2022 BEDFORD, MA HAZARD MITIGATION PLAN UPDATE AND MUNICIPAL VULNERABILITY PREPAREDNESS SUMMARY OF FINDINGS

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EXECUTIVE SUMMARY

Hazard mitigation attempts to permanently reduce or alleviate the loss of life, injury, and property damage resulting from natural and human-made hazards through long-term, attainable strategies. These long-term strategies include planning, policy changes, programs, projects, and other appropriate activities.

The Federal Disaster Mitigation Act, passed in 2000, requires that after November 1, 2004, all municipalities that wish to be eligible to receive funding for hazard mitigation grants must adopt a local multi-hazard mitigation plan.

In 2019, the Town of Bedford, Massachusetts was awarded a Municipal Vulnerability Preparedness (MVP) Planning Grant from the Executive Office of Environmental Affairs (EEA) to update the 2010 Town of Bedford Hazard Mitigation Plan (HMP), further assess vulnerabilities, and develop a plan to prepare for current and future climate change impacts in Bedford. While reduction of the Town's contributions to climate change were considered, planning efforts focused mainly on climate adaptation and resilience. In order to address multijurisdictional and regional issues, Town staff and representatives from surrounding municipalities, and stakeholders with local and regional interests and influence were invited to participate in a Community Resilience Building (CRB) Workshop held on December 6, 2019 to comment on shared hazards and opportunities for mitigation.

The Town evaluated natural hazard mitigation planning through the lens of climate change during the workshop, generating this 2022 Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Summary of Findings. The following document has been designed to meet the requirements of the Federal Disaster Mitigation Act. Upon completion of the CRB process, the Town will be designated by EEA as an MVP Certified Community. This designation makes the Town eligible for grant funds to implement resiliency planning and the improvement projects outlined herein.

The following document provides a general overview of several natural hazards that can potentially impact the Town of Bedford. Existing mitigation measures are discussed for each hazard, and existing mitigation measures for all natural hazards are compiled. Additional sections outline the mitigation process that has taken place since the 2010 Bedford Hazard Mitigation Plan as well as the priority actions and associated action plan identified during the CRB Workshops outlined in Section 2.3. The following actions were identified as the five current highest priorities to improve the Town's resilience to climate change:

1. Assess and construct redundant underground electrical system/microgrid at Town Campus to be under the control of the Town.

2. Develop a Town Emergency Communications Plan and identify most effective means to reach vulnerable populations including residents with economic, language, and physical barriers.
3. Working with the local utility companies, continue to identify vulnerable street trees and perform proactive maintenance along overhead power lines.
4. Review and update the Comprehensive Emergency Management Plan.
5. Coordinate with downstream communities and other planning commissions to manage rivers and streams. Develop and implement proactive Beaver Management Plan.

1.0 INTRODUCTION

1.1 What is Hazard Mitigation Planning?

Hazard mitigation planning is the process of figuring out how to reduce or eliminate the loss of life and property damage resulting from natural hazards such as extreme heat, floods, major snow and rain events, earthquakes, and hurricanes.

Long-term strategies for hazard mitigation include planning, policy changes, programs, capital improvement projects, and other pertinent activities. Each of these strategies offers a significant return on investment when adopted prior to the occurrence of a natural disaster. The National Institute of Building Sciences estimates that every dollar spent on mitigation can result in a savings of $4 to $11 in avoided losses, depending on the strategy and sector. These estimates do not quantify the avoidance of social impacts, particularly on marginalized communities. Additional benefits of local hazard mitigation planning include an increased awareness of vulnerabilities, improved safety and welfare of citizens, and community commitment to mitigation.

1.2 Project Background

Funding for hazard mitigation is available through a variety of sources, including the Federal Emergency Management Agency (FEMA). FEMA currently has four mitigation grant programs: The Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation (PDM) Grant, the Flood Mitigation Assistance (FMA) Grant, and the Building Resilient Infrastructure & Communities (BRIC) Program. As of November 1, 2004, municipalities that wish to continue to be eligible to receive these hazard mitigation grants must adopt a local multi-hazard mitigation plan per the Federal Disaster Mitigation Act, passed in 2000. This planning requirement does not affect disaster assistance funding, which FEMA directs towards relief and recovery where a disaster has already occurred. The Town of Bedford undertook this local hazard mitigation planning initially with the creation of the Town of Bedford Hazard Mitigation Plan (HMP), in June of 2010, with assistance from the Metropolitan Area Planning Council.

Massachusetts is pursuing an integrated approach to climate change and natural hazards, including strategies to reduce greenhouse gas emissions and encourage communities to proactively address climate hazards unique to their community. Governor Charlie Baker issued Executive Order No. 569: Establishing an Integrated Climate Change Strategy for the Commonwealth in September 2016. This order established timelines for the state to review and update its emission standards and created the Municipal Vulnerability Preparedness (MVP) program, under which this HMP Update is being conducted. This document acts as the final MVP Community Resilience Building Workshop Summary of Findings Report and has been designed to meet the requirements of the Federal Disaster Mitigation Act.

2.0 PLANNING PROCESS AND PUBLIC PARTICIPATION

The Town of Bedford received a Municipal Vulnerability Preparedness (MVP) Planning Grant from the Executive Office of Environmental Affairs to evaluate climate hazards facing the Town, discuss municipal strengths and vulnerabilities, and identify opportunities to improve the Town's overall resiliency. The grant specifies using the Community Resilience Building (CRB) framework, a public-input process developed by The Nature Conservancy, to leverage the local knowledge and experience of community members to develop a Town-specific list of priorities to respond to climate-related hazards. This process was further expanded into an update of the 2010 Town of Bedford Hazard Mitigation Plan.

2.1 MVP Core Team and Kick-Off Meeting

Upon award of the MVP Planning Grant, the Town contracted with Beals and Thomas, Inc. as an MVP certified provider to complete the CRB process. The following individuals from the Town of Bedford and Beals and Thomas, Inc. comprised the primary MVP Core Team:

- Jeanette Rebecchi, AICP, DPW Transportation Program Manager
- Adrienne St. John, Public Works Engineer
- David Grunes, Fire Chief
- Eric J. Las, PE, Beals and Thomas, Inc., Facilitator
- Mary Kate Schneeweis, Beals and Thomas, Inc., Facilitator

In preparation of the CRB process and HMP update, the MVP Core Team held a kick-off meeting in Bedford on July 25, 2019.

The MVP Core Team corresponded by telephone and email over the course of the CRB and HMP update process, to discuss the format, procedures, and requirements of the project. These goals are specifically detailed in Section 6.0.

2.2 General Planning Timeline

The following planning process took place according to the general timeline below. Specific workshops and public listening sessions information can be found in the following Sections.

- Awarded MVP Planning Grant: June 6, 2019
- Core Team Establishment of Approach: July 25, 2019
- CRB Workshop: December 11, 2019
- Public Listening Session #1: March 4, 2020
- Public Listening Session #2: May 2021
- HMP/Summary of Findings available for public review: May 26, 2021
- Final Report: June 16, 2021
- Receipt of MEMA Comments: September 23, 2021
- Resubmission to MEMA: December 23, 2021
- Receipt of FEMA Comments: February 18, 2022
- Submission to FEMA: April 27, 2022
- Receipt of Approval Pending Adoption: May 10, 2022

Bedford MVP Designation Schedule

2.3 Community Resilience Building Workshop

The central objectives of the CRB Workshop were to define local natural and climate-related hazards of concern, identify existing strengths and vulnerabilities, develop prioritized actions for the community and identify immediate opportunities to collaboratively advance actions to increase resiliency.

Attendees at the CRB Workshop, December 11, 2019

The Town chose to conduct the CRB process over the course of one eight-hour workshop held on December 11, 2019. The Town invited 60 individuals to participate as stakeholders in the CRB process. These stakeholders included a variety of community members with interest in resiliency efforts, including representatives of municipal and state government, non-profits, and other interest groups.

Refer to Table 1 for a list of invited stakeholders, with asterisks denoting those who attended the workshop. Appendix B includes the presentations and handouts provided to workshop participants.

Table 1: Final MVP Stakeholder List

Contact	Organization	Attendance
Taissir Alani	Bedford Facilities Department	*
Elizabeth Bagdonas	Bedford Conservation Department	*
Jacinda Barbehenn	Bedford Planning Board	*
Michael Barbehenn	Bedford Conservation Land Stewards/Trails Committee	
Dot Bergin	*The Bedford Citizen*	*
Robert Bongiorno	Bedford Police Department	*
Joan Bowen	League of Women Voters of Bedford	*
Robert Cole	Billerica Fire Department	*
Christa Collins	Sudbury Valley Trustees	*
Patrick Cook	Middlesex Community College	
Stephanie Cronin	Middlesex 3 Coalition	
Donald Cullis	Bedford Land Acquisition Committee	
John Daniels	Bedford Fire Department	*
Michael Donnell	Bedford Energy and Sustainability Committee	
Corinne Doud	Mothers Out Front	*
Kristin Dowdy	Bedford Department of Public Works - Engineering	*
Jacqueline Edwards	Bedford Arbor Resource Committee	
Brian Farless	Eastern Middlesex Mosquito Control	
Amy Fidalgo	Bedford Town Manager's Office	*
Tony Fields	Bedford Planning Department	
Margot R. Fleischman	Bedford Select Board/Community Preservation Committee	*
Dennis Freeman	Bedford Department of Public Works - Grounds	*
Jeff French	Bedford Police Department	
Carl Gagnon	Bedford Department of Public Works - Highway	
Amber Goodspeed	Hanscom Field Regional Airport	
Ken Gordon	Massachusetts State Representative	
Michael Griffin	Bedford School Department	
David Grunes	Bedford Fire Department	*
Sandra Hackman	Bedford Council on Aging	
Amy Hamilton	Bedford Recreation Department	
Ralph Hammond	Rotary Club of Bedford	*
Audrey Horst	Office of Massachusetts State Senator Mike Barrett	
Joe Kitko	Edith Nourse Rogers Memorial Veterans Hospital	
Christopher Laskey	Bedford Code Enforcement Department	*
John Linz	Bedford Historic Preservation Commission	*
David Manugian	Bedford Department of Public Works	*
Daniel Martin	Middlesex Community College	*
Ed McGrath	Bedford Department of Public Works - Recycling	*

Contact	Organization	Attendance
Richard Michaud	Edith Nourse Rogers Memorial Veterans Hospital	
Emily Mitchell	Bedford Select Board	
William Moonan	Bedford Select Board	
Chris Nelson	Bedford Department of Public Works - GIS	*
Catherine Perry	Bedford Planning Department	*
Linh Phu	US FWS - Great Meadows National Wildlife Refuge	
Ed Pierce	Bedford Select Board	
Heidi Porter	Bedford Dept of Health & Human Services/Board of Health	*
Jason Raposa	Bedford Department of Public Works - Water/Sewer	*
Jeanette Rebecchi	Bedford Department of Public Works	*
Frank Richichi	Bedford ad hoc Community Garden Task Force	
Michael Rosenberg	Bedford Select Board	
Alyssa Sandoval	Bedford Economic Development	*
JoAnn Santiago	Bedford School Committee	*
Ron Scaltreto	Bedford Facilities Department	*
Shawn Schiffer	Rotary Club of Bedford	
Jonathan Sills	Bedford School Department	
Adrienne St. John	Bedford Department of Public Works - Engineering	*
Sarah Stanton	Bedford Town Manager	
Sue Swanson	Mothers Out Front	*
Mark Sullivan	Bedford Fire Department	*
Maureen Sullivan	Bedford Chamber of Commerce	
Christina Wilgren	Bedford Housing Partnership	*
Allan Wirth	Bedford Conservation Commission	
David Wong	Hanscom Air Force Base	
John Zupkus	Shawsheen River Watershed Association	
Director	MBTA	
Editor	*Bedford Minuteman*	

2.3.1 Regional Partners and Inter-Community Considerations

Some hazard mitigation issues are strictly local; The problem originates primarily within the municipality and can be solved at the local level. Other issues are inter-community and require cooperation between two or more municipal entities. Regional mitigation may involve state, regional, or federal agencies, or several municipalities.

To address multijurisdictional and regional issues, representatives from surrounding municipalities, and regional organizations with ties to Bedford, were invited to participate in the CRB Workshop. Discussions occurred on shared hazards and the associated risks, and input was provided on actions the Town of Bedford can take to improve its resiliency. These stakeholders include the following:

- The Middlesex 3 Coalition a public-private partnership to promote businesses and improve quality of life along the Route 3 Corridor, and

includes representatives of the communities of Tyngsborough, Westford, Chelmsford, Lowell, Tewksbury, Billerica, Burlington, and Lexington.

- The Hanscom Field Regional Airport and Hanscom Air Force Base, whose infrastructure extends into the adjacent towns of Lincoln, Concord and Lexington.
- The Eastern Middlesex Mosquito Control District provides mosquito control services to 26 participating communities located west and northwest of Boston. The governing body is comprised of one representative from each municipal government.
- Mothers Out Front is a group of daughters, mothers and grandmothers who are working with town and other allies on a host of initiatives to address climate change.
- Billerica Fire Department

2.3.2 Hazard Identification and Assessment Process

The first half of the workshop focused on identifying the top hazards facing the Town, as well as related strengths and vulnerabilities. Facilitators presented demographic data specific to Bedford from the United States Census Bureau, the American Community Survey (ACS), and the University of Massachusetts Boston. In addition, stakeholders were given a presentation and handout summarizing climate change data from the Massachusetts Climate Change Projections, published in December 2017. As a large group, stakeholders discussed the primary hazards facing Bedford, reaching agreement on the top hazards. After discussion, stakeholders identified the top hazards facing the Town of Bedford as the following:

Workshop participants identifying action items

- Flooding and Extreme Precipitation
  Bedford has a significant area within the 1% Annual Chance Flood (formerly known as the 100-year floodplain). As determined by a Geographic Information Systems (GIS) analysis of FEMA data, approximately 23.8% of the Town is mapped as 1% Annual Chance Flood in the riverine floodplain associated with the Concord River, Elm Brook, Shawsheen River, Spring Brook, and Vine Brook.

- Heat/Drought/Fire
  Heat, Drought, and Fire were grouped as one hazard by the CRB participants, as they create related issues and are influenced by each other. These hazards pose health concerns, strains on emergency management, loss of vegetation and can impact safe water supply and distribution system pressures.

- Winter Storms
  Winter Storms were noted as contributors to infrastructure damage such as the collapse of building roofs under the weight of snow, as well as interruption of transportation routes due to ice, downed trees and overhead wires.

- High Winds and Severe Storms
  High Winds and Severe Storms were of particular concern. Attendees recalled the microburst the Town experienced in 2014, which downed 50-70 trees, and included extreme wind, hail, and lightning.

  Discussion of additional hazards and their associated vulnerabilities are included in Section 4.0 herein.

2.4 Public Input Opportunities

2.4.1 Refinement of Hazard Mitigation Strategies

Opportunities for public input included hosting of a listening session conducted during the drafting of the plan. This meeting was publicized in the *Bedford Citizen*, and posted on the Town's website and social media. At this listening session, the MVP Core Team provided an overview of the results of the CRB process, with a focus on the priority actions. Attendees then divided up into two groups to review the actions by each of three topics: societal, infrastructural, and environmental. These small groups rotated between each topic to refine the priorities, timeframe, and actions. Based on the input received at this meeting, the action matrix was updated. A copy of the meeting announcement in the Bedford Citizen soliciting public input, as well as the materials presented during the listening session, is included in Appendix F.

2.4.2 Public Comment Period

A final public input opportunity was held virtually from May 26, 2021 to June 15, 2021 to review the results of the CRB process. Members of the MVP Core Team prepared a guided walkthrough of the MVP and HMP update process, and summarized the top actions identified at the CRB workshops. The Draft Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Summary of Findings was then made available for public comment for a period of three weeks. During this period, announcements requesting input on the report were posted on the Town's website and social media pages, and an article was published in a newspaper of local circulation. A sample announcement soliciting public comment is enclosed in Appendix F.

Public comments were incorporated into the 2022 Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Summary of Findings .

Refer to Appendix F for the virtual input materials, and written comments received during and after the listening session

3.0 COMMUNITY PROFILE

3.1 Overview

The Town of Bedford is located in Middlesex County and is bordered by Billerica to the north, Burlington and Lexington to the east, Lincoln to the south, and Concord and Carlisle to the west. Bedford is 11 miles south of Lowell, and 15 miles northwest of Boston.

Major roadways providing access to Bedford include U.S. Route 3 and State-numbered routes 4, 62, and 225. The Minuteman Bikeway runs from Depot Park at South Road in Bedford easterly approximately 10 miles through Lexington and Arlington to Cambridge. Commuter rail stations are located in Concord and Billerica. Bedford is serviced by the Massachusetts Bay Transit Authority (MBTA) bus routes 62, 62/76, and 351, the Lowell Regional Transit Authority (LRTA), and a Town-operated weekday minibus. Hanscom Airfield, which is operated by Massport, is located in the southern part of the Town, but accessed through Lincoln.

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

Bedford maintains its rural character through the protection of its rivers, ponds, fields, and forests designated as conservation lands. The Town preserves open spaces with walking trails and bikeways as well as athletic fields and parks. The Concord River and adjoining Great Meadows National Wildlife Refuge forms the Town's western boundary with Concord and Carlisle. Another prominent river – the Shawsheen – has headwaters at Hanscom Field and runs through the eastern part of Bedford into Billerica

The Town is home to a mix of business and industry, including major employers such as Middlesex Community College, the Edith Nourse Rogers Memorial Veterans Hospital, MITRE, iRobot and Hanscom Air Force Base, who employ some 28,000 persons alone. The Town's strong business community has a Chamber of Commerce with 150 members ranging from local professional firms to large corporations with global headquarters in Bedford. The Town is a Platinum rated "BioReady" community with 30 life sciences companies, and a growing high-tech and robotics hub.

The Town is comprised of approximately 14,123 people and 5,346 housing units according to U.S. Census Data. The population has increased approximately 6.1% from April 2010 to July 2019.

Table 2: Bedford Characteristics

2019 Population = 14,123

- 5.1% are under age 5
- 17.6% are over age 65
- 20.3% speak languages other than English at home (over age 5)
- 4.8% have a disability (under age 65)
- 3.3% persons living below the poverty line

Employment = 68.1% (ages 16+)

Source: U.S. Census Bureau and ACS April 2010-July 2019

Some of Bedford's unique characteristics include:

- Bedford was the first Massachusetts community to pass the Community Preservation Act (CPA).
- Bedford is home to one of the region's major conservation resources, the Great Meadows National Wildlife Refuge.
- Bedford contains both Hanscom Air Force Base and Hanscom Field. Hanscom Field is the region's largest general aviation airport, and acts as a reliever airport to Boston's Logan International Airport. Operated by Massport, Hanscom Field provides private and commercial aviation services, and leases space to area flight schools.
- Bedford has one of the region's major VA Hospitals. The Edith Nourse Rogers Memorial Veterans Hospital has over 500 beds.
- Bedford is home to Middlesex Community College.

- Bedford has a number of diverse public recreational facilities including the Minuteman Bikeway, the Narrow Gauge and Reformatory Branch Rail Trails, Springs Brook Park, Fawn Lake, 38 miles of public trails, community gardens, horse farms, and a private tennis and swimming club.
- Bedford is a mature Boston suburb, and due to its location and desirable resources, is largely built-out. However, encroaching redevelopment of residential and commercial parcels continues to put pressure on the Town's natural resources, and generates excessive amounts of traffic.

The Town of Bedford maintains a website at *http://www.bedfordma.gov*.

3.2 Existing Land Use

Tables 3 and 4 provide a breakdown of existing land uses and cover types in Bedford, based upon the most recent land use data for the state of Massachusetts compiled by MassGIS using aerial photogrammetric data from 2016. Land cover can be identified as the main physical characteristic occupying the land (e.g. impervious, forested, etc.), while land use identifies the primary purpose of the landscape (e.g. residential, commercial, industrial, etc.).

Table 3: Existing Land Use in Bedford, 2016

Category of Use	Area (acre)	Percentage
Residential – single-family, multi-family, and other	3,500	39.4
Tax exempt	2,291	25.8
Open land	1,451	16.4
Right-of-way	648	7.3
Commercial	312	3.5
Industrial	307	3.5
Unknown	154	1.7
Mixed use	92	1.0
Agriculture	45	0.5
Recreation	45	0.5
Open Water	16	0.2
Forest	7	0.1
Total	***8,869***	

Source: MassGIS (2016)

Table 4: Existing Land Cover in Bedford, 2016

Cover Type	Area (acre)	Percentage
Deciduous and Evergreen Forest	3,531	39.8
Forested, Emergent, and Scrub/Shrub Wetland	2,085	23.5
Impervious	1,595	18.0
Developed Open Space	1,404	15.8
Grassland and Pasture/Hay	123	1.4
Open Water	89	1.0
Scrub/Shrub	23	0.3
Bare Land	11	0.1
Aquatic Bed	7	0.1
Cultivated	1	0.0
Total	***8,869***	

Source: MassGIS (2016)

The most common cover type in Bedford is forest, which makes up approximately 40% of the Town's land area, with an additional 24% of area occupied by various types of wetlands. The next most populous cover type was impervious (i.e. developed) land at 18%. Single-family residential land uses are the largest developed category of land use, making up approximately 30% of the Town's land area, with multi-family residential and primarily residential mixed uses adding an additional 10%. Approximately 26% of the Town are tax-exempt uses, reflecting significant open space areas such as the Great Meadows National Wildlife Refuge, as well as institutional uses such as the Hanscom Air Force Base.

3.3 Existing Plans

A number of plans were reviewed to garner issues related to natural hazards. In many ways these plans built upon the work of the 2010 Hazard Mitigation Plan. For instance the 2019 Storm Water Management Plan included language eventually used at Town Meeting to adopt a local Stormwater Bylaw. Additionally, the Planning Board now places increased emphasis on Low Impact Development (LID) and landscape aspects in its review of development applications.

Stormwater Management Plan, 2019

The Stormwater Management Plan was designed to implement the Town's Stormwater Management Program (SWMP), including regulations and bylaws. The plan outlines Town-specific municipal separate storm sewer (MS4) information as well as the Town's requirement to regulate and manage stormwater pollution prevention plans (SWPPP), inspection reports, annual reports, training, and information required by the EPA's General Permit.

Bedford Comprehensive Emergency Management Plan, 2017
The Comprehensive Emergency Management Plan (CEMP) is an all-hazards emergency operations plan, which defines the scope of preparedness and emergency management capabilities. The CEMP facilitates preparedness, mitigation, response, and short-term recovery, which sets the stage for a successful long-term recovery. The CEMP consists of a Base Plan supplemented with an Emergency Operations Support Annex. The Base Plan forms the overall framework for emergency management. The Annex provides additional detail on essential discipline-specific functions.

Climate Change and Resiliency Plan, 2017
The Climate Change and Resiliency Plan was created by the Minuteman Advisory Group on Interlocal Coordination (MAGIC) to assess climate change vulnerabilities and strategies for combating climate change in 13 municipalities including Bedford, Acton, Bolton, Boxborough, Carlisle, Concord, Hudson, Lexington, Lincoln, Littleton, Maynard, Stow, and Sudbury, Massachusetts. The plan outlines ecological systems, public health, effects on agriculture, and economic and built environment damages as the priority concerns regarding climate change impact. Outlined starting points for combating climate change in these communities included engaging in regional green and clean infrastructure planning, and prioritizing active transportation investments, to build and bolster community-level climate resiliency.

Bedford Pedestrian and Bicycle Plan, 2015
The Bedford Pedestrian and Bicycle Plan works to develop ways to improve walking and bicycling capacity and connectivity to incentivize transportation which is less impactful to the environment. The plan's goals were to develop a pedestrian/bicycle connectivity master plan for sidewalks, safe crossings, off-road pedestrian and multipurpose trails, and identifying relatively safe on-road bicycle routes and lanes.

Bedford Comprehensive Plan, 2013
The Bedford Comprehensive Plan addresses the changes in development within the Town and identifies specific challenges and opportunities in areas such as land use, natural and cultural resources, economic development, transportation, housing needs and services, facilities, recreation and energy. The Plan includes strategies to preserve the natural resources of the Town.

Town of Bedford Tree Policy
The Bedford Tree Policy was developed to promote a diverse, healthy, and sustainable urban tree canopy to provide general welfare for the community while also improving air and water quality, erosion control, carbon absorption, and to assist in moderating air temperatures and increase property values.

Open Space and Recreation Plan, 2004-2008
The Open Space and Recreation Plan works to preserve the agricultural and natural resources along with the historical structures and sites, and other remaining open space within the Town of Bedford. By preserving these areas, they work to prevent overdevelopment, preserve Bedford's natural character, and protect water resources, aquifer recharge areas and wildlife habitats.

Sudbury – Assabet – Concord River Watershed Action Plan, 2005
The Sudbury – Assabet – Concord River Watershed Action Plan addresses growth and development, water quality, water quantity, land protection, open space, habitat, biodiversity, outreach and education, and recreational opportunities. Bedford is partially within the SuAsCo watershed, which has a drainage area of 377 square miles.

Relevant goals from the plan include the promotion of smart growth to minimize impacts from development, land protection, and public education. The plan also stresses the importance of the watershed communities and others working together to achieve common goals.

Specific actions include: encouraging communities to adopt low-impact development (LID) bylaws; encouraging municipalities to work across boundaries; requiring developers to look at cumulative impacts; continuing research studies on water balance; conserving water; increasing funding for open space protection; identifying priority lands for protection; and encouraging communities to adopt the Community Preservation Act.

Bedford Community Development Plan, 2004
The plan focused mainly on transportation with some mapping of housing opportunities and an update of the Town's economic profile. The plan did identify two possible future conservation sites – the Eisenhauer property and Harvard property. The Harvard property abuts the Great Meadows Wildlife Refuge. The Town did secure 34 acres of the Eisenhauer property; 28 for open space and 6 for active recreation.

3.4 Potential Future Land Use

Most major developments are regulated by the Planning Board through subdivision control and special permits or site plan reviews under the Zoning Bylaw. In a few cases the Zoning Board of Appeals is the reviewing authority. These approvals are a preliminary step prior to issuance of building permits from the Code Enforcement Department. Small developments such as individual houses on established or ANR lots, or accessory buildings on residential properties, may be 'by right' and only need a building permit from the Code Enforcement Department. Bedford has extensive wetland areas and therefore many developments fall under the Conservation Commission's regulation through the MA Wetlands Protection Act and a local wetlands bylaw. Aquifer protection permits under the Zoning Bylaw are under the jurisdiction of the Select Board.

According to the Assistant Planner, the Town of Bedford under current conditions is largely built out, but has a few remaining undeveloped parcels that could potentially support small subdivisions or Planned Residential Developments (PRDs). A significant amount of both residential and industrial redevelopment and building expansion is occurring, sometimes putting more pressure on natural resources

In addition to site-specific redevelopment, the Town identified the following upcoming larger developments:

Ultragenyx Therapeutics - 170 Middlesex Turnpike
Ultragenyx is currently constructing a gene manufacturing facility on Middlesex Turnpike. The planned Phase I facility will encompass 100,000 square feet and is expected to be in full operation by 2023. An additional 86,000 square feet could double capacity, if needed, as part of a Phase II on-site expansion. A similar facility is also being proposed at 172 Middlesex Turnpike.

LCB Senior Living, "The Residences at Bedford" - 240-244 South Road
LCB Senior Living is seeking approval to develop a 92-residence senior housing community with a total floor area of approximately 90,000 square feet. The proposed facility would occupy two plots of land, one that is currently a single residential unit and the other has been a contractor's storage site, zoned Industrial A.

4.0 OVERVIEW OF HAZARDS AND VULNERABILITIES

The following Section provides a general overview of past occurrences of natural hazards, as well as the potential impacts of said hazards to the Town of Bedford.

4.1 Overview of Hazards and Impacts

In preparation of the HMP Update, the Town of Bedford evaluated the fourteen natural hazards outlined in the 2018 Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan (SHMCAP). The SHMCAP identifies the risk that various natural hazards pose to the following critical sectors: populations, government, the built environment, natural resources and the environment, and the economy. SHMCAP is the first plan in the nation to integrate climate adaptation into its hazard mitigation plan. The plan addresses how climate change intensifies existing natural hazards, as well as outlines an adaptation strategy. The SHMCAP complies with FEMA requirements that states maintain hazard mitigation plans to maintain eligibility for disaster recovery funding.

Table 5 summarizes the fourteen hazard risks for Massachusetts, grouped by their primary interaction with climate change as described in the SHMCAP. This table notes where risks in Bedford differ from the state assessment. The state analysis takes into account the frequency of the hazard, historical records, and variations in land use. An explanation of the definitions used can be found at the end of the table. The following sections of this chapter more specifically describe past incidences of these hazards and their impacts unique to Bedford.

A number of impacts can occur from any of the outlined natural hazards. Most common are electrical outages and closures of roadways. This can occur due to high winds that knock down wires and limbs, from heavy snow falls that take time to clear, or from a landslide that carries debris onto a roadway. In addition to causing inconveniences, these impacts can result in economic losses to local businesses that cannot function without electricity, or to their customers or employees who cannot get to the business. Minimizing vulnerability to natural hazards can help to reduce these and other impacts to people's safety, health, and overall economic success.

Table 5: Frequency and Severity of Natural Hazards in Massachusetts

Hazard	Frequency in State	Severity in State	Issues in Bedford
Changes in Precipitation			
Flood	High	Serious to extensive	Same as State
Dam Failure	Low	Extensive	Same as State. Three dams are registered in Bedford with DCR.
Drought	Medium	Serious	Same as State
Landslides	Low	Minor	Not a major issue in Bedford
Sea Level Rise			
Coastal Flooding	High	Serious to extensive	Not a major issue in Bedford
Coastal Erosion	Location Dependent	Serious to extensive	Not a major issue in Bedford
Tsunami	Very Low	Extensive to catastrophic	Not a major issue in Bedford
Rising Temperature			
Average/Extreme Temperature	High	Serious	Same as State
Brush Fires	Medium	Serious	Same as State
Invasive Species	High	Minor	Same as State
Extreme Weather			
Hurricanes	Medium	Extensive to catastrophic	Same as State
Severe Winter Storms/Nor'easters	High	Serious	Same as State
Tornadoes	Medium	Extensive to catastrophic	Same as State
Other Severe Weather (wind, hail, lightning)	Medium	Serious	Same as State
Non-Climate-Influenced Hazards			
Earthquakes	Low	Catastrophic	Same as State

Definitions Used in the Commonwealth of Massachusetts State Hazard Mitigation Plan

Frequency
- Very Low Frequency: Events that occur less frequently than once in 1,000 years (less than 0.1% per year).
- Low Frequency: Events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year).
- Medium Frequency: Events that occur from once in 10 years to once in 100 years (1% to 10% per year).
- High Frequency: Events that occur more frequently than once in 10 years (greater than 10% per year).

Severity
- Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., 1 or 2 communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.
- Serious: Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.
- Extensive: Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.
- Catastrophic: Property and public infrastructure destroyed; essential services stopped; thousands of injuries and fatalities.

Table 6 lists those federal disaster and emergency declarations for Middlesex County.

Table 6: Natural Disaster and Emergency Declarations for Middlesex County 1991 to present

ID Number	Type	Date
4379	Severe Winter Storm and Snowstorm	March 2018
4214	Severe Winter Storm, Snowstorm, and Flooding	January 2015
4110	Severe Winter Storm, Snowstorm and Flooding	April 2013
4051	Severe Storm/Snowstorm	October 2011
1959	Severe Storm and Snowstorm	January 2011
1895	Severe Storms, Flooding	March 2010
3296	Severe Winter Storm	December 2008
1701	Severe Storms and Inland and Coastal Flooding	April 2007
1642	Severe Storms, Flooding	May 2006
1614	Severe Storms, Flooding	October 2005
3252	Hurricane (Katrina)	August 2005
3201	Snow	January 2005
1512	Flooding	April 2004
3191	Snowstorm	December 2003
3175	Snowstorm	February 2003
3165	Blizzard	March 2001
1364	Severe Storms, flooding	March 2001
1224	Heavy Rain, flooding	June 1998
1142	Severe Storms, Flooding	October 1996
1090	Blizzard	January 1996
3103	Blizzard	March 1993
920	Severe Coastal Storm	October 1991
914	Hurricane (Bob)	August 1991

Source: www.fema.gov

4.1.1 Overview of Potential Damages to Existing Development

The purpose of the vulnerability assessment is to estimate the extent of potential damages from natural hazards of varying types and intensities. A vulnerability assessment and estimation of damages was performed for hurricanes, earthquakes, and flooding. The methodology used for hurricanes and earthquakes was the HAZUS-MH software. HAZUS-MH is a tool to help estimate potential damages from certain types of natural hazards. The methodology for flooding was developed specifically to address the issue where flooding was not solely related to location within a FEMA floodplain.

The following overview of the HAZUS-MH is taken from the FEMA website. For more information, go to Hazus | FEMA.gov.

> "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."

HAZUS-MH can be run at three different levels. Level 1, at which the analyses contained herein were performed, relies upon default data on building types, utilities, and transportation corridors from national databases as well as census data. While the databases include a wealth of information on the communities that are a part of this study, 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 only generally indicate the possible extent of damages due to certain types of natural disasters and allow for a comparison between different types of disasters. Therefore, this analysis should be considered a starting point to understanding potential damage from the hazard events. If interested, communities could build a more accurate database and further test disaster scenarios.

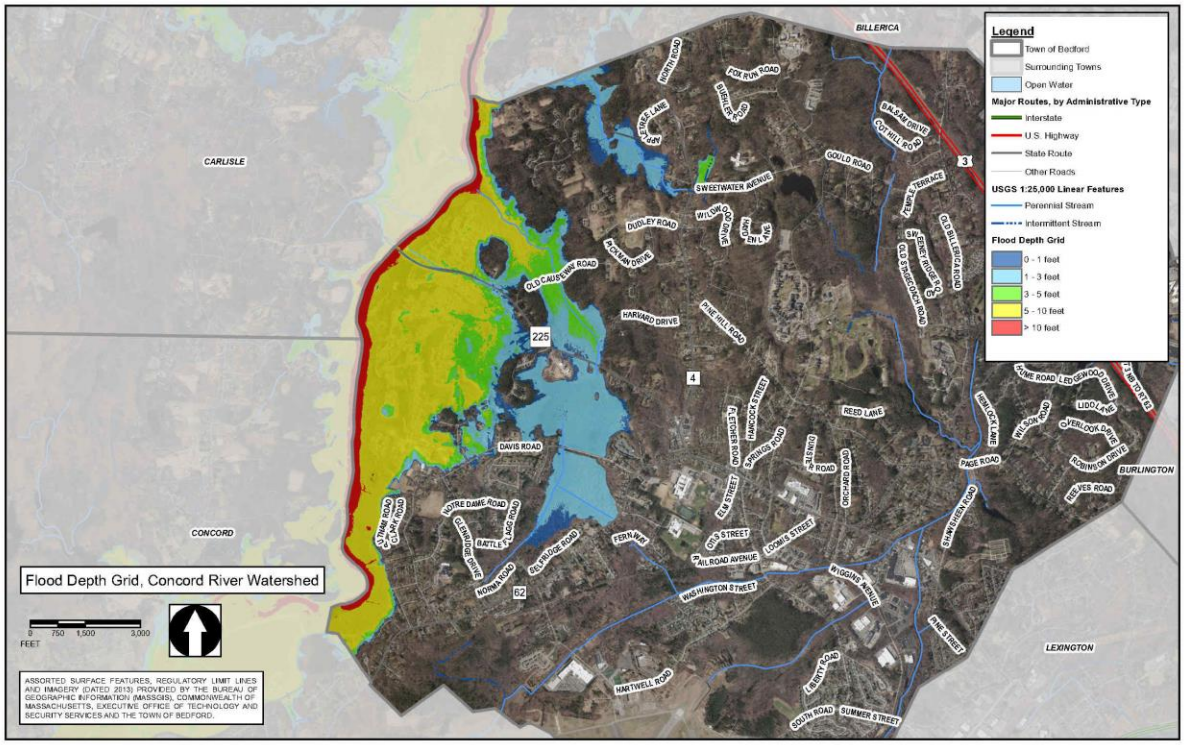
4.2 Changes in Precipitation

4.2.1 Flood-Related Hazards

Flooding was the most prevalent natural hazard identified by local officials in Bedford. Flooding can occur during hurricanes, nor'easters, severe rainstorms, and thunderstorms. It may also be associated with alterations to flow patterns, such as beaver activity and inadequate drainage facilities.

The geographic extent of riverine flooding is depicted on FEMA Flood Insurance Rate Maps (FIRMs). FEMA-mapped floodplains in the Town of Bedford occur along the Concord River, Elm Brook, Shawsheen River, Spring Brook, and Vine Brook. Approximately 1,834 acres of the Town are mapped as at risk for the 1% annual chance flood event (colloquially, the 100-year flood zone).

FEMA also prepares Flood Depth Grids to depict the depth of possible flooding in association with its Flood Insurance Studies (FIS). A copy of the Flood Depth Grid for the Concord River Watershed is depicted below:



There have been a number of major rainstorms that have resulted in significant flooding in eastern Massachusetts over the last fifty years. Excluding hurricanes, significant rainstorms include:

- August 1954
- March 1968
- January 1979
- April 1987
- October 1991 ("The Perfect Storm")
- October 1996
- June 1998
- March 2001
- April 2004
- October 2005
- May 2006
- April 2007
- March 2010
- April 2013
- January 2015

Increased development and unmitigated increases in impervious areas upstream of and within Bedford are contributing to flooding impacts. This issue and the mitigation strategies to address it involve the cooperation of Bedford and the surrounding communities. The drainage systems that serve these communities are a complex system of storm drains, roadway drainage structures, pump stations, and other facilities owned and operated by a wide array of agencies and government entities. This includes, but is not limited to, the Town of Bedford, Massachusetts Department of Transportation (MassDOT), the Massachusetts Bay Transportation Authority (MBTA), the Massachusetts Port Authority (Massport), and the U.S. Government. The planning, construction, operations, and maintenance of these structures are integral to flood hazard mitigation efforts. These agencies must be considered the communities' regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do, including budgetary and staffing constraints and numerous competing priorities.

A drainage study conducted by Camp Dresser & McKee Inc. in March 2000 highlights the following flooding and drainage characteristics in Bedford. In addition, recent discussions with local officials in Bedford yielded similar findings, all of which has been outlined below:

- Much of the flooding is “nuisance” flooding, causing inconvenience but not damage, though some areas do experience damage as noted below.
- Flooding occurs in flood plains along rivers, but flooding also results from issues related to drainage system capacity.
- Preserving and maintaining areas that provide storage for stormwater is critical. These areas include wetlands, drainage ditches, streams, flood plains, public and private properties.
- The Concord River incorporates the largest floodplain in the Town. It is slow to rise and to fall. The Great Meadows Wildlife Refuge is located along the river, providing flood protection and buffer areas.
- Flooding along the Concord River cannot be solely addressed by the Town of Bedford because of the size of the watershed and multi-town coverage.
- The Shawsheen River reacts more rapidly than the Concord River; it quickly rises and falls as a storm event occurs. The Shawsheen flooded over Burlington Road and Middlesex Turnpike during the October 1996 and June 1998 storms, cutting off access to Lahey Hospital in Burlington.
- Elm Brook and Vine Brook are also areas that experience frequent flooding.
- When the state expanded Route 3 in 2003, Bedford lost some localized flood plain area where the Shawsheen River passes under Route 3. However, the Town was successful in having the culverts reconstructed slightly wider to pass larger storms.
- Beaver activity causes localized flooding. To resolve some of the chronic flooding, the DPW has contracted with a wildlife specialist to install beaver control structures. These devices allow water to move through a dam without the beavers sensing water movement.
- Increased development is creating more and more impervious surface area and point discharges.
- Maintenance of drainage facilities in private developments and commercial/industrial areas is generally unknown.

The 2000 drainage study also identified a number of areas outside of the FEMA-mapped floodplain that experience routine flooding. Due to the length of time lapsed since completion of this study, these areas are not specifically reiterated herein. In some cases, there are mitigation efforts to attempt to alleviate the flooding, but in other cases no efforts are yet underway due to funding or prioritization of more pressing projects.

From September 1973 through September 2019, Bedford property owners filed a total of 93 losses with the National Flood Insurance Program. The following table provides further detail from the database:

Table 7: Flood Insurance Policies and Claims in Bedford (as of September 30, 2019)

Total Number of Policies	177
Insurance in Force	$48,304,600
Total Premiums	$241,454
Number of Paid Losses	93
Closed Paid Losses since 1973	$995,259

Source: Massachusetts Department of Conservation and Recreation

4.2.1.1 Repetitive Loss Properties

As defined by the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), a repetitive loss property is any property which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978. For more information on repetitive losses see National Flood Insurance Program Community Rating System | FEMA.gov

There are thirteen (13) repetitive loss properties in Bedford, with ten of those properties in single-family residential use and the other three properties classified by FEMA as Other, Non-Residential. These repetitive loss properties had a total of 41 losses between 1979 and 2021, totaling $707,602 in damages. Three of the properties have had four or more losses as of 2019.

4.2.1.2 Estimated Damages from Flooding

Consistent with the methodology used for the prior HMP, HAZUS-MH was not used to estimate flood damages in Bedford, as the riverine module is not a reliable indicator of flooding in areas where inadequate drainage systems, beaver activity, and increased impervious surfaces contribute to flooding even in areas outside of mapped flood zones. In lieu of using HAZUS, B+T used methodology developed by MAPC to give a rough approximation of flood damages.

Based on the 2010 HMP, approximately 349 acres of Bedford's total land area of 8,855 acres have been identified by local officials as areas of flooding. This amounts to 3.94% of the Town's total land area. The number of structures within each flood area was estimated by weighting the percentage of the total land area to the total number of structures in the town (5,283). This total is the same number of structures used by HAZUS for the hurricane and earthquake calculations.

HAZUS uses an average value of $964,442 per structure for the building replacement value in this community. The calculations were done for a low estimate of 10% building damages and a high estimate of 50% consistent with prior methodology and as suggested in the FEMA September 2002 publication "State and Local Mitigation Planning How-To Guides" (Page 4-13). The range of estimates for flood damages is $20,334,000 to $101,673,000. These calculations are approximate only and are meant to show an order of magnitude of damage. These calculations are not based solely on location within the floodplain or a particular type of storm (i.e. 100-year flood).

Table 8: Estimated Damages from Flooding in Bedford, based on CDM Drainage Report, 2000

ID	Flood Hazard Area	Approx. Area (Acres)	% of Total Land Area in Bedford	# of Struct.	Replacement Value	Low Estimate of Damages	High Estimate of Damages
1	Carlisle Road	13.58	0.15%	8	$7,795,575	$ 779,558	$3,897,788
2	Harvard/Old Causeway Road	5.07	0.06%	3	$2,904,234	$ 290,423	$1,452,117
3	Harvard Drive near University	10.52	0.12%	6	$6,063,225	$ 606,323	$3,031,613
4	Wildwood Drive at Beverly Road	7.25	0.08%	4	$4,178,021	$ 417,802	$2,089,010
5	VA Hospital, Springs Road	2.14	0.02%	1	$1,222,835	$ 122,284	$ 611,418
6	Paul Revere at Old Middlesex Road	4.62	0.05%	3	$2,649,476	$ 264,948	$1,324,738
7	Hamilton Road/Hunt Road	4.93	0.06%	3	$2,853,282	$ 285,328	$1,426,641
8	Anthony Road #9	3.86	0.04%	2	$2,241,865	$ 224,186	$1,120,932
9	Dunster Road	27.86	0.32%	17	$16,049,713	$1,604,971	$8,024,857
10	Richard Road/Fern Way	27.33	0.31%	16	$15,744,004	$1,574,400	$7,872,002
11	Bonnievale Drive	7.8	0.09%	5	$4,483,729	$ 448,373	$2,241,865

ID	Flood Hazard Area	Approx. Area (Acres)	% of Total Land Area in Bedford	# of Struct.	Replacement Value	Low Estimate of Damages	High Estimate of Damages
12	Sheridan Road	10.17	0.12%	6	$5,859,419	$ 585,942	$2,929,710
13	Glenridge Drive (cul-de-sac)	2.47	0.03%	1	$1,426,641	$ 142,664	$713,321
14	Norma Road at Glen Terrace	9.49	0.11%	6	$5,451,807	$ 545,181	$2,725,904
15	Raytheon on Hartwell Road	1.64	0.02%	1	$968,078	$96,808	$484,039
16	Hartwell Road	1.72	0.02%	1	$968,078	$96,808	$484,039
17	Washington Street along Elm Brook	25.39	0.29%	15	$14,623,072	$1,462,307	$7,311,536
18	Foster Road	6.3	0.07%	4	$3,617,554	$ 361,755	$1,808,777
19	Railroad Avenue at Commercial Avenue	3.89	0.04%	2	$2,241,865	$ 224,186	$1,120,932
20	Loomis Street	13.43	0.15%	8	$7,744,624	$ 774,462	$3,872,312
21	The Great Road Shopping Center	24.73	0.28%	15	$14,215,460	$1,421,546	$7,107,730
22	Alfred Circle	18.5	0.21%	11	$10,648,857	$1,064,886	$5,324,429
23	Pine Street at #26	8.85	0.10%	5	$5,095,147	$ 509,515	$2,547,574
24	Springs Brook near Old Billerica Road	3.31	0.04%	2	$1,885,204	$188,520	$942,602
25	Route 62 near Route 3; Meadowbrook	50.62	0.57%	30	$29,144,241	$2,914,424	$14,572,121
26	Vine Brook at Burlington Road	26.29	0.30%	16	$ 15,132,587	$ 1,513,259	$7,566,293
27	Burlington Road (Middlesex Turnpike to Crosby Drive)	15.5	0.18%	9	$8,916,507	$ 891,651	$4,458,254
28	Near Middlesex Turnpike (west of Plank Street)	2.79	0.03%	2	$1,630,447	$ 163,045	$ 815,224
29	Former Pre-owned Electronic (near Middlesex Turnpike)	1.64	0.02%	1	$ 968,078	$ 96,808	$ 484,039

ID	Flood Hazard Area	Approx. Area (Acres)	% of Total Land Area in Bedford	# of Struct.	Replacement Value	Low Estimate of Damages	High Estimate of Damages
30	Springs Brook/Alcott Street	7.63	0.09%	5	$4,381,826	$ 438,183	$2,190,913
31	Daniels Drive	1.74	0.02%	1	$1,019,029	$101,903	$509,515
32	Francis Kelley Road	2.13	0.02%	1	$1,222,835	$122,284	$611,418
	Total	**353.21**	**3.98%**	**211**	**$203,347,320**	**$20,334,732**	**$101,673,660**

4.2.2 Drought

Droughts are defined as periods of prolonged lack of precipitation. Risks posed by drought may overlap by those posed by heat, but also include the potential for decreased availability of water supply as groundwater and surface water sources are depleted. Drought may also result in an increased risk of wildfires as a result of dry trees and brush, as well as a decrease in agricultural production. While locations such as open space, water supply areas, and agricultural land are more vulnerable to drought, the geographic extent of this hazard is generally the same throughout the Town.

The Massachusetts Drought Management Plan dated September 2019, evaluates drought based on six indices, including precipitation, streamflow, groundwater, lakes and impoundments, fire danger, and evapotranspiration. Massachusetts classifies drought levels as follows in Table 9:

Table 9: Drought Classification Levels

Drought Level	2001-2019 Classification	2019 Classification	Index Percentile Ranges
Level 0	Normal	Normal	>30
Level 1	Advisory	Mild Drought	≤30 and >20
Level 2	Watch	Significant Drought	≤20 and >10
Level 3	Warning	Critical Drought	≤10 and >2
Level 4	Emergency	Emergency Drought	≤2

Bedford is located in the Northeast Massachusetts Drought Region. A history of recorded droughts in the Northeast Region since 2001 is included below.

Table 10: History of Drought Declarations in the Northeast Region, 2001 - 2021

Begin Date	End Date	Drought Level
December 2001		Advisory
February 2002	May 2002	Watch
June 2002	October 2002	Advisory
October 2007	March 2008	Advisory
August 2010	October 2010	Advisory
June 2016		Watch
July 2016	November 2016	Warning
December 2016		Watch
January 2017	March 2017	Advisory
May 2020		Significant Drought
June 2020		Mild Drought
July 2020	September 2020	Significant Drought
October 2020	November 2020	Mild Drought
March 2021	TBD	Mild Drought

Source: Massachusetts Department of Conservation and Recreation

4.2.3 Landslides

Landslides result from activities that destabilize an area or as a secondary impact from another natural hazard such as heavy precipitation. In addition to structural damage to buildings and the blockage of transportation corridors, landslides can lead to sedimentation of water bodies.

Landslide intensity can be measured into four categories by the estimated volume of material and the expected speed of the flow as follows:

Table 11: Landslide Volume and Velocity

Estimated Volume (m^3)	Fast Moving (Rock Fall)	Rapid Moving (Debris Flow)	Slow Moving (Slide)
<0.001	Slight intensity	--	--
<0.5	Medium intensity	--	--
>0.5	High intensity	---	--
<500	High intensity	Slight intensity	--
500-10,000	High intensity	Medium intensity	Slight intensity
10,000 – 50,000	Very high intensity	High intensity	Medium intensity
>500,000	--	Very high intensity	High intensity
>>500,000	--	--	Very high intensity

Cardinali et al 2002

According to the Slope Stability Map of Massachusetts, there are few steep slopes in the Town, and local officials state that landslides are not a major threat or occurrence in Bedford. There have been localized issues of steep slopes during construction, but those areas were stabilized once construction was completed. Town officials did not identify any problems with areas of geologic instability such as sinkholes or subsidence.

4.3 Sea Level Rise

The Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) considers coastal flooding, coastal erosion, and tsunamis as hazards that may be exacerbated by sea level rise. Bedford is located approximately 13.8 miles from the nearest coastline and has an average elevation of approximately 135 feet above sea level. Accordingly, these hazards are not anticipated to directly impact Bedford.

4.4 Rising Temperatures

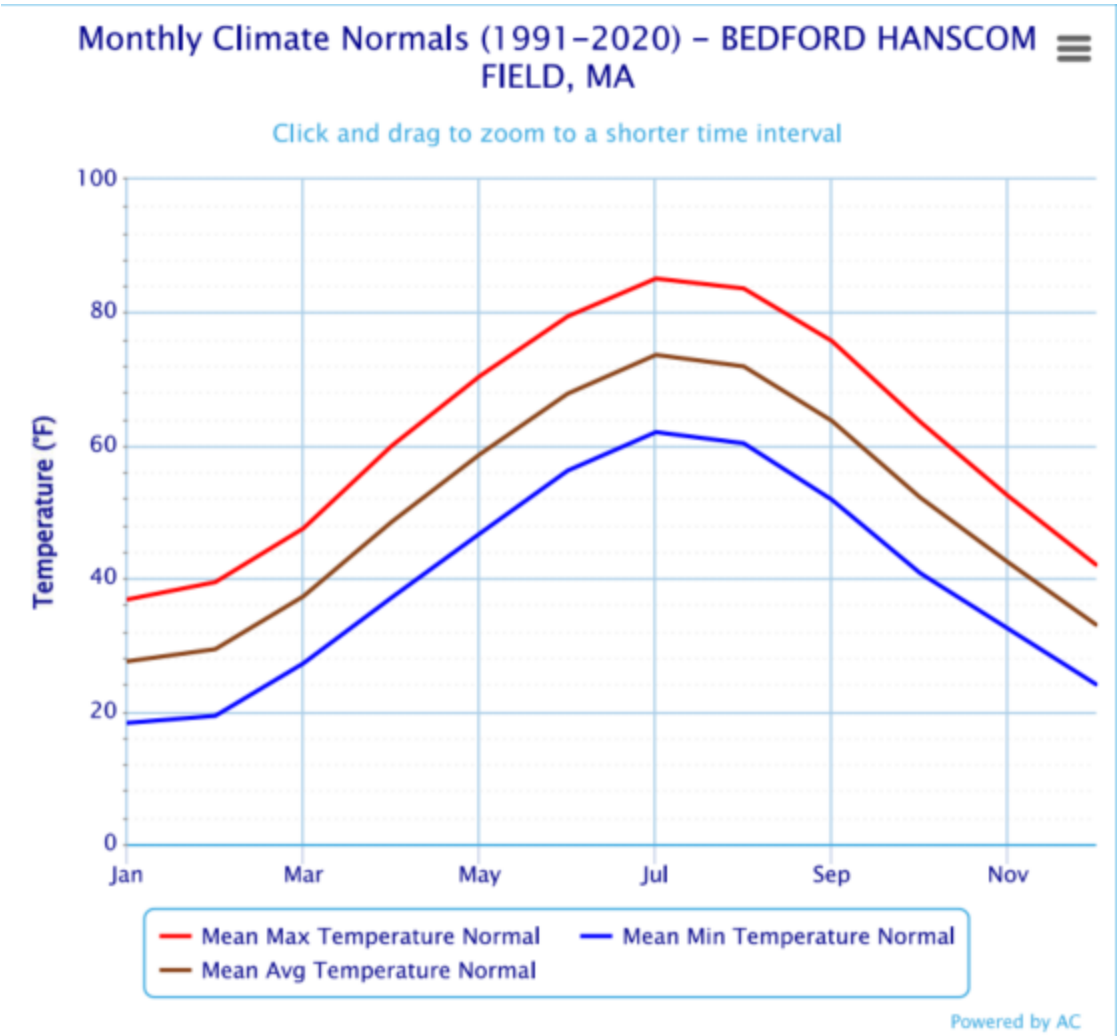
4.4.1 Extreme Temperatures

Heat and heat-related illnesses were identified by stakeholders as having a disproportionate impact to vulnerable populations, such as the elderly who make up 18.6% of Bedford's residents. In addition to the drought and wildfire-related impacts discussed elsewhere herein, extreme temperatures may result in an increased demand in utilizing municipal buildings as cooling stations. Subsequent secondary impacts of extreme heat anticipated in Bedford include a greater demand on the electrical grid from heavy use of conventional air conditioners.

Extreme cold temperatures have impacts on the Town's infrastructure from freezing and thawing, including damage to roadways and subsurface pipes. Such cold temperatures may have an impact on the health and wellbeing of vulnerable residents, particularly those unable to afford the costs of heating.

The geographic extent of this hazard is generally the same throughout the Town of Bedford, although impervious and developed areas may result in localized areas of high temperature relative to the surrounding air, known as the heat island effect.

Monthly mean maximum, minimum, and average temperatures at Hanscom Field are depicted below:



NOWData – NOAA Online Weather Data

According to NOAA data collected at Hanscom Field, an average of 15 days per year exceed a maximum temperature of 90 degrees from 2000 through 2021, with a maximum of 32 days in 2020. An average of 92 days per year have a minimum temperature below 32 degrees from 2000 through 2021, with a minimum of 71 days, also in 2020. Record high and low temperatures for the region are identified in Table 12.

Table 12: Record High and Low Temperatures

	Temperature	Date
Record high temperature	103°F	July 2011
Record low temperature	-18°F	February 1934

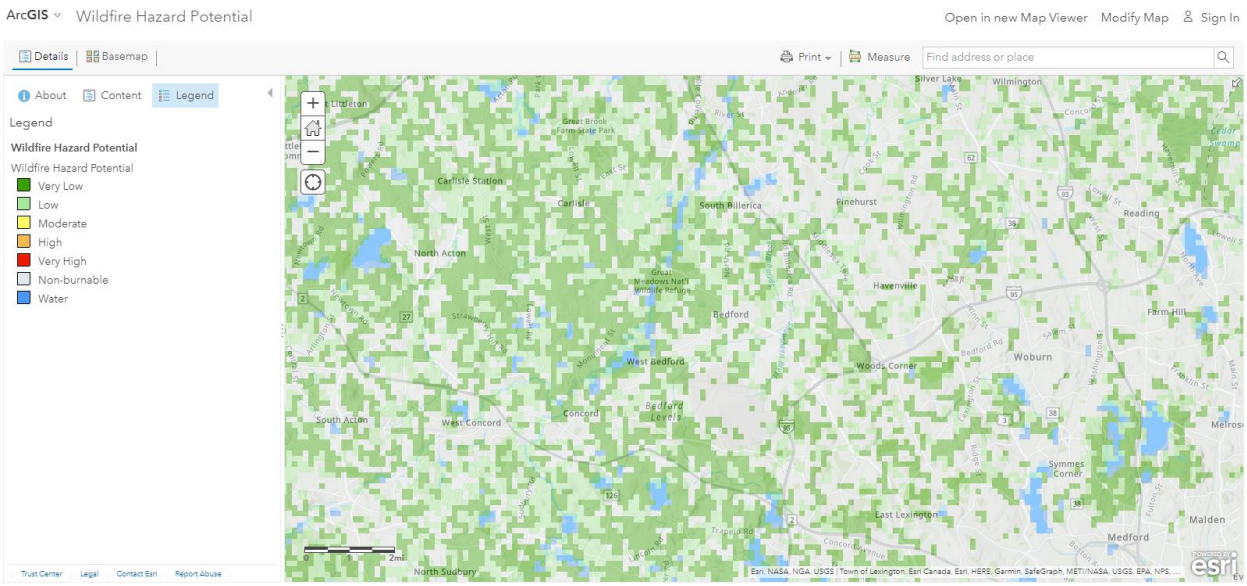
Source: National Weather Service, NOWData - NOAA Online Weather Data, Boston Area, MA

4.4.2 Wildfire

According to the State Hazard Mitigation Plan, the Commonwealth of Massachusetts experiences at least one notable wildfire each year, with each fire impacting an average of 1.17 acres. Approximately 90% of wildfires in the past 10 years were caused by humans and 10% by lightning.

In addition to the obvious threats to human life and property, wildfires can increase the risk of erosion during subsequent rain events due to the loss of vegetative ground cover. Drought conditions can devoid the landscape, further exacerbating the risk of wildfire. It is also important to remember that fire can also be a result of other events such as from the aftermath of an earthquake.

Based on the Wildfire Hazard Potential1 (WHP) GIS raster data developed by the U.S. Forest Service's (USFS) Fire Modeling Institute, the Town of Bedford ranges from low to very low risk for wildfires based on national averages (i.e., compared to all states in the conterminous US). This GIS model was prepared by the USFS to help inform assessments of wildfire risk or prioritization of fuels management needs across large landscapes throughout the US.



USFS Wildfire Hazard Potential

[1] https://www.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=fc0ccb504be142b59eb16a7ef44669a3

Bedford is generally located within an area of no to low risk for wildfires according to the State Hazard Mitigation Plan. According to local officials, natural fires in Bedford have not been a significant issue. The Bedford Fire Department responses to approximately six brush fires annually. These fires do not usually cause significant property damage or injuries. The conservation areas near the Shawsheen Cemetery and Massport have historically posed a slightly higher risk for fires as they are areas used by youths for campfires. Fire hydrants located throughout the Town are predominantly served by the Town water system, although a few properties are still using private wells.

4.4.3 Invasive Species

Invasive species are those non-indigenous species that have a high likelihood of spreading beyond their area of introduction and establishing themselves without cultivation. Invasive species can outcompete natural species in the same community and are highly adaptable. The anticipated impacts of a changing climate are expected to exacerbate their spread.

The Executive Office of Energy and Environmental Affairs (EEA) established the Massachusetts Invasive Plant Advisory Group (MIPAG) to develop strategies for invasive species management at the state level. MIPAG has identified 69 plant species as invasive to Massachusetts. In their 2005 report entitled *The Evaluation of Non-Native Plant Species for Invasiveness in Massachusetts*, MIPAG developed a list of criteria "…to objectively evaluate and categorize plant species suspected of being, or with the potential to become, invasive in Massachusetts." Such criteria are summarized below:

Table 13: Invasive Plant Species Criteria

	Criteria that must be met
Base criteria	1-4
Invasive	1-9
Likely Invasive	1-5, at least one of 6-9, at least one of 10-12
Potentially Invasive	1-4, (not 5), 13-15

1. **Be nonindigenous to Massachusetts.**
2. **Have the biologic potential for rapid and widespread dispersion and establishment in minimally managed habitats.**
3. **Have the biologic potential for dispersing over spatial gaps away from site of introduction.**
4. **Have the biologic potential for existing in high numbers away from intensively managed artificial habitats.**
5. **Be naturalized in Massachusetts (persists without cultivation in Massachusetts)**
6. **Be widespread in Massachusetts, or at least common in a region or habitat type(s) in the state.**
7. **Have many occurrences of numerous individuals in Massachusetts that have high numbers of individuals forming dense stands in minimally managed habitats**
8. **Be able to out-compete other species in the same natural plant community.**
9. **Have the potential for rapid growth, high seed or propagule production and dissemination, and establishment in natural plant communities.**
10. **Have at least one occurrence in Massachusetts that has high numbers of individuals forming dense stands in minimally managed habitats**
11. **Have the potential, based on its biology and its colonization history in the northeast or elsewhere, to become invasive in Massachusetts.**
12. **Be acknowledged to be invasive in nearby states but its status in Massachusetts is unknown or unclear. This may result from lack of field experience with the species or from difficulty in species determination or taxonomy.**
13. **The species, if it becomes naturalized in Massachusetts, based on its biology and biological potential, would pose an imminent threat to the biodiversity of Massachusetts and**
14. **Its naturalization in Massachusetts is anticipated, and**
1. **15. The species has a documented history of invasiveness in other areas of the Northeast.**

The Evaluation of Non-Native Plant Species for Invasiveness in Massachusetts, MIPAG

Some of those invasive species impacting Bedford include Japanese knotweed (*Reynoutria japonica*) and oriental bittersweet (*Celastrus orbiculatus*). In addition to invasive plant species, a number of insects, such as the emerald ash borer (*Agrilus planipennis*) and the Asian long-horned beetle (*Anoplophora glabripennis*) threaten street trees, homeowner landscaping and local forests.

Massachusetts maintains multiple laws and regulations intended to control invasive species, including a list of prohibited plants provided by the Department of Agricultural Resources (DAR), the Wetlands Protection Act (310 CMR 10.00), and others outlined in the Massachusetts State Hazard Mitigation and Climate Adaptation Plan.

4.5 Extreme Weather

4.5.1 Hurricanes/Tropical Storms

Wind-related hazards include hurricanes, micro-bursts, nor'easters, and tornadoes, as well as high winds associated with severe rainstorms and thunderstorms.

The region has been impacted by hurricanes throughout its history, starting with the Great Colonial Hurricane of 1635. Hurricanes are Categorized 1-5 using the Saffir-Simpson Hurricane Scale based on wind speeds. Refer to the Hurricane Category Table below:

Table 14: Hurricane Category

Category	Wind Speeds (Mph)
Category 1	74-95
Category 2	96-110
Category 3	111-130
Category 4	131-155
Category 5	156

NOAA Comparing Hurricane Categories

A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. The eye of one hurricane passed right through Boston in 1944. According to the State Hazard Mitigation Plan, 63 hurricane or tropical storm events have occurred in the vicinity of Massachusetts between 1842 and 2016. This equates to a frequency of once every three years. Hurricanes that have occurred in the region include[2]:

- 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 Hazel October 15, 1954
- Hurricane Diane August 17-19, 1955
- Hurricane Donna September 12, 1960
- Hurricane Gloria September 27, 1985
- Hurricane Bob August 19, 1991
- Hurricane Irene September 3, 2011

[2] Information on storms provided by Cambridge Emergency Management Department. It is assumed that these same storms affected eastern Massachusetts, including Bedford.

- Hurricane Sandy October 30, 2012

*Category 3.

According to NOAA, an unnamed tropical storm tracked directly through Bedford in 1897, while the tropical storm remnants of Hurricane Bertha tracked through Bedford in 1996. The wind speeds of these storms as they tracked through the Town were approximately 53 to 70 mph. The tracks of approximately nine hurricanes or tropical storms have passed within ten miles of Bedford since 1842 as shown on Figure 1

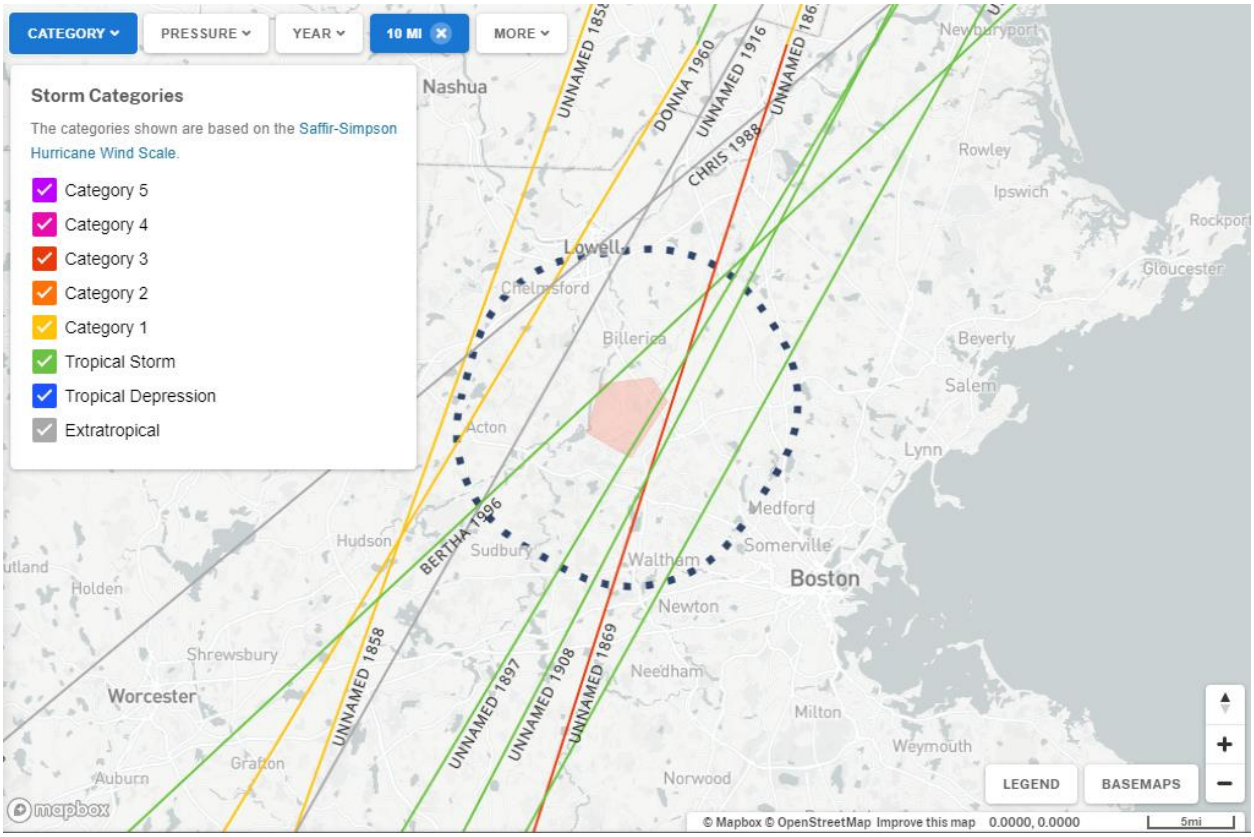


Figure 1 NOAA Historical Hurricane Tracks

4.5.1.1 Estimated Damages from Hurricanes

For the purposes of this plan a 1% chance event with peak gust speeds of 83 miles per hour and a 0.1% chance event with peak gust speeds of 106 miles per hour were chosen to illustrate damages. This can help planners and emergency personnel evaluate the impacts of storms that might be more likely in the future, as we enter a period of more intense and frequent storms due to climate change.

Table 15: Estimated Damage in Bedford from a 1% or 0.1% Chance Hurricane Event

	100-Year	1,000-year
Building Characteristics		
Estimated total buildings	5,283	
Estimated total building replacement value (Year 2021 $)	$5,095,149,000	
General Building Damage		
# of buildings sustaining minor damage	89	997
# of buildings sustaining moderate damage	5	167
# of buildings sustaining severe damage	1	12
# of buildings destroyed	0	4
Population Needs		
% of hospital beds available on day of event	147	147
# of households displaced	0	20
# of people seeking public shelter	0	18
Debris		
Building debris generated (tons)	409	3,683
Tree debris generated (tons)	3,983	13,720
Value of Damages		
Total property damage	$15,437,000	$87,643,000

4.5.2 Severe Winter Storms/Nor'easters

In Massachusetts, coastal storms with a counterclockwise rotation, known as nor'easters, occur one to two times per year. Winter storms are a combination of hazards because they often involve wind, ice, flooding, and snowfall. The average annual snowfall for Bedford is 48-72 inches.

NOAA National Centers for Environmental Information has developed a Regional Snowfall Index for significant storms that impact the northeastern region of the United States. The RSI ranks storms into five categories based on the spatial extent of the storm, the amount of snowfall, and the juxtaposition of these elements with population as outlined below.

Table 16: Regional Snowfall Index Values

Category	RSI Value	Description
1	1–3	Notable
2	3–6	Significant
3	6–10	Major
4	10–18	Crippling
5	18.0+	Extreme

https://www.ncdc.noaa.gov/snow-and-ice/rsi/

A list of snowstorms ranked under the RSI between 2000 and 2021 is outlined below:

Table 17: Regional Snowfall Index and Societal Impacts for the Northeast, 2000-2021

Start Date	End Date	Category	RSI	Area of Snow	Population
2021-02-16	2021-02-20	1	1.146	156,422	60,387,216
2021-01-30	2021-02-03	3	6.188	177,515	60,990,940
2020-12-14	2020-12-18	2	5.583	163,139	60,504,917
2019-11-29	2019-12-03	1	2.386	159,295	52,787,511
2019-01-18	2019-01-21	1	2.831	172,076	59,153,084
2018-11-14	2018-11-16	1	2.016	173,883	60,958,725
2018-03-20	2018-03-22	1	1.598	104,912	54,227,211
2018-03-11	2018-03-15	2	4.335	171,105	57,502,057
2018-03-05	2018-03-08	1	2.096	175,853	60,907,768
2018-03-01	2018-03-03	1	2.185	151,415	52,939,672
2018-01-03	2018-01-05	1	2.548	172,240	60,240,318
2017-03-12	2017-03-15	4	10.658	176,160	60,603,632
2017-02-09	2017-02-10	1	2.154	175,084	60,655,477
2016-11-17	2016-11-22	1	2.154	150,944	48,054,817
2016-01-22	2016-01-24	4	17.758	92,140	52,963,122
2015-02-14	2015-02-16	1	1.14	176,958	60,987,376
2015-02-08	2015-02-10	1	1.897	136,000	44,457,219
2015-01-29	2015-02-03	1	2.606	175,690	60,670,793
2015-01-25	2015-01-28	3	6.158	177,785	60,992,661
2014-12-09	2014-12-14	1	1.881	162,706	51,280,184
2014-11-26	2014-11-28	1	1.756	173,671	60,326,804
2014-02-11	2014-02-14	2	4.398	176,679	59,114,214
2014-01-20	2014-01-22	1	1.294	169,039	59,023,320
2013-12-30	2014-01-03	1	2.766	170,587	59,042,162
2013-12-13	2013-12-16	1	2.678	174,507	58,818,190
2013-03-17	2013-03-20	1	1.621	173,441	58,544,700

Start Date	End Date	Category	RSI	Area of Snow	Population
2013-03-03	2013-03-09	1	1.308	157,056	58,614,413
2013-02-08	2013-02-10	3	9.212	172,576	58,579,289
2012-12-28	2012-12-31	1	1.095	173,479	58,679,218
2012-12-24	2012-12-28	1	2.004	174,200	58,845,960
2011-10-25	2011-10-31	1	1.849	157,709	55,844,726
2011-02-24	2011-02-27	1	1.736	155,855	43,474,028
2011-02-01	2011-02-04	1	1.779	170,298	56,938,590
2011-01-26	2011-01-27	1	2.643	174,690	58,910,064
2011-01-09	2011-01-13	2	3.377	174,940	58,907,580
2010-12-24	2010-12-28	2	3.238	174,950	58,912,655
2010-02-21	2010-03-01	4	17.827	174,950	58,912,816
2010-02-12	2010-02-19	1	1.085	174,690	58,873,066
2010-02-08	2010-02-11	2	3.061	146,360	58,156,565
2010-02-04	2010-02-08	3	9.062	90,382	50,257,627
2009-12-28	2010-01-04	2	3.735	174,383	58,858,437
2009-12-18	2009-12-21	1	2.836	130,657	56,388,060
2009-12-07	2009-12-11	1	1.702	169,750	57,511,523
2009-02-26	2009-03-03	1	1.474	171,125	58,315,320
2009-02-22	2009-02-24	1	1.429	169,443	56,989,600
2008-12-21	2008-12-23	1	2.96	174,921	58,910,684
2008-12-18	2008-12-22	1	2.645	174,930	58,911,304
2007-12-14	2007-12-17	1	1.726	166,377	54,824,473
2007-11-30	2007-12-04	1	1.294	169,895	57,377,950
2007-04-03	2007-04-06	1	1.08	161,476	47,541,472
2007-03-16	2007-03-18	2	3.151	173,883	58,758,178
2007-02-11	2007-02-16	3	6.891	174,949	58,912,781
2006-02-10	2006-02-14	2	4.946	174,950	58,912,730
2005-02-28	2005-03-02	2	3.005	174,949	58,912,741
2005-01-22	2005-01-24	2	3.772	172,989	58,891,510
2003-12-04	2003-12-08	3	9.398	174,950	58,912,724
2003-02-14	2003-02-18	4	14.671	163,081	58,771,975
2003-01-01	2003-01-04	1	2.444	167,617	57,344,653
2002-12-23	2002-12-26	2	3.631	170,318	58,592,271
2000-12-28	2001-01-01	2	3.228	168,395	54,141,847
2000-02-16	2000-02-20	1	1.309	172,979	58,891,980
2000-01-24	2000-02-01	1	1.366	174,036	58,757,576
2000-01-24	2000-01-27	1	2.483	174,940	58,910,447

Bedford DPW provides standard snow removal operations: pre-treatment, sanding/salting, plowing, and clearing sidewalks. The number of new residential developments adds to the effort of snow removal in order to accommodate safe travel and, in particular, school buses and emergency response services.

Another winter-related challenge is that some commercial and industrial property owners place snow in wetlands, impeding water flow and causing localized flooding. Enforcement of this practice can be difficult.

As expected, a number of public safety issues can arise during snowstorms.

- Impassible streets are a challenge for emergency vehicles and safe travel. The timing of a storm can impact school dismissal, so planning is important to stay ahead of the bus routes.
- Snow-covered sidewalks force people to walk in the street, which is already less safe due to snow, slush, puddles, and ice.
- Large piles of snow can also block sight lines for drivers, particularly at intersections.
- Not all residents are able to clear their properties, especially the elderly.
- As snow melts, flooding and refreezing of snowmelt can cause dangerous roadway and sidewalk conditions.

4.5.3 Tornadoes/Microbursts

Tornadoes or other high-wind events can cause extensive damage. Downed trees can knock out power lines and block major roadways, which hinders emergency response. Microbursts can create the same problems as they typically occur during major thunderstorms creating a sudden, localized, downdraft of air that creates wind shears at low altitudes.

The extent of tornadoes can be measured by damage intensity and estimated wind speed on the Fujita Scale, or based on the speed of a three-second wind gust and related damage on the Enhanced Fujita Scale, which was adopted February 1, 2007.

Table 18: Fujita Tornado Damage Scale

Fujita Scale		Enhanced Fujita Scale		Typical Damage
Scale	Wind Estimate (MPH)	Scale	3-Second Gust (MPH)	
F0	< 73	**EF0**	65-85	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	**EF1**	86-110	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	**EF2**	111-135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	**EF3**	136-165	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	**EF4**	166-200	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	**EF5**	Over 200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds); trees debarked; incredible phenomena will occur.

National Weather Service

Past high wind events that have occurred within the Town include a tornado, which touched down in Bedford in 1986 at the eastern end of Hanscom Airfield. A list of tornadoes recorded in the larger Middlesex County is included below:

Table 19: Middlesex County Tornadoes

Date and Time		Deaths	Injured	F-Scale
October 24, 1955	6:05:00 PM	0	0	F1
June 19, 1957	1:47:00 PM	0	0	F1
June 19, 1957	2:00:00 PM	0	0	F1
July 11, 1958	4:00:00 PM	0	0	F2
August 25, 1958	4:00:00 AM	0	0	F2
July 3, 1961	3:00:00 PM	0	0	F0
July 18, 1963	1:20:00 PM	0	0	F1
August 28, 1965	12:10:00 PM	0	0	F2
July 11, 1970	1:15:00 AM	0	0	F1
July 1, 1971	1:45:00 PM	0	1	F1
November 7, 1971	9:00:00 AM	0	0	F1
July 21, 1972	3:00:00 PM	0	4	F2
September 29, 1974	3:05:00 PM	0	1	F3
July 18, 1983	2:30:00 PM	0	0	F0
September 27, 1985	1:00:00 PM	0	0	F1
August 7, 1986	1:10:00 PM	0	0	F1
August 22, 2016	2:20:00 AM	0	0	EF1
August 23, 2021	10:40:00 AM	0	0	EF0
August 23, 2021	12:10:00 PM	0	0	EF0

NOAA National Centers for Environmental Information

High winds can also occur as a result of non-tornado. In August 2014, a series of microbursts occurred within Suffolk, Worcester, and Middlesex Counties, particularly affecting Bedford. Winds during the event were predicted to have been between 90 and 100 miles per hour, collapsing large trees on overhead wires. Approximately eight (8) homes, as well as several vehicles and outbuildings, were damaged by falling trees. One home was also damaged by fire when a primary electrical line came down on the house. Several roadways were closed for up to six days following this storm while trees and powerlines were cleared.

Source: Julie Loncich/WCVB-TV

4.6 Non-Climate Influenced Hazards

4.6.1 Earthquakes

Often occurring along subsurface fault boundaries, earthquakes are movements of the earth's surface that can pose a risk to human health, man-made structures, and various infrastructure. As noted in the SHMCAP, earthquakes in New England are considered 'intraplate' earthquakes as they occur deep within the North American Plate.

Earthquakes can result in impacts beyond the obvious structural impacts. Buildings can suffer structural damage that is not readily apparent. Earthquakes can cause damage to roadways, making emergency response difficult. Water lines and gas lines can break, causing flooding, fires and explosions. These types of utility service interruptions could disrupt manufacturing processes for critical manufacturing facilities located within Bedford. Equipment in buildings can also be vulnerable. 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 could be severely impacted during an earthquake. Earthquakes can also trigger landslides.

The United States Geological Survey prepared a 2014 Seismic Hazard Map of Massachusetts depicting Peak Ground Acceleration (PGA). The State Hazard Mitigation Plan explains that:

> "PGA measures the strength of a potential earthquake in terms of the peak acceleration of ground movement. The potential damages due to an earthquake increase as the acceleration of ground movement increases.

Peak ground acceleration is expressed as a percentage of a known acceleration, the acceleration of gravity…Therefore, the geographic areas with the highest PGA have the highest potential for damages during an earthquake."

The extent of earthquakes can be measured on various scales by the PGA experienced as outlined below:

Table 20: Modified Mercalli Intensity and Equivalent Peak Ground Acceleration and Richter Scale Magnitude

Mercalli Intensity	Equivalent Richter Scale Magnitude	Description	Abbreviated Modified Mercalli Intensity Scale Description	Acceleration (percent g) (PGA)
I		Detected only on seismographs.	Not felt except by a very few under especially favorable conditions	< .17
II	< 4.2	Some people feel it.	Felt only by a few persons at rest, especially on upper floors of buildings	.17 – 1.4
III		Felt by people resting; like a truck rumbling by.	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.	.17 – 1.4
IV		Felt by people walking.	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.	1.4 – 3.9
V	< 4.8	Sleepers awake; church bells ring	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.	3.9 – 9.2
VI	< 5.4	Trees sway; suspended objects swing; objects fall off shelves.	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	9.2 – 18
VII	< 6.1	Mild alarm; walls crack; plaster falls	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	18 – 34
VIII		Moving cars are uncontrollable; masonry fractures, poorly	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with	34 – 65

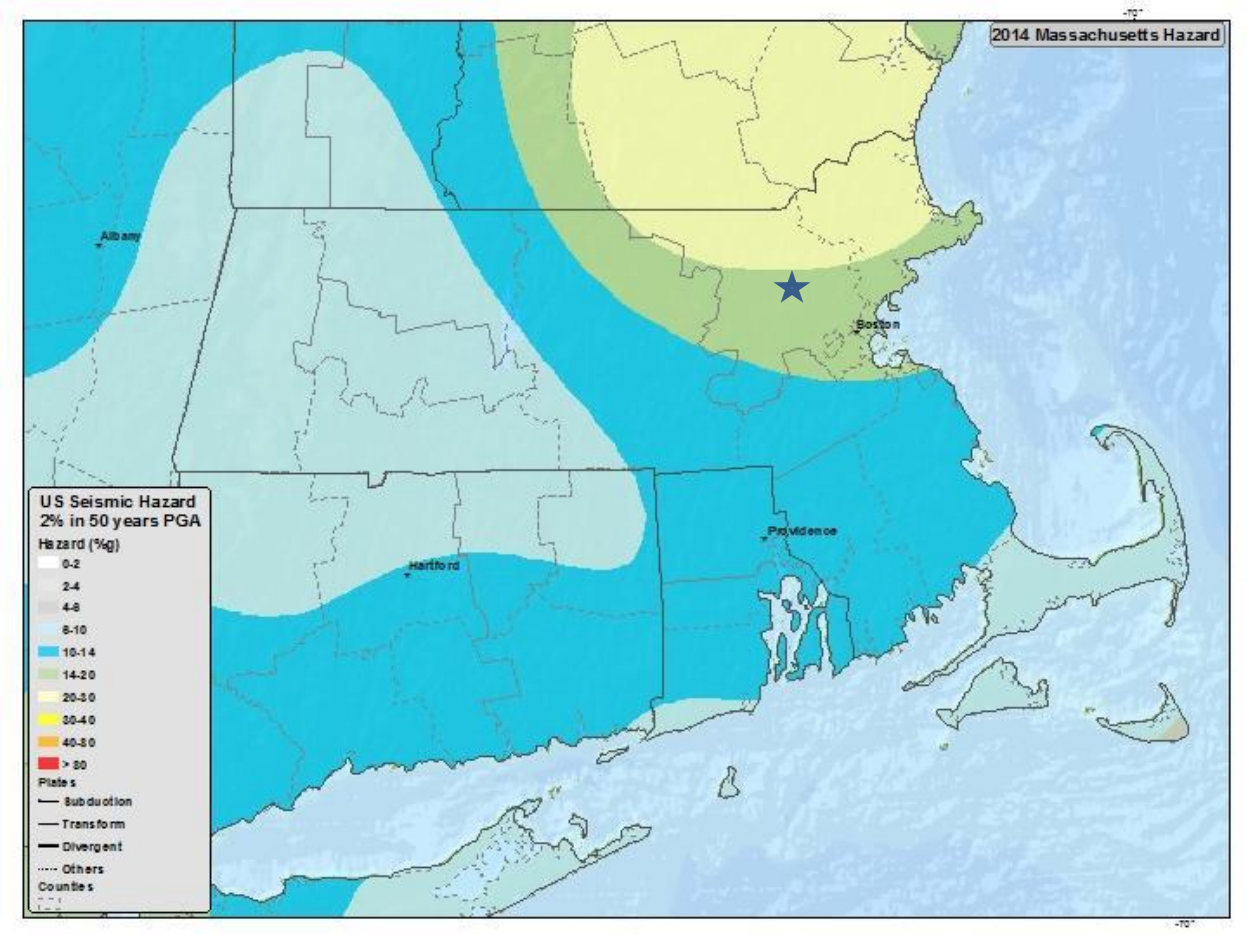
Mercalli Intensity	Equivalent Richter Scale Magnitude	Description	Abbreviated Modified Mercalli Intensity Scale Description	Acceleration (percent g) (PGA)
		constructed buildings damaged.	partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.	
IX	< 6.9	Some houses collapse; ground cracks; pipes break open.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.	65-124
X	< 7.3	Ground cracks profusely; many buildings destroyed; liquefaction and landslides are widespread.	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.	>124
XI	< 8.1	Most buildings and bridges collapse; roads, railways, pipes and cables are destroyed; general triggering of other hazards occurs.	Few, if any, (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.	>124
XII	> 8.1	Total destruction; trees fall; ground rises and falls in waves.	Damage total. Lines of sight and level are distorted. Objects thrown into the air.	>124

Source: State Hazard Mitigation and Climate Adaptation Plan

New England experiences an average of five earthquakes per year. According to the Weston Observatory at Boston College, more than 6,400 earthquakes have occurred in New England between 1638 to May 2013, with most originating in the La Malbaie fault in Quebec or from the Cape Ann fault located off the coast of Rockport. According to the State Hazard Mitigation Plan, only 35 of these earthquakes are considered significant. The region has experienced larger earthquakes of magnitude 6.0 in 1727 and 1755. Other notable earthquakes occurred here in 1638 and 1663.

No earthquake epicenters have been recorded within Bedford. Although new construction adheres to the most recent building codes for seismic standards, much of the development in the Town pre-dates the latest technical recommendations from the National Earthquake Hazards Reduction Program.

According to the 2014 Seismic Hazard Map, Bedford is located in a section of the state with a PGA of 14 to 20 with a 2% probability of exceedance in 50 years. This is the zone with the second highest PGA in the state. Probability of exceedance refers to the likelihood that an event with greater than the given estimate will occur during the given time period.



4.6.1.1 Estimated Damages from Earthquakes

The HAZUS earthquake module allows users to define different types of earthquakes and to input various parameters. The module is more useful where there is a great deal of data available on earthquakes. In New England, defining the parameters of a potential earthquake is much more difficult because there is little historical data. The earthquake module does offer the user the opportunity to select a number of historical earthquakes that occurred in Massachusetts. For the purposes of this plan, two earthquakes were selected: a 1963 earthquake with a magnitude of 5.0 and an earthquake with a magnitude of 7.0. Updated building count and replacement value were used to provide an updated estimate for 2021 based on a percentage increase from 2010.

Table 21: Estimated Damage in Bedford from a Magnitude 5.0 and 7.0 Earthquake

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	5,283	
Estimated total building replacement value (Year 2021 $)	$5,095,149,000	
Building Damages		
# of buildings sustaining slight damage	26	1,405
# of buildings sustaining moderate damage	5	614
# of buildings sustaining extensive damage	0	130
# of buildings completely damaged	0	24
Debris		
Building debris generated (tons)	0	57,000
Value of Damages		
Total property damage	$3,751,583	$372,284,776

4.7 Critical Infrastructure in Hazard Areas

Critical infrastructure includes those facilities that perform an important function during a natural disaster such as shelters and emergency operation centers. Critical infrastructure also includes locations that house sensitive populations, such as schools or nursing homes. These may include utilities, communication facilities, or transportation corridors. The purpose of mapping the natural hazards and critical facilities is to present an overview of hazards in the community and how they relate to critical facilities.

Much of the critical infrastructure in Bedford is clustered near the center of Town in an upland area located away from floodplains. Other critical infrastructure sites, such as sewer pump stations, are located in or near floodplains. Seven facilities are located in the 500-year FEMA floodplain (X500), and seven facilities are located within the 100-year floodplain (AE). Five facilities are located within locally identified areas of flooding. A list of those critical facilities subject to flooding is included in Table 22 below, with a complete list of critical facilities included in Appendix C.

Table 22: Critical Facilities Located within Areas Subject to Flooding in Bedford

Name	Type	FEMA Flood Zone	Locally Identified Flood Area
Page Road Sewer Pump Station	Sewer Pumping Station	AE	No
Washington Street II Sewer Pump Station	Sewer Pumping Station	No	Washington Street along Elm Brook
Bonnievale Drive Sewer Pump Station	Sewer Pumping Station	AE	Bonnievale Drive
Carlisle Road Sewer Pump Station	Sewer Pumping Station	X500	No
Ledgewood Drive Sewer Pump Station	Sewer Pumping Station	X500	No
Main Sewer Pump Station	Sewer Pumping Station	AE	The Great Road Shopping Center
Meadowbrook Road Sewer Pump Station	Sewer Pumping Station	X500	No
Middlesex Turnpike Sewer Pump Station	Sewer Pumping Station	AE	No
Norma Road Sewer Pump Station	Sewer Pumping Station	X500	No
Washington Street I Sewer Pump Station	Sewer Pumping Station	No	Washington Street along Elm Brook
Winchester Drive Sewer Pump Station	Sewer Pumping Station	No	Richard Road/Fern Way
Shawsheen Funeral Home	Funeral Home	X500	No
Wilson Mill Dam	Dam	AE	No
Well # 2	Municipal Well	AE	No
Well # 4	Municipal Well	AE	No
Well # 5	Municipal Well	X500	No

5.0 EXISTING MITIGATION MEASURES

This section provides more detail on the Town of Bedford's existing mitigation measures for specific natural hazard, as well as existing mitigation measures that apply to all natural hazards. These mitigation measures may be included among Bedford's strengths. Additional strengths identified at the Community Resiliency Building Workshop are outlined in the CRB Risk Matrix included in Appendix E.

5.1 Flood-Related Mitigation

Bedford 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:

a) Participation in the National Flood Insurance Program (NFIP). FEMA maintains a database on flood insurance policies and claims. This data is available through the State's Flood Hazard Management Program administered through the Department of Conservation and Recreation.
b) The Town continues to implement its National Pollution Discharge Elimination System (NPDES) Phase II Stormwater Program. As part of Phase 2, the DPW has started to record the amount of debris collected from the catch basin cleaning program.
c) Good examples of new development minimizing stormwater impacts are being built in Town. For example, leaching basins for roof drains, rain gardens, and other low-impact development (LID) practices are included in the design of new developments.
d) The Conservation Commission requires long-term maintenance plans for stormwater management systems.
e) Street sweeping occurs two times per year.
f) All catch basins are cleaned in the spring. High maintenance basins are cleaned more frequently. The DPW addresses minor flooding complaints as needed with installation of catch basins and connections to existing drainage systems. Bedford DPW repairs approximately 50 catch basins each year.
g) The Eastern Middlesex Mosquito Control District is periodically contracted to maintain drainage ditches and small streams. By removing debris dams and blockages, waterways flow more efficiently and stagnant pools for mosquito habitat are eliminated.
h) The DPW has a General Order of Conditions from the Conservation Commission to perform stream cleaning as needed and make localized stream improvements.
i) Development in the Town must follow the MassDEP Stormwater Standards. The Town requires infiltration of roof runoff.

j) The Wetlands Protection Bylaw regulates disturbances to lands within 100 feet of Land Subject to Flooding or Inundation.
k) The Town has flood plain regulations in place. No new buildings are allowed in flood plains. Smaller projects such as decks or additions may occur, but mitigation is required. No work is allowed in 10-year flood plain.
l) The Zoning Bylaw establishes a Flood Plain/Wetland District. Most uses require a special permit and certification by a Professional Engineer that the development will not increase flooding during a 100-year flood, and that the applicant can demonstrate that the site is not subject to flooding. Other uses, such as roads, golf courses, and greenhouses are permitted if the Special Permit Granting Authority (SPGA) deems that the uses are "in harmony" with the intent of the district.
m) The Town received funding to compensate for wetland and flood plain losses associated with the Route 3 expansion. They used this funding and CPA funds to purchase 16 acres of the Altmann property on Dudley Road.
n) The Town continues to monitor opportunities for acquisition of properties to protect floodplain and wetlands.
o) Bedford was one of the first towns to adopt the Community Preservation Act, which applies a surcharge against property taxes to create a local Community Preservation Fund. This fund can be used for projects in the categories of open space protection, historic preservation, affordable housing, and outdoor recreation. The Town of Bedford has renewed its commitment to the fund each year with the maximum 3% surcharge.

5.1.1 Dams

There are three Town-owned dams permitted by the Massachusetts Department of Conservation and Recreation (DCR):

- Fawn Lake Dam — Low Hazard
- Old Water Supply Dam — Significant Hazard
- Wilson Corne Mill Dam — Significant Hazard

All three dams have been reconstructed within the last 10 years and are inspected regularly. As required for Significant Hazard dams, both the Old Reservoir Dam and Wilson Corne Mill Dam have approved Emergency Action Plans on file.

5.2 Wind-Related Hazards

The Town of Bedford proactively mitigates against damage due to high winds. The Town is serviced by Eversource, who routinely removes hazard trees which could impact their overhead wires. Some of the specific actions are provided below.

a) The DPW Grounds Operations Manager is designated as the Bedford Tree Warden and oversees maintenance to trees within the Town's Right of Way and on public lands. The DPW also work with Eversource to keep the power lines free from tree limbs.
b) The Town appropriates funds for the on-going Hazardous Tree Program to remove hazardous or dead trees. On average approximately 200 trees are removed or trimmed within the right of ways annually. This program has been incredibly effective at reducing power outages and it is necessary to continue this program.
c) The Bedford Arbor Resources Committee was formed in 1999 to address tree issues in the Town. Its mission is "To enhance the quality of life in Bedford by protecting and preserving, developing and managing the arbor resources on publicly-owned lands and by encouraging preservation and development of resources on private lands."
d) The Town has established a Tree Mitigation Revolving Fund to plant trees on publicly-owned lands in accordance with the Town Tree Policy

5.3 Winter-Related Hazards

The Town of Bedford currently employs a number of measures to mitigate for winter storm events. These are described below.

a) The Town provides standard snow removal operations and does their own salting and sanding.
b) Sections 46.15 and 46.16 of the Town's General Bylaws prohibit vehicles on streets from interfering with snow clearing and authorizes the DPW to remove such vehicles.
c) Section 46.5 of the Bylaws requires that property owners with a slanted roof abutting a sidewalk must install a barrier to prevent snow and ice from falling on the sidewalk.
d) Section 46.10 of the Bylaws prohibit owners of land that abuts a public sidewalk from dumping snow on any previously cleared sidewalk, street, or way, and allows enforcement by the Department of Public Works.

5.4 Fire-Related Hazards

The Fire Department has the equipment, including a new four-wheel drive vehicle, to access brush fires.

a) Section 47.6 of the Town Bylaws requires a permit for open fires, and the Fire Chief can ban all open fires during hazardous conditions. Outdoor burning is allowed from January 15 – May 1, but a permit is required. The homeowner must apply directly to the Fire Department for the day the burning is requested.
b) The Fire Department reviews all subdivision and site plans for compliance with site access, water supply needs, and all other applicable regulations.
c) The Town has a task force to handle major fires if necessary, which includes a tanker task force available through the state fire mobilization.

5.5 Geologic Hazards

5.5.1 Earthquakes

In prior plan preparation, most municipal officials acknowledged that earthquakes were the hazard for which their community was least prepared. If an earthquake hits, the entire region would face significant challenges. Earthquakes often trigger fires. The water distribution system may be disrupted, thus posing a risk for public health and firefighting capabilities.

a) Local rivers and ponds are available to be tapped for water supply if necessary.
b) A tanker task force is available through state fire mobilization. FEMA has 8- 12 tankers that can be deployed anywhere in the US within 72 hours.

5.5.2 Landslides

a) Town design standards in the subdivision regulations have maximum slope restrictions for new roads. In addition, all temporary and permanent slopes must be stabilized appropriately.

5.6 Existing Multi-Hazard Mitigation Measures

The Town of Bedford has several mitigation measures in place that address more than one hazard. The following describes these measures:

Existing Town-Wide Mitigation for Multiple Hazards

a) Multi-Department Review of Developments – Multiple Town departments, including Planning, Code Enforcement, Health, DPW, Fire,

Police and Conservation are asked to review subdivision and site plans prior to approval. This practice has proven to be very effective.

b) Comprehensive Emergency Management Plan (CEMP) – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response, and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures, and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan.
c) Enforcement of the State Building Code – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads.
d) Participation in the Battle Road Regional Emergency Management Planning Committee (REPC) – The Battle Road REPC serves as the Local Emergency Management Planning Committee (LEPC) for the following communities: Arlington, Bedford, Belmont, Burlington, Carlisle, and Lexington.

5.7 Opportunities to Expand and Improve Existing Capabilities

In addition to the mitigation measures described in this section, existing planning initiatives are described in Section 3.3. The Town has identified opportunities to improve upon existing policies and programs as follows:

- Prioritize infrastructure in need of maintenance and repair through the Town's existing programs, and identifying additional funding opportunities to conduct these activities.
- Evaluate the Town's capability to provide local and regional shelters, as well as heating, cooling, and charging stations, that are accessible to vulnerable populations, particularly with respect to transportation.
- Improve the Town's communication with the broader public in the event of an emergency, such as investment in additional forms of communication, and targeting vulnerable populations.
    - Improve the Town's communication with various institutions with respect to their emergency response programs and preparedness.
- Conduct additional public outreach regarding the availability of various programs and incentives for hazard preparedness and greenhouse gas reduction
- Review and update existing municipal bylaws and regulations, including the Town's MS4 permit, to incorporate future climate projections. These projections would address development during the project design phase, particularly for infiltration and inflow investigations.

- Reevaluate the Town's existing wetlands by-law relative to the protections provided to floodplains.

The Action Plan included in Section 7.3 identifies actions that build upon existing programs and associated areas of improvement. The Town's ability to expand and improve existing capabilities is most limited by staff capacity to take on additional projects and scope. The Town recently adopted the top recommendation of the Bedford Net Zero Plan, and designated funds from the FY2023 budget through Town Meeting for an Energy and Sustainability Manager.

6.0 HAZARD MITIGATION GOALS AND OBJECTIVES

The goals in the 2010 Plan were reviewed and affirmed as follows:

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, and 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.

In addition, the central objectives of the CRB process were added to the plan goals:

9. Define the top local natural and climate-related hazards of concern.

10. Identify existing and future strengths and vulnerabilities within the Town.

11. Develop prioritized actions for the community.

12. Identify immediate opportunities to collaboratively advance planning actions to increase resiliency.

7.0 POTENTIAL MITIGATION MEASURES

The following Sections outline the mitigation process that has taken place since the 2010 Bedford Hazard Mitigation Plan as well as the top priority actions and associated action plan identified during the CRB Workshops outlined in Section 2.3 herein. The Action Plan was subsequently refined as a result of public feedback received during the Listening Session described in Section 2.4.1

7.1 Mitigation Progress Since 2010

Since completion of the last Plan, Bedford made significant progress in implementing additional measures to mitigate natural hazards. The following table lists the current status of mitigation measures identified in the 2010 Plan.

Table 23: Mitigation Progress Since 2010

Mitigation Measure	2010 Priority	2010 Time Frame	Current Status
A. Culvert Upgrades at Vine Brook near Route 62	High	Short Term	Complete
B. Drainage Improvements at Railroad Avenue by Elm Brook	High	Short Term	Proposed to be replaced with Minuteman Bikeway Extension; reiterated in 2022 plan as Action 13
C. Retrofit of Emergency Operation Center	High	Short Term	Complete; now located at Town Hall
D. Elevating Transformer at the Main Sewer Station	High	Long Term	Under design; reiterated in 2022 plan as Action 14
E. Tree Maintenance Program	High	Ongoing	Ongoing as part of annual DPW and utility company operations; reiterated in 2022 plan as Action 17
F. Public Education on Flooding	National Flood Insurance Program (NFIP)	Short Term	Ongoing as part of continued participation in NFIP; reiterated in 2022 plan as Action 40
G. Continuation of Open Space Protection and Land Acquisition	NFIP	Ongoing	Ongoing as part of continued participation in NFIP
H. Acquisition of Structures and Land on Bonnievale Drive	Medium	Long Term	Complete
I. Acquisition of Structures and Land on Bridge Street	Medium	Long Term	No longer relevant; structures have been or will be improved

7.1.1 Changes to Development in Hazard-Prone Areas

The Bedford Zoning Bylaw prohibits new construction in the flood plain. Any changes in flooding vulnerability stem from the new 2018 FEMA map boundaries rather than from new construction. The Town always uses the most recent FEMA data, even in preliminary form, as the basis for all new development restrictions.

7.2 Top Priority Actions

Following discussions as a large group at the conclusion of the December 2019 Community Resilience Building Workshop, stakeholders identified the following actions as the five highest priorities to improve the Town's resilience to climate change:

1. Assess and construct redundant underground electrical system/microgrid at Town Campus under the control of the Town.
2. Develop a Town Emergency Communications Plan and identify most effective means to reach vulnerable populations including residents with economic, language, and physical barriers.
3. Continue to identify vulnerable trees and perform proactive maintenance. Encourage utility companies to continue tree maintenance programs to identify and monitor vulnerable trees along overhead power lines.
4. Review and update Comprehensive Emergency Management Plan.
5. Coordinate with downstream communities and other planning commissions to manage rivers and streams. Conduct maintenance of hazard trees along the banks. Develop and implement proactive Beaver Management Plan.

7.3 The Action Plan

The Action Plan outlines action items for Bedford in the tables on the following pages. The priorities were established through a consensus-building process that consisted of a workshop with various boards, districts, and departments as outlined in Section 1.3. While reduction of the Town's contributions to climate change were considered, planning efforts focused mainly on climate adaptation and resilience.

The Core Team conducted a Benefit-Cost Review of the actions identified by stakeholders based on the principles outlined in Using Benefit-Cost Review in Mitigation Planning prepared by FEMA. The Core Team utilized Method A: Simple Listing Technique. Priorities were expressed through timeframe designations in accordance with the CRB process. Projects that are defined as "ongoing" are currently underway, and will be addressed continuously over the plan's effective period.

Project funding sources were broken down as “Capital”, “Operations,” “Staff,” or “All.” “Capital” projects are standalone projects greater than $5,000 that would be funded through the Town’s 6-year Capital Project’s Plan. This Plan encompasses all approved municipal departments' capital requests, and reflect the goals and priorities of the Select Board, Finance Committee, and Capital Expenditures Committee. Projects on the Plan are funded through a variety of sources including the tax levy, municipal bonds, Community Preservation Act funds, or other grants. Projects funded through “Operations” are ongoing in nature, and thereby absorbed into the responsible department’s annual operating budget. “All” simply implies the project is multi-faceted, and would be funded through a variety of means. Costs were generally estimated based on Core Team knowledge of similar project prices in the following categories:

- Very high (over $1 million)
- High ($500,000 - $1 million)
- Medium ($100,000 - $500,000)
- Low ($50,000 - $100,000)
- Very low (under $50,000)

7.3.1 Infrastructure Actions

Item #	Action Description	Priority Level	Hazard Addressed	Fiscal Year Implementation	Responsible Department	Cost	Funding Source	Type
1	Assess and construct redundant underground electrical system/microgrid through Town Campus under the control of the Town.	High	All	Ongoing through 2027	Facilities Dept/ Select Board/Utility Companies	Very High	Capital	Project
2	Convert municipal facilities to solar power.	High	All	2026-2027	Facilities Dept, Energy and Sustainability Committee/Select Board	Very High	Capital	Project
3	Promote programs and policies that incentivize private use of renewable energy.	High	All	Ongoing through five-year plan cycle	Planning Board /ZBA/Energy and Sustainability Committee	Low	Staff	Policy
4	Continue capital plan funding for emergency generators in Town buildings, and infrastructure enhancements to assist with continuity of operations during an emergency.	High	All	Ongoing through five-year plan cycle	Facilities Department/Department of Public Works	Medium	Capital	Project
5	Assess Town trails and other off-road paths and harden to facilitate emergency access via a UTV	High	Flooding and Extreme Precipitation	Ongoing	Trails Committee/Department of Public Works	Medium	Capital	Project
6	Update Town's Complete Streets Policy to incorporate climate change projections and consider language regarding “Green Streets”.	High	Flooding and Extreme Precipitation	2023-2025/Ongoing through five-year plan cycle	Department of Public Works /Planning Board/Transportation Advisory Committee/Select Board/Economic Development	Low	Staff	Policy
7	Create a Transportation Demand Management Team.	High	All	2022-2024	Planning Board/Select Board/Economic Development	Low	Staff	Policy
8	Continue to perform maintenance and clearing of sidewalks, bike trails and roadways prior to and after a major storm event.	High	All	Ongoing through five-year plan cycle	Department of Public Works	Low	Operations	Project
9	Conduct regular inspections of water and sewer mains, prioritizing areas that have recurring severe issues. Coordinate with appropriate parties to repair leaks in gas, water, and sewer lines. Continue existing inflow and infiltration investigations of sewer system, incorporating precipitation projections where possible. Continue to ensure that sewer lines do not contaminate nearby active wells.	High	All	Ongoing through five-year plan cycle	Department of Public Works/ Utility Companies	High	Operations	Project
10	Routinely maintain and repair Town-owned stormwater facilities, including the ongoing maintenance and cleaning of catch basins.	High	All	Ongoing through five-year plan cycle	Department of Public Works	Medium	Operations	Project

11	Identify and reduce wellfield vulnerabilities.	High	Heat/Drought/Fire	2023-2025	Department of Public Works	Medium	All	All
12	Develop an Emergency Action Plan in case of failure of all MWRA water supply lines.	High	All	2024	Department of Public Works	Medium	Staff	Plan
13	Implement drainage improvements on Railroad Ave and Commercial Ave by Elm Brook.	High	Flooding and Extreme Participation	2023	Department of Public Works	Medium	Boston MPO Transportation Improvement Program (TIP)	Project
14	Elevate transformer, and switch to aboveground fuel tank at Main Sewer Station.	High	Flooding and Extreme Precipitation	2023	Department of Public Works	Medium	Capital	Project
15	Study the feasibility to augment the MWRA water connection through Burlington to improve water quality and isolated pressure issues. Implement recommendations.	Medium	Extreme Precipitation	Ongoing through five-year plan cycle	Department of Public Works/Select Board	Very High	Capital	Project
16	Continue to prioritize replacement, maintenance, and repair of Town-owned bridges and culverts including a dry season evaluation of these areas. Identify future funding opportunities for repairs.	Medium	Flooding and Extreme Precipitation, Winter Storms	Ongoing through five-year plan cycle	Department of Public Works	Very High	Operations & Capital	Project
17	Review Operations & Maintenance Plan to ensure dam maintenance. Develop an Emergency Action Plan in the event of inundation or dam breach.	Medium	Flooding and Extreme Precipitation	Ongoing through five-year plan cycle	Department of Public Works/Conservation Commission	Low	Staff	Plan
18	Evaluate and update bylaws, regulations, and zoning ordinances to increase climate change resiliency. Continue to promote Low-Impact Development practices.	Medium	All	2023-2025	Planning Board/ZBA/Conservation Commission	Low	Staff	Policy
19	Continue to identify vulnerable trees and perform proactive maintenance. Encourage utility companies to continue tree maintenance programs to identify and monitor vulnerable trees along overhead power lines.	Medium	All	Ongoing through five-year plan cycle	Department of Public Works/Utility Companies	Medium	Operations	Project
20	Continue investment in local transit initiatives.	Medium	All	Ongoing through five-year plan cycle	Department of Public Works	Medium	Operations & Capital	Project
21	Conduct a flood risk assessment to map and inventory vulnerable areas and infrastructure. Identify, prioritize, and implement mitigation measures.	Lower	Flooding and Extreme Precipitation	2026-2027/ Ongoing through five-year plan cycle	Department of Public Works/Fire Department	High	All	All

7.3.2 Societal Actions

Item #	Action Description	Priority Level	Hazard Addressed	Fiscal Year Implementation	Responsible Department	Cost	Funding Source	Type
22	Review and update Comprehensive Emergency Management Plan.	High	All	2023-2025	Town Manager's Office/Police Department/ Fire Department/Health & Human Services/Facilities Department	Low	Capital	Plan
23	Coordinate with local institutions such as Middlesex Community College, the VA hospital, and Hanscom Air Force Base/MassPort to facilitate communications, planning, and emergency response.	High	All	2023-2025	Police Department/ Fire Department/Town Manger's Office	Low	Staff	Policy
24	Develop a Town Emergency Communications Plan, and identify most effective means to reach vulnerable populations including residents with economic, language, and physical barriers.	High	All	2023-2025	Town Manager's Office/Health & Human Services/Police Department/ Fire Department	Low	Staff	Plan
25	Identify vulnerable households and assess their level of risk and emergency preparedness. Identify ways in which the Town can support these vulnerable populations.	High		2024	Health & Human Services/Fire Department	Medium	Staff	All
26	Continue to develop and support existing outreach programs to ensure residents are aware of resources available in the event of an emergency.	High	All	2024	Select Board/Health & Human Services	Medium	Operations	Project
27	Create an ADA-compliant website to act as a repository for local hazard mitigation information including various protocols, evacuation areas, in case of emergency guidelines, climate change information, and how to manage "at home hazards".	Medium	All	2024	Town Manager's Office/IT/Fire Department	Low	Staff	Project
28	Evaluate how to improve reporting, communication, and management of non-emergency issues.	Medium	All	Ongoing through five-year plan cycle	Town Manager's Office	Low	Staff	Plan

7.3.3 Environmental Actions

Item #	Action Description	Priority Level	Hazard Addressed	Fiscal Year Implementation	Responsible Department	Cost	Funding Source	Type
29	Develop invasive species management program and educational programs to promote hearty, non-invasive, drought-tolerant, and diverse species. Update Bylaws accordingly.	High	All	2025	Conservation Commission/Planning Board	Low	All	All
30	Review and develop additional flood zone and stormwater regulations.	High	Flooding and Extreme Precipitation	2024	Conservation Commission/Department of Public Works	Low	Staff	Policy
31	Develop and adopt an Integrated Vector-borne Disease Program to manage pests, including mosquitos, ticks and their vectors (e.g. deer).	High	Flooding and Extreme Precipitation, Heat/Drought/Fire	2024	Conservation Commission/Board of Health	Medium	All	All
32	Acquire funding for additional public outreach and education for tick/mosquito control. Establish mosquito repellent stations in public locations.	High	All	2023-2025	Board of Health	Low	Capital	Project
33	Identify, assess, and acquire land for flood management projects and additional conservation land.	High	Flooding and Extreme Precipitation, High Winds and Extreme Storms	Ongoing through five-year plan cycle	Conservation Commission/Department of Public Works/Land Acquisition Committee/Trails Committee/Select Board	Very High	Capital	Project
34	Coordinate with downstream communities and other planning commissions to manage rivers and streams. Conduct maintenance of hazard trees along the banks. Develop and implement proactive Beaver Management Plan.	High	Flooding, Winter Storms, High Winds, and Extreme Precipitation	Ongoing through five-year plan cycle	Department of Public Works/Conservation Commission	Medium	Operations	Plan & Project
35	Update bylaws and regulations to incorporate future climate projections into project design. Develop green infrastructure requirements to promote the use of rain barrels, rain gardens, tree trenches, tree re-planting, etc. Develop landscape irrigation regulations.	High	All	2024	Department of Public Works/Planning Board	Low	Staff	Policy

36	Continue coordination with conservation land managers and apply for funding for materials to maintain Town-owned conservation areas.	Medium	All	Ongoing through five-year plan cycle	Conservation Commission/Department of Public Works/Trails Committee	Low	Capital	Project
37	Encourage municipal buildings to install green infrastructure.	Medium	Flooding and Extreme Precipitation	Ongoing through five-year plan cycle	Department of Public Works/ Facilities Department	Very High	Capital	Project
38	Dredge areas of major flooding to increase flood storage.	Medium	Flooding and Extreme Precipitation, High Winds and Extreme Storms	2026-2027	Department of Public Works/Eastern Middlesex Mosquito Control District	High	Capital	Project
39	Evaluate opportunities for wetland restoration projects with a flood control element.	Medium	All	Ongoing through five-year plan cycle	Conservation Commission/Planning Board	Low	Capital	Project
40	Update the existing Wetlands By-law.	Lower	Flooding and Extreme Precipitation, Heat/Drought/Fire	2024	Conservation Commission	Low	Staff	Policy
41	Update Open Space and Recreation Plan.	Lower	All	2025	Conservation Commission/Recreation Department	Low	Staff	Plan
42	Provide educational outreach to homeowners located in floodplains to increase resiliency to flooding.	Lower	Flooding and Extreme Precipitation, High Winds and Severe Storms	2024	Conservation Commission	Low	Staff	Project

8.0 PLAN ADOPTION AND MAINTENANCE

8.1 Plan Adoption

In accordance with the Disaster Mitigation Act of 2000, a local HMP is required by the Federal Emergency Management Agency (FEMA) for municipalities to receive funding for non-emergency disaster assistance. Local HMPs are reviewed by the Massachusetts Emergency Management Agency (MEMA) followed by FEMA for approval, then adopted by local officials. Updates to local HMPs are required every 5 years

The Bedford Hazard Mitigation Plan will be adopted by the Select Board upon receipt of an Approval Pending Adoption notice from FEMA; see Appendix G for a draft Certificate of Adoption.

8.2 Plan Maintenance and Implementation Schedule

The MVP Core team will continue to meet on an as-needed basis to function as the Hazard Mitigation Implementation Team, with one Town department or official designated as the coordinator. Additional members could be added to the Hazard Mitigation Implementation Team from businesses, non-profits, and institutions.

The Town anticipates that additional public engagement will be undertaken during the five-year term of this HMP. Such engagement may be the responsibility of the newly-designated Energy and Sustainability Manager position, and may include outreach methods such as newsletters or postings on the Town's website. Agendas and minutes from meetings of the Hazard Mitigation Implementation Team, as well as further opportunities for public input, will be made available on the Town's website.

Annual Survey on Progress – The coordinator of the Hazard Mitigation Implementation Team will conduct an annual meeting to review progress on mitigation action items and identify any new hazards or updated extents of hazards. This will be coordinated with the annual update required by Bedford's designation as an MVP-certified community.

This information will be used to prepare a report or addendum to the local Hazard Mitigation Plan. The Hazard Mitigation Implementation Team will have primary responsibility for tracking progress and updating the plan.

Develop a Year Four Update – During the fourth year after initial plan adoption, the coordinator of the Hazard Mitigation Implementation Team will convene the team to begin to prepare for an update of the plan, which will be required by the end of year five in order to maintain approved plan status with FEMA. The team will use the information from the year four biannual review to identify the needs and priorities for the plan update. At this point, the Hazard Mitigation Implementation Team may decide to undertake the update themselves, contract with Beals + Thomas to update the plan, or to hire another consultant.

Prepare and Adopt an Updated Local Hazard Mitigation Plan – 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 update of the Bedford Hazard Mitigation Plan will be forwarded to MEMA and DCR for review and to FEMA for approval.

8.3 Integration of the Plans with other Planning Initiatives

Upon approval of the Bedford Hazard Mitigation Plan by FEMA, the Hazard Mitigation Implementation 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 each department's ongoing work. At a minimum, the plan will be reviewed and discussed with:

- Fire/Emergency Management
- Police
- Public Works/Engineering
- Planning
- Conservation
- Recreation
- Health
- Code Enforcement
- Facilities

Existing planning initiatives are addressed more fully in Section 3.3, and opportunities to improve upon these existing policies and programs are addressed more fully in Section 5.7.

Other groups the local team may coordinate with include large institutions (hospitals, colleges), chambers of commerce, land conservation organizations, and watershed groups. The plan will also be posted on the community's website with the caveat that the local team coordinator will review the plan for sensitive information that would be inappropriate for public posting (such as critical facilities). The posting of the plan on a website will include a mechanism for citizen feedback, such as an e-mail address to send comments.

In addition, the plan will be made available for review by state agencies such as MEMA, DCR, and DOT, and regional agencies such as the MWRA.

9.0 RESOURCES

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Appendices

Appendix A
Local Mitigation Plan Review Tool

LOCAL MITIGATION PLAN REVIEW TOOL - Town of Bedford, MA

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: Town of Bedford, MA	**Title of Plan:** Municipal Vulnerability Preparedness Summary of Findings, 2021 Draft **Hazard Mitigation Plan Update**	**Date of Plan:** June 16, 2021
Single or Multi-jurisdiction plan? Single		**New Plan or Plan Update?** Update
Local Point of Contact: David Grunes **Title:** Fire Chief **Agency/Address:** Town of Bedford, Fire Department, 55 Great Road, Bedford, MA 01730 **Phone Number:** 781-275-7262 x4201 **E-Mail:** dgrunes@bedfordma.gov		**Regional Point of Contact:** **Title:** **Agency/Address:** **Phone Number:** **E-Mail:**

State Reviewer: Jeffrey Zukowski	**Title:** Hazard Mitigation Planner	**Date:** December 23, 2021; 1/21/2022;

FEMA Reviewer: Jay Neiderbach Brigitte Ndikum-Nyada	**Title:** FEMA Community Planner Community Planner	**Date:** 1/14/2022 1/18/22- 1/21/22; 2/14/22-2/15/22;
Date Received in FEMA Region I	12/23/2021; 1/21/2022;	
Plan Not Approved	1/21/2022**; 2/15/2022**	
Plan Approvable Pending Adoption		
Plan Adopted		
Plan Approved		
Plan Expires		

SECTION 1:
REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan (section and/or page number)**	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	pp. 4-10, Appendices B and F	X	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	pp. 4-10, Appendices B and F	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	pp. 4-10, Appendices B and F	X	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	pp. 14-16	X	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	pp. 61-62		**X**
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	pp. 61-62	X	
ELEMENT A: REQUIRED REVISIONS A5-a. The plan must describe how the jurisdiction will continue to seek participation after the plan has been approved and during the plan's implementation, monitoring, and evaluation. *Refer to Section 8.2 for additional information regarding continued public participation upon approval of the plan.*			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	pp. 18-48, Appendix D	X	
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	pp. 18-48	X	
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	pp. 18-48, Appendix D	X	
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	p. 25	X	
ELEMENT B: REQUIRED REVISIONS			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	pp. 14-16, 49-53		X
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	pp. 25, 49-50, 55-56	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	p. 54	X	
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	pp. 56-60, Appendix E	X	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	pp. 56-60		X
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	pp. 14, 62	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT C: REQUIRED REVISIONS **C1-a.** The plan must describe the jurisdiction's ability to expand on and improve its existing policies and programs. (**See** FEMA Local Mitigation Planning Handbook page 4-1 for Capability Assessment and the **worksheet** on pages 4-16 to 4-28. *Local Mitigation Planning Handbook (fema.gov).* *Refer to Section 5.7 for additional information regarding the Town's ability to improve its existing policies and programs.* **C5-c:** The plan **must identify** the expected timeframes for completion and provide an explanation to these three funding sources "Capital," "Operations" and "All." If it is Capital Improvement Plan, provide the full name and describe what "ALL" and Operations mean. **Timeframe** provided as "On-going needs to explain. If 'On-going,' falls within the five-year plan cycle as indicated for some actions, that needs to be stated. *Refer to Section 7.3, 7.3.1, 7.3.2, and 7.3.3 for clarified definitions of timeframes for completion and funding sources.*			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	pp. 17-18, 56	X	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	p. 55		X
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	pp. 55-60	X	
ELEMENT D: REQUIRED REVISIONS **D2-a -** The plan **must** describe the status of hazard mitigation actions in the previous plan by identifying those that have been completed or not completed. For actions that have not been completed, the plan **must** either describe whether the action is no longer relevant or be included as part of the updated action plan. There are a few actions from the previous HMP, listed as "**No Update**" or "**on-going**" without an explanation of what they mean. Describe or expand on them. *Refer to Table 23 in Section 7.1 for expanded status of prior hazard mitigation actions*			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Appendix G		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	N/A		

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT E: REQUIRED REVISIONS			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
ELEMENT F: REQUIRED REVISIONS			

SECTION 2:
PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Recommended Correction:

The Town of Bedford is encouraged to take a second look at the title assigned to this plan. The current plan's title is *"Municipal Vulnerability Preparedness Summary of Findings, 2021 Draft Hazard Mitigation Plan Update."* A reference made on page 131 (pdf) of the plan by Jeanette Rebecchi, Transportation Manager, is worth mentioning here: She referred to the Plan title as: **"Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Report."** Consider revising this title to capture Ms Jeanette's reference. This plan's a HMP and MVP is integrated to HMP.

Element A: Planning Process

Strengths:

- The planning process is well detailed. The inclusion of meeting materials will help guide future updates.
- A diverse group of stakeholders were involved in the planning process, ensuring a range of perspectives and comprehensive analysis. The Regional Partners and Inter-Community consideration partners is such group of stakeholders to have at the hazard mitigation planning process table.
- The public listening session was noticed in multiple ways to encourage better awareness.

Opportunities for Improvement:

- Invite additional municipal officials from neighboring towns in addition to the business community and Billerica Fire Department.
- Include more information about how the plan will be evaluated during the annual survey and what parts will be evaluated.
- Make it easier to keep the plan updated by creating set criteria for evaluation as well as a schedule for when and how evaluation will occur.
- Include detailed and specific information on continuous outreach to stakeholders and the public.
- HM Plan requirement element **A6** is where the community describes the method and schedule for keeping the plan current, updating and plan maintenance. This schedule should also accommodate any required plan revisions after State and FEMA reviews. It is strongly encouraged that the community avoid and prevent its hazard mitigation plan from expiring. The community's HMP expired since 2016. Without an approved HMP, the town is not eligible to receive certain FEMA disaster grants.

Element B: Hazard Identification and Risk Assessment

Strengths:

- Maps clearly highlight the areas and facilities that are most at risk.
- The plan incorporates 500-year floodplain data into the flood profile and map. While not regulatory, the 500-year data is a great planning tool for future development.

Opportunities for Improvement:

- Include more information about previous occurrences of flooding, such as what structures were flooded, where the flooding occurred, how much rain occurred, etc.
- Provide a clearer description of the community's greatest vulnerabilities as a summary of the risk assessment.
- The plan doesn't specifically provide a definite location for severe winter storms / nor'easters or tornadoes / high winds on pages 37 – 43. It is important to either use a map or describe where exactly in the community are these natural hazards prone to have any impacts. If the impacts are town-wide, state that.
- Provide a longer timeframe when discussing previous occurrences. This can give a more accurate picture of future risks.

Element C: Mitigation Strategy

Strengths:

- The plan includes of a variety of different types of mitigation actions (local plans and regulations, structure and infrastructure projects, natural system protections, and education and awareness programs).

Opportunities for Improvement:

- Provide more information about the community's participation in the NFIP (compliance efforts, public outreach, current date of flood maps, etc.).
- Provide more details about what mitigation actions will entail and the sub-tasks that will be involved.
- Existing **capabilities** were briefly described. Describe existing authorities, policies, programs and resources **and the ability to expand and improve upon** them. Include a discussion on any need for modifications on how they could be expanded and improved upon, to further reduce risk. **See** FEMA Local Mitigation Planning Handbook page 4-1 for Capability Assessment and the **worksheet** on pages 4-16 to 4-28. Local Mitigation Planning Handbook (fema.gov)
- In the next HMP update, go above meeting the minimum requirement of element C6.d. An updated Hazard Mitigation Plan **must explain how** the Town of Bedford **incorporated** the Mitigation Plan, when appropriate, into other planning mechanisms as a demonstration of progress in local hazard mitigation efforts. This sentence from page 14 of the plan does not really address this requirement: *"In many ways these plans built upon the work of the 2010 Hazard Mitigation Plan."* Improve this requirement in the next update.

Element D: Plan Update, Evaluation, and Implementation (*Plan Updates Only*)

Strengths:

- The plan includes a projection of planned and/or potential future development.

Opportunities for Improvement:

- Describe the changes to the 2018 flood maps and what impact these have had on the assessed risk to development within the community.
- Consider including a discussion on how mitigation activities have increased the community's resilience and support other long-term community planning goals.
- Consider adding a section on planned and/or potential future development, if applicable.
- Describe general land use changes in neighboring jurisdictions, if applicable, that may affect the community's risk.
- Including a discussion of lessons learned about implementing mitigation actions would strengthen the plan, as would a short narrative on some "success stories" about their implementation.

B. Resources for Implementing Your Approved Plan

Refer to the Massachusetts Integrated State Hazard Mitigation and Climate Action Plan, Resilient MA Climate Clearinghouse, and State's Climate Action Page to learn about hazards relevant to Massachusetts and the State's efforts and action plan.

Technical Assistance:

FEMA

- FEMA Climate Change: Provides resources that address climate change.
- FEMA Library: FEMA publications can be downloaded from the library website. These resources may be especially useful in public information and outreach programs. Topics include building and construction techniques, NFIP policies, and integrating historic preservation and cultural resource protection with mitigation.
- FEMA RiskMAP: Technical assistance is available through RiskMAP to assist communities in identifying, selecting, and implementing activities to support mitigation planning and risk reduction. Attend RiskMAP discovery meetings that may be scheduled in the state, especially any in neighboring communities with shared watersheds boundaries.

Other Federal

- EPA Resilience and Adaptation in New England (RAINE): A collection of vulnerability, resilience and adaptation reports, plans, and webpages at the state, regional, and community levels. Communities can use the RAINE database to learn from nearby communities about building resiliency and adapting to climate change.
- EPA Soak Up the Rain: Soak Up the Rain is a public outreach campaign focused on stormwater quality and flooding. The website contains helpful resources for public outreach and easy implementation projects for individuals and communities.
- NOAA C-CAP Land Cover Atlas: This interactive mapping tool allows communities to see their land uses, how they have changed over time, and what impact those changes may be having on resilience.
- NOAA Sea Grant: Sea Grant's mission is to provide integrated research, communication, education, extension and legal programs to coastal communities that lead to the responsible use of the nation's ocean, coastal and Great Lakes resources through informed personal, policy and management decisions. Examples of the resources available help communities plan, adapt, and recovery are the Community Resilience Map of Projects and the National Sea Grant Resilience Toolkit
- NOAA Sea Level Rise Viewer and Union for Concerned Scientists Inundation Mapper: These interactive mapping tools help coastal communities understand how their hazard risks may be changing. The "Preparing for Impacts" section of the inundation mapper addresses policy responses to protect communities.
- NOAA U.S. Climate Resilience Toolkit: This resource provides scientific tools, information, and expertise to help manage climate-related risks and improve resilience to extreme events. The "Steps to Resilience" tool may be especially helpful in mitigation planning and implementation.

State

- Massachusetts Emergency Management Agency: The Massachusetts State Hazard Mitigation Officer (SHMO) and State Mitigation Planner(s) can provide guidance regarding grants, technical assistance, available publications, and training opportunities.

- Massachusetts Departments of Conservation and Recreation and Environmental Protection can provide technical assistance and resources to communities seeking to implement their hazard mitigation plans.
- https://www.mass.gov/guides/floodplain-management Massachusetts 2020 Model Floodplain Bylaws. https://msc.fema.gov/portal
- MA Mapping Portal: Interactive mapping tool with downloadable data

Not for Profit

- Kresge Foundation Online Library: Reports and documents on increasing urban resilience, among other topics.
- Naturally Resilient Communities: A collaboration of organizations put together this guide to nature-based solutions and case studies so that communities can learn which nature-based solutions can work for them.
- Rockefeller Foundation Resilient Cities: Helping cities, organizations, and communities better prepare for, respond to, and transform from disruption.

Funding Sources:

- Massachusetts Coastal Resilience Grant Program: Funding for coastal communities to address coastal flooding, erosion, and sea level rise.
- Massachusetts Municipal Vulnerability Preparedness program: Provides support for communities to plan for climate change and resilience and implement priority projects.
- Massachusetts Water Quality Grants: Clean water grants that can be used for river restoration or other kinds of hazard mitigation implementation projects.
- Grants.gov: Lists of grant opportunities from federal agencies (HUD, DOT/FHWA, EPA, etc.) to support rural development, sustainable communities and smart growth, climate change and adaptation, historic preservation, risk analyses, wildfire mitigation, conservation, Federal Highways pilot projects, etc.
- FEMA Hazard Mitigation Assistance (HMA): FEMA's Hazard Mitigation Assistance provides funding for projects under the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA). States, federally recognized tribes, local governments, and some not-for-profit organizations are eligible applicants.
- GrantWatch: The website posts current foundation, local, state, and federal grants on one website, making it easy to consider a variety of sources for grants, guidance, and partnerships. Grants listed include The Partnership for Resilient Communities, the Institute for Sustainable Communities, the Rockefeller Foundation Resilience, The Nature Conservancy, The Kresge Climate-Resilient Initiative, the Threshold Foundation's Thriving Resilient Communities funding, the RAND Corporation, and ICLEI Local Governments for Sustainability.
- USDA Natural Resource Conservation Service (NRCS) and Rural Development Grants: NRCS provides conservation technical assistance, financial assistance, and conservation innovation grants. USDA Rural Development operates over fifty financial assistance programs for a variety of rural applications.

Appendix B
Workshop Materials

Agenda for December 11, 2019 Workshop

Introductory Presentations for December 11, 2019 Workshop

Newspaper Article Summarizing December 11, 2019 Workshop

MEETING DATE:	December 11, 2019
MEETING TIME:	8:00 AM to 4:00 PM
MEETING LOCATION:	Reed Room, Bedford Town Hall 10 Mudge Way, Bedford, MA
REFERENCE:	Municipal Vulnerability Preparedness Stakeholder Workshop Bedford, Massachusetts B+T Project No. 3142.00
PREPARED BY:	Beals and Thomas, Inc.
COPIES TO:	Attendees

AGENDA ITEMS:

Time	Activity	
8:00 – 8:30 AM	Sign-in and Breakfast	
8:30 – 8:40 AM	Welcome, Workshop Overview, and Introductions	Sarah Stanton, Bedford Town Manager
8:40 – 8:55 AM	MVP Program Overview	Beals and Thomas, Inc.
8:55 – 9:15 AM	Science and Resources	Beals and Thomas, Inc.
9:15 – 9:45 AM	Large Team Exercise: Top Hazards	Stakeholders and Facilitators
9:45 – 11:45 AM	Small Team Exercises: Strengths and Vulnerabilities	Stakeholders and Facilitators
11:45 – 12:15 PM	**Break and Lunch**	
12:15 – 2:15 AM	Small Team Exercises: Actions to Address Strengths and Vulnerabilities	Stakeholders and Facilitators
2:15 – 2:30 PM	Small Group Report Outs	Small Group Representatives
2:30 – 3:30 PM	Large Team Exercise: Prioritize Overall Actions	Stakeholders and Facilitators
3:30 – 3:45 PM	Wrap-Up and Next Steps	Mary Kate Schneeweis

MKS/314200AG001

Team Members

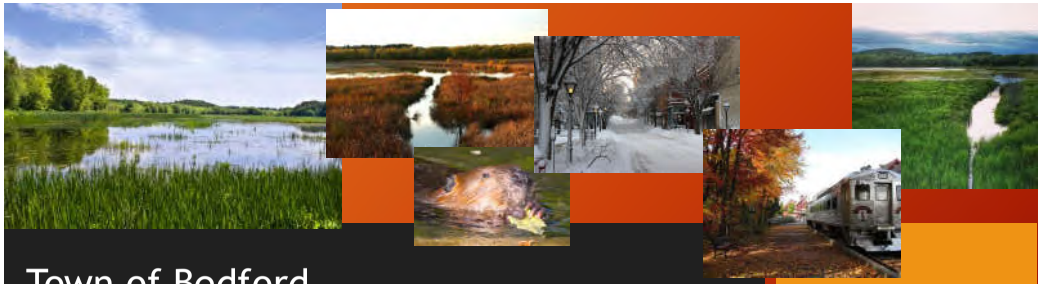
Town of Bedford Core Team

- Jeanette Rebecchi, AICP, Transportation Program Manager
- Adrienne St. John, Public Works Engineer
- David Grunes, Fire Chief

Beals and Thomas, Inc. (B+T) Facilitators

- Mary Kate Schneeweis
- Nick Santangelo, EIT
- Andrew Gorman, CESSWI
- Caroline Booth

Roundtable Stakeholder Introductions



Town of Bedford
Community Resilience Building Workshop

Presented By:

BEALS+THOMAS

Municipal Vulnerability Preparedness (MVP) Program

The Nature Conservancy

www.CommunityResilienceBuilding.org

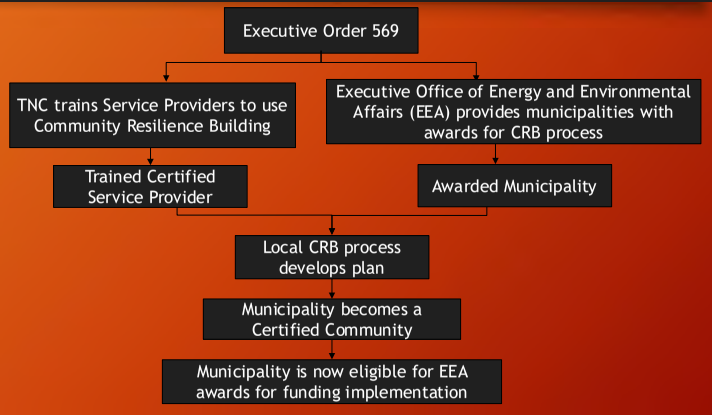
Welcome and Introduction

- Sarah Stanton, Town Manager

2014 Microburst, Julie Loncich/WCVB-TV

Overview of the MVP Process

MVP Overview

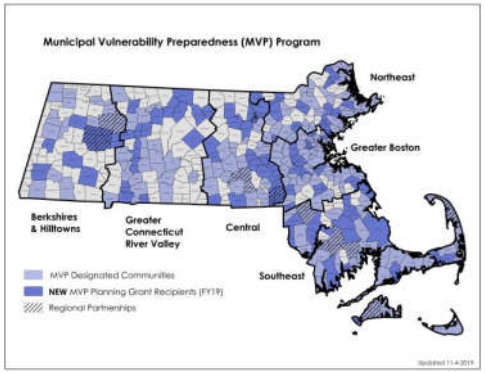


Workshop Objectives

- Define extreme weather and natural and climate-related hazards
- Identify existing and future vulnerabilities and strengths
- Develop and prioritize actions for the community and broader stakeholder networks
- Identify opportunities for the community to advance actions to reduce risks and build resilience.

State's Vision for the MVP Program

1. Engage community
2. Identify climate change impacts and hazards
3. Complete assessment of vulnerabilities and strengths
4. Develop and prioritize actions
5. Take action!



Hazard Mitigation Plan Update

- Required for municipalities to receive Federal Emergency Management Agency (FEMA) funding for non-emergency disaster assistance
- Updates required every 5 years
- Effective plan entitled Town of Bedford Mitigation Plan by the Metropolitan Area Planning Council in 2010
- Additional EEA funds for communities with expiring hazard mitigation plans who are undertaking MVP process
- Similar public input process to MVP program

Town of Bedford MVP Designation Schedule

- Receipt of Planning Grant: July 18, 2019
- Core Team Establishment of Approach: July 25, 2019
- Workshop: December 11, 2019
- HMP Public Review: March 2020
- Public Listening Session: April 2020
- Final Report: June 2020

MVP Action Grants

- Town will be eligible upon designation as MVP community
- Project categories include:
  - Detailed vulnerability/risk assessments
  - Local bylaw and ordinance improvements
  - Engineering and construction retrofits
  - Ecological restoration projects
  - Nature-based solutions to reduce vulnerability

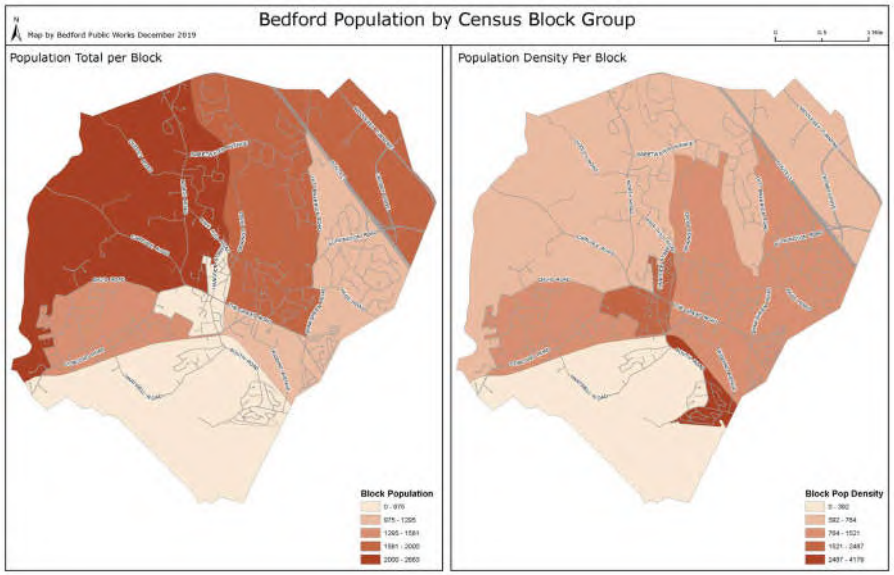
Mitigation Planning Benefits

- A process for communities to identify policies, activities and tools to implement mitigation actions
  - Increases awareness of vulnerabilities
  - Promotes safety and welfare of communities and citizens
  - Cultivates community commitment to mitigation
- Lack of hazard awareness and mitigation plan could lead to unnecessary losses to infrastructure and critical facilities and potential human casualties

Bedford Demographics

- Total Population (2018): 14,195
- Potential Vulnerable Populations:
  - Age 60+: 24.7% (2010 census), 27.6% (2020 projected), 29.3% (2030 projected)
  - Persons with Disabilities: 3.9%
  - Speak language other than English at home: 19.9%
  - Below poverty line: 2.5%

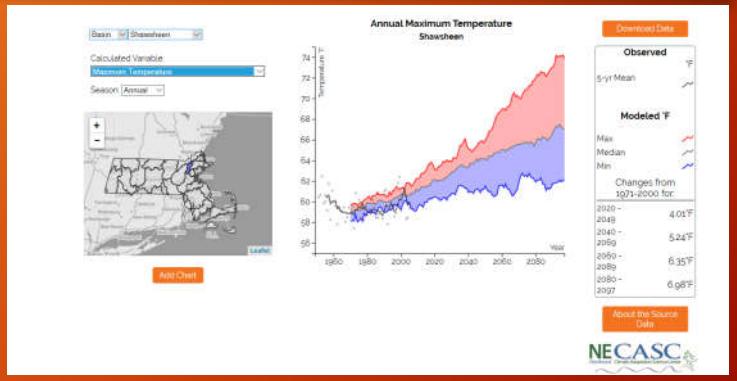
Source: Center for Social & Demographic Research, Gerontology Institute, John W. McCormack Graduate School of Policy & Global Studies, UMass Boston; United States Census Bureau; American Community Survey



FY 2019 Action Grant Examples

- Boston - Climate Ready Zoning and Design Guidelines
- Natick - Tree Planting Plan to Mitigate Heat Islands and Reduce Runoff
- Salem - Sanitary Sewer Trunk Line Relocation Assessment
- Montague - City Road Flooding Protection Project: Design and Permitting

Science and Resources



Severe Storms, Winter Storms, and Hurricanes

- Severe Storms: wind, hail, lightning
  - 2014 microburst downed 50 – 70 trees
- Hurricanes: heavy rain, high winds
  - 39 hurricanes with significant wind or rain impacts in New England since 1938
  - Most recent was Hurricane Sandy in 2012
- Winter Storms: heavy snow, freezing rain, extreme wind, extreme cold
  - Severe Winter Storm defined as 6 inches or more of snow in 24 hours
  - Regional record for winter snowfall: 126.5 inches in 1995

Bedford Hazard Mitigation Plan

- Updated and adopted in 2010
- Recommendations to address natural hazards
- Prioritized mitigation based on anticipated area of hazard impact, expected benefit, and cost

Hazard	Statewide Frequency of Occurrence	Severity	Risk to Bedford
Flooding	High	Serious to Extensive	Same as state
Dam Failures	Low	Extensive	Three dams registered in Bedford with DCR
Hurricanes	Medium	Extensive to Catastrophic	Same as state
Severe Storms (wind, hail, lightning)	Medium	Serious	Same as state
Tornadoes	Medium	Extensive to Catastrophic	Not a major issue in Bedford
Winter Storms	High	Serious	Same as state
Earthquakes	Low	Catastrophic	Same as state
Landslides	Low	Minor	Not a major issue in Bedford
Brush Fires	Medium	Serious	Not a major issue in Bedford

Massachusetts Climate Change Projections (Shawsheen Basin)

- Temperature
  - Increased average temperatures and number of days with maximum temperature above 90˚F
    - Annually – 10 to 32 more days with temperatures above 90˚F by 2050s
  - Decrease in number of days with minimum temperature below 32˚F
    - Winter – 4 to 14 fewer days with temperatures below 32˚F by 2050s
- Precipitation
  - Increase in number of days with greater than 1” precipitation and total precipitation
    - Annually – approximately 1 to 3 more days with precipitation greater than 1” by 2050s
- Drought
  - Increase in consecutive dry days
    - Summer – potential increase of 1 to 2 more consecutive days with less than 1mm of precipitation

Flooding

- Most prevalent natural hazard identified in 2015 HMP
- Riverine floodplain associated with following
  - Great Meadows Wildlife Refuge
  - Concord River – largest area of flooding
  - Elm Brook
  - Shawsheen River
  - Springs Brook
  - Vine Brook
- Drainage-related flooding issues from stormwater capacity

Summary of Workshop Exercises

- Develop and prioritize list of **Hazards**
- Identify community **Strengths** and **Vulnerabilities**
  - Infrastructural
  - Societal
  - Environmental
- Determine and prioritize **Actions**
  - Identify the actions needed to reduce the vulnerability or reinforce the strength represented by each feature/asset.
  - Priority (high, medium, low)
  - Timeframe (ongoing, short-term, long-term)

10-Minute Break

- When you return, please sit at the table that corresponds to your nametag color

Definitions

- **Hazard** – cause of negative impacts to community
- **Risk** – potential result from hazard
- **Vulnerability** – feature (societal, environmental, or infrastructural) that is susceptible to risk
- **Action** – addresses vulnerability

Workshop Exercises

Risk Matrix Columns 1-4

- List top **hazards** for community in top row
- For each sector (infrastructural, societal, environmental)
  - Identify **vulnerabilities** and **strengths**
    - Determine location
      - List on Risk Matrix
      - Mark on Base Map
    - Identify ownership of issue or place.
    - Identify if feature/asset is a strength and/or vulnerability

Hazards vs. Vulnerabilities

Hazards	Vulnerabilities
Flooding →	Residences in flood zone
Drought →	Water supply
Wind →	Overhead power lines
Wildfire →	Dry vegetation

Lunch Break

- Please help yourself to the lunch provided.

Small Group Exercises: Complete Risk Matrix


Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

Top Priority Hazards (tornado, Floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat waves, etc.)

H-M-L priority for action over the Short or Long term (circle Long term)

X = Vulnerability S = Strength

Features	Location	Ownership	V or S					Priority H-M-L	Time Short &/or Long term
Infrastructural									
Societal									
Environmental									

Examples of Ecological Restoration

- Dam Removal


Risk Matrix Columns 5-10

- Determine actions
  - Identify the actions needed to reduce the vulnerability or reinforce the strength represented by each feature/asset.
- Prioritize
  - Priority (High, Medium, Low)
  - Timeframe (ongoing, short-term, long-term)

Examples of Green Infrastructure/LID

- Stormwater Management with Green Roofs


- Stormwater Management with Bioretention Areas and Rain Gardens


If Possible: Use Nature Based Solutions

- Use or mimic natural systems to address hazards
  - Ecological Restoration
  - Green Infrastructure
  - Low-Impact Development (LID)

Image Source: *Nature-Based Solutions to address global societal changes*; Cohen, et al. 2016

Next Steps

- Town and B+T to compile results of workshop into summary report and updated HMP
- Provide draft summary report/HMP for public review
- Hold listening session to present list of priority actions and how to implement
- Submit final summary report/HMP to EEA to receive MVP designation, and to MEMA and FEMA for review and comment
- Incorporate MEMA/FEMA comments on HMP
- Final HMP approval from Board of Selectmen

Small Group Report Out

- Small group spokesperson
  - 3-5 minute summary to present completed matrices
    - What Risks were identified?
    - What were the top priority Hazards identified?
    - Were there any other items of discussion worth noting?

Large Group Discussion

- Identify top 3-5 priority actions
- Further refine timeframe(s)

Bedford Works Toward Building a More Resilient Community

By **Dot Bergin** | December 16, 2019

How vulnerable is our town as we look ahead to potential climate change and its impact on our infrastructure?

Thoughtful residents would say, “In the light of recent severe weather events-think snowstorms or high winds bringing down power lines”- we are already at a time when preparedness is key to the wellbeing of the town.

On December 11, Town officials, Committee chairs (Selectmen, Planning, etc.), Department Heads (Police, Fire, DPW) and representatives of community organizations including Mothers Out Front and the League of Women Voters, spent eight hours grappling with these questions at a “Community Resilience Building Workshop” led by environmental consultants Beals and Thomas. The workshop’s goal was to identify hazards from climate change, assess the town’s strengths and vulnerabilities, and develop and prioritize mitigating actions.

Here is the background:

- In July of this year Town Manager Sarah Stanton received a Planning Grant from the Commonwealth’s Municipal Vulnerability Preparedness (MVP) program, created by Governor Baker in 2016. *The program provides support for cities and towns in Massachusetts to begin the process of planning for climate change resiliency and implementing priority projects. The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans*. Read more here: https://www.mass.gov/municipal-vulnerability-preparedness-mvp-program (https://www.mass.gov/municipal-vulnerability-preparedness-mvp-program) .
- Stanton formed a team, headed by Town Engineer Adrienne St. John, to hire an environmental consultant to lead a workshop identifying hazards unique to Bedford.
- The December Community Resilience Building Workshop brought together a broad cross-section of the town, offering different perspectives on climate change.
- In March 2020, the consultants will leverage the research coming out of the workshop to update the town’s existing Hazard Mitigation Plan (HMP), which was first drawn up in 2010. Having an HMP plan in place means that in an emergency, funding aid can be provided by FEMA. The plan must be updated every five years. See https://www.mass.gov/files/documents/2018/10/26/SHMCAP-

September2018-Full-Plan-web.pdf (https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf) ; https://www.mass.gov/service-details/local-hazard-mitigation-planning (https://www.mass.gov/service-details/local-hazard-mitigation-planning)

- To further involve Bedford residents, a public "listening" event will take place in April 2020 when all townspeople will have the opportunity to voice opinions and ideas on climate change preparedness.
- In June 2020, Beals and Thomas will deliver a final report to the state.

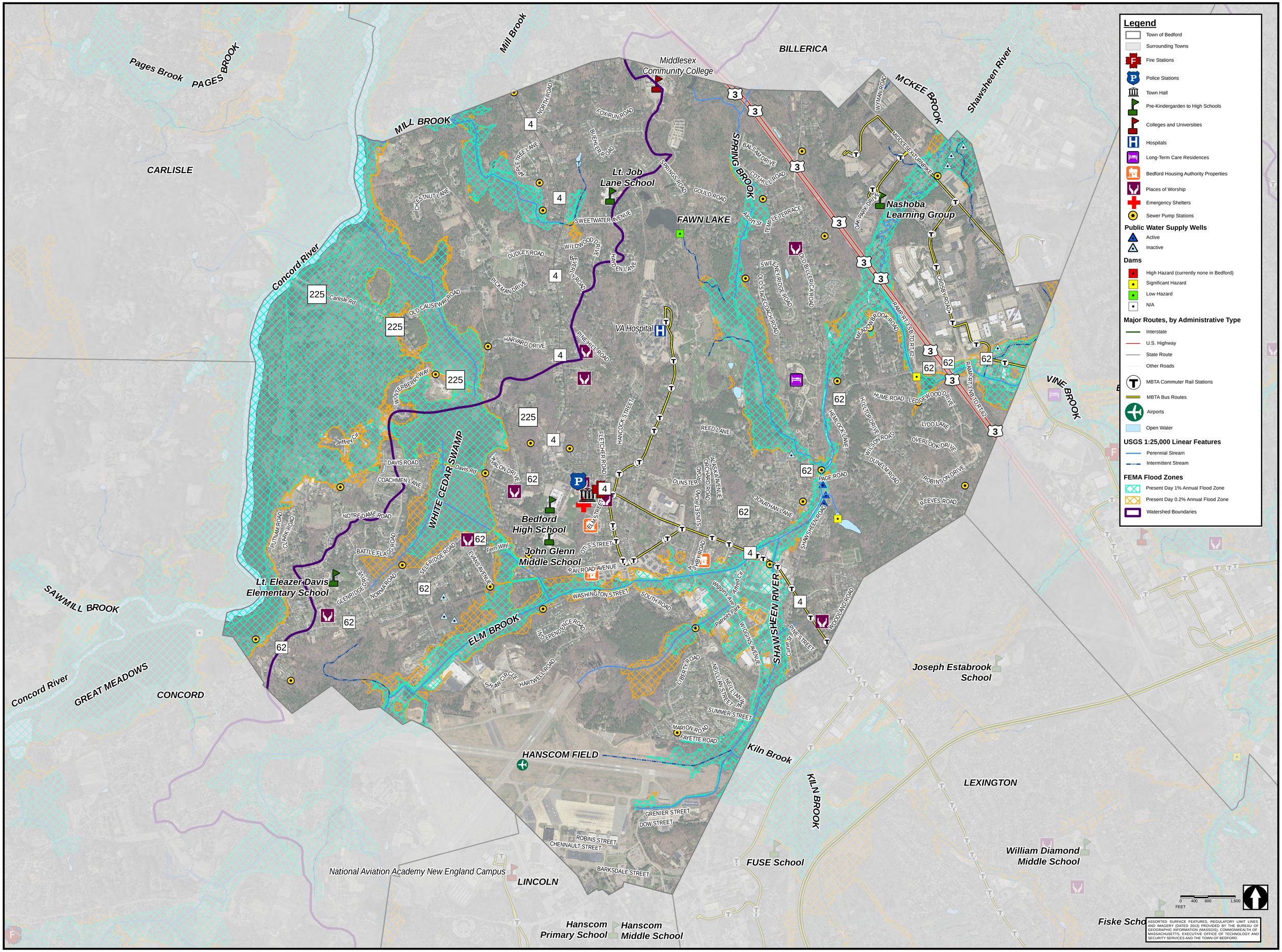
Based on the engagement with townspeople that has already happened and that will continue into 2020, the Beals and Thomas report will summarize – and prioritize- the town's concerns. Bedford will then be able to apply to the Commonwealth for an Action Grant to complete a major project as identified through the workshop and hearings. Action Grants can range from small sums to substantial amounts. For example, in 2018, Natick received $9,000 to plant trees to mitigate heat islands wile Salem won more than $300,000 for extensive sewer work.

The December workshop was more than a "lecture" – it was a hands-on exercise in which the 40 or more stakeholders attending were divided into groups for an intensive exploration of the town's strengths and vulnerabilities. This reporter was privileged to be in a workgroup with the Police Chief and three professional employees of the DPW, who provided helpful background on our group's wide-ranging questions. Some of these questions were:

- Are the bridges in town safe?
- What can we do about frequent downed power lines that cut off neighborhoods?
- Is our town-wide communication system robust enough to reach all populations in town, including certain particularly vulnerable ones (residents with accessibility issues, or non-English speaking residents who may not understand our current reverse 911 notifications.)
- How secure is our water supply?
- How prone are our waterways (Shawsheen, Vine Brook, Concord river) to flooding?
- What are the regulations homeowners need to know regarding stormwater?
- What facilities do we now have in place in case of a town-wide emergency, such as an extended power outage? In severe weather events over the past few years, we have offered a heating/cooling/phone charging station where residents could come and stay for a few hours but we are not set up for a true "shelter," with sleeping and medical facilities. Is there a shelter nearby?
- How would we handle a massive traffic jam, if residents were trying to get to a safe place in a severe weather event or another environmental hazard?

At the conclusion of the workshop, each roundtable group presented its major concerns and ideas for remedial action. In subsequent articles, *The Citizen* will explore these in more detail.

Appendix C
Base Map and Critical Facilities


Legend
Town of Bedford
Surrounding Towns
Fire Stations
Police Stations
Town Hall
Pre-Kindergarden to High Schools
Colleges and Universities
Hospitals
Long-Term Care Residences
Bedford Housing Authority Properties
Places of Worship
Emergency Shelters
Sewer Pump Stations
Public Water Supply Wells
Active
Inactive
Dams
High Hazard (currently none in Bedford)
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Major Routes, by Administrative Type
Interstate
U.S. Highway
State Route
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Open Water
USGS 1:25,000 Linear Features
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Intermittent Stream
FEMA Flood Zones
Present Day 1% Annual Flood Zone
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FAWN LAKE
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Pages Brook
PAGES BROOK
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NORTH ROAD
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PINE TREE LANE
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SPRINGS ROAD
GOULD ROAD
BALSAM DRIVE
COTHILL ROAD
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MIDDLESEX TURNPIKE
OAK PARK DRIVE
CROSBY ROAD
SWEETWATER AVENUE
WILDWOOD DRIVE
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DUDLEY ROAD
PICKMAN DRIVE
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ELM STREET
OLS STREET
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ASHBY ROAD
WASHINGTON STREET
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RAMP RT 3 SB TO RT 62
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0 400 800 1,600
FEET
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Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
Hanscom Air Force Base	Military	No	No
Town Hall	Municipal - Emergency Operation Center	No	No
Town Center Building	Municipal	No	No
Old Town Hall	Municipal	No	No
Police Station	Municipal	No	No
Fire Station	Municipal	No	No
Council on Aging	Municipal	No	No
Department of Public Works	Municipal	No	No
Hartwell Road Water Facility	Municipal - DPW Storage	No	No
Department of Public Works Salt Shed	Municipal - DPW	No	No
Department of Public Works Sand Shed	Municipal - DPW	No	No
Department of Public Works Seasonal Storage	Municipal - DPW	No	No
Town Center Shelter	Shelter	No	No
U.S. Post Office	Post Office	No	No
Town Emergency AM Radio Antenna	Municipal	No	No
Page Road Sewer Pump Station	Sewer Pumping Station	AE	No

Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
Bandera Sewer Pump Station	Sewer Pumping Station	No	No
Bonnievale Sewer Pump Station	Sewer Pumping Station	AE	Bonnievale Drive
Carlisle Sewer Pump Station	Sewer Pumping Station	X500	No
Chelmsford Sewer Pump Station	Sewer Pumping Station	No	No
Davis Road II Sewer Pump Station	Sewer Pumping Station	No	No
Davis Sewer Pump Station	Sewer Pumping Station	No	No
El-Will Farm Sewer Pump Station	Sewer Pumping Station	No	No
Evans Sewer Pump Station	Sewer Pumping Station	No	No
Harvard Sewer Pump Station	Sewer Pumping Station	No	No
Israel Putnam Sewer Pump Station	Sewer Pumping Station	No	No
Lantern Sewer Pump Station	Sewer Pumping Station	No	No
Ledgewood Sewer Pump Station	Sewer Pumping Station	X500	No
Macintosh Sewer Pump Station	Sewer Pumping Station	No	No
Main Sewer Pump Station	Sewer Pumping Station	AE	The Great Road Shopping Center
Meadowbrook Sewer Pump Station	Sewer Pumping Station	X500	No
Middlesex Sewer Pump Station	Sewer Pumping Station	AE	No
Mill Dam Sewer Pump Station	Sewer Pumping Station	No	No
Norma Road Sewer Pump Station	Sewer Pumping Station	X500	No
Old Billerica Sewer Pump Station	Sewer Pumping Station	No	No
Page Road Sewer Pump Station	Sewer Pumping Station	AE	No

Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
Parker Road Sewer Pump Station	Sewer Pumping Station	No	No
Pollard Inn Lane Sewer Pump Station	Sewer Pumping Station	No	No
Reeves Road Sewer Pump Station	Sewer Pumping Station	No	No
South Road Sewer Pump Station	Sewer Pumping Station	No	No
Washington I Sewer Pump Station	Sewer Pumping Station	No	Washington Street along Elm Brook
Washington II Sewer Pump Station	Sewer Pumping Station	No	Washington Street along Elm Brook
Winchester Sewer Pump Station	Sewer Pumping Station	No	Richard Road/Fern Way
Well # 2	Municipal Well	AE	No
Well # 4	Municipal Well	AE	No
Well # 5	Municipal Well	X500	No
Reeves Road Stand Pipe	Stand Pipe	No	No
Pine Hill Road Stand Pipe	Stand Pipe	No	No
Crosby Drive Stand Pipe	Stand Pipe	No	No
Carlton Willard	Nursing Home	No	No
Ashby Place	Senior Housing	No	No
Bedford High School	School	No	No
Job Lane School	School	No	No
Davis Elementary School	School	No	No
Middlesex Community College	School	No	No
John Glenn Middle School	School	No	No
Leap School	School	No	No
Nashoba Learning Center	Special Education School	No	No
MITRE Corporation	Industrial	No	No

Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
The Edge Sports Center	Place of Assembly	No	No
First Church of Christ	Place of Assembly	No	No
First Parish Unitarian Church	Place of Assembly	No	No
Lutheran Church	Place of Assembly	No	No
St. Michael's Catholic Church	Place of Assembly	No	No
St. Paul's Church	Place of Assembly	No	No
Bedford Funeral Home	Funeral Home	No	No
Shawsheen Funeral Home	Funeral Home	X500	No
A Place to Grow- Bedford	Daycare	No	No
After School at Inch by Inch	Daycare	No	No
Bedford Montessori School Day Care	Daycare	No	No
Bright Horizons at Crosby Drive Day Care	Daycare	No	No
Harris, Kathryn Day Care	Daycare	No	No
Inch by Inch Child Development Centre	Daycare	No	No
Puchacz, Carolyn J. Day Care	Daycare	No	No
St. Paul's Weekday Nursery School	Daycare	No	No
Trelegan, Kathy Day Care	Daycare	No	No
Open Arms Christian Preschool	Daycare	No	No
Recreation Kids Club Day Care	Daycare	No	No
Goddard School	Daycare	No	No
Edith Nourse Rogers. Veterans Hospital	Hospital, Veterans Housing	No	No
Fawn Lake Dam	Dam	No	No
Wilson Mill Dam	Dam	AE	No
Old Water Supply Dam	Dam	No	No

Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
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Town Hall	Municipal - Emergency Operation Center	No	No
Town Center Building	Municipal	No	No
Old Town Hall	Municipal	No	No
Police Station	Municipal	No	No
Fire Station	Municipal	No	No
Council on Aging	Municipal	No	No
Department of Public Works	Municipal	No	No
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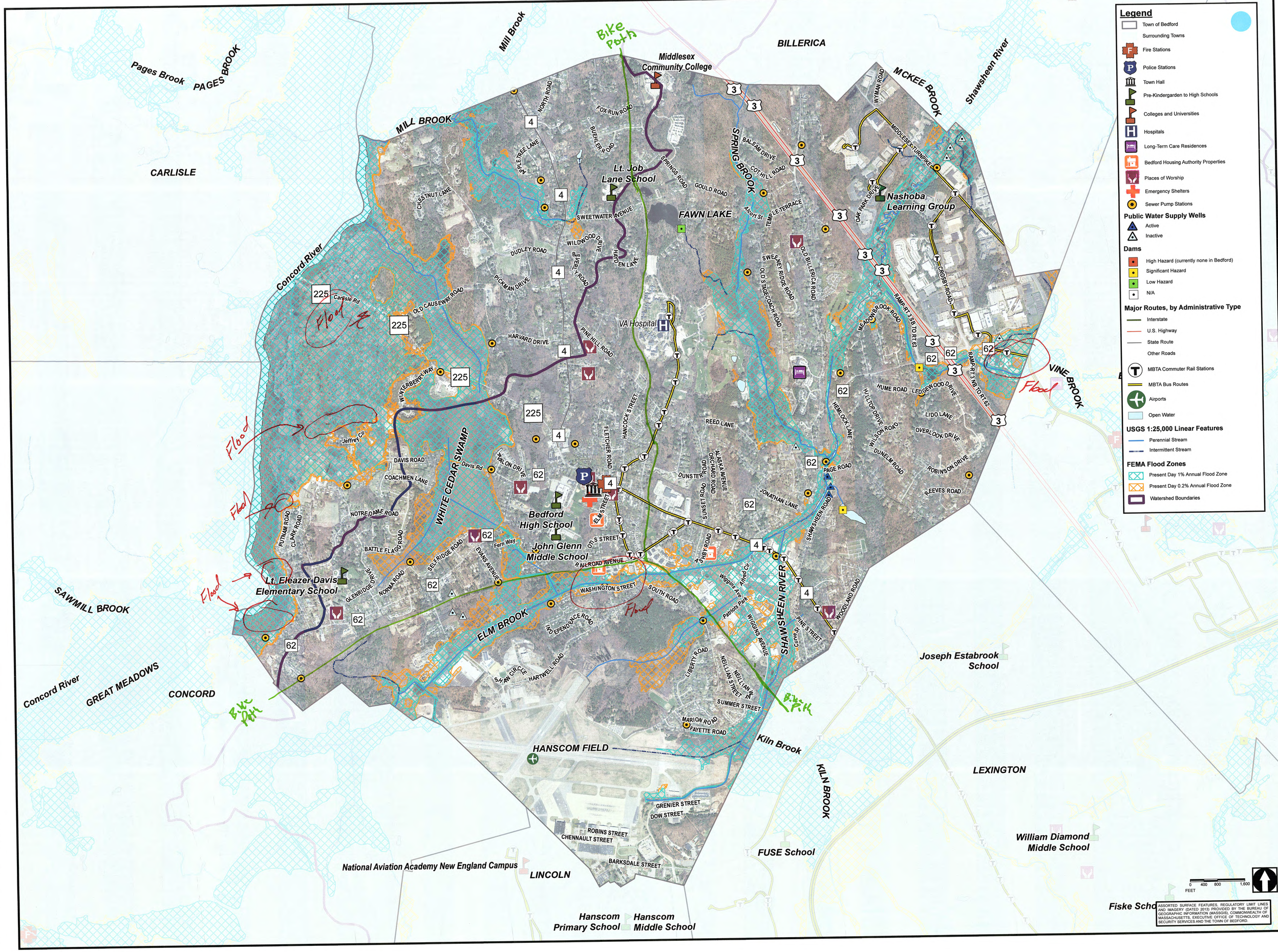
Department of Public Works Salt Shed	Municipal - DPW	No	No
Department of Public Works Sand Shed	Municipal - DPW	No	No
Department of Public Works Seasonal Storage	Municipal - DPW	No	No
Town Center Shelter	Shelter	No	No
U.S. Post Office	Post Office	No	No
Town Emergency AM Radio Antenna	Municipal	No	No
Page Road Sewer Pump Station	Sewer Pumping Station	AE	No

Appendix D
Participatory Mapping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DOW STREET
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CHENNAULT STREET
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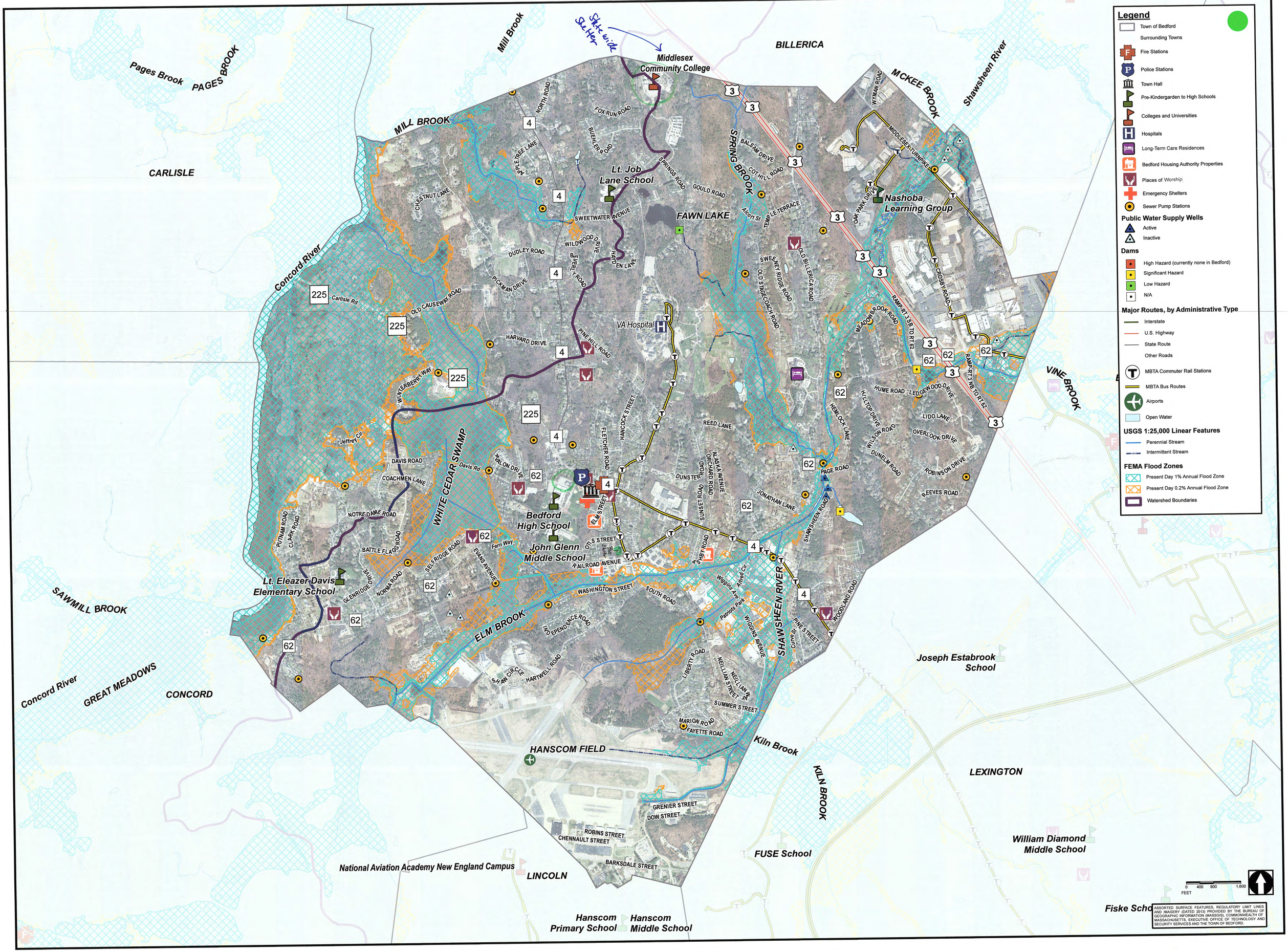
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SUNSET ROAD
ALASKA AVENUE
ORCHARD ROAD
JOHN ROAD
GRENIER STREET
DOW STREET
ROBINS STREET
CHENNAULT STREET
BARKSDALE STREET
Skate with Stutter
225
62
3
4
0 400 800 1,600
FEET
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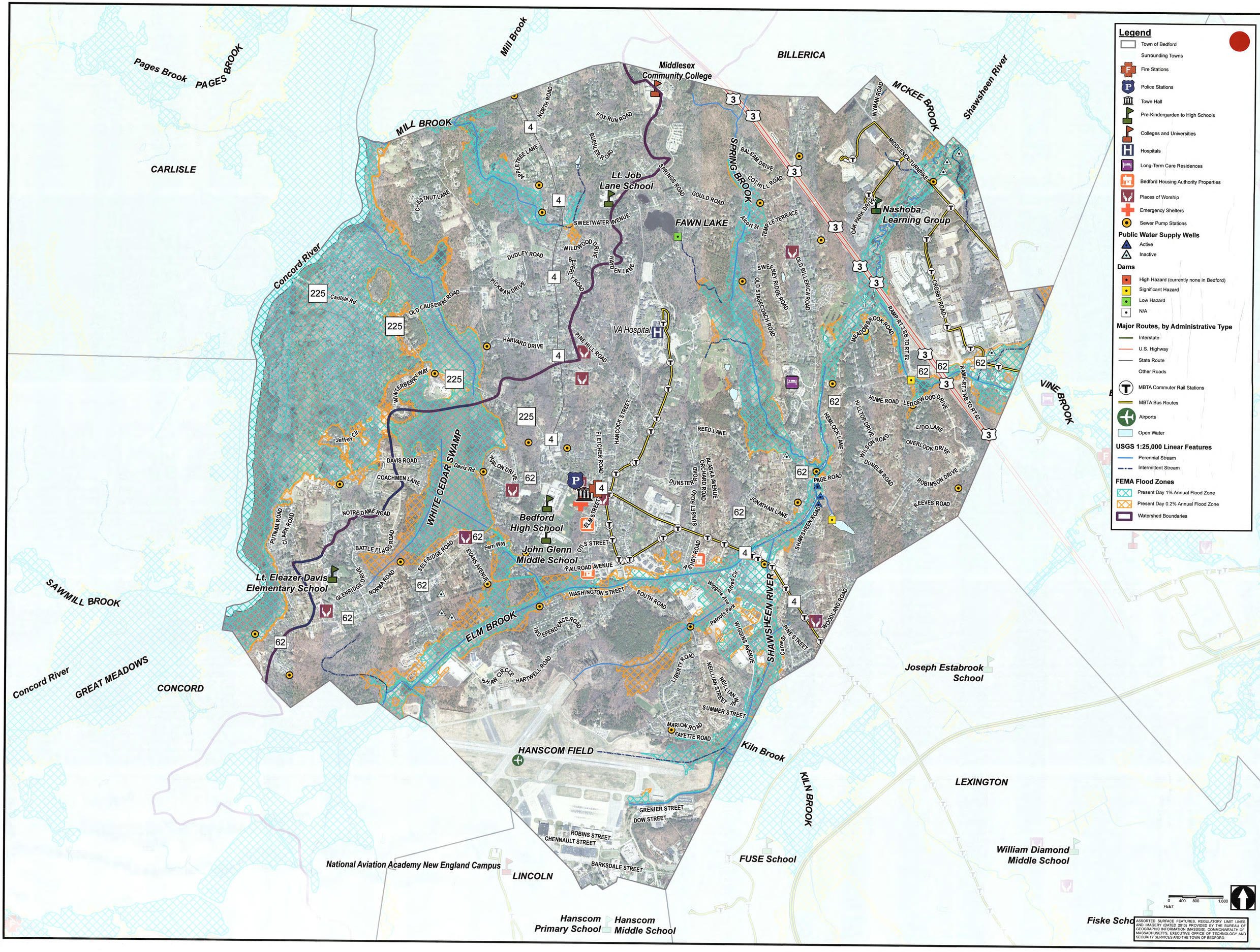

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- Places of Worship
- Emergency Shelters
- Sewer Pump Stations

Public Water Supply Wells

- Active
- Inactive

Dams

- High Hazard (currently none in Bedford)
- Significant Hazard
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Major Routes, by Administrative Type

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USGS 1:25,000 Linear Features

- Perennial Stream
- Intermittent Stream

FEMA Flood Zones

- Present Day 1% Annual Flood Zone
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- Watershed Boundaries

Appendix E
CRB Risk Matrices

Community Resilience Building Risk Matrix **Master Spreadsheet** www.CommunityResilienceBuilding.org

H-**M**-**L**priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Flooding and Extreme Precipitation	Heat/Drought/Fire	Winter Storms	High Winds and Severe Storms	Priority H - M - L	Time S hort L ong O ngoing
Infrastructural									
Communications/Electrical Infrastructure (Aboveground utility lines, transformers, green energy projects)	Townwide	Public (Town) and Private (Eversource)	V/S	Research feasibility of constructing a redundant underground electrical system/microgrid under the control of the Town.				H	O
				Enhance tree triming practices with all overhead utlility companies, specifically targeting telecom companies that do not currently conduct tree trimming in the area					
				Convert municipal facilities to solar power, and incentivize private development of renewable energy.					
Natural Gas Lines	Townwide	Private (National Grid)/Public	V	Convert facilities powered by natural gas to renewable solutions such as district energy or heat pumps				M	O/L
				Request National Grid to ID lines located in areas with high groundwater, reinforce pipes to avoid corrosion					
				Further identify and repair major leaks.					
Sewer and Water Infrastructure (wells, water, and sewer mains, infiltration and inflow investigations)	Townwide	Public (Town and MWRA)	V/S	Continue existing inflow and infiltration investigations of sewer system, incorporating precipitation projections where possible				M	O
				Install generators at sewer pump stations					S
				Conduct regular inspections of water and sewer pipes, prioritizing areas that have recurring severe issues					O
					Identify and obtain funding to improve water connection with MWRA to reduce bacteria.				
Culverts, Bridges, and Dams	Townwide	Public	V/S	Prioritize replacement and repair of Town-owned bridges and culverts		Prioritize replacement and repair of Town-owned bridges and culverts		M	O
				Review Operations & Maintenance Plan for dam maintenance and 100-year flood.		Ensure ice and debris removal is monitored at bridges and culverts	Perform a dry season evaluation of culverts, dams, and bridges (during periods of low flow).		
				Identify funding opportunities for maintenance and repair work		Identify funding opportunities for maintenance and repair work			
Stormwater Infrastructure and Services	Townwide	Public and Private	V/S	Continue to promote Low-Impact Development practices on all public and private projects				M	S
				Conduct ongoing cleaning/maintenance of catchbasins				H	O
				Routinely maintain and repair Town-owned stormwater facilities				M	
Transportation Infrastructure and Services (including Middlesex Turnpike)	Townwide (South Road and high density areas)	Public (Town and state)	V/S	Continue investment in amenities and outreach to encourage use of existing public transportation opportunities				M	O
				Continue clearing of roadways post-hazard occurrence (e.g. ice and snow removal), and improve clearing on non-vehicular paths such as sidewalks and the Minuteman Bike Trail					
				Establish a community data gathering portal to report areas of repeated roadway flooding or closure, develop a matrix to prioritize said repairs, and protocol to close the loop with reporting residents					S
				Encourage people to stay home in bad weather using the community notification system				H	O
				Continue to allow at-home buisnesses to reduce traffic demand					S
				Create a Transportation Demand Management Team					O
				Ensure Town's Complete Streets Policy considers and incorporates climate projections					
					Provide transportation to cooling stations.		Continue to perform sidewalk maintenance.		
				Advocate to expand MBTA service area to provide transit connections to surrounding towns				M	L
				Ensure Middlesex Turnpike has access to multiple modes of transportation in case of need for evacuation				L	L
Hanscom Airport and Air Force Base	Southerly Portion of Town	Public	V/S	Improve communication between Town and Hanscom Airport/AFB staff in association with emergency response and preparedness.				M	S/O
Fire Hydrants	Townwide	Public	V/S	Continued maintenance of and cleaning of hydrants, including routine flushing				H	O
Roadways, trails, and bikeways	Townwide	Public	V/S	Harden trails in flood-prone areas, as needed, for emergency access.	Maintenance of trail system for brush removal and clearing of dead/combustible vegetation.		Identify vulnerable trees and perform proactive maintenance.	M	O
Generator in Municipal Buildings	Specific	Public	S	Continuation of capital plan for generators				L	O
Municipal Buildings	Town Campus	Public	S	Provide safe facilities and access to services for residents displaced by flood events.	Coordinate with Town Departments & Bedford Citizen Corps to provide cooling stations.	Coordinate with Town Departments & Bedford Citizen Corps to provide warming stations.	Designate a generator/charging station location.	M	O
Societal									
Regional Shelters, Council on Aging/Heating, Cooling, and Charging Stations	Library, Town Hall, Middlesex Community College, Town Campus and	Public (Town)	V/S	Enhance existing plans and capabilities of the Town to provide safe facilities in the event of a emergency				L	L
				Enhance existing plans, increase capacity, and potentially add new shelters.				M	
				Review need for transportation to/from safe facilities and cooling/heating stations				L	O
				Continue annual generator inspections					
Town Emergency Communication and Support	Townwide	Public and Private	V/S	Improve outreach to marginalized groups through knowledgeable organizations such as the Council on Aging, and identify the best avenues of communication for each marginalized group				H	S
				Utilize Bedford TV to communicate emergencies and resources					O
				Develop town communication template for easy dissemination and a list of neighborhood resources. Template to be geared to address economic, language, and physical barriers of residents.					
				Invest in email and text forms of emergency communication					L
				Educate residents regarding "at home hazards" and how to mitigate them					S
				Hire a consultant to create an ADA-compliant website				M	L
				Improve communication of stations' availability and hours, across multiple platforms with focus on vulnerable populations.				H	S
				Coordinate with Middlesex Community College staff to improve public knowledge of facility availability.					
Social Engagement and Outreach (social media, the Bedford Citizen, cultural organizations, Bedford TV)	Townwide (including	Various	S	Improve public knowledge of various sources of communication				M	S
				Offer translation services for official communications					
Vulnerable Populations and Isolated Residents (VA Hospital)	Multiple Locations	Public and Private	V	Establish a team to identify vulnerable households and assess level of risk and preparedness. Identify ways in which the Town can them provide support				H	S/L
				Continue to fund and support existing outreach programs.					L
Bedford Citizen Corps (BCC) Outreach	Townwide	Private/Municipal	S	Hire consultant to perform a study for emergency response/ shelter management to reduce dependence on Bedford Citizen Corps.				M	L
Ashby Place and Carleton Willard	Townwide	Private	V	Continue to fund and support existing outreach programs.				H	L
Institutional facilities (Colleges, Hospitals, etc.)	Townwide	Public and Private	S	Partner with local institutions to facilitate communications, planning, and emergency response, including coordination regarding shelters				M	S
Evacuation and Emergency Protocol	Townwide	Public	V/S	Review and update evacuation protocol				L	L
				Continue emergency protocols to provide the Town with information on which shelters to move to in an emergency					
Green Energy Programs	Townwide	Public (State)	V		Evaluate programs that fund or provide energy assessments specific to low-income communities, such as MassSaves		Evaluate programs that fund or provide energy assessments specific to low-income communities, such as MassSaves	M	O
					Improve communication regarding the availability of various programs		Improve communication regarding the availability of various programs		L
Environmental									
Wetland Systems	Townwide	Public and Private	V/S	Update the existing wetlands by-Law				L	L
Trees and Forests/Tree Management	Townwide	Public and Private	V/S	Develop incentives to or requirements for private developers to re-plant trees after clearing.				M/L	O/S
				Promote native and diverse species for plantings and update bylaws accordingly				L (Blue group) H (Yellow Group)	O
				Create an inventory and inspection of tree health				M	L
				Create an education program promoting native, natural, drought, or flood resistant species					
Bylaws and Regulations (Including MS4 Permit)	Townwide	Public	V/S	Review and update bylaws to incorporate future climate projections into development project design				M	O
				Review and develop additional flood zone and stormwater regulations.	Develop landscape irrigation regulations.			H	
Landscaping in Development/Green Infrastructure	Townwide	Public and Private	V	Increase the use of rain barrels and rain gardens on both public and private property.				M	O
				Encourage municipal buildings to install green roof infrastructure					
Active Wells and Water Supplies	Specific	Public/ Shared with Lexington	V	Develop an Emergency Action Plan in case of failure of all MWRA water supply lines.				H	O
				Continue to ensure that sewer lines do not pose a threat of cross contaminate to nearby active wells, considering climate projections in such evaluations				L	L
Trails and Conservation Land/ Open Space/Conservation Areas	Townwide	Public (state and town) and Private	V/S	Construct additional trails and acquire additional conservation land				H	O
				Develop invasive species management plans				M/L	O/L
				Maintain communication between Town and other conservation area land managers					
				Identify areas for floodplain management projects					
				Apply for funding for equipment and staff to maintain Town-owned conservation areas				H	L
				Update Open Space Plan				L	O
Wildlife Management, Pest Control, and Suseptibility to Vector Born Illnesses	Townwide	Public and Private	V/S	Advocate for neighboring towns to participate in the Mosquito Control District				H	O/L
				Develop and adopt expanded plan to manage ticks and their vectors (e.g. deer)					
				Develop and implement Mosquito Control Plan					
				Develop and implement proactive Beaver Management Plan					
				Acquire funding for additional public outreach and education for tick/mosquito control					S
				Invest in mosquito repelant stations at public locations					
Water Bodies & Waterways	Specific	Public	V/S	Assess land acquisition to acquire and restore land near major water bodies to prevent erosion and mitigate flooding			Assess land acquisition to acquire and restore land near major water bodies to prevent erosion and mitigate flooding	M	L

				Consider dredging these areas to increase flood storage			Consider dredging these areas to increase flood storage		
Floodplains, Rivers and Streams	Townwide	Various	V	Study the acquisition of private property located in the floodplain		Study the acquisition of private property located in the floodplain		**M**	**O**
				Research grant opportunities and provide educational outreach to homeowners located in floodplains to increase resiliency to flooding			Research grant opportunities and provide educational outreach to homeowners located in floodplains to increase resiliency to flooding	**L**	**L**
				Coordinate with downstream communities and other planning commissions to manage the rivers and streams.	Identify wellfield vulnerabilities	Identify and maintain hazard trees along banks		**H**	**O**
				Evaluate opportunities for wetland restoration projects with a flood control element				**M**	

Community Resilience Building Risk Matrix **Blue Group** www.CommunityResilienceBuilding.org

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Features	Location	Ownership	V or S	Flooding	Winter Storms	Wind Storms	Heat/Drought/Fire	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Dams/Bridge	Townwide	Public	Both	Review O&M Plan for Dam Maintenance and 100-year flood.	Ice and debris removal	Identify potentially falling trees and prioritize debris removal on trails and roadways.	Perform a dry season evaluation of dams and bridges (during periods of low flow).	M	O
Utilities (Water/Electric)	Townwide	Public & Private	Both	Consider 'flood proofing' underground utilities and removing sump pumps on private and public lands.			N/A	H	S
Roadways/trails/bike paths	Townwide	Public	Both	Add culverts under trails in flood-prone areas for emergency access	Identify access areas impacted by storm events and develop an emergency access plan.	Identify vulnerable trees and perform proactive maintenance.	Maintenance of trail system for brush removal and clearing of dead/combustible vegetation.	M	O
Municipal Buildings	Town Campus	Public	S	Provide shelter and access to services for residents displaced by flood events.	Coordinate with CERT Team to provide warming stations.	Designate a generator/charging station location.	Coordinate with CERT Team to provide cooling stations.	M	O
Catch Basins & Fire Hydrants	Townwide	Public & Private	Both	Continued maintenance and cleaning of hydrants and catch basins.			N/A	H	O
Airfield	Southerly Part of Town	Public	Both	Establish better communication between town government and airfield. Enhance emergency access to airfield.				M	S
Societal									
Institutional Facilities (VA Hospital, Colleges, etc)	Townwide	Public & Private	S	Increase community planning and capacity to provide shelter.			Provide additional cooling stations.	M	S
Emergency Shelter/COA/CERT Team	Town Campus	Public	Both	Enhance existing plans, Increase capacity, and potentially add new shelters.				M	L
Communication (Including Outreach)	Townwide	Public	Both	Develop town communication template for easy dissemination and a list of neighborhood resources. Template to geared to address economic, language, and physical barriers of residents. Utilize Bedford TV in process.				H	O
Vulnerable Population Services/Facilities	Townwide	Public	Both	Coordinate with various caregivers to understand their emergency preparedness.				H	S
Bylaw/Regulations	Townwide	Public	V	Review and develop additional floodzone and stormwater regulations.	N/A	N/A	Develop landscape irrigation regulations.	H	O
Transportation	Townwide	Public	V	Engage with Complete Streets program and foster multiple forms of transportation.	Continue to provide ice and snow removal (noted as a strength).	Continue to perform sidewalk maintenance.	Provide transportation to cooling stations.	H	O
Environmental									
Wetlands	Townwide	Both	Both	Pursue beaver management and mosquito/disease control	N/A	N/A	Review Bylaws	M	L
Uplands	Townwide	Both	Both	Develop regulations/plans to protect certain uplands	N/A	Identify hazard trees and group plantings	Maintenance of dead vegetation	H	S
Open Space	Townwide	Both	Both	Open space planning and create GIS data layer to highlight specific parcels (potentially hire a consultant).				H	S
Trees	Townwide	Both	Both	N/A	Identify hazard trees and promote native and diverse species			H	O
Groundwater Elevations/Gas Lines	Townwide	Both	V	Update the groundwater elevation map and inventory vulnerable areas	N/A	N/A	N/A	H	O
Rivers & Streams	Townwide	Both	V	Coordinate with downstream communities and other planning commissions.	Identify hazard trees,		Identify wellfield vulnerabilities	H	O

Community Resilience Building Risk Matrix — **Green Group** — www.CommunityResilienceBuilding.org

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Features	Location	Ownership	V or S	Flooding/Extreme Precipitation	High Wind	Winter Storms	Heat/Drought	Priority (H - M - L)	Time (Short Long Ongoing)
Infrastructural									
Communication/Electrical Infrastructure (aboveground utility lines, transformers, green energy projects)	Townwide	Public (Town) / Private (Eversource)	V/S	Move utilities underground Supply back-up generators to Town facilities Identify and remove double poles in coordination with upcoming 5G plan Convert municipal facilities to solar power, and incentivise private development of renewable energy				H	O/L
Natural Gas Lines	Townwide (identified leaks)	Private (National Grid)	V	Identify lines located in areas with high groundwater tables, and reenforce pipes to avoid corrosion Further identify and repair major leaks, and convert facilities powered by natural gas to renewable solutions such as district energy or heat pumps		Further identify and repair major leaks, and convert facilities powered by natural gas to renewable solutions such as district energy or heat pumps		M	O/L
Sewer and Water Infrastructure (wells, water and sewer mains, infiltration and inflow investigations)	Townwide (unlined mains, wells)	Public (Town, MWRA)	V/S	Continue existing inflow and infiltration investigations, and strengthen existing connections with MWRA system Install generators at sewer pump stations			Identify and obtain funding to improve connection with MWRA to reduce bacteria	H	O S O
Culverts, Bridges, and Dams	Townwide	Public (Town, State)	V/S	Conduct an inventory and evaluation of structures to identify their ownership and condition, and use this inventory to prioritize replacement and repair Identify funding opportunities for maintenance and repair work		Conduct an inventory and evaluation of structures to identify their ownership and condition, and use this inventory to prioritize replacement and repair Identify funding opportunities for maintenance and repair work		H	S O
Stormwater Infrastructure	Townwide	Public (Town)	V/S	Retrofit existing stormwater management facilities with low-impact development alternatives Conduct an inventory of necessary maintenance and repair of stormwater facilities		Retrofit existing stormwater management facilities with low-impact development alternatives Conduct an inventory of necessary maintenance and repair of stormwater facilities		M	S O
Transportation Infrastructure and Services (	Townwide (South Road and high density areas)	Public (Town, State)	V/S	Continue investment in amenities and outreach to encourage use of existing public transportation opportunities Continue clearing of roadways post-hazard occurance, and improve clearing on non-vehicular paths such as sidewalks and the Minuteman Bike Trail Establish a community data gathering portal to report areas of repeated roadway flooding or closure, develop a matrix to prioritize said repairs, and protocol to close the loop with reporting residents				M	O O S
Societal									
Heating, Cooling, and Charging Stations	Library, Town Hall	Public (Town)	S	Improve communication of stations' availability an dhours, across multiple platforms with focus on vulnerabile populations				H	S
Regional Shelter	Middlesex Community College	Public (State)	V/S	Coordinate with Middlesex Community College staff to improve public knowledge of facility availability, and develop plan for transportation of people to the shelter in the event of an emergency				M	S
Town Communication and Support (Reverse 911, Community Emergency Response Team)	Townwide	Public (Town)	S	Improve outreach to marginized groups through knowedlgeable organizations such as the Council on Aging, and identify the best avenues of communication for each marginalized group				H	S
Social Engagement and Outreach (social media, the Bedford Citizen, cultural organizations)	Townwide	Various	S	Improve public knowledge of various sources of communitcation Offer translation services for official communications				M	S
Vulnerable Populations (elderly, disabled, transient, Bedford Housing Authority)	Multiple	Private	V	Evaluate locations of vulnerable populations relative to areas at high risk for hazards, and understand these communities capacity for emergency preparedness				H	S/L
VA Hospital	Springs Road	Public (Federal)	V	Improve communication between Town and VA staff in association with emergency response and preparedness			Interconnect VA hospital with municipal water supply	M	O
Hanscom Airport and Air Force Base	Hanscom Drive	Public (Federal)	V	Improve communication between Town and airport/AFB staff in association with emergency response and preparedness				M	O
Green Energy Programs	Townwide	Public (State)	V			Evaluate grant funding for energy assessments specific to low-income communities Improve communication regarding the availability of various programs		M	O L
Environmental									
Town Waterways and Floodplains	Multiple (Shawsheen River)	Various	V	Study the acquisition of private property located in the floodplain Evaluate opportunities for wetland restoration projects with a flood control element		Study the acquisition of private property located in the floodplain Evaluate opportunities for wetland restoration projects with a flood control element		M	O
Environmental Bylaws, Regulations, and Initiatives (Net Zero plan, MS4, stormwater regulations, floodplain zoning)	Townwide	Public (Town)	V/S	Review and update bylaws to incorporate future climate projections Evaluate requirements for tree planting				M	O S
Trees and Tree Management	Townwide	Various	V/S		Evaluate existing tree planting requirements relative to tolerance for drought, wind, and other hazards Coordinate with utility companies regarding tree management adjacent to power lines Develop incentives for private developers to re-plant trees after clearing			M/L	O/S
Wildlife Management (ticks, mosquitoes, deer, bears, beavers, Mosquito Control District)	Townwide	Various	V/S	Evaluate why neighboring towns are not participating the the Mosquito Control District Develop and adopt expanded plan to manage ticks and their vectors (e.g. deer) Develop proactive beaver management plan			Evaluate why neighboring towns are not participating the the Mosquito Control District Develop and adopt expanded plan to manage ticks and their vectors (e.g. deer) Develop proactive beaver management plan	H	O/L
Protected Open Space	Multiple	Various (Town, State, non-profits)	S	Develop invasive species management plans Improve communication between Town and other open space land managers Identify areas for floodplain management projects			Develop invasive species management plans Improve communication between Town and other open space land managers Identify areas for floodplain management projects	M/L	O/L

Community Resilience Building Risk Matrix **Red Group** www.CommunityResilienceBuilding.org

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Features	Location	Ownership	V or S	Flooding	Severe Storms	Drought	Heat	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Household Resiliency	Townwide	Private	V	Hire intern to review existing Fire and DPW infromation regarding past emergency and non-emergency responses to identify houses or neighborhoods that require resiliency improvements, and then hire a home improvement expert to provide an "At-Home Hazard Audit".				H	L
Comprehensive Emergency Communication	Townwide	Municipal	S	Invest in email and text forms of emergency communication. Hire consultant to create an ADA-compliant website.				H	S
Roads/Evacuation Routes/Traffic	Townwide	Public/Private	V	Hire a consultant to develop an Evacuation Plan for emergency situations.				M	L
Regional Water Supply	Townwide	Public	S			Hire consultant to review in town back-up water supplies.		L	L
Sewer Pump Stations	Townwide	Municipal	V/S	Hire consultant to review viability of connecting sewer pump stations to Fiberoptic Network. Purchase back-up generators.				L	O
Overhead Power Lines	Townwide	Private	V/S	Hire intern to develop a tree trimming program. Hire consultant to perform a feasibility study to move utilities underground.				L	O
Societal									
Elderly Population (Ashby Place & Carleton Willard)	Townwide	Private	V	Retain consultant to identify at risk persons. Continue to sund and support existing outreach programs.				H	L
Transient/VA Communities	Specific	Private	V	Hire consultant to determine the size, extent, and location of these communiites to better plan for emergency response.				H	L
BCC Outreach	Townwide	Private/Municipal	S	Hire consultant to perform a study for emergency response/ shelter management to reduce dependance on BCC.				M	L
Suseptibility to Vector Born Illnesses	Townwide	Pubic	V	Aquire funding for public outreach and education for statewide tick/moquitor control. Invest in mosquito repelant stations at public locations.				H	S
Group Homes	Specific	Private/Public	V	Hire consultant to create a Town requirement or license regulating the operation of Group Homes.				H	L
Isolated People	Townwide	Private	V	Invest in language translation services for all forms of municipal outreach/communication.				H	S
Environmental									
Wetland Systems	Townwide	Private/Public	V/S	Aqure wetlands professional to review, map, survey, and idetnify existing wetlands		Aqure wetlands professional to review, map, survey, and idetnify existing wetlands		L	L
Trees/Forests	Townwide	Private/Public	V/S			Hire consultant to perform study to determine locations of heat islands and potential locations for planting trees to mitigate the affects. Develop a forst management committee to perform a Habitat Evaluation of protected forests.		M	L
Rivers/Streams	Townwide	Public	V	Apply for grant to provide home owners in flood plains for home improvement to increase resiliency to flooding.				L	L
Beavers	Townwide		V	Hire professional to trap and re-locate beavers. Purchase and install Beaver Decievers throughout waterways affected by beavers.		Hire professional to trap and re-locate beavers. Purchase and install Beaver Decievers throughout waterways affected by beavers.		M	O
Wetlands Bylaws/Stormwater Regulations	Townwide	Municipal	S	Retain funding for additional staff member to review and implement applicable bylaws and regulations				M	S
Open Space	Townwide	Private/Public	V/S	Apply for funding for equipment and staff to maintain Town owned Openspace.				L	O

Community Resilience Building Risk Matrix **Yellow Group** www.CommunityResilienceBuilding.org

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Features	Location	Ownership	V or S	Flooding	Drought/Fire	Extreme Temperature/Heat	Extreme Weather Events	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Storm Drainage/Sink Hole	Throughout	Private + Public	V	Green Roofing Regulations and incorporating Green Roofs into Municipal Building designs				H	Ongoing
				Review Development and Stormwater Standards				H	Ongoing
							Work with surrounding Towns to conduct extreme storm modeling research and updates	H	Ongoing
				Implement the use of Rain Barrels to mitigate runoff				H	Ongoing
Transportation	Route 4 and 225/ Throughtout	Public	V	Continuing to allow at-home buisnesses				H	Ongoing
				Creating a reverse 911 call encouraging people to stay home in bad weather				H	Short
				Create a Transportation Demand Managemnt Teams				H	Ongoing
				Creating a connection between MBTA in Bedford and surrounding Towns				H	Long
Power Lines	Throughout	Public/Town	V	Investigation fundig opportunities to transition the Town to underground powerlines				M	Long
				Lobbying legislature to change to Town generated utilities				M	Long
				Tree Management				H	Ongoing
Water and Sewer Pipes	Throughout	Public	V	Upgrading and maintaining pipes		Upgrading and maintaining pipes		M	Ongoing
				Regular inspections of water and sewer pipes and prioritizing areas that have reoccuring severe issues				M	Ongoing
						Future repairs to factor in and increase in extreme temperature and weather events		M	Ongoing
Generatore in Town Buildings and Schools	Specific	Public	S	Continuation of Capital Plan				L	Ongoing
Protected Lands	Specific	Public	S	Continue to evaluate and purchase land - creating more conservation land				L	Ongoing
				Increase land evaluation within the Open Space Plan				L	Ongoing
Societal									
Bedford Housing Authority/Affordable Housing	Throughout + Specific	Public	V	Generator implementation within affordable housing units				L	Short
				Create a curvey to be conducted to assess levels of vulnerability				H	Short
				Create a more direct communication method to these areas for states of emergency if they do not have cell phones to receive reverse 911 calls				M	Short
Road Blockage + Power Outages Limiting Access to Work	Throughout	Public	V	Continuing to allow at-home buisnesses				H	Ongoing
				Creating a connection between MBTA in Bedford and surrounding Towns				H	Long
				Creating a reverse 911 call encouraging people to stay home in bad weather				H	Short
				Create a Transportation Demand Managemnt Teams				H	Ongoing
Reverse 911 Calls/ Communications	Throughout	Public/Town	S+V	Publisizing the Reverse 911 Call Program				H	Short/Ongoing
Safe Zones and Shelters	Specific	Public/Town	S	Creating a shuttle system in and out of these areas				L	Ongoing
				Continue annual generator inspections				L	Ongoing
Middlesex Turnpike Area	Specific/ East Side of Town	Private + Public	S+V	Add a shelter in this area for emergencies				L	Ongoing
				Create access to Public Tranporation in and out of this area for emergencies				L	Ongoing
Evacuation/Emergency Protocols	Throughout	Public	S+V	Implement an evacuation protocol				L	Long
				Continue emergency protocols to provide the Town with information on which shelters to move to in an emergency				L	Long
Environmental									
Tree Cover	Throughout	Private + Public	S+V	Create an inventory and inspection of tree health				M	Long
				Update By-Laws and Regulations to require plantings to be be of more resilent species				H	Long
				Create an education program on natural, drought, and flood resistant species				M	Long
Landscaping in Development / Green Infrastructure	Throughout	Private + Public	V	Encouraging swales as a more desirable BMP				M	Ongoing
				Increase the use of rain barrells and rain gardens in Town				M	Ongoing
				Green roofed infrastructure				M	Ongoing
Active Wells/ Watersupply	Specific	Public/ Shared with Lexington	V	Conduct a sustainabilty study of the current wells if the Lexington Watersupply fails				H	Ongoing
				Relocate the active wells away from the Floodplain and Sewage pumps				H	Ongoing
Major Water Bodies	Specific	Public	S+V	Assessing land acquisition to aquire and restore land near these areas and prevent erosion			Assessing land acquisition to aquire and restore land near these areas and prevent erosion	M	Long
				Consider dredging these areas to increase water storage			Consider dredging these areas to increase water storage	M	Long
Pest Control (mosquitos and ticks)	Throughout	Private + Public	S+V	Limit open water sources during breeding seasons		Limit open water sources during breeding seasons		H	Short
				Continue pubic edication about these threats				H	Short
Trails and Conservation Land	Specific	Public/Town/State	S	Continue to preserve these areas				H	Ongoing

Appendix F
Public Input Information

Newspaper Article Soliciting Public Input for March 4, 2020 Session

Introductory Presentation for March 4, 2020 Public Input Session

Announcement for Virtual Public Input Opportunity

Newspaper Article for Virtual Public Input Opportunity

Summary of Findings Presentation for Virtual Public Input Opportunity

Public Comments Received

The Bedford Citizen | (https://www.thebedfordcitizen.org/2020/02/bedford-takes-climate-change-seriously-and-you-are-invited-to-share-your-ideas/)

Bedford Takes Climate Change Seriously – And You are Invited to Share your Ideas

By **Dot Bergin** | February 26, 2020

On Wednesday, March 4 the public is invited to a community meeting to learn about local climate-related hazards and to provide input on actions to be developed in response. The meeting will take place in the Reed Room, Bedford Town Hall at 7 pm.

This "listening session" is an outgrowth of the Community Resiliency Building (CRB) Workshop that took place in December 2019, attended by more than 60 residents, committee chairs, and Town of Bedford staff. To refresh your memory of that meeting, read the report in *The Citizen*: https://www.thebedfordcitizen.org/2019/12/bedford-works-toward-building-a-more-resilient-community/ (https://www.thebedfordcitizen.org/2019/12/bedford-works-toward-building-a-more-resilient-community/)

At the earlier workshop, citizens gathered to evaluate the climate hazards facing the Town (think, extreme weather events, flooding, paralyzing snowstorms, among others) and offered many suggestions on ways to improve the town's resiliency. The March 4 meeting will offer opportunities to learn about actions the Town could take. Results will be incorporated into an update of the Town's Hazard Mitigation Plan (last reviewed in 2014) and in turn, the Plan will come up for further public review in April.

The sequence of Community Resilience Building Workshops incorporating public review leading to action plans is made possible by a grant from the Executive Office of Energy and Environmental Affairs that Town Manager Sarah Stanton received in the summer of 2019. Once the Town completes the CRB process, it will be designated as a Municipal Vulnerability Preparedness community which will enable Bedford to apply for future grant funding. Many towns in the Commonwealth have already received this designation and are using their funds for projects as varied as widespread tree planting to large-scale replacement of sewer lines.

How should Bedford use future grant money? Come to the March 4 meeting to hear about the possibilities and make

your voice heard!

Support trusted journalism and double your impact. The Citizen is eligible for up to $26,500 in matching funds when you donate today (https://www.thebedfordcitizen.org/donate/) .

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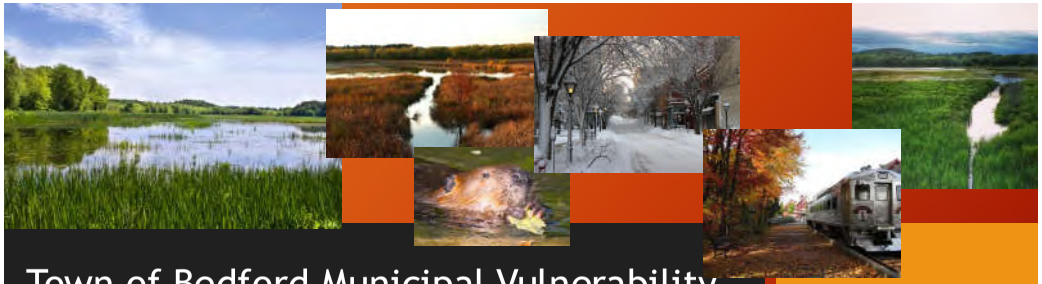
Go to our home page (https://www.thebedfordcitizen.org) for more stories.

Municipal Vulnerability Preparedness (MVP) Program

www.CommunityResilienceBuilding.org



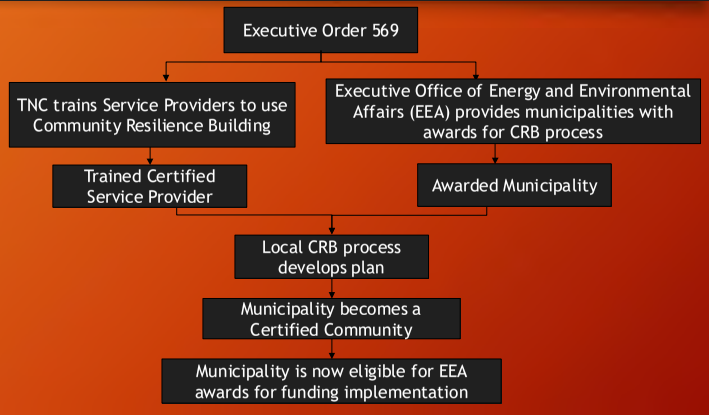
Town of Bedford Municipal Vulnerability Preparedness and Hazard Mitigation Plan

Presented By:

BEALS+THOMAS

Public Listening Session #1
March 4, 2020

MVP Overview



Welcome and Introduction

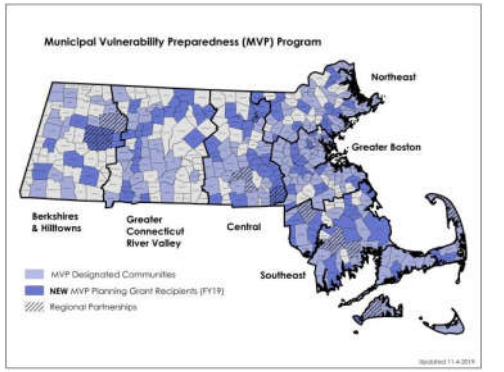
- Jeanette Rebecchi, AICP, Transportation Program Manager

2014 Microburst, Julie Loncich/WCVB-TV

Overview of the MVP Process

State's Vision for the MVP Program

1. Engage community
2. Identify climate change impacts and hazards
3. Complete assessment of vulnerabilities and strengths
4. Develop and prioritize actions
5. Take action!



December Workshop Objectives

- Define extreme weather and natural and climate-related hazards
- Identify existing and future vulnerabilities and strengths
- Develop and prioritize actions for the community and broader stakeholder networks
- Identify opportunities for the community to advance actions to reduce risks and build resilience.

Town of Bedford MVP Designation Schedule

- Core Team Establishment of Approach: July 25, 2019
- CRB Workshop: December 11, 2019
- Public Listening Session #1: March 4, 2020
- Public Listening Session #2: April 2020
- HMP/Summary of Findings available for public review: May 2020
- Final Report: June 2020

Sample Action Grants FY20

- Chelmsford: Dunshire Drive Culvert Replacement & Deep Brook Stream Restoration: Phase I
- Harvard: Community Climate Action & Land Stewardship Plan
- Medford: Equity-Centered Process for Climate Action and Adaptation Planning
- Monson: Energy Resiliency for Town Hall-EOC-Police HQ Facility
- Worcester: Worcester Senior Center Parking Lot – Nature-Based Solutions

Mitigation Planning Benefits

- A process for communities to identify policies, activities and tools to implement mitigation actions
  - Increases awareness of vulnerabilities
  - Promotes safety and welfare of communities and citizens
  - Cultivates community commitment to mitigation
- Lack of hazard awareness and mitigation plan could lead to unnecessary losses to infrastructure and critical facilities and potential human casualties

Hazards vs. Vulnerabilities

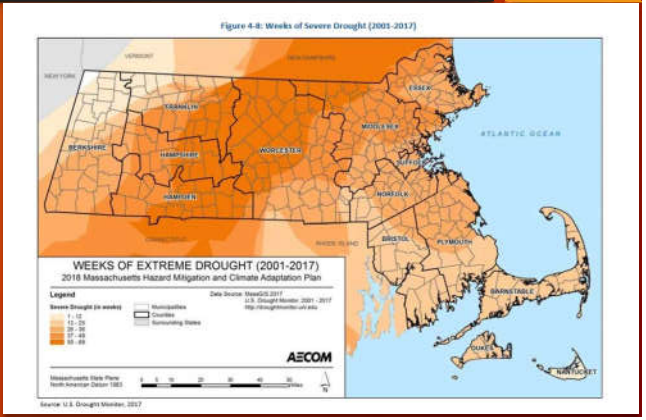
Hazards		Vulnerabilities
Flooding	→	Properties in flood zone
Drought	→	Water supply
Wind	→	Trees & overhead power lines
Wildfire	→	Dry vegetation

Hazard Mitigation Plan Update

- Required for municipalities to receive Federal Emergency Management Agency (FEMA) funding for non-emergency disaster assistance
- Updates required every 5 years
- Effective plan entitled Town of Bedford Mitigation Plan by the Metropolitan Area Planning Council in 2010
- Additional EEA funds for communities with expiring hazard mitigation plans who are undertaking MVP process
- Similar public input process to MVP program

Heat, Drought, and Fire

- September 2016 drought affected 52.13% of Massachusetts land.
  - Major crop/pasture loss
  - Widespread water shortages and restrictions



Hazards Prioritized by the CRB Workshop

- Flooding and Extreme Precipitation
- Heat, Drought, and Fire
- Winter Storms
- High Winds and Severe Storms

Winter Storms

- Winter Storms: heavy snow, freezing rain, extreme wind, extreme cold
  - Severe Winter Storm defined as 6 inches or more of snow in 24 hours
  - Regional record for winter snowfall: 126.5 inches in 1995

Flooding and Extreme Precipitation

- Most prevalent natural hazard identified in 2010 HMP
- Riverine floodplain associated with following
  - Great Meadows Wildlife Refuge
  - Concord River
  - Elm Brook
  - Shawsheen River
  - Spring Brook
  - Vine Brook
  - Mongo Brook
- Drainage-related flooding issues from stormwater system capacity

Massachusetts Climate Change Projections (Shawsheen Basin)

- Temperature
  - Increased average temperatures and number of days with maximum temperature above 90˚F
    - Annually – 10 to 32 more days with temperatures above 90˚F by 2050s
  - Decrease in number of days with minimum temperature below 32˚F
    - Winter – 4 to 14 fewer days with temperatures below 32˚F by 2050s
- Precipitation
  - Increase in number of days with greater than 1" precipitation and total precipitation
    - Annually – approximately 1 to 3 more days with precipitation greater than 1" by 2050s
- Drought
  - Increase in consecutive dry days
    - Summer – potential increase of 1 to 2 more consecutive days with less than 1mm of precipitation

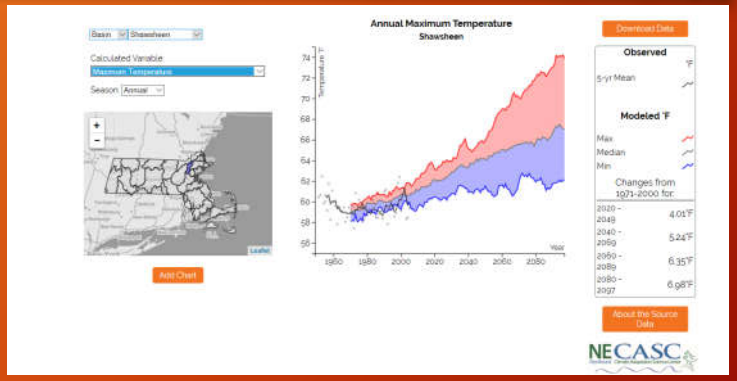
High Winds and Severe Storms

- Severe Storms: wind, hail, lightning
  - 2014 microburst downed 50 – 70 trees in Bedford
- Hurricanes: heavy rain, high winds
  - 39 hurricanes with significant wind or rain impacts in New England since 1938
  - Most recent was Hurricane Sandy in 2012

December Workshop: Top Priorities

- Infrastructure: Communications and Electrical Infrastructure
  - Aboveground utilities, transformers, green energy projects
- Societal: Vulnerable Populations and Isolated Residents
  - Including the VA hospital, isolated groups, elderly, persons with disabilities
- Environmental: Floodplains, Rivers, and Streams

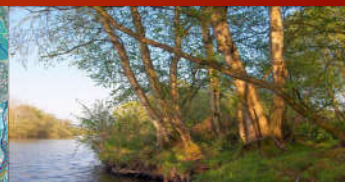
Massachusetts Climate Change Projections (Shawsheen Basin)



Floodplain, Rivers, and Streams Action Items

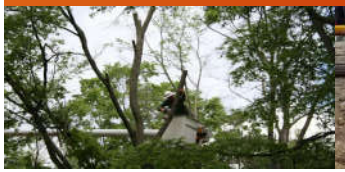
- Study the acquisition of private property located in the floodplain.
- Research grant opportunities and provide educational outreach to homeowners located in floodplains to increase resiliency to flooding.
- Identify wellfield vulnerabilities.
- Identify and maintain hazard trees along banks.
- Evaluate opportunities for wetland restoration projects with a flood control element.





Communications + Electrical Infrastructure Action Items

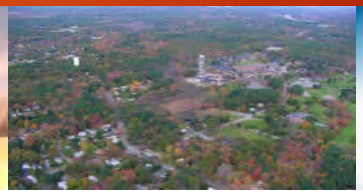
- Research feasibility of constructing a redundant underground electrical system under the control of the Town.
- Enhance tree trimming practices with all overhead utility companies, specifically targeting telecom companies that do not currently conduct tree trimming in the area.
- Convert municipal facilities to solar power and incentivize private development of renewable energy.



Small Group Exercises

Vulnerable Populations and Isolated Residents Action Items

- Establish a team to identify vulnerable households and assess level of risk and preparedness. Identify ways in which the Town can provide them support.
- Continue to fund and support existing outreach programs.


Refinement of Priorities

- 5-10 minutes at each table: review lists of high priority action items for categories
  - Infrastructural
  - Societal
  - Environmental
- Provide facilitators with input regarding actions
- Vote on top three priorities across any category via upcoming electronic survey

Next Steps

- Hold listening session #2 to present final list of priority actions to Board of Selectmen: April 2020, TBD
- Incorporate workshop results into summary report/HMP
- Provide draft summary report/HMP for public review
- Submit final summary report/HMP to EEA to receive MVP designation, and to MEMA and FEMA for review and comment
- Incorporate MEMA/FEMA comments on HMP

TOWN OF BEDFORD
BEDFORD, MASSACHUSETTS 01730

For Immediate Release

Developing Local Resiliency to Climate Hazards:
Hazard Mitigation Plan Update & Municipal Vulnerability Preparedness Report
Released for Public Comment

(5/26/21) The Town of Bedford in conjunction with Beals & Thomas, Inc. have released a draft of the combined Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Report. This Report identifies the top climate hazards facing the Town of Bedford, and generates a list of strategies to better protect the community from current and future climate hazard events. To learn more about the planning process and findings, watch a brief 15 minute recorded presentation. For additional background information, and to read a copy of the full Report visit the Bedford Department of Public Works website.

Public comment will be accepted through June 15, 2021 via email, phone, or letter:
Attn: Jeanette Rebecchi, DPW Transportation Program Manager
Department of Public Works
314 Great Road
Bedford, MA 01730
Email: jrebecchi@bedfordma.gov
Phone: 781-918-4274

Seeking Comment on Bedford's Updated 'Hazard Mitigation Plan and Municipal Vulnerability Preparedness Report'

By **Bedford Department of Public Works** | June 4, 2021

Public comment on the Town of Bedford's *Hazard Mitigation Plan Update, and Municipal Vulnerability Preparedness Report* will be accepted through June 15, 2021,

- By email to jrebecchi@bedfordma.gov (mailto:jrebecchi@bedfordma.gov) ,
- By telephone at 781-918-4274, or
- Via a letter addressed to Jeanette Rebecchi, DPW Transportation Program Manager, Department of Public Works, 314 The Great Road, Bedford, MA, 01730

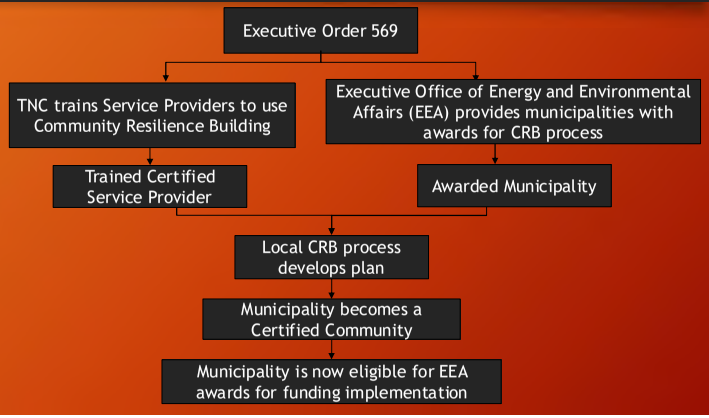
The Town of Bedford in conjunction with Beals & Thomas, Inc. has released a draft of the combined Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Report.

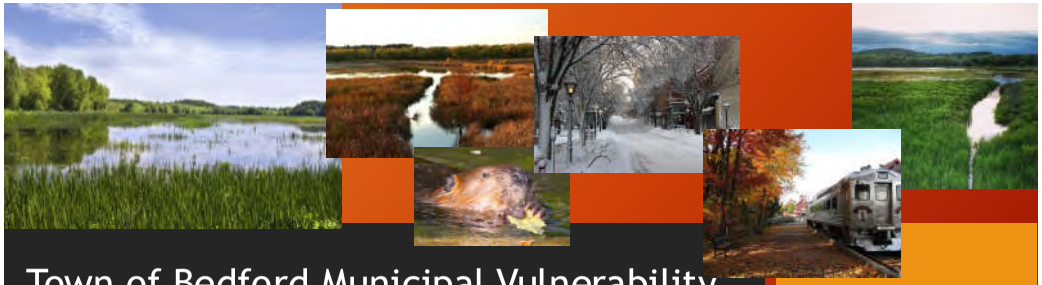
This report identifies the top climate hazards facing the Town of Bedford and generates a list of strategies to better protect the community from current and future climate hazard events.

To learn more about the planning process and findings, watch a brief 15 minute recorded presentation (https://youtu.be/nzacMmvcNyM) .

For additional background information, and to read a copy of the full report, visit the Bedford Department of Public Works website (https://www.bedfordma.gov/department-of-public-works/webforms/municipal-vulnerability-preparedness-hazard-mitigation-plan) .

MVP Overview





Town of Bedford Municipal Vulnerability Preparedness and Hazard Mitigation Plan

Presented By:

TOWN OF BEDFORD Incorporated September 23,1729

BEALS+THOMAS

Virtual Public Input Opportunity

Municipal Hazard Mitigation Plan

- Update to 2010 Plan completed using funds from MVP Planning Grant
- Approved by both Massachusetts and Federal Emergency Management Agencies; update required every 5 years
- Required for municipalities to receive FEMA funding for non-emergency disaster assistance
- Must address natural hazards outlined in the Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan

U.S. DEPARTMENT OF HOMELAND SECURITY

FEMA

MASSACHUSETTS EMERGENCY MANAGEMENT AGENCY

Municipal Vulnerability Preparedness (MVP) Program

The Nature Conservancy

www.CommunityResilienceBuilding.org

Draft Hazard Mitigation Plan Overview

- Section I: Introduction
  - Definitions and MVP Background
- Section II: Planning Process and Public Participation
  - Intro to Local Planning Process and Public Participation
  - Overview of CRB Workshop
  - Public Input Opportunities
- Section III: Community Profile
  - Existing Land Use and Plans
  - Discussion of Potential Future Land Use
  - Other Local and Regional Planning Initiatives
- Section IV: Overview of Hazards and Vulnerabilities
  - Overview of Hazards and Impacts
  - Critical Facilities and Specific Areas of Community Concern
- Section V: Existing Mitigation Measures
- Section VI: Hazard Mitigation Goals
- Section VII: Potential Mitigation Measures Identified
  - Top Priority Actions
  - The Action Plan
- Section VIII: Plan Adoption and Maintenance

Mitigation Planning Benefits

- A process for communities to identify policies, activities and tools to implement mitigation actions
  - Increases awareness of vulnerabilities
  - Promotes safety and welfare of communities and citizens
  - Cultivates community commitment to mitigation
- Lack of hazard awareness and mitigation plan could lead to unnecessary losses to infrastructure and critical facilities and potential human casualties

Section I: Introduction

- What is hazard mitigation planning?
- Previous hazard mitigation planning completed by Bedford
  - 2010 Hazard Mitigation Plan
  - 2019 MVP Planning Grant
- Goals for the HMP Update and CRB Workshop Summary of Findings Report

Town of Bedford MVP Designation Schedule

- Core Team Establishment of Approach: July 25, 2019
- CRB Workshop: December 11, 2019
- Public Listening Session: March 4, 2020
- Plan Drafting and Finalization: April 2020 – May 2021
- Virtual Public Input Opportunity: May 2021
- Final Report: June 2021

Overview of the CRB Workshop Process

DURING WORKSHOP

A Prepare for the Workshop	1. Establish a core team with goals. 2. Engage stakeholders. 3. Prepare materials for workshop. 4. Decide on participant arrangements.	
B Characterize Hazards	1. Identify past, current, and future impacts. 2. Determine the highest-priority hazards.	
C Identify Community Vulnerabilities and Strengths	1. Identify infrastructural vulnerabilities and strengths. 2. Identify societal vulnerabilities and strengths. 3. Identify environmental vulnerabilities and strengths.	Infrastructural
D Identify and Prioritize Community Actions	1. Identify and prioritize infrastructural actions. 2. Identify and prioritize societal actions. 3. Identify and prioritize environmental actions.	Societal
E Determine the Overall Priority Actions	1. Identify highest-priority actions. 2. Further define urgency and timing.	
F Put It All Together	1. Generate final workshop products.	Environmental
G Move Forward	1. Continue community outreach and engagement. 2. Secure additional data and information. 3. Inform existing planning and project activities.	

Community Components

Section II: Planning Process and Public Participation

Section III: Community Profile

Existing Land Uses

Existing Plans

- Stormwater Management Plan, 2019
- Bedford Comprehensive Emergency Management Plan, 2017
- Climate Change and Resiliency Plan, 2017
- Bedford Pedestrian and Bicycle Plan, 2015
- Bedford Comprehensive Plan, 2013
- Town of Bedford Tree Policy
- Open Space and Recreation Plan 2004-2008
- Sudbury – Assabet – Concord River Watershed Action Plan, 2005
- Bedford Community Development Plan, 2004

Potential Future Land Use

- 170 & 172 Middlesex Turnpike
- LCB Senior Living, "The Residences at Bedford" - 240-244 South Road
- Minuteman Bikeway Extension Project

CRB Workshop Objectives

- Define extreme weather and natural and climate-related hazards
- Identify existing and future vulnerabilities and strengths
- Develop and prioritize actions for the community and broader stakeholder networks
- Identify opportunities for the community to advance actions to reduce risks and build resilience.

Hazards Prioritized by the CRB Workshop

- Flooding and Extreme Precipitation
- Heat, Drought, and Fire
- Winter Storms
- High Winds and Severe Storms

Section IV: Overview of Hazards and Vulnerabilities

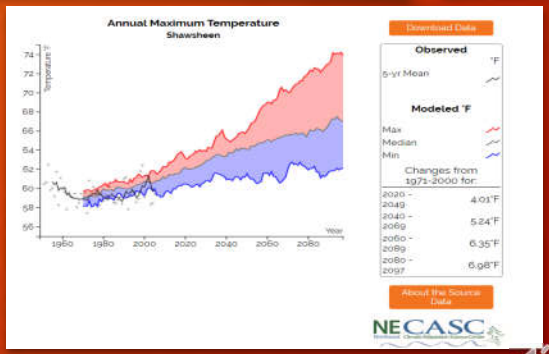
- Flood-Related Hazards
- Sea Level Rise
- Average and Extreme Temperatures
- Drought
- Wildfire
- Landslides
- Tsunami
- Invasive Species
- Hurricanes/Tropical Storms
- Severe Winter Storm/Nor'easter
- Tornadoes/Microbursts
- Severe weather
- Earthquakes

Section V: Existing Mitigation Measures

- Summary of existing mitigation Town has in place for:
  - Flood-related hazards
  - Wind-related hazards
  - Winter-related hazards
  - Fire-related hazards
  - Geologic hazards
- Summary of existing multi-hazard mitigation measures

Overview of Hazards and Vulnerabilities

- Definition of hazards and their interaction with climate change
  - Changes in precipitation
  - Sea level rise
  - Rising temperatures
  - Extreme weather
  - Non-climate influenced hazards
- Past occurrences of hazards in Bedford
- Potential impacts resulting from hazards
  - Extent of damages, where possible



Sample Action Grants FY20 - FY21

- Uxbridge – Integrated Vector-borne Disease Control Program ($256,926 Award)
- Lexington & Resilient Mystic Collaborative – Upper Mystic River Watershed Regional Stormwater Wetlands ($670,000 Award)
- Newburyport – Resilient Critical Infrastructure: Adapting a Wastewater Treatment Facility, Underground Electric Lines, and Public Rail Trail to Future Sea Level Rise and Storm Surge ($1,000,000 Award)

Section VI: Hazard Mitigation Goals and Objectives

Central objectives of the CRB process were added to the plan goals from 2010:

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

Public Comment

- Presentation materials and draft HMP will be available at: https://www.bedfordma.gov/department-of-public-works/webforms/municipal-vulnerability-preparedness-hazard-mitigation-plan
- Submit written public comments by end of day on **June 15, 2021** to:
  - Jeanette Rebecchi, Transportation Manager
  - 314 The Great Road
  - Bedford, MA 01730
  - jrebecchi@bedfordma.gov
  - (781) 918-4274

Section VII: Potential Mitigation Measures

Top Priority Actions

- Assess and construct redundant underground electrical system/microgrid at Town Campus under the control of the Town.
- Develop a Town Emergency Communications Plan and identify most effective means to reach vulnerable populations including residents with economic, language, and physical barriers.
- Continue to identify vulnerable trees and perform proactive maintenance. Encourage utility companies to continue tree maintenance programs to identify and monitor vulnerable trees along overhead power lines.
- Review and update Comprehensive Emergency Management Plan.
- Coordinate with downstream communities and other planning commissions to manage rivers and streams. Conduct maintenance of hazard trees along the banks. Develop and implement proactive Beaver Management Plan.

Next Steps

1. Incorporate listening session results and public comments into final summary report/HMP
2. Submit final summary report/HMP to EEA and MEMA
3. Incorporate MEMA comments and submit updated draft to FEMA for review and comment
4. Select Board to vote to adopt final plan upon FEMA approval
5. Submit MVP Action Grant applications

Mary Kate Schneeweis

From: Perry, Catherine <cperry@bedfordma.gov>
Sent: Thursday, June 10, 2021 11:40 AM
To: Fields, Anthony <afields@bedfordma.gov>; Rebecchi, Jeanette <jrebecchi@bedfordma.gov>
Subject: MVP/ Hazard Mitigation Plan

I got around to reviewing the draft circulated by Jeanette.

The actions identified as "Bedford's Priorities" seem sensible and don't involve the Planning Board.

(I see that work with utility companies on trees under power lines is one; I don't think it needs to mention PB or BARC).

Of the full list, the following numbered actions have PB involvement identified: 3,6, 7,16,27,33 and 37.

A few of these reflect my (fairly tentative) suggestions – that there may be potential to alleviate flooding by acquiring land and/or doing projects to increase water detention/ flood plain capacity, and that if rainfall is increasing it would be good to incorporate projections in stormwater calcs.

I didn't think of anything missed off the list (other than dealing with pandemics, which is ironic, but may not be considered within the scope, at least for the climate-related portion)

I'm not clear what the intention is for a TDM Team (#7)

In the background narrative, I'm not sure MAPC's buildout analysis from 2000 is worth mentioning, and it's odd to jump from there to two specific current development proposals. I would have discussed the fact that Bedford's largely built out but has a few remaining undeveloped parcels that could potentially support small subdivisions/PRDs, and that a significant amount of redevelopment or building expansion is occurring on both the residential and industrial sides, sometimes putting more pressure on natural resources.

Catherine Perry MRTPI AICP
Assistant Planner
Town of Bedford

Mary Kate Schneeweis

From: sdorer@aol.com <sdorer@aol.com>
Sent: Saturday, June 12, 2021 8:55 AM
To: Rebecchi, Jeanette <jrebecchi@bedfordma.gov>
Cc: Robert Dorer <rdorer@verizon.net>
Subject: Public Comment

Jeanette,

My name is Sarah Dorer - a resident at 2 Otis Street. I listened to the presentation to "The Hazard MItigation Plan and Municipal Vulnerability Preparedness Report" and find all the recommendations laudable. However, I would like more information on how the 3rd recommendation will be carried out - "Continue to identify vulnerable trees and perform proactive maintenance. Encourge utility companies to continue tree maintenance programs to identify and monitor vulnerable trees along powelines". I have lived in Bedford for close to 40 years, and over the years, and even very recently, have been very frustrated by the lack of response to this particular issue. I am not sure whose responsibility it is to notify the utility companies. As a resident in Bedford, I have always assumed that we can contact the DPW and then the DPW can contact the utility companies. It seems to me that a message to the utility companies from a town's DPW is far more effective than a resident's request.
Perhaps some clarification on that issue to the townspeople is needed.

On a personal note, even within the past few months, my husband and I have contacted the DPW in Bedford with trees of concern on our street (Otis Street) and just around the corner on Highland Ave...and there has been absolutely no response or even acknowledgement of the concern. There is one tree on Otis, just as you turn in from South Road that absolutely needs trimming. It is a small tree in the town's right-of-way with part of it leaning directly on some line. Then, around the corner on Highland there is a huge dead tree that has already broken off, but is hanging in the air and has the potential to bring down all the lines in that area. The tree is very obvious and dangerous.

Thanks for reading...not sure if you can pass this information along... Would love to know that this email has been received. Thank you for your work on this project.

Sarah Dorer
2 Otis Street
Bedford
781-248-1832

Mary Kate Schneeweis

From: John Stella <johnstella2@yahoo.com>
Sent: Saturday, June 12, 2021 12:22 PM
To: Rebecchi, Jeanette <jrebecchi@bedfordma.gov>
Subject: RECCOMENDATIONS

I RECCOMEND TOWN OF BEDFORD AND DPW TO STUDY FLOOD PROBLEMS THAT AFFECT HOMEOWNERS AND BUSINESS NEAR WATERWAYS SUCH AS CONCORD RIVER, ELM BROOK, SHAWSWHEEN RIVER AND VINEBROOK RIVER IN BEDFORD .

FLOODING IS THE MOST SERIOUS PROBLEMS THAT BEDFORD HAS TO FACE IN SHORT AND LONG TERM .

FLOODING IS MOST FACTOR IN BEDFORD BECAUSE THERE ARE LOTS OF WETLANDS , SMALL STREAMS, AND RIVERS OR BROOK .

MOST IMPORTANT TO STUDY FLOOD PROBLEMS THAN A TORANDO AND HURRICANES .

WOULD RECCOMEND STUDY A FLOOD PROBLEM IN BEDFORD . WOULD NOT RECCOMEND BEDFORD TO STUDY FOR HURRICANE AND TORANDO

HIGH THREAT : FLOOD

LOW THREAT : HURRICANE , TORANDO .

I STRONGLY RECCOMEND THIS IMPORTANT ISSUE THE TOWN WILL HAVE TO ADDRESS THIS SHORT AND LONG TERM PROBLEM : FLOODING .

JOHN STELLA

Mary Kate Schneeweis

From: Sue Swanson <sueswanson2003@gmail.com>
Sent: Monday, June 14, 2021 9:16 PM
To: Rebecchi, Jeanette <jrebecchi@bedfordma.gov>
Subject: Public Comment - Municipal Vulnerability Preparedness Report

Dear Jeanette,

Thank-you for sharing the draft copy of the Municipal Vulnerability Preparedness Report. And thanks again for including me in the original stakeholders meetings in December 2019!

I waited until the last minute, but I did read the report. I am satisfied with the results; although I am sure there is more we can do, this seems to be a thoughtful balance of need and capacity.

I greatly appreciate the attention that has been paid to vulnerable populations. Bedford does have a sizable community of aging residents who face problems of mobility and access to social media. Also noted are the number of non-English-speaking residents and of others who may not easy access to emergency notices in understandable formats.

As a climate activist and a member of Mothers Out Front, I am glad that the threat of increased extreme weather events and other climate-change related issues is being addressed. My only comment in this regard is that we cannot take our trees and greenspace for granted. Mature trees provide heat reducing shade and are also able to sequester substantial amounts of carbon from the air. I am concerned that many trees are being culled, perhaps even for understandable reasons, and that this may have a negative impact on our climate resiliency.

One final thought is a question about the management of open space. Has there been any thought about replacing some (not all) of the grassy areas with native plantings? Or leaving fallen leaves to mulch over winter? Just a thought. Would thoughtful native plantings along the riverbanks help manage flooding? Or is that already happening, by itself, along banks that are not privately owned?

Again, thank-you for inviting me to comment. I appreciate that and I appreciate what you and the Town are doing to preserve and protect our community!

Sincerely yours,

Sue Swanson
45 Shawsheen Road, Unit 32.
781-275-2659

Mary Kate Schneeweis

From: T Gleason <terrygleasonhome@gmail.com>
Sent: Tuesday, June 15, 2021 10:38 PM
To: Rebecchi, Jeanette <jrebecchi@bedfordma.gov>
Cc: Sue Swanson <sueswanson2003@gmail.com>
Subject: Comments HMP

Hi Jeanette,
Here are my comments on the draft HMP. I cc'ed Sue (Mothers Out Front rep). Keep me in the loop for any new updates.
-Terry

page Text
3 1.1 " HMP is ... damage resulting from natural hazards such as ..."
Comment:
On p. 1, HM is "... damage from natural and human-made ..."
Since the Plan does address damage due to human-caused climate change as stated on p. 1, the corresponding text on p. 3 should be corrected to also include "and human-made"

3 Executive Order 569, 2016
Comment
Instead of Executive Order 569, 2016, use a 2021 reference that is much more appropriate.

29 4.4.2 Wildfire
Comment:
The 250 acre Burlington Landlocked Forest borders Bedford. With the expected increase of drought conditions, the lack of easy access to the area, and an abundance of dead trees, this area needs a serious risk assessment in coordination with the Town of Burlington.

==========
General Comment:
The term "mitigation" has a strict, narrow meaning in climate change policies and science. It means the reduction of GHG, or capturing and sequestering existing emissions.

When agencies and reports use "mitigation" in the moregeneral sense when talking about "mitigating the effects" of climate change, it can lead agencies to suggest or claim they are indeed addressing climate change mitigation when in fact they are only addressing adaptation or resilience (as this report does).

To prevent misleading citizenry and Town leaders, the HMP should clarify, up front, that the report is focussed on short-term climate change resilience and adaptation. And without an ambitious plan and its execution to reduce emissions, i.e., mitigation in the narrower climate change sense, any HMP plan will quickly be out-dated.

In addition, the clarification would be a good opportunity to explain that the risks and threats will only grow even after we reach our net zero goals.

-Terry Gleason

Mary Kate Schneeweis

From: Porter, Heidi <hporter@bedfordma.gov>
Sent: Monday, June 14, 2021 1:43 PM
To: Rebecchi, Jeanette <jrebecchi@bedfordma.gov>
Cc: Alani, Taissir <taissir_alani@bedfordps.org>
Subject: RE: Public Comment - Municipal Vulnerability Preparedness Report

Hi Rebecca-

I didn't see town/school building temperature control as a consideration in the plan. Given the need for Bedford schools to close last week due to excessive temperatures and lack of A/C in many of the classrooms within the 4 schools, the BOH would like to request a project be added to the Municipal Vulnerability Preparedness Report Action Matrix:

- expand availability of air conditioned/temperature controlled classrooms and gathering spaces in the schools due to higher temperatures occurring in the fall and late spring given the potential impact on learning and student/staff health while school is in session (school year and for summer school). The BOH views this as a HIGH priority.

We understand the project has to be on the Matrix to be considered for future grant funding. Thank you for the opportunity to comment further given the time since our workshop. Happy to answer any questions or provide further detail.

Thank you,

Heidi Porter, MPH, REHS/RS
she/her/hers
Director of Health and Human Services
Town of Bedford, MA
12 Mudge Way
Bedford, MA 01730
phone: 781-275-6507
fax: 781-687-6157
email: hporter@bedfordma.gov

From: Rebecchi, Jeanette <jrebecchi@bedfordma.gov>
Sent: Monday, May 24, 2021 4:17 PM
To: Manugian, David <dmanugian@bedfordma.gov>; Fidalgo, Amy <afidalgo@bedfordma.gov>; Freeman, Dennis <dfreeman@bedfordma.gov>; Nelson, Chris <cnelson@bedfordma.gov>; St. John, Adrienne <astjohn@bedfordma.gov>; Dowdy, Kristin <kdowdy@bedfordma.gov>; Sandoval, Alyssa <asandoval@bedfordma.gov>; Laskey, Christopher <claskey@bedfordma.gov>; Alani, Taissir <taissir_alani@bedfordps.org>; Sullivan, Mark <msullivan@bedfordma.gov>; Bongiorno, Robert <rbongiorno@police.bedfordma.gov>; Porter, Heidi <hporter@bedfordma.gov>; McGrath, Ed <emcgrath@bedfordma.gov>; Scaltreto, Ron <ronald_scaltreto@bedfordps.org>; Raposa, Jason

<jraposa@bedfordma.gov>; Grunes, David <dgrunes@bedfordma.gov>; Daniels, John <johnd@bedfordma.gov>; Perry, Catherine <cperry@bedfordma.gov>
Subject: Public Comment - Municipal Vulnerability Preparedness Report

Hi everyone,

After quite a year, the final draft of the combined Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Report (see attached) is available for public comment. If you recall from the December, 2019 Workshop you attended, submission of the final report to the Executive Office of Energy and Environmental Affairs (EEA), MEMA, and FEMA will open up grant opportunities for the Town. For EEA Action Grants in particular, the project that you would like funded must appear in the Action Matrix included in the Report (see pages 48-50).

If you have any feedback on the draft Report, please reach out to me by June 15, 2021. Additional notices will be released later this week to the wider community to solicit feedback.

Thanks!
Jeanette
on behalf of the MVP Core Team

Jeanette Rebecchi, AICP
Transportation Program Manager

Town of Bedford - DPW
314 Great Road
Bedford, MA 01730
Ph: (781) 918 - 4274
Office Hours: Mon/Wed/Thurs

Response to Municipal Vulnerability Preparedness Draft Report

Daniel Churella June 15, 2021

Summary
The Top Priority Actions identified in the report have numerous weaknesses, return minimal benefit, and do not effectively address Bedford's most prevalent natural hazards and vulnerabilities. Green Infrastructure projects, a Micro Geothermal Network for Town Center Campus, and planting more trees would provide a more robust, environmentally beneficial, cost effective and fundable response to climate change induced vulnerabilities. I urge the MVP Core Team and the Consultants to include these and other more beneficial projects as priority actions in the final Hazard Mitigation Plan.

Although this response to the Draft Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Report is informed by my position as the Chair of the Bedford Arbor Resources Committee (BARC), the opinions expressed here are mine only and do not represent an official position of BARC.

The origin and primary purpose of establishing the Municipal Vulnerability Preparedness Plan was to incorporate the hazards and resultant vulnerabilities brought on by climate change into the Hazard Mitigation Plans of Massachusetts cities and towns. Completing this planning process would then make the municipality eligible for grants from the Executive Office of Energy and Environmental Affairs (EEA) for hazard mitigation projects. Funding criteria for these projects are specified.

The draft report states on page 47 that the top priority actions were decided at the December, 2019 CRB workshop. Does this mean that any inputs from the public listening session on March 4, 2020 were disregarded in setting the final priorities?

One of the central objectives of the CRB process was to *"Identify existing and future strengths and vulnerabilities within the Town".* Nowhere in the draft report is there any mention of what strengths were identified.

The weaknesses of the five Top Priority Actions identified in the draft report include:

- Do not contribute to slowing climate change or meeting greenhouse gas emission and carbon neutrality goals
- Do not effectively address flooding which was identified as the most prevalent natural hazard affecting Bedford
- Provide only minimal return on substantial investment for the Town

- Do not employ the preferred Nature Based Solutions
- Do not fit well into the specified project funding criteria

The first Top Priority Action is to *"Assess and* ***construct a redundant underground electrical system/microgrid at Town Campus*** *under control of the Town".* This project would be very expensive but provide little actual benefit to the Town. The only benefit would be a marginally more reliable electricity supply to the Town Center buildings, some of which already have backup generators. How often do these buildings lose power as a result of a fault in the electrical grid within the Town Center campus? No data is provided in the report. If power were lost on the trunk lines feeding the localized grid, there would be no realized benefit at all.

A much better and more beneficial project for the Town Center campus would be construction of a **Micro Geothermal Network** (MGN). [1] These systems provide very efficient heating and cooling to buildings by exchanging heat with water circulating in a network of wells. The advantages include:

- Elimination of burning fossil fuels (natural gas) for heat
- Reduction of climate change caused by greenhouse gas emissions, both carbon dioxide and methane, which is 83X more potent than CO2
- Contributing to the Massachusetts carbon neutrality goals
- Heating in winter and efficient cooling in summer
- Dramatically reduced overall energy consumption and associated costs
- Continuous and substantial return on investment. According to the 2020 Bedford Annual Energy Report, the Town spends $300K annually for gas to heat the Town Center buildings and about 10% of the total electricity use is for summer AC. The gas expense would be eliminated and the AC expense would be reduced
- Numerous opportunities for project funding. Meets EEA criteria; National Grid is mandated to construct several MGN demonstration systems and is currently looking for project proposals; possible funding from recently passed Climate Change law
- Town Center is well suited to a MGN, with a cluster of high energy demand buildings and plenty of open space to accommodate the many required wells

Flooding from extreme precipitation was identified as the **most prevalent natural hazard affecting Bedford**. The <u>fifth</u> Top Priority Action provides a weak, reactive, unimaginative and inadequate response to this primary hazard: *"Coordinate with downstream communities and other planning commissions to manage rivers and streams. Conduct maintenance of hazard trees along the banks. Develop and implement proactive Beaver Management Plan".* ??

A much **more effective approach to the flooding problem** would include:

- Capturing rain where it falls and controlling runoff before it reaches streams and low areas

- Applying Nature Based Solutions to the problem
- Develop Green Infrastructure[2,3] projects and incorporate these concepts in all Town projects. Examples include:
    - Rain gardens and street planter boxes
    - Rainwater harvesting
    - Bioswales
    - Permeable pavement (Draft Report page 22: "Increased development and unmitigated increases in impervious areas…are contributing to flooding impacts.")
    - Green streets, parking lots and roofs
- See trees as part of the solution, rather than just part of the problem
    - Trees are an important and cost effective component of urban storm water management[4]
    - A single mature tree can capture between 700 (deciduous) and 4000 (evergreen) gallons of rain per year
    - Trees are the most efficient, effective and least costly mechanism for removing and sequestering carbon dioxide from the atmosphere
    - Trees provide myriad other benefits[5] including
        - Clean the air
        - Increase the supply of clean water
        - Prevent water pollution
        - Prevent soil erosion
        - Cool streets and urban areas and reduce heat islands
        - Conserve energy
- These approaches to controlling flooding also help with heat, drought and fire, which was identified as the second most prevalent natural hazard affecting Bedford

Implementing Green Infrastructure projects and concepts should be the highest priority action for reducing municipal vulnerability to climate change induced hazards. The benefits of this approach include:

- Contribute to reducing climate change caused by greenhouse warming
- Effectively address the two most prevalent local hazards of flooding and heat/drought
- Provide solutions based on natural processes ("Nature does it best")
- Have a high benefit to cost ratio ("More bang for the buck")
- Provide ongoing return on investment
- Save money on installation, operations, maintenance, and recovery activities
- Can build from an extensive base of knowledge, resources, well developed methods and techniques, and proven economics (Don't have to "reinvent the wheel")
- Align well with EEA funding criteria
- Climate change is increasingly being recognized as an existential threat, creating many other public and private funding opportunities
- Provides less tangible benefits in areas such as health and well being, desirability and property value, economic opportunity, community pride

The third Top Priority Action is *"Continue to **identify vulnerable trees and perform proactive maintenance**. Encourage utility companies to continue tree maintenance programs to identify and monitor vulnerable trees along overhead power lines"*. Eversource completed a project to prune trees near every power line in town last summer and fall and removed a total of 96 public and private trees near power lines during the winter. Only six trees will be replaced. Page 42 of the draft report states: "The Town appropriates funds for the on-going Hazardous Tree Program to remove hazardous or dead trees. On average approximately 200 trees are removed or trimmed within the right of ways annually." Although the priority action is to continue this work, most of the benefit has already been achieved. A more beneficial priority action would be to replace every tree that is removed and achieve no net loss of Town trees annually. Again, look at trees as part of the solution and not just part of the problem. See comments on trees in the flooding section above. Funding is available from a number of sources to plant trees, but no funding is available to remove them.

The fourth Top Priority Action is *"Hire a consultant to review and **update Comprehensive Emergency Management Plan**"*. The current plan was updated in 2017. How much has changed since then? How will the Town's resiliency to climate change be enhanced by a plan update? Although updating this plan is listed as a top priority, there is no information in the draft report about the need or benefits. Hiring a consultant seldom actually solves a problem.

References

1. Geothermal Networks https://www.greenribboncommission.org/wp-content/uploads/2020/08/GRCx-Geothermal-Values-Slides-FINAL_compressed.pdf?utm_medium=email&_hsmi=100505379&_hsenc=p2ANqtz-8A5RDi5OCHGbgKOnbUzZ5a_RkxVSW1HUaBLPGvtBZy2HtSh6NMCaqk_FlyksLDMSPwjrGJjFJ5vhJBAjpLQnFuETmBg&utm_content=100505379&utm_source=hs_email
2. Green Infrastructure - EPA https://www.epa.gov/green-infrastructure
3. Green Infrastructure – NDRC https://www.nrdc.org/stories/green-infrastructure-how-manage-water-sustainable-way
4. Role of Trees in Stormwater Management – EPA https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6134866/
5. Benefits of trees https://canopy.org/tree-info/benefits-of-trees/

Appendix G
Draft Certificate of Adoption

Bedford, Massachusetts

RESOLUTION NO. ____

A RESOLUTION OF THE TOWN OF BEDFORD, MA ADOPTING THE 2022 BEDFORD, MA HAZARD MITIGATION PLAN UPDATE AND MUNICIPAL VULNERABILITY PREPAREDNESS SUMMARY OF FINDINGS

WHEREAS the Town of Bedford, Select Board recognizes the threat that natural hazards pose to people and property within Bedford; and

WHEREAS the Town of Bedford has prepared a multi-hazard mitigation plan, hereby known as the 2022 Bedford, MA Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Summary of Findings in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS the 2022 Bedford, MA Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Summary of Findings dated _____ identifies mitigation goals and actions to reduce or eliminate long- term risk to people and property in Bedford from the impacts of future hazards and disasters; and

WHEREAS adoption by the Town of Bedford Select Board demonstrates their commitment to the hazard mitigation and achieving the goals outlined in the 2022 Bedford, MA Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Summary of Findings dated _____.

NOW THEREFORE, BE IT RESOLVED BY THE SELECT BOARD OF BEDFORD, MASSACHUSETTS THAT:

Section 1. In accordance with _____, the Town of Bedford, Select Board adopts the 2022 Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Summary of Findings dated _____.

ADOPTED by a vote of _____in favor and__against, and__abstaining, this_____day of

_____,_____.

By:_____ (print name)
ATTEST:

By:_____ (print name)
APPROVED AS TO FORM:

By:_____ (print name)