes and in 1855 made \$280,000 in footwear, but by 1865 there had been a shift away from manufacturing shoes and toward the production of leather. In that year alone, the tanneries of Woburn shipped \$1.7 million of leather and Woburn was at the head of the tanning industry in the country. Immigrants from Ireland and Canada moved to Woburn to take the jobs in the tanneries and in 1884, 26 large tanneries employed 1500 men producing \$4.5 million worth of leather. Henry Thayer of Woburn originated chrome tanning, which took the place of bark tanning in 1901. The tan yards clearly supplemented the city's subsistence farming from the earliest settlement times. By 1915 there was some diversification in the city's economy and residents were making ice cream, machine tools, mops, and paper boxes among other things. Woburn developed as an early English town settlement and has a notable early burying ground. Suburban growth began in the mid-19th century and has continued. Completion of Routes 128 and 93 established Woburn as a suburban economic hub. (Narrative based on information provided by the Massachusetts Historic Commission).

The city maintains a website at www.woburnma.gov

Table 3: Woburn Characteristics

- | |
|--|
| <p>Population: 40,228 people</p> <ul style="list-style-type: none"> • 5.6% are under age 5 • 19.6% are under age 18 • 16.3% are over age 65 • 5.5% of households have no vehicle available • 79.7% of the population is White • 5.9% of the population is Black • 8.8% of the population is Asian • 4.6% of the population is Latinx |
|--|

Number of Housing Units = 16,872

- 61.3% are owner-occupied

Source: 2019 American Community Survey

The City of Woburn has several unique characteristics to keep in mind while planning for natural hazards:

- Woburn has been proactive in addressing the impact of climate on natural hazards. The community is certified by the state as a Municipal Vulnerability Preparedness community.
- Records from flooding in 2010 highlight that significant flood damage occurred throughout the city, with 100% of disaster flood claims located outside the FEMA 1% chance flood zone.
- Woburn is located in the Mystic River watershed. Woburn collaborates with neighboring towns and the Mystic River Watershed Association to reduce stormwater impacts.
- Flooding occurs in multiple locations along the Aberjona River.
- Drought has negative impacts on trees, vegetation, and waterways. Drought also has economic impacts as the city must rely on more expensive water from the MWRA for part of its water supply.

SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION

MAPC employs a six-step planning process based on FEMA's hazard mitigation planning guidance focusing on local needs and priorities but maintaining a regional perspective matched to the scale and nature of natural hazard events and regional climate change. Public participation is a central component of this process, providing critical information about the local occurrence of hazards while also serving as a means to build a base of support for hazard mitigation activities. MAPC supports participation by the general public and other plan stakeholders through two public meetings, posting of the plan to the City's website, and invitations sent to neighboring communities, city boards and commissions, and other local or regional entities to review the plan and provide comment.

PLANNING PROCESS SUMMARY

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

Figure 1: Six-Step Planning Process



1. **Map the Hazards** – MAPC relies on data from a number of different federal, state, and local sources in order to map the areas with the potential to experience natural hazards. This mapping represents a multi-hazard assessment of the municipality and is used as a set of base maps for the remainder of the planning process. A particularly important source

of information is the knowledge drawn from local municipal staff on where natural hazard impacts have occurred. These maps can be found in Appendix B.

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

- City of Woburn Zoning Ordinances
- City of Woburn Community Resilience Building Workshop Summary of Findings 2019
- Woburn Housing Production Plan
- Blue Hill Observatory
- Boston HIRA
- FEMA, Flood Insurance Rate Maps for Norfolk County, MA, 2012
- FEMA, Hazards U.S. Multi-Hazard
- FEMA, Local Mitigation Plan Review Guide, October 2011
- Fourth National Climate Assessment, 2018
- Massachusetts Flood Hazard Management Program
- Massachusetts Office of Coastal Zone Management Shoreline Change Data
- Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams 2018
- Massachusetts State Hazard Mitigation Plan, 2013
- Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018
- Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data
- National Weather Service
- Nevada Seismological Library
- New England Seismic Network, Boston College Weston Observatory, <http://aki.bc.edu/index.htm>
- NOAA National Climatic Data Center, <http://www.ncdc.noaa.gov/>
- Northeast Climate Adaptation Science Center
- Northeast States Emergency Consortium, <http://www.nesec.org/>
- Tornado History Project
- US Census, 2010 and American Community Survey 2017 5-Year Estimates
- USGS, National Water Information System, <http://nwis.waterdata.usgs.gov/usa/nwis>

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

4. **Develop Mitigation Strategies** – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Section 7.
5. **Plan Approval & Adoption** – Once a final draft of the plan is complete it is sent to MEMA for the state level review and, following that, to FEMA for approval. Typically, once FEMA has approved the plan the agency issues a conditional approval (Approval Pending Adoption), with the condition being adoption of the plan by the municipality. More information on plan adoption can be found in Section 9 and documentation of plan adoption can be found in Appendix D.
6. **Implement & Update the Plan** – Implementation is the final and most important part of any planning process. Hazard Mitigation Plans must also be updated on a five-year basis making preparation for the next plan update an important on-going activity. Section 9 includes more detailed information on plan implementation.

2016 PLAN IMPLEMENTATION & MAINTENANCE

The 2016 City of Woburn Hazard Mitigation Plan contained a risk assessment of identified hazards for the city and mitigation measures to address the risk and vulnerability from these hazards. Since approval of the plan by FEMA and local adoption progress has been made on implementation of the measures. The city has advanced a number of projects for implementation, including multiple drainage projects. In addition, the city completed a climate resilience planning program and has been certified by the state in the Municipal Vulnerability Preparedness program.

THE LOCAL MULTIPLE HAZARD COMMUNITY PLANNING TEAM

MAPC worked with the local community representatives to organize a Local Hazard Mitigation Planning Team for Woburn. MAPC briefed the local representatives as to the desired composition of that team as well as the need for public participation in the local planning process.

The Local Hazard Mitigation Planning Team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The local team was tasked with working with MAPC to set plan goals, provide information on the hazards that impact the city, existing mitigation measures, and helping to develop new mitigation measures for this plan update. The Local Hazard Mitigation Planning Team membership is listed below.

Tina Cassidy	Planning Board Director, Project Manager
Jay Duran	Superintendent of Public Works
John E. Corey, Jr.	City Engineer
Len Burnham	Deputy Superintendent of Public Works
Robert Rufo	Police Chief



Therese Murray	Conservation Administrator
Thomas Quinn	Building Commissioner
Donald Kenton	Fire Chief
Melissa Cushing	Resident

The Woburn Planning Board and Conservation Commission are the primary entities responsible for regulating development in city. Feedback was assured through the participation of the Conservation Administrator and Planning Board Director. In addition, MAPC, the State-designated regional planning authority for Woburn, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as the Department of Transportation.

The Local Hazard Mitigation Planning Team met on the following dates: March 16, 2021, April 22, 2021, and July 13, 2021. The purpose of the meetings was to introduce the Hazard Mitigation planning program, consider climate impacts, review, and update hazard mitigation goals, and to gather information on local hazard mitigation issues and sites or areas related to these. Later meetings focused on verifying information gathered by MAPC staff and discussion of existing mitigation practices, the status of mitigation measures identified in the 2016 hazard mitigation plan, and potential new or revised mitigation measures. The agendas for these meetings are included in Appendix A.

PUBLIC MEETINGS

Public participation in the hazard mitigation planning process is important, both for plan development and for later implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historic and potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding of the concept of hazard mitigation and climate impacts, potentially creating support for mitigation actions taken in the future to implement the plan. To gather this information and educate residents on hazard mitigation, the city hosted two public meetings, one during the planning process and one after a complete draft plan was available for review.

The public had an opportunity to provide input to the Woburn hazard mitigation planning process during a public meeting held on June 3, 2021 and hosted on Zoom. The draft plan update was presented at a Planning Board meeting held on July 27, 2021 and hosted on Zoom. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. The attendance list for each meeting can be found in Table 4. See public meeting notices in Appendix C.

Table 4: Woburn Public Meetings

Meeting #1 June 3, 2021 (virtual)
Total Attendance: 9

Meeting #2 July 27, 2021

Total Attendance: 15

LOCAL STAKEHOLDER INVOLVEMENT

The local Hazard Mitigation Planning Team reached out to local stakeholders that might have an interest in the Hazard Mitigation Plan including neighboring communities, agencies, businesses, nonprofits, and other interested parties. Notice was sent to the following organizations and neighboring municipalities inviting them to review the Hazard Mitigation Plan and submit comments to the city. In addition, meetings were advertised in the local press, on the city website, and through City social media platforms.

Town of Winchester

Town of Stoneham

Town of Burlington

Town of Wilmington

Town of Reading

Mystic River Watershed Association

Woburn Social Capital

Woburn Council of Social Concern

Attorney Mark Salvati

Edens

Leggat McCall Properties

Robert D. Murray Associates

Woburn Housing Authority

Woburn Residents Environmental Network

Woburn Chamber of Commerce

Murtha Cullina Attorneys

Riemer Law

Cummings Properties

See Appendix C for public meeting notices. The draft Woburn Hazard Mitigation Plan 2021 Update was posted on the City's website for the second public meeting. Members of the public could access the draft document and submit comments or questions to the city.

PUBLIC COMMENT

At the first public meeting a commenter provided mapping and photos of specific flooding areas of concern. These include Olympia Avenue, Washington Street, and Henshaw Avenue near the I-93 exchange. In each location flooding is associated with the Aberjona River. Another commenter expressed support for strategies that would establish residential water use restrictions to address drought concerns. Another commenter expressed interest in strategies that would support residents who may be more impacted by, or vulnerable to, natural hazards. After the second meeting a commenter expressed appreciation for inclusion of flooding areas identified in the first public meeting, and reiterated concern about Olympia Avenue and Henshaw Street flooding. These locations have been added to Table 8: Locally Identified Areas of Flooding and to the maps in Appendix B.

CONTINUING PUBLIC PARTICIPATION

Following the adoption of the plan update, the planning team will continue to provide residents, businesses, and other stakeholders the opportunity to learn about the hazard mitigation planning process and to contribute information that will update the city's understanding of local hazards.

As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the City's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with city and state open meeting laws.

PLANNING TIMELINE

March 16, 2021	Meeting of the Woburn Local Hazard Mitigation and MVP Planning Team
April 22, 2021	Meeting of the Woburn Local Hazard Mitigation and MVP Planning Team
June 3, 2021	First Public Meeting held virtually
July 13, 2021	Meeting of the Woburn Local Hazard Mitigation and MVP Planning Team
July 27, 2021	Second Public Meeting with the Woburn Planning Board
August 23, 2021	Draft Plan Update submitted to MEMA
TBD	Draft Plan Update submitted to FEMA
TBD	Notice of Approvable Pending Adoption sent by FEMA
TBD	Plan Adopted by the City of Woburn
TBD	FEMA final approval of the plan for 5 years

POST-APPROVAL IMPLEMENTATION AND PLAN UPDATE TIMELINE

Mid-2024 2024	Conduct Mid-Term Plan Survey on Progress Seek FEMA grant to prepare next plan update
2025	Begin process to update the plan
2026	Submit Draft 2026 Plan Update to MEMA and FEMA
2026	FEMA approval of 2026 Plan Update

SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the City of Woburn as well as the relationship between those hazards and current land uses, potential future development, and critical infrastructure. This section also includes a vulnerability assessment that estimates the potential damages that could result from certain large-scale natural hazard events. In order to update Woburn's risk assessment, MAPC gathered the most recently available hazard and land use data and met with City staff to identify changes in local hazard areas and development trends. MAPC also used FEMA's damage estimation software, HAZUS.

With the adoption of the Hazard Mitigation and Climate Adaptation Plan 2018 (SHMCAP), Massachusetts became the first state to integrate climate projections in a state hazard mitigation plan. Following the state model, the projected impacts of our warming climate on natural hazards are integrated throughout the risk assessment. Key impacts include rising temperatures, which in turn affect precipitation patterns, sea level, and extreme weather.

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

Fourth National Climate Assessment, 2018 (Chapter 2-1)

CLIMATE CHANGE OBSERVATIONS AND PROJECTIONS

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

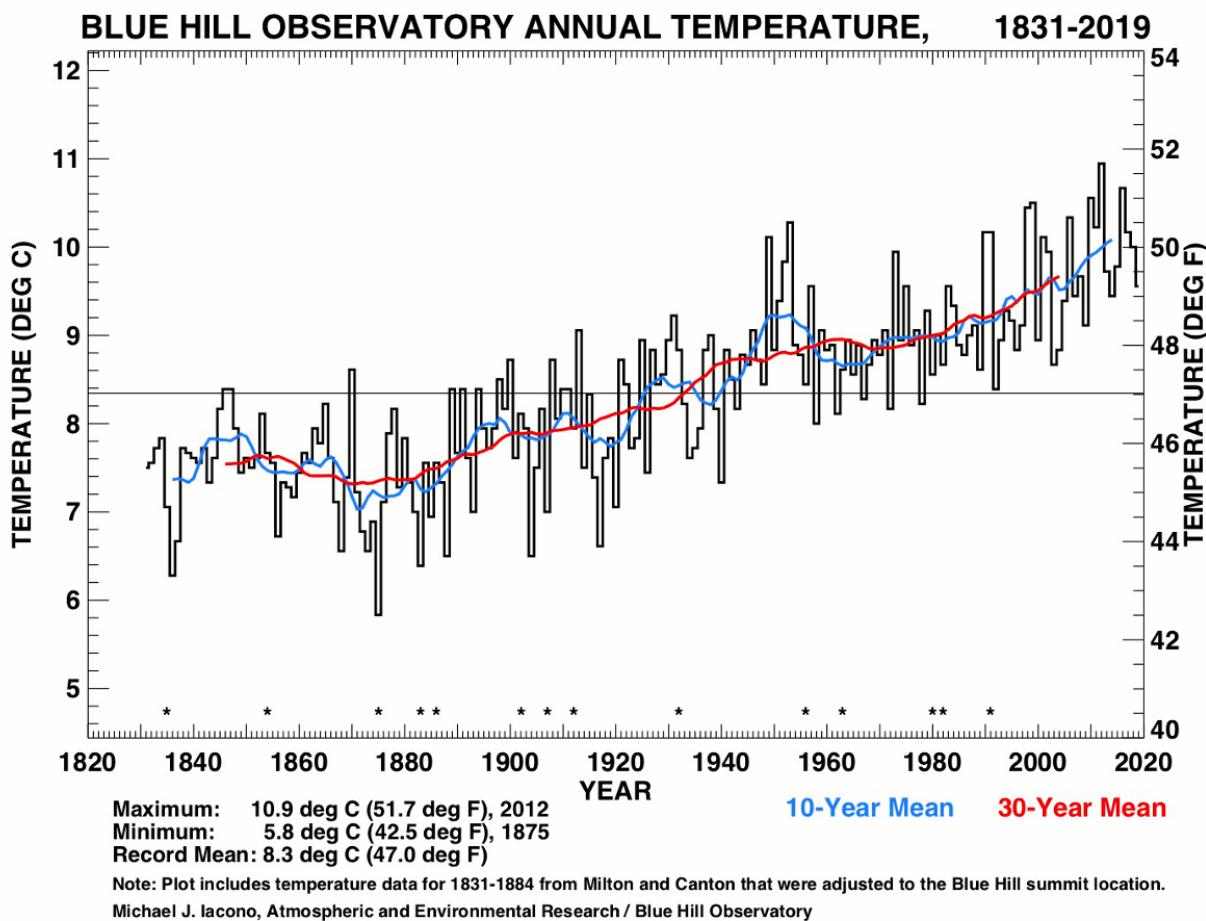
Temperature

Our climate has always been regulated by gases, including carbon dioxide, methane, and nitrous oxide, that blanket the earth. These gases trap heat that would otherwise be reflected out to space; without them our planet would be too cold to support life. We refer to these gases as "greenhouse gases" (GHGs) for their heat trapping capacity. The combustion of fossil fuels, our primary energy source in the age of industrialization, releases GHGs into the atmosphere. In the past century, human activity associated with industrialization has contributed to a growing concentration of GHGs in our atmosphere.

Records from the Blue Hill Observatory in Milton, MA show that average temperatures (30-year mean) have risen approximately 3 degrees (F) in the almost 200 years since record keeping began in 1831.

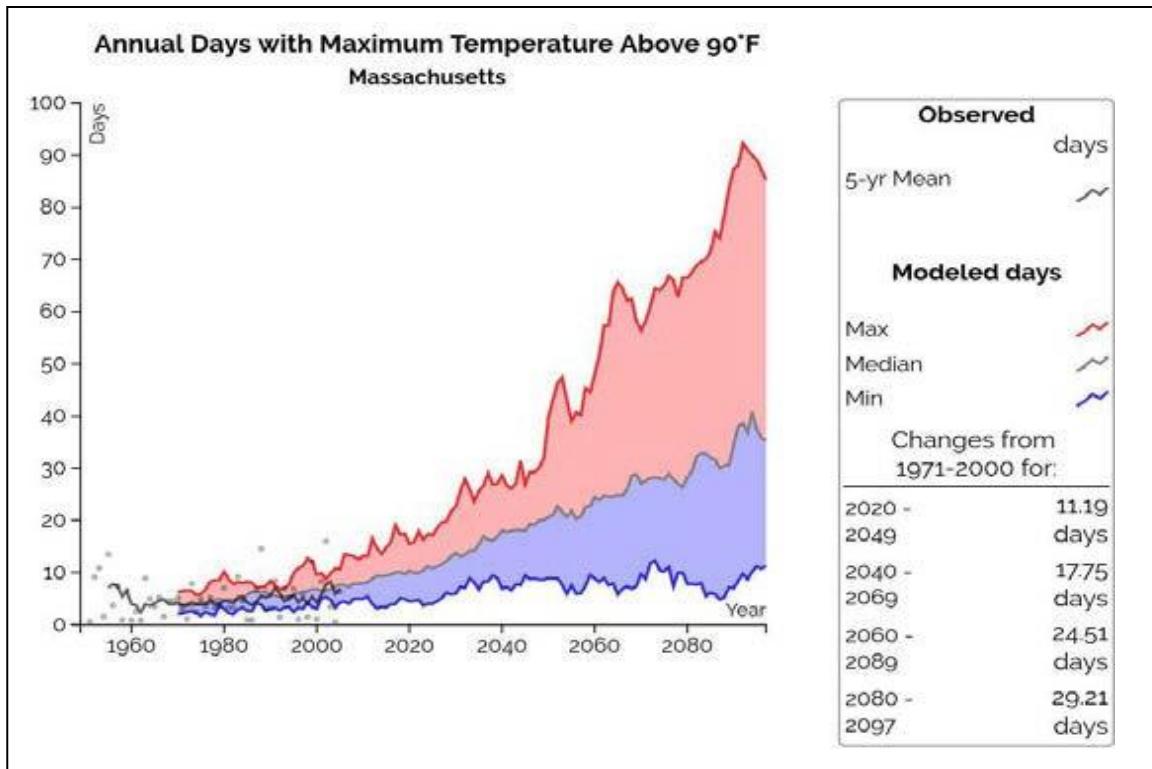


Figure 2: Observed Increase in Temperature



Climate projections include an increase in average temperature and in the number of extreme heat days. Extreme cold day are projected to decrease in number. The Northeast Climate Adaptation Science Center (NECASC) projects average temperatures in Massachusetts will increase by 5 degrees F by mid-century and nearly 7 degrees F by the end of the century. Figure 3 shows the NECASC range of projections for increases in the number of days over 90 degrees annually.

Figure 3: Projected Increase in Annual Days Over 90 Degrees F



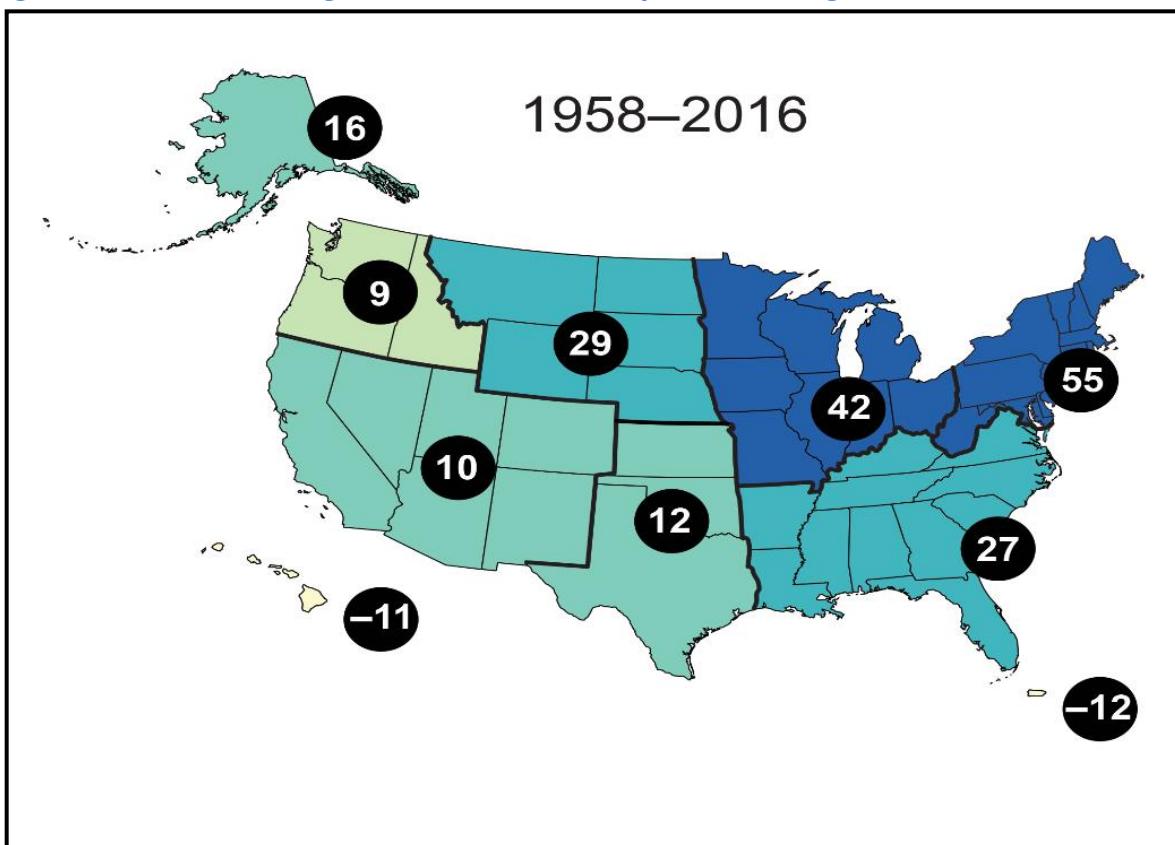
Source: Northeast Climate Adaptation Science Center

Precipitation Patterns

Annual precipitation in Massachusetts has increased by approximately 10% in the fifty-year period from 1960 to 2010 (MA Climate Adaptation Report, 2011). Moreover, there has been a significant increase in the frequency and intensity of large rain events. For the Northeast US, according to the Fourth National Climate Assessment 2018, in the past sixty years there has been a 55% increase in the amount of annual precipitation that falls in the top 1% of storm events (Figure 4). Changes in precipitation are fueled by warming temperatures which increase evaporation and, therefore, the amount of water vapor in the air.

Total annual precipitation in Massachusetts is projected to increase by 1 to 6 inches by mid-century, and by 1.2 to 7.3 inches by the end of this century (SHMCAP p. 2-22). The Fourth National Climate Assessment predicts that the pattern of increasing frequency and intensity of extreme rain events will continue. By 2070 to 2099, (relative to 1986 to 2015) they project a 30-40% increase in total annual precipitation falling in the heaviest 1% of rain events (Figure 5).

Figure 4: Observed Change in Total Annual Precipitation Falling in the Heaviest 1% of Events

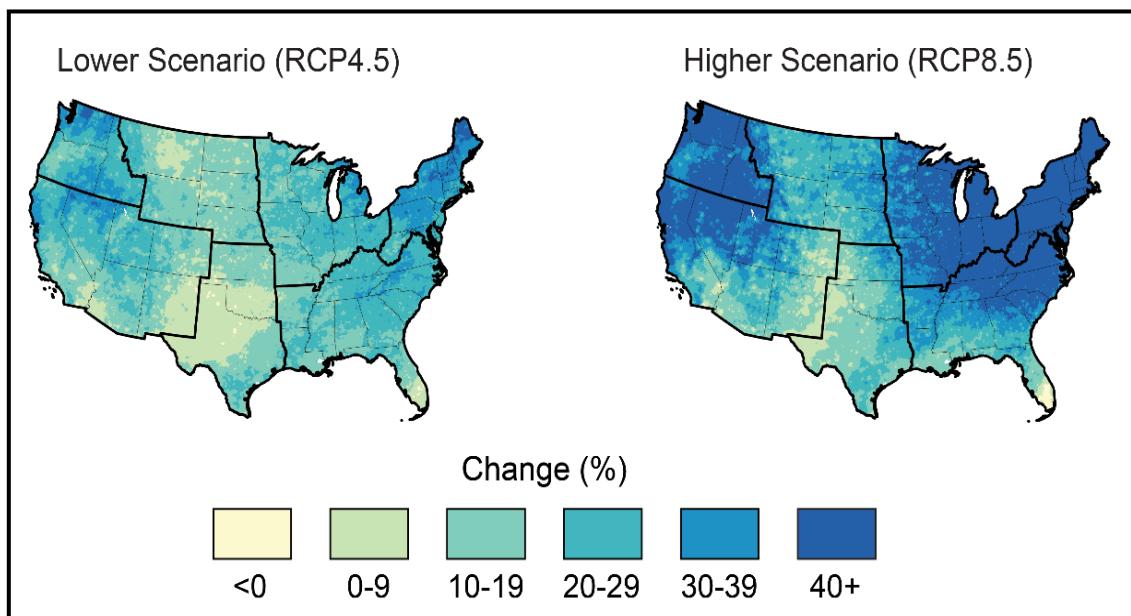


Source: Fourth National Climate Assessment, 2018

Numbers circled in black indicate % change.

Despite overall increasing precipitation, more frequent and significant summer droughts are also a projected consequence of climate change. This is due to projections that precipitation will increase in winter and spring and decrease slightly in the summer and, a result of earlier snow melt, and higher temperatures that will reduce soil moisture.

Figure 5: Projected Change in Total Annual Precipitation Falling in the Heaviest of 1% of Events for 2070-2099

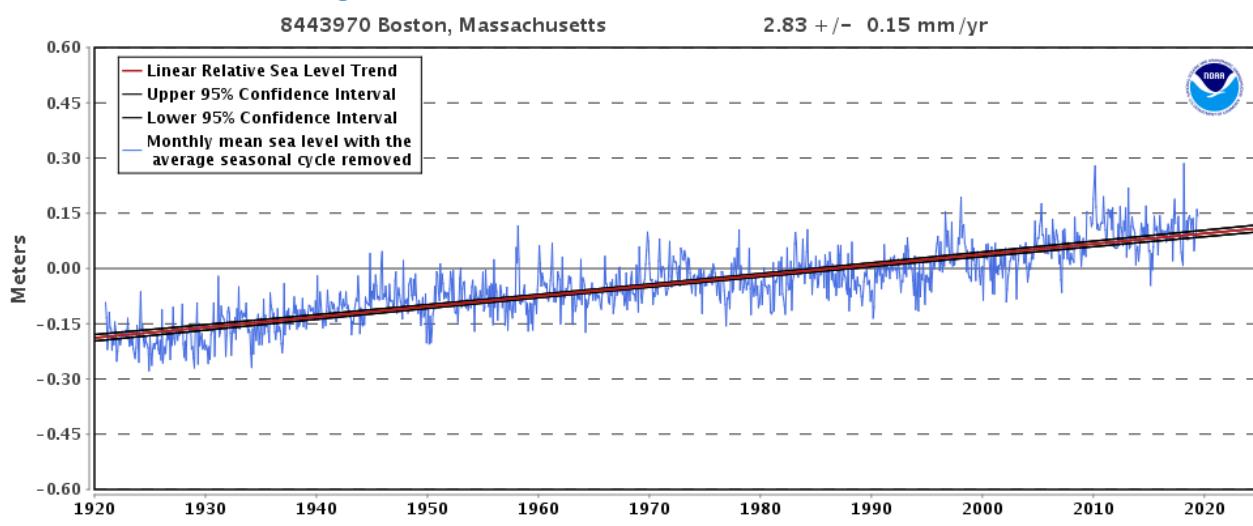


Source: Fourth National Climate Assessment, 2018

Sea Level Rise

Records from the Boston Tide Station show nearly one foot of sea level rise in the past century (Figure 6). Warming temperatures contribute to sea level rise in two ways. First, warm water expands to take up more space. Second, rising temperatures are melting land-based ice which enters the oceans as melt water. A third, quite minor, contributor to sea level rise in New England is not related to climate change. New England is still experiencing a small amount of land subsidence (drop in elevation) in response to the last glacial period.

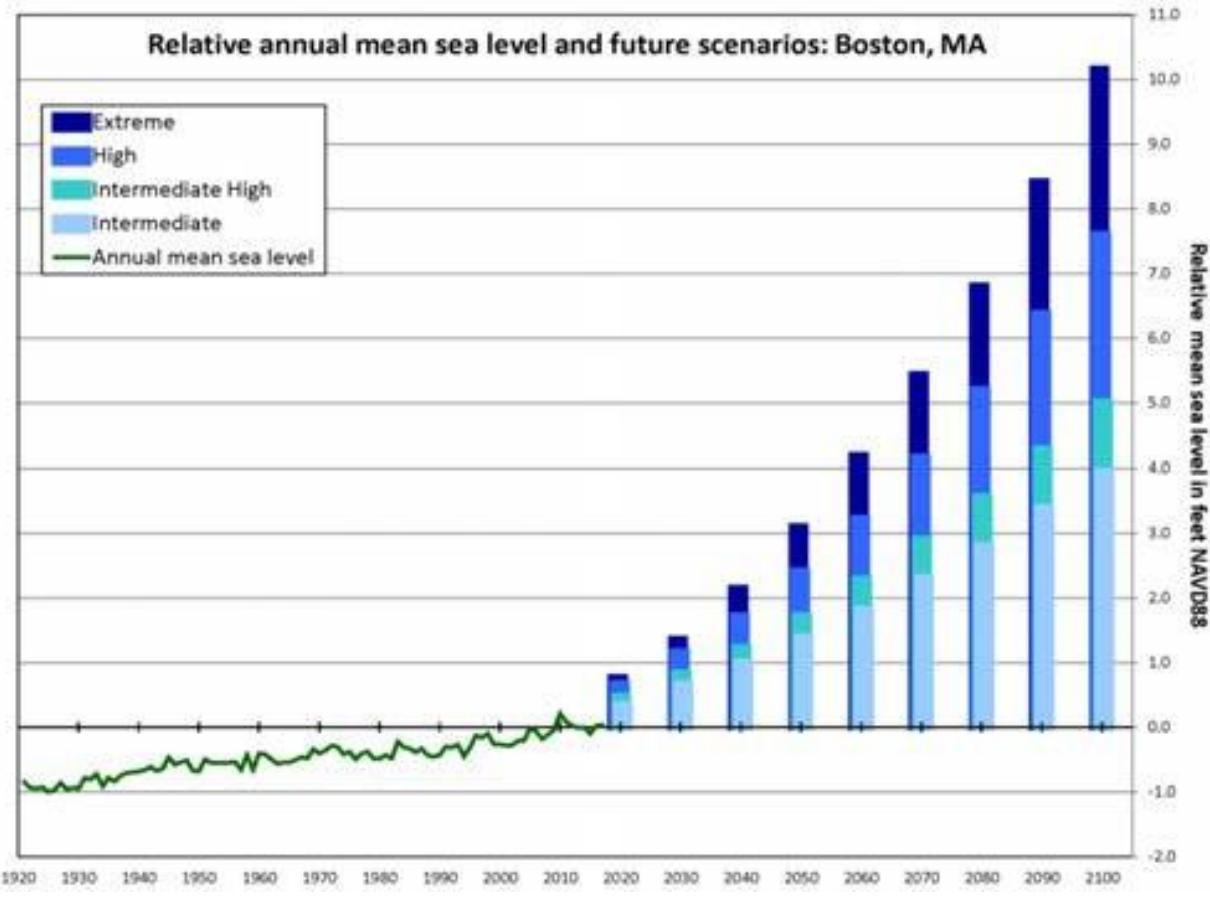
Figure 6: Observed Increase in Sea Level Rise



Source: NOAA

Projections of sea level rise through 2100 vary significantly depending on future greenhouse gas emissions and melting of land-based glaciers. Currently sea level is rising at an increasing rate. Figure 7 shows the recent rate of sea level rise, and a range of sea level rise scenarios. Projections for 2100 range from 4 feet to 10 feet. With ten feet representing the most extreme scenario. For 2050, the projections range approximately 1.5 to 3 feet.

Figure 7: Recent and Projected Increase in Sea Level Rise



Source: SHMCAP

Following the outline of the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), this local hazard mitigation plan organizes consideration of natural hazards based on their relationship to projected climate changes. Table 5 below, from the SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts. Ice Jams are an unlikely natural hazard; with no known record of occurrence in Woburn. Woburn has chosen not to profile ice jams since they are a secondary hazard. Finally, since Woburn is an inland community, it is not vulnerable to Tsunamis, Coastal Flooding, and Coastal Erosion; hazards related to coastal areas are not addressed.

Table 5: Climate Change and Natural Hazards

Primary Climate Change Interaction	Natural Hazard	Other Climate Change Interactions	Representative Climate Change Impacts
 Changes in Precipitation	Inland Flooding	Extreme Weather	Flash flooding, urban flooding, drainage system impacts (natural and human-made), lack of groundwater recharge, impacts to drinking water supply, public health impacts from mold and worsened indoor air quality, vector-borne diseases from stagnant water, episodic drought, changes in snow-rain ratios, changes in extent and duration of snow cover, degradation of stream channels and wetland
	Drought	Rising Temperatures, Extreme Weather	
	Landslide	Rising Temperatures, Extreme Weather	
 Sea Level Rise	Coastal Flooding	Extreme Weather	Increase in tidal and coastal floods, storm surge, coastal erosion, marsh migration, inundation of coastal and marine ecosystems, loss and subsidence of wetlands
	Coastal Erosion	Changes in Precipitation, Extreme Precipitation	
	Tsunami	Rising Temperatures	
 Rising Temperatures	Average/Extreme Temperatures	N/A	Shifting in seasons (longer summer, early spring, including earlier timing of spring peak flow), increase in length of growing season, increase of invasive species, ecosystem stress, energy brownouts from higher energy demands, more intense heat waves, public health impacts from high heat exposure and poor outdoor air quality, drying of streams and wetlands, eutrophication of lakes and ponds
	Wildfires	Changes in Precipitation	
	Invasive Species	Changes in Precipitation, Extreme Weather	
 Extreme Weather	Hurricanes/Tropical Storms	Rising Temperatures, Changes in Precipitation	Increase in frequency and intensity of extreme weather events, resulting in greater damage to natural resources, property, and infrastructure, as well as increased potential for loss of life
	Severe Winter Storm / Nor'easter	Rising Temperatures, Changes in Precipitation	
	Tornadoes	Rising Temperatures, Changes in Precipitation	
	Other Severe Weather (Including Strong Wind and Extreme Precipitation)	Rising Temperatures, Changes in Precipitation	
Non-Climate-Influenced Hazards	Earthquake	Not Applicable	There is no established correlation between climate change and this hazard

OVERVIEW OF HAZARDS AND IMPACTS

Table 6 summarizes the frequency and severity of hazard risks for Massachusetts and Woburn. The Massachusetts frequency assessment is based on data in the SHMCAP. The Woburn frequency assessment reflects data from the National Climatic Data Center (NOAA) for Middlesex County*, from the SHMCAP** and, from the local Hazard Mitigation Team***.

Table 6: Hazards Risk Summary

Hazard	Frequency	
	Massachusetts	Woburn
Inland Flooding	43 floods per year	4.4 floods per year*
Drought	2% chance of drought warning in any given month	2% chance of drought warning in any given month**
Landslides	1 notable event every other year	Three recorded***
Coastal Flooding	6 floods per year	NA
Coastal Erosion	Highly variable (frequency can't be measured)	NA
Tsunami	1 in 39 years	NA
Extreme Temperatures	2 heat events and 1.5 cold events yearly	1 heat event every 11 years and 1 cold event every 3.5 years*
Brush Fires	One notable event per year	Rare to have notable events***
Invasives	Increasing	Increasing***
Hurricane/Tropical Storm	One storm every two years	1 recorded event in 1861
Severe Winter Storms/Nor'easters	One notable winter storm and one nor'easter per year	2 per year*
Tornadoes	1.7 per year	None recorded
Other Severe Weather (Thunderstorms/High Winds)	20-30 thunderstorms annually; 43.5 high wind events annually	7 thunderstorms per year*
Earthquake	10 - 15% chance of Mag 5 in a 10-year period	10 - 15% chance of Mag 5 in a 10-year period **

CHANGING PRECIPITATION PATTERNS

INLAND FLOODING

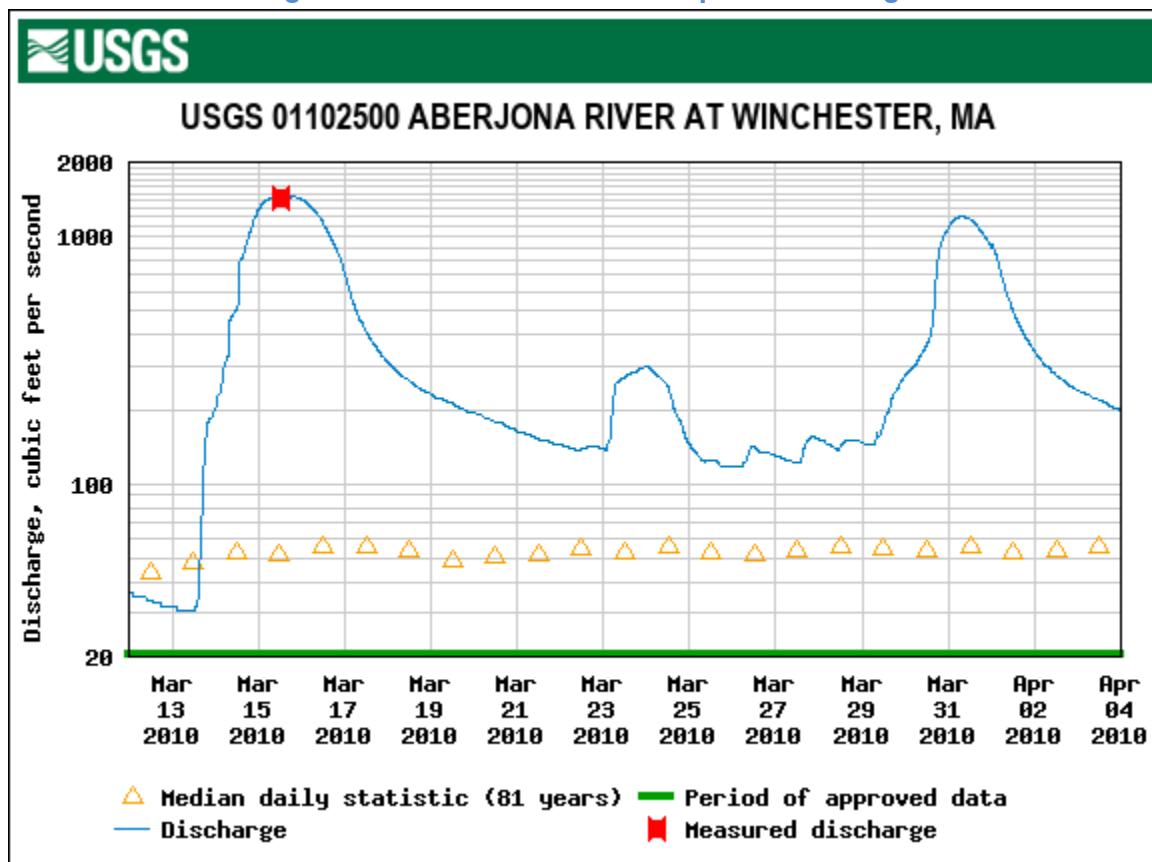
Inland flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Northeasters can occur at any time of the year, but they are most common in winter. Hurricanes are most common in the summer and early fall. Large rain storms can occur year-round. Climate change has the potential to exacerbate these issues over time due to increasing extreme rainfall events. Increase in average annual rainfall may also lead to more incidents of basement flooding caused by high seasonal groundwater levels.

Flooding was the most prevalent serious natural hazard identified by local officials in Woburn. Inland flooding can be associated with overflowing rivers and streams, stormwater flooding associated with impervious surfaces and stormwater infrastructure, and in more rare cases ice jams, ground failures (erosion), and in some communities beaver dams. Woburn is subject to two kinds of flooding: inland/riverine flooding where the rate of precipitation and/or amount of stormwater runoff overwhelms the capacity of natural or structured drainage systems causing overflow and urban flooding in which precipitation causes the water table to rise and leads to flooding of low-lying areas such as streets and underpasses. These types of flooding are often combined as storm events lead to large amounts of draining stormwater.

Woburn is located in the Mystic River Watershed. The watershed partially or wholly encompasses 22 communities north and west of Boston. Its headwaters begin in Reading and form the Aberjona River which flows through Woburn and Winchester and into the upper Mystic Lake. From the lower Mystic Lake, the Mystic River flows through Arlington, Somerville, Medford, Everett, Chelsea, Charlestown, and East Boston before discharging to Boston Harbor.

The March 2010 rainstorms fit the profile of a type of event expected to increase in frequency as the climate warms. That is, significant precipitation, falling in late winter as rain rather than snow, on ground saturated with snow melt, and while vegetation is still dormant. The Blue Hill Observatory in Milton recorded 17.7 inches of rain from three storms in the 19 days from March 13 to 31. As shown at the USGS gage located on the Aberjona River downstream from Horn Pond in Winchester the river surged, recording the third highest discharge on March 15, 2010, dating back to 1940 (Figure 8). The March 2010 storms were a federally declared disaster making federal assistance available to residents who did not carry flood insurance. Based on the claims, Woburn experienced extensive flood damage, with eight flood insurance claims and 390 disaster claims, 99% of which were located outside of FEMA Special Flood Hazard Areas. Some of the claims are in the vicinity of Woburn's streams and wetlands, but many are not associated with waterways or wetlands. This is not unusual in urbanized areas. See Map 3 in Appendix B for claim locations.

Figure 8: March 2010 USGS Aberjona River Gage



Local data for previous flooding occurrences are not collected by the City of Woburn. The best available local data is for Middlesex County through the National Climatic Data Center. Middlesex County, which includes the City of Woburn, experienced 48 flood events from 2010 through 2020. No deaths or injuries were reported and the total reported property damage in the county was \$36.5 million dollars. Nearly all of the damage is attributed to the events in March 2010. This is an average of 4.4 flood events each year. Measures of flooding severity include river forecasts of minor, moderate, or severe flooding.

Table 7: Middlesex County Flood Events, 2010 through 2020

Date	Deaths	Injuries	Property Damage
3/14/2010	0	0	26430000
3/29/2010	0	0	8810000
4/1/2010	0	0	0
8/28/2011	0	0	5000
10/14/2011	0	0	0
6/8/2012	0	0	0
6/23/2012	0	0	15000
7/18/2012	0	0	5000

10/29/2012	0	0	0
6/7/2013	0	0	0
7/1/2013	0	0	0
7/23/2013	0	0	0
9/1/2013	0	0	10000
3/30/2014	0	0	35000
3/30/2014	0	0	0
7/27/2014	0	0	0
8/31/2014	0	0	0
10/22/2014	0	0	20000
10/23/2014	0	0	0
12/9/2014	0	0	35000
5/31/2015	0	0	0
8/4/2015	0	0	0
8/15/2015	0	0	125000
9/30/2015	0	0	0
4/6/2017	0	0	0
6/27/2017	0	0	1000
7/12/2017	0	0	1000000
7/18/2017	0	0	0
8/2/2017	0	0	5000
10/25/2017	0	0	0
10/30/2017	0	0	0
1/12/2018	0	0	0
1/13/2018	0	0	0
4/16/2018	0	0	0
6/25/2018	0	0	15000
8/8/2018	0	0	35000
8/12/2018	0	0	30000
8/17/2018	0	0	0
10/29/2018	0	0	0
11/3/2018	0	0	0
11/10/2018	0	0	0
7/6/2019	0	0	0
8/7/2019	0	0	300
9/2/2019	0	0	0
6/21/2020	0	0	0
6/28/2020	0	0	5000
7/23/2020	0	0	0

9/10/2020	0	0	3000
TOTAL	0	0	36584300

Source: NOAA, National Climatic Data Center

ICE JAMS

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

DAM FAILURE OR OVERTOPPING

Dams can fail because of structural problems or age, independent of any storm event. Earthquakes can be a cause of dam failure by causing structural damage. Dams can also fail structurally because of flooding arising from a storm, or they can overspill due to flooding. In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the path of the dam's floodwaters.

A concern for dams in Massachusetts is that many were built in the 19th century without the benefits of modern engineering or construction oversight. In addition, some dams have not been properly maintained. The increasing intensity of precipitation is the primary climate concern related to dams, as they were most likely designed based on historic weather patterns. The SHMCAP indicates that changing precipitation patterns may increase the likelihood of overflow events. Dam failure is a highly infrequent occurrence, but a severe incident could result in loss of lives and significant property damage. According to the Association of State Dam Safety Officials, three dams have failed in Massachusetts since 1984, one of which resulted in a death.

Horn Pond Dam (aka Scalley Dam): Horn Pond covers approximately 120 acres and has a watershed area of 10 square miles. The primary outlet control structure is controlled by a weir and a slide gate with a secondary emergency riprap spillway that handles elevated water levels. The spillway is located on the southerly side of Horn Pond and enters Horn Pond Brook which flows through the Town of Winchester. In severe weather events and in anticipation of a rainfall of 4 inches or greater, the city notifies the downstream cities and towns that they will be lowering the pond to increase storm water runoff storage. When the capacity exceeds the storage volume, the pond begins to crest at elevation 42.0 (NGVD29) thus creating flooding of the local roadway and impacting the residences and apartments that directly abut Horn Pond Brook. Since the 2016 plan, the outlet structure has been modified to improve the ability to manage flood events. Horn Pond Dam is classified by the State Office of Dam Safety as being a significant hazard dam.

DCR Dam Hazard Classification

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

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

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

LOCALLY IDENTIFIED AREAS OF INLAND FLOODING

Information on potential flood hazard areas was taken from two sources. The first is the National Flood Insurance Rate Maps (FIRM). The FIRM flood zones are shown on Map 3 in Appendix B. The “Locally Identified Areas of Flooding” described below were identified by City staff as areas where flooding is known to occur. These areas do not necessarily coincide with the flood zones on the FIRMs. Flood sources include inadequate drainage systems, high groundwater, or other local conditions that may not be within a Special Flood Hazard Area. The numbers correspond to the numbers on Map 8, “Local Hazard Areas.”

Table 8: Locally Identified Areas of Flooding

Map ID	Name	Description
1	Lake Terrace and Circle	Lake Terrace and Lake Circle – Flooding in this area affects both the roadway and homes in the area. Flooding is caused by an inadequate drainage system.
2	Arlington Road	Flooding in this area is caused by an inadequate drainage system. Drainage work has been done so flooding should be reduced
3	Dragon Court	Flooding in this area is centered around a low-lying area at #29. Flooding affects both homes and the roadway. There is no existing storm drain infrastructure in this area.
4	Washington St. near Cedar Court	This area floods during heavy rains because of insufficient capacity in the existing storm drain system. The drainage system backs up and the excess runoff travels over Washington Street.
5	Bartlett Dr. and Pearl St. Rear	This area floods because of an under-sized drainage system.
6	Ward St. at Traverse St.	This area floods due to a limited storm drain system and impacts homes as well as the roadways. A dry well has been installed, flooding is reduced but not completely resolved.

7	Lillian St. near the Kennedy School	Flooding in this area occurs behind homes on Lillian Street. The primary cause of the flooding is the location of the existing storm drain inlet. Some repairs have been done to reduce flooding.
8	Cambridge Rd.	The flooding on Cambridge Road is in the vicinity of Russell Street and is caused by insufficient capacity in the drainage system. Impacts include flooding of local businesses. Major work has been done here and conditions are significantly improved, but additional capacity is needed.
9	Winn St. to Hart St.	Winn Street near Hamilton Road experiences flooding of homes. Cleaning of a major culvert has reduced flooding significantly.
11	Salem St. at Aberjona Dr.	This area was identified as an area where emergency access could be blocked during flood events.
13	Prospect St. and Jefferson Avenue	Flooding due to drainage issues occurs at the intersection and up to Garfield Street and along the wetlands area between Auburn Avenue and Hanson Court.
14	New Boston St.	Flooding from Halls Brook impacts the roadway.
15	Olympia Rd.	Flooding occurs in the Olympia Avenue in the vicinity of the Aberjona River. Flooding here is difficult to address because drainage systems are located on land not controlled by the City.
16	Henshaw St.	Flooding in this vicinity is associated with the Aberjona River.

REPETITIVE LOSS STRUCTURES

As defined by FEMA, a repetitive loss property is a NFIP-insured structure that has had two or more paid flood losses of \$1,000 or more in any given 10-year period since 1978. There are 7 repetitive loss properties in Woburn. The properties are shown on the maps in Appendix A. These repetitive loss properties had a total of 17 losses from 1978 to 2020, totaling \$634,454 in paid claims. For more information on repetitive losses see

https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt and

<https://www.fema.gov/repetitive-flood-claims-grant-program-fact-sheet>.

Table 9 summarizes the number and location of repetitive loss structures located within Woburn and the number of losses and total claims associated with them.

Table 9: Summary of Repetitive Losses and Claims

	A, AE, AO, AH Zones	VE Zone	X Zones	Total
Number of Properties	2	0	5	7
Number of Losses	6	0	11	17
Total Claims	\$456,760	0	\$177,694	\$634,454

Source: Department of Conservation and Recreation, FEMA Repetitive Loss data

DROUGHT

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

Droughts are projected to increase in frequency and intensity in the summer and fall as weather patterns change. Factors contributing to this include increasing evaporation as a result of warmer weather, earlier snow melt, and more extreme weather patterns. Drought impacts can include reduced groundwater and surface water levels, affecting water quality and quantity, and the organisms that rely on aquatic resources. Drought also increases stress on plant communities and, the likelihood of forest and brush fires. Communities may be affected by water use restrictions, affecting drinking water supply and outdoor water use. Economic sectors impacted could include recreation, agriculture, and forestry.

Five levels of drought have been developed to characterize drought severity: Normal, Advisory, Watch, Warning, and Emergency. These drought levels are based on the conditions of natural resources and are intended to provide information on the current status of water resources. The levels provide a basic framework from which to take actions to assess, communicate, and respond to drought conditions.

Woburn does not collect data relative to drought events. Because drought tends to be a regional natural hazard, this plan references state data as the best available data for drought. Drought is a city-wide hazard in Woburn. The SHMCAP using data collected since 1850, calculates that statewide there is a 1% chance of being in a drought emergency in any given month. For drought warning and watch levels, the chance is 2% and 8% respectively in any given month (Table 10).

Table 10: Frequency of Massachusetts Drought Levels

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

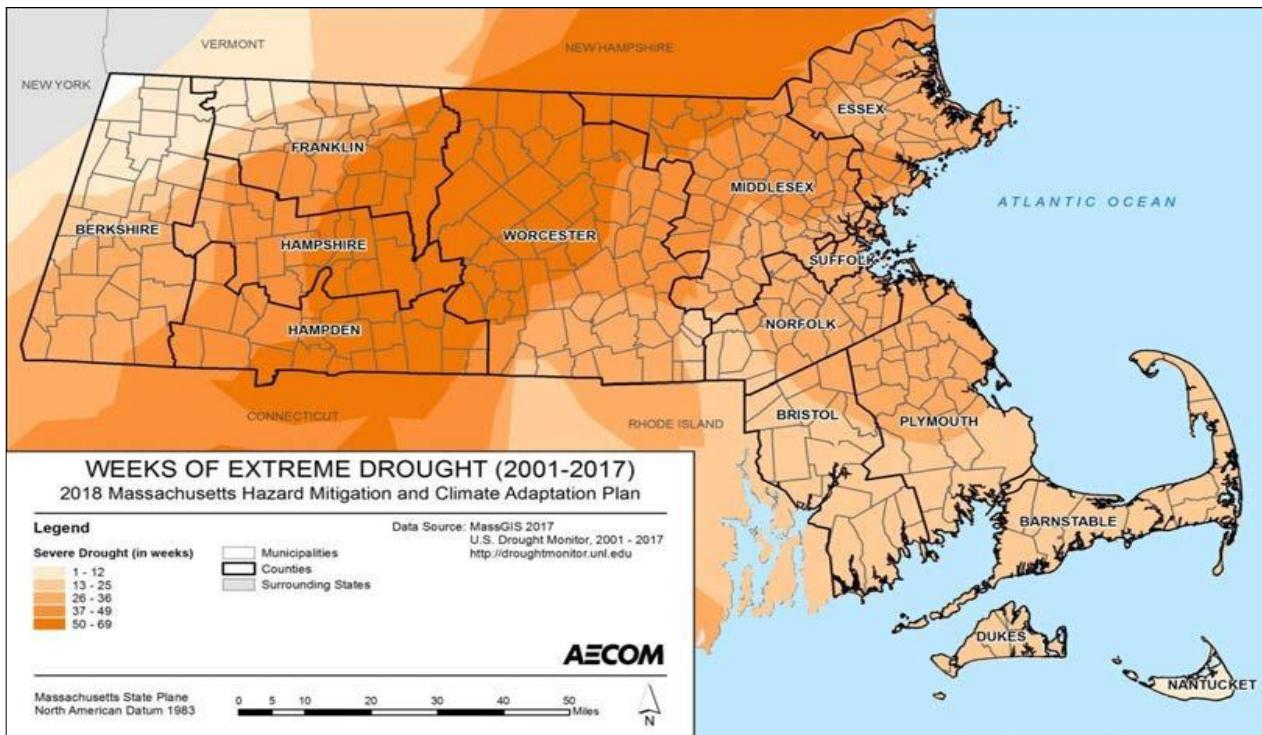
Source: SHMCAP

Drought emergencies have been reached infrequently, with five events occurring between 1850 and 2012: 1883, 1911, 1941, 1957, and 1965 to 1966. Due to its long duration, the drought from 1965 to 1966 is viewed as the most severe drought to have occurred in Massachusetts in modern times. The drought that extended from July 2016 to April 2017 reached the Drought Warning level. Determinations regarding the end of a drought or reduction of the drought level

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

The U.S. Drought Monitor characterizes droughts as moderate, severe, extreme, or exceptional. Severe drought is characterized by likely crop and pasture losses, water shortages, and water restrictions. As shown in Figure 9 below, Woburn experienced between 37 and 49 weeks of severe drought between 2001 and 2017. A concern for Woburn is the impact of drought on Woburn's water supply. In addition to impacting natural resources, drought causes Woburn to rely on the Metropolitan Water Resources Authority, a more expensive source, to augment city water supply.

Figure 9: Weeks of Severe Drought (2001-2017)



Source: SHMCAP

LANDSLIDES

According to the U.S. Geological Survey, “The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors.” Among the contributing factors are, erosion by rivers or ocean waves over steepened slopes; rock and soil slopes weakened through saturation by snowmelt or heavy rains; earthquake created stresses that make weak slopes fail; excess weight from accumulation of rain or snow; and stockpiling of rock or ore from waste piles or man-made structures. In Massachusetts, according to the SHMCAP, the most common cause of landslides are geologic conditions combined

with steep slopes and/or heavy rains. Landslides associated with heavy rains typically occur on steep slopes with permeable soils underlain by till or bedrock.

Landslides can result from human activities that destabilize an area or can occur as a secondary impact from another natural hazard, such as flooding. In addition to structural damage to buildings and the blockage of transportation corridors, landslides can lead to sedimentation of water bodies. Typically, a landslide occurs when the condition of a slope changes from stable to unstable. Natural precipitation such as heavy snow accumulation, torrential rain, and run-off may saturate soil, creating instability enough to contribute to a landslide. More frequent extreme rain events may increase the chance of landslides as saturated soils are conducive to landslides. Drought may also increase the likelihood of landslides if loss of vegetation decreases soil stability.

The SHMCAP, utilizing data from the MA Department of Transportation from 1986 to 2006 to estimates that, on average, roughly one to three known landslides have occurred each year. A slope stability map published by the MA Geological Survey and UMass-Amherst indicates that the most significant risk of landslide is in western Massachusetts. According to the SHMCAP, factors that influence landslide severity include soil properties, topographic position and slope, and historical incidence.

Woburn is classified as having low susceptibility and a low incidence of landslides (see Map 4, Appendix B). Should a landslide occur in the future, the type and degree of impacts would be highly localized. The city's vulnerabilities could include damage to structures, damage to transportation and other infrastructure, and localized road closures. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Woburn. The Building Inspector reports that there have been three small landslides in the last decade. Each was associated with former quarries and caused minor damage on private property.

RISING TEMPERATURES

AVERAGE AND EXTREME TEMPERATURES

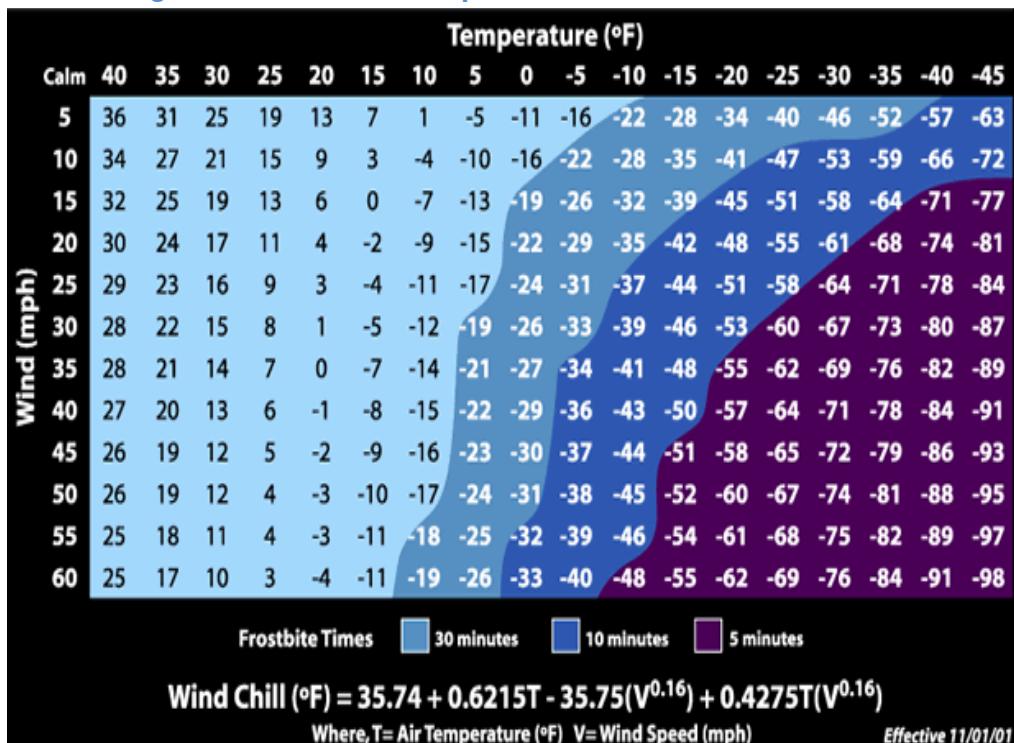
Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time where there is a long stretch of excessively hot or cold weather. Woburn has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those that are far outside of the normal seasonal ranges for Massachusetts.

EXTREME COLD

The severity of extreme cold temperature is typically measured using the Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed. The index is provided in Figure 11 below. A Wind Chill warning is issued when the Wind Chill Index is forecast to fall below -25 degrees F for at least 3 hours. Extreme cold is a dangerous situation

that can result in health emergencies for susceptible people, such as those without shelter, those who are stranded, or those who live in homes that are poorly insulated or without heat.

Figure 10 Wind Chill Temperature Index and Frostbite Risk



The City of Woburn does not collect data for previous occurrences of extreme cold. The best available local data are for Middlesex County, through the National Climatic Data Center (NCDC). There have been three extreme cold events in the past eleven years, which caused no deaths, no injuries, or property damage. This is an average of one event every 3.5 years. Extreme cold is a city-wide hazard for Woburn.

Table 11: Middlesex County Extreme Cold and Winch Chill Occurrences 2011 through 2020

Date	Deaths	Injuries	Damages
2/14/2015	0	0	0
2/15/2016	0	0	0
2/16/2016	0	0	0

Source: NOAA, National Climatic Data Center

EXTREME HEAT

A heat wave in Massachusetts is defined as three or more consecutive days above 90°F. Another measure used for identifying extreme heat events relies on the Heat Index. According to the National Weather Service (NWS), the Heat Index is a measure of how hot it really feels relative humidity is factored in with the actual air temperature. The NWS issues an advisory when the heat

index (Figure 12) is forecast to exceed 100°F for two or more hours; an excessive heat advisory is issued if the forecast predicts the temperature will rise above 105°F.

Figure 11: Heat Index Chart

		Temperature (°F)															
		80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
Relative Humidity (%)	40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
	45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
	50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
	55	81	84	86	89	93	97	101	106	112	117	124	130	137			
	60	82	84	88	91	95	100	105	110	116	123	129	137				
	65	82	85	89	93	98	103	108	114	121	128	136					
	70	83	86	90	95	100	105	112	119	126	134						
	75	84	88	92	97	103	109	116	124	132							
	80	84	89	94	100	106	113	121	129								
	85	85	90	96	102	110	117	126	135								
	90	86	91	98	105	113	122	131									
	95	86	93	100	108	117	127										
	100	87	95	103	112	121	132										
Category		Heat Index				Health Hazards											
Extreme Danger		130 °F – Higher				Heat Stroke or Sunstroke is likely with continued exposure.											
Danger		105 °F – 129 °F				Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.											
Extreme Caution		90 °F – 105 °F				Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.											
Caution		80 °F – 90 °F				Fatigue possible with prolonged exposure and/or physical activity.											

The City of Woburn does not collect data on excessive heat occurrences. The best available local data are for Middlesex County, through the National Climatic Data Center. In the past eleven years there has been one excessive heat day and no deaths, injuries, or property damage (see Table 12). This is an average of one extreme heat occurrence every 11 years.

Table 12: Middlesex County Extreme Heat Occurrences 2010 through 2020

Date	Deaths	Injuries	Damage
7/6/2010	0	0	0

Source: NOAA, National Climatic Data Center

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.

Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions. 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.

Due to what is termed the “heat island effect”, areas with less shade and more dark surfaces (pavement and roofs) will experience even hotter temperatures; these surfaces absorb heat during the day and release it in the evening, keeping nighttime temperatures warmer as well. Map 10 in Appendix B displays areas that are among the hottest 5% of land in the MAPC region based on land surface temperature derived from satellite imagery on July 13, 2016, when the high temperature at Logan Airport was 92°F. There are areas of Woburn that have significant heat islands including west of Route 93 and along Main Street (see Map 9). It is also worth noting that heat impacts are more likely to be felt by residents without air conditioning, by those who work outdoors, and those with underlying health conditions.

Average temperatures in Massachusetts are projected to increase by 3.8 to 10.8 degrees by the end of the century (SHMCAP). Over time our climate will become more similar to areas south of New England. Impacts on natural resources include a longer growing season and northern migration of plants and animals, including invasive species. The SHMCAP identifies ecosystems that are expected to be particularly vulnerable to warming temperatures. These include coldwater fisheries, vernal pools, spruce-fir forests, northern hardwood forests (Maple, Beach, Birch), Hemlock forests, and urban forests (due to heat island impacts).

WILDFIRE

A wildfire is a non-structure fire occurring in a forested, shrub or grassland areas. In the Boston Metro region these fires rarely grow to the size of a wildfire, as seen more typically in the western U.S. A more likely occurrence is brush fires that typically burn no more than the underbrush of a forested area. There are three different classes of wildfires:

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

A wildfire differs greatly from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to unexpectedly change direction, and its ability to jump gaps such as roads, rivers, and fire breaks. Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when most vegetation is void of any appreciable moisture, making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced somewhat. As the

climate warms, drought and warmer temperatures may increase the risk of wildfire as vegetation dries out and becomes more flammable. The National Wildfire Coordinating Group classifies the severity of wildfires based on their acreage.

Fires can present a hazard where there is the potential to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials might exist to allow the fire the spread into homes. Protecting structures from fire poses special problems and can stretch firefighting resources to the limit. If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If the wild fire destroys the ground cover, then erosion becomes one of several potential problems.

POTENTIAL BRUSHFIRE HAZARD AREAS

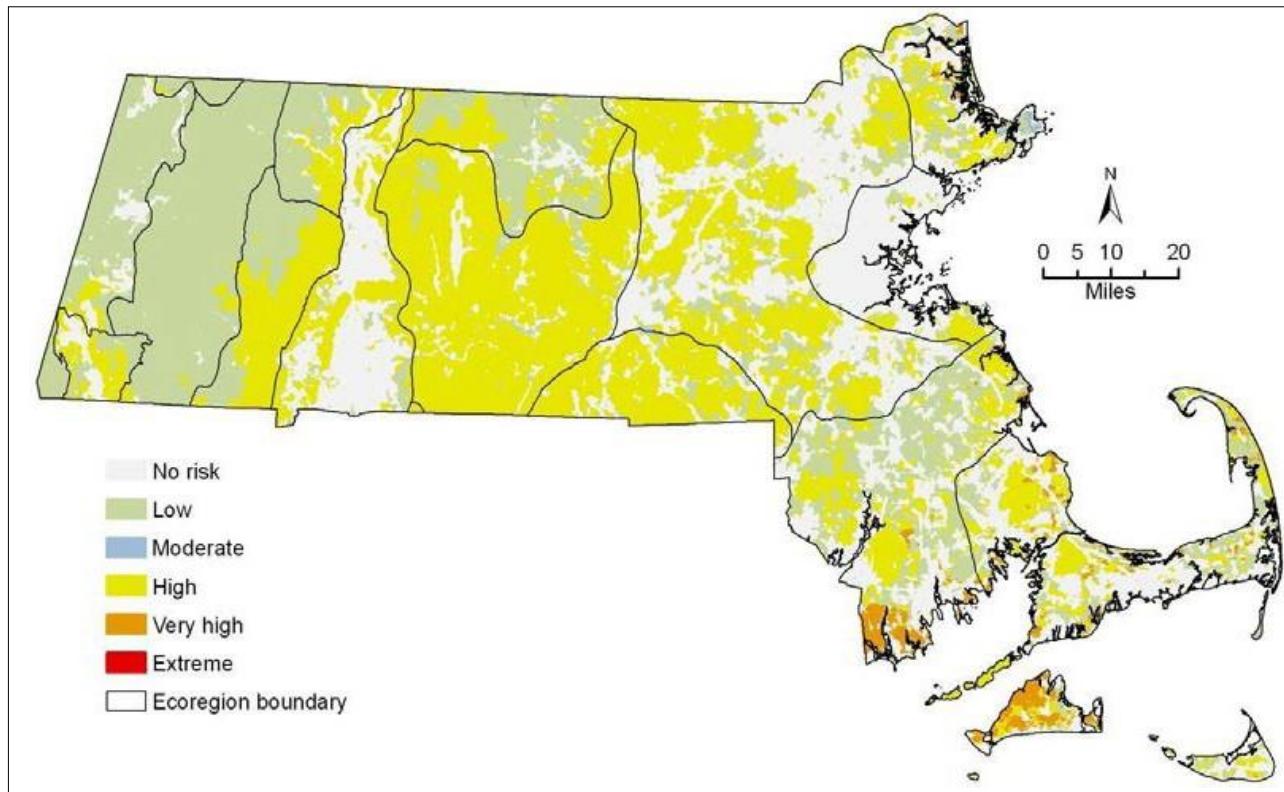
The SCHMCAP includes a graphic that depicts statewide fire risk incorporating three risk components: fuel, wildland-urban interface, and topography (Figure 12). The wildland-urban interface reflects communities where housing and vegetation intermingle, and fire can spread from structures to vegetated areas. The most susceptible fuels are pitch pine, scrub oak and oak forests. Topography can affect the behavior of fires, as fire spreads more easily uphill. Woburn is shown in the no risk zone. Fire was not identified as a common occurrence, but one additional area of concern along railroad tracks was identified. The most common cause of wildfires is the careless disposal of smoking materials and unintended campfires.

The following areas of city were identified as having the highest potential for brush fires. The numbers correspond to the numbers on Map 8, "Hazard Areas":

Table 13: Locally Identified Areas of Brushfire Risk

Map ID	Name	Description
10	Adjacent to Horn Pond	On the westerly side of Horn Pond and north of the Woburn Country Club golf course is an area where numerous fires have occurred over the years. With many walking trails bisecting the area, fire hazards such as the carelessness with cigarettes and children playing with matches are of great concern.
12	Cabot Road	Adjacent to Cabot Road and along the railroad tracks there is the potential for brushfires.

Figure 12: Wildfire Risk Areas



Source: SHMCAP

While there are areas of fire risk, city officials indicate that significant brush fires are not a common occurrence.

INVASIVE SPECIES

The 2018 SHMCAP includes invasive species as a natural hazard for the first time. They are defined as “non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health”. In new habitats invasive species displace native species if they have competitive advantages including that they are not subject to biological controls from their native habitat. Some of the more recognizable invasive plant species noted in the SHMCAP include Norway maple, garlic mustard, Japanese barberry, black swallowwort, buckthorn, purple loosestrife, water milfoil, Japanese knotweed, and phragmites. Invasive pests include gypsy moth, hemlock wooly adelgid, and the Asian long-horned beetle. Green crabs are a notable marine invasive. The Massachusetts Invasive Plant Advisory Group categorizes invasive severity as either limited prevalence in Massachusetts, partial containment potential, or public health threat.

The City of Woburn is concerned with the presence of exotic and invasive species since they degrade natural vegetation and habitat and threaten native biodiversity. The presence of invasive species may cause a reduction in both plant and animal (wildlife) diversity. Natural vegetation can get choked out and this in turn causes a decline in the types and abundance of

available food and shelter for wildlife. Removal of established invasive plants can require considerable effort; therefore prevention efforts are preferred. Since invasive species are often inadvertently introduced at disturbed sites, the City uses permitting to require development proponents (as appropriate) to submit an invasive species control plan which includes a description of invasive species present at the site and specifies methods for removal and control of invasive species, with required monitoring and written reporting with photographs of the areas of concern.

Some invasive species known to be present in Woburn include: Japanese Knotweed, Oriental Bittersweet, Garlic Mustard, Common Reed, Common Buckthorn, Purple Loosestrife, Honeysuckle, Reed Canary-Grass, Tree of Heaven, Porcelain Berry, Spotted Knapweed, Parrot Feather, and Norway Maple. Canada Geese are also a concern, as are the Gypsy Moth, Hemlock Woody Adelgid, and the Emerald Ash Borer. We have had one reported possible sighting of the Asian Long-horned Beetle.

EXTREME WEATHER

HURRICANES AND TROPICAL STORMS

A hurricane is a violent wind and rainstorm with wind speeds of 74 to 200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as the storm hits land. A tropical storm has similar characteristics, but wind speeds are between 34 and 73 miles per hour. Climate models suggest that hurricanes and tropical storms will become more intense as warmer ocean waters provide more fuel for the storms. In addition, rainfall amounts associated with hurricanes are predicted to increase because warmer air can hold more water vapor. Since 1900, 39 tropical storms have impacted New England (NESEC). Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane.

Although uncommon, the City of Woburn's entire area is vulnerable to hurricanes, which occur between June and November. As shown on Map 5 in Appendix B, a tropical storm tracked through Woburn in 1861. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. The city also experiences the impacts of the wind and rain from hurricanes and tropical storms regardless of whether the storm track passed through the city. The hazard mapping indicates that the 100-year wind speed in Woburn is 110 miles per hour.

Table 14: Hurricane Records for Massachusetts 1938-2018

Hurricane Event	Date
Great New England Hurricane*	September 21, 1938
Great Atlantic Hurricane*	September 14-15, 1944
Hurricane Doug	September 11-12, 1950
Hurricane Carol*	August 31, 1954
Hurricane Edna*	September 11, 1954
Hurricane Diane	August 17-19, 1955

Hurricane Event	Date
Hurricane Donna	September 12, 1960
Hurricane Gloria	September 27, 1985
Hurricane Bob	August 19, 1991
Hurricane Earl	September 4, 2010
Tropical Storm Irene	August 28, 2011
Hurricane Sandy	October 29-30, 2012

*Category 3

Source: National Oceanic and Atmospheric Administration

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

Table 15: Saffir/Simpson Scale

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

Source: NOAA

Hurricanes typically have regional impacts beyond their immediate tracks. Falling trees and branches are a significant problem because they can result in power outages when they fall on power lines or block traffic and emergency routes. Hurricanes are a city-wide hazard in Woburn. Potential hurricane damages to Woburn have been estimated using HAZUS-MH. Total damages are estimated at \$25 million for a Category 2 hurricane and \$103 million for a Category 4 hurricane. Hurricanes and tropical storms are a rare event having passed directly through Woburn only once.

SEVERE WINTER STORM/NOR'EASTER

A northeast storm, known as a nor'easter, is typically a large counterclockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 10 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rain or snow, depending on temperatures. Many of the historic flood events identified in the previous section were precipitated by nor'easters, including the "Perfect Storm" event in 1991. More recently, blizzards in February 2013, January 2015, and in March 2018 were large nor'easters that caused significant snowfall amounts.



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

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

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

Table 16: Regional Snowfall Index

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

Source: SHMCAP

The most significant winter storm in recent history was the “Blizzard of 1978,” which resulted in over three feet of snowfall and multiple day closures of roadways, businesses, and schools. In Woburn, blizzards and severe winter storms have occurred in the following years:

Table 17: Severe Weather Major Disaster Declarations in Eastern MA

Storm Event	Date
Severe Winter Storm and Snowstorm	March 2018
Severe Winter Storm, Snowstorm, and Flooding	January 2015
Severe Winter Storm, Snowstorm, and Flooding	February 2013
Hurricane Sandy	October/November 2012
Severe Storm and Snowstorm	October 2011

Tropical Storm Irene	August 2011
Severe Winter Storm and Snowstorm	January 2011
Severe Winter Storm and Flooding	December 2008
Severe Storms and Inland and Coastal Flooding	April 2007
Severe Storm and Flooding	October 2005
Severe Storms & Flooding	March 2001
Blizzard	January 1966
Winter Coastal Storm	December 1992
Severe Coastal Storm	October 1991
Hurricane Bob	August 1991
Hurricane Gloria	September 1985
Coastal Storm, Flood, Ice, Snow	February 1978
Hurricane, floods	August 1955
Hurricanes	September 1954

Source: FEMA

Winter storms, including heavy snow, blizzards, and ice storms, are the most common and most familiar of the region's hazards that affect large geographic areas. The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response. The impacts of winter storms are often related to the weight of snow and ice, which can cause roof collapses and also causes tree limbs to fall. This in turn can cause property damage and potential injuries. Power outages may also result from fallen trees and utility lines.

Winter storms are a potential city-wide hazard in Woburn. Map 6 in Appendix A indicates that the average annual average snowfall in most of Woburn is between 48 and 72 inches. A number of public safety issues can arise during snow storms. Impassable streets are a challenge for emergency vehicles and affect residents and employers. Snow-covered sidewalks force people to walk in streets, which are already less safe due to snow, slush, puddles, and ice. Large piles of snow can also block sight lines for drivers, particularly at intersections. Refreezing of melting snow can cause dangerous roadway conditions. In addition, transit operations may be impacted, as they were in the 2015 blizzards which caused the closure of the MBTA system for one day and limited services on the commuter rail for several weeks.

As with hurricanes, warmer ocean water and air will provide more fuel for winter storms. According to the SHMCAP it appears that Atlantic coast nor'easters are increasing in frequency and intensity. Further, the SHMCAP notes that research suggests that warmer weather in the Arctic

is producing changes to atmospheric circulation patterns that favor the development of winter storms in the Eastern United States.

The City of Woburn does not keep local records of winter storms. Data for Middlesex County is the best available data to help understand previous occurrences and impacts of heavy snow events. According to National Climate Data Center (NCDC) records, from 2010 through 2020, Middlesex County experienced 19 heavy snowfall events, resulting in no injuries or deaths, and over a million dollars in property damage. Heavy snow is considered to be high frequency events based on past occurrences, as there have been 19 events in the past eleven years, for an average of almost 2 events each winter.

Table 18: Heavy Snow Events and Impacts in Middlesex County, 2010 through 2020

Date	Deaths	Injuries	Property Damage (\$)
12/26/2010	0	0	0
1/12/2011	0	0	50000
1/18/2011	0	0	0
1/21/2011	0	0	0
2/1/2011	0	0	1109500
2/29/2012	0	0	0
3/1/2012	0	0	0
12/17/2016	0	0	0
1/7/2017	0	0	0
2/9/2017	0	0	0
2/12/2017	0	0	0
12/9/2017	0	0	0
1/4/2018	0	0	3000
2/17/2018	0	0	0
3/7/2018	0	0	25000
3/13/2018	0	0	0
3/13/2018	0	0	10000
1/19/2019	0	0	0
3/3/2019	0	0	0
Total	0	0	1197500

Source: NOAA, National Climatic Data Center

ICE STORMS

The ice storm category covers a range of different weather phenomena that collectively involve rain or snow being converted to ice in the lower atmosphere leading to potentially hazardous conditions on the ground. Hail size typically refers to the diameter of the hailstones. Warnings

and reports may report hail size through comparisons with real-world objects that correspond to certain diameters:

Table 19: Hail Size Comparisons

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

Source: NOAA

While ice pellets and sleet are examples of these, the greatest hazard is created by freezing rain conditions, which is rain that freezes on contact with hard surfaces leading to a layer of ice on roads, walkways, trees, and other surfaces. The conditions created by freezing rain can make driving particularly dangerous and emergency response more difficult. The weight of ice on tree branches can also lead to falling branches damaging electric lines.

City-specific data for previous ice storm occurrences are not collected by the City of Woburn. The best available local data is for Middlesex County through the National Climatic Data Center. There were no ice storms in Middlesex County since 2010. Middlesex County did experience 27 hail events from 2010 through 2020. That is an average of 2.5 events each year. There is some indication that if winters warm, temperatures may be more likely to produce icing conditions.

Table 20: Middlesex County Hail Events, 2010 through 2020

Date	Magnitude	Deaths	Injuries	Property Damage (\$)
5/4/2010	0.75	0	0	0
5/7/2011	0.75	0	0	0
6/1/2011	0.75	0	0	0
8/2/2011	0.75	0	0	0
8/19/2011	0.75	0	0	0
3/13/2012	1.25	0	0	0

3/14/2012	0.88	0	0	0
6/23/2012	0.75	0	0	0
7/18/2012	1.75	0	0	0
10/30/2012	1	0	0	0
6/17/2013	0.75	0	0	0
5/25/2014	1	0	0	0
7/3/2014	1	0	0	0
8/7/2014	0.75	0	0	0
9/6/2014	0.88	0	0	0
8/4/2015	2	0	0	0
8/15/2015	0.88	0	0	0
7/23/2016	0.88	0	0	0
7/23/2016	0.75	0	0	0
6/27/2017	1	0	0	0
8/2/2017	0.75	0	0	0
6/22/2019	0.75	0	0	0
6/29/2019	0.75	0	0	0
6/6/2020	1	0	0	0
6/28/2020	1	0	0	0
7/30/2020	0.75	0	0	0
8/23/2020	1	0	0	0

Source: NOAA, National Climatic Data Center

*Magnitude refers to diameter of hail stones in inches

TORNADOES

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

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

Tornado damage severity is measured by the Enhanced Fujita scale, which is based on the amount of damage created. As of February 1, 2007, the National Weather Service began rating tornados using the Enhanced Fujita-scale (EF-scale), which allows surveyors to create more precise assessments of tornado severity. The EF-scale is summarized below:

Table 21: Enhance Fujita Scale

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

Source: SHMCAP 2018

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touchdown somewhere in the Northeast region every year. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC). Recent tornado events in Massachusetts were in Springfield in 2011 and in Revere in 2014. The Springfield tornado caused significant damage and resulted in four deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16, moved north into Revere's business district along Broadway, and ended near the intersection of Routes 1 and 60. The path was approximately two miles long and 3/8 mile wide, with wind speeds up to 120 miles per hour. Approximately 65 homes had substantial damages and 13 homes and businesses were rendered uninhabitable.

Since 1950, there have been eighteen tornadoes in Middlesex County recorded by the Tornado History Project. None of the tornados impacted Woburn. There have been two F3 and four F2,

and nine F1 tornados. The eighteen tornadoes resulted in a total of one fatality and 7 injuries. Damage estimates range from 775,000 to and \$3.7 million as summarized in Table 22. This an average of one tornado every 4 years.

Table 22: Tornado Records for Middlesex County

Date	Fujita	Fatalities	Injuries	Width (yd)	Length (mi)	Damage
10/24/1955	1	0	0	10	.1	\$500-\$5000
6/19/1957	1	0	0	17	1	\$5K-\$50K
6/19/1957	1	0	0	100	.5	\$50-\$500
7/11/1958	2	0	0	17	1.5	\$50K-\$500K
8/25/1958	2	0	0	50	1	\$500-\$5000
7/3/1961	0	0	0	10	.5	\$5K-\$50K
7/18/1963	1	0	0	50	1	\$5K-\$50K
8/28/1965	2	0	0	10	2	\$50K-\$500K
7/11/1970	1	0	2	20	25.2	\$5K-\$50K
10/3/1970	3	1	0	60	35.4	\$50K-\$500K
7/1/1971	0	0	0	200	0.48	\$5K-\$50K
11/7/1971	1	0	0	10	.1	\$50-\$500
7/21/1972	2	0	4	37	7.6	\$500K-\$5M
9/29/1974	3	0	1	33	.1	\$50K-\$500K
7/18/1983	0	0	0	20	.4	\$50-\$500
9/27/1985	1	0	0	40	.1	\$50-\$500
8/7/1986	1	0	0	73	4	\$50K-\$500K
8/22/2016	1	0	0	400	.85	\$10

Source: The Tornado History Project

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

Although tornadoes are a potential city-wide hazard in Woburn, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Woburn would greatly depend on the track of the tornado. Based on the record of previous occurrences since 1950, Tornado events in Woburn are a low frequency event as there has been no tornado activity in Woburn. According to the SHMCAP, it is possible that severe thunderstorms which can include tornadoes may increase in frequency and intensity. However, scientists have less confidence in the models that seek to project future changes in tornado activity.

OTHER SEVERE WEATHER

SEVERE THUNDERSTORMS

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. A thunderstorm typically features lightning, strong winds, rain, and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 1.5 miles in diameter and last for about 30 minutes. A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding. The severity of thunderstorms ranges from commonplace and of short duration to intense storms that cause damage due to high winds, flooding, or lightning strikes.

The best available data on previous occurrences of thunderstorms in Woburn is for Middlesex County through the National Climatic Data Center (NCDC). For the years 2015 through 2020, NCDC records show 41 thunderstorm events in Middlesex County (Table 23). These storms resulted in a total of \$1.6 million in property damage. There were no injuries or deaths reported. This is an average of 7 events per year.

Table 23: Middlesex County Thunderstorm Events, 2015 through 2020

Date	Magnitude	Deaths	Injuries	Property Damage
5/28/2015	45	0	0	7000
8/4/2015	40	0	0	110000
8/15/2015	45	0	0	85000
2/25/2016	50	0	0	201000
3/17/2016	45	0	0	10000
7/22/2016	50	0	0	60000
7/23/2016	50	0	0	295000
8/22/2016	50	0	0	51000
9/11/2016	50	0	0	120000
5/18/2017	50	0	0	3000
6/13/2017	52	0	0	37000
6/23/2017	50	0	0	29500
6/27/2017	50	0	0	2000
7/12/2017	50	0	0	19000
8/2/2017	50	0	0	14000
9/6/2017	50	0	0	8000
5/15/2018	40	0	0	12000
6/18/2018	50	0	0	59500
6/25/2018	43	0	0	12000
7/17/2018	45	0	0	3000
7/26/2018	50	0	0	5000
8/7/2018	50	0	0	3000
8/17/2018	50	0	0	4000

9/6/2018	50	0	0	2000
10/23/2018	46	0	0	10000
6/30/2019	50	0	0	800
7/17/2019	50	0	0	7250
7/31/2019	50	0	0	2500
8/7/2019	50	0	0	800
9/4/2019	50	0	0	21700
5/15/2020	60	0	0	285000
6/6/2020	50	0	0	7600
6/21/2020	50	0	0	38200
6/28/2020	50	0	0	6000
7/2/2020	50	0	0	15300
7/5/2020	50	0	0	12800
7/23/2020	50	0	0	40600
7/30/2020	50	0	0	4400
8/22/2020	50	0	0	6000
8/23/2020	50	0	0	25600
8/27/2020	50	0	0	1600
TOTAL		0	0	\$1,638,150

Source: NOAA, National Climatic Data Center

*Magnitude refers to maximum wind speed

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

Based on the record of previous occurrences, thunderstorms in Woburn are high frequency events as this hazard has occurred an average of seven times per year in the past six years. As noted previously, the intensity of rainfall events has increased significantly, and those trends are expected to continue. The SHMCAP does not specifically address whether climate will affect the intensity or frequency of thunderstorms.

NON-CLIMATE INFLUENCED HAZARDS

EARTHQUAKES

Earthquakes are the sole natural hazard for which there is no established correlation with climate impacts. Damage in an earthquake stems from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location. An earthquake in New England affects a much wider area than a similar earthquake in California due to New England's solid bedrock geology (NESEC).

Seismologists use a magnitude scale known as the Richter scale to express the seismic energy released by each earthquake. The typical effects of earthquakes in various ranges are summarized below:

Table 24: Richter Scale and Effects

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

Source: Nevada Seismological Library (NSL), 2005

From 1668 to 2016, 408 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes in the distant past, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Anne. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940. A 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historic records of some of the more significant earthquakes in the region are shown in Table 25.

Table 25: Historic Earthquakes in Massachusetts or Surrounding Area

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA - Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA - Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA - Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA

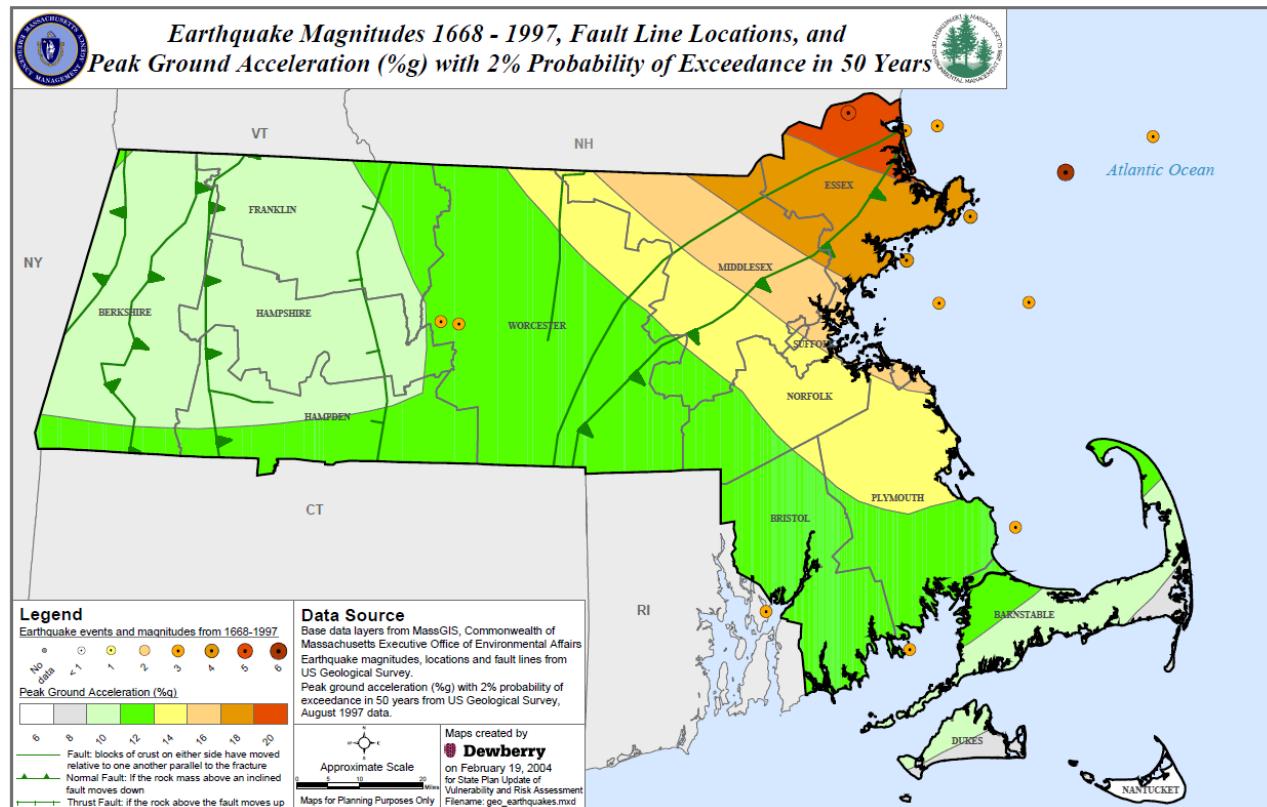
Location	Date	Magnitude
MA - Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA - Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA - Brewster	8/8/1847	4.2
MA - Boxford	5/12/1880	NA
MA - Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
MA - Nantucket	10/25/1965	NA
MA - Boston	12/27/74	2.3
MA - Nantucket	4/12/12	4.5
ME - Hollis	10/17/12	4.0

Source: Boston HIRA

One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (%g). The range of peak ground acceleration in Massachusetts is from 10 %g to 20 %g, with a 2% probability of exceedance in 50 years. Woburn is in the 16 %g to 18 %g range, making it a moderate to high area of earthquake risk within the state, although the state as a whole is considered to have a low risk of earthquakes compared to the rest of the country. There have been no recorded earthquake epicenters within Woburn.

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

Figure 13: State of Massachusetts Earthquake Probability Map



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

According to the SHMCAP there is a 10-15% chance of a magnitude 5 earthquake in a given ten-year period. Earthquakes are a potential city-wide hazard in Woburn. Although new construction under the most recent building codes generally will be built to seismic standards, much of the development in the city pre-dates the most recent building code. Potential earthquake damages to Woburn have been estimated using HAZUS-MH. Total building damages are estimated at \$756 million for a 5.0 magnitude earthquake and \$6.9 billion for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 31.

LAND USE AND DEVELOPMENT TRENDS

Existing Land Use

The most recent land use statistics available from the state are from aerial imagery completed in 2016. Table 26 shows the acreage and percentage of land in 11 categories. If the primary

residential categories are aggregated, residential uses make up 39% of the area of the city. Commercial and industrial uses combined make up 19.6% of the city. Agriculture, and Open Land, total 15.7% of the land. The tax-exempt category represents 11.2% of Woburn's land. Most of this land is additional open space.

Table 26: City of Woburn 2016 Land Use

Land Use Type	Acres	Percentage
Residential - single family	2477	29.9
Residential - multi-family	739	8.9
Mixed use, primarily commercial	5	.02
Commercial	648	7.8
Residential, other	2	.03
Industrial	978	11.8
Agriculture	5	.06
Open land	1252	15.1
Unknown	51	.61
Right-of-way	1199	14.5
Tax exempt	931	11.2
Total	8287	99.92

For more information on how the land use statistics were developed and the definitions of the categories, please go to <https://docs.digital.mass.gov/dataset/massgis-data-land-use-2005>.

Economic Elements

Post-WWII development of Woburn was most influenced by the opening of Route 128 in 1951 and then I-93 in 1963. Woburn's location at the crossroads of these two components of the regional highway system greatly influenced new industrial, commercial, and residential development beyond the historic City center. Access to the regional highway system has allowed commercial and industrial development to flourish. The major local roads providing north-south access are Main Street (Route 38), Cambridge Street (Route 3), and Washington Street. The major east-west routes are Lexington Street, Montvale Avenue and Salem Street. Most of these streets contain significant local retail nodes.

NATURAL, CULTURAL, AND HISTORICAL RESOURCE AREAS

The city has many historic sites including the First and Second Burial Grounds, the Baldwin Mansion, the Rumford House, the Battle Road Conservation Area, the 1790 House, the First Congregational Church, the Middlesex Canal, the Library, and the U.S. Post Office. Several of these properties are on the National Register of Historic Places. The city has 950 acres of publicly owned open space and recreation land. This represents 11% of the total acreage of the city. The largest of these areas is Horn Pond. Horn Pond is very popular for walking with a network of trails going around the pond.

DEVELOPMENT TRENDS

Development trends throughout the metropolitan region are tracked by MAPC's Development Database, which provides an inventory of new development over the last decade. The database tracks both completed developments and those currently under construction. In addition, the Planning Board Director provided data on projected finished since 2016. The database includes 11 completed projects. Where available we include several attributes of the new development, including site acreage, housing units, and commercial space. Six of the completed projects are housing projects, and five are commercial. The completed projects in Woburn include a total of 449 housing units and just over 500,000 square feet of commercial space (see Table 27).

Table 27: Summary of Woburn Developments, 2016-2021

Name	Status	Year	Housing Units	Commercial Square Feet	Project Type
The Armory	Built	2020	18	5,000	Mixed use
Woburn Foreign Motors	Built			180,000	Dealership
Woburn Landing	Built			200,000	Hotel and 3 restaurants
Baldwin Woods	Built		41		Town houses
Hurld-Wyman School	Built			72,302	New school
Winning Farm Village	Built		147		Town houses
Emery Flats	Built	2020	200		apartments
Dragon Court	Built	2017	20		Multi-family
Homewood Suites/Hampton Inn	Built				Hotel
Carlson Way	Built	2020	23		Single-family
Woburn Boys and Girls Club	Built	2020		43,700	recreation

POTENTIAL FUTURE DEVELOPMENT

MAPC consulted with the Planning Board Director to determine areas that may be developed in the future, based on the City's comprehensive planning efforts and current trends and projects. In order to characterize any change in the city's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with the FEMA Flood Insurance Rate Map and the hottest 5% of land surface in the MAPC region. These areas are listed below with their flood and heat risk outlined in Table 28. This information is provided so that planners can ensure that development proposals comply with floodplain zoning and that careful attention is paid to drainage, heat, and other issues.

Table 28: Relationship of Development to Hazard Areas

Map ID	Potential Future Project	Flood Zones	High Heat
A	12 Montvale		100%

B	4 Montvale		100%
C	Woburn Fire Headquarters		
D	8-10 Green Street		
E	Winning Farm Village		
F	Emblem 120		100%
G	Battle March Village		
H	Trouvaille		
I	Ferullo Drive		
J	Townhomes at 285		68%
K	Woburn Village (Mall)	12% in .2% chance zone	98%
K	Avalon Woburn Village	12% in .2% chance zone	98%
L	Tidd Home		
M	The Ledges Woburn Heights		
N	The Vale	13% in AE zone, 4% in .2% chance zone	7%
O	Alan R. Gerrish Drive	6% in .2% chance zone	
P	Borselli Drive II		
Q	27 Montvale		100%
R	57 Russell Street	<1% in AE Zone, 1% in .2% chance zone	
S	Garfield Avenue		
T	132 Pleasant Street		
U	43 Mill Street		
V	0 Walnut Street		100%
W	Baldwin Woods II (Seaver)		

CRITICAL FACILITIES & INFRASTRUCTURE IN HAZARD AREAS

Critical facilities and infrastructure include facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, communications, and electricity) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are 166 facilities identified in Woburn. They are listed in Table 29 and are shown on the maps in Appendix B.

Explanation of Columns in Table 29

- **Column 1: ID #:** The first column in Table 29 is an ID number which appears on the maps that are part of this plan. See Appendix B.
- **Column 2: Name:** The second column is the name of the site.
- **Column 3: Type:** The third column indicates what type of site it is.
- **Column 4: FEMA Flood Zone:** The fourth column addresses the risk of flooding. A “No” entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone, as follows:
Zone AE Zones AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by detailed methods. Mandatory flood insurance purchase requirements apply.
- **Zone A** Areas subject to inundation by the 1-percent-annual-chance flood event. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.
- **Zone AE** Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.
- **Zone AH** Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are 1–3 feet. BFEs derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.
- **Zone X (shaded)** Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (formerly Zone B)
- **Zone X (unshaded)** Minimal risk areas outside the 1-percent and .2 percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. (formerly Zone C)
- **Column 5: Locally Identified Area of Flooding:** The fifth column indicates the risk of flooding in local hazard areas. A “No” entry in this column means that the site is not within any of the mapped flood hazard zones. If there is an entry in this column, it indicates the local hazard area.
- **Column 6:** Brushfire Risk indicates locally identified brushfire risk. If there is an entry in this column, it indicates the local hazard area.
- **Column 7:** Hot spots indicates areas that are within the 5% of hottest areas in the MAPC region based on satellite data from 2016.

Table 29: Critical Facilities and Relationship to Hazard Areas

ID	Name	Type	FEMA Flood Zone	Locally Identified Flood Area	Brushfire Risk	Hot Spot
1	Skyworks	Hazardous Material Site	No	No	No	Yes

3	Analytical Answers	Hazardous Material Site	No	No	No	No
4	Anderson Regional Transportation Center	Transportation Facility	No	No	No	Yes
5	Anika Therapeutics	Hazardous Material Site	No	No	No	Yes
6	Boston Child Development Center	School	No	No	No	No
7	Erin Anzivino	Child Care	No	No	No	No
8	Maria Duffany	Child Care	No	No	No	No
9	Chomerics/Parker Hannafin	Hazardous Material Site	No	No	No	Yes
10	Woburn City Hall	Municipal	No	No	No	Yes
11	Hind Chebbo	Child Care	No	No	No	No
12	Country Club Heights	Assisted Living	No	No	No	No
13	Delta F. Corporation	Hazardous Material Site	No	No	No	Yes
14	Douglas Battery	Hazardous Material Site	No	No	No	No
15	Warren Avenue	Elder Housing	No	No	No	No
16	Fuller System Inc.	Hazardous Material Site	No	No	No	No
17	General Eastern Instruments	Hazardous Material Site	X: 0.2% Chance	No	Cabot Rd	Yes
18	Gentest Corp	Hazardous Material Site	No	No	No	No
19	Goodyear Elementary School	School	No	No	No	No
20	Donna Adgate	Child Care	No	No	No	No
21	Herley-MDI	Hazardous Material Site	No	No	No	Yes
22	Scalley Dam	Dam	AE: Floodway	Arlington Road	No	No
23	Horn Pond Waste Water Treatment	Water Treatment	No	No	No	No
25	Joyce Middle School	School	X: 0.2% Chance	No	No	Yes
26	Kennedy Middle School	School	No	No	No	No
27	Kindercare	School	No	No	No	No
31	Library Park	Elder Housing	No	No	No	No
32	Altavesta Elementary School	School	No	No	No	No
32	Linscott Elementary School	School	No	No	No	No
33	Little Folks Day School	School	No	No	No	Yes
34	Little Hands Big Hearts	School	No	No	No	No
35	Launch and Learn Educare Center	School	No	No	No	No
37	Metallized Products, Inc.	Hazardous Material Site	No	No	No	Yes

38	Modular Genetics Inc.	Hazardous Material Site	No	No	No	Yes
39	Lauren Flaherty	Child Care	No	No	No	No
40	Lauren Burgess	Child Care	No	No	No	No
41	Murphy's Waste Oil Services	Hazardous Material Site	No	No	No	No
42	New England Rehab	Medical Facility	No	No	No	No
43	After School Club	Child Care	No	No	No	No
44	New Horizons at Choate	Assisted Living	No	No	No	No
45	Nichols Street Extention	Elder Housing	No	No	No	No
46	O'Brien Ice Rink	Place of Assembly	No	No	No	Yes
47	Organix, Inc.	Hazardous Material Site	No	No	No	No
48	PPG Finishes	Hazardous Material Site	No	No	No	Yes
49	Prism Science Works	Hazardous Material Site	No	No	No	No
50	Pro Science Analytical	Hazardous Material Site	No	No	No	Yes
51	Public Works Department	Municipal	No	No	No	No
52	Puddle Duck Day Care	Child Care	No	No	No	Yes
53	Rag Rock Storage Tank	Water Storage Tank	No	No	No	No
54	Reeves Elementary School	School	No	No	No	No
55	Rohm & Haas-Advanced Materials	Hazardous Material Site	X: 0.2% Chance	No	No	Yes
56	Lahey	Hazardous Material Site	No	No	No	No
57	Shamrock Elementary School	School	No	No	No	No
58	Sprint Spectrum	Hazardous Material Site	X: 0.2% Chance	No	Cabot Rd	Yes
59	St. Charles	School	No	No	No	No
60	The Afterschool Club	Child Care	No	No	No	No
62	Ivanilde Dos Santos	Child Care	No	No	No	No
63	Annemarie Cobb	Child Care	No	No	No	No
64	Kris George	Child Care	No	No	No	No
65	The Warren House	Assisted Living	No	No	No	No
66	Thermo-electron Tecomet	Hazardous Material Site	No	No	No	Yes
68	Moppets	School	No	No	No	No
69	United States Postal Service	Federal Facility	No	No	No	No
70	US Food & Drug Administration	Hazardous Material Site	No	No	No	Yes
71	Vaisala	Hazardous Material Site	No	No	No	Yes

72	Van Waters & Rogers	Hazardous Material Site	No	No	No	Yes
73	Waltham Street Tank	Water Storage Tank	No	No	No	No
74	Well A2	Well	No	No	No	No
75	Well B	Well	No	No	No	No
76	Well C2	Well	AE: 1% Chance	No	No	No
77	Well D2	Well	No	No	No	No
78	Well I	Well	No	No	No	No
79	Whispering Hill Tank	Water Storage Tank	No	No	No	No
80	White Elementary School	School	No	No	No	No
81	Winchester Community Health Institute	Medical Facility	No	No	No	No
82	Winfield Brooks	Hazardous Material Site	No	No	No	Yes
83	Woburn Creative Start Program	School	No	No	No	Yes
84	Woburn Elks	Place of Assembly	No	No	No	No
85	Fire Department Headquarters	Fire Station	No	No	No	No
86	Woburn High School	School	No	No	No	Yes
87	Woburn Housing	Elder Housing	No	No	No	No
88	Woburn Nursing Center	Nursing Home	No	No	No	No
89	Woburn Police Department	Police Station	No	No	No	No
90	World Of Wonder	School	No	No	No	No
92	Yusa Inc.	Hazardous Material Site	No	No	No	Yes
93	East Woburn Fire Station	Fire Station	No	No	No	No
94	North Woburn Fire Station	Fire Station	No	No	No	Yes
95	West Side Fire Station	Fire Station	No	No	No	No
96	Fire Station	Fire Station	No	No	No	No
97	Sullivan, Nancy Day Care	Child Care	No	No	No	No
98	Sheeran, Susan M. Day Care	Child Care	No	No	No	No
99	Magro, Rosemary Day Care	Child Care	No	No	No	No
100	Courtney, Diane Day Care	Child Care	No	No	No	No
101	Chamberlain, Pauline J. Day Care	Child Care	No	No	No	No
102	LaFlamme, Deborah L Day Care	Child Care	No	No	No	No
103	Serafino, Sally E. Day Care	Child Care	No	No	No	No
104	O'Hearn, Kim L. Day Care	Child Care	No	No	No	No
105	Fee, Susan M. Day Care	Child Care	No	No	No	No
106	Szweda, Marie Day Care	Child Care	No	No	No	No

107	Woburn EOC (@ Police Department)	Emergency Operations Center	No	No	No	No
108	Woburn EOC (@Fire Department)	Emergency Operations Center	No	No	No	No
109	Healthsouth New England Rehab Hospital	Hospital	No	No	No	No
110	Bournewood Caulfield Center Hospital	Hospital	No	No	No	No
111	Draper Street Sewer Pump Station	Sewer Pump Station	No	No	No	No
112	Dix Road Sewer Pump Station	Sewer Pump Station	No	No	No	No
113	Senior Center	Senior Center	No	No	No	Yes
114	Dragon Court Sub Station	Power Substation	No	No	No	No
115	Green Street Sub Station	Power Substation	No	No	No	No
116	Cove Street Sub Station	Power Substation	No	No	No	No
117	Webster Avenue Family Housing	Family Housing	No	No	No	No
118	Woburn District Court House	Court House	No	No	No	Yes
119	Woburn Police Communication Tower	Communication Tower	No	No	No	No
120	Comcast Cable Broadcast Center	Communication Tower	No	No	No	No
121	Logan Express	Transportation Facility	No	No	No	Yes
122	Montvale Avenue Bridge	Bridge	No	No	No	No
123	Rte 93 Bridge	Bridge	No	No	No	No
124	Salem Street Bridge	Bridge	No	No	No	No
125	Mishawum Road Bridge	Bridge	No	No	No	No
126	Carrie Simpson Day Care	Child Care	No	No	No	No
127	Cantone Day Care	Child Care	No	No	No	No
128	Boys and Girls Club ASP	Child Care	No	No	No	No
129	Project Learn @ Hurld Elem School ASP	Child Care	No	No	No	Yes
130	Project Learn @ Linscott School	Child Care	No	No	No	No
131	Stacey Bickford Day Care	Child Care	No	No	No	No
132	Edna Cabral Day Care	Child Care	No	No	No	No
133	Christy Gibson Day Care	Child Care	No	No	No	No
134	Susan Greekwood Day Care	Child Care	No	No	No	No
135	Michelle Kenney Day Care	Child Care	No	No	No	No
136	Tina Lentine Day Care	Child Care	No	No	No	No
137	Kerstin Lochrie Day Care	Child Care	No	Pearl and Bartlett St.	No	No
138	Christine Mcardle Day Care	Child Care	No	No	No	No

139	Sharon Newell Day Care	Child Care	No	No	No	No
140	Mary Packard Day Care	Child Care	No	No	No	No
141	Rosa Palacio Day Care	Child Care	No	No	No	No
142	Gisela Reynosa Day Care	Child Care	No	No	No	No
143	Marie Rodriguez Day Care	Child Care	No	No	No	No
144	Wendy Vander Brug Day Care	Child Care	No	No	No	No
145	Children's Center Day Care	Child Care	No	No	No	No
146	Kelly Barrucci	Child Care	No	Bedford Street	No	No
147	Little Sprouts	Child Care	No	No	No	Yes
148	Lynn Patti Gangi	Child Care	No	No	No	No
149	Patricia Katin	Child Care	No	No	No	No
150	Michelle Tango	Child Care	No	No	No	No
151	Xiaolin Wang	Child Care	No	No	No	No
152	Paula Houle	Child Care	No	No	No	No
153	Marlene Soler	Child Care	No	No	No	No
154	Kimberly Higgins	Child Care	No	No	No	No
155	Elizabeth Marquinhos	Child Care	No	No	No	No
156	Marianne Filtzer	Child Care	No	No	No	No
157	Margaret Hibbard	Child Care	No	No	No	No
158	Kelley Smith	Child Care	No	No	No	No
159	Hurld Wyman	School	No	Henshaw St	No	No
160	Benchmark	Assisted Living	No	No	No	No
161	Superior Court	Court House	No	No	No	Yes
162	Family Probate Court	Court House	X: 0.2% Chance	No	Cabot Rd	Yes
163	Woburn Public Library	Library	No	No	No	No
164	LCS at the Vale	Assisted Living	No	Henshaw St	No	No
165	MGH/Brigham at the Vale	Medical Office	No	Henshaw St	No	No
166	Russell St Pump Station	Sewer Pump Station	No	Cambridge Road	No	Yes
167	Spence Farm	Recreation	No	No	No	No
168	Saint Anthony Club	Community Facility	No	No	No	No
169	YMCA	Recreation	No	No	No	No
170	Irish American Club	Community Facility	No	No	No	Yes
171	Primrose	Child Care	No	No	No	No
172	American Legion	Community Facility	No	No	No	Yes
173	South End Italian Club	Community Facility	No	No	No	Yes
174	Windrose	Assisted Living	No	No	No	No

VULNERABILITY ASSESSMENT

The purpose of the vulnerability assessment is to estimate the extent of potential damages from natural hazards of varying types and intensities. A vulnerability assessment and estimation of damages was performed for hurricanes, earthquakes, and flooding through the HAZUS-MH software.

Introduction to HAZUS-MH

HAZUS- MH (multiple-hazards) is a computer program developed by FEMA to estimate losses due to a variety of natural hazards. The following overview of HAZUS-MH is taken from the FEMA website. For more information on the HAZUS-MH software, go to <https://www.fema.gov/hazus/>

“HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods, and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response, and recovery planning.

HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations.”

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

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

ESTIMATED DAMAGES FROM HURRICANES

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

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

Table 30: Estimated Damages from Hurricanes

	Category 2	Category 4
Building Characteristics		
Estimated total number of buildings	12,000	
Estimated total building replacement value (2014 \$)	\$6,911,000,000	
Building Damages		
# of buildings sustaining minor damage	235	1,847
# of buildings sustaining moderate damage	9	363
# of buildings sustaining severe damage	1	23
# of buildings destroyed	0	6
Population Needs		
# of households displaced	1	41
# of people seeking public shelter	1	19
Debris		
Building debris generated (tons)	1,871	9,210
Tree debris generated (tons)	3,078	8,807
# of truckloads to clear building debris	75	368
Value of Damages		
Total property damage (buildings and content)	\$26,072,270	\$103,228,190
Total losses due to business interruption	\$110,715,420	\$10,303,100

ESTIMATED DAMAGES FROM EARTHQUAKES

The HAZUS earthquake module allows users to define an earthquake magnitude and model the potential damages caused by that earthquake as if its epicenter had been at the geographic

center of the study area. For the purposes of this plan, two earthquakes were selected: magnitude 5.0 and a magnitude 7.0. Historically, major earthquakes are rare in New England, though a magnitude 5 event occurred in 1963.

Table 31: Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	12,000	
Estimated total building replacement value (2014 \$)	\$6,911,000,000	
Building Damages		
# of buildings sustaining slight damage	3,659	437
# of buildings sustaining moderate damage	2,125	2,463
# of buildings sustaining extensive damage	661	3,356
# of buildings completely damaged	181	6,425
Population Needs		
# of households displaced	871	9,748
# of people seeking public shelter	447	4,975
Debris		
Building debris generated (tons)	244,000	1,655,000
# of truckloads to clear debris (@ 25 tons/truck)	9,760	66,200
Value of Damages		
Total property damage	\$959,436,400	\$6,701,670,200
Total losses due to business interruption	\$185,539,700	\$942,328,300

ESTIMATED DAMAGES FROM FLOODING

The HAZUS flooding module allows users model the potential damages caused by a 100-year flood event and a 500-year flood event.

Table 32: Estimated Damages from Flooding

	100-Year Flood	500-Year Flood
Building Characteristics		
Estimated total number of buildings	12,000	
Estimated total building replacement value (2014 \$)	\$6,911,000,000	
Building Damages		
# of buildings sustaining limited damage	42	39

# of buildings sustaining moderate damage	0	51
# of buildings sustaining extensive damage	0	1
# of buildings substantially damaged	0	5
Population Needs		
# of households displaced	363	398
# of people seeking public shelter	3	18
Value of Damages		
Total property damage	\$31,480,000	\$36,220,000
Total losses due to business interruption	\$73,370,000	\$53,690,000

IMPACTS ON PEOPLE

Just as some locations in Woburn will be more vulnerable to climate impacts than others, it is also true that climate change and natural hazards will not affect all residents of Woburn equally. People who may be more susceptible to negative health effects can include older adults, young children, pregnant women, people with disabilities, and people with pre-existing health conditions, as they are more likely to be physically vulnerable to the health impacts of extreme heat and poor air quality. Individuals with physical mobility constraints may need additional assistance with emergency response. Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions. People who live in substandard housing and in housing without air conditioning have increased vulnerability to heat-related illnesses. Black and Latino residents in Massachusetts are hospitalized for asthma at considerably higher rates than the population as whole, reflecting the reality that longstanding societal inequities can lead to differential health outcomes based on race and ethnicity.

Low-income people are often more susceptible to financial shocks, which can occur after extreme weather, and which can impact financial security and the ability to secure safe shelter and meet medical needs. Social isolation can also influence vulnerability, as it limits access to critical information, municipal resources, and social support systems. In the absence of strong social support networks and translation services, people living alone and those with limited English language proficiency may experience social isolation. People of color and undocumented immigrants may also experience social isolation where there are historically strained or tenuous relationships with government officials and first responders. Certain occupations may also experience more severe impacts. People who work outdoors, or in unregulated temperatures, are at increased risk for heat-related illnesses.

In developing mitigation measures Woburn will want to consider the needs of all of its residents. In Woburn 8% of residents are below the poverty level (4-person household earning less than \$24,563) and 39% are low-income (4-person household earning less than \$78,150) (American Community Survey). 4% of residents are limited English speaking, and 18% speak another

language at home (Census 2010). The over 65 population is growing, and 29% of residents 65 or older live alone (Census 2010). As is true at the statewide level, Black and Latino residents are hospitalized for asthma at much higher rates than White residents (MA DPH).

RISK ASSESSMENT SUMMARY

CLIMATE CHANGE	NATURAL HAZARD	PRIORITY (H/M/L)	KEY CONCERNS SOCIETY	KEY CONCERNS BUILT ENVIRONMENT	KEY CONCERNS NATURAL RESOURCES
Changes in Precipitation 	Inland Flooding	High	Elderly residents and environmental justice populations	Roadway closures	Pollutants, scouring
	Drought	High	Increases costs for irrigation, drinking water supply		Impacts on water resources, vegetation
	Landslide	Low	Private property damage		
Sea Level Rise 	Coastal Flooding	NA	NA	NA	NA
	Coastal Erosion	NA	NA	NA	NA
	Tsunami	NA	NA	NA	NA
Rising Temperatures 	Average and Extreme Temperatures	Medium	Elderly populations if no access to cooling or financial resources to buy an AC		Increasing invasives, stress on resources
	Wildfires	Low			Damage to resources
	Invasive species	Low	Potential health impacts of pests		Loss of biodiversity
Extreme Weather 	Hurricanes / Tropical Storms	High	Power outages	Street closures, house flooding, emergency access, wind damage to buildings, power outages	Tree damage
	Severe Winter Storms	High	Power outages, elderly or isolated residents	Damage to public buildings with snow loads, power outages which can affect water treatment plants, road blockages.	Tree damage
	Tornadoes	Low			
	Other (Wind/Thunderstorms/Microbursts)	Med-High	Power outages, property damage	Power loss, road closures (same as above)	Tree damage
Non-Climate Hazard	Earthquake	Low	Property damage	Infrastructure damage	

SECTION 5: HAZARD MITIGATION GOALS

The Woburn Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2016 Hazard Mitigation Plan for the City of Woburn. All of the goals are considered critical for the city, and they are not listed in order of importance. Prior to the Hazard Mitigation Plan update process, the City of Woburn developed a Climate Change Vulnerability Analysis and Action Plan. The local team chose to incorporate climate considerations as noted in Goal 10.

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

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

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

- Ensure that the Planning Department considers hazard mitigation in its review and permitting of new development.
- Review zoning regulations to ensure that the ordinance incorporates all reasonable hazard mitigation provisions.
- Ensure that all relevant municipal departments have the resources to continue to enforce codes and regulations related to hazard mitigation.

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

- Begin to assess the vulnerability of municipal buildings and infrastructure to damage from an earthquake.
- Maintain existing mitigation infrastructure in good condition.

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

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

- Continue to participate in the Mystic Region REPC and Region IV A (Board of Health).

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

GOAL 8. Educate the public about natural hazards and mitigation measures that can be undertaken by property-owners.

- Provide information on hazard mitigation activities in the languages most frequently spoken in Woburn.

GOAL 9. Take maximum advantage of resources from FEMA and MEMA to educate City staff and the public about hazard mitigation.

GOAL 10. Consider the potential impacts of future climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning.

SECTION 6: EXISTING MITIGATION MEASURES

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

The City's existing mitigation measures, which were in place prior to the original 2005 Plan, are listed by hazard type here and are summarized in Table 33 below. Many upgrades to existing measures are noted in the following sections.

EXISTING MULTI-HAZARD MITIGATION MEASURES

Comprehensive Emergency Management Plan (CEMP) – The city has an up-to-date CEMP plan that meets the state's requirements.

Enforcement of the State Building Code – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads.

Regional Emergency Planning Committee (REPC) – The Mystic REPC serves as the emergency planning committee for 19 cities and towns. The Mystic REPC's 19 member cities and towns work together to develop plans to educate, communicate, and protect their communities in case of natural and man-made emergencies.

The Massachusetts Public Health Emergency Preparedness Region 4A – Woburn is a member of Region 4A, one of 15 regions within Massachusetts and is comprised of 33 cities and towns throughout the metro west area, which together form the General Coalition (GC).

EXISTING CITY-WIDE MITIGATION FOR FLOOD-RELATED HAZARDS

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

National Flood Insurance Program (NFIP) – Woburn participates in the NFIP with 43 policies in force as of the January 11, 2021. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at <http://www.fema.gov/business/nfip/statistics/pocstat.shtm>

Flood insurance policies in force (as of January 11, 2021)	43
Coverage amounts of flood insurance policies	\$16,059,500

Premiums paid	\$64,512
Closed losses (Losses that have been paid)	39
Total payments (Total amount paid on losses)	\$832,770

Since the 2016 plan, the policies in force have decreased by 6 and the closed losses have not changed. The City complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.

City Storm Drain System- All streets are swept once a year at a minimum and usually twice a year. The main roads are generally swept three or four times with some roads being done more frequently. Catch basin cleaning is also done annually. The DPW has a preventative maintenance plan and if flash floods or other storm events are forecast, they have a list of culverts and catch basins that are checked and cleaned if necessary. The DPW has three pieces of equipment and does all of the work in-house.

Maintenance of the water distribution system: The City is in its ninth year of a cleaning and relining program as well as replacing gates and valves. The exercise of valves and gates is done as part of the flushing program. In the past two years the DPW has been using an iPad to log in information as it undertakes this work.

Zoning ordinance—The relevant section of the zoning ordinance is Section 9: Floodway and Flood Plain Districts.

Subdivision regulations – The Woburn Planning Board’s Land Subdivision Rules and Regulations – 1998 Edition – contain standards for drainage on subdivisions.

EXISTING CITY-WIDE MITIGATION FOR DAM-RELATED HAZARDS

DCR dam safety regulations apply to Scalley Dam at Horn Pond. Woburn is working with Winchester on improving dam operations.

EXISTING CITY-WIDE MITIGATION FOR WIND-RELATED HAZARDS

CEMP: The CEMP addresses wind risks.

Massachusetts State Building Code - The City has adopted the Massachusetts State Building Code. The Massachusetts State Building Code contains detailed regulations regarding wind loads.

Tree trimming – Under the direction of the tree warden the city maintains public shade trees within the public right-of-way. When EverSource needs to remove or trim a shade tree they will call and meet the Tree Warden on site before any work is done. EverSource also sends a plan 1 year in advance before any major work is done.

EXISTING CITY-WIDE MITIGATION FOR WINTER-RELATED HAZARDS

Building Code – The Building Code addresses snow loads.

Snow Removal – The City utilizes two areas for snow disposal. One is the ball field at the Veterans School off of School Street and the other is a smaller, satellite area at Saint Anthony's Church on Main Street. The city does not dump snow into Horn Pond because it is the City's water supply.

Road treatment -The City uses a combination of sand and salt to treat the roads during the winter. The city is careful to minimize the use of sand and salt on Arlington Road because of its proximity to the water supply at Horn Pond. The city also minimizes the use of salt on roads adjacent to wetlands. Salt is used primarily when there is a hilly road where safety takes precedence.

Due to environmental concerns and economics, the trend in snow and ice control has been to reduce the volume of sand that is mixed with salt. The DPW has phased out the use of sand. There has also been a concerted effort to reduce the volume of salt used during storms by supplementing the application of salt with chemical enhancements such as calcium chloride.

EXISTING CITY-WIDE MITIGATION FOR FIRE-RELATED HAZARDS

Outdoor burning – Outdoor burning is regulated by the Department of Environmental Protection, which allows outdoor burning of brush, cane, forestry debris, etc. during an annual period usually from January 15th through May 1st under the supervision and control of the Fire Department. Permits are issued during the annual period each year between the hours of 9:30 AM and 2:00 PM. The Woburn Fire Department web page contains a link with more information on outdoor burning.

Development review –The Fire Department is involved in reviewing new developments.

EXISTING CITY-WIDE MITIGATION FOR GEOLOGIC HAZARDS

Massachusetts State Building Code – The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0).

COMPILED LIST OF EXISTING MITIGATION

Table 33 summarizes the many existing natural hazard mitigation measures already in place in Woburn when the first Hazard Mitigation Plan was developed in 2016. Because of the number of entities, public and private, involved in natural hazard mitigation, it is likely that this list is a starting point for a more comprehensive inventory of all measures.

Table 33: Existing Natural Hazard Mitigation Measures in Woburn

Type of Existing Mitigation Measures	Effective Y/N	Changes Needed
MULTIPLE HAZARDS		
Comprehensive Emergency Management Plan (CEMP)	Y	Updating it currently
Massachusetts State Building Code	Y	State level control
The Mystic Region REPC	Y	Through fire prevention
MA Public Health Emergency Preparedness Region 4A	Y	
FLOOD HAZARDS		
Participation in the National Flood Insurance Program.	Y	
Maintenance of the City storm drain system	Y	
Maintenance of the water distribution system including relining water mains and exercising valves and gates.	Y	
Floodway and Floodplain Districts of the zoning ordinance.	N	Needs upgrades
Subdivision regulations governing drainage, plan requirements and run-off rates.	Y	In need of update, in progress
DAM HAZARDS		
DCR statewide dam safety regulations.	Y	Inspections and action plan complete
WIND HAZARDS		
Comprehensive Emergency Management Plan (CEMP)	Y	
The Massachusetts State Building Code.	Y	
Tree trimming program	Y	
WINTER HAZARDS		
Massachusetts State Building Code	Y	
Snow removal and plowing	Y	Backup for larger storms would be helpful
Road treatments during snow storms.	Y	
GEOLOGIC HAZARDS		
The Massachusetts State Building Code	Y	
BRUSH FIRE HAZARDS		
State regulation of outdoor burning	Y	Follow DEP and hotline
Development review	Y	With the Building Dept.

MITIGATION CAPABILITIES AND LOCAL CAPACITY FOR IMPLEMENTATION

Under the Massachusetts system of “Home Rule,” the City of Woburn is authorized to adopt and from time to time amend local ordinances and regulations that support the city’s capabilities to mitigate natural hazards. These include Zoning Ordinances, Subdivision and Site Plan Review Regulations, Wetlands Ordinance, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Ordinances may be amended by the City Council to improve the city’s capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission. The City of Woburn has recognized several existing mitigation measures that require implementation or improvements and has the capacity within its local boards and departments to address these.

SECTION 7: MITIGATION MEASURES FROM PREVIOUS PLAN

IMPLEMENTATION PROGRESS ON THE PREVIOUS PLAN

At a meeting of the Woburn Hazard Mitigation Planning Committee, City staff reviewed the mitigation measures identified in the 2016 Woburn Hazard Mitigation Plan and determined whether each measure had been implemented or deferred. Of those measures that had been deferred, the committee evaluated whether the measure should be deleted or carried forward into this Hazard Mitigation Plan 2021 Update. The decision on whether to delete or retain a particular measure was based on the committee's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the city to act on the measure. Table 34 summarizes the status of mitigation measures from the 2016 plan.

Table 34: Mitigation Measures from the 2016 Plan

Mitigation Action	Priority in 2016 plan	Current Status	Include in 2021 Plan?
Drainage improvements at Arlington Road/Lake Avenue	High	Not complete	Y
Drainage improvements Cambridge Road	High	Some culvert improvements done, in design for additional improvements	Y
Drainage improvements at Hart Street-24" relief line	Low	Not complete, did some cleaning of the stream that lessened flooding	Y
Hart St/Winn St stream and culvert cleaning	High	Stream and culvert maintenance reduced flooding	Y
Drainage improvements Salem Street at Aberjona Dr	High	Not complete, requires more than drainage improvements	N
Bedford Road: Marlboro to Cambridge	High	Complete	N
Stream maintenance	High	Work done, and needs to continue	Y
Stream culvert maintenance	High	Work done, and needs to continue	Y
Storm drain cleaning and maintenance	Medium	Work done, and needs to continue	Y
Drainage improvements at Lake Terrace and Lake Circle	Medium	Not complete	Y
Drainage improvements at Dragon Court	Medium	Complete	N
Drainage improvements at Washington Street at Staples	Medium	Not complete	Y
Drainage improvements at Bartlett Drive and Pearl Street	Medium	Not complete	Y
Drainage improvements Washington Street near Wendy's	Medium	Complete	N
Drainage improvements Ward Street at Traverse Street	Medium	Minor issue only in major storms, not a priority	N

Mitigation Action	Priority in 2016 plan	Current Status	Include in 2021 Plan?
Drainage improvements Lillian Street near the Kennedy School	Medium	Minor issue only in major storms, not a priority	N
Retrofit public buildings to withstand snow loads	Medium	Buildings retrofitted with solar were evaluated.	N
Winter storm public awareness campaign	Medium	Continue to focus on RAVE sign-up	Y
Implement seismic upgrades to the communications center	Low	Completed retrofit, but still need seismic analysis	Y
Consider becoming a Firewise Community	Low	Not complete	Y
Purchase a brush truck	Medium	Not complete	Y
Conduct a public awareness campaign about the risk of extreme temperatures.	Low	Started as part of MVP project	Y
Develop an ordinance to restrict the use of public water for non-essential uses.	Low	Adequately addressed with current regulations	N

As indicated in Table 34, Woburn made good progress implementing mitigation measures identified in the 2016 Hazard Mitigation Plan. Considerable work has been done to address drainage problems citywide. Three drainage projects were completed, and progress was made to reduce flooding on four additional projects. Progress was also made on stream, culvert and catch basin maintenance. A number of projects that were partially completed or not initiated have been continued into this plan update. The city also did outreach regarding heat risks, evaluated snow loads for some of its buildings, and is currently considering language restricting non-essential use of public water supply.

Overall, fifteen mitigation measures from the 2016 plan will be continued in the plan update. Most retain the same priority in this 2021 Update. Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the City's decision-making processes. The challenges the city faces in implementing these measures are primarily due to limited funding and available staff time. This plan should help the city prioritize the best use of its limited resources for enhanced mitigation of natural hazards.

SECTION 8: HAZARD MITIGATION STRATEGY

WHAT IS HAZARD MITIGATION?

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

<https://www.fema.gov/hazard-mitigation-grant-program>

<https://www.fema.gov/pre-disaster-mitigation-grant-program>

<https://www.fema.gov/flood-mitigation-assistance-grant-program>

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

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

(Source: FEMA Local Multi-Hazard Mitigation Planning Guidance)

REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

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

REGIONAL PARTNERS

In developed urban and suburban communities such as the metropolitan Boston area, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are complex systems of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including the City, the Massachusetts Water Resources Authority (MWRA), Massachusetts Department of Transportation (MassDOT) and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operation, and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the communities' regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and they must make decisions about numerous competing priorities.

Following, is a brief overview of regional facilities found in Woburn and a discussion of inter-municipal issues.

OVERVIEW OF REGIONAL FACILITIES WITHIN WOBURN

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

- State Routes 128, 38, and 3/3A (MassDOT)
- Commuter Rail Mishawum and Anderson/Woburn stations (MBTA)

INTER-COMMUNITY CONSIDERATIONS

Mitigation measures for the following regional issues should be considered as Woburn develops its own local plan:

A) Coordinate and Review Developments on a Regional Basis

As Woburn and the surrounding communities are undergoing development, it is vital that these communities communicate and provide input during the review processes. When addressing housing, transportation, and economic development projects, the impacts to neighbors must be addressed. Woburn is a member of the North Suburban Planning Council (NSPC) of MAPC. NSPC includes the 8 surrounding communities who meet regularly to share information on planning issues.

B) Watershed Management

The Aberjona River is a tributary to the Mystic River. Woburn is working closely with the Mystic River Watershed Association and its member communities to collaborate on projects and sharing information. The group has been tackling issues related to stormwater management, flooding, water use, and climate change.

NEW DEVELOPMENT AND INFRASTRUCTURE

As part of the process of developing recommendations for new mitigation measures for this plan update, the City considered the issues related to new development, redevelopment, and infrastructure needs in order limit future risks. Taking into consideration the Wetlands Act and ordinance enforced by the Conservation Commission and adoption of more stringent stormwater regulations, the city determined that existing regulatory measures are taking good advantage of local Home Rule land use regulatory authority to minimize natural hazard impacts of development. Priorities in this plan include a focus on regulatory updates designed to reduce future flooding.

PROCESS FOR SETTING PRIORITIES FOR MITIGATION MEASURES

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

Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events, the extent of the area impacted, and the relation of a given mitigation measure to the City's goals. In addition, the local Hazard Mitigation Planning Team also took into consideration factors such as the number of homes and businesses affected, whether or not road closures occurred and what impact closures had on delivery of emergency services and the local economy, anticipated project costs, whether any environmental constraints existed, and whether the city would be able to justify the costs relative to the anticipated benefits.

Table 35 below demonstrates the prioritization of the City's potential hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of:

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event

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

INTRODUCTION TO MITIGATION MEASURES TABLE

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

Priority – As described above and summarized in Table 35, the designation of high, medium, or low priority was done considering potential benefits and estimated project costs, as well as other factors in the STAPLEE (Social, Technical, Administrative, Legal, Economic, and Environmental) analysis.

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

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

Potential Funding Sources – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated, or designed, or if it is still in the conceptual stages. MEMA

and DCR assisted MAPC in reviewing the potential eligibility for hazard mitigation funding. Each grant program and agency has specific eligibility requirements that would need to be taken into consideration. In most instances, the measure will require a number of different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for, or selected for, funding. Upon adoption of this plan, the local team responsible for its implementation should begin to explore the funding sources in more detail.

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

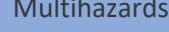
Army Corps of Engineers (ACOE) – The website for the North Atlantic district office is <http://www.nae.usace.army.mil/>. The ACOE provides assistance in a number of types of projects including shoreline/streambank protection, flood damage reduction, flood plain management services and planning services.

Massachusetts Emergency Management Agency (MEMA) – The grants page <https://www.mass.gov/hazard-mitigation-assistance-grant-programs> describes the various Hazard Mitigation Assistance Program.

Table 35: Mitigation Measures Prioritization

Climate Change	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME (YEAR)	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY (H/M/L)
Inland Flooding								
 Changes in Precipitation	Drainage improvements at Arlington Rd/Lake Ave	Site specific	Engineering	2022	High	High	BRIC/City	High
	Drainage improvements at Cambridge Rd	Site specific	Engineering	2022	High	High	BRIC/City	High
	Hart St./Winn St. stream and culvert cleaning	Site specific	Engineering	2023	High	High	City	High
	Stream maintenance	Various	Engineering Conservation	2025	High	High	City	High
	Stream culvert maintenance		Engineering	2025	High	High	City	High
	Drainage improvements at Lake Terrace and Circle	Site specific	Engineering	2026	Medium	High	BRIC/City	Medium
	Drainage improvements at Washington St at Staples	Site specific	Engineering	2025	Medium	High	BRIC/City	Medium
	Gill street	Site specific	Engineering	2025	Medium	High	BRIC/City	Low
	Drainage improvement at Prospect St and Jefferson Avenue	Site specific	Engineering	2024	Medium	High	BRIC/City	High
	Identify stormwater flooding sources outside FEMA flood zones	Citywide	Planning	2021	High	Low	MAPC	High
	Provide property retrofit materials to residents	Citywide	Planning	2021	High	Low	MAPC	High
	New Boston St. at Hall's Brook	Citywide	Engineering	2024	High	High	State grant	High
 Drought	Prospect Street and Jefferson Avenue	Site specific	Engineering	2024	High	High	FEMA	High
	Develop water conservation outreach	Citywide	DPW	2023	Low	Medium	City	High
	Landslide							
	Identify areas of landslide risk, notify property owners	Citywide	DPW	2025	Low	Low	City	Low
 Rising Temperatures	Extreme Heat and Heat Waves							
	Conduct public awareness about health risks	Citywide	BOH Emer. Mgmt.	2022	Low	Low	City	Low



	ACTION	GEOGRAPHIC COVERAGE	LEAD	TIME FRAME	EST. BENEFIT	EST. COST	FUNDING SOURCE	PRIORITY
	Review HVAC capacity for municipal buildings	Site Specific	DPW/Schools	2023	Medium	High	State grant	High
Wildfires								
	Consider becoming a Firewise Community	Citywide	Fire Dept.	2025	Medium	Low	City	Low
	Purchase a brush truck	Citywide	Fire Dept.	2025	Medium	Medium	City	Low
Invasive species								
	Manage invasives through permitting requirements	Large Development	Conservation Planning	2021	High	Low	City	Medium
	Hurricanes and Tropical storms (see Multihazards)							
	Severe Winter Storm/Nor'easter							
	Public awareness campaign	Citywide	Emer. Mgmt.	2022	Low	Low	City	Medium
	Tornadoes (see Multihazards)							
	Other Severe weather (wind, thunderstorms) (see Multihazards)							
	Multihazards							
	Adopt a Climate Action Plan	Citywide	Mayor	2022	High	High	State grant	High
	Increase funding of tree management work	Citywide	DPW	2025	High	High	City	Medium
	Earthquake							
	Seismic upgrades for the communications center	Site specific	Emer. Mgmt.	2025	Medium	High	City	Low

DESCRIPTION OF MITIGATION MEASURES

Changes in Precipitation

Inland Flooding

Arlington Road Drainage Improvements – Clean, inspect and evaluate storm drain lines, manholes and catch basins. Install hydrodynamic separators at four outfalls.

Cambridge Road – This project seeks to upgrade the drainage system to handle a larger volume of flow by replacing the existing drain under Cambridge Road with a 30-inch pipe.

Hart Street/Winn Street -- Cleaning of the Hart Street area stream and culvert under Winn Street

General stream maintenance- Sediment and debris and trash have decreased the hydraulic capacity of streams and drainage swales. Trash removal and dredging of approximately 10,000 linear feet is necessary.

General stream culvert maintenance – Some culverts in the city have become blocked with sediment, debris, and trash. The report identifies 20 culverts in need of cleaning.

Lake Terrace and Lake Circle Drainage Improvements – Clean, inspect and evaluate storm drain lines, manholes and catch basins. Install additional catch basins and drain manholes.

Washington Street near Cedar Street (Staples) – This drainage project consists of installing a parallel relief system to convey stormwater under Washington Street.

Gill street – Flooding occurs at the end of Gill Street due to inadequate drainage. Investigate clearing the drainage ditch and establishing better drainage to Hall's Brook.

Drainage improvement at Prospect St and Jefferson Avenue – Drainage work is needed hear due to an undersized 60-inch culvert.

Investigate sources of stormwater flooding – As noted in this plan, stormwater flooding occurs in many locations outside of FEMA flood zones. The City will analyze flooding locations and reach out to residents to investigate historic flood damage.

Provide property retrofit materials to residents – The City will develop materials and do outreach to encourage adoption of property retrofit strategies.

New Boston St. at Hall's Brook – Flooding from Hall's Brook impacts the roadway. Drainage improvements are needed.

Prospect Street and Jefferson Avenue – Flooding due to drainage issues occurs at the intersection and up to Garfield Street and along the wetlands area between Auburn Avenue and Hanson Court.

Drought

Encourage water conservation – Develop materials for residents. Consider additional strategies such as encouraging use of rain barrels.

Landslide

Identify landslide risks – Assess potential for landslides. Notify affected properties as appropriate.

Extreme Heat and Heatwaves

Conduct a public awareness campaign about the risk of extreme temperatures – Extreme heat and cold can have impacts on residents as well as on property. Extreme heat and cold can be

deadly for sensitive populations such as the elderly and extreme cold can lead to freezing pipes and damage for property-owners. A public education campaign could use print publications as well as social media to both educate residents and alert them to times when these conditions are anticipated.

Review HVAC capacity for municipal buildings – Investigate and improve cooling capacity in the municipal and school buildings that have not been updated.

Wildfires

Consider becoming a Firewise Community – The national Firewise Communities program offers communities a structured way to undertake community-based activities to lessen the impact of brush fires.

Purchase a brush truck – The Fire Department would like to purchase a brush truck to be better equipped to respond to brush fires.

Invasive Species

Manage invasives through permitting requirements - Utilize permit conditions issued by the Conservation Commission, Planning Board, and others to remove and control invasive species, particularly on large development parcels.

Severe Winter Storm/Nor'easter

Public awareness campaign – The City should increase its public awareness activities including the use of social media and written materials on winter hazards that would be available at City Hall and mailed to residents with their tax bills.

Multihazards

Increase funding of tree management work – Funding would increase the capacity of the DPW to manage street trees, addressing and reducing damage caused by wind and other sources. (This item addresses **Hurricanes and Tropical Storms, Tornadoes, and Other Severe Weather.**)

Adopt a climate action plan – A climate action plan will focus on strategies to reduce greenhouse gas emissions. This will help address long-term climate impacts, as well as developing alternate energy strategies that can reduce vulnerability to power outages.

Earthquake

Implement seismic upgrades to the communications center - The Public Safety building should be reviewed to determine if changes are needed in order to be brought up to seismic standards. This review would help determine and address the potential for a collapse of the communications system that would impact the City's ability to respond to emergencies after an earthquake.

SECTION 9: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION

The Woburn Hazard Mitigation Plan 2021 Update was adopted by the Mayor on [ADD DATE]. See Appendix D for documentation. The plan was approved by FEMA on [ADD DATE] for a five-year period that will expire on [ADD DATE].

PLAN MAINTENANCE

MAPC worked with the Woburn Hazard Mitigation Team to prepare this plan. This group will continue to meet on an as-needed basis to coordinate the implementation and maintenance of this plan. A member of the City staff will be designated as the team coordinator. Additional members could be added to the local team from businesses, non-profits, and institutions. The city will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the Hazard Mitigation Team, these will be placed on the City's web site, and any meetings of the Hazard Mitigation Team will be publicly noticed in accordance with city and state open meeting laws.

IMPLEMENTATION AND EVALUATION SCHEDULE

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

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

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

The Hazard Mitigation Implementation Team will use the information from the Mid-Term progress review to identify the needs and priorities for the plan update and seek funding for the plan update process. Potential sources of funding may include FEMA Pre-Disaster Mitigation grants and the Hazard Mitigation Grant Program. Both grant programs can pay for 75% of a planning project, with a 25% local cost share required.

Prepare and Adopt an Updated Local Hazard Mitigation Plan – Once the resources have been secured to update the plan, the Hazard Mitigation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However, the Hazard Mitigation Implementation Team decides to update the

plan, the city will need to review the current FEMA hazard mitigation plan guidelines for any changes in requirements for hazard mitigation plans since the previous plan. Once the next plan update is prepared, the City will submit it to MEMA and FEMA for review and approval and adopt the plan update in order to obtain formal FEMA approval of the plan.

INTEGRATION OF THE PLANS WITH OTHER PLANNING INITIATIVES

Upon approval of the Woburn Hazard Mitigation Plan 2021 Update by FEMA, the Local Hazard Mitigation Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire/Emergency Management
- Police
- Public Works
- Planning
- Engineering
- Building Department
- Conservation

Other groups that will be coordinated with include large institutions, Chambers of Commerce, land conservation organizations and watershed groups. The plan will also be posted on the City's website with the caveat that a local team coordinator will review the plan for sensitive information that would be inappropriate for public posting. The posting of the plan on the website will include a mechanism for citizen feedback such as an e-mail address to send comments.

The hazard mitigation plan provided crucial data and analysis for the climate resilience planning completed by the city and referenced in Appendix E. The plan has contributed to a focus on stormwater management including the adoption of a Stormwater Ordinance and associated regulations. The Hazard Mitigation Plan will also be integrated into other city plans and policies as they are updated and renewed, including the Open Space and Recreation Plan, Comprehensive Emergency Management Plan, Master Plan, and Capital Plan.

SECTION 10: LIST OF REFERENCES

- City of Woburn Zoning Ordinances
- City of Woburn Community Resilience Building Workshop Summary of Findings 2019
- Woburn Housing Production Plan
- Blue Hill Observatory
- FEMA, Flood Insurance Rate Maps for Norfolk County, MA, 2012
- FEMA, Hazards U.S. Multi-Hazard
- FEMA, Local Mitigation Plan Review Guide, October 2011
- Fourth National Climate Assessment, 2018
- Massachusetts Flood Hazard Management Program
- Massachusetts Office of Coastal Zone Management Shoreline Change Data
- Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams 2018
- Massachusetts State Hazard Mitigation Plan, 2013
- Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018
- Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data
- National Weather Service
- Nevada Seismological Library
- New England Seismic Network, Boston College Weston Observatory, <http://aki.bc.edu/index.htm>
- NOAA National Climatic Data Center, <http://www.ncdc.noaa.gov/>
- Northeast Climate Adaptation Science Center
- Northeast States Emergency Consortium, <http://www.nesec.org/>
- Tornado History Project
- US Census, 2010 and American Community Survey 2017 5-Year Estimates
- USGS, National Water Information System, <http://nwis.waterdata.usgs.gov/usa/nwis>

APPENDIX A: MEETING AGENDAS

Woburn Hazard Mitigation Plan Update

LOCAL HAZARD MITIGATION PLANNING TEAM

Meeting #1

Tuesday, March 16, 2021

10:00 am

via Zoom

AGENDA

1. Welcome and introductions
2. Overview of the planning process
3. Climate integration/MVP review
4. Review hazards – identify key concerns
5. Identify/update local hazards
 - a) Flood Hazard Areas
 - b) Fire Hazard Areas (brushfires/ wildfires)
6. Review critical infrastructure
7. Next steps



City of Woburn, Massachusetts

City Hall, 10 Common Street
Woburn, MA 01801

(781) 932-4400

MEETING AGENDA

HAZARD MITIGATION PLAN UPDATE COMMITTEE

April 22, 2021
2:00 p.m. – 3:30 p.m. (virtual)

1. Review Hazard Mitigation Goals
2. Review/update mitigation measure from the original (2008) plan
3. Reivew/update mitigation measure from the 2015 plan
4. Update on current FEMA grant opportunities
5. Plan the first public meeting



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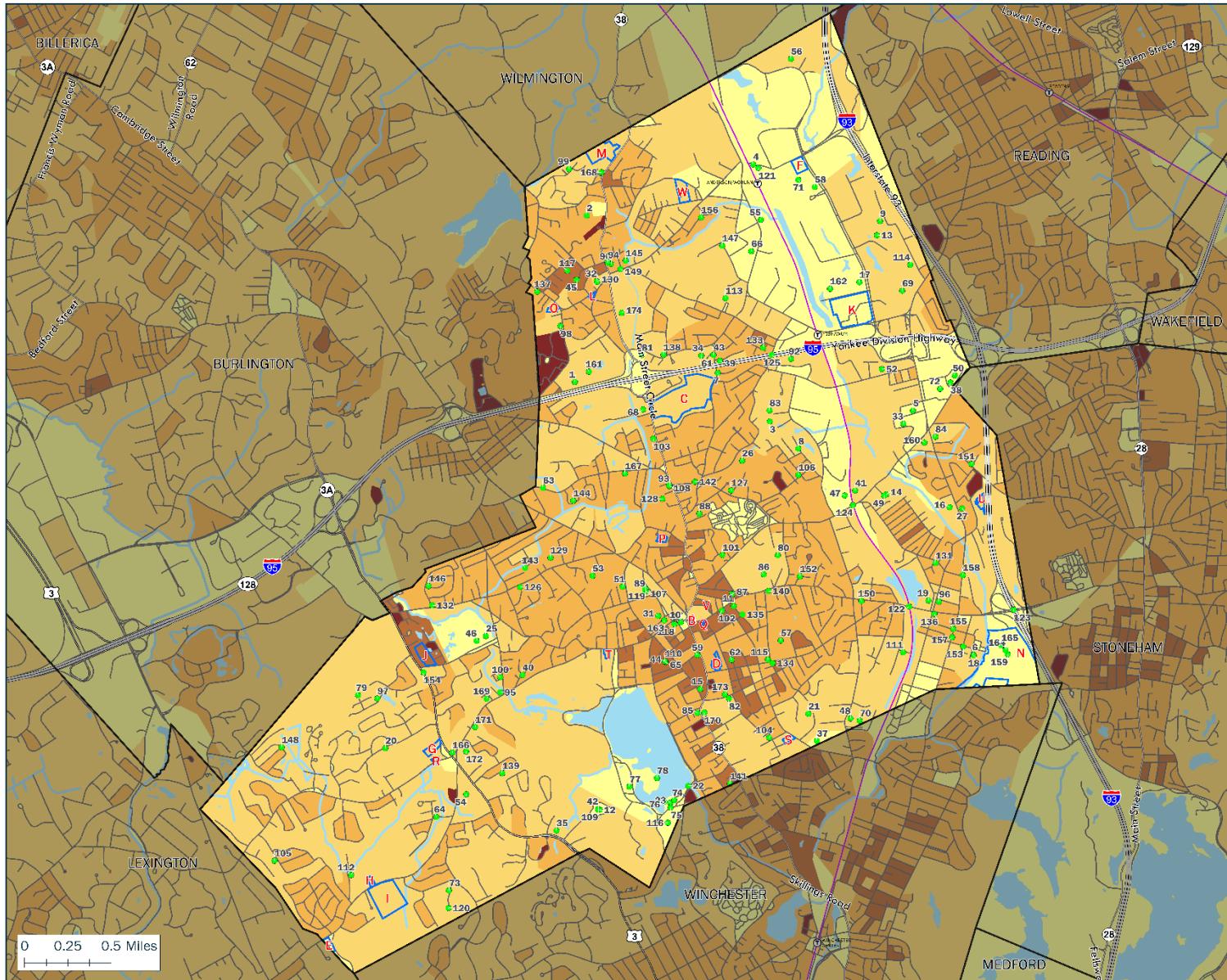
MEETING AGENDA

HAZARD MITIGATION PLAN UPDATE COMMITTEE

July 13, 2021
10:00 a.m. –11:30 p.m. (virtual)

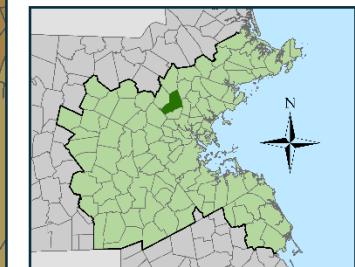
1. Feedback received from the public meeting
2. Develop mitigation measures for the plan
3. Update on any final information needed
4. Next steps to complete the plan

APPENDIX B: HAZARD MAPPING



FEMA Hazard Mitigation Planning Grant WOBURN, MA

Map 1: Population Density



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Map Sources:

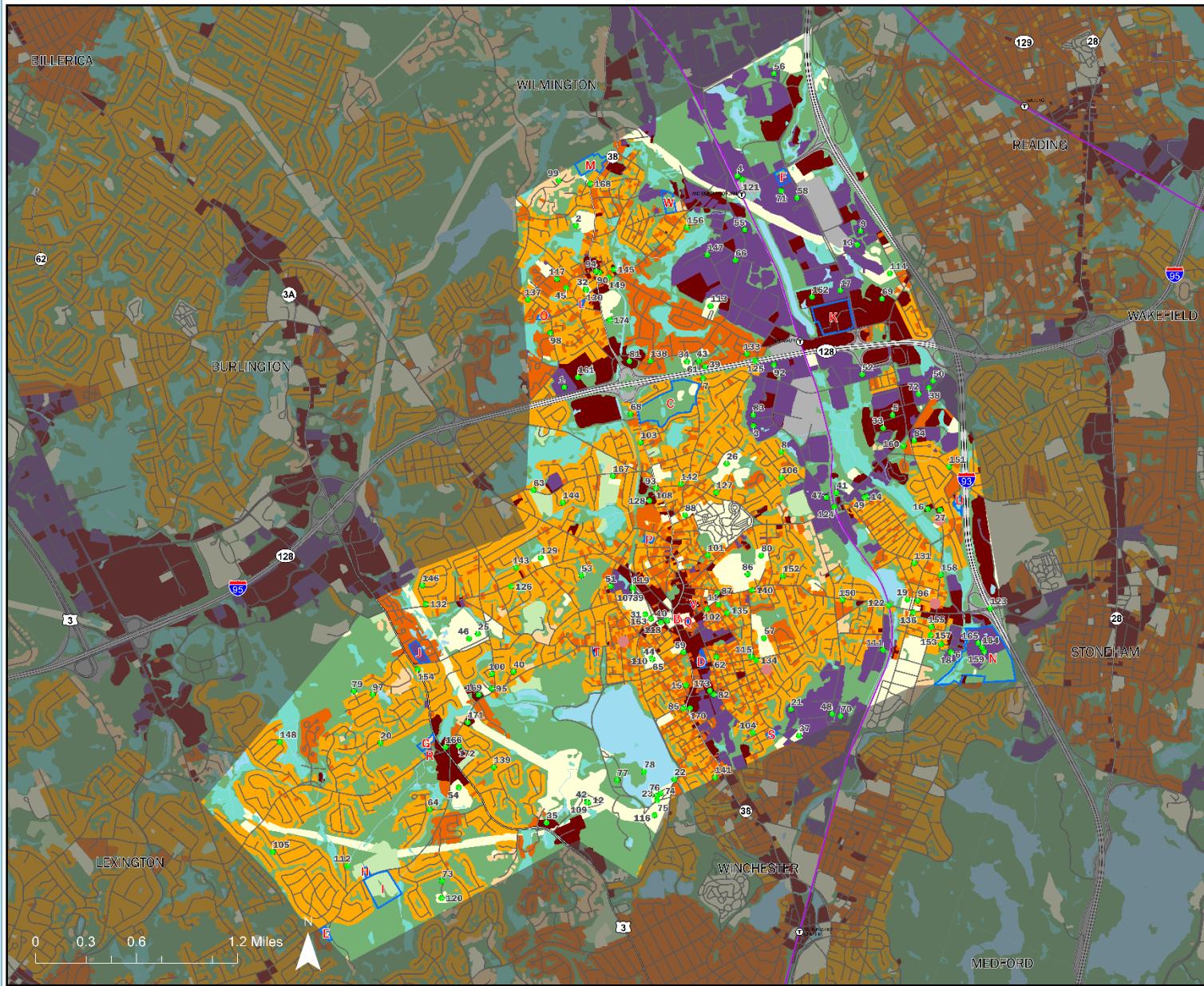
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Fire Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)

WOBURN, MA

Date: 7/21/2021

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MAPC **FEMA Hazard
Mitigation Planning Grant
WOBURN, MA**
Map 2: Land Use

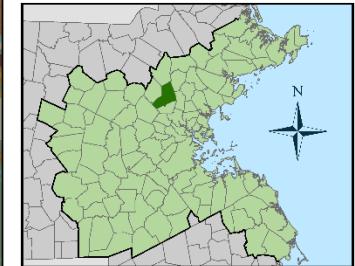
All Roads	
● Critical Infrastructure	Interstate
● Repetitive Loss Sites	U.S. Highway
■ Development Areas	State Route
■	Streets

* See details in separate table

Water Bodies	
■	Water Bodies

Rail	
● Stations	Commuter Rail

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



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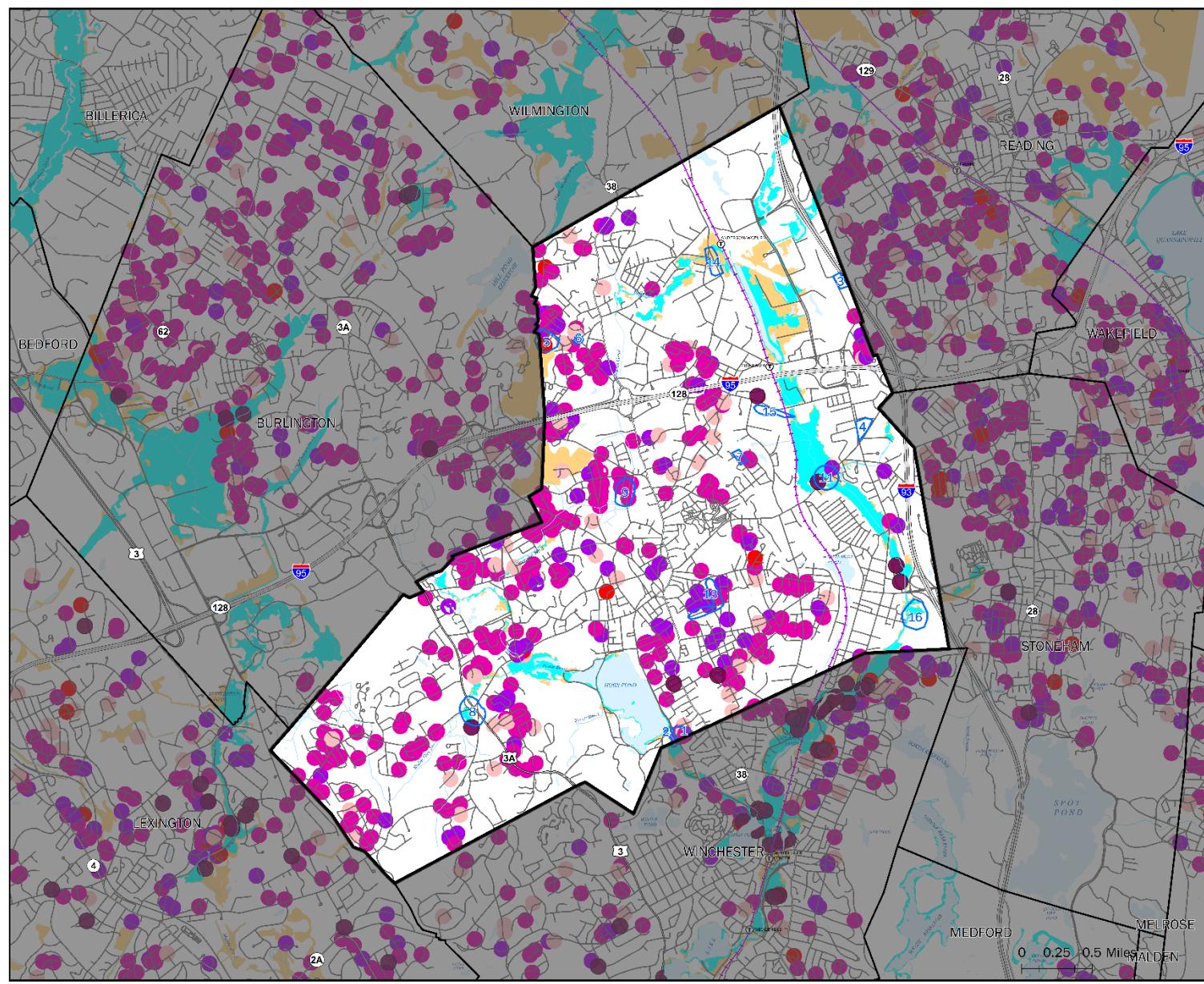
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESCI)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)

WOBURN, MA

Date: 7/21/2021

Path: K:\DataServices\Projects\Current_Projects\Environment\PDW\Project_Files\GDM\Map2.msc





FEMA Hazard Mitigation Planning Grant WOBURN, MA

Map 3: Flood Zones

Sites

- Locally Identified Flooding
- > See details in separate table

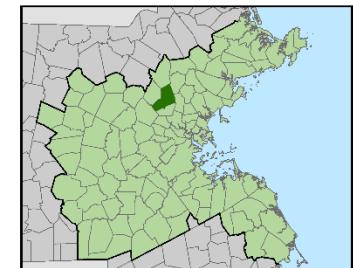
- Water Bodies

Rail

- Stations
- Commuter Rail
- Trains

March 2010 Flood Claims

- Flood Insurance
- Disaster Assistance
- 0 to 1 inch
- 2 to 6 inches
- 6 inches to 2 feet
- 2 feet plus



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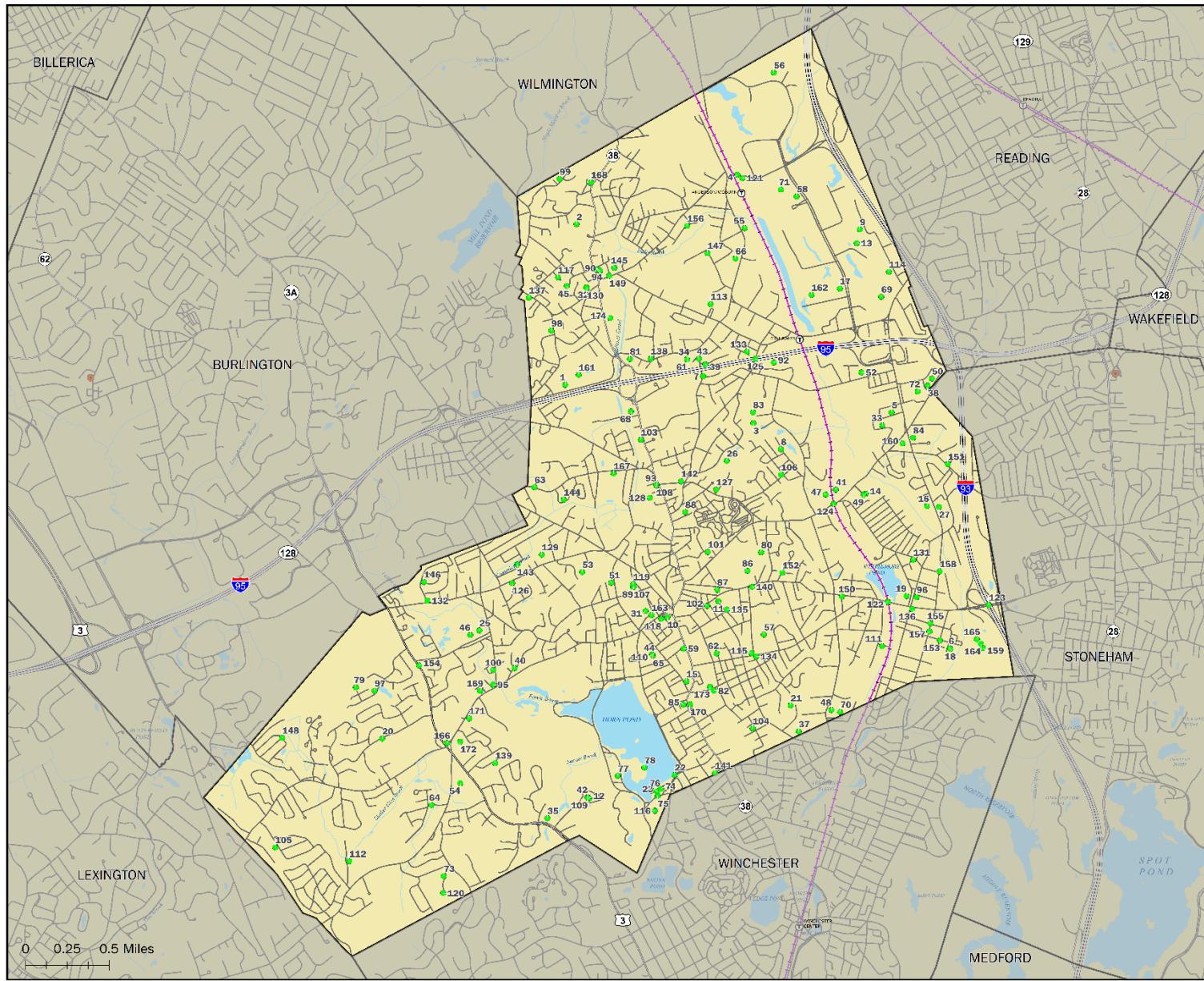
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)

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

WOBURN, MA
Date: 8/13/2021

Map 3: Flood Zones | Woburn, MA | 08/13/2021 | © 2021 MAPC

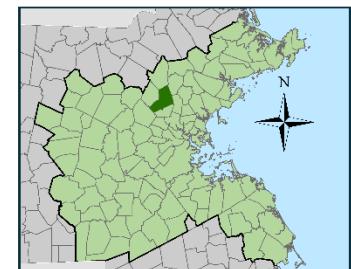




FEMA Hazard Mitigation Planning Grant WOBURN , MA

Map 4:
Earthquakes / Landslides

- Sites**
● Critical Infrastructure Sites*
* See details in separate table
- All Roads**
Train Stations
Commuter Rail Lines
Trains
Interstate
U.S. Highway
State Route
Street
- Earthquakes**
● Epicenters
- Landslides**
- High landslide incidence (greater than 15% of the area is involved in landsliding)
 - High susceptibility to landsliding and moderate incidence
 - High susceptibility to landsliding and low incidence
 - Moderate susceptibility to landsliding and low incidence
 - Low landslide incidence (less than 1.5 % of the area is involved in landsliding)



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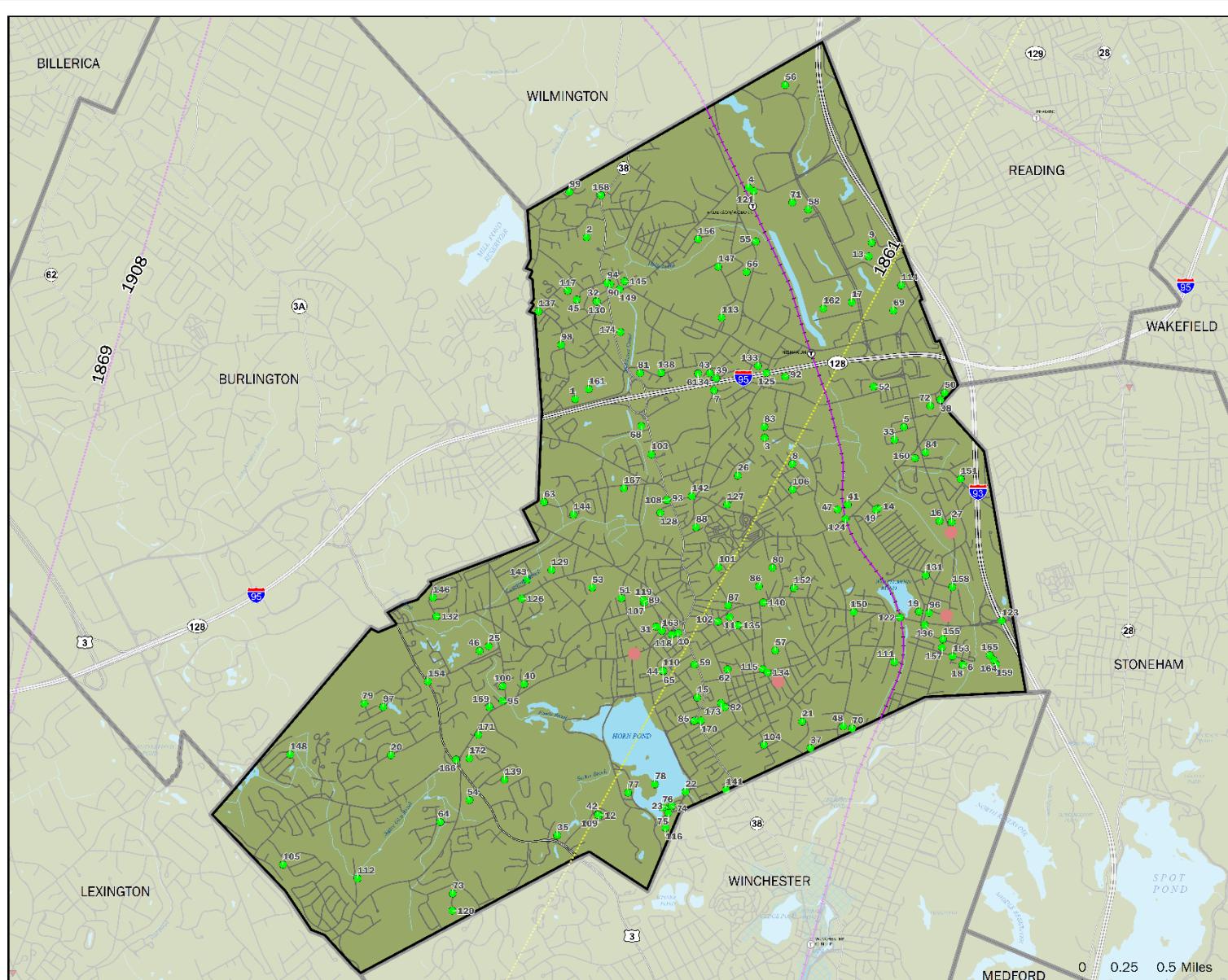
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Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)

Date: 7/23/2021
WOBURN, MA

File Name: D:\Data\Server\Projects\Woburn\Public\Hazards\EarthquakeLandslideMap1.mxd





FEMA Hazard
Mitigation Planning Grant
WOBURN , MA

Map 5:
Hurricanes / Tornadoes

Sites

- Critical Infrastructure Sites*
- Repetitive Loss Sites
- * See details in separate table

Train Stations

Commuter Rail Lines

Trains

Tornadoes

▼ Tornado

Storm Tracks

— Tropical Depression

— Tropical Storm

— Category 1 Hurricane

— Category 2 Hurricane

— Category 3 Hurricane

Year of storm noted on map

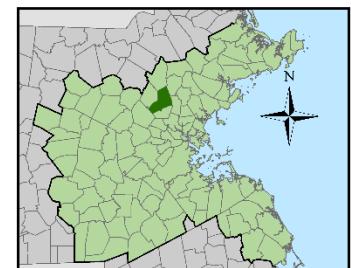
Hurricane Surge Inundation Area

Water Bodies

100 Year Wind Speeds

Miles Per Hour

90 MPH	
100 MPH	
110 MPH	
120 MPH	
130 MPH	

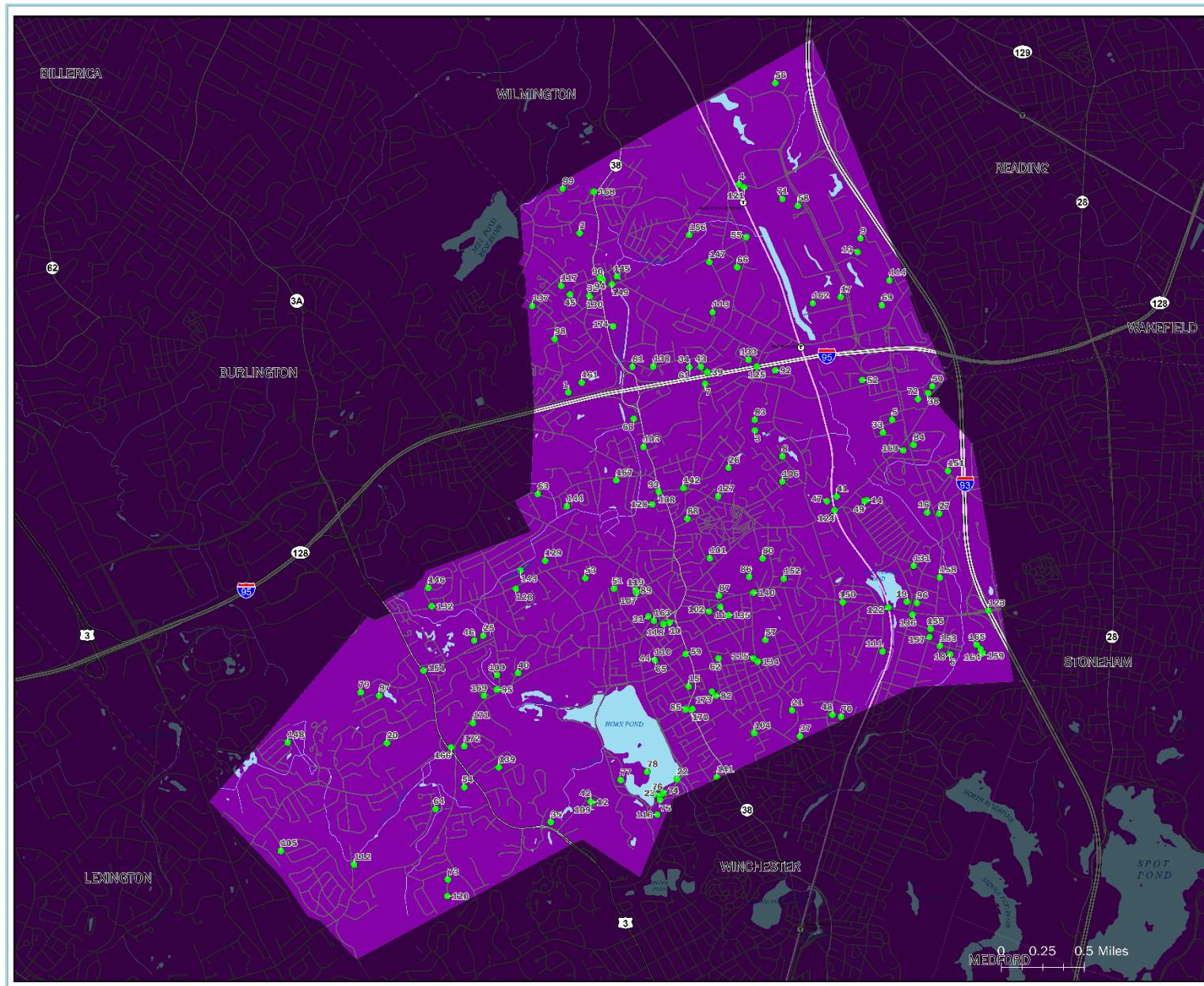


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interpretation, or parcel-level analyses.

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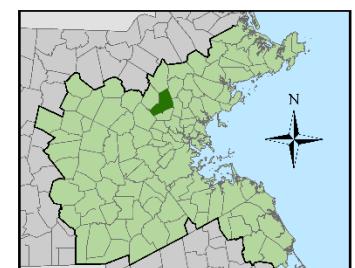
Data Sources:
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Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)

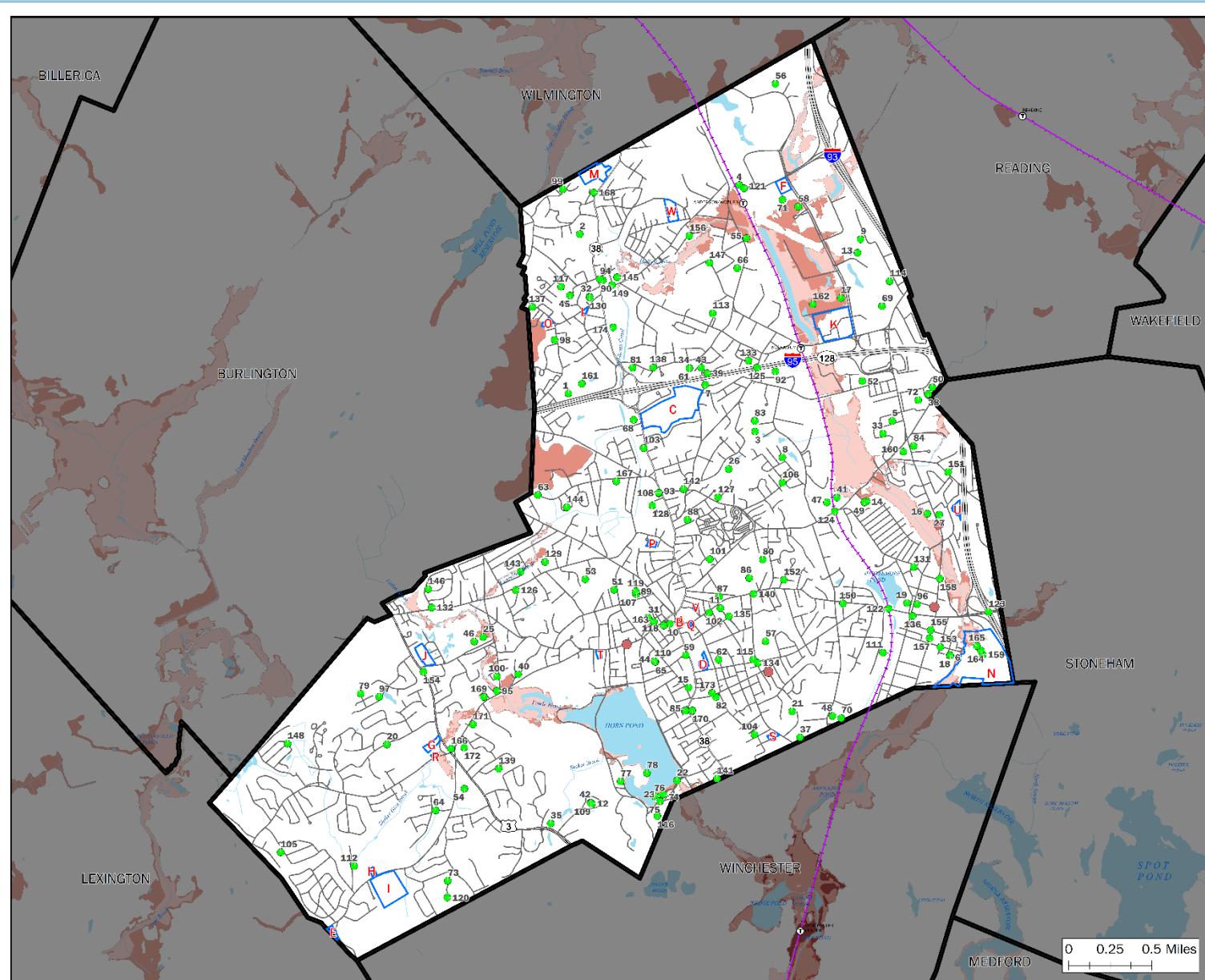
Date: 3/23/2021



FEMA Hazard Mitigation Planning Grant WOBURN, MA

Map 6: Average Snowfall

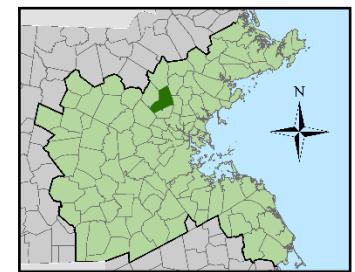




FEMA Hazard
Mitigation Planning Grant
WOBURN, MA

Map 7:
Composite Natural Hazards

- Sites**
- Critical Infrastructure
 - Repetitive Loss Sites
 - Development Areas
 - * See details in separate table
- Composite Natural Hazards**
- | |
|-----------------------|
| Low (2 Hazards) |
| Moderate (3 Hazards) |
| High (4 Hazards) |
| Very High (5 Hazards) |
- Composite natural hazards shown for areas of existing development. Hazards include:
- 100 year wind speed of 100 MPH or higher
 - Moderate landslide risk
 - FEMA flood zones (100 year and 500 year)
 - Average snowfall of 36.1" or more
 - Hurricane surge inundation areas
- Water Bodies**
- All Roads**
- Interstate
 - U.S. Highway
 - State Route
 - Street
- Train Stations**
- Commuter Rail Lines**
- Trains**
- Subway Lines**
- Blue
 - Green
 - Orange
 - Red
 - Silver



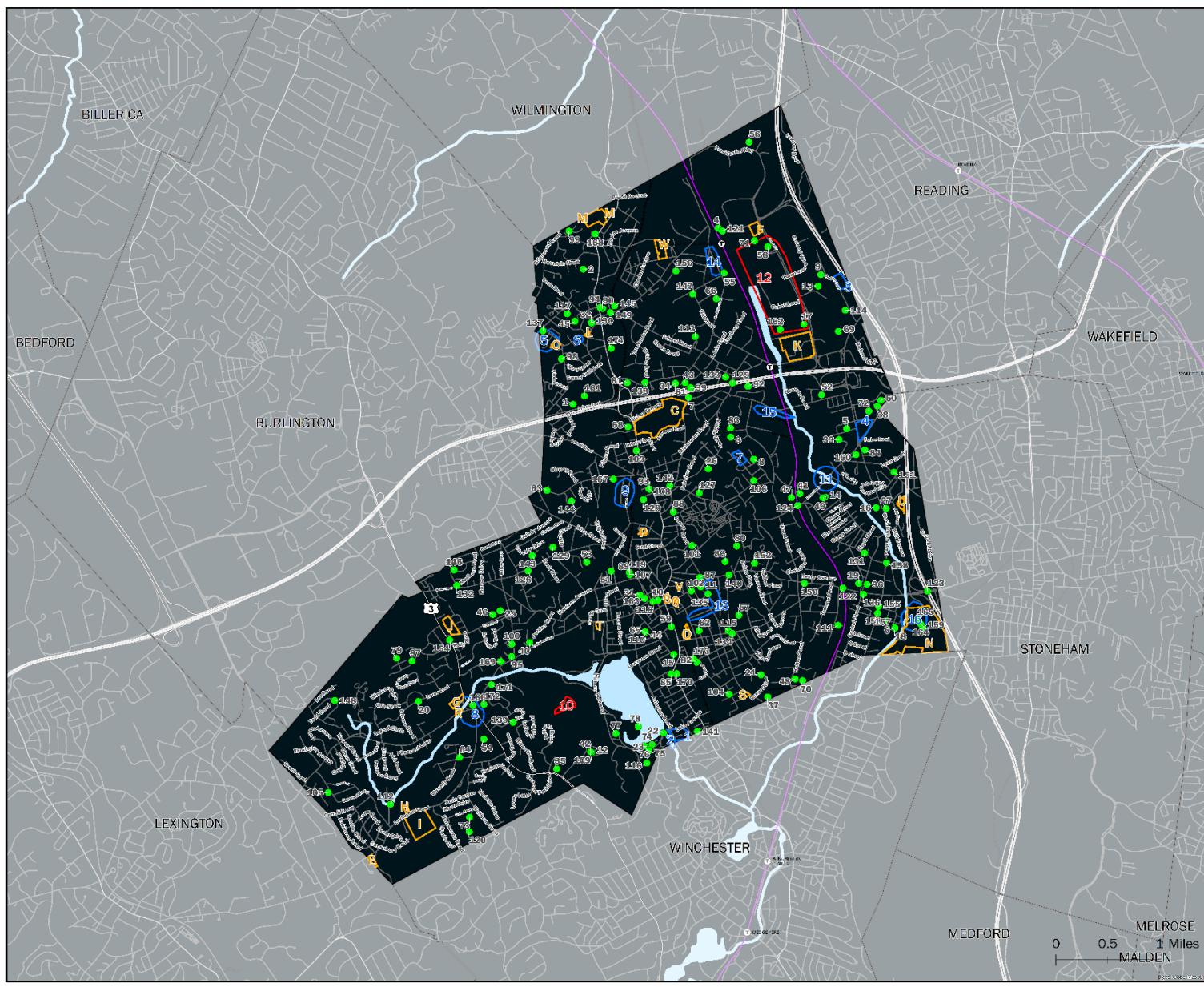
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Data Sources

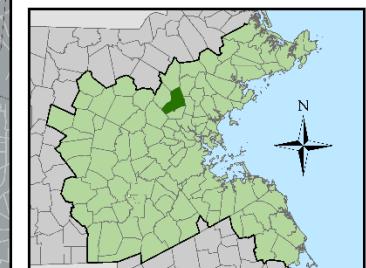
Composite Natural Hazard:
Wind, Landslide Risk, Snow - Northeast States Emergency Consortium (NFSFC)
Flood Zones - 2013 FEMA/MassGIS
Hurricane Surge - 2013 U.S. Army Corps of Engineers, New England District
Roads - MassDOT, CTPS
Repetitive Loss Sites: DCR/Office of Flood Hazard Management
Critical Infrastructure: Metropolitan Area Planning Council (MAPC) /
WOBURN, MA
Date: 7/23/2021





FEMA Hazard
Mitigation Planning Grant
WOBURN, MA

Map 8: Local Hazard Areas



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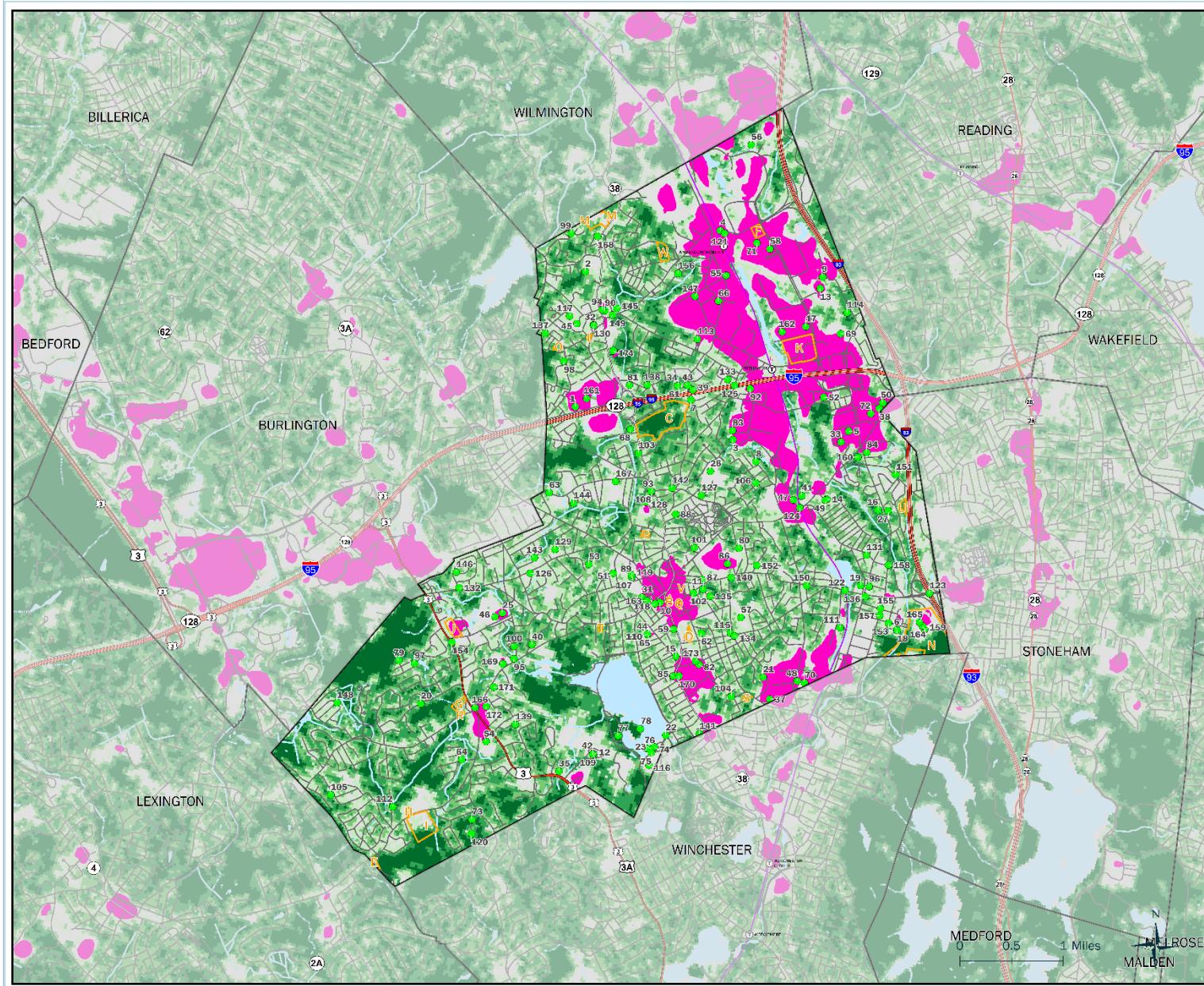
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Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
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WOBURN, MA
Date: 8/13/2021

AssetID=planned_hazard_map_woburn_ma_08132021.dwg





FEMA Hazard
Mitigation Planning Grant

WOBURN, MA

Map 9: High Land Surface Temperature

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Data Sources:
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Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
WOBURN, MA

Map 9: Land Surface Temperature, Critical Infrastructure, Development Areas, Roads, Hydrography, and Transportation. This map provides a detailed view of land surface temperature across the Woburn area and surrounding towns. The map includes labels for major roads, rail stations, and hydrographic features. A legend on the right side defines symbols for tree canopy coverage, climate, sites, transportation, roads, and hydrography. The map also includes a scale bar indicating 1 mile.

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APPENDIX C: PUBLIC MEETINGS

CALENDAR LISTING / MEDIA ADVISORY

WOBURN'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT JUNE 3 PUBLIC MEETING

Meeting to present Woburn's Hazard Mitigation Plan and solicit public comments

Who: Woburn residents, business owners, representatives of non-profit organizations and institutions, and others who are interested in preventing and reducing damage from natural hazards and future climate change impacts.

What: On Thursday, June 3 at 7:00 PM, a presentation will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the City on the development of its Hazard Mitigation Plan update.

The plan identifies natural hazards affecting Woburn such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the City can take to reduce its vulnerability to these hazards. Upon approval of the plan by the City and by FEMA, Woburn will be eligible for hazard mitigation grants.

When: Thursday, June 3 at 7:00 PM

Where: The meeting will be held virtually on Zoom.
Register in advance with this link:

<https://zoom.us/meeting/register/tJcpdeCrqTkoEtxo5Cvo9pTfHcoEysEdxvCs>

After registering, you will receive a confirmation email with information about joining the meeting.

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

##

**Mayor Scott Galvin and the City invite you to a
Climate Change and Natural Hazards
Public Meeting**

**Natural hazards have serious impacts on the
City of Woburn and its residents**



The City of Woburn is updating its Hazard Mitigation Plan to prepare for future extreme weather events. The plan will make the City eligible to apply for funding of priorities identified in the plan.

Have you experienced flooding? Do you have concerns about future climate impacts? Please join us. We are seeking your input.

Date: Thursday, June 3, 2021

Time: 7:00 PM

Location: Virtual Meeting on Zoom

Register in advance with this link:

<https://zoom.us/meeting/register/tJcpdeCrgTkoEtzo5Cvo9pTfHcoEysEdxvCs>

After registering, you will receive a confirmation email containing information about joining the meeting.

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

CALENDAR LISTING / MEDIA ADVISORY

WOBURN'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT JULY 27 PUBLIC MEETING

Meeting to present Woburn's Hazard Mitigation Plan and solicit public comments

Who: Woburn residents, business owners, representatives of non-profit organizations and institutions, and others who are interested in preventing and reducing damage from natural hazards and future climate change impacts.

What: At a public meeting on Tuesday, July 27 at 7:00 PM, a presentation on the *Woburn Draft Hazard Mitigation Plan, 2021* will be hosted by the Planning Board. The presentation will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the City on the development of its Hazard Mitigation Plan update. The draft plan will be posted on the Planning Board website from July 27 to August 9 and public comments will be accepted during that time.

The City of Woburn has prepared the draft Hazard Mitigation plan to document natural hazards that affect the City, such as floods, hurricanes, and severe winter storms, and to recommend actions that the City can take to reduce its vulnerability to these hazards. Once completed and approved by the Federal Emergency Management Agency (FEMA), the City will be eligible for federal Hazard Mitigation Grants from FEMA.

When: Tuesday, July 27, 2021 at 7 PM

Where: The meeting will be held virtually on Zoom.

Join Zoom Meeting

<https://us02web.zoom.us/j/84491561118?pwd=YjgwT3MzdII3cW9ldVVOMlgxZ1hVdz09>

Meeting ID: 844 9156 1118

Passcode: 437524

Planning Board information:

[Agendas and Minutes - City of Woburn \(woburnma.gov\)](#)

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

##



Climate Change and Natural Hazards Public Meeting

Natural hazards have serious impacts on the
City of Woburn and its residents



The City of Woburn is updating its Hazard Mitigation Plan to prepare for future extreme weather events. The plan will make the City eligible to apply for funding of priorities identified in the plan. Please join us for a presentation on the final draft of the Plan. The Plan will also available for public comment until August 10, 2021. The plan will be posted on the Planning Board website on July 27.

Date: Tuesday, July 27, 2021

Time: 7:00 PM

Location: Virtual Meeting on Zoom

<https://us02web.zoom.us/j/84491561118?pwd=YjqwT3MzdII3cW9IdVVOMiqxZ1hVdz09>

Meeting ID: 844 9156 1118

Passcode: 437524

Planning Board Information:

[Planning Board - City of Woburn \(woburnma.gov\)](http://www.woburnma.gov)

For more information, please contact MAPC Environmental Planner Anne Herbst at (617) 933-0781 or email aherbst@mapc.org.



City of Woburn, Massachusetts Planning Board

City Hall, 10 Common Street
Woburn, MA 01801

Phone: 781-897-5817

Tina Cassidy,
Planning Director

Dan Orr,
Grant Writer/Planner

Karen Smith, Planner

MEETING AGENDA

Tuesday, July 27, 2021 Meeting | 7:00 p.m.

This meeting will be a **virtual meeting** held on **Tuesday, July 27, 2021 beginning at 7:00 p.m.** To view this meeting on computer, laptop, tablet or smartphone with speakers and microphone, use this link at the above date and time:

<https://us02web.zoom.us/j/84491561118?pwd=YigwT3MzdII3cW9ldVV0MlgxZ1hVdz09>

At the prompt enter Passcode: 437524

By telephone, dial 1 929 205 6099 US (New York); at the prompt enter Meeting ID: 844 9156 1118 and at next prompt enter Passcode: 437524

To watch the meeting live on YouTube:

<https://www.youtube.com/watch?v=7tkKRALFkFQ>

1. **ROLL CALL** of members

2. **PUBLIC HEARINGS:**

- a. **PUBLIC HEARING: PROPOSED ZONING AMENDMENT** to amend Section 25 of the 1985 Woburn Zoning Ordinances by revising the maximum permitted density authorized in Subsection F thereof by deleting the number "fifty-seven (57)" and replacing it with "twenty (20) units per acre" / Attorney Joseph Tarby, on behalf of ND Properties LLC.

- b. **PUBLIC HEARING: SPECIAL PERMIT APPLICATION** to authorize 37,728 sq. ft. of light manufacturing floor space at 32 Cabot Road / CONTINUUS Pharmaceuticals, Inc.

3. **SPECIAL PERMITS:**

- a. **REQUEST FOR (MINOR) MODIFICATION TO SPECIAL PERMIT SITE PLAN OF RECORD** / Lord Hobo Brewery

4. **SUBDIVISIONS:**

- a. **DOWNS COURT SUBDIVISION:** Request for acceptance of revised As-built Plan and release of remaining surety being held to guarantee subdivision completion / Fred Cialdea

- b. **ALAN GERRISH DRIVE (88-92 PEARL STREET) SUBDIVISION:** Request to accept revised drainage and access easement and release all lots from restriction regarding sale of units / Cattle Crossing LLC

The items listed are those reasonably anticipated by the Chair which may be discussed at the meeting. Some items may be discussed in a different order than appears on the printed agenda, not all items listed may in fact be discussed, and other items not listed may also be brought up for discussion to the extent permitted by law.

5. **PRESENTATION OF DRAFT UPDATED HAZARD MITIGATION PLAN** / Planning Director Tina Cassidy and MAPC's Principal Environmental Planner Anne Herbst
6. **COMMERCE WAY CORRIDOR OVERLAY DISTRICT (CWCOD)** and Concept Plan for 0 New Boston Street development: Selection of Planning Board members to serve on Concept Plan Review Committee
7. **APPROVAL OF MINUTES:** June 21, 2021 meeting
8. **PLANNING BOARD DIRECTOR UPDATE:** Status reports/discussion on various matters including schedule of upcoming Board meetings and staff's progress relative to scheduling subdivision construction completion date discussions for the September meetings
9. **OTHER BUSINESS MATTERS NOT KNOWN AT THE TIME OF POSTING THAT MAY LEGALLY COME BEFORE THE BOARD**
10. **ADJOURNMENT**

The items listed are those reasonably anticipated by the Chair which may be discussed at the meeting. Some items may be discussed in a different order than appears on the printed agenda, not all items listed may in fact be discussed, and other items not listed may also be brought up for discussion to the extent permitted by law.

APPENDIX D: PLAN ADOPTION

**CERTIFICATE OF ADOPTION
CHIEF EXECUTIVE OFFICER
CITY OF WOBURN, MASSACHUSETTS**

**A RESOLUTION ADOPTING THE
CITY OF WOBURN HAZARD MITIGATION PLAN 2021 UPDATE**

WHEREAS, the City of Woburn established a Committee to prepare the City of Woburn Hazard Mitigation Plan 2021 Update; and

WHEREAS, the City of Woburn Hazard Mitigation Plan 2021 Update contains several potential future projects to mitigate potential impacts from natural hazards in the City of Woburn, and

WHEREAS, duly-noticed public meetings were held by the LOCAL HAZARD MITIGATION PLANNING TEAM on June 3, 2021 and the Planning Board on July 27, 2021 and

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

NOW, THEREFORE BE IT RESOLVED that I, Scott Galvin, Mayor of the City of Woburn, MA adopt the City of Woburn Hazard Mitigation Plan 2021 Update, in accordance with M.G.L. 40 §4 or the charter and ordinances of the City of Woburn.

ADOPTED AND SIGNED this Date _____

Name/Title _____ Signature _____

Scott Galvin
Mayor

APPENDIX E: MVP WORKSHOP RESULTS

Highest Priorities developed in Climate Resilience Planning Workshop, April 2019

- Horn Pond Brook hydraulic and vegetation improvements for flood control and fish migration.
- Address flooding at Four Corners at the intersection of Cambridge and Russell Streets.
 - Reduce flooding by adding flood storage and wetland creation/restoration in adjacent empty lot along Russell Street that the City is in the process of acquiring.
 - Repair culvert along Shaker Glen Brook
 - Floodproof businesses
 - Work with business to add green infrastructure as well as permeable surfaces
 - Repair drainage to allow emergency access to west side of the City during high intensity rain events
- Increase storage, drainage upgrades, drainage improvements, raise roads and add green infrastructure in areas that flood regularly, including but not limited to Four Corners, Olympia Ave, Nashua/Draper St, New Boston St, Washington Street, Salem St, and School St.
- Improve stream crossings/culverts – increase capacity and clean regularly.
- Additional funding to DPW for road/drainage maintenance and upgrades. DPW preventative maintenance plan and stormwater management plan.
- Add an additional emergency shelter in the City.
- Coordinate and improve communications systems with EMS. Work with doctors, senior center, housing authority, grocery stores and shelters to pass along information on the RAVE system (State and local emergency notification system) to seniors, low income, commuting, non-English speaking residents. Create list of at-risk residents in case of power failure. Provide incentives to look in on fragile residents more systematically. Consider more extensive training (less than EMS).
- Upgrade and increase drinking water management for increased population and drought. This could include redundant pumps, capital improvement plan, investment, and execution.
- Add additional requirements for new developments. These areas can contribute to stormwater retention and green infrastructure to reduce flooding. Avoid losing open space. Floodplain zoning should be for a 500-year storm.
- Develop a stormwater task force. Review and update stormwater ordinance as necessary to address stormwater quality and quantity and to promote stormwater management onsite.
- Maximize site-specific stormwater retention. Identify opportunities for enhanced stormwater retention.