TOWN OF BELLINGHAM
HAZARD MITIGATION PLAN
2020 UPDATE

MAPC 50 YEARS
METROPOLITAN AREA PLANNING COUNCIL
SMART GROWTH AND REGIONAL COLLABORATION

Final Plan 2020 Update
Adopted by the Town
November 2, 2020

ACKNOWLEDGEMENTS & CREDITS

This plan was prepared for the Town of Bellingham 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 Massachusetts Municipal Vulnerability Preparedness Program.

MAPC Officers
President, Erin Wortman, Town of Stoneham
Vice President, Adam Chapdelaine, Town of Arlington
Secretary, Sandra Hackman, Town of Bedford
Treasurer, Sam Seidel, Gubernatorial
Executive Director, Marc D. Draisen, MAPC

Credits

Project Manager	Martin Pillsbury
GIS and Data Services:	Caitlin Spence

Massachusetts Emergency Management Agency

Director:	Samantha Phillips

Department of Conservation and Recreation

Commissioner:	Jim Montgomery

Bellingham Local Hazard Mitigation Team

Anne Matthews	Conservation Administrator
Bruce Wilson	Health Agent, Board of Health
Denis Fraine	Town Administrator
Don DiMartino	Director, Dept. of Public Works
Gerald Daigle	Police Chief
Jesse Riedle	Dept. of Public Works
Jim Kupfer	Town Planner/Zoning Enforcement Officer
Lee Rolls	Police Dept.
Mark Poirier	Deputy Fire Chief
Mary MacKinnon	Chief Financial Officer
Steve Gentile	Fire Chief
Tim Aicardi	Inspector of Buildings, Building Dept.
Tim Inacio	Dept. of Public Works
Tom Degnan	Assistant Director, Dept. of Public Works

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SECTION 1: EXECUTIVE SUMMARY

Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events. In the communities of the Boston region of Massachusetts, hazard mitigation planning tends to focus most on flooding, the most likely natural hazard to impact these communities. The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five-year intervals.

PLANNING PROCESS

Preparation of this plan update was conducted by the Town of Bellingham in a coordinated process with the neighboring Town of Franklin as part of a Municipal Vulnerability Preparedness (MVP) project for the two towns. Coordination of the Hazard Mitigation Plan updates for each town was led by Local Hazard Mitigation Teams in Bellingham and Franklin, composed of staff from key municipal departments. The two-town Municipal Vulnerability Preparedness (MVP) program focused on identifying climate risks and resilience strategies, which were integrated into the Hazard Mitigation Plans for both towns. The project was kicked off by a joint meeting of the MVP Core Team for both towns held on September 12, 2019 in Franklin. The two towns collaborated to hold a joint MVP workshop on November 20, 2019 in Franklin. The results of that workshop are included in this Hazard Mitigation Plan. The Bellingham local Hazard Mitigation Team met three times during plan development, on October 21, 2019, February 18, 2020, and May 26, 2020. Of note, due to the COVID-19 pandemic in the Spring of 2020, the final team meeting was conducted remotely via Zoom. At the series of three meetings, the local team identified critical infrastructure, mapped sites where the impacts of natural hazards most affect the town, updated the inventory of new development sites, endorsed goals for the updated plan, provided updates to the Town's existing mitigation measures, and prioritized and endorsed new or revised hazard mitigation recommendations that would benefit the town.

Public participation in the planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the Town takes to mitigate them. The Town's Local Hazard Mitigation Team hosted two public meetings, the first during plan development on March 12, 2020, which also provided a Listening Session for the joint MVP project, and the second, held via Zoom on August 13 , 2020, which provided an opportunity for the public to review and comment on the draft plan update, which was posted on the Town's website for public review. Key town stakeholders and neighboring communities were notified and invited to attend the meeting and review the draft plan. Comments received by the town are included in Appendix C.

RISK ASSESSMENT

The Bellingham Hazard Mitigation Plan assesses the potential impacts to the town from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, and drought. The risk assessment identifies the historic and existing impacts for each category of natural hazard, as

well as the impacts of a warming climate identified in the CRB Workshop. The geographic extent of the hazards is shown in the map series in Appendix A. The Bellingham Local Hazard Mitigation Planning Team identified 66 Critical Facilities. These are also shown on the map series and listed in Table 28, 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) analysis to estimate physical, economic, and social impacts of disasters. The HAZUS-MH analysis for Bellingham estimates property damages from Hurricanes of category 2 and 4 ($16.2 million to $62.8 million), earthquakes of magnitudes 5 and 7 ($321 million to $2.4 billion), and the 1% and .2% chance of flooding ($24.6 to $32.6 million).

HAZARD MITIGATION GOALS

The Bellingham Local Hazard Mitigation Team reviewed and endorsed the following hazard mitigation goals at the February 20, 2020 team meeting. The team added a ninth goal focused on incorporating climate change resiliency into its planning.

1. Prevent and reduce the loss of life, injury, public health impacts 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.

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

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

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

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

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

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

HAZARD MITIGATION STRATEGY

The Bellingham Local Hazard Mitigation Team identified a hazard mitigation strategy that includes a number of mitigation measures that would serve to reduce the Town's vulnerability to natural hazards. Overall, the hazard mitigation strategy recognizes that mitigating hazards for Bellingham 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.

The Town of Bellingham has utilized the previous Hazard Mitigation Plan to integrate hazard mitigation planning principles throughout the Town's administration. As recommended by the plan, the Town has acquired and developed a robust GIS system that depicts the community's comprehensive infrastructure system. Bellingham has also updated their local regulations, including a Wetlands Bylaw and Stormwater Regulations to support modern stormwater principles, and the Town has conducted a stormwater and drinking water educational campaign.

Global climate change and a variety of other factors impact the Town'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 Town's other related plans and policies.

PLAN REVIEW & UPDATE PROCESS

The process for developing Bellingham's Hazard Mitigation Plan 2020 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. The plan was also available on the Town's website for public comment. Public comments received are shown in Appendix C.
Section 4: Risk Assessment	MAPC gathered the most recently available hazard and land use data and met with town staff to identify changes in local hazard areas and development trends. Town staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. 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 Bellingham 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 town with input from the local Hazard Mitigation Team.
Sections 7 and 8: Hazard Mitigation Strategy	Mitigation measures from the previous plan (2010) were reviewed and assessed as to whether they were completed, in progress, or deferred. The Local Hazard Mitigation Team determined whether to carry forward measures into the 2020 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2010 plan. The updated mitigation measures were prioritized based on current conditions.
Section 9: Plan Adoption & Maintenance	This section of the plan was updated with a new on-going plan implementation review and five year update process that will assist the Town in incorporating hazard mitigation issues into other Town planning and regulatory review processes and better prepare the Town for the next comprehensive plan update. The major steps for plan maintenance are also summarized in the planning timeline on page 20.

As indicated in Table 33, Bellingham made good progress implementing mitigation measures identified in the 2011 Hazard Mitigation Plan. In particular, In particular, the Town had success with removal of the Caryville Dam, completion of drainage improvements for Stone Street, adoption of a Wetlands Bylaw and regulations, protection of four additional open space areas, adoption of a Stormwater Enterprise Fund, improved GIS mapping capabilities, public education on stormwater, improved communications for emergency operations, and an improved Public Safety facility.

Several projects that were not completed will be continued into this plan update. These include drainage upgrades at Lake Shore Drive, a hydrologic analysis/drainage assessment for Peters River, drainage mitigation for High Street, removal of Farmers Dike at Saddleback Hill Road, a drainage analysis at Green Acres on Newland Avenue, fire hydrant upgrades, open space acquisition, public education on stormwater and on brush fire hazards, and adoption of an updated stormwater bylaw.

Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision-making processes. Town will document any actions taken within this five-year cycle of the Hazard Mitigation Plan on challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Bellingham Hazard Mitigation Implementation Team, as described in Section 9 Plan Adoption and Maintenance.

SECTION 2: INTRODUCTION

PLANNING REQUIREMENTS OF THE FEDERAL DISASTER MITIGATION ACT

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

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

The Town of Bellingham contracted with the Metropolitan Area Planning Council (MAPC) to assist Bellingham and Franklin in updating their local Hazard Mitigation Plans and to conduct the Municipal Vulnerability Preparedness project, which is integrated into this plan updates of both Towns.

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.

PREVIOUS FEDERAL/STATE DISASTERS

Since 1991, there have been 24 natural hazard events that triggered federal or state disaster declarations that included Norfolk 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: Presidentially Declared Disasters, 1991-2020

Disaster Name	Date of Event	Declared Areas
Hurricane Bob	August 1991	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Severe Coastal Storm No Name Storm	October 1991	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Blizzard	March 1993	Statewide

Disaster Name	Date of Event	Declared Areas
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
Snowstorm	January 2005	Statewide
Hurricane Katrina	August 2005	Statewide
Severe Storms, Flooding	October 2005	Statewide
Severe Storms, Flooding	May 2006	Statewide
Severe Storm, Inland, Coastal Flooding	April 2007	Statewide
Severe 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
Tropical Storm Irene	August 2011	Barnstable, Berkshire, Bristol, Dukes, Franklin, Hampden, Hampshire, Norfolk, Plymouth
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
Severe winter storm and flooding	March 2018	Barnstable, Bristol, Essex, Nantucket, Norfolk, Plymouth
Severe winter storm and Snowstorm	March 2018	Essex, Middlesex, Norfolk, Suffolk, Worcester

Source: MA Hazard Mitigation and Climate Adaptation Plan

FEMA FUNDED MITIGATION PROJECTS

The Town of Bellingham has not previously received FEMA funding for mitigation projects.

COMMUNITY PROFILE

The Town of Bellingham is a moderate sized residential community situated on the southwestern area of metropolitan Boston. Although settled since the colonial era, the town has never experienced any prolonged periods of intensive industrial or commercial development. Bellingham evolved from agricultural village to rural small town and to bedroom suburb with local commercial activity. However, this pattern of growth has been changing. The dramatic upsurge in business activity in Bellingham in recent decades is a consequence of many factors. Certainly the heavy development of Boston's inner suburbs, and especially the towns along Route 128 with the accompanying problems of land shortages, rising prices and congestion have led business decision-makers to look to the I-495 area.

Bellingham has a positive business climate, supported by local improvements in public infrastructure. The town also has a strong commitment to providing good municipal services. This is exemplified by the construction of a new library, fire station and elementary school, as well as improvements in the town's playgrounds and ball fields.

Bellingham is located in Southeastern Massachusetts and is bordered by Franklin and Wrentham on the east; Woonsocket, Rhode Island, on the south; Blackstone, Mendon, and Hopedale on the west; and Milford and Hopkinton on the north. Bellingham is 25 miles southeast of Worcester and 30 miles southwest of Boston. The town is located in two major watersheds, the Charles River to the north and the Blackstone River to the south.

Principal highways are Interstate 495 and state Routes 126 and 140. Commuter rail service to Boston is available in neighboring Franklin. Bellingham is served by the Greater Attleboro Taunton Regional Transit Authority (GATRA), which provides two shuttle bus routes connecting to the MBTA Commuter Rail in Franklin.

Bellingham belongs to the Southwest Area Planning Council (SWAP) subregion of the Metropolitan Area Planning Council. Bellingham is also a member of the I-495/MetroWest Partnership. The town is governed by a Selectboard with a Town Administrator. The town operates under the open town meeting format. The town maintains a website at http://www.bellinghamma.org/

Bellingham has just over 17,000 residents. Notably, 22% of Bellingham's population lives alone, and half of those living alone are over 65 years old. Other demographic characteristics are summarized in Table 3.

Table 3: Bellingham Demographic Characteristics

Population = 17,016 people

- 4.8% are under age 5
- 13.3% are over age 65
- 7.9% have a disability
- 2.7% are over 65 with a disability
- 7.9% speak a language other than English-at home
- 2.8 speak English "less than well"
- 22.8% of householders live alone
- 12.0% of householders are over 65 living alone
- 3.1% of households have no vehicle available

Number of Housing Units = 6,808

- 16.0 % were built 1949 or earlier

Source: 2018- American Community Survey

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

- Bellingham along with Franklin is participating in the Massachusetts Municipal Vulnerability Preparedness community as part of this project.
- Bellingham lies within the headwater portion of both the Charles River and Blackstone River watersheds and has several smaller tributaries to these rivers.
- Bellingham is part of the Natural Valley Storage project implemented by the US Arm Corps of Engineers, which preserved significant natural floodplain areas to mitigate potential floods.
- Bellingham relies on local groundwater sources for all of its public water supply, from wells in both the Charles River and Blackstone River watersheds. Water quantity and quality are important concerns for maintaining the water supply and the for the health of the many streams and wetlands within the town.
- Bellingham relies on two different regional wastewater treatment facilities: the Charles River Water Pollution Control District's in Medway, MA for the northern part of town, and the Woonsocket, Rhode Island wastewater treatment facility for the southern part of town that is in the Blackstone River watershed.
- Records from flooding in 2010 highlight that flood damage during such an extreme event occurs mostly in areas outside of the designated flood zone (only 6.6% of flood claims were within the FEMA designated flood hazard area).

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. 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 local stakeholders through two public meetings hosted by the local Hazard Mitigation Team, posting of the plan to the Town's website, and invitations sent to neighboring communities, town 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:

    - 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 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, Bellingham Economic Development Study, 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/
    - Towns of Bellingham and Franklin Community Resilience Building Workshop, 2019
    - Town of Bellingham General By-Laws
    - Town of Bellingham Master Plan, 2010
    - Town of Bellingham Open Space and Recreation Plan, 2017
    - Town of Bellingham, Silver Lake Dam Emergency Action Plan, 2019
    - Town of Bellingham Zoning By-Laws
    - 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. All current municipal mitigation measures have been 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.

2010 PLAN IMPLEMENTATION & MAINTENANCE

The 2011 Town of Bellingham Hazard Mitigation Plan contained a risk assessment of identified hazards for the town and mitigation measures to address the risk and vulnerability from these hazards. Since approval of the plan by FEMA progress has been made on implementation of many of its recommended mitigation measures. The In particular, the Town had success with removal of the Caryville Dam, completion of drainage improvements for Stone Street, adoption of a Wetlands Bylaw and regulations, adoption of a Stormwater Enterprise Fund, protection of four additional open space areas, improved GIS mapping capabilities, public education on stormwater, improved communications for emergency operations, and a new Public Safety facility.

THE LOCAL HAZARD MITIGATION TEAM

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

Anne Matthews	Conservation Administrator
Bruce Wilson	Health Agent, Board of Health
Denis Fraine	Town Administrator

Don DiMartino	Director, Dept. of Public Works
Gerald Daigle	Police Chief
Jesse Riedle	Dept. of Public Works
Jim Kupfer	Town Planner/Zoning Enforcement Officer
Lee Rolls	Police Dept.
Mark Poirier	Deputy Fire Chief; Director
Mary MacKinnon	Chief Financial Officer
Steve Gentile	Fire Chief
Tim Aicardi	Inspector of Buildings, Building Dept.
Tim Inacio	Dept. of Public Works

The Bellingham Planning Board, Conservation Commission, and Building Department are the primary municipal entities responsible for regulating development in town. Input and feedback for the plan update was assured through the participation of the Town Planner/Zoning Enforcement Officer, the Conservation Administrator, and the Building Inspector. In addition, representatives of most town departments, boards and commissions participated in an all-day Community Building Resilience workshop on November 20, 2019. In addition, MAPC, the State-designated regional planning authority for Bellingham, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as the Massachusetts Department of Transportation, the Department of Environmental Protection, and the Department of Conservation and Recreation.

The Local Hazard Mitigation Planning Team met on the following dates: October 21, 2019, February 18, 2020, and May 26, 2020. The purpose of the meetings was to introduce the Hazard Mitigation planning program, review and update hazard mitigation goals, and to gather information on local hazard mitigation issues and sites or areas related to these. The team also coordinated the Municipal Vulnerability Preparedness Workshop held on November 20 along with the Town of Bellingham, at an MVP Core Team meeting on September 12, 2019. Local team Meetings focused on verifying local information on hazard areas and development trends, updating existing mitigation practices, reviewing the status of mitigation measures recommended in Bellingham's 2011 Hazard Mitigation Plan, and developing new or revised mitigation measures for the updated plan. The agendas for these meetings are included in Appendix B.

PUBLIC MEETINGS

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

was available for review. The first public meeting was held in the Bellingham Municipal Building on February 12, 2020. See meeting notice and agenda in Appendix C. This meeting also provided an opportunity for a public Listening Session on the Community Resilience Building Workshop that had been held on November 20, 2019.

The public had an opportunity to review the draft plan Bellingham Hazard Mitigation Plan Update 2020 at the second public meeting held on August 13, 2020 hosted by the Planning Board. Due to restrictions on public gatherings related to the COVID-19 pandemic, the Town hosted this meeting remotely via the Zoom online platform. See meeting notice and agenda in Appendix C.

Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. The draft plan was posted on the Town's website and available for public review until August 20, 2020. Notices of the draft plan were also sent to the Town and City Clerks in all neighboring communities, including Blackstone, Hopedale, Medway, Mendon, Milford, Franklin, and Wrentham, MA and Woonsocket, RI.

In addition to the two public meetings, Bellingham and neighboring Franklin held an all-day workshop attended by 41 town staff, board and committee members, and community stakeholders. The workshop focused on climate impacts to infrastructure, society, and the environment, and its findings and recommendations are summarized in Appendix E.

LOCAL STAKEHOLDER INVOLVEMENT

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

City of Woonsocket, RI
Town of Blackstone, MA
Town of Franklin, MA
Town of Hopedale, MA
Town of Medway, MA
Town of Mendon, MA
Town of Milford, MA
Town of Wrentham, MA
Bruce Wilson, Bellingham Board of Health Agent
Denis Fraine, Bellingham Town Administrator
Gary M Premo, Metacomet Emergency Comm. Center
James S. Kupfer, Town Planner/Zoning Compliance
Joanne Rebelo, Bellingham Schools
Kelly Grant, Bellingham Master Plan Committee

Lee Rolls, Bellingham Police Dept.
Mark Poirier, Bellingham Deputy Fire Chief
Mary Mackinnon, Bellingham CFO
Paul Redmond, Bellingham Treasurer
Stephen Dockray, Tri-County RVTSD
Susan Speers , Metacomet Land Trust
Tim Aicardi, Bellingham Building Commissioner
Tom Degnan, Bellingham Dept. of Public Works

See Appendix C for public meeting notices. The draft Bellingham Hazard Mitigation Plan 2020 Update was posted on the Town's website for the second public meeting. Members of the public could access the draft document and submit comments or questions to the Town.

PUBLIC COMMENT

In the first public meeting on February 12, 2020, participants expressed support for strategies that will address stormwater flooding, and encouraged the town to continue to take proactive steps to mitigate the impacts of climate change. In the Community Resilience Building workshop that took place on November 20, 2019, participants developed a robust list of priorities to increase resilience to climate-related natural hazards. These are documented in Appendix E. The draft Hazard Mitigation Plan 2020 Update was presented at the second public meeting on August 13, 2020 hosted by the Planning Board, and the plan was available for review and comment on the Town website until August 20, 2020. No comments were submitted to the town.

CONTINUING PUBLIC PARTICIPATION

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

TIMELINE: PLAN DEVELOPMENT AND APPROVAL

September 12, 2019	Meeting of the Bellingham-Franklin MVP Core Team
October 21, 2019	Meeting#1 of the Bellingham Local Hazard Mitigation Team
November 20, 2019	Bellingham-Franklin MVP Workshop
February 18, 2020	Meeting#2 of the Bellingham Local Hazard Mitigation Team
March 12, 2020	First Public Meeting at the Bellingham Municipal Building

May 27, 2020	Meeting#3 of the Bellingham Local Hazard Mitigation Team
August 13, 2020	Second Public Meeting hosted by the Planning Board via Zoom
September 9, 2020	Draft Plan Update submitted to MEMA
September 16, 2020	MEMA review; revised Draft Plan Update submitted to MEMA
October 27, 2020	FEMA review, revised Draft Plan Update submitted to MEMA
October 28, 2020	Notice of Approvable Pending Adoption (APA) sent by FEMA
November 2, 2020	Plan Adopted by the Bellingham Selectboard
TBD	FEMA final approval of the plan for 5 years

TIMELINE: POST-APPROVAL PLAN IMPLEMENTATION

After the plan has been approved by FEMA, the Town will observe the following timeline to implement the plan over the five-year approval period and prepare for the next plan update.

If the Town wishes to apply for a FEMA grant to prepare the next plan update, which will be due in 2025, a grant application should be submitted approximately two years before this plan expires, in order to allow time for the grant to be approved, and the next plan update to be completed before this plan expires. See Section 9 for more details on plan adoption and maintenance.

2022	Conduct Mid-Term Plan Survey on Progress
2023	Seek FEMA grant to prepare next plan update
2024	Begin process to update the plan
2025	Submit Draft 2025 Plan Update to MEMA and FEMA
2025	FEMA approval of 2025 Plan Update

SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Bellingham 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 Bellingham's risk assessment, MAPC gathered the most recently available hazard and development data and met with Town staff to identify changes in local hazard areas and development trends. MAPC also used FEMA's damage estimation software, HAZUS.

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

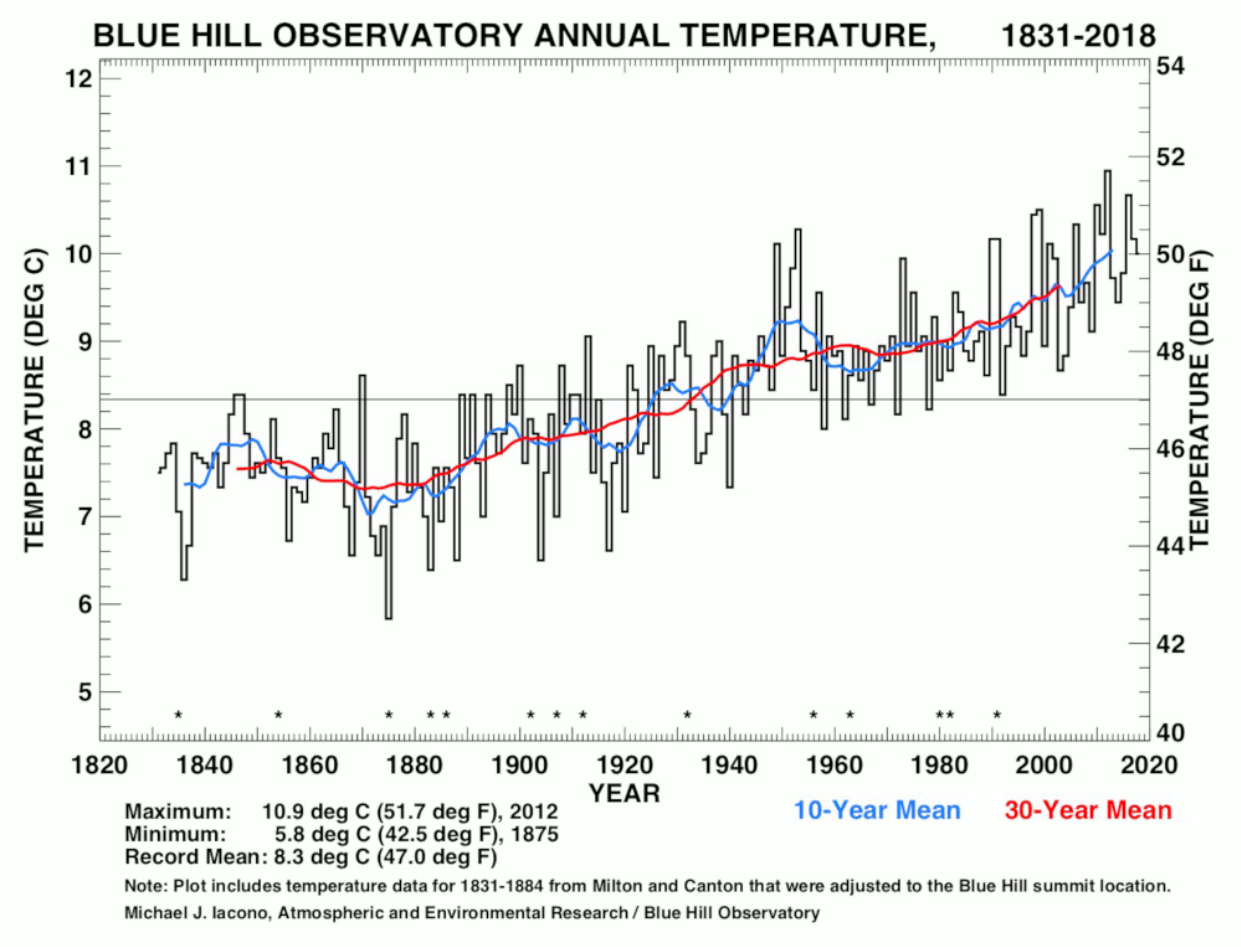
Climate change observations come from a variety of data sources that have measured and recorded changes in recent decades and centuries. Climate change projections, however, predict future climate impacts and, by their nature, cannot be observed or measured. As a result of the inherent uncertainty in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

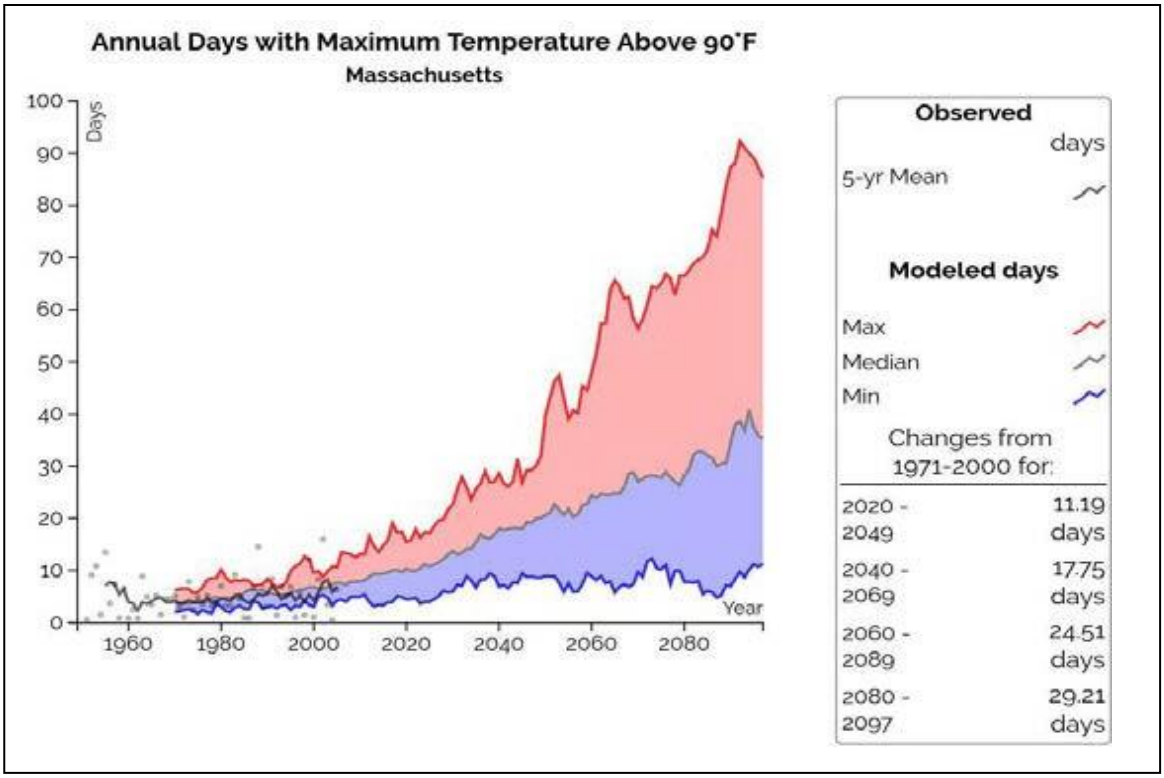
Records from the Blue Hill Observatory in Milton, MA show that average temperatures (30-year mean) have risen approximately 3 degrees (F) in the almost 200 years since record keeping began in 1831.

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. These increases may be slightly less in coastal communities. 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



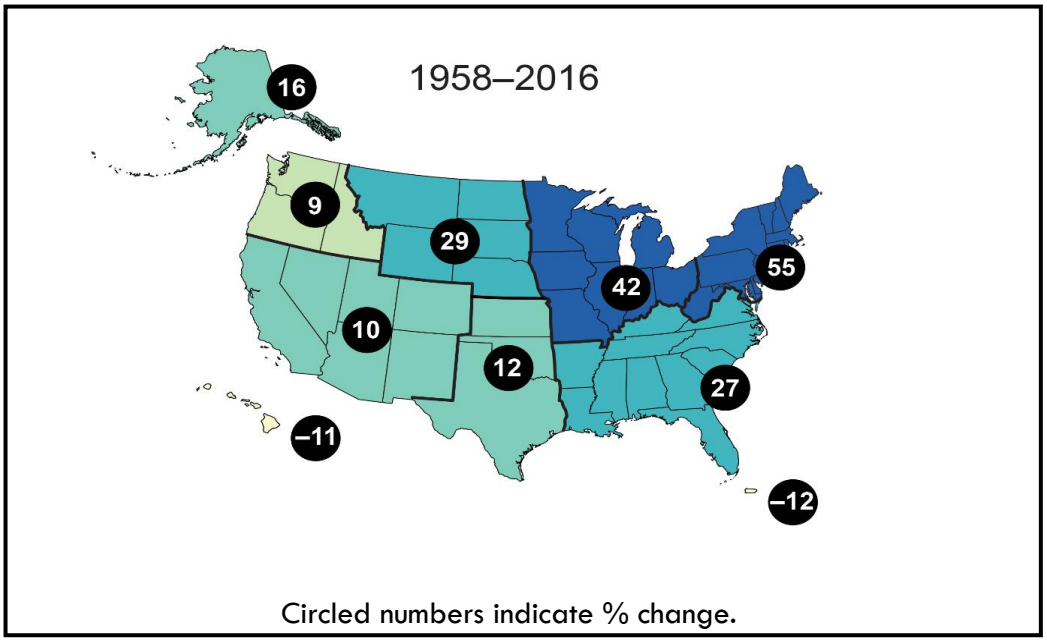
Source: Northeast Climate Adaptation Science Center

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. They project by 2070 to 2099, (relative to 1986 to 2015) a 30-40% increase in total annual precipitation falling in the heaviest 1% of rain events (Figure 5).

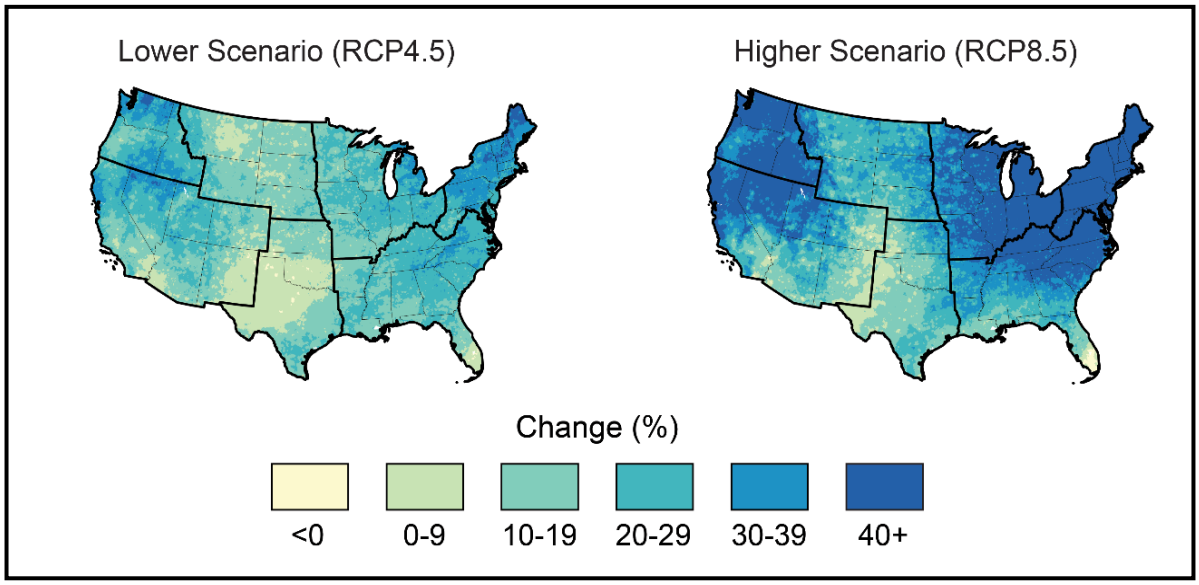
Figure 4: Observed Change in Total Annual Precipitation Falling in the Heaviest 1% of Events



Source: Fourth National Climate Assessment, 2018

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



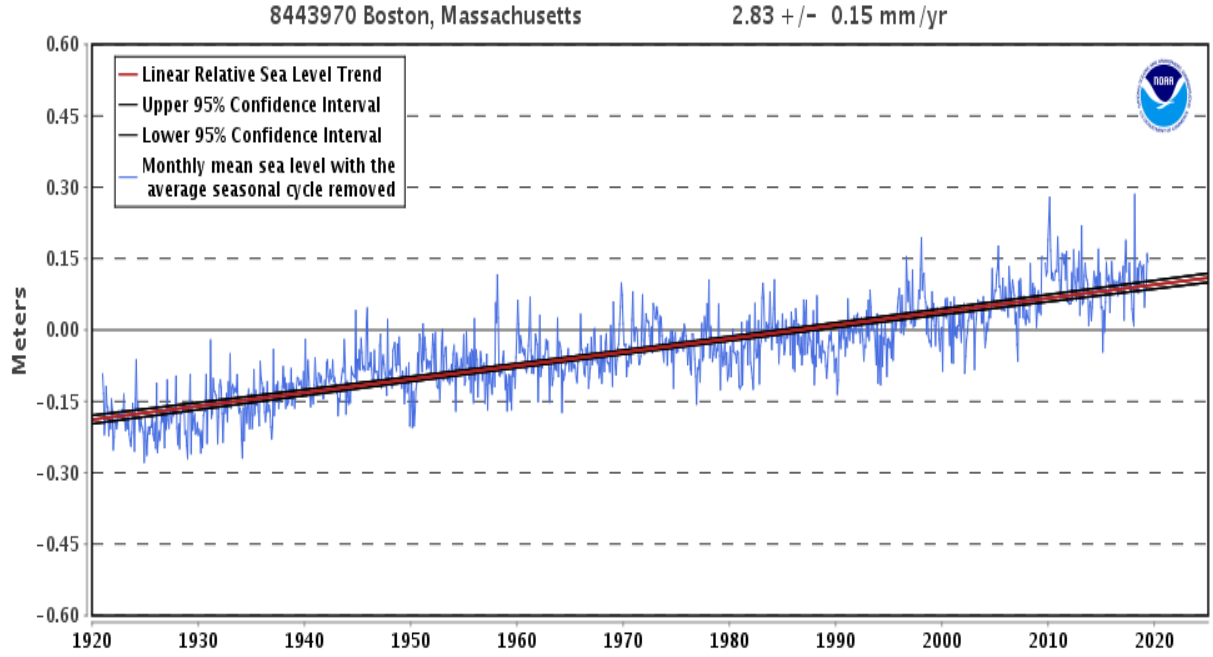
Source: Fourth National Climate Assessment, 2018

Sea Level Rise

Although Bellingham is not a coastal community, information on sea level rise is included as an important trend that has implications for the regional economy, and considering that there is MBTA Commuter Rail service to Boston in neighboring Franklin, a number of Bellingham residents commute to jobs in Boston.

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.

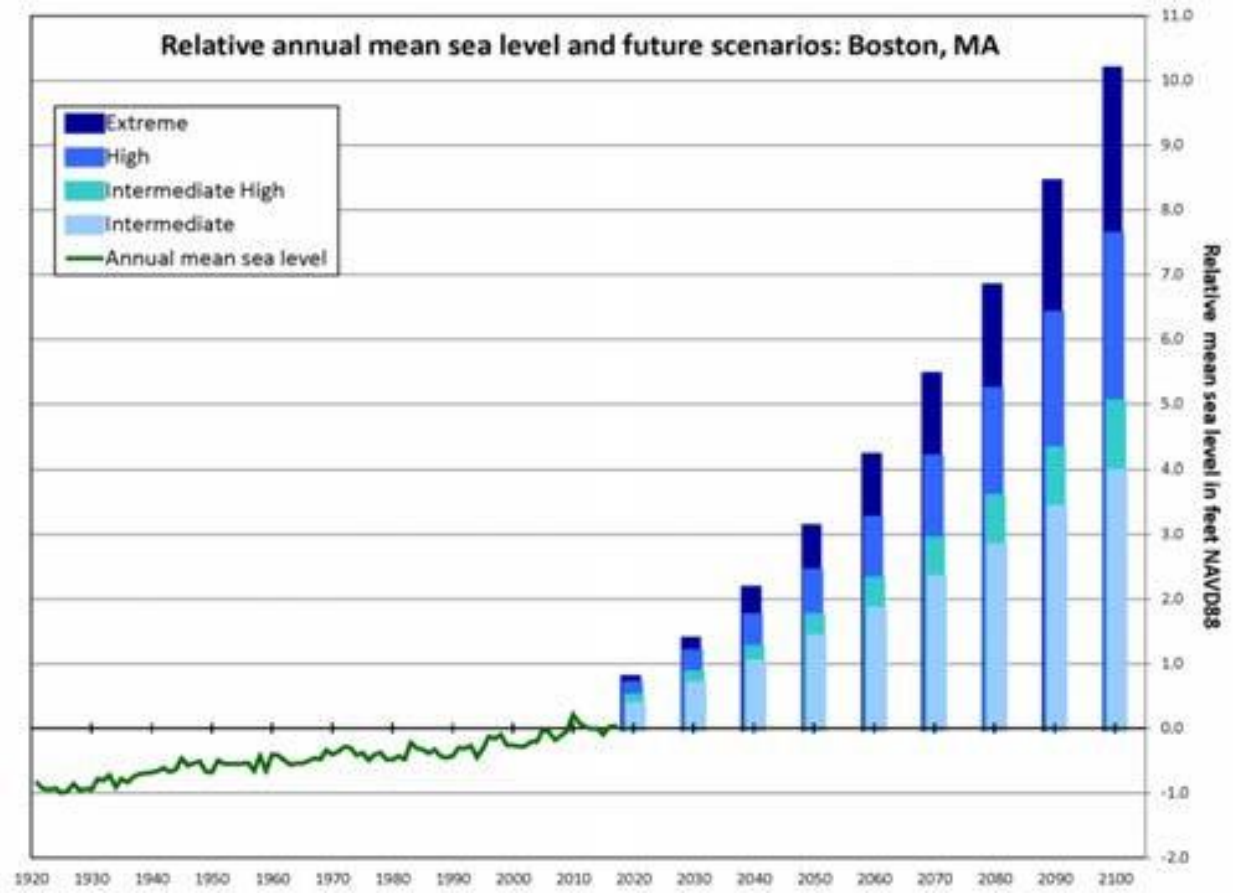
Figure 6: Observed Increase in Sea Level Rise



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.

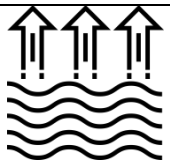
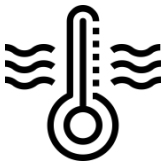
Figure 7: Recent and Projected Increase in Sea Level Rise



Source: SHMCAP

Following the general outline of the Massachusetts State Hazard Mitigation and Climate Adaptation Plan, this local hazard mitigation plan organizes consideration of natural hazards based on their relationship to projected climate changes. Table 4 below, from the SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts.

Table 4: 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 5 summarizes the frequency and severity of hazard risks for Massachusetts and Bellingham. The Massachusetts frequency assessment is based on data in the SHMCAP. The Bellingham frequency assessment reflects data from the National Climatic Data Center (NOAA) for Norfolk County, from the SHMCAP, and the local Hazard Mitigation Team.

Table 5: Hazards Risk Summary

Hazard	Frequency		Severity	
	Massachusetts	Bellingham	Massachusetts	Bellingham
Flooding	Substantial every 3rd year	Medium 1 event in 10 years	Serious	Serious
Drought	1% any given month	Medium 1% any given month	Minor	Minor
Landslides	Every other year	Very Low None Recorded	Minor	Minor
Extreme Temperatures	2 heat events and 1 cold event event/year	Medium 4 heat events in 10 years/2 cold events in 10 years*	Minor	Minor
Brush Fires	One notable event per year	Very Low No significant events in 10 years	Minor	Minor
Hurricane/Tropical Storm	One every two years	High One every two years	Serious	Extensive
Severe Winter Storms/Nor'easters	One notable event per year	High One notable event per year	Extensive	Serious
Tornadoes	1.7 per year	Very Low None recorded	Serious	Serious
Other Severe Weather (Thunderstorms/High Winds)	20-30 thunderstorms annually; 43.5 high wind events annually	High 3 events per year	Minor	Minor
Earthquake	10 - 15% chance of Mag 5 in 10-years	Very Low None recorded	Extensive	Extensive

Source, Massachusetts State Hazard Mitigation Plan, adapted for Bellingham

Frequency

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

Severity

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

It should be noted that several of the hazards listed in the 2018 Massachusetts State Hazard Mitigation plan are not applicable to the Town of Bellingham, as follows:

- **Coastal hazards:** since Bellingham is an inland community, the Town is not vulnerable to Coastal Flooding, Coastal Erosion, and Tsunamis.
- **Ice jams** are not a hazard in Bellingham. The US Army Corps Ice Jam Database shows no record of ice jams in Bellingham.
- **Major Urban Fires**, due to the lack of significant wildfire areas in close proximity to urban development that could pose a significant threat of major urban fire.

CHANGING PRECIPITATION PATTERNS

OVERVIEW OF TOWN-WIDE WATER RESOURCES

The town Bellingham is divided between the Blackstone River basin, into which the southern half of the town drains, and Charles River basin, into which the northern half of the town drains. Bellingham is also home to several large bodies of water, such Silver Lake, Box Pond, and Lake Hiawatha. Virtually all of the 100-year and 500-year flood zones in town are located near major bodies of water. However, some of the town's localized flooding problems are related to insufficient drainage or flood management structures, such as culverts, dams and drain pipes that are not large enough to quickly transport stormwater flows during high intensity rainfall events.

As with most of eastern Massachusetts the natural hazard threat that is most prevalent in the town of Bellingham. Most of the town's flood-related hazards are related to high intensity rainstorms and tropical storms. In addition, the spring rainy season can be a particularly hazardous time, as runoff from melting winter snow saturates much of the town's wetlands and fills the town's streams and brooks. An intense rain event at this time of year can often overwhelm the natural flood storage areas of the town and create flood hazards on streets and around residential and business areas in town. That is exactly what happened in March 2010, as described below.

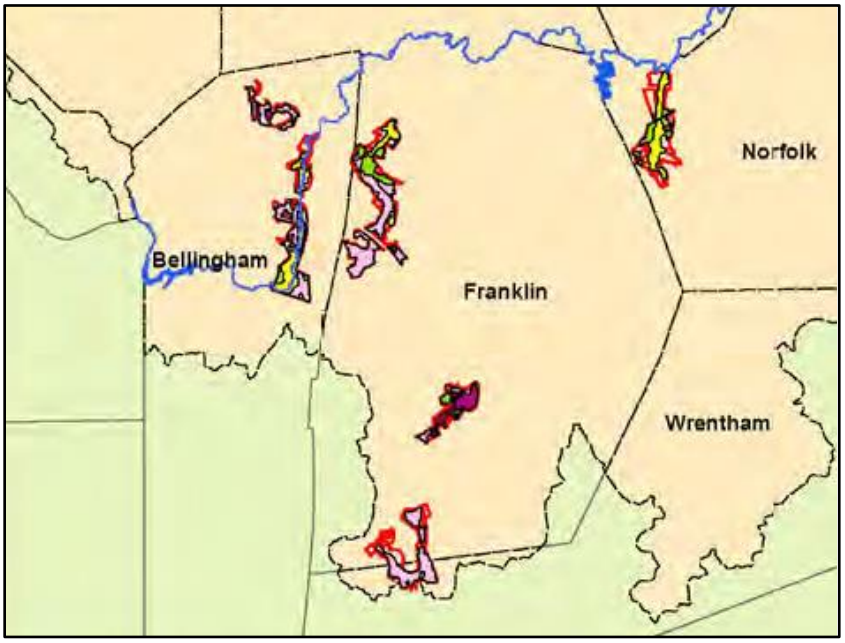
The northern half of Bellingham lies within the headwaters of the Charles River, which is 80 miles in length--the longest river with its entire length in Massachusetts. The Charles River watershed has

a drainage area of approximately 308 square miles and encompasses all or part of 35 municipalities. The watershed can be described as three distinct regions, which include the suburban and semi-rural, upper watershed, the moderately densely developed middle watershed, and the urban lower watershed, which drains through the Boston metropolitan area.

In recent years the water quality of the Charles River has been clean enough for boating and swimming for the greater part of each year. However, the greatest remaining source of pollution to the river is non-point source pollution from stormwater runoff. The watershed experiences elevated levels of phosphorus, which are the subject of a Total Maximum Daily Load (TMDL) issued by the MA Department of Environmental Protection. The TMDL established targets for reduction of phosphorus in the river, which are implemented in each town through the "MS4" Stormwater Permits issued by EPA. There are also concerns about the levels of streamflow in the Charles River, especially in the summer low-flow season. The quantity of water available for water supply withdrawals is regulated by the state's Water Management Act through registration and permitting of each town's withdrawal from wells or surface water sources.

In the 1960's studies by the US Army Corps of Engineers revealed that the communities upstream of Newton had a history of only minimal flooding. Extensive marshes, swamps and wet meadows scattered around the upper watershed were holding floodwaters and then only slowly letting them go. In 1974 Congress authorized the "Charles River Natural Valley Storage Area," allowing for the acquisition and permanent protection of 17 scattered wetlands in the middle and upper watershed. Final acquisition totaled 8,103 acres, with 3,221 acres of land acquired in fee and 4,882 acres in flood easement, at total project cost of $8,300,000. In Bellingham, 340.9 acres have been protected by the Natural Valley Storage Project, as shown on Figure 8.

Figure 8: Natural Valley Storage Areas in Bellingham and Franklin



Source: US Army Corps of Engineers

Along with the land protected by the Army Corp's Natural Storage Area, the town has been a leader in adopting groundwater protection zoning. Given the town's reliance on wells drawing from its local aquifers, water resource protection has been a high priority of the town.

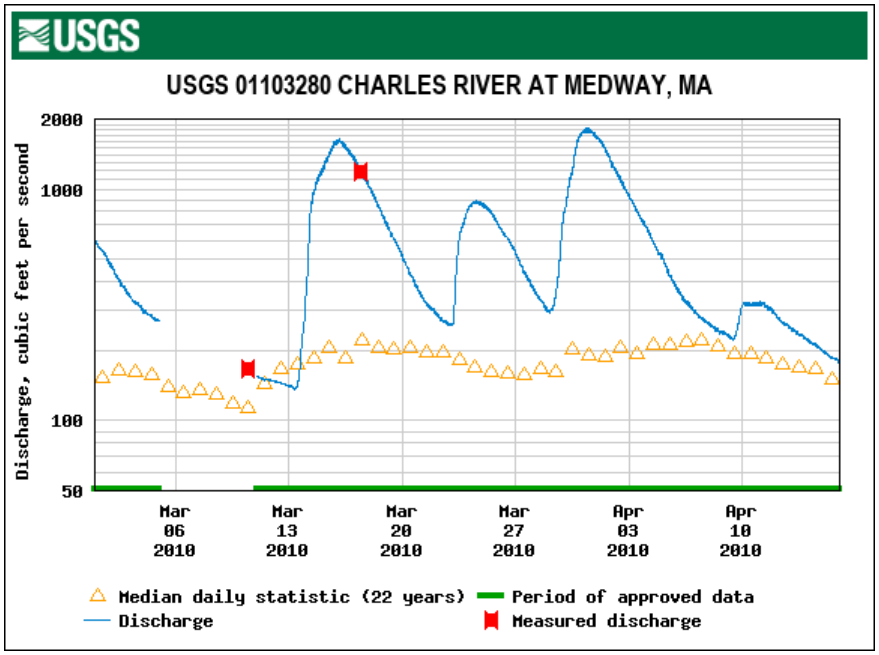
FLOODING HAZARDS

Flooding was the most prevalent natural hazard identified by local officials in Bellingham. Flooding can be associated with overflowing rivers and streams in their floodplains, stormwater flooding associated with impervious surfaces and stormwater infrastructure, as well as beaver dams. According to the Local Team, beavers are a significant problem to the town.

Inland flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Northeasters are most common in winter. Hurricanes and severe thunderstorms are most common in the summer and early fall. 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.

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, on frozen ground, as rain rather than snow. 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 in the USGS gage in Medway, the closest gage to Bellingham downstream on the Charles River, flow reached 1,500 cubic feet per second (cfs) on March 16 and peaked again on March 31 at 1,760 cfs. The river's flow stayed well above the median for this time of year, about 200 cfs, for several weeks (Figure 9).

Figure 9: March-April 2010 Charles River Flow at Medway



Source: USGS National Water Information System

The March 2010 storms were a federally declared disaster making federal assistance available to property owners who did not carry flood insurance. Based on the claims, Bellingham experienced widespread flood damage, with 135 disaster claims, 93% of which were located *outside* of FEMA Flood Hazard Zones. See Map 3 in Appendix A for claim locations.

The best available local data on Bellingham's previous flooding events are the records for Norfolk County available from the National Environmental Information Center. Norfolk County, which includes the Town of Bellingham, experienced 34 flood events from 2010 through 2019 (see Table 6). No deaths or injuries were reported and the total reported property damage in the county was $25 million dollars. Nearly all of the damage is attributed to the events in March 2010. This is an average of 3.2 flood events each year.

Table 6: Norfolk County Flood Events, 2010 through 2019

Date	Deaths	Injuries	Property Damage
03/14/2010	0	0	16.64M
03/29/2010	0	0	8.320M
04/01/2010	0	0	0.00K
07/24/2010	0	0	20.00K
08/05/2010	0	0	0.00K
08/25/2010	0	0	8.00K
08/28/2011	0	0	0.00K
08/15/2012	0	0	0.00K
10/29/2012	0	0	0.00K
06/07/2013	0	0	0.00K
07/29/2013	0	0	0.00K
08/09/2013	0	0	15.00K
10/22/2014	0	0	0.00K
10/23/2014	0	0	0.00K
8/15/2015	0	0	0.00K
8/18/2015	0	0	0.00K
6/07/2016	0	0	5.00K
8/14/2016	0	0	5.00K
4/1/2017	0	0	5.00K
7/12/2017	0	0	0.00K
7/18/2017	0	0	1.00K
8/2/2017	0	0	0.00K
9/30/2017	0	0	10.00K
10/25/2017	0	0	0.00K
10/29/2017	0	0	0.00K

Date	Deaths	Injuries	Property Damage
1/12/2018	0	0	0.00K
1/13/2018	0	0	0.00K
4/16/2018	0	0	0.00K
7/06/2018	0	0	10.00K
10/29/2018	0	0	0.00K
11/03/2018	0	0	0.00K
4/15/2019	0	0	0.00K
7/06/19	0	0	0.00K
7/19/19	0	0	0.00K
Total	**0**	**0**	**25 M**

Source: NOAA, National Environmental Information Center

Potential flood damages to Bellingham have been estimated using HAZUS-MH. Total damages building and business interruption losses are estimated at $24.6 million for a 100-year (1% annual chance) storm and $32.6 million for a 500-year (0.2 % annual chance) storm.

LOCALLY IDENTIFIED AREAS OF FLOODING

Information on potential flood hazard areas was taken from two sources. The first is the National Flood Insurance Rate Maps. The FIRM flood zones are shown on Map 3 in Appendix A. The "Locally Identified Areas of Flooding" described below were identified by the Local Hazard Mitigation Team as areas where flooding is known to occur. These areas do not necessarily coincide with the flood zones from the FIRM maps. Flooding sources include inadequate drainage systems, high groundwater, and other local conditions. The numbers correspond to the numbers on Map 8, "Local Hazard Areas." in Appendix A.

1) *Box Pond Dam* (Flooding)
   The Box Pond Dam is a privately owned dam. This dam has been identified as needing immediate repairs and restoration, including replacement of the sidewalls and removal of vegetation and debris from the spillway. A dam breach would result in significant to catastrophic downstream flooding to the eastward commercial, industrial and residential properties in Bellingham.

2) *Caryville Dam* (Flooding)
   This hazard was included in the previous plan but has since been eliminated as the dam has been removed.

3) *Stone Street* (Flooding)
   This hazard was included in the previous plan, but has since been eliminated as the Town has implemented drainage improvements in the area.

4) *Lake Shore Drive* (Flooding)
According to the Local Committee, Lake Shore Drive and four to five single family houses in the vicinity sustain regular flooding as the result of poorly functioning drainage. Flooding results from backups at the Lake Shore Drive detention basin. According to the Local Committee, the basin was improperly constructed to handle water flow in this vicinity. Reconstruction of the drainage system and detention basin should mitigate flooding around Lake Shore Drive.

5) Peter's River at Wrentham Road (Flooding)
In the event of a large rainstorm or annual spring event, there are about 40 single family homes along Florida Avenue, Wrentham Road, and Gaby Lane that are in the vicinity of Peter's River and sustain flooding. Flooding is caused by several reasons; downstream debris and sedimentation cause upstream backups, level gradients causing slow water flow, and development along floodplains. Hydro analysis would help the town understand the depth of these problems. Another potential mitigation measure includes stream restoration.

6) *High Street* (Flooding)
In the event of a large storm event, High Street sustains flooding. Flooding can result in partial to complete road closure. The town replaced the High Street Bridge about ten years ago which has helped to mitigate the flooding.

7) *Saddleback Street* (Flooding)
During large storm events Saddleback Street has the potential to flood. Flooding is likely caused by three factors; one, there is a small brook that flows through an old farmer's dike, occasionally there are backups at the dike; two, the culvert at Saddleback Street frequently clogs; and three, Saddleback Street has a relatively level and low lying grade, which adds to the flood risk as water flows slowly in this area. The town checks the Saddleback Street culvert about once month to prevent back ups. Potential mitigation could include removal of the farmer's dike, which would allow the brook to flow naturally.

8) *Green Acres* (Flooding)
Green Acres, a single family subdivision, sustains flooding in most rain storms. There are several homes in Green Acres that flood or have the potential to flood. Arnold Brook, which goes subterranean at this location, frequently backs up at the above to below ground interchange causing flooding to the nearby homes and roadways. Potential mitigation measures include hydro analysis and/or the installation of a drainage pipe system to ease Arnold Brook's transition from above to below ground.

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. 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.

According to FEMA records there are no repetitive loss properties in Bellingham

DAMS

Dams can fail because of structural problems or age, independent of any storm event. Dam failure can follow an earthquake 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.

According to the DCR Office of Dam Safety, Bellingham has eight dams. The Town owns four of them, three are privately owned, and one belongs to the US Army Corps of Engineers (Table 7). Local Team identified two of these dams as potential hazards to the town; the Box Pond Dam and the Caryville Dam. The DCR Office of Dam Safety has classified the degree of potential hazard, as listed below. Only one dam in Bellingham is classified as "significant" hazard, the Silver Lake Dam. The town has recently completed an Emergency Action Plan for this dam, as described below. Three dams are classified as "low hazard," and the remaining four dams are too small to be classified by DCR. The hazard classification does not indicate the condition of a dam or its likelihood to fail, but the potential damage downstream if a dam should fail.

Table 7: Dams in Bellingham

Dam Name	River	Owner	Hazard Classification
Box Pond Dam	Charles River	Unionville Commercial Realty Trust	Low
Old Mill Dam	Charles River	Town of Bellingham, Conservation Commission	N/A
North Bellingham Dam	Charles River	US Army Corps of Engineers	Low
Silver Lake Dam	Peters River	Town of Bellingham, Conservation Commission	Significant
Beaver Pond Dam	N/A	Unregulated small dam	N/A

Jenks Pond Dam	Peters River	Town of Bellingham, Department of Public Works	Low
Lakeview Pond Dam	Tributary of Peters River	Unregulated small dam	N/A
Crystal Lake Dam	Tributary of Peters River	Town of Bellingham, Conservation Commission	N/A

Source: DCR Office of Dam Safety

DCR Dam Hazard Classification

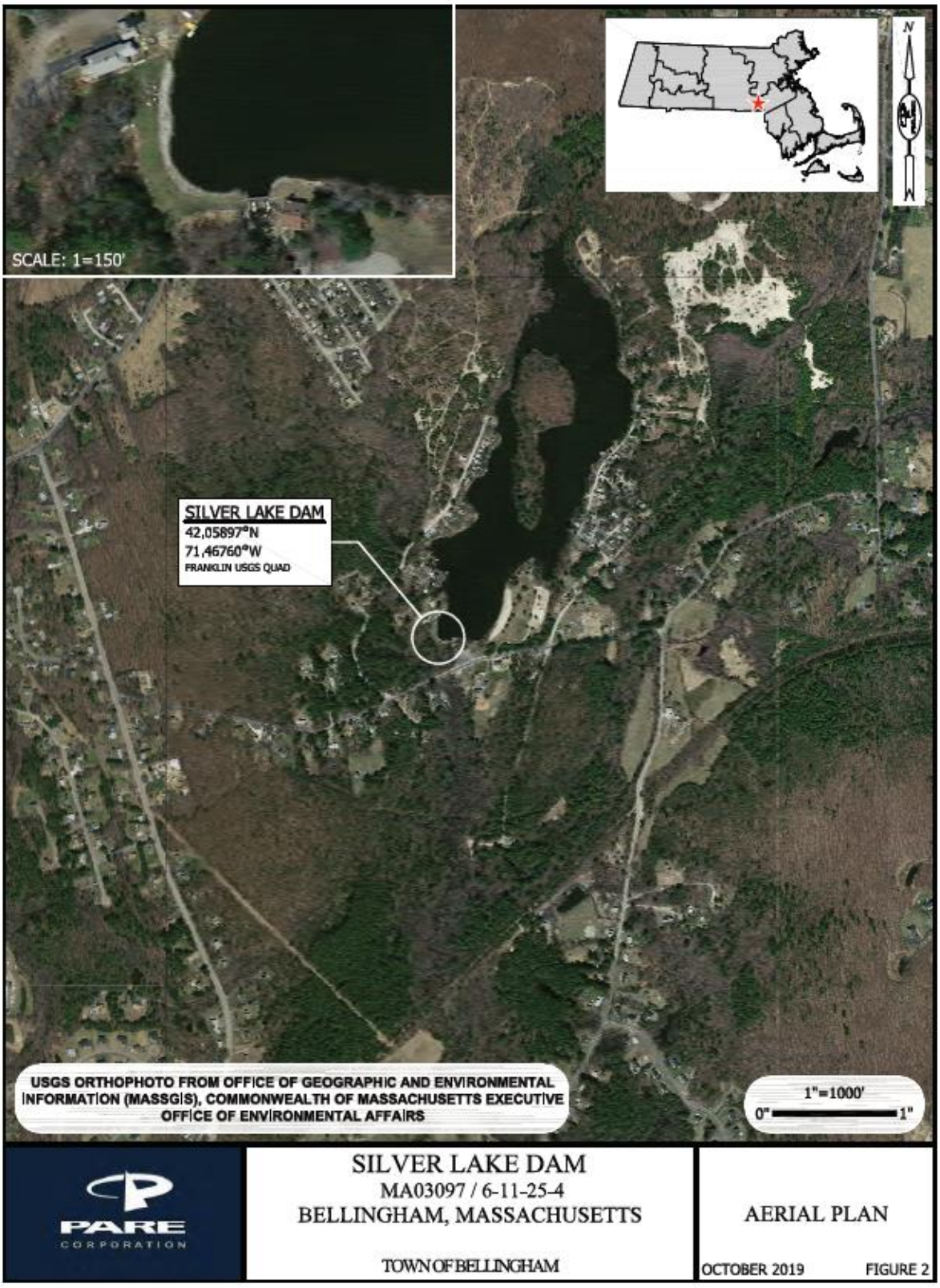
High: Dams located where failure or mis-operation will likely cause loss of life and serious damage to homes(s), industrial or commercial facilities, important public utilities, main highways(s) or railroad(s).

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.

The Silver Lake Dam Emergency Action Plan (EAP) provides information on dam operations, potential inundation impacts, and notification procedures and responsibilities for emergency response in the event of dam failure. The dam impounds Peters Brook, a tributary of the Blackstone River, for recreational purposes. The earthen/gravity dam has a hydraulic/structural height of 8 to 10 feet and an embankment length of 100 feet. The lake has a surface area of 42 acres and normal storage of 440 acre-feet and a maximum storage of 560 acre-feet. Operable components of the dam include the stop logs at the primary spillway, which are removed or replaced to implement drawdown of the impoundment. The last rehabilitation projects were spillway replacement in 1998 and embankment rehabilitation in 2000.

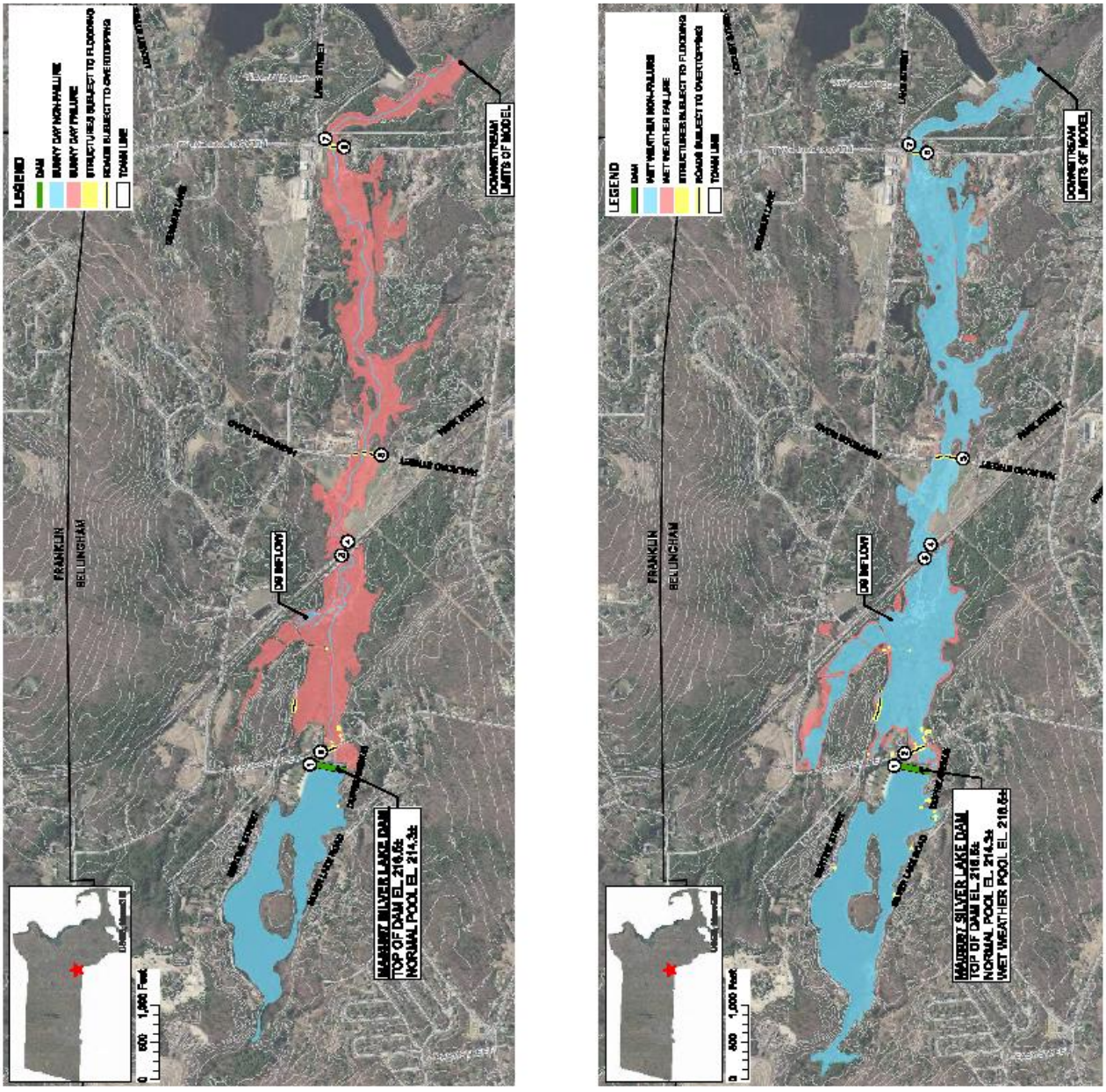
Figure 10: Silver Lake Dam



Source: Silver Lake Dam Emergency Action Plan, 2019

The potential impact of dam overtopping was modelled for both normal conditions(sunny day) and wet weather (100-year flood), as shown on Figure 11 (the areas shaded red would be impacted by inundation due to dam failure). The analysis shows that under both scenarios, roads would be overtopped at four river crossings downstream of the dam, including Cross Street, Embankment D5 Trunkline Trail, Railroad Avenue, and Embankment D5 Pulaski Boulevard. The analysis also identifies five structures that would be impacted under sunny day conditions and 13 structures that would be impacted during wet day conditions. The plan includes response actions that should be take in each scenario.

Figure 11: Silver Lake Dam Potential Inundation Areas



Source: Silver Lake Dam Emergency Action Plan, 2019

There have been no reported dam failures in the town. Based on the previous record, dam failure in Bellingham is a very low frequency event, occurring less frequently than once in 100 years (less than 1% chance per year).

DROUGHT

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

Droughts are projected to increase in frequency and intensity in the summer and fall as weather patterns change. 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.

Bellingham 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. 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 8).

Table 8: 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

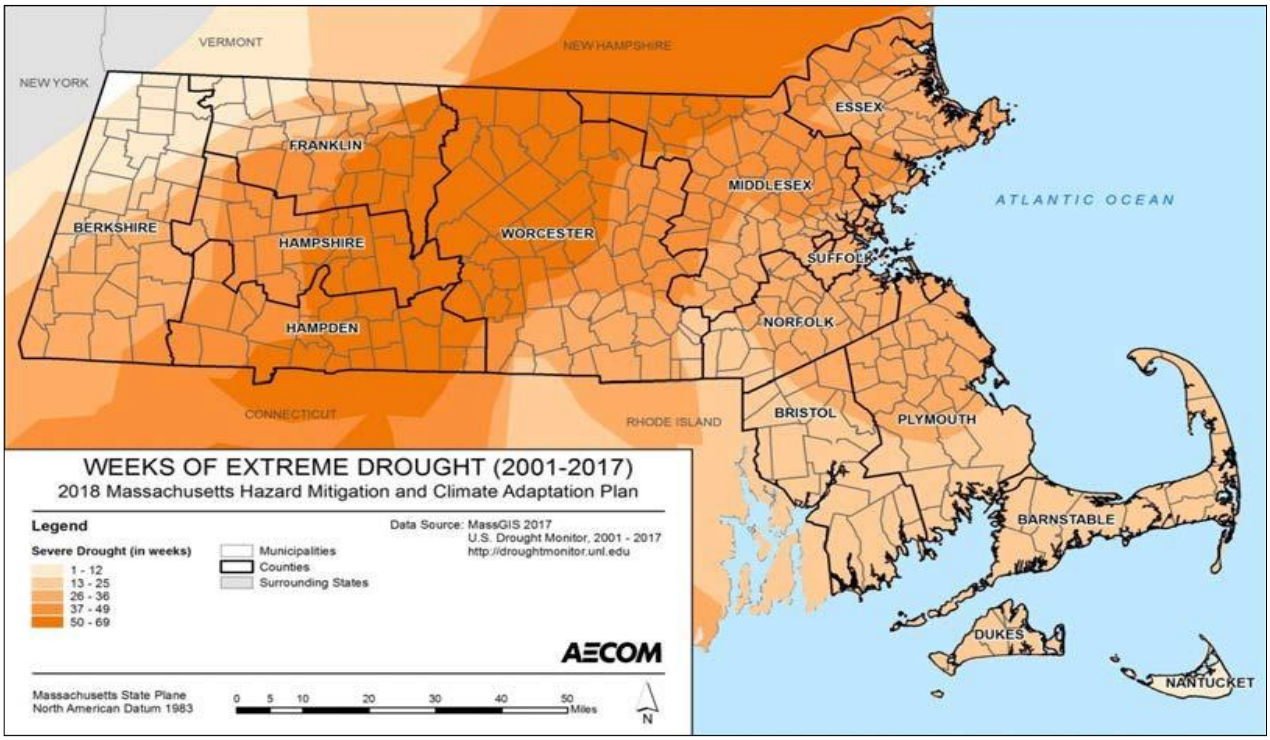
Source: SHMCAP

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 12 below, Bellingham experienced between 13 and 25 weeks of severe drought between 2001 and 2017.

Figure 12: 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.

Bellingham is classified as having low susceptibility and a low incidence of landslides (see Map 4, Appendix A). Should a landslide occur in the future, the type and degree of impacts would be highly localized. The town'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 Bellingham. There are no recorded instances of landslides having occurred in the Town of Bellingham.

RISING TEMPERATURES

AVERAGE AND EXTREME TEMPERATURES

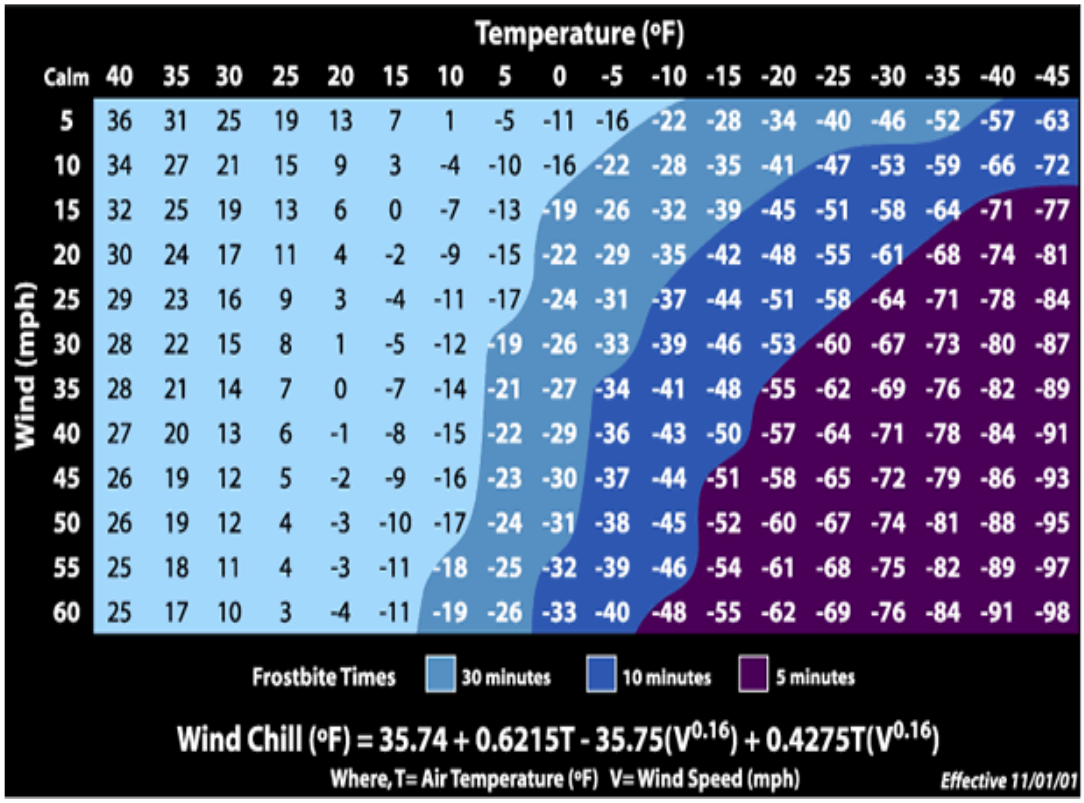
Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time where there is a long stretch of excessively hot or cold weather. Bellingham has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

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 13 below. 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.

The best available local data for previous occurrences of extreme cold are for Norfolk County, through the National Environmental Information Center. There have been two extreme cold events recorded in the past ten years, which caused no deaths, no injuries, or property damage, as shown in Table 9. This is an average of one event every 5 years.

Figure 13 Wind Chill Temperature Index and Frostbite Risk



Source: National Weather Service

Table 9: Norfolk County Extreme Cold and Wind Chill Occurrences 2010-2019

Date	Deaths	Injuries	Damages
2/13/2016	0	0	0
2/16/2016	0	0	0

Source: NOAA, National Environmental Information 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 14) 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 14: Heat Index Chart

Relative Humidity (%) \ Temperature (°F)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
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 best available local data on previous excessive heat occurrences are for Norfolk County, through the National Environmental Information Center. In the past ten years there has been one excessive heat day recorded, and no deaths, injuries, or property damage (see Table 10). This is an average of one extreme heat occurrence every ten years.

Table 10: Norfolk County Extreme Heat Occurrences 2010-2019

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

Source: NOAA, National Environmental Information 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. In Bellingham 13.3% of the population is over age 65. People who live in older housing stock and in housing without air conditioning have increased vulnerability to heat-related illnesses. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage. Heat impacts are more likely to be felt by residents without air conditioning, by those who work outdoors, and those with underlying health conditions.

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 A 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. Hot spots are typically associated with areas of impervious surfaces and little or no tree cover. Since over half of Bellingham is forested land, there are not significant hot spots in town. As shown on Map 9, there are three relatively small areas of hot spots. These include business and commercial sites along the Interstate 495 corridor as well as two areas along the Route 140 corridor near the border with Franklin and Mendon.

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

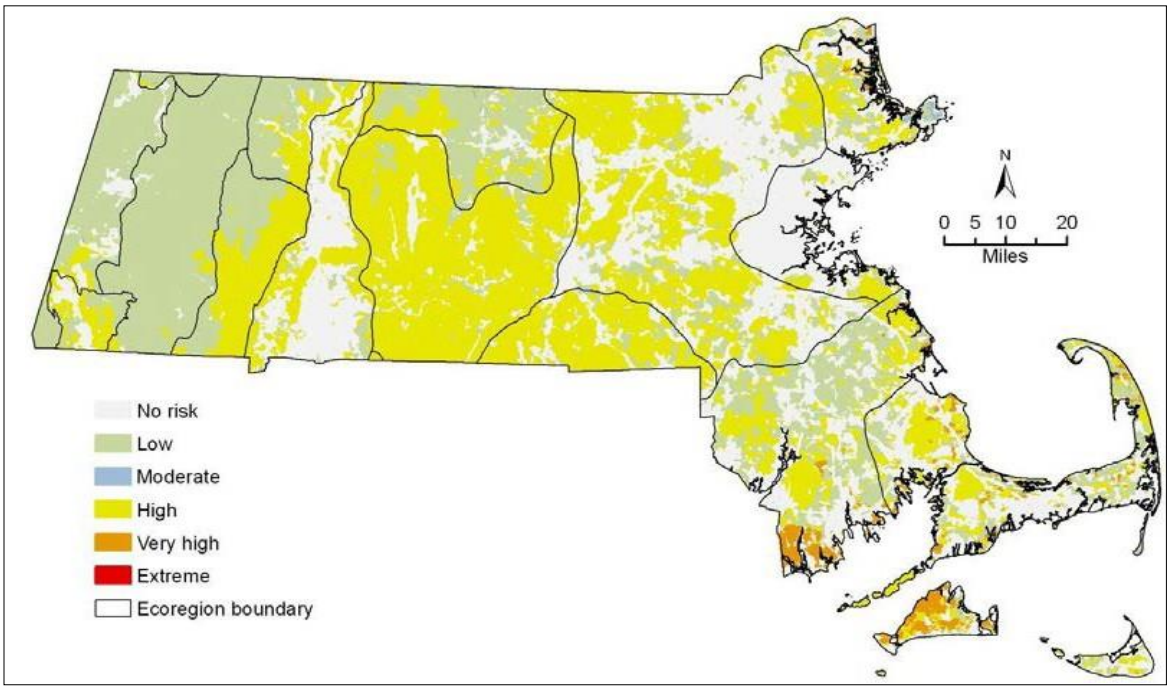
A wildfire differs greatly from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to unexpectedly change direction, and its ability to jump gaps such as roads, rivers, and fire breaks. Wildfire season can begin in March and usually ends in 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.

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 depicts statewide fire risk incorporating three risk components: fuel, wildland-urban interface, and topography (Figure 15). 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. Bellingham is shown in the moderate and high-risk zones on the statewide map.

Figure 15: Wildfire Risk Areas



Source: SHMCAP

Brushfire was not identified by the Hazard Mitigation Team as a significant hazard. The town responds to about 30 brush fires annually. Most fires are inadvertently caused by pedestrian recreational use, careless disposal of cigarettes, and by weather conditions such as lack of rainfall and lightning. These fires typically result in minimal damage and there have been no reports of significant property damage, injuries, or deaths as the result of brush fires.

Most brush fires occur in areas of public open space or near roadways. The Local Team identified the following potential fire hazard areas. The numbers correspond to the numbers on Map 8.

9) Saddleback Forest
10) Chestnut Street and Mohawk Street
11) I-495 Corridor
12) High School
13) Farm Street/I-495

Based on the previous record, brushfires are a high frequency event in Bellingham, occurring more frequently than once in 5 years (greater than 20% chance per year).

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 below 74 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, Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. Named hurricanes in Massachusetts since 1938 are shown in Table 11. The most significant damage in the region was caused by the Great New England Hurricane of September 1938.

Table 11: Hurricane Records for Massachusetts, 1938 to 2020

Hurricane Event	Date
Great New England Hurricane	September 21, 1938
Great Atlantic Hurricane	September 14-15, 1944
Hurricane Doug	September 11-12, 1950
Hurricane Carol	August 31, 1954
Hurricane Edna	September 11, 1954
Hurricane Diane	August 17-19, 1955
Hurricane Donna	September 12, 1960
Hurricane Gloria	September 27, 1985
Hurricane Bob	August 19, 1991
Hurricane Earl	September 4, 2010
Tropical Storm Irene	August 28, 2011
Hurricane Sandy	October 29-30, 2012

Source: National Oceanic and Atmospheric Administration

Hurricane intensity is measured according to the Saffir/Simpson scale, which categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. These are combined to estimate potential damage. Table 12 gives an overview of the wind speeds, surges, and range of damage caused by different hurricane categories:

Table 12: 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

Given its location the Town of Bellingham's entire area is vulnerable to hurricanes, which occur between June and November. As shown on Map 5 in Appendix A, four hurricanes or tropical storms have historically tracked through Bellingham. Two tropical storms tracked through the town, one through the southeast corner and another, southwest to northeast, in 1861. In 1915 a tropical depression tracked west to east through the town. A Category 1 hurricane tracked southwest to northeast through Bellingham in 1944.

A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. The town also experiences the regional impacts of the wind and rain from hurricanes and tropical storms regardless of whether the storm track passes directly through the town. The hazard mapping in Appendix A indicates that the 100-year wind speed in Bellingham is 110 miles per hour.

Hurricanes typically have regional impacts beyond their immediate track. Falling trees and branches are a significant problem because they can result in power outages when they fall on power lines or block traffic and emergency routes. Hurricanes are a town-wide hazard in Bellingham. Potential hurricane damages to Bellingham have been estimated using HAZUS-MH. Total damages building and business interruption losses are estimated at $16.2 million for a 100-year return period hurricane (roughly Category 2) and $62.8 million for a 500-year return period hurricane (roughly Category 4). Hurricanes and tropical storms are an infrequent event having passed directly through Bellingham only four times in 150 years.

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 associated with 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.

Bellingham 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.

SEVERE WINTER STORM/BLIZZARD

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.

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

The National Weather Service defines "heavy snow fall" as an event generating at least four inches of snowfall within a 12-hour period. The Northeast Snowfall Impact Scale (NESIS), developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service (Kocin and Uccellini, 2004), characterizes and ranks high impact northeast snowstorms. These storms have large areas of 10-inch snowfall accumulations and greater. NESIS has five categories: Extreme, Crippling, Major, Significant, and Notable. NESIS 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 NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers. The NESIS categories are summarized in Table 13.

Table 13: NESIS Categories

Category	NESIS	Value Description
1	1 – 2.499	Notable
2	2.5 – 3.99	Significant
3	4 – 5.99	Major
4	6 – 9.99	Crippling
5	10+	Extreme

Source: Massachusetts State Hazard Mitigation Plan, 2013

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 Bellingham, blizzards and severe winter storms have occurred in the following years (Table 14):

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

Table 14: 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
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
Blizzard	January 1966
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 town-wide hazard in Bellingham. Map 6 in Appendix A indicates that the average annual average snowfall in Bellingham is between 48 and 72 inches. A number of public safety issues can arise during snow storms. Impassible 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.

Data for Norfolk County from the National Environmental Information Center is the best available local data on previous occurrences and impacts of heavy snow events. From 2010 through 2019, Norfolk County experienced 18 heavy snowfall events, resulting in no injuries, deaths, or property damage (Table 15).

Table 15: Heavy Snow Events and Impacts in Norfolk County, 2010 through 2019

Date	Deaths	Injuries	Property Damage ($)
1/12/2011	0	0	0
1/26/2011	0	0	0
12/29/2012	0	0	5K
2/8/2013	0	0	0
3/7/2013	0	0	0
3/18/2013	0	0	0
12/14/2013	0	0	0
1/2/2014	0	0	0
1/21/2014	0	0	0
2/5/2014	0	0	0
1/26/2015	0	0	0
2/2/2015	0	0	0
2/8/2015	0	0	0
2/14/2015	0	0	0
1/23/16	0	0	0
2/5/2016	0	0	100K
3/14/2017	0	0	0
11/15/2018	0	0	0
Total	**0**	**0**	**105K**

Source: NOAA, National Environmental Information Center

Heavy snow is considered to be high frequency events based on past occurrences, as there have been 18 events in the past ten years, for an average of almost 2 events each winter. As with nor'easters, warmer ocean water and air will provide more fuel for storms. According to the SHMCAP changing atmospheric patterns favor the development of winter storms.

TORNADO

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 Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. 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 in Table 16.

Table 16: Enhanced Fujita Scale

Fujita Scale			Derived		Operational EF Scale	
F Number	**Fastest ¼ mile (mph)**	**3-second gust (mph)**	**EF Number**	**3-second gust (mph)**	**EF Number**	**3-second gust (mph)**
0	40 – 72	45 – 78	0	65 – 85	0	65 – 85
1	73 – 112	79 – 117	1	86 – 109	1	86 – 110
2	113 – 157	118 – 161	2	110 – 137	2	111 – 135
3	158 – 207	162 – 209	3	138 – 167	3	136 – 165
4	208 – 260	210 – 261	4	168 – 199	4	166 – 200
5	261– 318	262 – 317	5	200 – 234	5	Over 200

Source: Massachusetts State Hazard Mitigation Plan, 2013

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). More 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 eleven tornadoes in Norfolk County recorded by the Tornado History Project. There have been one F3 and one F2, and three FI tornados. These eleven tornadoes resulted in a total of one fatality and 23 injuries and $4.1 million in damages, as summarized in Table 17. This an average of one tornado every 6 years.

Table17: Tornado Records for Norfolk County

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
June 1953	3	0	17	667	28	$500K – 5M
11/21/1956	2	0	0	17	0.1	$500-$5000
8/9/1972	1	1	6	30	4.9	$5K-$50K
9/6/1973	1	0	0	10	1.1	$5K-$50K
7/10/1989	0	0	0	23	0.1	$500-$5000
5/18/1990	0	0	0	10	0.2	$500-$5000
5/18/1990	0	0	0	10	0.2	$500-$5000
6/30/2001	0	0	0	80	0.1	-
8/21/2004	1	0	0	40	6	$1,500,000
5/9/2013	0	0	0	50	0.38	$20,000
06/23/2015	0	0	0	200	0.48	-

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 town-wide hazard in Bellingham, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Bellingham would greatly depend on the track of the tornado. The more densely developed areas in the central and southern part of town and along the Interstate 495 would have the greatest vulnerability for damages should a tornado pass that those areas of the town. Based on the record of previous occurrences since 1956, Tornado events in Bellingham are a very low frequency event as there not been a tornado event recorded in the town.

According to the SHMCAP, it is possible that severe thunderstorms which can include tornadoes may increase in frequency and intensity due to climate change. 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 15 miles in diameter and last for about 30 minutes. A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding.

The best available data on previous occurrences of thunderstorms in Bellingham are records for Norfolk County from NOAA's National Environmental Information Center. For the years 2010 through 2019, NOAA records show 30 thunderstorm events in Norfolk County (Table 18). This is an average of 3 events per year. These thunderstorms resulted in a total of $307,500 in property damage. There were no injuries or deaths reported.

Table 18: Norfolk County Thunderstorm Events, 2010 to 2019

DATE	MAGNITUDE	DEATHS	INJURIES_DIRECT	PROPERTY DAMAGE
6/6/2010	53	0	0	0
6/20/2010	50	0	0	5,000
6/24/2010	50	0	0	0
8/19/2011	50	0	0	1,000
6/23/2012	50	0	0	25,000
8/10/2012	50	0	0	5,000
8/15/2012	40	0	0	500
6/17/2013	50	0	0	3,000
7/29/2013	50	0	0	20,000
7/3/2014	50	0	0	20,000
7/28/2014	60	0	0	50,000
6/23/2015	50	0	0	5,000
8/4/2015	50	0	0	10,000
8/15/2015	50	0	0	10,000
2/25/2016	50	0	0	15,000
6/7/2016	50	0	0	10,000
7/18/2016	50	0	0	50,000
7/22/2016	50	0	0	50,000
7/23/2016	40	0	0	5,000
8/14/2016	50	0	0	5,000
6/9/2017	45	0	0	1,000
6/13/2017	48	0	0	1,000
6/23/2017	50	0	0	1,000
8/2/2017	50	0	0	2,500
9/6/2017	50	0	0	1,000

7/17/2018	45	0	0	3,000
9/6/2018	50	0	0	1,000
11/3/2018	50	0	0	500
7/17/2019	50	0	0	2,000
7/31/2019	50	0	0	5,000
TOTAL		**0**	**0**	**307,500**

Source: NOAA, National Environmental Information Center

Microbursts are another wind hazard that are typically associated with strong thunderstorms. In June of 2001 the town sustained damages from a microburst.

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

Based on the record of previous occurrences, severe thunderstorms in Bellingham are high frequency events as this hazard has occurred an average of three times per year in the past ten 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.

ICE STORMS

The ice storm category covers a range of different weather phenomena that collectively involve rain or snow being converted to ice in the lower atmosphere leading to potentially hazardous conditions on the ground. Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects, creating ice buildups of **one-fourth of an inch** or more. An ice storm warning, which is now included in the criteria for a winter storm warning, is issued when a **half inch or more** of accretion of freezing rain is expected.

Sleet and hail are other forms of frozen precipitation. Sleet occurs when raindrops fall into subfreezing air thick enough that the raindrops refreeze into ice before hitting the ground. The difference between sleet and hail is that sleet is a wintertime phenomenon whereas hail falls from convective clouds (usually thunderstorms), often during the warm spring and summer months.

Hail size typically refers to the diameter of the hailstones. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters shown in Table 19:

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
Tea cup	3.00
Grapefruit	4.00
Softball	4.50

The greatest ice-related 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.

The best available local data on previous ice storm and hail occurrences in Bellingham is from NOAA's National Environmental Information Center (NEIC), which provides data by county. Although NEIC records do not show any ice storms for Norfolk County, where Bellingham is located, there were five ice storms recorded for neighboring Worcester and Middlesex Counties, as shown in Table 20. These resulted in a total of $3.1 million in property damages, one injury, and no deaths. According to the Massachusetts State Hazard Mitigation Plan, ice storms occur more frequently in the higher elevations of Western and Central Massachusetts, which includes parts of Middlesex and Worcester counties.

Table 20: Ice Storms, Middlesex and Worcester Counties, 1998 through 2019

LOCATION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE
WESTERN MIDDLESEX	1/9/1998	0	0	5,000
NORTHERN WORCESTER	1/9/1998	0	0	15,000
SOUTHERN WORCESTER	11/16/2002	0	0	150,000
NORTHERN WORCESTER	1/15/2007	0	1	15,000
NORTHERN WORCESTER	2/1/2008	0	0	0
SOUTHERN WORCESTER	12/11/2008	0	0	3,000,000
TOTAL		**0**	**1**	**3,185,000**

Source: NOAA, National Environmental Information Center

For hail storms, NEIC records show that Norfolk County experienced 12 events from 2010 to 2019, with no recorded property damage, injuries, or deaths (Table 21).

Table 21: Norfolk County Hail Events, 2010 through 2019

DATE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE
6/5/2010	1.5	0	0	0
6/20/2010	1	0	0	0
6/1/2011	0.75	0	0	0
6/23/2012	0.88	0	0	0
7/18/2012	0.75	0	0	0
5/21/2013	0.75	0	0	0
9/1/2013	0.75	0	0	0
8/7/2014	0.75	0	0	0
5/12/2015	0.75	0	0	0
6/23/2015	1	0	0	0
8/4/2015	1	0	0	0
6/30/2019	0.75	0	0	0
TOTAL		**0**	**0**	**0**

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

Ice storms are considered to be medium frequency events based on past occurrences, and as defined by the Massachusetts State Hazard Mitigation Plan. This hazard occurs once in five years to once in 50 years, with a 2% to 20% chance of occurring each year. There is some indication that as winters warm, temperatures may be more likely to produce icing conditions.

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 in Table 22.

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2007, 355 earthquakes were recorded in Massachusetts (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

Table 22: 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

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 23.

Table 23: Historical Earthquakes in Massachusetts or Surrounding Area

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

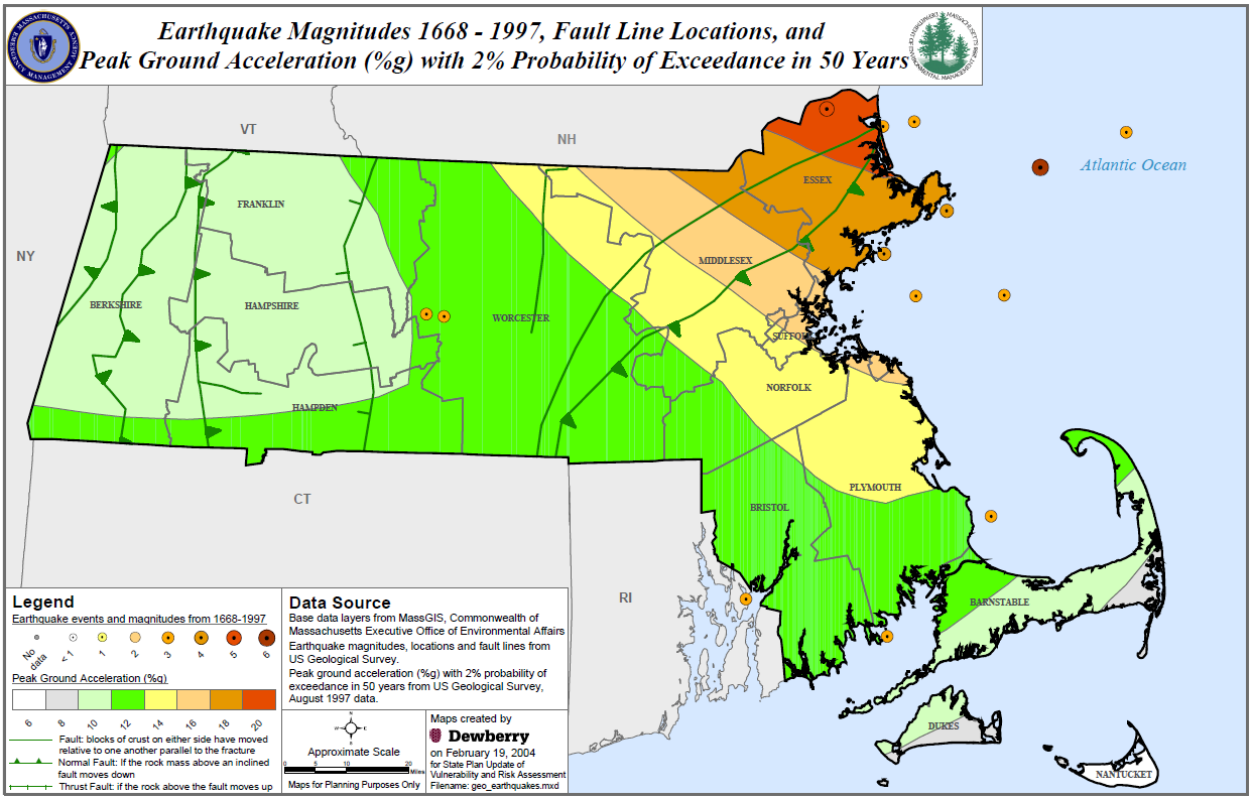
Location	Date	Magnitude
MA - Brewster	8/8/1847	4.2
MA - Boxford	5/12/1880	NA
MA - Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
MA - Nantucket	10/25/1965	NA
MA - Boston	12/27/74	2.3
MA - Nantucket	4/12/12	4.5
ME - Hollis	10/17/12	4.0

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 (Figure 16). Bellingham is in the lower end of the range for Massachusetts, at 12 %g, making it a relatively low area of earthquake risk within the state, which 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 Bellingham.

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.

Figure16: State of Massachusetts Earthquake Probability Map



Source: Massachusetts State Hazard Mitigation Plan

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 the SHMCAP there is a 10-15% chance of a magnitude 5 earthquake in a given ten-year period. Earthquakes are a potential town-wide hazard in Bellingham. Although new construction under the most recent building codes generally will be built to seismic standards, much of the development in the town pre-dates the most recent building code. Potential earthquake damages to Bellingham have been estimated using HAZUS-MH. Total building and income loss damages are estimated at $321 million for a 5.0 magnitude earthquake and $2.4 billion for a 7.0 magnitude earthquake. Other potential impacts of earthquakes, such as sheltering needs and debris removal, are detailed in Table 30.

LAND USE AND DEVELOPMENT TRENDS

Existing Land Use

Land use statistics available from Mass. GIS are from the statewide MacConnell Land Use analysis based interpretation of aerial photography. Table 24 shows the acreage and percentage of land in 29 categories of the town's total 12,086 acres. Notably, forested land is the largest category in Bellingham at nearly 6,000 acres, or 49.2% of the town, and adding the 736 acres of forested wetlands brings the total forest coverage to 55% of the town. The largest developed land use category by far is residential; if the five residential categories are aggregated, total residential uses make up 2,588 acres, or 21.4% of the town. Commercial and industrial combined make up 4.2% of the town at 509 acres. Wetlands make up 4.6% and crop and crop and pasture land cover 1.8% of the town. The remaining seventeen land use categories with 1% or less of land area each total 1,534 acres, representing 12.61% of the town's area

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Table 24: Town of Bellingham, MA Land Use

Land Use Type	Acres	Percentage
Crop Land (1)	128.9	1.1%
Pasture (2)	85.9	0.7%
Forest (3)	5944.6	49.2%
Wetland (4)	560.9	4.6%
Mining (5)	117.0	1.0%
Open Land (6)	174.4	1.4%
Participation Recreation (7)	86.8	0.7%
Water-Based Recreation (9)	5.3	0.0%
Multi-Family Residential (10)	285.0	2.4%
High Density Residential (11)	449.1	3.7%
Medium Density Residential (12)	619.2	5.1%
Low Density Residential (13)	1055.3	8.7%
Commercial (15)	291.9	2.4%
Industrial (16)	217.0	1.8%
Urban Open (17)	68.6	0.6%
Transportation (18)	163.1	1.3%
Waste Disposal (19)	5.4	0.0%
Water (20)	341.5	2.8%
Cranberry Bog (23)	0.0	0.0%
Powerline (24)	183.0	1.5%
Golf Course (26)	177.6	1.5%
Marina (29)	0.0	0.0%
Urban Public (31)	79.9	0.7%
Cemetery (34)	44.2	0.4%
Nursery (36)	7.1	0.1%
Forested Wetland (37)	736.0	6.1%
Very Low Density Res. (38)	179.0	1.5%
Junkyards (39)	30.6	0.3%
Brushland/Successional (40)	48.3	0.4%
TOTAL ACRES	**12085.8**	**100.0%**

Source: Mass. GIS, MacConnell Land Use Statistics

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

Several decades ago, Bellingham was primarily residential community, but today the town has three unique and active business corridors, and a wealth of commercial and industrial businesses. The town generally splits into three distinct areas from north to south. The northern third is closest to Interstate 495, at exit 18, with Hartford Avenue as the main business corridor. The middle third is located along the Route 140 corridor near the geographic center of town, contains most town facilities, and is the closest connection to the Franklin Commuter Rail Line. The southern third is more densely populated, contains many smaller businesses along the Pulaski Boulevard[3] corridor, and is closest to the larger Rhode Island city of Woonsocket.

The Town has a mix of industry, major distribution centers, small businesses as well as nearly 1,000,000 sq. ft. of retail which is located off of Interstate 495. The largest employers in Bellingham are generally located in Hartford Ave, with retailers representing the thirteen biggest private employers in town, as summarized in Table 25.

Table 25: Major Employers in Bellingham, 2016

Company Name	Address	Number of Employees	NAICS Description
Market Basket	274 Hartford Ave	250-499	Supermarkets/Other Grocery Stores
Walmart	250 Hartford Ave	100-249	Department Stores
Home Depot	229 Hartford Ave	100-249	Home Centers
Whole Foods Market	255 Hartford Ave	100-249	Supermarkets/Other Grocery Stores
Algonquin Industries	139 Farm St	100-249	Machine Shops
Asphalt Engineering	190 S Maple St	100-249	Highway Street & Bridge Construction
Blue Linx	419 Maple St	100-249	Lumber, Plywood, Millwork/Wood Panel Wholesale
Van Lumber Co	27 S Maple St	100-249	Other Building Material Dealers
Super Stop & Shop	70 Pulaski Blvd	100-249	Supermarkets/Other Grocery Stores
Bellingham Memorial Middle	130 Blackstone St	100-249	Elementary & Secondary Schools
Antron Engineering & Machine	170 Mechanic St	50-99	Machine Shops
Uno Pizzeria & Grill	205 Hartford Ave	50-99	Full-Service Restaurants

Source: Infogroup 2016

Grocery store chains like Market Basket, Whole Foods, Stop & Shop, and Walmart represent Bellingham's $17,000,000 grocery store sector, and the town is known as a shopping destination in the surrounding towns and nearby Rhode Island.

Of jobs that are located in Bellingham, the most prominent industry sectors (as defined by the North American Industry Classification System - NAICS) are Retail Trade (36 percent of all jobs); Accommodation & Food Services (14 percent); and Wholesale Trade (13 percent).

HISTORIC, CULTURAL, AND NATURAL RESOURCES

The following description is excerpted from Bellingham's 2017 Open Space and Recreation Plan, prepared for the Town by PGC Associates, Inc., of Franklin, MA:

Bellingham was originally part of Dedham. On May 11, 1719, town residents submitted a request to the town of Dedham to enable them to establish their own independent town. Later that same year (on November 17, 1719), with signing the Bellingham Petition, Bellingham joined Norfolk County as an independent town.

Bellingham had its early days spent in the industry of farming. This remained the primary industry until the 20th century. The industrial revolution made headway in Bellingham through developing factories along the Charles River. Taking advantage of abundant water power, numerous mills producing goods from leather to cotton became part of Bellingham's industrial character. Some are still standing.

Buildings provide significant insight to an earlier time. Among the historic structures in Bellingham are the old Town Hall [pictured on the cover of this plan], the Caryville Mill and the North Bellingham Mill. Town Hall, built by the Town of Bellingham and the Baptist Society was completed in 1802. Though built by one religious group, it was to be used by all members of different faiths. Maple Street is the site of the North Bellingham Mill. Built in 1810 by Joseph Ray, this mill currently is home to several businesses including the Scandia Cabinet Company. The Caryville Mill was the second textile mill in Bellingham. Constructed in 1830 by Joseph Fairbanks, it has recently been torn down.

Overall, the topography of the town generally consists of elevations from just fewer than 200 feet above sea level to just under 400 feet. Repeated advances of glacial ice are primarily responsible for the current topography of the area, which is characterized by low, rounded hills and open valleys. The bedrock throughout the town is generally covered by stratified glacial deposits of sand and gravel (Hinckley, Merrimac, and Windsor soils) at lower elevations, while the hills have a veneer of glacial till (mostly Charlton, Paxton, and Montauk soils).

The town lies in the Blackstone River to the south and the Charles River Watershed to the north. The Charles River begins in Hopkinton and flows through 23 cities and towns to Boston Harbor. Among the major issues impacting the Charles are streamflow and stormwater runoff. The Blackstone River begins in the Worcester area and flows through 29 cities and towns to Pawtucket, RI. Its Peters River tributary flows through Bellingham. Stormwater runoff is among the biggest issues impacting the Blackstone River, as well as wastewater treatment plant discharges.

Most wetlands in Bellingham are associated with the Charles River and its tributaries as well as the Peters River. They provide wildlife habitat, floodwater storage, and help clean water that passes through them.

DEVELOPMENT TRENDS

Development trends throughout the metropolitan region are tracked by MassBuilds, MAPC's Development Database, which provides an inventory of development over the last decade. For this plan the new development sites were reviewed and updated by Bellingham's Town Planner/Zoning Enforcement Officer. There have been 15 development projects in the Town of Bellingham since 2009. The 15 developments in Bellingham shown in Table 26 include a total of 371 housing units and 732,125 square feet of commercial space.

The MassBuilds sites are located within areas of Low Incidence for landslides, with an annual snowfall of 36 to 48 inches, and a 100-year maximum wind speed of 110 miles per hour, all of which are one uniform hazard category for the entire town. Since they are not located within brushfire hazard or flood hazard areas, new development has not increased the Town's vulnerability to natural hazards.

Table 26: Summary of Bellingham Development Sites

Name	Status	Year	Housing Units	Comm. Sq. Feet
Macy School Development -Res	Construction	2020	12	
Irving Oil - Gas & Conv. store	Completed	2020		7,725
Bonvie Homes --Res	Permitting	2020	300	
160 High Street - Warehouse	Completed	2019		427,500
Calarese Professional Building	Completed	2009		5,000
Hartford Village II – Res.	Completed	2020	18	
Stall Brook Business Park	Construction	2021		7,400
Urban Air Trampoline Park	Completed	2017		35,000
Cedar Hill-Res	Completed		4	
Locust Street-Res.	Completed		8	
Pine Acres-Res.	Completed		29	
316 Hartford St - Solar	Completed			
EMC Solar	Completed			
Cumberland Farms-gas/conv.	Completed			
Victory Packaging	Completed			250,000

Source: Bellingham Town Planner/Zoning Enforcement Officer

POTENTIAL FUTURE DEVELOPMENT

MAPC consulted with Bellingham's Town Planner/Zoning Enforcement Officer to determine areas that may be developed in the future, based on the Town's comprehensive planning efforts and current trends and projects. A total of 19 sites were identified and mapped. These areas are listed below in Table 27 and shown on Map 8 in Appendix A. The developments include 12 residential projects and seven commercial or industrial projects, including a solar facility.

POTENTIAL FUTURE DEVELOPMENT IN HAZARD AREAS

In order to characterize any potential change in the town's vulnerability associated with these developments, a GIS mapping analysis was conducted which overlaid the 19 development sites with the FEMA Flood Insurance Rate Map and the map of Hot Spots. Table 26 shows the relationship between potential future development areas and these hazard areas. The analysis shows that seven of the 19 sites are partially located in a Zone A or AE , with three of these having less than 1% of their area in a flood zone and two more with less than 10%. Two other sites had 19.8% and 30.8% within a flood zone, typically a portion of the site that is not built on given the restrictive zoning requirements of the town.

It should be noted all of the development sites are in the same category for other hazards types including landslide risk (low incidence town-wide) average annual snowfall (36 to 48 inches town-wide), and maximum wind speed (110 miles per hour town-wide), as these hazards occur uniformly across all areas of the town, with no geographic variability. This information is provided so that planners can ensure that development proposals comply with floodplain zoning and that careful attention is paid to drainage and other issues as well as mitigation of urban heat island impacts..

Table 27: Relationship of Potential Development to Hazard Areas

Map ID	Potential Future Project	Development Type	Project Status	Flood Zones
A	Bellingham Shores	100-unit single-family cluster	Permitted	3.87% in A & 5.96% in AE: 1% Annual Chance
B	Lake View Estates	40 single-family home (40B)	Construction	
C	D & N Estates	8-lot residential subdivision	Construction	
F	Fafford 1	100 single family homes on 2 sites	Construction	
H	Fafford 2	100 single family homes on 2 sites	Construction	2.33% in A: 1% Annual Chance
I	High Ridge	40 single-family home (40B)	Permitted	
J	Citgo	Gas station/convenience store	Construction	
K	Sunken Meadow 40B	28 single family homes (40B)	Permitting-litigation	0.66% in AE: 1% Annual Chance

Map ID	Potential Future Project	Development Type	Project Status	Flood Zones
M	Duhamel Way	8 single family homes	Construction	
O	NE Country Club	Zoning overlay for 300+ homes for age 55+ and golf course	Planning	0.97% in AE: 1% Annual Chance
P	186 Maple	Solar facility	Permitted	
S	190 Farm Street	Industrial Asphalt Engineering		30.83% in A: 1% Annual Chance
T	Self Storage	Self-storage facility	Construction	8.89% in A and 9.89% in AE: 1% Annual Chance
V	Lobissier	Residential overlay-170 units	Permitting	
W	Lincoln Properties	Industrial site, 350,000 sq. ft.	Construction	0.06% in AE: 1% Annual Chance
X	Campinelli	250 apartments (40B)	Permitting	
Y	Williams Way Cultivation	Marijuana cultivation, 60K s.f.	Construction	
Z	Williams Way Solar	5MW Solar on town property	Construction	
AA	Pine Hollow	36 townhome units	Construction	

Source: Bellingham Town Planner/Zoning Enforcement Officer

CRITICAL FACILITIES & INFRASTRUCTURE IN HAZARD AREAS

Critical facilities and infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, 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 66 facilities identified in Bellingham. These are listed in Table 26 and are shown on the maps in Appendix A.

Table 26 shows the location of the critical facilities with respect to FEMA flood zones and other categories of hazards. It is notable that the only critical facilities located within FEMA flood zones are bridges, dams, culverts, and pump stations, which by definition are typically sited on or in close proximity to rivers and streams. None of the critical town buildings or other sites such as schools, child care centers, and elderly housing are located in a FEMA flood zone. Two other categories of hazards, landslide incidence and average annual snowfall, do not have any geographic variation across the town, falling into a single category for all facilities town-wide. The urban heat or "hot spot" analysis shows that there are three sites with the mapped hot spots, including two schools and a health care facility. These hot spots are related to the parking areas associated with these facilities, as hot spots correspond with significant paved areas.

Explanation of Columns in Table 28

- ***Column 1: ID #:*** The first column in Table 27 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 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. (formerly Zone C)
- ***Column 5: Average Annual Snowfall***: All of Bellingham falls into the category of 36.1 - 48.0 inches
- ***Column 6: Landslide Incidence***: All of Bellingham falls into the Low Incidence category
- ***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 28: Critical Facilities and Relationship to Hazard Areas

MAP#	NAME	TYPE	Within FEMA Flood Zone	Landslide Incidence	Avg Annual Snow Fall	Within Hot Spot
001	South Elementary School	School	No	Low incidence	36.1 - 48.0	No
003	Bellingham High School	School	No	Low incidence	36.1 - 48.0	Yes
004	Bellingham Memorial Middle School	School	No	Low incidence	36.1 - 48.0	Yes
006	Stall Brook Elementary School	School	No	Low incidence	36.1 - 48.0	No
007	Early Childhood Program	Child Care	No	Low incidence	36.1 - 48.0	No
008	Stall Brook Pump Station 7 & 8	Water Pump Station	No	Low incidence	36.1 - 48.0	No
009	Center Fire Station II	Fire Station	No	Low incidence	36.1 - 48.0	No
010	Fire Station I	Fire Station	No	Low incidence	36.1 - 48.0	No
011	Bellingham Senior Center	Senior Center	No	Low incidence	36.1 - 48.0	No
012	Bellingham DPW	Municipal	No	Low incidence	36.1 - 48.0	No
013	Bellingham Municipal Center	Auxiliary Emergency Operations Center	No	Low incidence	36.1 - 48.0	No
014	Police Station	Police Station/ Emergency Ops Center	No	Low incidence	36.1 - 48.0	No
015	Wee Folk Day Care	Child Care	No	Low incidence	36.1 - 48.0	No
016	Depot Court	Elder Housing	No	Low incidence	36.1 - 48.0	No
017	Wrentham Manor	Elder Housing	No	Low incidence	36.1 - 48.0	No
018	Water Pump Station 11	Water Pump Station	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
019	Water Pump Station 3	Water Pump Station	No	Low incidence	36.1 - 48.0	No
020	Water Pump Station 4	Water Pump Station	X: 0.2% Annual Chance	Low incidence	36.1 - 48.0	No
021	Benelli Street Pump Station	Sewer Pump Station	X: 0.2% Annual Chance	Low incidence	36.1 - 48.0	No
022	Wrentham Street Bridge	Bridge	AE: Regulatory Floodway	Low incidence	36.1 - 48.0	No
023	Lake Street Bridge	Bridge	No	Low incidence	36.1 - 48.0	No
024	Arcand Bridge (Cross St.)	Bridge	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
025	Cross Street Pumping Station Well	Water Pump Station	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
027	Silver Lake Dam	Dam	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
029	Potter Drive Pump Station	Sewer Pump Station	No	Low incidence	36.1 - 48.0	No
030	Water stand pipe 1	Water Stand Pipe	No	Low incidence	36.1 - 48.0	No
031	Mechanic St Sewer Pump Station	Sewer Pump Station	No	Low incidence	36.1 - 48.0	No
032	Water stand pipe 2	Water Stand Pipe	No	Low incidence	36.1 - 48.0	No

MAP#	NAME	TYPE	Within FEMA Flood Zone	Landslide Incidence	Avg Annual Snow Fall	Within Hot Spot
033	Florida Power and Light	Power Substation	No	Low incidence	36.1 - 48.0	No
034	North Main St Sewer Pump Station	Sewer Pump Station	No	Low incidence	36.1 - 48.0	No
035	Water Pump Station 5	Water Pump Station	No	Low incidence	36.1 - 48.0	No
036	Water stand pipe 3	Water Stand Pipe	No	Low incidence	36.1 - 48.0	No
037	American Nation Power	Power Plant	No	Low incidence	36.1 - 48.0	No
038	High Street Bridge	Bridge	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
039	Pearl Street Bridge	Bridge	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
041	D & D Cellular Tower	Communication Tower	No	Low incidence	36.1 - 48.0	No
042	Jaco Cellular Tower	Communication Tower	No	Low incidence	36.1 - 48.0	No
043	Farm Street Bridge	Bridge	No	Low incidence	36.1 - 48.0	No
044	North Main Street Bridge	Bridge	No	Low incidence	36.1 - 48.0	No
045	North Main Street/Main Ave Bridge	Bridge	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
046	Chestnut Street Cellular Tower	Communication Tower	No	Low incidence	36.1 - 48.0	No
047	South Main Street Bridge	Bridge	No	Low incidence	36.1 - 48.0	No
048	Paine Street Bridge	Bridge	AE: Regulatory Floodway	Low incidence	36.1 - 48.0	No
049	Box Culvert	Culvert	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
050	Arch Culvert	Culvert	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
051	School Admin Building	IT Center	No	Low incidence	36.1 - 48.0	No
052	Well #12	Well	No	Low incidence	36.1 - 48.0	No
053	Wrentham Rd Water Filtration Plant	Water Treatment	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
054	Hartford Rd Water Filtration Plant	Water Treatment	No	Low incidence	36.1 - 48.0	No
055	Old Bridge Ln. Sewer Pumping Station	Sewer Pumping Station	No	Low incidence	36.1 - 48.0	No
056	Dupre Road Sewer Pumping Station	Sewer Pumping Station	No	Low incidence	36.1 - 48.0	No
057	Pine Grove Sewer Pumping Station	Sewer Pumping Station	X: 0.2% Annual Chance	Low incidence	36.1 - 48.0	No
058	Library	Cooling & Heating Ctr.	No	Low incidence	36.1 - 48.0	No
059	Goddard School	Pre-School	No	Low incidence	36.1 - 48.0	No
060	Gates to Education	Day Care	No	Low incidence	36.1 - 48.0	No
061	Convenient MD	Clinic	No	Low incidence	36.1 - 48.0	No
062	Bellingham Urgent Care	Clinic	No	Low incidence	36.1 - 48.0	Yes
063	Maple Street Bridge	Bridge	No	Low incidence	36.1 - 48.0	No
064	Maple Street Bridge	Bridge	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No

MAP#	NAME	TYPE	Within FEMA Flood Zone	Landslide Incidence	Avg Annual Snow Fall	Within Hot Spot
065	Plymouth Road Bridge	Bridge	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
066	Hartford Ave. Bridge	Bridge	AE: Regulatory Floodway	Low incidence	36.1 - 48.0	No
067	Depot Street Bridge	Bridge	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
068	Pulaski Blvd Bridge	Bridge	No	Low incidence	36.1 - 48.0	No
069	Arcand Dam	Dam	No	Low incidence	36.1 - 48.0	No
070	Box Pond Dam	Dam	AE: 1% Annual Chance	Low incidence	36.1 - 48.0	No
071	Railroad Street Bridge	Bridge	AE: Regulatory Floodway	Low incidence	36.1 - 48.0	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 http://www.fema.gov/plan/prevent/hazus/index.shtm

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

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data. Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the Town of Bellingham, 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 a 500-year return period hurricane event; storms that are 1% and 0.2% likely to happen in a given year, and roughly equivalent to a Category 2 and Category 4 hurricane. The damages caused by these hypothetical storms were modeled as if the storm track passed directly through the town, bringing the strongest winds and greatest damage potential.

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

Table 29: Estimated Damages from Hurricanes

	100-Year	500-Year
Building Characteristics		
Estimated total number of buildings	6,016	
Estimated total building replacement value (2014 $)	$2,561,000,000	
Building Damages		
# of buildings sustaining minor damage	238	1,145
# of buildings sustaining moderate damage	17	197
# of buildings sustaining severe damage	1	14
# of buildings destroyed	0	6
Population Needs		
# of households displaced	1	8
# of people seeking public shelter	0	3
Debris		
Building debris generated (tons)	747	3,563
Tree debris generated (tons)	6,273	15,342
# of truckloads to clear building debris	30	143
Value of Damages		
Property damage (buildings and content)	$15,728,030	$59,169,160
Losses due to business interruption	$491,330	$3,638,800
Total Losses	$16,219,3,0	$62.807.960

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 30: Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	6,016	
Estimated total building replacement value (2014 $)	$2,561,000,000	
Building Damages		
# of buildings sustaining slight damage	1,765	205
# of buildings sustaining moderate damage	920	1.321
# of buildings sustaining extensive damage	241	1,776
# of buildings completely damaged	60	2,700
Population Needs and Impacts		
# of households displaced	190	3,133
# of people seeking public shelter	98	1,630
# of injuries (range depending on time of day)	36 - 123	732 – 1,102
# of deaths (range depending on time of day)	1 - 6	30 - 99
Debris		
Building debris generated (tons)	53,000	428,000
# of truckloads to clear debris (@ 25 tons/truck)	2,120	17,120
Value of Damages		
Capital Stock Losses	$281,454,500	$2,161,420,900
Income Losses	$40,458,200	$248,912,600
Total Losses	$321,910,000	$2,410,330,000

ESTIMATED DAMAGES FROM FLOODING

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

Table 31: Estimated Damages from Flooding

	100-Year Flood (1% chance)	500-Year Flood (0.05% chance)
Building Characteristics		
Estimated total number of buildings	6,016	
Estimated total building replacement value	$2,561,000,000	
Building Damages		
# of buildings sustaining limited damage	10	11
# of buildings sustaining moderate damage	14	20
# of buildings sustaining extensive damage	0	
# of buildings substantially damaged	0	
Population Needs		
# of households displaced	98	124
# of people seeking public shelter	1	1
Value of Damages		
Building Loss	$17,460,000	$24,010,000
Business Interruption	$7,140,000	$8,640,000
Total Losses	$24,600,000	$32,650,000

SECTION 5: HAZARD MITIGATION GOALS

The Bellingham Hazard Mitigation Team reviewed the goals from the town's 2011 Hazard Mitigation Plan. All of the goals are considered critical for the Town and they are not listed in order of importance. The local team discussed and endorsed the goals and chose to add an additional goal for this 2020 plan update, addressing climate change resiliency (Goal 9).

1. Prevent and reduce the loss of life, injury, public health impacts 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.

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

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

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

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

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

9. Consider the impacts of climate change and incorporate climate mitigation and resilience in all planning efforts.

SECTION 6: EXISTING MITIGATION MEASURES

The existing protections in the Town of Bellingham 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. Bellingham's adoption of a Stormwater Enterprise Fund could contribute significantly to efforts to address stormwater improvements related flooding as well as water quality.

The Town's existing mitigation measures are listed by hazard type here and are summarized in Table 32 below. Upgrades to existing measures are noted in the following sections.

EXISTING MITIGATION MEASURES FOR FLOOD-RELATED HAZARDS

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

- *Participation in the National Flood Insurance Program (NFIP)* – Bellingham participates in the NFIP with 67 policies in force as of September 2019. There have been 12 claims paid for a total of $68,214. FEMA maintains an online database on flood insurance policies. This can be found on the FEMA website at https://www.fema.gov/policy-claim-statistics-flood-insurance.

The following information is provided on flood insurance policies for the Town of Bellingham:

Flood insurance policies in force	67
Coverage amount of flood insurance policies	$18,773,800
Premiums paid	$93,740
Number of closed losses (losses that have been paid)	12
Total payments (total amount paid on losses)	$68,214

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

- *Street Sweeping* – The Bellingham Department of Public Works conducts street sweeping. All streets are swept two times per year as required by the MS4 Stormwater Permit issued by EPA in 2016. Street sweeping begins as soon as possible each spring.
- *Catch Basin Cleaning* – The town has about 2,400 catch basins in its stormwater system. All catch basins were cleaned in 2020, and thereafter they will be cleaned as needed when they become one-third full of sediments, as required by the MS4 Stormwater Permit.
- *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.

- *The Massachusetts Stormwater Policy* – This policy was adopted by the MA Department of Environmental Protection and is applied locally to developments within the jurisdiction of the Conservation Commission. DEP has recognized the need to update the policy to make it consistent with the MS4 Stormwater Permit issued by EPA. An update process was initiated by DEP in 2019.

- *The MS4 Stormwater Permit Program*: includes monitoring, mapping, and upgrades to stormwater infrastructure, public education programs, detection and elimination of illicit discharges to the stormwater system, and construction and post-construction stormwater bylaws and regulations. The permit was first issued in 2003, and a major revision was issued in 2016 which took effect in 2019.

- *Infrastructure Improvements* – Within the past 10 years, the town upgraded much of its infrastructure such as culverts, bridges, roads, and drainage systems. Examples of improvements include a culvert replacement at 500 Hartford Avenue, a dam removal, and replacement of a bridge on South Main St..

- *Regulations and By-Laws* – The town has adopted several regulations and bylaws that address flooding, preserve wetlands, and protect the town from natural hazards. Since the last plan the town adopted a Wetlands Bylaw and Regulations. Current measure including the following:

    - *Flood Plain Requirements (4500), Article IV, Zoning By-Laws*: The Flood Plain District is herein established as an overlay district. The uses in underlying districts are allowed provided that they meet the following additional requirements as well as those of the Massachusetts State Building Code dealing with construction in flood plains. The Flood Plain District includes all special flood hazard areas designated as Zone A, A1-30 on the Bellingham Flood Insurance Rate Maps, (FIRM), and the Flood Boundary and Floodway Map, Community-Panels Numbers 250232 00001-0007, effective Dec. 15, 1982 on file with the Town Clerk and Building Inspector. Those maps as well as the accompanying Bellingham Flood Insurance Study are incorporated herein by reference.
    - *Wetlands Protection: the town adopted a Wetlands Protection Bylaw, Section 235-1, which requires that: "*
        No person shall remove, fill, dredge or alter any resource areas, or land in or under such areas, within 100 feet of any isolated or contiguous freshwater wetland, marsh, wet meadow, floodplain, bog, swamp, lake, river, pond, stream, creek, bank, estuary or vernal pool, without filing a notice of intent under this bylaw and the Massachusetts Wetlands Protection Act[1] and obtaining an order of conditions approving such work. Corresponding Wetlands Regulations were also adopted (Chapter 247)
    - *Stormwater Management, Article 43, Rules and Regulations Governing the Subdivision of Land*: Multiple regulations including (Section 43.4), Water Resource Districts (Section 43.5), Roadway Subdrains (Section 43.6), Buried Subdrains (Section 43.62), and Roadway Swales (Section 43.63).

- *Open Space Acquisition*-- The Conservation Commission acquires open space parcels that can mitigate flood impacts by retaining natural drainage and recharge features. Since the 2011 Hazard Mitigation Plan, seven additional parcels have been acquired, totaling 105 acres (Table 32).

Table 32: Open Space Parcels Acquired Since 2011

Parcel	Location	Acres
2-1	Lot 177 High Street	11.7
99B	Off Mechanic St. & Crystal Way	22.6
3	Off Saddleback Hill Road	18.5
2	Off Saddleback Hill Road	5.37
16 &16A	Meg Lane, Parcel A & B, Whitehall	33.19
Parcel A	230 Wrentham Road-Pine Acres	3.086
Parcel D	230 Wrentham Road-Pine Acres	10.5

Source: Bellingham Conservation Commission

EXISTING DAM FAILURE MITIGATION MEASURES

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

EXISTING MITIGATION MEASURES FOR WIND-RELATED HAZARDS

- *Massachusetts State Building Code* – The town enforces the Massachusetts State Building Code whose provisions are generally adequate enough to mitigate most wind damage. The code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence. If a tornado were to occur, the potential for severe damages would be high.
- *Tree Trimming* – The Bellingham Tree Warden and local electric company National Grid, conduct regular tree trimming. The town responds to downed tree limbs caused by winds, lightning strike reports and other weather-related incidents. The town utilizes a bucket truck for tree removal efforts. The town recently increased resources for tree management, with a 4-year, $100,000 program focusing on diseased trees, gypsy moths, and drought impacted trees. In the second year of the program, 83 of 116 diseased trees have been removed.

EXISTING MITIGATION MEASURES FOR WINTER-RELATED HAZARDS

- *Roadway Treatments* – The town primarily uses salt for roadway deicing in the winter.
- *Snow Removal & Disposal* – The town Highway Department performs regular snowplow operations during winter storms. The town does not do any snow disposal except for removing snow at the municipal building.

EXISTING MITIGATION MEASURES FOR FIRE-RELATED HAZARDS

- *Permits Required for Outdoor Burning* – The Fire Department requires a written permit for outdoor burning. The property-owner must come into the Fire Station and fill out a form.
- *Fire Hydrant Regulations* – The Bellingham Development Handbook requires that fire hydrants be installed at all new developments at the expense of the developer.
- *Subdivision Review* – The Fire Department is involved in reviewing subdivision plans from conceptual design through occupancy to ensure that there is adequate access for fire trucks and an adequate water supply.
- *Portable Water Pumps* – Rivers and ponds in town are available to be tapped into for water supply if necessary.
- *All Terrain Vehicles* – The town maintains all-terrain vehicles for fighting forest fires. These vehicles provide access to remote areas that otherwise would not be reachable.

EXISTING TOWN-WIDE MITIGATION FOR EARTHQUAKE HAZARDS

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

EXISTING MULTI-HAZARD MITIGATION MEASURES

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

Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to a Table 1612.2.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which are required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.

- *Multi-Department Review of Developments* (Technical Review Committee)– Multiple departments, such as the Town Administrator, Planning, Zoning, Health, Highway, Fire, Police, and Conservation, review all subdivision and site plans prior to approval.
- *Comprehensive Emergency Management Plan (CEMP)* – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan. The CEMP is available online through secure access for town personnel.
- *Reverse 911*– The town recently employed a Reverse 911system, which allows the police to contact numerous residents at once in the case of an emergency or natural disaster.

COMPILATION OF EXISTING MITIGATION MEASURES

Table 33 summarizes the many existing natural hazard mitigation measures already in place in Bellingham when the first Hazard Mitigation Plan was developed in 2011 and updated for this 2020 plan.

Table 33: Existing Natural Hazard Mitigation Measures in Bellingham

Type of Existing Mitigation	Description	Effectiveness/Changes Needed
FLOOD HAZARDS		
1) Participation in the National Flood Insurance Program (NFIP)	The town participates in the NFIP and has adopted the effective FIRM maps. The town actively enforces the floodplain regulations.	Effective. There are 67 insurance policies in force / Encourage all eligible homeowners to obtain insurance
2) Street Sweeping	Every street gets swept two times a year as required by the Town's MS4 Stormwater Permit.	Effective. Has been updated to comply with MS4 Permit, more frequent sweeping / None
3) Catch Basin Cleaning	All 2,400 catch basins are cleaned when they become one-third full of sediments.	Effective. All cleaned in 2020, will be cleaned as they are 1/3 full, as per MS4 Permit / None
4) Enforcement of the State Building Code	Regulates for wind loads, earthquake resistant design, flood-proofing and snow loads.	Most effective for new construction & redevelopment / None
5) Massachusetts Stormwater Regulations	This policy is applied to developments within the jurisdiction of the Conservation Commission.	Partially effective/Needs to be updated for MS4 groundwater recharge requirements
6) Infrastructure Improvements	Infrastructure improvements include culverts, bridges, roads, and drainage systems Culvert was replaced at 500 Hartford St; a dam was removed, and a bridge replaced since the last plan	Partially Effective / Often need more funding, resources for significant capital projects; coordination with the state on MassDOT projects
7) Regulations, By-Laws, and Plans	Includes: Floodplain Protection, Water Resources Districts, Stormwater Bylaw. The town adopted a local Wetlands bylaw and regulations since the last plan	Effective/Need to update the stormwater bylaw to meet current MS4 permit requirements
8) Open Space acquisition	The Conservation Commission acquires open space parcels that can mitigate flood impacts by retaining natural drainage and recharge features.	Effective
DAM HAZARDS		
9) DCR Dam Safety Regulations	The state has enacted dam safety regulations mandating inspections and emergency action plans.	Partially effective/ Enforcement by DCR can be an issue due to staff capacity / None.
10) State permits required for dam construction	State law requires a permit for the construction of any dam.	Most effective for new construction or dam rebuilding. The town rebuilt 2 dams and removed one / None.
11) Silver Lake Dam	The Town prepared an Emergency Action Plan (EAP) in 2019	Effective / None
BRUSH FIRE HAZARDS		

12) Permits required for outdoor burning.	The Fire Department requires a written permit for outdoor burning. The permit must be obtained from the Fire Dept.	Effective/None.
13) Fire Hydrant Regulations	The Bellingham Fire Department requires that fire hydrants be installed at all new developments at the expense of the developer.	Effective/None.
14) Subdivision Review	The Fire Department is involved in reviewing all subdivision plans.	Effective/None.
15) Portable Water Pumps	Rivers and ponds in town are available to be tapped for non-potable water supply such as firefighting if necessary.	Effective/None.
16) All-Terrain Vehicles	For fighting remote forest fires	Effective/None.
GEOLOGIC HAZARDS		
17) The Massachusetts State Building Code	The Town enforces the Massachusetts State Building Code.	Effective for construction since earthquake code revisions; older buildings may be more vulnerable / None
18) Comprehensive Emergency Management Plan (CEMP)	Addresses mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies.	Emphasis is on emergency response / Periodically update the plan
WIND HAZARDS		
19) Massachusetts State Building Code	The town enforces the Massachusetts State Building Code.	Most effective for new construction and redevelopment / None
20) Tree-Trimming	The Town and National Grid conduct regular tree trimming and removal. Last year town funding was increased $100K for a 4-year effort to address tree diseases, gypsy moth, and drought; 83 pf 116 diseased trees have been removed.	Effective for most situations / More capacity needed for large scale storm events
WINTER HAZARDS		
21) Roadway Treatments	The Highway Department conducts salting deicing services throughout the town during winter storms.	Effective for most situations / None
22) Snow Removal & Disposal	The town and its contractors conduct regular plowing and snow removal operations.	Effective for most situations / May be shortage of contractors for large scale storm events.
MULTI-HAZARDS		
23) Massachusetts State Building Code	Regulates wind loads, earthquake resistant design, flood-proofing and snow loads.	Most effective for new construction and redevelopment

		/ None.
24) Multi-Department Review of Developments	Multiple department within town review site plans before development.	Most effective for new construction / None.
25) Comprehensive Emergency Management Plan (CEMP)	Addresses mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies.	Emphasis is on emergency response / Periodically update the plan
26) Reverse 911	The town employs Reverse 911 which allows the police to contact numerous residents at once in the case of an emergency or natural disaster.	Effective/None

MITIGATION CAPABILITIES AND LOCAL CAPACITY FOR IMPLEMENTATION

Under the Massachusetts system of "Home Rule," the Town of Bellingham is authorized to adopt and from time to time amend local bylaws and regulations that support the town's capabilities to mitigate natural hazards. These include Zoning Bylaws, Subdivision and Site Plan Review Regulations, Wetlands Bylaws, Stormwater Bylaws, Health Regulations, Public Works regulations, and local enforcement of the State Building Code, the Wetlands Protection Act, and the MS4 Stormwater Permit. Local Bylaws may be amended by the Town Meeting to improve the town's capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission. The town has adopted numerous such local bylaws as described above.

The Town of Bellingham has recognized several existing mitigation measures that require implementation or improvements and has the capacity within its local boards and departments to address these. The Town's Planning Department is leading a comprehensive zoning bylaw review. The Public Works Department has overall responsibility for maintain and improving the towns' stormwater infrastructure, which has a major influence on localized flooding. The Conservation Commission enforces state and local wetland regulations, which help maintain the natural flood storage capabilities of the town's wetlands. The town's efforts to protect open space also contribute to minimizing impervious surfaces and preserving open and vegetated land that can reduce stormwater runoff and the flooding it causes

SECTION 7: MITIGATION MEASURES FROM PREVIOUS PLAN

IMPLEMENTATION PROGRESS ON THE PREVIOUS PLAN

The Town of Bellingham has utilized the previous Hazard Mitigation Plan to integrate hazard mitigation planning principles throughout the Town's administration. As recommended by the plan, the Town has acquired and developed a robust GIS system that depicts the community's comprehensive infrastructure system. Bellingham has also updated their local regulations, including a Wetlands Bylaw and Stormwater Regulations to support modern stormwater principles, and the Town has conducted a stormwater and drinking water educational campaign.

At a meeting of the Bellingham Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures proposed in the 2011 Bellingham 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 2020 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. Table 33 summarizes the status of mitigation measures from the 2011 plan.

As indicated in Table 34, Bellingham made significant progress implementing mitigation measures identified in the 2011 Hazard Mitigation Plan. In particular, the Town had success with removal of the Caryville Dam, completion of drainage improvements for Stone Street, adoption of a Wetlands Bylaw and regulations, adoption of a Stormwater Enterprise Fund, protection of four additional open space areas, improved GIS mapping capabilities, public education on stormwater, improved communications for emergency operations, and an improved Public Safety facility.

Several projects that were not completed will be continued into this plan update. These include drainage upgrades at Lake Shore Drive, a hydrologic analysis/drainage assessment for Peters River, drainage mitigation for High Street, removal of Farmers Dike at Saddleback Hill Road, a drainage analysis at Green Acres on Newland Avenue, fire hydrant upgrades, open space acquisition, public education on stormwater and on brush fire hazards, and adoption of an updated stormwater bylaw.

Overall, 13 mitigation measures from the 2011 plan will be continued in this 2020 plan update. Most retain the same priority in this plan update, but several were classified as "other" in the previous plan, a category that is not retained in this plan update. Those are now categorized as high priority, including High Street drainage mitigation, removal of Farmers Dike, a drainage analysis at Green Acres (Newland Avenue), and municipal facility upgrades for the Department of Public Works.

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

Table 34: Status of Mitigation Measures from the 2010 Plan

Hazard/Area	Mitigation Recommended in the 2011 Bellingham Hazard Mitigation Plan	Priority In 2011 Plan	2020 Status Completed ~ In Progress or Not Completed / Notes	Include in 2020 PLAN?
FLOOD HAZARDS				
A) Dam Restoration and Structural Upgrades	The Caryville Dam Restoration	High	Completed, dam was removed	NO
	The Box Pond Dam Restoration	High	Not a town dam, privately owned	NO
B) Stone Street Mitigation	Channel Restoration	High	Completed	NO
	Divert pipe to discharge underground	High	Completed	NO
D) Protection of Open Space	Protection of open space includes acquiring conservation land and land acquisition	High	In Progress--Four new areas have been preserved with Conservation Restrictions	YES
E) Revisions to Development Bylaws and Regulations	Revise and strengthen existing regulations and by-laws	High	In Progress: Wetlands bylaw adopted; Stormwater in progress, November 2020 Town Meeting	YES
F) Drainage Upgrades at Lake Shore Drive	Upgrade/replace stormwater detention basin	Medium	Not completed	YES
	Install a drainage piping empty into the lake	Medium	Not completed	YES
G) Hydro Analysis at Peter's River	Hydrologic Analysis/Drainage Study	Medium	Not completed	YES
J) Water-Related Public Education	Public education on water resources such as flood prevention and stormwater management	Medium	In progress with MS4 program	YES
N) High Street Mitigation	Conduct a hydro analysis (dam collapsed at Maple Street Mills)	Other	Not completed	YES

Hazard/Area	Mitigation Recommended in the 2011 Bellingham Hazard Mitigation Plan	Priority In 2011 Plan	2020 Status Completed ~ In Progress or Not Completed / Notes	Include in 2020 PLAN?
O) Remove Farmer Dike at Saddleback Hill Rd	Remove Farmer Dike	Other	Not completed	YES
P) Drainage Analysis at Green Acres (Newland Avenue)	Drainage Analysis	Other	Not completed	YES
FIRE HAZARDS				
H) Brush Fire Regulations	Backyard Setback Requirements for Fire Protection	Medium	Not completed	YES
	Public Education on Brush Fire Prevention	Medium	In Progress	YES
K) New Fire Fighting Truck	Purchase a new fire fighting truck	Medium	Completed	NO
L) Water Main & Hydrant Improvements	Water main and fire hydrants extensions and size upgrades (6 inches to 8+inches)	Medium	Not completed	YES
MULTI-HAZARDS				
C) Acquire GIS & Mapping Technology	Improve Mapping Capabilities	High	Completed	NO
I) Inter-municipal Communication	Improve communications between municipalities	Medium	Completed	NO
M) Communications for Emergency Operations	Upgrading with wireless communications	Medium	Completed	NO
Q) Municipal Facilities Upgrades	Renovate or build a new public safely facility	Other	Completed	NO
	Renovate or build a new DPW facility	Other	Not completed	YES

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 often more than a local issue. The drainage systems that serve these communities are complex systems of storm drains, roadway drainage structures, and other facilities owned and operated by a wide array of agencies including the Town, the Massachusetts Department of Transportation (MassDOT), the Norfolk County Mosquito Control Project, and the Army Corps of Engineers (ACOE) which established the Charles River Natural Valley Storage project. 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 in Bellingham and a discussion of inter-municipal issues.

OVERVIEW OF REGIONAL FACILITIES WITHIN OR NEAR BELLINGHAM

Major facilities owned, operated and maintained by federal, state, regional or private entities in Bellingham include State Routes 126, 140 and Interstate 495, maintained by MassDOT. In addition, Bellingham utilizes the Charles River Pollution Control District for wastewater treatment for the northern part of town, which operates a wastewater treatment facility located on the Charles River downstream from Bellingham in Medway. The town also uses the Woonsocket (RI) Wastewater Treatment facility for the southern part of town. The facility is located on the Blackstone River in the City of Woonsocket, RI. In addition, the MBTA provides commuter rail service to Boston at two stations in neighboring Franklin, and shuttle service is provided by the Greater Attleboro Taunton Transit Authority (GATRA).

INTER-COMMUNITY CONSIDERATIONS

Bellingham, as well as its surrounding communities, is undergoing significant development. In order to avoid or minimize impacts from any residential and commercial development, communication between Bellingham and the surrounding communities, including input in the review processes, is vital.

Maintaining adequate drainage, floodplains, and water quality of the Charles River Basin and Blackstone River Basin is an important consideration for Bellingham and the surrounding communities. This planning project, which includes a joint Municipal Vulnerability Preparedness Project with the Town of Franklin, is a good example of regional cooperation. Both towns are also members of the Southwest Area Planning Council (SWAP), a subregional planning form facilitated by the Metropolitan Area Planning Council for 10 towns southwest of Boston, mostly in the upper Charles River watershed.

NEW DEVELOPMENT AND INFRASTRUCTURE

As part of the process of developing recommendations for new mitigation measures for this plan update, the Town considered the issues related to new development, redevelopment, and infrastructure needs in order limit future risks. Taking into consideration the town's updated Zoning Bylaw with Floodplain Overlay District, the Wetlands bylaw and regulations enforced by the Conservation Commission, the Stormwater Enterprise Fund, and the Stormwater Bylaw, the town determined that existing regulatory measures are taking good advantage of local Home Rule land use regulatory authority to minimize natural hazard impacts of development. Priorities for the future include coordinated implementation and enforcement of these and other bylaws.

PROCESS FOR SETTING PRIORITIES FOR MITIGATION MEASURES

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

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

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

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event
Estimated Costs	
High	Estimated costs greater than $100,000
Medium	Estimated costs between $10,000 to $100,000
Low	Estimated costs less than $10,000 and/or staff time
Overall Priority	

High	Action very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure
Medium	Action may have political and public support and necessary maintenance has potential to occur following the project
Low	Not clear if action has political and public support and not certain that necessary maintenance can occur following the project

Table 35: Mitigation Measures Prioritization

Mitigation Action	Geographic Coverage	Estimated Benefit (H/M/L)	Estimated Cost (H/M/L)	Overall Priority (H/M/L)
FLOOD HAZARDS				
A) Drainage Upgrades at Lake Shore Drive	Lake Sh0re Dr	Medium	High	Medium
B) Peter's River – flooding on Wrentham Rd.	Wrentham Rd.	Medium	Low	Medium
C) Water-Related Public Education	Town-wide	Medium	Low	Medium
D) High Street Mitigation	High Street	Medium	Low	Medium
E) Remove Farmer Dike at Saddleback Hill Rd	Saddleback Hill Road	Medium	Low	Medium
F) Green Acres – Newland Avenue drainage problems	Town-wide	Medium	Medium	Medium
G) Protection of Open Space - Town wide	Town-wide	High	Med-High	High
H) Protection of Open Space for Stormwater Facilities	Town-wide	High	Med-High	High
I) Revisions to Bylaws and Regulations	Town-wide	High	Low	High
MULTIHAZARDS				
J) Municipal Facility Upgrade-DPW	Town-wide	High	High	High
K) Provide sheltering at the Senior Center for the senior population in any emergency response.	Town-wide	High	TBD	High
BRUSHFIRE HAZARDS				
L) Water Main & Hydrant Improvements	Town-wide	Medium	Med-High	Medium
M) Brush Fire Setback Regulations	Town-wide	Medium	Low	Medium
N) Brush Fire Public Education	Town-wide	Medium	Low	Medium
Wind Hazards				
O) Wind hazards--tree damage mitigation	Town-wide	Medium	Medium	Medium
Geologic Hazards				
P) Public Building earthquake assessments	Site specific	Low	Low	Low

Mitigation Action	Geographic Coverage	Estimated Benefit (H/M/L)	Estimated Cost (H/M/L)	Overall Priority (H/M/L)
Winter Hazards				
P) Public building snow load assessment	Site specific	Low	Low	Low
Drought Hazards				
Q) Town-wide: drought mitigation	Town-wide	Medium	Low	Medium
Extreme Temperatures				
R) Extreme heat and cold mitigation	Town-wide	Low	Low	Low
S) Extreme heat mitigation	Town-wide	Medium	Low	Medium

DESCRIPTION OF MITIGATION MEASURES

Flooding Hazards

A) Drainage System Upgrades at Lake Shore Drive

The town has identified the reconstruction of the drainage system and detention basin at Lake Shore Drive as priority mitigation measure. Inadequate street drainage, water runoff from an abutting condo complex, and increased impervious surface causes portions of Lake Shore Drive and four or five single family homes to flood. According to the Local Committee, the stormwater detention basin along Lake Shore Drive was not properly constructed. Reconstruction of the basin may help to alleviate some of the flooding.

B) Hydro Analysis at Peter's River

In the event of a large rain storm or spring event there are about 40 single family home along Florida Avenue, Wrentham Road, and Gaby Lane that sustain frequent flooding. There are several causes to flooding in this area; downstream debris and sedimentation cause upstream backups, level gradients causing slowed water flow, and develop along floodplains. A hydro analysis study would help the town understand the depth of this problem. Another potential mitigation measure includes stream restoration.

C) Water-Related Public Education

Increase public awareness re: stormwater, use of pesticides, fertilizers and other chemicals as well as septic systems to reduce contaminants and hazardous materials from entering water sources in case of flooding. The town has begun a public outreach effort through its MS4 permit program

D) High Street Mitigation

Mitigation to High Street is a priority mitigation measure. In a large storm event, High Street sustains flooding. Flooding can result in partial to complete road closure. The town replaced the High Street Bridge about ten years ago which has served to mitigate most of the flooding. Hydro analysis could be conducted as a prelude to future mitigation.

E) Remove Farmer's Dike at Saddleback Street

During large storm events Saddleback Street has the potential to flood. Flooding is caused by three reasons: One, there is a small brook that flows through an old farmer's dike that occasionally backs up; two, the culvert at Saddleback Street gets clogged; and three, the area around Saddleback Street has a fairly level gradient slowing water flow. Currently, the town checks the Saddleback Street culvert about once month to prevent back ups. Potential future mitigation could include removal of the farmer's dike, which would allow the brook to flow naturally through that section.

F) Drainage Analysis at Green Acres

This area sustains flooding in most rain storms. There are several homes in Green Acres that flood or have the potential to flood. Flooding in this area is caused by development within the floodplain of Arnold Brook. Also, during large storm events, there are backups at the point Arnold Brook goes under ground. Potential mitigation measures include hydro analysis and/or the installation of a drainage pipe to ease the surface to subterranean transition of Arnold Brook.

G) Open Space-Protection Town wide

Although Bellingham has not sustained significant flooding compared to more urban and densely populated towns, protection of open space is important in order to ensure that future development does not increase flooding. Open space acquisitions or Conservation Restrictions can preserve land to mitigate and absorb stormwater.

H) Protection of Open Space for Stormwater Facilities

Targeted acquisition of land for stormwater measures such as retention facilities, swales, and bioretention/recharge. This will assure that sites are available to implement green infrastructure stormwater solutions and comply with the MS4 Permit.

I) Revisions to Bylaws and Regulations

Revise and strengthen existing stormwater bylaw and regulations to be consistent with current MS4 Permit requirements.

Multihazards

J) Municipal Facility Upgrade-DPW

The town is currently seeking to either renovate or build a new Department of Public Works facility. The DPW facility is estimated to cost $10 Million. A fully operational facility that meets the needs of the town is essential to the town's ability to adequately prepare and respond to natural hazards.

K) Provide sheltering at the Senior Center for the senior population in any emergency response.

Brushfire Hazards

L) Water Main & Hydrant Upgrades

Water main and fire hydrants installation and extensions; upgrade size from 6" to 8"+

M) Backyard Setback Requirements for Fire Protection

A town regulation for a minimum backyard setback would help minimize risk to property and personal injury from brush fires, by keeping a buffer between vegetated/forested areas and structures.

N) Public Education on Brush Fire Prevention

In order to reduce the risk of brush fires, further education of the public should be provided at conservation areas, for example with signage. In addition, homeowners in close proximity to forest areas could be educated on vegetation management on their own properties and how to maintain buffers.

Wind Hazards

O) Town-wide wind hazards, tree damage

Increase tree maintenance program and coordinate with utilities

Earthquake Hazards

P) Public Building earthquake assessment

Identify public buildings vulnerable to earthquakes and assess options to make them more resistant to earthquakes

Winter Hazards

Q) Public Buildings snow load assessment

Identify public buildings vulnerable to damage from snow loads and conduct a structural assessment

Drought Hazards

R) Town-wide drought mitigation

Adopt guidelines for new development to promote drought tolerant landscaping and site design measures

Extreme Temperature Hazards

S) Town-wide extreme temperature public education

Conduct a public awareness program on extreme temperatures and resources available to residents

T) Town-wide extreme heat mitigation

Adopt Site Design regulations to increase shade tree plantings near buildings, increase trees used in parking areas and along public ways.

INTRODUCTION TO POTENTIAL 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 have 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 36 Recommended Hazard Mitigation Measures

Hazard Category Issue/Location	**Mitigation Measure**	**Priority**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
Flooding						
A) Drainage Upgrades at Lake Shore Drive	Upgrade/replace stormwater detention basin	Medium	Dept of Public Works	2024-25	Medium-High $50-150 K	Bellingham Stormwater Enterprise, General Fund, PDM, DEP
	Install drainage piping emptying into the lake	Medium	Dept of Public Works	2024-25	High: $500 K to $1 M	Bellingham Enterprise, General Fund, PDM, DEP
B) Peter's River – flooding on Wrentham Road	Conduct a Hydrologic Analysis/Drainage Study. (possible mitigation with stream restoration)	Medium	Dept of Public Works	2021-22	Low: $10 - $25K	Bellingham Stormwater Enterprise, General Fund, PDM, DEP
C) Water-Related Public Education	Public education on water resources such as flood prevention and stormwater management	Medium	Dept of Public Works	2021-22	Low: Staff time and education materials	Bellingham Stormwater Enterprise, General Fund
D) High Street Mitigation	Conduct a Hydrologic Analysis/Drainage Study	Medium	Dept of Public Works	2021-22	Low: $5-25 K	Bellingham Stormwater Enterprise, General Fund
E) Saddleback Hill Rd flooding	Remove Farmer Dike	Medium	Dept of Public Works	2022-24	Low: $2-6 K	Bellingham Stormwater Enterprise, General Fund

Hazard Category Issue/Location	**Mitigation Measure**	**Priority**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
F) Green Acres – Newland Avenue drainage problems	Conduct a Drainage Analysis	Medium	Dept of Public Works	2022-23	Low: $5-25 K	Bellingham Stormwater Enterprise, General Fund
G) Protection of Open Space - Town wide	Protection of open space, acquiring land to mitigate and absorb stormwater.	High	Conservation Comm.	2020-25	Medium to High	Town of Bellingham General Fund, EOEEA, Land Donations
H) Protection of Open Space for Stormwater Facilities	Acquisition of land for stormwater measures such as retention facilities, swales, and bioretention/recharge	High	Dept of Public Works	2020-25	Medium to High	Bellingham Stormwater Enterprise, Land Donations
I) Revisions to Bylaws and Regulations	Revise and strengthen existing stormwater regulations and by-laws	High	Planning Board	2020-21	Low: Staff Time	Bellingham General Fund
Multi Hazards						
J) Municipal Facilities Upgrades	Renovate or build new Public Works facility	High	Dept. of Public Works	2024-25	High: $10 M	Bellingham Capital Funds
K) Sheltering at the Senior Center	Provide sheltering at the Senior Center for the senior population in any emergency response.	High	Fire Department	2020	TBD	Bellingham General Fund

Hazard Category Issue/Location	**Mitigation Measure**	**Priority**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
Wildfire Hazards						
L) Water Main & Hydrant Improvements	Water main and fire hydrants installation and extensions— upgrade size from 6" to 8"+	Medium	Dept. of Public Works	2022-24	Medium-High $20-500 K	Bellingham Water Dept. Capital Funds
M) Brush Fire Regulations	Backyard Setback Requirements for Fire Protection	Medium	Fire Department	2021-22	Low -Staff time	Bellingham General Fund
N) Public Education	Public Education on Brush Fire Prevention	Medium	Fire Department	2020-25	Low-Staff time	Bellingham General Fund
Wind Hazards						
O) Town-wide wind hazards--tree damage	Increase tree maintenance program; coordinate with utilities	Medium	Dept of Public Works, Tree Warden and Conservation Comm.	2020-2025	Medium	Bellingham General Fund
Geologic Hazards						
0) Town-wide: Public Buildings-Earthquake hazards	Identify public buildings that may be vulnerable to earthquakes and assess options to make them more resistant to earthquakes	Low	Dept of Public Works	2023-2025	Low: Staff time and assessment	Bellingham General Fund

Hazard Category Issue/Location	Mitigation Measure	Priority	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
Winter Hazards						
P) Town-wide Public Buildings: Snow loads	Identify public buildings that may be vulnerable to damage from snow loads and conduct a structural assessment if needed	Low	Dept. of Public Works	2023-2025	Low: Staff time and assessment	Bellingham General Fund
Drought Hazards						
Q) Town-wide: drought	Adopt guidelines for new development to promote drought tolerant landscaping and site design measures	Medium	Planning Board, Conservation Comm, HMP/MVP Core Team	2020-2023	Low: Staff time	Bellingham Stormwater Enterprise, General Fund
Extreme Temperatures						
R) Town-wide: Extreme heat and cold	Conduct a public awareness program on the risks of extreme temperatures and resources available to residents	Low	Board of Health	2020-2025	Low: Staff time; cost of educational materials	Bellingham General Fund
S) Town-wide: Extreme heat and cold	Adopt Site Design regulations to increase shade tree plantings near buildings, increase trees used in parking areas and along public ways.	Medium	Planning Board, Conservation Comm.	2020-2023	Low: Staff Time	Bellingham Stormwater Enterprise, General Fund

*** KEY to Cost categories:**

LOW: Less than $50,000
MEDIUM $50,000 to $100,00
HIGH: Over $100,000

SECTION 9: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION

The Bellingham Hazard Mitigation Plan 2020 Update was adopted by the Selectboard on November 2, 2020. 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 Bellingham Hazard Mitigation Planning Team to prepare this plan. After approval of the plan by FEMA, this group will meet to function as the Hazard Mitigation Implementation Team, with the Town Planner/Zoning Enforcement Officer designated as coordinator. Additional members could be added to the local implementation team from businesses, non-profits and institutions. The Town will encourage public participation during the next 5-year planning cycle. As annual updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with town and state open meeting laws.

IMPLEMENTATION AND EVALUATION SCHEDULE

Annual Review – The coordinator of the Hazard Mitigation Implementation Team will convene the team annually to consider changes or revisions to the plan that may be needed, progress and accomplishments, and any new hazards or problem areas that have been identified.

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

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

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

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

INTEGRATION OF THE PLANS WITH OTHER PLANNING INITIATIVES

Upon approval of the Bellingham Hazard Mitigation Plan 2020 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 and Community Development
- Facilities Department
- Conservation Commission
- Water and Sewer Department
- Board of Health
- Building Department

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 Town'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 will be integrated into other town 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

Blue Hills Observatory

FEMA, Local Mitigation Plan Review Guide, October 2011

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

FEMA, Hazards U.S. Multi-Hazard (HAZUS-MH)

Fourth National Climate Assessment, 2018

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, Bellingham Economic Development Study, 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 Environmental Information Center, http://www.ncdc.noaa.gov/

Northeast Climate Adaptation Science Center

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

Town of Bellingham, *Open Space and Recreation Plan,* 2017

Town of Bellingham *Master Plan,* 2010

Town of Bellingham, *Silver Lake Dam Emergency Action Plan*, 2019

Town of Bellingham, *General Bylaws*

Town of Bellingham, *Zoning Bylaw*

Tornado History Project

US Census, 2010 and American Community Survey 2017

Town of Bellingham, *General Bylaws*

USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis

APPENDIX A: HAZARD MAPPING

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

The map series consists of nine maps as described below. The maps in this appendix are necessarily reduced scale versions for general reference. Full sized higher resolution PDF's of the maps can be downloaded from: https://mapc-org.sharefile.com

Map 1.	Population Density
Map 2.	Land Use
Map 3.	Flood Zones
Map 4.	Earthquakes and Landslides
Map 5.	Hurricanes and Tornadoes
Map 6.	Average Snowfall
Map 7.	Composite Natural Hazards
Map 8.	Hazard Areas
Map 9	(Sea Level Rise, not included in this plan)
Map 10	High Land Surface Temperatures

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

Map 2: Land Use – This map shows land use based on the MassGIS statewide land use database. The map also shows potential future development sites and critical facilities, both of which were identified by the Local Hazard Mitigation Team.

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

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

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

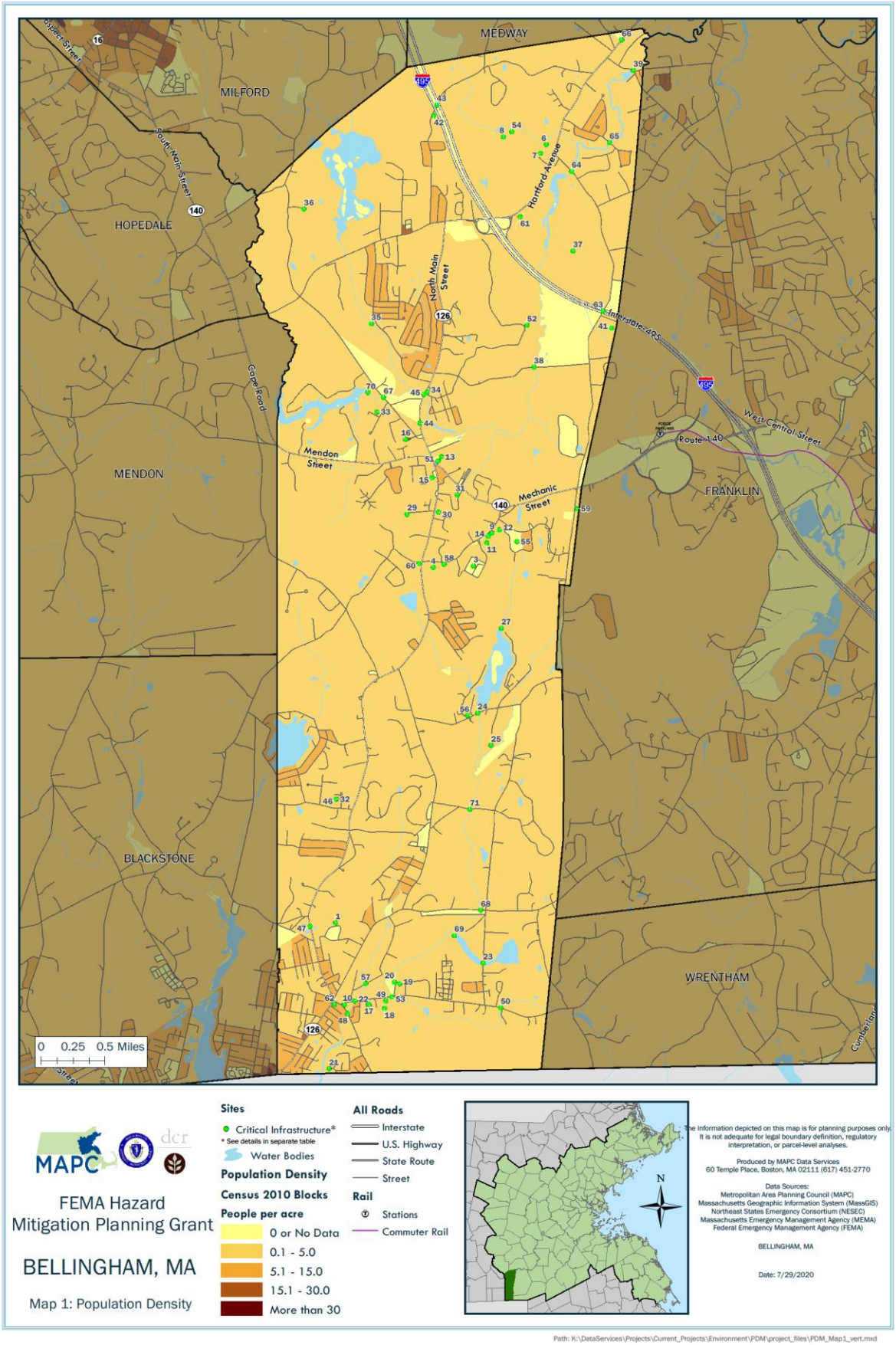
Map 5: Hurricanes and Tornadoes – This map shows the storm tracks for both hurricanes and tropical storms, if any occurred in or near this community. This information must be viewed in context. A storm track only shows where the eye of the storm passed through. In most cases, the effects of the wind and rain from these storms were felt in other communities even if the track was not within that community. This map also shows the location of tornadoes with a classification as to the level of damages. What appears on the map varies by community since not all communities experience the same wind-related events. These maps also show the 100-year wind speed.

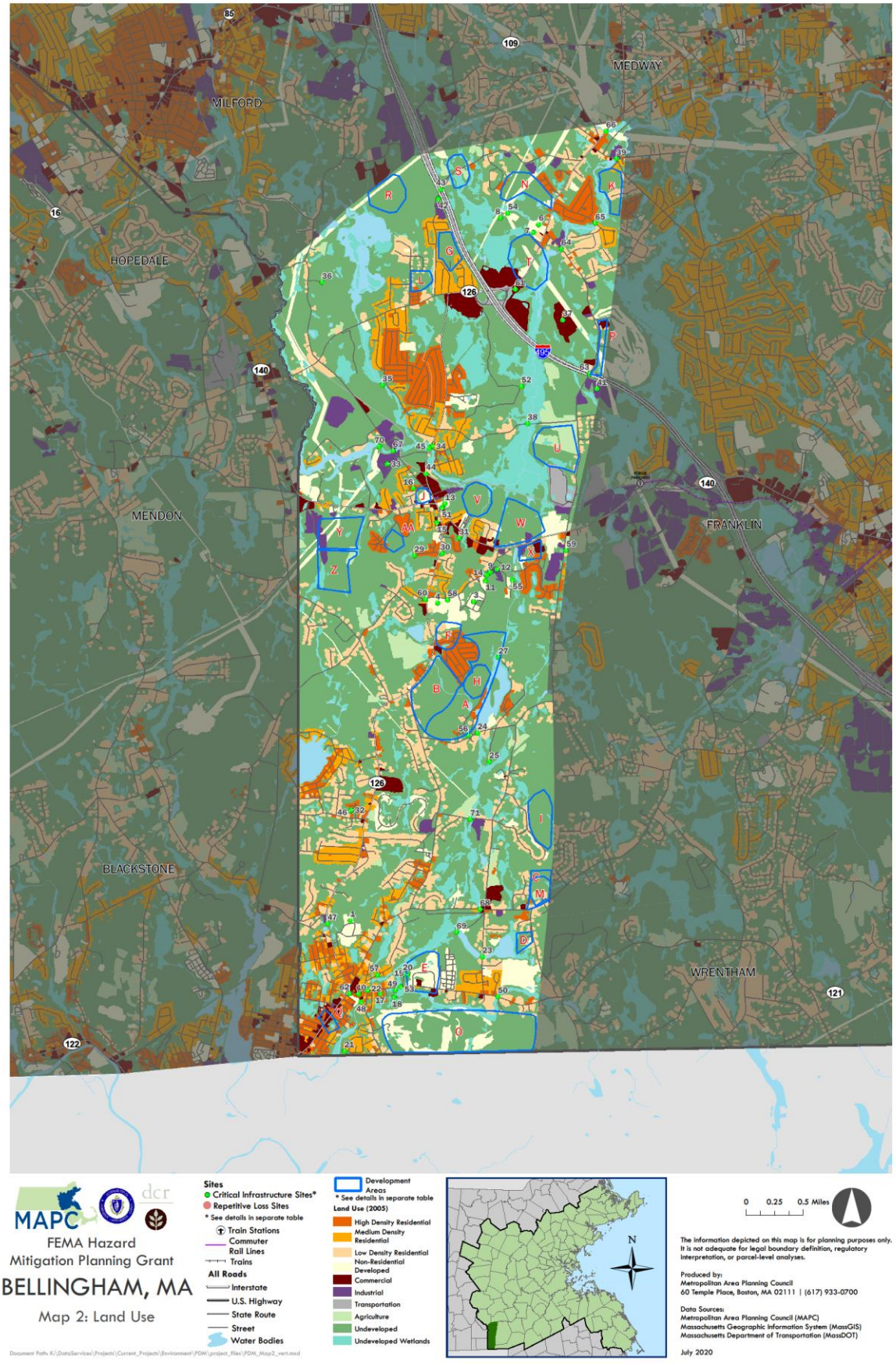
Map 6: Average Snowfall - - This map shows the average snowfall. It also shows storm tracks for nor'easters, if any storms tracked through the community.

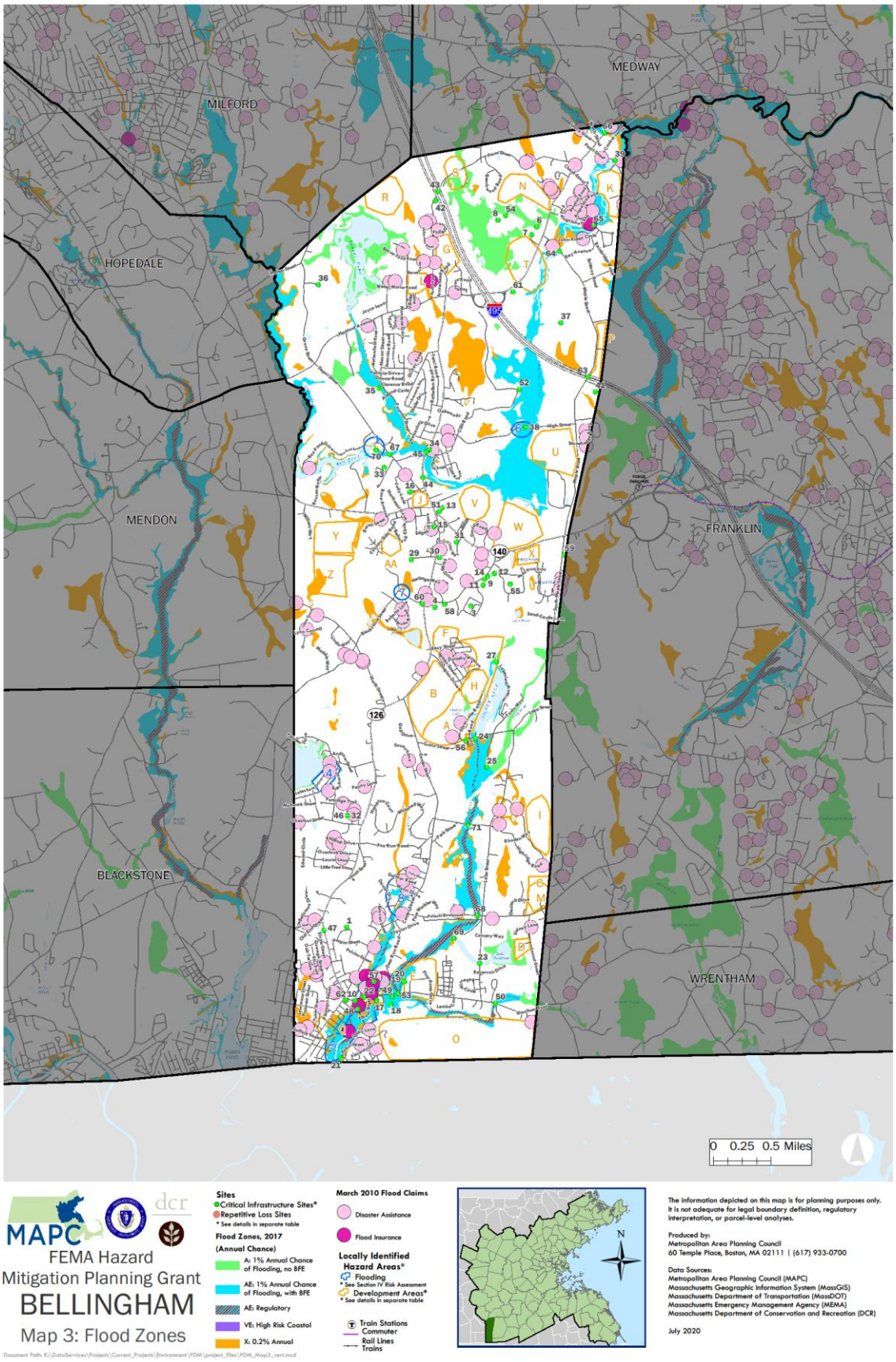
Map 7: Composite Natural Hazards - This map shows four categories of composite natural hazards for areas of existing development. The hazards included in this map are 100-year wind speeds of 110 mph or higher, low and moderate landslide risk, FEMA Q3 flood zones (100 year and 500 year) and hurricane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

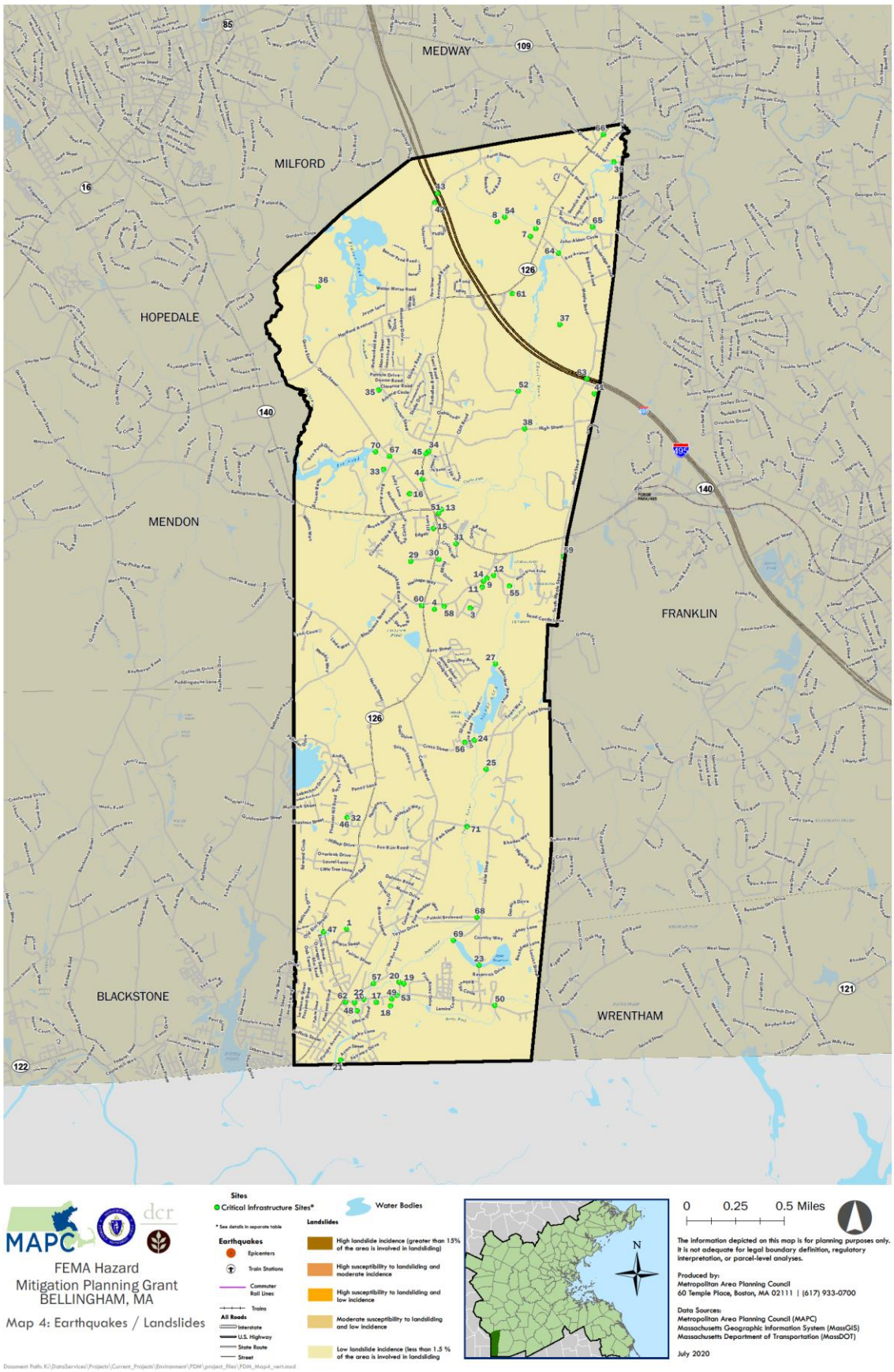
Map 8: Hazard Areas – For each community, locally identified hazard areas are overlaid on an aerial photograph dated April 2010. The critical infrastructure sites are also shown. The source of the aerial photograph is Mass GIS.

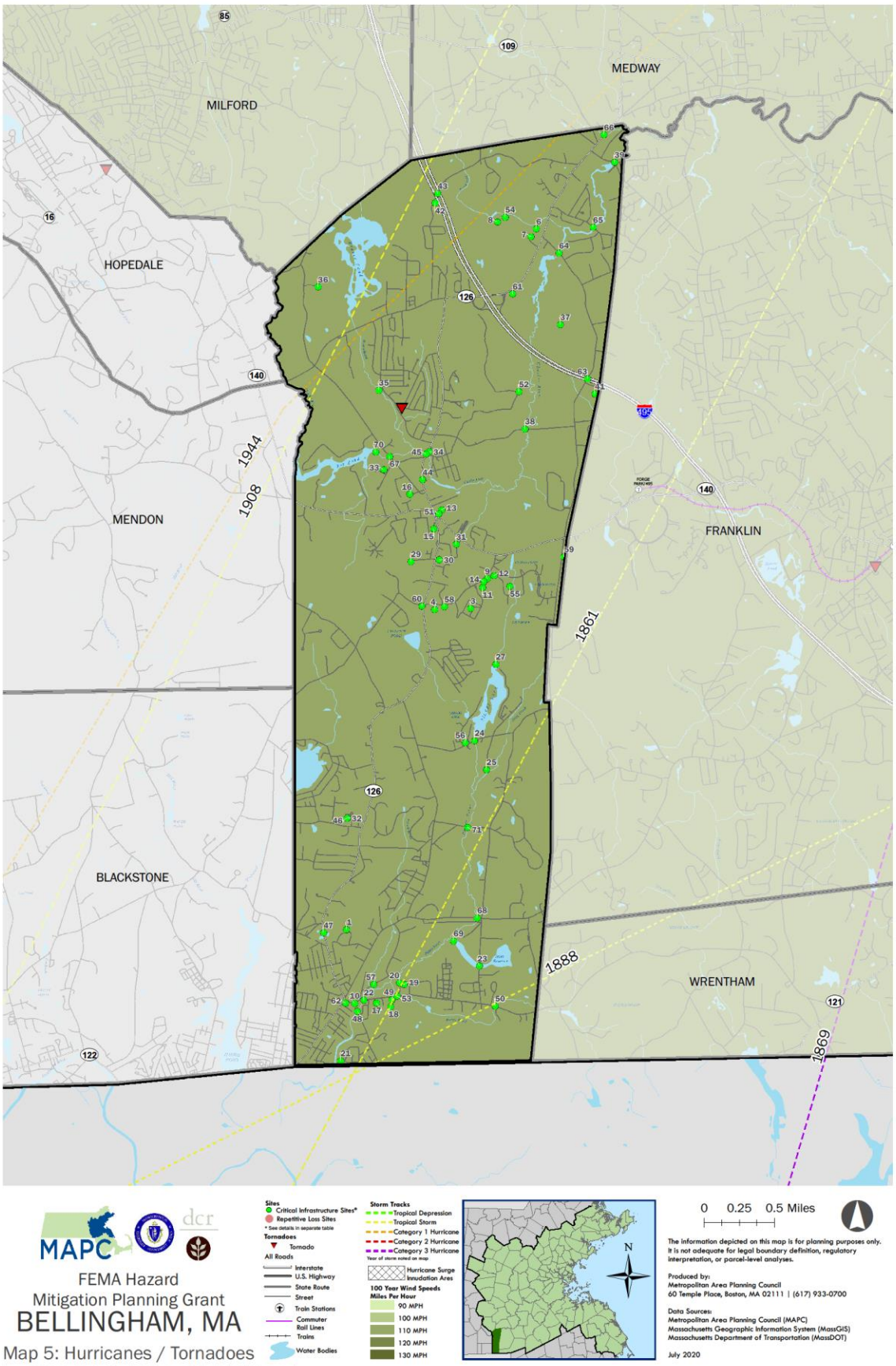
Map 10: High Land Surface Temperature - MAPC uses LANDSAT 30m spatial resolution satellite data to extract land surface temperature to assess a community's exposure to present-day extreme heat and any vulnerabilities to rising temperatures with climate change. The extreme heat analysis uses date from 2016 with satellite images on days of 90° or higher at Logan Airport, July 13 and August 30, 2016 and created land surface temperature using a methodology development by Walawender, Hajto, and Iwaniuk (2012) called Landsat TRS Tools. This map illustrates the hottest areas in the top fifth percentile for the 101 towns in Metropolitan Boston.


MEDWAY
MILFORD
HOPEDALE
MENDON
BLACKSTONE
FRANKLIN
WRENTHAM
Hartford Avenue
North Main Street
Mendon Street
Mechanic Street
West Central Street
Route 140
Interstate 495
Cape Road
South Main Street
0 0.25 0.5 Miles
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
BELLINGHAM, MA
Map 1: Population Density
Sites
Critical Infrastructure*
* See details in separate table
Water Bodies
Population Density
Census 2010 Blocks
People per acre
0 or No Data
0.1 - 5.0
5.1 - 15.0
15.1 - 30.0
More than 30
All Roads
Interstate
U.S. Highway
State Route
Street
Rail
Stations
Commuter Rail
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
BELLINGHAM, MA
Date: 7/29/2020
Path: K:\DataServices\Projects\Current_Projects\Environment\PDM\project_files\PDM_Map1_vert.mxd


MILFORD
MEDWAY
HOPEDALE
MENDON
FRANKLIN
BLACKSTONE
WRENTHAM
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BELLINGHAM, MA
Map 2: Land Use
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Water Bodies
Development Areas
* See details in separate table
Land Use (2005)
High Density Residential
Medium Density Residential
Low Density Residential
Non-Residential Developed
Commercial
Industrial
Transportation
Agriculture
Undeveloped
Undeveloped Wetlands
N
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by:
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111 | (617) 933-0700
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Massachusetts Department of Transportation (MassDOT)
July 2020


MEDWAY
MILFORD
HOPEDALE
MENDON
FRANKLIN
BLACKSTONE
WRENTHAM
0 0.25 0.5 Miles
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BELLINGHAM
Map 3: Flood Zones
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Flood Zones, 2017
(Annual Chance)
A: 1% Annual Chance of Flooding, no BFE
AE: 1% Annual Chance of Flooding, with BFE
AE: Regulatory
VE: High Risk Coastal
X: 0.2% Annual
March 2010 Flood Claims
Disaster Assistance
Flood Insurance
Locally Identified Hazard Areas*
Flooding
* See Section IV Risk Assessment
Development Areas*
* See details in separate table
Train Stations
Commuter
Rail Lines
Trains
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by:
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111 | (617) 933-0700
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Massachusetts Department of Transportation (MassDOT)
Massachusetts Emergency Management Agency (MEMA)
Massachusetts Department of Conservation and Recreation (DCR)
July 2020


MEDWAY
MILFORD
HOPEDALE
MENDON
FRANKLIN
BLACKSTONE
WRENTHAM
85
109
16
126
140
495
121
122
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BELLINGHAM, MA
Map 4: Earthquakes / Landslides
Sites
Critical Infrastructure Sites*
* See details in separate table
Earthquakes
Epicenters
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Water Bodies
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
N
0
0.25
0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by:
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111 | (617) 933-0700
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Massachusetts Department of Transportation (MassDOT)
July 2020


MILFORD
MEDWAY
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WRENTHAM
1944
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1861
1888
1869
85
109
16
140
126
495
121
122
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BELLINGHAM, MA
Map 5: Hurricanes / Tornadoes
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Tornadoes
Tornado
All Roads
Interstate
U.S. Highway
State Route
Street
Train Stations
Commuter Rail Lines
Trains
Water Bodies
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
100 Year Wind Speeds Miles Per Hour
90 MPH
100 MPH
110 MPH
120 MPH
130 MPH
N
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by:
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111 | (617) 933-0700
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Massachusetts Department of Transportation (MassDOT)
July 2020

MAPC

FEMA Hazard Mitigation Planning Grant

BELLINGHAM, MA

Map 6: Average Snowfall

Sites
- Critical Infrastructure Sites* (* See details in separate table)

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

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

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

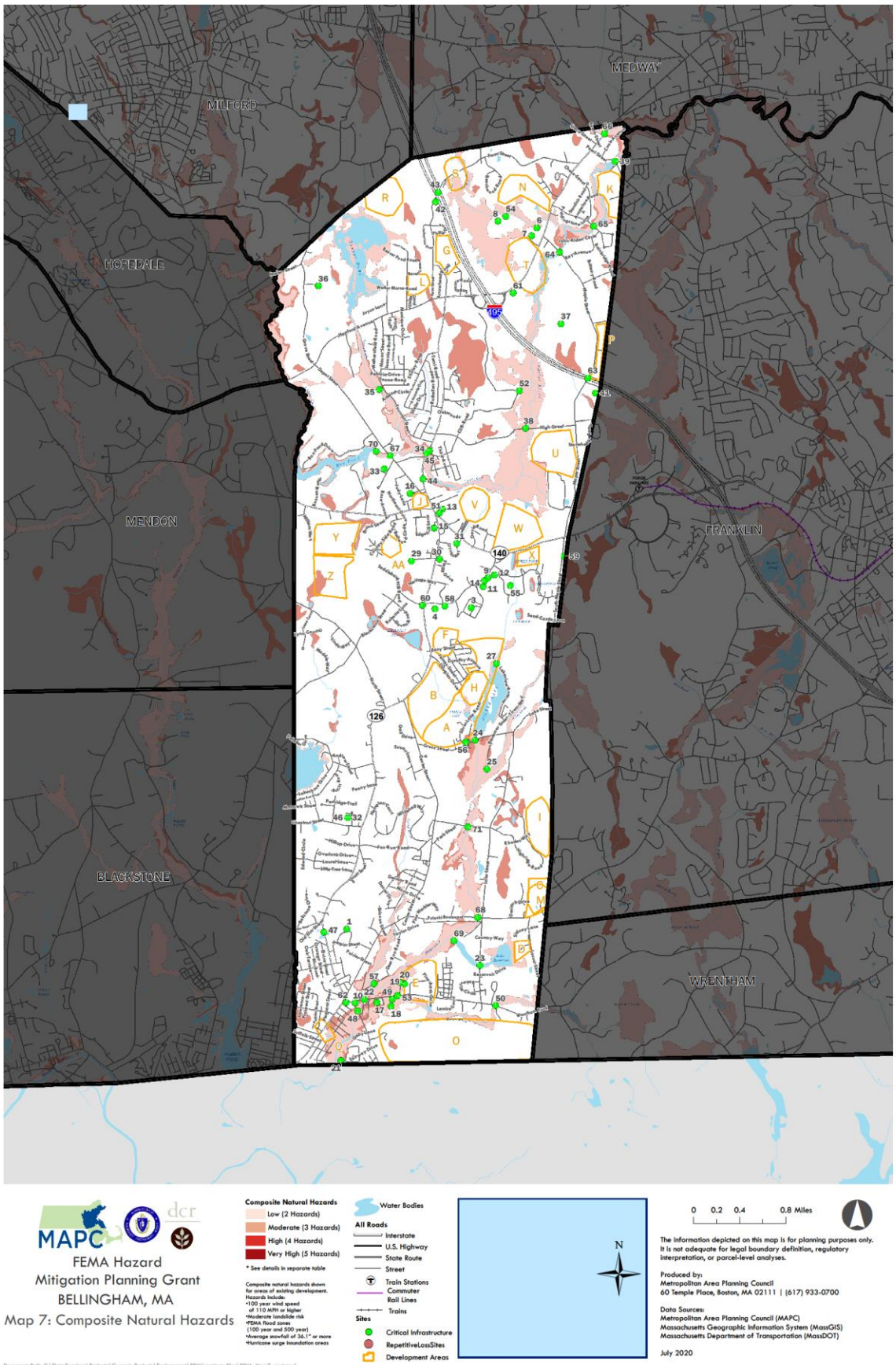
0 0.2 0.4 0.8 Miles

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

Produced by:
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111 | (617) 933-0700

Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Massachusetts Department of Transportation (MassDOT)

July 2020


MEDWAY
MILFORD
HOPEDALE
MENDON
FRANKLIN
BLACKSTONE
WRENTHAM
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BELLINGHAM, MA
Map 7: Composite Natural Hazards
Composite Natural Hazards
Low (2 Hazards)
Moderate (3 Hazards)
High (4 Hazards)
Very High (5 Hazards)
* See details in separate table
Composite natural hazards shown for areas of existing development. Hazards include:
•100 year wind speed of 110 MPH or higher
•Moderate landslide risk
•FEMA flood zones (100 year and 500 year)
•Average snowfall of 36.1" or more
•Hurricane surge inundation areas
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Street
Train Stations
Commuter Rail Lines
Trains
Sites
Critical Infrastructure
RepetitiveLossSites
Development Areas
N
0 0.2 0.4 0.8 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by:
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111 | (617) 933-0700
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Massachusetts Department of Transportation (MassDOT)
July 2020


MEDWAY
MILFORD
HOPEDALE
MENDON
FRANKLIN
BLACKSTONE
WRENTHAM
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140
495
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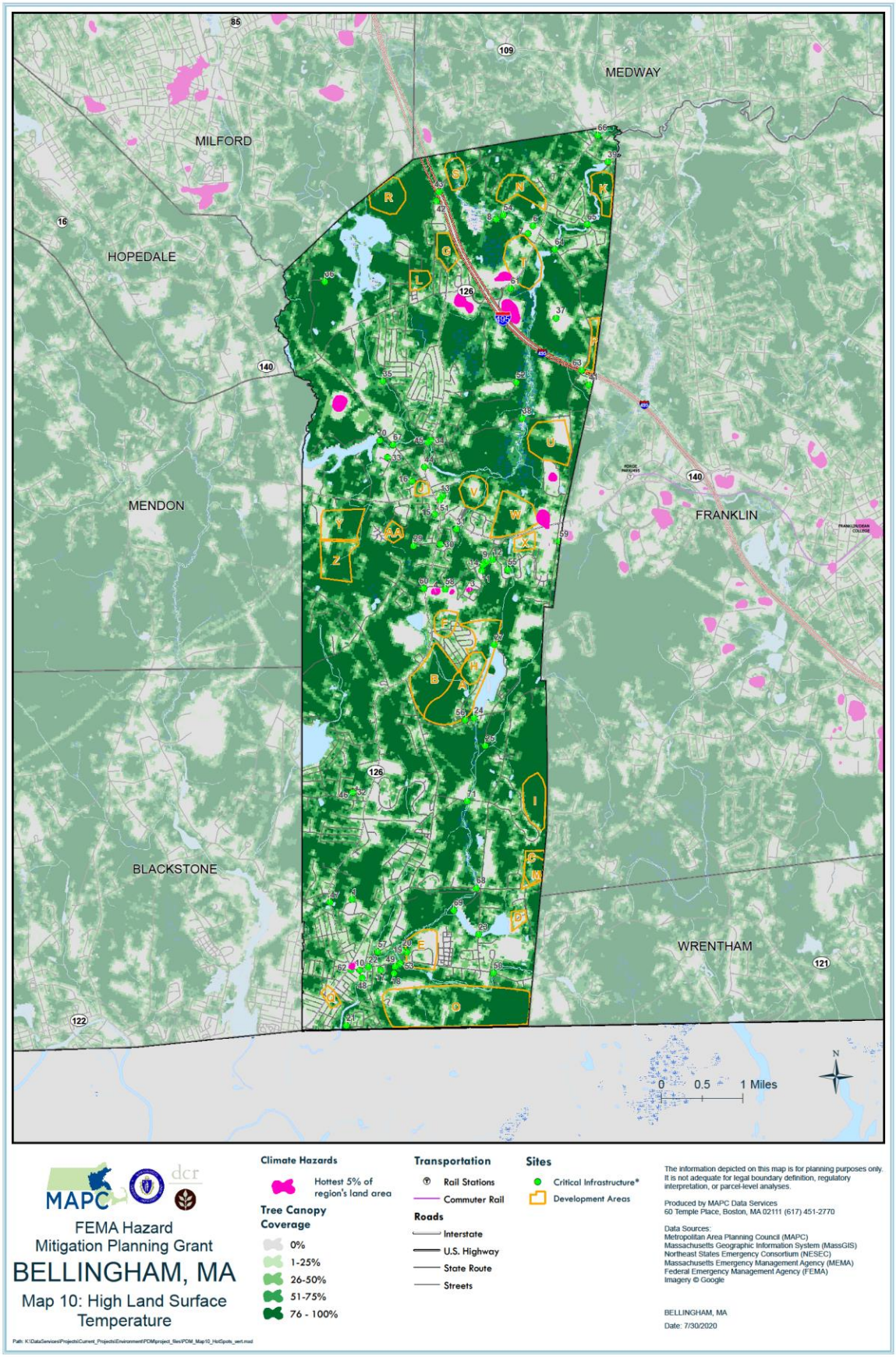
121
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BELLINGHAM, MA
Map 8: Local Hazard Areas
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Locally Identified
Hazard Areas
Brush Fires
Flooding
Historic
* See Section IV Risk Assessment
Development Sites
* See details in separate table
Train Stations
Commuter
Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
N
0 0.225 0.45 0.9 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by:
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111 | (617) 933-0700
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Massachusetts Department of Transportation (MassDOT)
Imagery from 2015
July 2020


MEDWAY
MILFORD
HOPEDALE
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0 0.5 1 Miles
N
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
BELLINGHAM, MA
Map 10: High Land Surface Temperature
Climate Hazards
Hottest 5% of region's land area
Tree Canopy Coverage
0%
1-25%
26-50%
51-75%
76 - 100%
Transportation
Rail Stations
Commuter Rail
Roads
Interstate
U.S. Highway
State Route
Streets
Sites
Critical Infrastructure*
Development Areas
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
BELLINGHAM, MA
Date: 7/30/2020

APPENDIX B: LOCAL TEAM MEETINGS

Bellingham-Franklin
Municipal Vulnerability Preparedness Project

MVP Core Team

First Meeting
September 12, 2019, 9:30 AM
Franklin Municipal Building
355 East Central Street
3rd Floor Training Room

AGENDA

1. Welcome and Introductions
2. Overview and Purpose of MA Municipal Vulnerability Preparedness (MVP) Program and Community Resilience Building Workshop Method
3. Overview of Hazard Mitigation Plans to be updated
4. The role of this MVP Core Team and MAPC
5. Pre-View: Examples of Workshop Materials
6. Date and Location of MVP Workshop and HMP Team Meetings
7. Discussion of Workshop Invitees
8. Other Business / Next steps

Bellingham MVP/Hazard Mitigation Plan

AGENDA
Bellingham Local Team Meeting #1

Monday, October 21, 2019
9:30 to 11:00 AM

Lower Level Meeting Room
10 Mechanic Street, Bellingham

---

1. **Review Summary of the Hazard Mitigation Process**
2. **Update Critical Facilities Inventory and Mapping**
3. **Update Local Hazard Areas**
   a) Flood Hazard Areas
   b) Fire Hazard Areas (brushfires/wildfires)
   c) Other hazards (e.g. Dams, Extreme Heat, Winter Storms, etc)
4. **Update New and Potential Development Sites**
5. **Prepare for MVP Workshop (Nov. 20, 2019)**
   - Identify local stakeholders to invite
   - Invitation Letter, town outreach, RSVP's
   - Review Workshop agenda
   - Review Workshop Materials

Bellingham/Franklin MVP/Hazard Mitigation Plan

Bellingham Local Team Meeting #2

Tuesday, February 18, 2020
10:00 to 11:30 AM

Lower Level Meeting Room
10 Mechanic Street, Bellingham

AGENDA

1. Review/De-brief MVP Workshop
2. Review and Update of Mitigation from the 2010 Plan
    - **Review and update the Mitigation Goals from the 2010 plan**
    - **Update the *Existing* Mitigation Measures from the 2010 plan**
    - **Status of the *Recommended* Mitigation Measures from the 2010 plan**
3. Prepare for MVP Public Forum (Listening Session)
4. Next Steps / Adjourn

Bellingham-Franklin MVP/Hazard Mitigation Plan

Bellingham Local Team Meeting #3

Tuesday, May 26, 2020
11:00 AM

VIA ZOOM
https://zoom.us/j/91122072478

Meeting ID: 911 2207 2478

One tap mobile
+16468769923,,91122072478# US

Dial by your location
+1 646 876 9923 US

AGENDA

1. Review and Finalize Mitigation Recommendations

- ❖ Review the attached summary of mitigation recommendations:
  - Confirm the new mitigation measures (in red text)
  - Confirm and/or update data in columns to right side of table
  - Consider additional mitigation from the MVP workshop (page 4)
  - Add other mitigation measure agreed to by the team, if any

2. Prepare for the Final Public Meeting – Thursday, June 25

3. Next Steps / Adjourn

APPENDIX C: PUBLIC MEETINGS

Town of Bellingham
Public Forum on
Municipal Vulnerability Preparedness and
Hazard Mitigation Plan Update 2020

March 12, 2020

TIME	ACTIVITIES	
6:00	Arrive, sign in and review climate posters	All attendees
6:10	Overview of MVP workshop and top priority actions	Jim Kupfer Town Planner
6:25	Questions and discussion on MVP Actions	All attendees
6:35	Overview of the Hazard Mitigation Plan Update 2020	Martin Pillsbury
6:45	Questions and discussion on Hazard Mitigation Plan	All attendees
6:55	Next steps: finalize draft plan, 2nd public meeting	Jim Kupfer
7:00	Adjourn Public Forum	

See the top MVP Actions and the Hazard Mitigation goals on reverse side

Community Forum:
Preparing for Climate Change and Hazard Mitigation Planning in the Town of Bellingham

Natural hazards can have serious impacts on the Town of Bellingham and its residents and businesses



This Community Forum will summarize the results of a **Municipal Vulnerability Preparedness** (MVP) Workshop that was held on November 20 jointly by the Towns of Bellingham and Franklin. The MVP Workshop brought together Town officials and staff, local businesses, institutions, and civic organizations to identify how Bellingham and Franklin may be vulnerable to the impacts of climate change, as well as the towns' strengths and actions they may take to increase their resilience. The forum will also summarize the 2020 Update of the town's **Hazard Mitigation Plan** which is currently being prepared by Bellingham with the assistance of the Metropolitan Area Planning Council (MAPC).

Date: Thursday, March 12, 2020
Time: 6:00 pm
Location: Bellingham Municipal Center
Arcand Meeting Room
10 Mechanic Street, Bellingham

For more information, please contact James Kupfer at jkupfer@bellinghamma.org

BELLINGHAM PLANNING BOARD

10 MECHANIC STREET BELLINGHAM, MASSACHUSETTS 02019
(508) 657-2892 PlanningBoard@bellinghamma.org

AGENDA
August 13, 2020
7:00 pm

MEETING LOCATION: 10 Mechanic Street

Pursuant to Governor Baker's March 12, 2020 Order Suspending Certain Provisions of the Open Meeting Law, and the Governor's March 15, 2020 Order imposing strict limitations on the number of people that may gather in one place, no in-person attendance of members of the public will be permitted at this meeting, but the public can participate through zoom. The information is located at the bottom of the agenda.

August 13, 2020

MEETING LOCATION: ARCAND MEETING ROOM – MUNICIPAL CENTER

7:00 pm **CONTINUATION PUBLIC HEARING:**

Red Mill Definitive Plan, Zoning Bylaws Article XXIX Downtown Residential Development Overlay District and §240-54, Stormwater Management. The applicant, Snowflake, LLC c/o Kevin Lobisser propose a 118-lot residential subdivision of land containing 114 single family lots and four multi-family lots on 85.6+/- acres between Mill Street and Mechanic Street in Bellingham, shown on Assessor's Map 51, 13-1, zoned Suburban and Business 1.

CONTINUED PUBLIC HEARING:

- Bellingham Shores Major Residential Development Special Permit, Definitive Subdivision, and Stormwater Management Plan.

GENERAL BUSINESS:

- Decommissioning Agreement – 186 Maple Street
- Memorandum of Understanding Planning Coordinator
- Minutes Signing: July 9, 2020 & July 25, 2020
- Voucher Reports
- Municipal Vulnerability Preparedness Plan & Hazard Mitigation Plan

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TOWN CLERK
OFFICE OF THE
2020 AUG -6 A 9:30

These agenda items are those reasonably anticipated by the Chair which may be discussed at the meeting. 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.

BELLINGHAM PLANNING BOARD
MECHANIC STREET
BELLINGHAM, MASSACHUSETTS 02019
(508) 657-2892 PLANNINGBOARD@BELLINGHAMMA.ORG

Meeting Minutes
Thursday August 13, 2020

MEETING LOCATION: *Remote Participation through Zoom*

Present at the Meeting:
William F. O'Connell Jr. (WFO), Chairman
Brian T. Salisbury (BTS), Vice Chairman
Dennis J. Trebino (DJT), Member
Russell E. Lafond (REL), Member
Philip M. Devine (PMD), Member
Elizabeth Berthelette, Associate Member

Other Officials:
James S. Kupfer (JSK), Town Planner and Zoning Compliance Officer
Amy Sutherland, Planning Coordinator

Chairman O'Connell opened the meeting at 7:00 pm.

The Town Planner explained that the Planning Board is meeting both in person with safety precautions put in place, but the public is still meeting by Zoom but the applicants are meeting at the Town Hall to meet face to face with Boards and the goal is to have the meeting evolve over time when hopefully the guidelines for in person meetings will loosen by the State guidelines.

uMunicipal Vulnerability Preparedness Plan & Hazard Mitigation Plan:
The Town of Bellingham has been working with Martin Pillsbury on the revisions to the towns municipal vulnerability preparedness plan & hazard mitigation plan. The town has been working on this for over a year and a half to develop the hazard mitigation plan along with the municipal vulnerability preparedness plan. This was done in collaboration with the town of Franklin in terms of outreach and discussion. The Consultant Pillsbury provided a presentation to the board. The last plan was approved in 2011. Once the plan is updated it will be submitted to FEMA.

There are six categories of the hazard mitigation include:
1. Prevention
2. Property Protection
3. Public Education
4. Natural Resources Protection
5. Structural Projects
6. Emergency Services Protection

The next part of the presentation explained how the plan was developed was discussed. This included Hazard Identification and Mappings, Inventory & Mapping of Critical Facilities, Assessment of Risks and Vulnerabilities, holding a public meeting, reviewing existing mitigation, recommending mitigation strategies, holding a second public meeting and then MEMA and FEMA Plan approval and Town Adoption.

The local identified flood hazard areas included: Box Pond Dam, Lake Shore Drive, Peter's River at Wrentham Road, High Street, Saddleback Street and Green Acres. The next part of the presentation focused on the critical facilities. This identified 66 sites such as fire and police stations, sites requiring assistance such as schools, elderly housing and critical infrastructure such as wells, pump stations, dams and communication areas. There was a chart which showed the vulnerability analysis and estimated damages when an event occurs. The mitigation strategies were discussed and there are currently things in place which to town has in place. The various strategies were noted in the plan. These are organized by hazard categories. The list of the Bellingham MVP High Priority Action items were reviewed.

The Board thanked Mr. Pillsbury for his presentation.

Hazard Mitigation Plan

Public Meeting

Natural hazards can have serious impacts on the Town of Bellingham and its residents and businesses

The Town of Bellingham has prepared an updated Hazard Mitigation Plan to help the town reduce its vulnerability to natural hazards such as flooding, hurricanes, droughts, and winter storms. The plan is part of a joint project with the Town of Franklin that also includes a Municiapl Vulnerability Preparedness project on climate resilience. Please join the Bellingham Planning Board meeting via Zoom, which will feature a presentation on the Hazard Mitigation Plan and an opportunity for questions and comments. Your participation is welcome, please join us!

Date:	Thursday, August 13, 2020
Time:	7:00 pm
Location:	Bellingham Planning Board Meeting via Zoom at: https://us02web.zoom.us/j/84624603767

For more information, please contact
Jim Kupfer at jkupfer@bellinghamma.org

MAPC

APPENDIX D: PLAN ADOPTION

Town of Bellingham
BOARD OF SELECTMEN
10 Mechanic Street
Bellingham, Massachusetts 02019
Tel: 508-657-2800 * 508-966-4425

CERTIFICATE OF ADOPTION
SELECTBOARD

TOWN OF BELLINGHAM, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF BELLINGHAM HAZARD MITIGATION PLAN 2020 UPDATE

WHEREAS the Town of Bellingham established a Committee to prepare the *Town of Bellingham Hazard Mitigation Plan 2020 Update*; and

WHEREAS the *Town of Bellingham Hazard Mitigation Plan 2020 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Bellingham, and

WHEREAS, duly noticed public meetings were held by the LOCAL HAZARD MITIGATION PLANNING TEAM on March 12, 2020 and August 13, 2020 and

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

NOW, THEREFORE BE IT RESOLVED that the Town of Bellingham Selectboard adopts the *Town of Bellingham Hazard Mitigation Plan 2020 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Bellingham.

ADOPTED AND SIGNED this Date. November 2, 2020

Name(s) Michael J. Connor

Title(s) Chair, Board of Selectmen

Signature(s)

APPENDIX E: MVP WORKSHOP RESULTS

HIGHEST PRIORITY ACTIONS FROM THE MVP WORKSHOP	VOTES
1. Emergency Sheltering and Evacuation • Work with senior facilities and housing on **emergency sheltering and evacuation** • **Identify vulnerable populations**, work with community and faith-based organizations to develop strategies to mitigate risks, provide shelters and transportation to shelters • Investigate **emergency services and shelters** and coordinate with Local Emergency Planning Committee; bring all stakeholders together; meet regionally • **Increase number and quality of shelters** – collaborate with community resources, EMP, Red Cross, hospitals, hotels, restaurants, etc. • Investigate **emergency access and backup plans** for Central Park Terrace senior housing • **Food Pantries**: increase outreach to foster support and expand existing sites	**27**
2. Communications and Vulnerable Populations • **Communications infrastructure**: identify ways to connect with people on EEE, extreme weather events • Plan to identify and leverage **services for demographic groups** that may slip between the cracks in social networks • **Increase awareness and educate the towns** on risks and mitigation through social media and town websites (EEE, etc.) • Develop a **robust communication plan** for emergency events that includes other languages • Strengthen communications with Non-Governmental Organizations related to **language barriers** and establish a **Task Force to identify vulnerable populations**	**19**
3. Water Resources	**16**

• Study **capacity of future water supply** for Franklin • **Water Quality:** reliance on wells: Communication & education; wetland protection, control/manage water bodies. • Review and update **stormwater regulations** • **Protect water supplies**	
4. Environment / Sustainable Development • Address **growth management in a sustainable fashion**; preserve open space • Identify key **habitat areas for future protection** measures and conservation	**10**
5. Reliable Power & Tree Management • **Tree maintenance**; cut back; utilities and towns • **Audit commercial generators** in towns • Future development **– underground power lines**	**9**
6. Public Safety Resources • Increase resources for **Public Safety and Public Works** in both towns	**9**
7. Green Energy • Apply for Green Communities and other similar sources • Locate/site solar farms in areas that have been previously cleared; don't impact the natural landscape	**6**
8. Long-Term Infrastructure Planning • Culverts and bridges, capital improvements and maintenance • Continued improvement of infrastructure: design for a new future; long range impact requirements	**2**

HIGHEST PRIORITY BELLINGHAM ACTIONS

1 Bellingham Schools (14) • Town schools should get together to discuss emergency planning, document plans	**14**
2. Bellingham DPW Building (8) • Replace Bellingham DPW building (8(	**8**
3. Bellingham: Beaver Management (3) • Develop Plan for beaver management to mitigate flooding at Stall Brook ;School and Hartford Avenue (3)	**3**
4. Bellingham: Senior Center(2) • Renovations needed for Bellingham Senior Center (1) • Improve infrastructure at Senior Center – generator; kitchen (1)	**2**
5. Bellingham: Flooding on Wrentham Road (1) • Study culverts to mitigate flooding on Wrentham Road (1)	**1**
6. Bellingham: Transport of Hazardous Materials (1) • Create alternate truck routes or restrict transport of hazardous materials on Blackstone Street (1)	**1**