Town of Stoneham

HAZARD MITIGATION AND MUNICIPAL VULNERABILITY PREPAREDNESS PLAN (HMP/MVP)

March 2021

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EXECUTIVE SUMMARY

Hazard mitigation planning is a proactive process used to systematically identify policies, actions, and tools that can be used to reduce the dangers to life and property from natural hazard events. Climate adaptation planning recognizes that climate change will exacerbate the vulnerabilities and risks associated with natural hazards. The Town of Stoneham (the "Town") completed a planning process focused on both hazard mitigation planning and climate adaptation, which provides a robust assessment and implementation plan to build the Town's resilience. The Town is now eligible for hazard mitigation funding through the Federal Emergency Management Agency (FEMA) and climate adaptation funding through the Massachusetts Executive Office of Energy and Environmental Affairs' Municipal Vulnerability Preparedness (MVP) Grant Program.

Planning Process

The Hazard Mitigation Plan and Municipal Vulnerability Preparedness Plan (HMP-MVP Plan) were led by Stoneham's Planning Department and completed through the following steps.

1) Convened a core team of municipal department heads who provided key input through meetings, online surveys, and interviews.
2) Created a set of hazard mitigation and climate adaptation goals.
3) Engaged the public through a Community Resilience Building Workshop and online public engagement techniques.
4) Established a list of critical facilities and assets.
5) Conducted a vulnerability and risk assessment of historic hazards and the potential impact of climate change.
6) Documented the Town's capacity to mitigate and respond to hazards.
7) Detailed progress on Stoneham's previously identified action items.
8) Developed an action and implementation strategy.
9) Sought public feedback on the final document.

Hazard Mitigation and Climate Adaptation Goals

The Town endorsed the following set of hazard mitigation and climate adaptation goals.

1. Prevent and reduce the loss of life, injury, public health impacts, and property damages resulting from all identified natural hazards and projected hazards under climate change.
2. Build and enhance local mitigation capabilities to ensure individual safety, reduce damage to public and private property and ensure continuity of emergency services.
3. Increase cooperation and coordination among private entities, Town officials and Boards, neighboring communities, State agencies, and Federal agencies.
4. Increase awareness of the benefits of hazard mitigation and climate resiliency measures through outreach and education.
5. Identify and seek funding for measures to mitigate or eliminate each known significant hazard area and reduce the impacts of climate change.
6. Ensure that future development meets federal, state, and local standards for preventing and reducing the impacts of natural hazards today and under climate change projections.

7. Integrate hazard mitigation planning and climate change projections as an integral factor in all relevant municipal departments, committees, and boards.

Vulnerability and Risk

Among the communities of Middlesex County, hazard mitigation and climate adaptation planning tend to focus on flooding because it is one of the most likely natural hazards to impact these communities. However, Stoneham's HMP-MVP Plan assesses the potential impacts from a variety of natural disasters including:

Flooding

Extreme Temperatures

Severe Thunderstorms, Wind, and Tornadoes

Nor'easters, Ice Storms, and Severe Snowstorms

The HMP-MVP Plan documents the location and exposure of Town critical facilities and assets. Among them are emergency services, roads, utilities, social services, and natural resources.

Hazard Mitigation and Climate Adaptation Strategy

Through the planning process, twenty-three high priority hazard mitigation and climate adaptation measures were identified covering the following topics:

- Communications with Residents
- Regulatory Updates
- Shelters
- Municipal Buildings and Services
- Culverts and Stormwater Drainage
- Roads and Bridges

Next Steps

Stoneham is dedicated to implementing the findings of this plan and documenting the process. As a now eligible community for funding through the MVP Program and FEMA, the Town will look to secure resources, and to work with regional and local stakeholders, to complete the projects identified herein. The Town will also continue to document hazard impacts and needed improvements to the Town's capacity to mitigate and adapt. Lastly, the Town will proactively incorporate the hazard mitigation and climate adaptation goals into municipal planning, budgeting, and operations. By doing so, Stoneham will be ready to update this plan in five years to maintain its eligibility for grant funding.

1 INTRODUCTION

The Town of Stoneham prepared a joint HMP-MVP Plan to reduce the impacts of natural hazards and climate change within the community and the region. The Stoneham HMP-MVP Plan was adopted by the Board of Selectmen on DATE.

1.1 What is a Hazard Mitigation Plan?

Natural hazards, such as earthquakes, hurricanes, and flooding, can result in loss of life, disruptions to everyday life, and property damage. Hazard mitigation is the effort to reduce these impacts through community planning, policy changes, education programs, infrastructure projects, and other activities.[1] Hazard mitigation *planning* uses a stepped process with the participation of a wide range of stakeholders to:

1. define local hazards,
2. assess vulnerabilities and risks,
3. review current mitigation measures, and
4. develop priority action items.

The resulting plan and implementation save lives and money. For every dollar spent on federal hazard mitigation grants, an average of six dollars is saved.[2] Mitigation planning offers many benefits. HMPs increase public awareness of natural hazards that may affect the community. They allow state, local, and tribal governments to work together and combine hazard risk reduction with other community goals and plans. HMPs focus resources and attention on the community's greatest vulnerabilities.

By completing an HMP, municipalities also become eligible for specific federal funding and allow potential funding sources to understand a community's priorities. Hazard mitigation funding is available through the FEMA. To be eligible for FEMA Grants, local governments are required to prepare an HMP meeting the requirements established in the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000.[3] A summary of disaster assistance programs offered by FEMA is included below.

[1] Federal Emergency Management Agency (FEMA), "Hazard Mitigation Planning."
[2] Federal Emergency Management Agency (FEMA) and Federal Insurance and Mitigation Administration, "Natural Hazard Mitigation Saves Interim Report."
[3] Federal Emergency Management Agency (FEMA), "Hazard Mitigation Grant Program."

Table 1-1. FEMA Grants

FEMA Grants	Purpose
Hazard Mitigation Grant Program (HMGP)	Funds the implementation of long-term hazard mitigation planning and projects after a Presidential major disaster declaration[4]
Pre-Disaster Mitigation (PDM) Program	Offers annual funding for hazard mitigation planning and projects[5]
Flood Mitigation Assistance (FMA) Program	Offers annual funding for planning and projects that reduce or eliminate flood damage to buildings insured under the National Flood Insurance Program (NFIP)[6]
Public Assistance (PA) Grant Program	Facilitates recovery after disasters by providing communities with funding for debris removal, life-saving emergency protective measures, and restoring public infrastructure[7]
Fire Management Assistance Grant (FMAG) Program	Funds mitigation, management, and control of fires on forests or grasslands, to prevent major disasters[8]

1.2 What is a Municipal Vulnerability Preparedness Plan?

In 2017, the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) initiated the Commonwealth's Municipal Vulnerability Preparedness (MVP) grant program to help communities become more resilient to the impacts of climate change. The program provides two grant phases. The first grant phase is the planning grant, which funds a planning process to identify priorities action items to address vulnerabilities and utilize strengths in preparation for climate change. The MVP planning process includes convening a team of municipal staff, engaging stakeholders in a Community Resilience Building (CRB) Workshop following a guidebook developed by the Nature Conservancy, and engaging the public. Communities that complete the planning grant program and prepare an MVP Plan become eligible for the second phase of MVP grant funding, the action grants, and receive increased standing in other state grant programs. MVP action grants fund the implementation of priority climate adaptation actions described in the MVP Plan.[9] Since these action grants are only distributed to Massachusetts municipalities, they are much less competitive than similar grants awarded at the national level.

1.3 Hazard Mitigation and Municipal Vulnerability Preparedness Planning in Stoneham

The Town of Stoneham received an MVP Planning Grant to simultaneously prepare an MVP plan and an HMP. Many of the required steps of the MVP process also satisfy requirements for drafting an HMP. As a result, the Town prepared this joint HMP-MVP Plan in accordance with FEMA guidelines for hazard mitigation planning (Title 44 Code of Regulations (CFR) 201.6) and with the Massachusetts Executive Office of Energy & Environmental Affairs' (EEA) requirements to follow the

[4] Federal Emergency Management Agency (FEMA), "Hazard Mitigation Assistance."
[5] Federal Emergency Management Agency (FEMA).
[6] Federal Emergency Management Agency (FEMA).
[7] Federal Emergency Management Agency (FEMA), "Public Assistance: Local, State, Tribal and Private Non-Profit."
[8] Federal Emergency Management Agency (FEMA), "Fire Management Assistance Grant Program."
[9] Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "MVP Program Information."

CRB Workshop Guidance, developed by The Nature Conservancy. This process enabled Stoneham to consider the impacts of climate change in its hazard mitigation planning, following the lead established by the Commonwealth when it adopted the first-ever Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018).

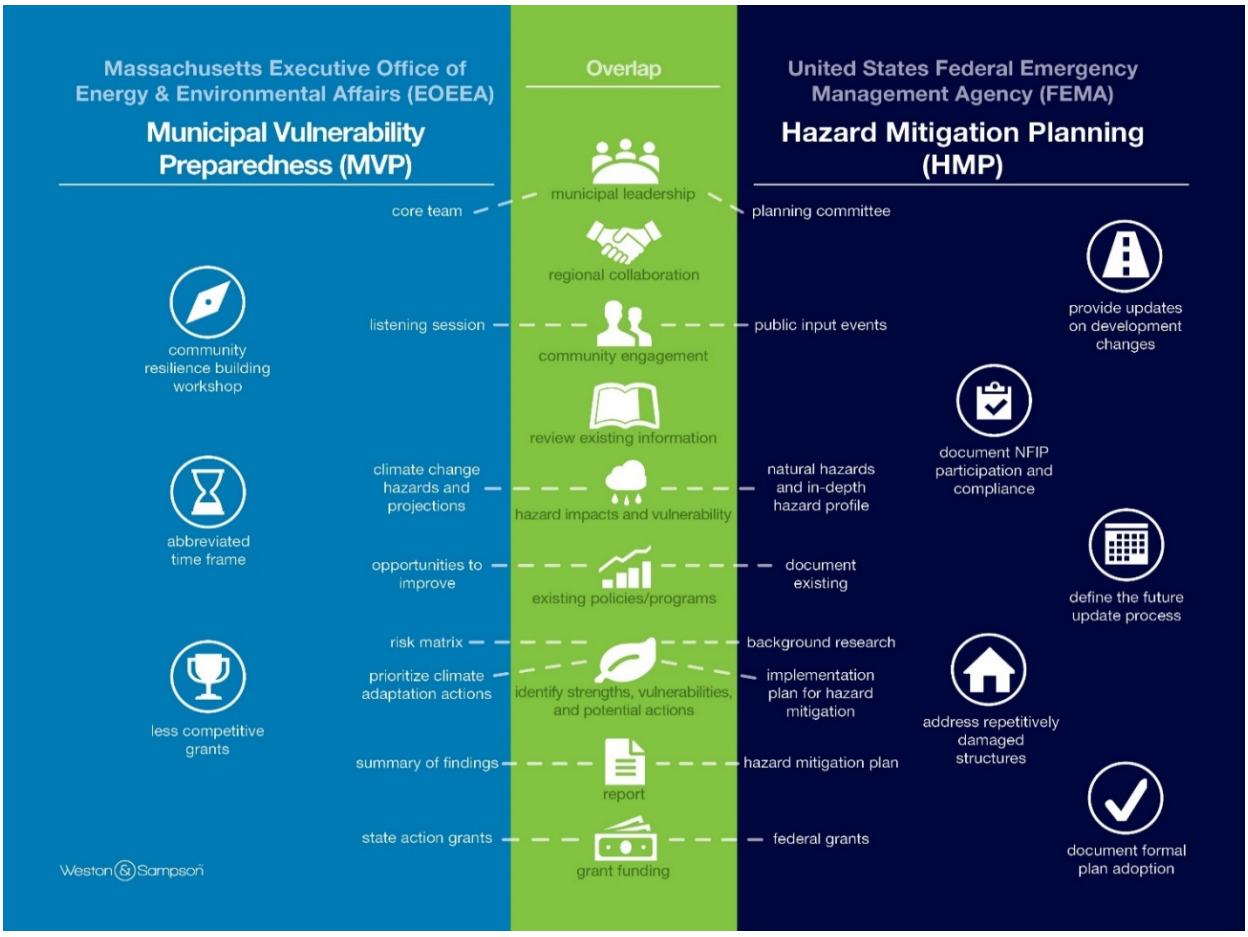


Figure 1-1: Commonalities and Difference between the MVP and HMP Processes

The joint HMP-MVP Plan convened a Core Team of municipal leaders to lead the process and provide local expertise. The Core Team met, corresponded via email, and contributed through interviews. Stakeholder engagement was conducted through the CRB Workshops, an online webinar, and an online survey. Chapter 3 provides more information about the overall process and outcomes.

1.4 Planning Process Summary

To prepare for the development of this MVP-HMP, the Town of Stoneham followed the process described in the Community Resilience Building Workshop Guidebook.[10] The Guidebook provides a clear approach on how to organize the public process for mitigating the impacts of, and increasing resilience against, natural hazards and climate change. An important aspect of the natural hazard and climate change impact mitigation planning process is the discussion it promotes among community members about creating a safer, more resilient community. Developing a plan that

[10] The Nature Conservancy, "Community Resilience Building Workshop Guide."

reflects the Town of Stoneham's values and priorities is likely to produce greater community support and result in greater success in implementing mitigation strategies that reduce risk.

Community Resilience Building Workshop Guidebook

The Community Resilience Building Workshop Guidebook provides a process for developing resilience action plans. The process has been implemented and successful in over three hundred communities.[11] The process, outlined below, is rich in information and dialogue and results in actionable plans and strong collaboration.

The **Community Resilience Building Workshop Guidebook's** central objectives are to:

- Define top local natural and climate-related hazards of concern
- Identify existing and future strengthen and vulnerabilities
- Develop prioritized actions for the community
- Identify immediate opportunities to collaboratively advance actions to increase resilience.

Federal regulation for HMP approval requires that stakeholders and the general public receive opportunities to be involved during the planning process and in the plan's maintenance and implementation. Community members can therefore provide input that can affect the content and outcomes of the mitigation plan. The planning and outreach strategy used to develop this MVP-HMP Plan had three tiers:

1. The Core Team, with representation from municipal leadership at the Town of Stoneham.
2. Stakeholders who could be vulnerable to, or provide strength against, natural hazards and/or climate change.
3. The public, who live and work in the Town.

1.4.1 Core Team

The Town of Stoneham convened the Core Team to act as a steering committee for the development of the HMP-MVP. The Core Team met on March 3, 2020, to plan for the Workshop, develop the mitigation plan, and transition to implementation of the plan's mitigation strategies. More information on these meetings is included in Appendix A.

The Core Team provided information on hazards affecting the town, identified critical infrastructure, identified key stakeholders, reviewed the status of existing mitigation measures, and developed proposed mitigation measures for this plan. Members of the Core Team are listed in Table 1-2.

[11] The Nature Conservancy, "Community Resilience Building."

Table 1-2. Stoneham's Core Team

Name	Title
Dennis Sheehan	Town Administrator
Erin Wortman	Town Planner
Brett Gonsalves	Town Engineer
Brian MacNeil	Facilities Director
Maureen Canova	Council on Aging
James McIntyre	Police Chief
Matthew Grafton	Fire Chief/Emergency Management Director
Cheryl Noble	Building Commissioner
Terry Dean	Board of Health

The Core Team developed the invitation list for the Community Resilience Building Workshop at which key stakeholders were invited to help the Town identify hazards, vulnerabilities, strengths, and proposed actions to mitigate the impacts of natural hazards and climate change. The Core Team sought to include municipal leaders as well as politicians, representatives from local nonprofit organizations, local schools, other local jurisdictions, regional organizations, and state government. The Core Team also suggested or made available reports, maps, and other pertinent information related to natural hazards and climate change impacts in Stoneham. These suggested resources included:

- Massachusetts Climate Change Projections (NECSC, 2018)
- Massachusetts Climate Change Adaptation Report (EEA, 2011)
- Massachusetts State Hazard Mitigation and Climate Change Adaptation (EEA and EOPSS 2018)
- Local Mitigation Plan Review Guide, October 2011 (FEMA, 2011)
- National Flood Insurance Program (NFIP) Flood Insurance Rate Map (FIRM) for Stoneham, Middlesex County, Massachusetts (FEMA, 2016)
- National Center for Environmental Information (NOAA)
- National Water Information System (USGS)
- US Census, 2019 and American Community Survey, 2013-2017 Estimates
- Stoneham Open Space and Recreation Plan 2018 (Town of Stoneham, 2018)
- Stoneham Town Center Strategic Action Plan 2014 (MAPC, 2014)

The Core Team created and reviewed a checklist of required activities to support the plan's development, the purpose, and needed resources. This checklist is illustrated below:

Stoneham MVP Engagement Checklist

Completed?	Required MVP Task	Resources Needed	Options	Lead
✓	Kick Off Meeting	• Phone call/introductory meeting to go over process and next steps	Phone call, in-person or virtual meeting	• Town/WSE
✓	Core Team Meeting	• Core team meeting scheduled • Presentation by consultant giving overview of process • Decisions made about stakeholders, etc.	In-person or virtual meeting	• Town coordinates meeting time/location/staff • WSE prepares presentation and gives options for next steps
✓	Listening Session 1 (during planning process)	• Presentation of MVP project during the planning process	Standalone meeting (online) or item at the end of an existing agenda	• Town – place item on agenda • WSE – prepare presentation
✓	Community Resilience Building Workshop (CRB Workshop)	• Invitee-only workshop of key community stakeholders (staff, board members, community leaders) • Usually 8 hours (shortened for online post-COVID19 events)	• 1 or 2 day online workshop • WSE recommends that we do a pre-workshop video and survey to prepare attendees • Ideally, uses engagement tools (maps, whiteboard, etc.)	• WSE prepares event materials and runs workshop • Town identifies attendees • Invitation list should be representative • Hours count toward Town time commitment
✓	Listening Session 2 (after completion of plan)	• Presentation of the findings from the planning process, data and research, community engagement	Standalone meeting (online) or item at the end of an existing agenda	• Town – place item on agenda • WSE – prepare presentation

Figure 1-2: Community Engagement Checklist

Stakeholders

1.4.2 Stakeholder Involvement: Community Resilience Building Workshop

Stakeholders with subject matter expertise, local knowledge, and experience, including public officials, regional organizations, neighboring communities, environmental organizations, and local institutions, were invited to engage in a two-part CRB Workshop, held online on December 1 and 3, 2020.

During the first workshop, Weston & Sampson provided information about natural hazards and climate change and participants identified top hazards, as well as infrastructural, societal, and environmental features in the Town, that are vulnerable to or provide strength against, these challenges.

Figure 1 3: Image of Stoneham Library. Photo from the Town of Stoneham.

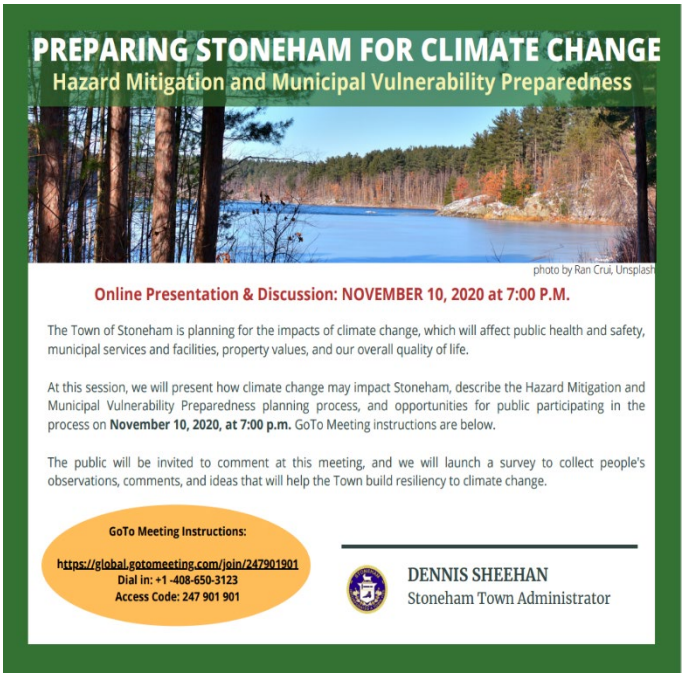
At the second Workshop, participants identified and prioritized key actions that would improve the Town's resilience to natural and climate-related hazards. Community representatives who were invited via email and those who participated in the process are presented in Table 3-2 in Appendix C and organized by category. Additional materials from the Workshop are also included in Appendix C.

This broad representation of local and regional entities ensures the HMP-MVP Plan aligns with operational policies and hazard mitigation strategies at different levels of government and implementation. A summary of key participants at the Workshop is included below:

- Staff members of the Town Planning Department, Engineering Department, Police Department, Fire Department, and Department of Public Works, along with many other municipal officials
- Representatives from the Council on Aging and Stoneham Board of Health
- State and regional representatives, including staff members from the Massachusetts Senate and the Towns of Melrose and Reading
- The MVP Regional Coordinator

1.4.3 Listening Sessions

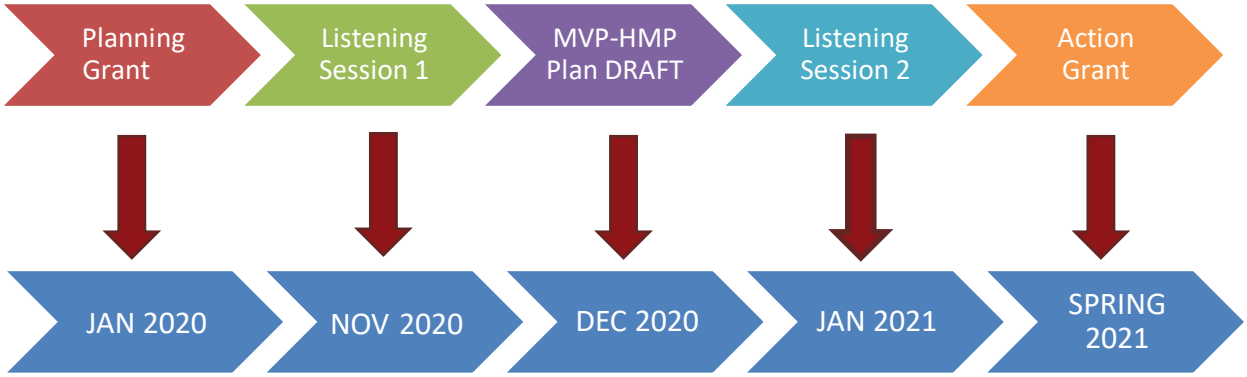
To gather information from the general public and to educate the public on hazard mitigation and climate change, the Town hosted an online listening session webinar with an accompanying online survey to collect comments. The Town received 42 responses through this survey. The draft Plan was posted on the Town's website along with the webinar and public comments were received between March 20th to and May 11th, 2021. During the virtual listening session, the project team presented information related to the MVP program, climate change in Stoneham, local strengths and vulnerabilities, existing mitigation measures, and priority action items for future climate adaptation. More information about the presentation and public comments are available in Appendix C, along with the meeting minutes and a subsequent news article published after the May 11th meeting.



Listening sessions were advertised on the Town's website and on their Facebook page. A survey captured public sentiment on municipal preparedness for climate change.

1.5 Planning Timeline

The HMP-MVP planning process proceeded according to the timeline below.
Information related to meetings associated with this timeline is included in more detail below:



1. Local Hazard Mitigation Planning Team / Municipal Vulnerability Preparedness Core Team

   Meeting 1: March 3, 2020 – Project Kickoff

2. HMP Stakeholder Meeting / MVP Community Resilience Building Workshop

   December 1st and December 3rd, 2020

3. Public Listening Sessions

   November 10th, 2020, and May 11th, 2021

4. Public Survey

   Survey and Public Comment Period: December 4, - February 28, 2021

The Stoneham Planning Board is the primary town agency responsible for regulating development in town. Feedback to the Planning Board was ensured through the participation of the Town Planning Director and Town Administrator on the local hazard planning team. In addition, the MAPC, the State-designated regional planning authority for Stoneham, works with all agencies that regulate development in the region, including the municipal entities listed above and state agencies, such as the Department of Conservation and Recreation and MassDOT. This regular involvement ensured that during the development of the Stoneham Hazard Mitigation Plan, the operational policies and any mitigation strategies or identified hazards from these entities was incorporated.

2 HAZARD MITIGATION AND CLIMATE ADAPTATION GOALS

The Core Team developed hazard mitigation goals to guide the planning process. These goals are included in more detail below:

1. **Prevent and reduce** the loss of life, injury, public health impacts, and property damages resulting from all identified natural hazards and projected hazards under climate change.

2. **Build and enhance** local mitigation capabilities to ensure individual safety, reduce damage to public and private property and ensure continuity of emergency services.

3. **Increase cooperation and coordination** among private entities, Town officials and Boards, neighboring communities, State agencies, and Federal agencies.

4. **Increase awareness** of the benefits of hazard mitigation and climate resiliency measures through outreach and education.

5. **Identify and seek funding** for measures to mitigate or eliminate each known significant hazard area and reduce the impacts of climate change.

6. **Ensure that future development meets federal, state, and local standards** for preventing and reducing the impacts of natural hazards today and under climate change projections.

7. **Integrate hazard mitigation planning and climate change** projections as an integral factor in all relevant municipal departments, committees, and boards.

3 COMMUNITY PROFILE, LAND USE, AND DEVELOPMENT TRENDS

3.1 Community Profile

Located in Middlesex County, Stoneham is a residential suburban community located less than 10 miles from Boston. It is neighbored by Woburn, Winchester, Medford, Melrose, Wakefield, Reading, and Malden. Stoneham is governed by a Town Administrator and a Board of Selectmen and operates under the open Town Meeting system. The Town maintains a website at https://www.stoneham-ma.gov/.

Stoneham was settled by colonists in 1634 and was originally part of Charlestown. Stoneham officially separated from Charlestown in 1725 and established the new township of Stoneham. Stoneham remained a small town during the colonial era. Traces of its colonial history are still noticeable in the Spot Pond Archeological District of the Middlesex Fells Reservation. During the Industrial Revolution, Stoneham prospered as a major shoe manufacturing center.[12] Stoneham is inside the Route 128 belt that delineates the core of metropolitan Boston. Public transportation is available in and around Stoneham. A tri-community greenway path runs through Stoneham accessible to walkers and bikers. The Oak Grove subway station, in neighboring Malden, is 3.8 miles from Stoneham Center. Several commuter rail stations are located in the bordering communities of Melrose, Winchester, Wakefield, Reading, Medford, Woburn, and Malden, each providing transportation to Boston's North Station. The MBTA's 132 bus route travels through Stoneham Center, offering transportation to the Orange Line at Oak Gove and Malden Station. Interstate 93 passes through Stoneham, and Route 128/Interstate 95 passes just to the north of the town.

Stoneham has active community spaces and events, including the public library, farmers market, and concerts on the common. Stoneham is home to a portion of the Middlesex Fells Reservation, which covers more than 2,200 acres and also spans the towns of Malden, Medford, Melrose, and Winchester. The Reservation includes two inactive reservoirs, Spot Pond and Fells Reservoir. Spot Pond is almost exclusively within Stoneham. The Reservation is managed by the Massachusetts Department of Conservation and Recreation and is part of the Metropolitan Park System of Greater Boston.[13] Pop-Up Stoneham is a program that presents temporary, free events on the Town Common that engage residents, businesses, and visitors of all ages while energizing the community. Stoneham is experiencing population growth: from 2010 to 2018, its population increased from 21,288 to 22,729 residents. This represents an almost 7% increase, which is higher than the state's overall population increase of 5.4% during the same period.[14]

3.2 Societal Features

Vulnerable populations are residents whose everyday stressors make it harder to adapt and recover when shocks or hazards occur. Children, the elderly, disabled residents, and low-income residents are considered vulnerable. Children are a significant subpopulation in Stoneham, making up almost 18% of residents, but this percentage is comparable to data for the State of Massachusetts. One census block group in town is listed as an Environmental Justice community based on 2010 income data. This area represents 2.6% of Stoneham's population (560 people). Please refer to Table 3-1 for more information.

[12] Stoneham Planning Board et al., "Stoneham Master Plan 2016."
[13] Executive Office of Energy and Environmental Affairs, MassParks "Middlesex Fells Reservation"
[14] United States Census Bureau, "QuickFacts: Stoneham Town, Middlesex County, Massachusetts."

Table 3-1. Stoneham Demographic Characteristics[15]		
Population	Stoneham	Massachusetts
2019	24,126	6,892,503
2010	21,437	6,547,629
Age		
Under the Age 18	17.7%	19.8%
Over Age 65	20.0%	16.5%
Households		
Owner-occupied housing unit rate, 2014-2018	65.9%	62.3%
Language other than English spoken at home	16.3%	23.6%
Median household income	$94,835	$77,378
Population Burdened by Housing Costs (housing with a mortgage)[16]	24.94%	27.33%
Population Burdened by Housing Costs (housing without a mortgage)[17]	38.76%	47.09%
Additional Information		
Persons in Poverty	5.0%	10.0%
Bachelor's degree or higher	46.3%	42.9%
With a Disability	10.5%	7.9%

Note: population burdened by housing costs is defined as housing costs above 35% of income
Source; US Census, 2019. Population data from the MA Department of Revenue, Division of Local Services, 2019.

3.3 Societal Features, Strengths, and Vulnerabilities

Stoneham's growing population, including its significant elderly population, may also be considered a vulnerability. Emergency services capacity will need to grow similarly to meet these increasing demands. Conversely, a growing population could provide more opportunities for volunteers and increased resident engagement, which would provide a community strength.

[15] United States Census Bureau, "QuickFacts: Stoneham Town, Middlesex County, Massachusetts."
[16] United States Census Bureau, "Estimate of percent of homeowners who are burdened by housing costs, between 2014-2018."
[17] Ibid.

Table 3-2. Societal Features in Stoneham

Both Vulnerability and Strength	Strengths	Vulnerabilities
• Senior housing facilities • Preschool facilities • Private day school facilities • Public housing • Non-profit facilities/multi-family housing buildings		• Manpower/mutual aid support • Social isolation • Information networks

3.4 Economic Features

In 2018, Stoneham's unemployment rate was 2.8%, a significant decrease from the Town's 8% unemployment rate only eight years during the country's 2008 financial crisis. With the impact from COVID19, the unemployment rate is currently 12.7%.[18] While some residents commute to cities including Boston, Billerica, and Burlington; most Stoneham residents (14% of the employed labor force) work in town.[19] The three largest employers in Stoneham are Bear Hill Nursing Center, Life Care Center, and Stoneham High School.[20] The largest local industries include educational services, health care, and social assistance.[21] Please refer to Table 3-3 for more information. Communication between businesses and the Town will be key in advancing hazard mitigation planning efforts and ensuring that large employers are aware of local risks and have emergency protocols in place.

Table 3-3: Stoneham Labor Data (2018)[22]

	Stoneham	Massachusetts
Labor Force	12,406 residents	3,755,481
Unemployment Rate	2.8%	6.0%
Commuters who drove to work	85.6%	70.7%
Residents with income below the poverty level	5.4%	11.1%

3.5 Infrastructure Features

Significant transportation infrastructure in and around Stoneham includes I-93, I-95, and Route 28. Local roads have been impacted by snow, ice, downed trees, and flooding. The Massachusetts Water Resources Authority (MWRA) provides water and sewer services to the Town of Stoneham. Stoneham's Public Works Water/Sewer Department is responsible for the operation and maintenance of the Town's five sewer pumping stations, approximately 75 miles of water mains, and 800 fire hydrants. They also maintain 75 miles of sewer and 6,100 water service connections and water meters. Backup power of all critical facilities providing water and sewer is essential.[23] See Section 3.5 for more information on critical facilities in Stoneham.

[18] 2020 Employment data compiled by ESRI Business Analyst.
[19] Ibid.
[20] MAPC, "Stoneham Space and Recreation Plan, 2018."
[21] United States Census Bureau, "Stoneham Town, Middlesex County, Massachusetts."
[22] United States Census Bureau.
[23] Town of Stoneham Water & Sewer web page.

Discussion of Existing Infrastructure

Participants at the CRB Workshop identified key infrastructure features in Stoneham that are vulnerable to, or provide protection against, natural hazards and climate change impacts.

Table 3-3. Infrastructure Features in Stoneham

Both Vulnerability and Strength	Strengths	Vulnerabilities
• Municipal buildings	• New high school construction	• Sewer pump stations • Stormwater drainage system • River/stream system • Narrow downtown street system/local roads • Dense neighborhood/roadway layout • Overhead electrical network • Senior Center basement flooding

3.6 Critical Facilities

Critical facilities are extremely essential components to the Town's function and protecting them from natural hazards is paramount. Critical facilities range in function from:

1. Resources that can be utilized to respond and recover from natural hazards.
2. Facilities where additional assistance might be needed.
3. Hazardous sites that could be dangerous if it is compromised during a natural disaster.

Based on information from Town staff, interviews with the Core Team and other experts, and input from stakeholders during the CRB Workshop, 121 critical facilities were identified in Stoneham. These facilities include public safety buildings, Town facilities, shelters, dams, evacuation routes, water and sewer infrastructure, natural resources, religious centers, schools, grocery and supplies stores, nursing homes, and other facilities. The full list of these structures is included in a table in Appendix C, shown in the map below, and included in the map series in Appendix B.

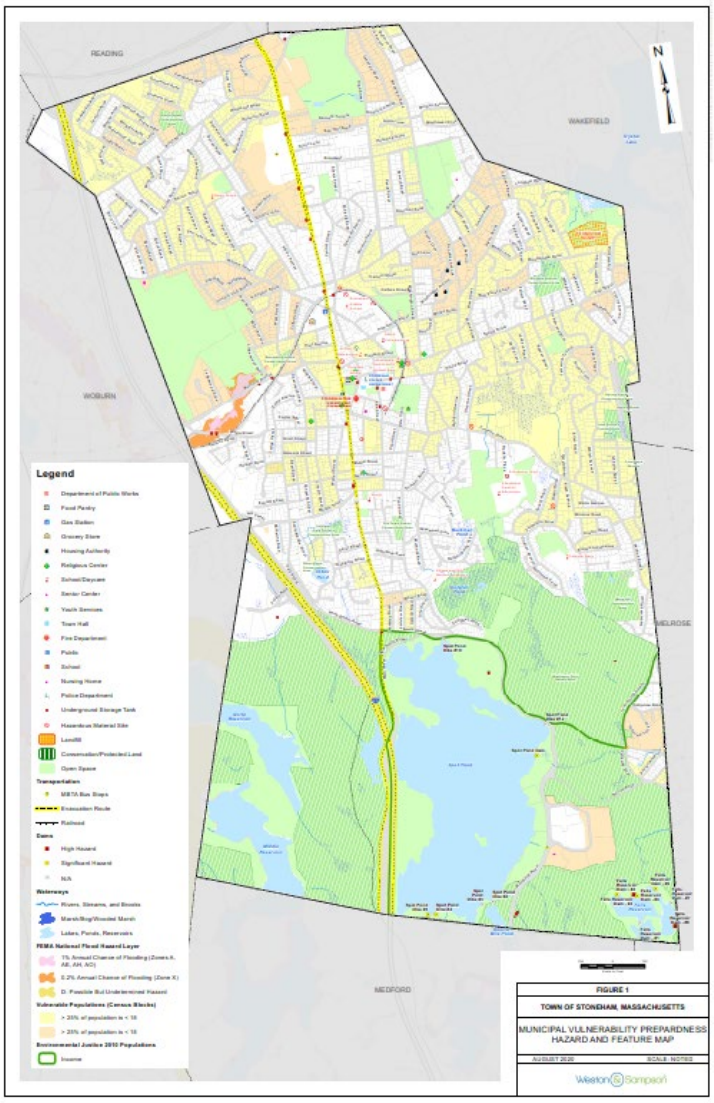


Figure 3-1: Stoneham's Hazard Map, which includes the location of critical facilities.

3.7 Land Use and Environmental Features

Stoneham is approximately 6.7 square miles, 8% of which consists of waterbodies, the largest of which is Spot Pond. Although Stoneham has transformed over time from an agricultural farm community to low-density suburban neighborhoods, approximately 37% of the town is zoned for open space (1,587 acres). Over 41% of Stoneham is made up of residential land uses the vast majority of which (35%) is occupied by single-family homes. Only a small portion of the town remains undeveloped and available for development or future open space. Some of this land has development constraints, such as wetlands, or is currently zoned for open space and is not permanently conserved.[24] Waterbodies provide significant space and recreational opportunities in town. These waterbodies include:

[24] Town of Stoneham, MAPC, "Stoneham Open Space and Recreation Plan, 2018."

- Spot Pond
- Dikes Pond Doleful Pond
- Fells Reservoir
- Buckman Pond

The graphic below illustrates a comparative breakout of land use in Stoneham.[25]

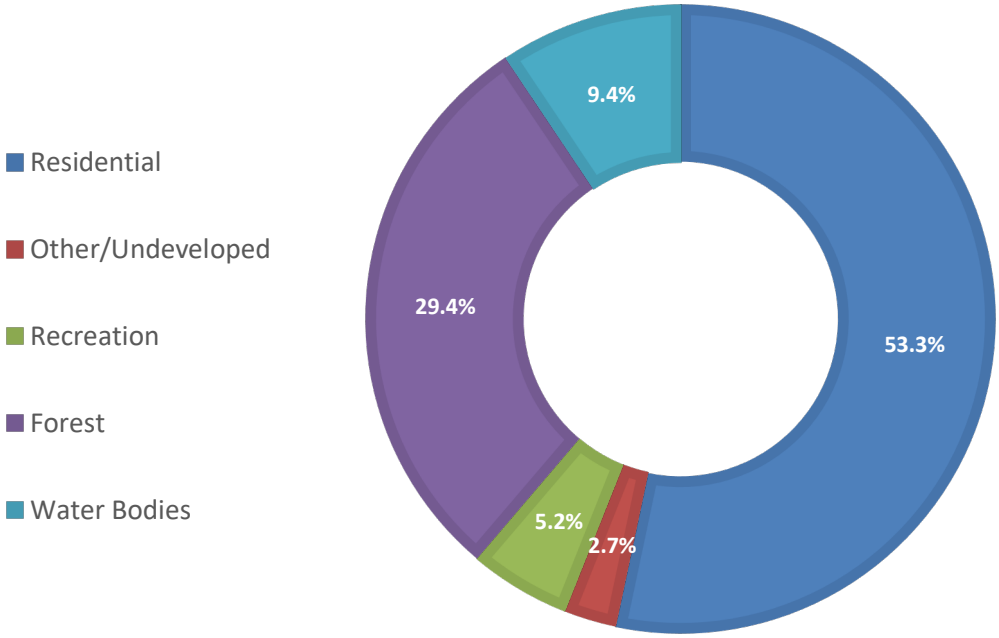


Figure 3-2: Land use in Stoneham

Discussion of Environmental Features

Workshop participants identified key environmental features in Stoneham that are most vulnerable to, or protect against, natural hazards and climate change impacts. Please see **Error! Reference source not found.** for more information.

Table 3-4. Environmental Features in Stoneham

Both Vulnerability and Strength	Strengths	Vulnerabilities
• 1/3 of the town is state-owned land • Air quality and water quality		• Air quality • Lack of adequate tree/landscape cover • Maple Street flood/stream issues

[25] Massachusetts Department of Public Health "Environmental Public Health Tracking Community Profile for Stoneham."

3.8 Recent and Potential Development

Development data was identified using input from the Stoneham Town Planner, and the Metropolitan Area Planning Council (MAPC) MassBuilds Database, which provides an inventory of recent, future, and potential development. The resulting documentation included 10 residential developments and 3 commercial developments, in Stoneham. These 13 developments in Stoneham consist of approximately 17,400 square feet of commercial space and 420 residential units. Please refer to Table 3-5 below for more information.

Table 3-5. Current and Future Development in Stoneham[26]

Name	Address	Construction Type	Square Feet or Number of Units	Year Completed
21 Montvale Ave	21 Montevale Avenue	Commercial	4,200 sf	2011
East School Redevelopment	12 Beacon Street	Residential	3	2012
Stella Way	6 Stella Way	Residential	6	2014
North School	175 Collincote Street	Residential	15	2014
51 Montvale Avenue	51 Montvale Avenue	Commercial	9,900 sf	2014
The Arbors	140 Franklin Street	Residential	54	2014
Wincrest Definitive Subdivision	93 Spalding Road	Residential	47	2015
380 Main Street	380 Main Street	Commercial	3,300 sf	2017
Sterling Hill	7 Woodland Road	Residential	48	2017
42 Pleasant Street	42 Pleasant Street	Residential	21	2018
Executive Drive	7 Executive Drive	Residential	300	2018
Smitty's Way	245 North Street	Residential	6	2020
Coventry Estates	42 High Street	Residential	9	2020
Gerald Road Extension	99 Gerald Road	Residential	5	2020
Doherty Lane Extension	13 Doherty's Lane	Residential	5	2020

[26] Metropolitan Area Planning Council (MAPC), "MassBuilds: Stoneham."

Fallon Road	299 Fallon Road	Residential	200	2020
489 Main Street	489 Main Street	Residential	6	
Rockville Park	Rockville Park	Residential	16	
Old Stoneham Lodge	471 Main Street	Mixed Use	10 residential 2 office	2020
Commons at Weiss Farm	170 Franklin Street	Residential	124	2022

Note: "PB" stands for Planning Board

4 HAZARD PROFILES, RISK ASSESSMENT & VULNERABILITIES

Each hazard profile in this chapter contains information related to areas vulnerable to the hazard, documentation of historic events, a risk assessment, and projected climate risk. The hazard profiles were updated using information from the 2013 Massachusetts State Hazard Mitigation Plan, the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), and additional research and assessment. The Core Team, expert interviews, CRB Workshop, and Listening Session results provided local accounts related to each hazard. Additionally, a GIS Assessment was conducted to determine the risk in Stoneham related to future flooding, hurricane, and earthquake events.

4.1 Statewide Overview of Hazards

4.1.1 Massachusetts State Hazard Mitigation and Climate Adaptation

The 2013 Massachusetts State Hazard Mitigation Plan and the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) examined natural hazards that have the potential to impact the Commonwealth. These plans summarize the frequency and severity of hazards of greatest concern. The frequency classification ranges from very low to high. Severity classifications range from minor severity to catastrophic. The box below gives further definitions of the frequency and severity characterizations. Table 4-1 summarizes the frequency and severity of hazard risk in Stoneham and the state. These frequency and severity classifications will assist the Town in prioritizing mitigation actions for each hazard.

Definitions used in the Commonwealth of Massachusetts State Hazard Mitigation Plan[27]

Frequency

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

Severity

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

[27] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."

Table 4-1. Hazard Risk Summary

Hazard	Frequency		Severity	
	Massachusetts[28]	Stoneham[29]	Massachusetts[30]	Stoneham[31]
Inland Flooding	High (1 flood disaster declaration event every 3 years; 43 floods per year of lesser magnitude)	High	Serious to Extensive	Serious
Dam failures	Very Low	Low	Serious to Extensive	Serious
Hurricane/Tropical Storm	High (1 storm every other year)	Medium	Serious to Extensive	Serious-Extensive
High Wind (Severe Weather)	High (43.5 events per year)		Minor to Extensive	Extensive
Tornadoes (Severe Weather)	High (1.7 events per year)	Low	Serious to Extensive	Extensive
Thunderstorms	High (20 to 30 events per year)		Minor to Extensive	Extensive
Nor'easter	High (1 to 4 events per year)		Minor to Extensive	Extensive
Snow and Blizzard (Severe Winter Weather)	High (1 per year)	High	Minor to Extensive	Serious
Ice Storms (Severe Winter Weather)	High (1.5 per year)		Minor to Extensive	Extensive

[28] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan"; Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[29] Stoneham Hazard Mitigation Plan (MAPC), October 2010.
[30] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan"; Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[31] Stoneham Hazard Mitigation Plan (MAPC), October 2010.

Table 4-1. Hazard Risk Summary

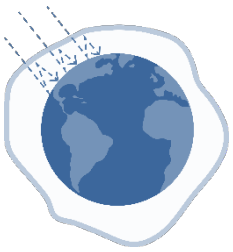
Hazard	Frequency		Severity	
	Massachusetts[28]	Stoneham[29]	Massachusetts[30]	Stoneham[31]
Earthquake	Very Low (10-15% probability of magnitude 5.0 or greater in New England in 10 years)	Low	Minor to Catastrophic	Catastrophic
Landslide	Low (once every two years in western MA)	Low	Minor to Extensive	Minor
Brush Fires	High (at least 1 per year)	Low	Minor to Extensive	Minor
Extreme Temperatures	High (1.5 cold weather and 2 hot weather events per year)		Minor to Serious	Serious
Drought	High (8% chance of "Watch" level drought per month [recent droughts in 2016 and 1960s])		Minor to Serious	Extensive

Not all hazards included in the 2018 State Hazard Mitigation and Climate Adaptation Plan, or the 2013 Massachusetts State Hazard Mitigation Plan apply to Stoneham. Given Stoneham's inland location, coastal hazards and tsunamis are unlikely to directly affect the Town and are not included in this table. It is assumed that the entire Town of Stoneham and its critical facilities are exposed to earthquakes, high wind events, hurricanes, winter storms, temperature extremes, and snow and ice, to a similar extent. Flood risk from riverine flooding is elevated in the vicinity of the flood zones. Landslides are more likely in areas with more unstable soil types.

4.1.2 Federally Declared Disasters in Massachusetts

Tracking historic hazards and federally declared disasters that occur in Massachusetts, and more specifically Middlesex County, helps planners understand the possible extent and frequency of hazards. Historically, Massachusetts has experienced multiple types of hazards, including flooding, blizzards, and hurricanes. Since 1991, there have been twenty-two storms in Massachusetts that resulted in federal or state disaster declarations. Sixteen disaster declarations occurred in Middlesex County. Federally declared disasters open additional FEMA grant opportunities for regional recovery and mitigation projects. The hazard profiles detailed below contain additional information about federally declared disasters.

4.1.3 Impacts of Climate Change



Many of the hazards that Stoneham is currently experiencing are projected to worsen due to climate change. Climate change is caused by the warming of the Earth's atmosphere. The Earth's atmosphere has naturally occurring greenhouse gases (GHG), like carbon dioxide (CO2), that work like a blanket and capture heat, which helps maintain the Earth's annual average temperature. When additional greenhouse gases are released through burning fossil fuels (oil, coal, and gas), that blanket gets thicker and the Earth's temperature increases. The global temperature increase impacts jet streams and climate patterns.

Massachusetts' future climate is expected to reflect historic climate patterns of states south of New England, depending upon various GHG emission scenarios. Climate change is likely to transform Massachusetts's typical precipitation cycle, leading to more intense rainfall and storms, and more severe episodic or flash droughts. Temperatures will increase during both the summer and the winter. Each hazard profile detailed below includes more information on how the frequency and intensity of the hazard are expected to shift with climate change and associated impacts.

4.1.4 Top Hazards as Defined in the CRB Workshop

At the CRB workshop, attendees determined the four top hazards/climate change impacts for use. These hazards include:

1. Increased precipitation and flooding
2. Increased temperatures
3. Wind
4. Drought

The CRB Workshop included two online group discussions about Town features, environmental hazards, and anticipated climate change impacts. Workshop participants discussed issues related to air quality and the town's desire to increase the town's overall landscaping and tree cover as ways to combat air quality and climate change issues at the local level. There was considerable discussion around the fact that it is both a strength and a weakness that approximately one-third of the town is state-owned land. Although this presents ample open space opportunities and provides some measure of growth management, the town has little to no say with regards to that property.

The impending effects of increased precipitation were discussed at length by the group. This increase in precipitation is expected to come in the form of both rain and snow events. Workshop participants discussed issues related to stormwater management that will be impacted by an increase in precipitation. Attendees discussed the need for a town-wide assessment of stormwater infrastructure and the town's river and stream system to determine where upgrades and improvements could be made that would achieve the greatest and most economical benefits.

Workshop attendees also discussed the impact of increased temperatures. The discussion identified that the expected increase in temperatures will impact a wide variety of aspects in Stoneham. The group discussed impacts related to building infrastructure, tree damage, and stormwater infrastructure, ending with a discussion of how the town could combat these impacts in innovative ways. It was identified that opportunities for renewable energy production, green infrastructure upgrades, regulatory incentives, and landscaping improvements were meaningful ways the town could address the potential impacts of increased temperatures.

Wind is a hazard that the workshop attendees identified as high impact. The group discussed infrastructure weaknesses that are threatened by high wind events. The discussion focused heavily on how high wind events will have an impact on the town's environmental features as well, identifying that tree damage and the associated wind-related debris are closely linked to stormwater management issues.

The sections below include more information about environmental hazards, climate change projections, and historic and anticipated impacts in Stoneham.

4.2 Flood-Related Hazards

Flooding was one of the four main hazards discussed by participants during Stoneham's MVP workshop. Flooding can be caused by various weather events including hurricanes, extreme precipitation, thunderstorms, nor'easters, and winter storms. While Stoneham currently experiences these events, the impacts of climate change will likely lead to increasingly severe storms and impacts. Potential impacts of flooding could include injury or mortality, property damage, and traffic disruption. Areas within the FEMA Flood Zones, repetitive flood loss sites, and local areas identified as flood-prone are more vulnerable to these impacts.

The following sub-sections provide more information on historic flood events, locally identified flood areas, potential flood hazards, a vulnerability assessment, and information related to dam failure risk. The analysis of flood hazard areas was informed by the FEMA National Flood Insurance Program (NFIP) Flood Insurance Rate Map (FIRM), a GIS vulnerability analysis, information from Stoneham town staff, input collected during expert interviews with local leaders, and accounts of past flood events provided by Stoneham MVP Workshop participants.

Waterbodies, topographical variations, and the prevalence of impervious surfaces throughout Stoneham all contribute to the runoff and flooding that occurs throughout Stoneham. Additional riverine and stormwater flooding in Stoneham is due to undersized culverts and insufficient stormwater detention and drainage. The Town is continuously maintaining and upgrading culverts so that they can better accommodate the stormwater volume they are receiving.

Flood hazards are also linked to erosion, which can compromise receiving water quality, slope stability, and the stability of building foundations. These impacts put current and future structures and populations located near steep embankments at risk. Erosion can also undercut streambeds and scour around stream crossings, creating a serious risk to roadways.

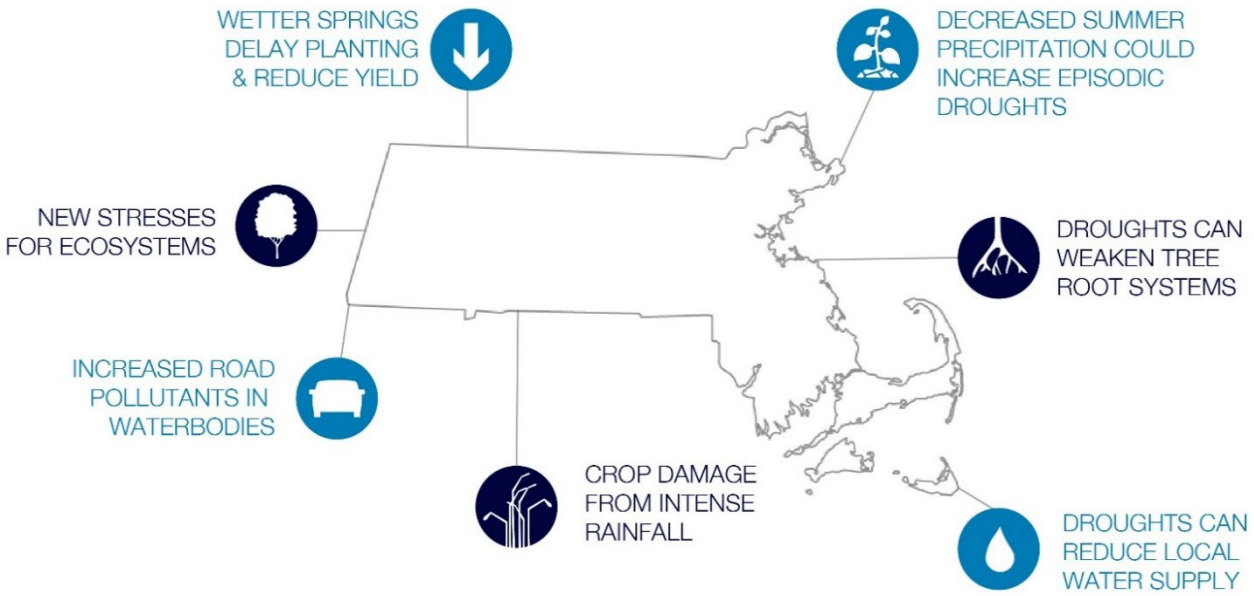


Figure 4-1: Potential Impacts of Fluctuating Precipitation

4.2.1 Areas Vulnerable to Flooding

Flooding can include both riverine (topping the banks of streams, rivers, ponds) and stormwater flooding water rainwater that does not properly infiltrate into the ground.

Riverine Flooding

Stoneham is home to a series of streams, ponds, and other waterbodies that include:

- Major streams: Sweetwater Brook, North Stream, Spot Pond Brook
- Ponds: Spot Pond, Doleful Pond, Dike's Pond, Buckman Pond, Dark Hollow Pond
- Reservoirs: Fells Reservoir, and portions of North and Middle Reservoirs

FEMA Flood Zones and Repetitive Loss Sites

FEMA-designated flood zones from the NFIP FIRM are included in the Appendix B map series. Areas within these zones are more vulnerable to flood events. The definitions of these flood zones are provided below. A FEMA Flood Zone X runs under Montvale Avenue on the west side of the town between the town line on the west and Lindenwood Road on the east, along with an AE regulatory floodway.[32] In addition, a Flood Zone A can be found in the southwestern quadrant of Stoneham (on the border with Winchester) in the Middlesex Fells.

[32] Federal Emergency Management Agency (FEMA), "Flood Insurance Rate Map: Stoneham, Middlesex County, Massachusetts."

Flood Insurance Rate Map Zone Definitions[33]

Zone A (1% annual chance): Zone A is the flood insurance rate zone corresponding to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Detailed hydraulic analyses are not performed for such areas, therefore, no BFEs (Base Flood Elevations) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone AE and A1-A30 (1% annual chance): Zones AE and A1-A30 are the flood insurance rate zones that correspond to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

Zone X (0.2% annual chance): Zone X is the flood insurance rate zone that corresponds to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone.

As defined by FEMA and the NFIP, a repetitive loss property is any insured property for which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978.[34] There are no repetitive flood loss buildings in Stoneham. Please refer to Section 5.3: Existing Townwide Mitigation for Flood Related Hazards, for more information about the NFIP. It is important to remember that repetitive loss data does not fully represent the damage that Stoneham sustains from flooding. Repetitive loss data only includes buildings that receive the FEMA designation, which does not include all buildings that have incurred flood damage.

Flooding events in Stoneham have been classified as high-frequency events. As defined by the Massachusetts State Hazard Mitigation and Climate Adaptation Plan this hazard occurs once every three years (33% chance per year).[35]

Stormwater Flooding

Stormwater flooding occurs during a precipitation event where the rate of rainfall is greater than the stormwater management system can handle. This may be due to an undersized culvert, poor drainage, topography, high amounts of impervious surfaces, or debris that causes the stormwater system to function below its design standard. In these cases, the stormwater management system becomes overwhelmed, causing water to inundate roadways and properties. Stormwater flooding can occur anywhere in Town and is not limited to areas surrounding water bodies.

[33] Federal Emergency Management Agency (FEMA), "Flood Zones."
[34] Federal Emergency Management Agency (FEMA), "Definitions: Repetitive Loss Structure."
[35] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."

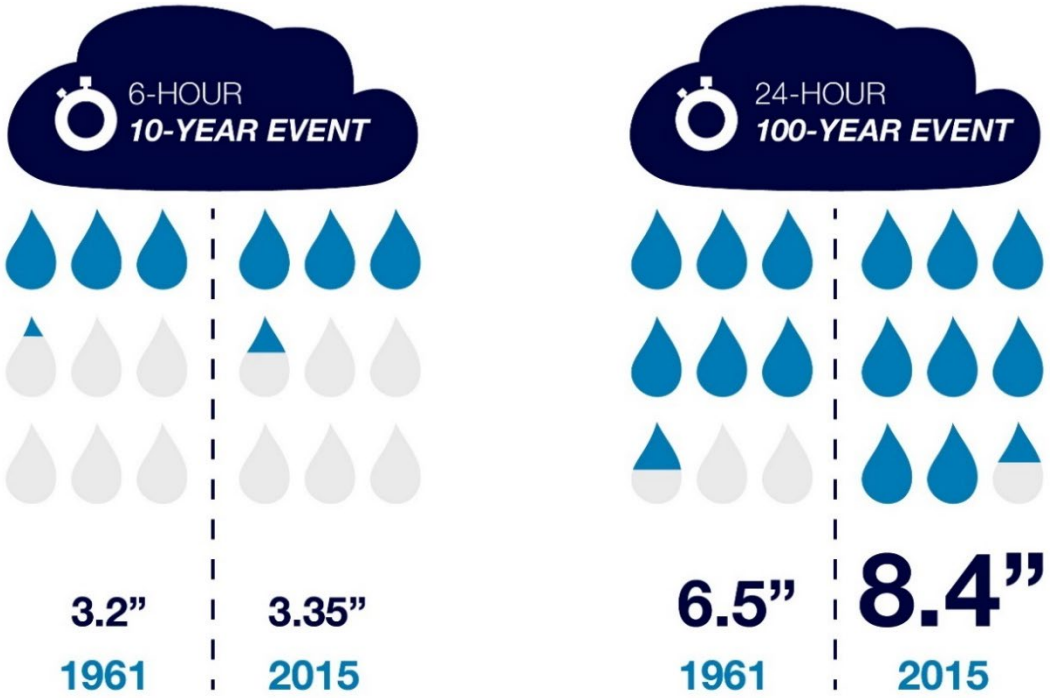


Figure 4-2: Design Storm Standards from 1961 (TP-40) and 2015 (NOAA Atlas 14)

Locally Identified Areas of Flooding

Town staff, local experts, and CRB Workshop participants helped identify local areas of flooding, which are summarized in Table 4-2. These areas may or may not overlap with FEMA-designated flood zones. However, these areas have been noted to flood during significant rain events. Identifying these areas is an important part of hazard mitigation planning. An awareness of vulnerable areas, particularly critical emergency routes, can help in prioritizing and implementing climate adaptation projects.

Table 4-2: Locally Identified Areas of Flooding

Name	Description
Montvale Avenue	Floodplain between Montvale Avenue and Maple (Sweet Brook)
Dike’s Pond	Overflows toward Marble Street, drains into wetlands (conservation land)
Franklin Street area	From Weiss Farm to Sunset Road
Main Street (DOT easement)	Drainage at Carroll Street to wetlands/woods

Middlesex Flooding Events

NOAA's National Centers for Environmental Information Storm Events Database provides information on previous flood events for Middlesex County, including details of municipalities that were impacted by extreme events. Stoneham is included in the Middlesex County data. The storms are categorized by event type, including flood and flash flood events.[36] Flash Flood events are considered by the NOAA's National Centers for Environmental Information Storm Events Database as "A life-threatening, rapid rise of water into a normally dry area beginning within minutes to multiple hours of the causative event (e.g., intense rainfall, dam failure, ice jam)." Floods are considered, "Any high flow, overflow, or inundation by water which causes damage. In general, this would mean the inundation of a normally dry area caused by an increased water level in an established watercourse, or ponding of water, that poses a threat to life or property."[37]

Middlesex County had 129 flood events and 30 flash flood events between 2000 and 2019. No deaths or injuries were reported. The property damage totaled $53.439 million (not adjusted for inflation). Incredibly, flooding during March 2010 caused more than 80% of the total property damage reported during this time (over $35 million). Property damages ranged from $1,000 to $26 million. Two events listed in the database were documented as county-wide impacts in May of 2006 with $5 million in damages.[38] Although not all of the flooding documented in the database directly affected Stoneham, the monetary impact of flooding is a proxy for the potential damage that could occur. Damages that occur regionally can also have an indirect impact on Stoneham, due to regionally dependent utilities, the supply of goods, transportation networks, and economic impacts, among other considerations.

Of the 159 total flood events that occurred in Middlesex County between 2000 and 2019, four directly affected Stoneham. The date and details are listed below:

Table 4-3. Flooding Events in Stoneham[39]

Date of Flooding Event	Description
June 24, 2008	In Stoneham, heavy rain resulted in flooding on Maple Street where two cars were submerged trapping their drivers.
March 29, 2010	Four to seven inches of rain fell across Middlesex County resulting in each of the seven gaged mainstem rivers o rise above flood stage. Numerous streets were closed and basements in Stoneham were flooded.
April 16, 2018	A low-pressure front moved along the New England coast bringing rain and some heavy downpours. Inland areas had a mixture of snow, freezing

[36] National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA), "Storm Events Database: Middlesex County."
[37] Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), and National Weather Service, "Storm Data Preparation."
[38] National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA), "Storm Events Database: Middlesex County."
[39] National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA).

	rain, and rain. An amateur radio operator reported that Elm Street at Central Street in Stoneham was flooded and impassible.
August 12, 2018	A cold front stalled over Southern New England drawing upon warm and very humid air to create showers with local downpours resulting in rainfall amounts of two to five inches in Northern Massachusetts. Woodland Road in Stoneham was flooded and impassible. A car was trapped in floodwaters on Oak Street.

Federal Declared Flood Disasters in Middlesex County

A disaster declaration is a statement made by a community when the needs required by a disaster or emergency are beyond the capabilities of that community. Eight disaster declarations were made in Middlesex County due to flooding between 2000 and 2015, as can be seen in Table 4-4 below.

Table 4-4. Previous Federal and State Disaster Declarations - Flooding[40]

Disaster Name and Date of Event	Disaster Number	Type of Assistance	Counties Under Declaration
Severe Storms & Flooding March 5-April 16, 2001	DR-1364	FEMA Hazard Mitigation Grant Program	Counties of Bristol, Essex, **Middlesex,** Norfolk, Suffolk, Plymouth, Worcester
Flooding April 1-30, 2004	DR-1512	FEMA Individual & Households Program; FEMA Hazard Mitigation Grant Program	Essex, **Middlesex,** Norfolk, Suffolk, Worcester
Severe Storms and Flooding October 7-16, 2005	DR-1614	FEMA Public Assistance; FEMA Individual & Households Program; FEMA Hazard Mitigation Grant Program	**All** 14 Massachusetts Counties
Severe Storms and Flooding May 12-23, 2006	DR-1642	FEMA Public Assistance; FEMA Individual & Households Program; FEMA Hazard Mitigation Grant Program	**Middlesex,** Essex, Suffolk
Severe Winter Storm and Flooding	DR-1813	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	**All** 14 Massachusetts Counties

[40] Federal Emergency Management Agency (FEMA), "Public Assistance Disaster Declarations"; Federal Emergency Management Agency (FEMA), "Disasters: Total Number of Declared Disasters"; Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."

Table 4-4. Previous Federal and State Disaster Declarations - Flooding[40]

Disaster Name and Date of Event	Disaster Number	Type of Assistance	Counties Under Declaration
December 11-18, 2008			
Severe Storm and Flooding March 12-April 26, 2010	DR-1895	FEMA Public Assistance; FEMA Individual & Households Program; FEMA Hazard Mitigation Grant Program	Bristol, Essex, **Middlesex,** Suffolk, Norfolk, Plymouth, Worcester
Severe Winter Storm, Snowstorm, and Flooding February 8-9, 2013	DR-4110	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	**All** 14 Massachusetts Counties
Severe Winter Storm, Snowstorm, and Flooding January 26-28, 2015	DR-4214	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	Barnstable, Bristol, Dukes, Essex, **Middlesex,** Nantucket, Norfolk, Plymouth, Suffolk, Worcester

4.2.2 GIS Flooding Exposure Analysis

Hazard location and extent of riverine flooding were determined using the currently effective FEMA Flood Insurance Rate Map (FIRM) data for Stoneham, which is dated 2016. The FIRM is the official map on which FEMA has delineated both the special flood hazard areas and the risk premium zones applicable to the community under the National Flood Insurance Program (NFIP). This includes high-risk areas that have a 1% annual chance of being flooded (often referred to as the "100-year floodplain"), which under the NFIP, is linked to mandatory purchase requirements for federally backed mortgage loans. It also identifies moderate to low-risk areas, defined as the area with a 0.2% annual chance of flooding (often referred to as the "500-year floodplain"). For purposes of this exposure analysis, the following special flood hazard areas identified in the Town of Stoneham's current FIRMs included:

- Flood Zone AE – Regulatory Floodway
- Flood Zone A (AE, AH) – 1% Annual Chance Flood Hazard
- Flood Zone X (shaded) – 0.2% Annual Chance Flood Hazard

A flood exposure analysis was conducted for critical facilities and vulnerable populations throughout the municipality using MassGIS data, FEMA flood maps, and information gathered from the municipality. No critical facilities in Stoneham are located within the 100-year flood zone or 500-year flood zone; however, two underground storage tanks (USTs) are evident in the floodplain along Sweetwater Brook on the west side of Stoneham. The block group that surrounds the Sweetwater Brook Flood Hazard Area includes the Lindenwood Cemetery, residential housing on the eastern side, and commercial, warehouse/industrial uses along Maple Street and Montvale Avenue. Residential apartments exist in the area. Sweetwater Brook continues into Woburn, which identified stormwater management in this area as a medium priority in Woburn's MVP Summary of Findings. Stoneham's Environmental Justice

community is located in the southwest quadrant of the town around Spot Pond. This area is outside of the 100 and 500-year flood plain.

Development patterns have not changed substantially since the 2010 Hazard Mitigation Plan, which stated that the Town is largely built out, with little land for new development.[41] According to Town officials and data supplied by MassBuilds, however, Stoneham continues to redevelop existing structures and infill where feasible, with large multi-family developments representing a greater proportion of new development overall (as described in Table 3-5). As new development and redevelopment occurs it will be subject to the latest building code requirements and zoning regulations peratining to wind, earthquakes, and flooding. The Town regulates development in flood-prone areas through its zoning and wetlands and resource protection bylaws, so even without proactive actions to mitigate development in floodprone areas, the vulnerability to flood is only slightly increased. It is recommended that the Town analyze parcels undergoing development (including infill development and redevelopment) to ensure that development does not occur in flood-prone areas.

Dams and Dam Failure

Dam failure is defined as a collapse of an impounding structure resulting in an uncontrolled release of impounded water from a dam.[42] Dam failures during flood events are of concern in Massachusetts, given the high density of dams constructed in the 19th century.[43]

Dams can fail due to overtopping caused by floods that exceed the capacity of the dam, deliberate acts of sabotage, structural failure of materials used in dam construction, movement and/or failure of the foundation supporting the dam, settlement, and cracking of concrete or embankment dams, piping and internal erosion of soil in embankment dams, and inadequate maintenance and upkeep. Many dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage.[44] Climate change may indirectly affect dam breaches for a variety of reasons. Dams are typically designed based on historic water flows and known hydrology. Climate change projections indicate that the frequency, intensity, and amount of precipitation will increase in New England. Increased precipitation may push dams over capacity. Therefore, dams will have to be monitored for safety. There are several mechanisms in place to manage water increases, such as slowly releasing water. It is advised that these events are monitored as they can add additional stress on the dam infrastructure.

Although dam failure does not occur frequently in Stoneham, it can cause property damage, injuries, and potentially fatalities. These impacts can be at least partially mitigated through a warning system to communities impacted by a dam failure. In addition, the breach may result in erosion of the rivers and stream banks that are inundated.

[41] Stoneham Hazard Mitigation Plan, 2010, p. 22.
[42] Department of Conservation and Recreation (DCR), "302 CMR 10.00: Dam Safety."
[43] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[44] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR).

In Stoneham, dam failure is classified as a low-frequency event, which is defined by the 2018 State Hazard Mitigation and Climate Adaptation Plan as occurring less frequently than once every 100 years (less than a 1% chance per year). Although there have been no recorded dam failures in Stoneham, a dam failure can still present a high level of risk and could result in a catastrophic event with extreme damage to property and loss of life.

According to town officials and the Massachusetts Department of Conservation and Recreation's (DCR) Office of Dam Safety, there are eight dams and six dikes in Stoneham Information related to these dams is summarized in Table 4-12. This summary table includes the hazard classification for each dam, which is defined by DCR as described below:

> *High:* Dams located where failure or mis-operation will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s), or railroad(s).
>
> *Significant:* Dams located where failure or mis-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s), or cause interruption of use or service or relatively important facilities.
>
> *Low:* Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

Table 4-4. Inventory of Dams in Stoneham

Dam Name	Impoundment	Dam Owner	Hazard Potential Classification
Spot Pond Dam	Spot Pond	Massachusetts Department of Conservation and Recreation	Significant Hazard
Spot Pond Dike #2	Spot Pond	Massachusetts Department of Conservation and Recreation	N/A
Spot Pond Dike #3	Spot Pond	Massachusetts Department of Conservation and Recreation	N/A
Spot Pond Dike #4	Spot Pond	Massachusetts Department of Conservation and Recreation	Significant Hazard
Spot Pond Dike #5	Spot Pond	Massachusetts Department of Conservation and Recreation	Significant Hazard

Table 4-4. Inventory of Dams in Stoneham

Dam Name	Impoundment	Dam Owner	Hazard Potential Classification
Spot Pond Dike #10	Spot Pond	Massachusetts Department of Conservation and Recreation	N/A
Spot Pond Dike #12	Spot Pond	Massachusetts Department of Conservation and Recreation	N/A
Fells Reservoir Dam #1	Fells Reservoir	Massachusetts Department of Conservation and Recreation	N/A
Fells Pond Reservoir Dam #2	Fells Reservoir	Massachusetts Department of Conservation and Recreation	Significant Hazard
Fells Pond Reservoir Dam #3	Fells Reservoir	Massachusetts Department of Conservation and Recreation	High Hazard
Fells Pond Reservoir Dam #4	Fells Reservoir	Massachusetts Department of Conservation and Recreation	Significant Hazard
Fells Pond Reservoir Dam #6	Fells Reservoir	Massachusetts Department of Conservation and Recreation	Significant Hazard
Fells Pond Reservoir Dam #7	Fells Reservoir	Massachusetts Department of Conservation and Recreation	N/A
Fells Pond Reservoir Dam #8	Fells Reservoir	Massachusetts Department of Conservation and Recreation	High Hazard

As of February 2017, all dams classified as high hazard potential or significant hazard potential were required to have an Emergency Action Plan (EAP).[45] This plan must be updated annually and submitted to the Commissioner and the Massachusetts Emergency Management Agency. The plan should also be retained by the dam owned and the Town in which the dam is located. Guidelines and a template were established by the Office of Dam Safety to ensure that all EAPs follow the proper format.

4.2.3 Climate Change Impacts: Flooding

Middlesex County's observed annual precipitation in 2005 was 56.17 inches.[46] Extreme rain and snow events are becoming increasingly common and severe particularly in the Northeast region of the country (please refer to Figure 4-4). Large rain or snow events that happened once a year in the middle of the 20th century now occur approximately every nine months. Additionally, the largest annual events now generate 10% more rain than in 1948. Regionally, New England has experienced the greatest increase in the frequency of extreme rain and snow events. These events now occur 85% more frequently than they did 60 years ago.

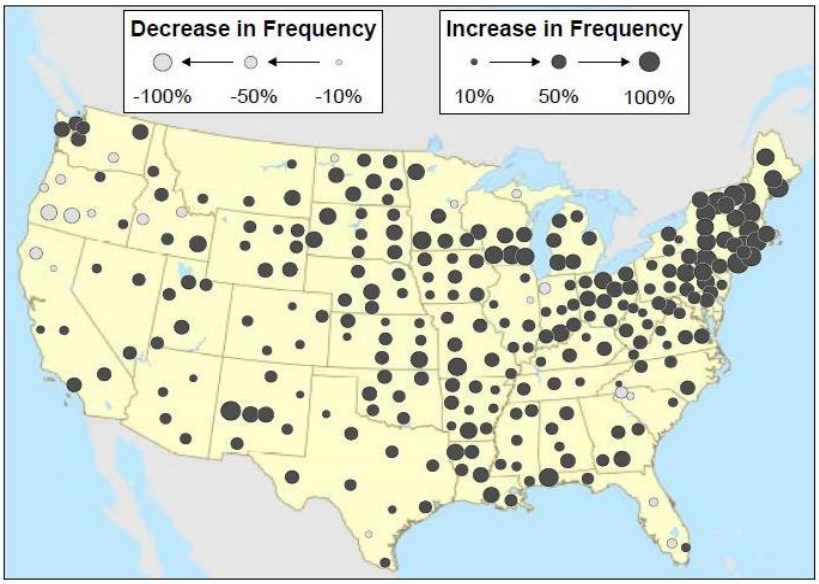


Figure 4-3. Changes in Frequency of Extreme Downpours[47]

4.3 Wind Related Hazard

High winds can occur during hurricanes, tornadoes, nor'easters, and thunderstorms. The entire area of Stoneham is vulnerable to the impacts of high wind. All current and future buildings including critical facilities and populations are vulnerable during high wind events. Wind may down trees and power lines. High wind and storm events cause property damage and hazardous driving conditions. While

[45] Massachusetts Department of Conservation and Recreation (DCR), "Emergency Action Plans."
[46] Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Annual Total Precipitation: Middlesex County, MA."
[47] Madsen and Willcox.

Stoneham's current 100-year wind speed is 98 mph[48], climate change will likely increase events and severity.

Extreme winds can take down trees and branches that cause service disruptions. An identified issue during storms in Stoneham is the damage to power lines from overhanging trees. Similarly, the Fire Department discussed the challenges that can occur when downed trees block roads and prevent or delay access to certain areas. Currently, the Stoneham Department of Public Works (DPW) has an ongoing, town-wide Tree Care Program, which maintains trees in the public right-of-way and on public grounds. Additionally, Eversource conducts a Vegetation Management Program and monitors tree limbs near power lines with routine trimming every four-five years.

4.3.1 Hurricanes and Tropical Storms

Tropical cyclones (including tropical depressions, tropical storms, and hurricanes) form over the warm waters of the Atlantic, Caribbean, and Gulf of Mexico. A tropical storm is defined as having sustained winds from 39 to 73 mph. If sustained winds exceed 73 mph, it is categorized as a hurricane. The Saffir-Simpson scale ranks hurricanes based on sustained wind speeds from Category 1 (74 to 95 mph) to Category 5 (156 mph or more). Category 3, 4, and 5 hurricanes are considered "Major" hurricanes. Wind gusts associated with hurricanes may exceed the sustained winds and cause more severe localized damage.

Hurricanes and tropical storms have a large spatial extent and are known to impact the entire town when one passes through this area. All existing and future buildings including critical facilities and populations may be at risk from hurricanes and tropical storm hazards. Impacts may include water damage in buildings from building envelope failure, business interruption, loss of communications, and power failure. Flooding is a major concern as slow-moving hurricanes can discharge tremendous amounts of rain on an area.

The official hurricane season runs from June 1 to November 30. However, storms are most likely to occur in New England during August, September, and October.[49] The region has been impacted by hurricanes throughout its history, the earliest recorded in 1635. Between 2000 and 2020, Massachusetts experienced six hurricanes and tropical storms, including Hurricanes Earl, Sandy, Jose, Florence, and Dorian, and Tropical Storm Irene. Sandy, Irene, and Earl led to federal emergency and disaster declarations. Hurricanes that have occurred in the region since 1938 are listed in Table 4-5 below.

Table 4-5. Hurricane Records for Eastern Massachusetts, 1938 to 2019[50]

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

[48] American Society of Civil Engineers (ASCE), "ASCE 7 Hazard Tool: Stoneham, Massachusetts."
[49] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR).
[50] National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA), "Storm Events Database: Middlesex County."

Hurricane Event	Date
Hurricane Diane	August 17-19, 1955
Hurricane Donna	September 12, 1960
Hurricane Gloria	September 27, 1985
Hurricane Bob	August 19, 1991
Hurricane Earl	September 4, 2010
Tropical Storm Irene	August 28, 2011
Hurricane Sandy	October 29-30, 2012
Hurricane Jose	September 20, 2017
Hurricane Florence	September 18, 2018
Hurricane Dorian	September 7, 2019

Note: Category 3*

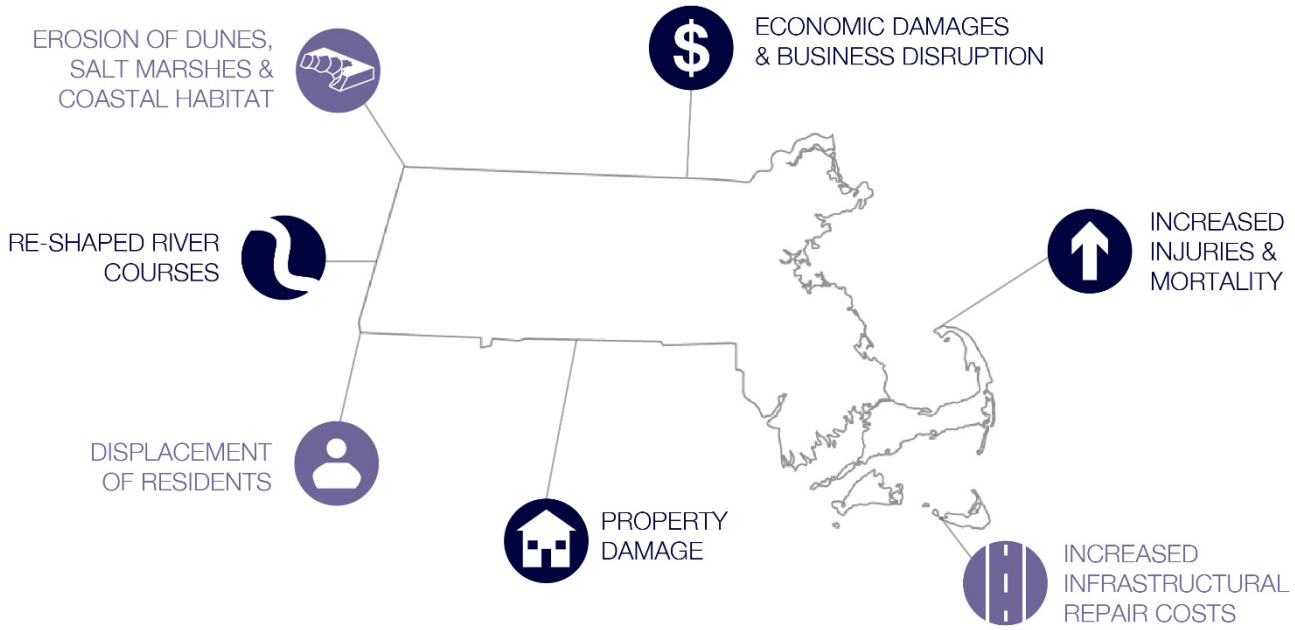


Figure 4-4: Potential Impacts of Extreme Storms, including High Wind Events

The Saffir/Simpson scale categorizes or rates hurricanes from 1 (minimal) to 5 (catastrophic) based on their intensity. This is used to provide an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on context.[51] More information is included in Table 4-14 below:

[51] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."

Table 4-6. Saffir/Simpson Scale[52]

Scale No. (Category)	Winds (mph)	Potential Damage
1	74 – 95	Minimal: damage is primarily to shrubbery and trees, mobile homes, and some signs. No real damage is done to structures.
2	96 – 110	Moderate: some trees topple, some roof coverings are damaged, and major damage is done to mobile homes.
3	111 – 130	Extensive: large trees topple, some structural damage is done to roofs, mobile homes are destroyed, and structural damage is done to small homes and utility buildings.
4	131 – 155	Extreme: extensive damage is done to roofs, windows, and doors; roof systems on small buildings completely fail; and some curtain walls fail.
5	*> 155*	*Catastrophic: roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, and entire buildings could fail.*

Note: Table adapted from NOAA

Hurricane damage in Stoneham was estimated using hurricane modeling software. Hazus Multi-Hazard (Hazus) is a GIS model developed by FEMA to estimate losses in a defined area due to a specified natural hazard. The Hazus hurricane model allows users to input specific parameters to model a defined hurricane magnitude, which is based on wind speed. The largest hurricane ever witnessed in Massachusetts was a Category 3 hurricane, which occurred in 1954. For this analysis, to estimate potential damage, both a category 2 and a category 4 hurricane were modeled. Although there have been no recorded Category 4 hurricanes recorded in Massachusetts, a storm was modeled to show the impact that could occur from an extreme scenario, something that could happen in the future due to climate change.

In Massachusetts, the return period for a category 2 hurricane is approximately 0.01 percent, and for a category 4 hurricane, it is approximately 0.005 percent. HAZUS models hurricanes based upon their return period. Therefore, a category 2 was modeled as a 100-year hurricane and a category 4 was modeled as a 500-year hurricane. To model each of these hurricanes, the study region must first be defined. The Town of Stoneham was outlined by the census tracts in the Town. The probabilistic scenario was used for Stoneham. This scenario considers the associated impact of thousands of storms that have a multitude of tracks and intensities. The output shows the potential impact that could occur in Stoneham if either a category 2 or a category 4 hurricane passed through. HAZUS is based on 2010 census data and 2014 dollars. The tables below show the estimated damage from both a category 2 and a category 4 hurricane in the municipality.

[52] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR).

Table 4-7. Infrastructural Damage from a Category 2 Hurricane on Buildings in Stoneham

Land Use Type	Total Number of Buildings	Total Number of Buildings Damaged[1]	Percent of Buildings Damaged[1]	Total Value of Building Damage[2]
Residential	6,440	206	3.2%	$15,029,490
Commercial	490	11	2.2%	$420,530
Industrial	120	3	2.5%	$29,310
Others	64	2	3.1%	$42,080
TOTAL	**7,114**	**222**	**3.1%**	**$15,521,400**

[1]Includes Slight, Moderate, Extensive, and Complete Damage
[2]Includes Building, Content, and Inventory

Table 4-8. Infrastructural Damage from a Category 4 Hurricane on Buildings in Stoneham

Land Use Type	Total Number of Buildings	Total Number of Buildings Damaged[1]	Percent of Buildings Damaged[1]	Total Value of Building Damage[2]
Residential	6,440	1,250	19.4%	$57,629,000
Commercial	490	77	15.7%	$3,701,500
Industrial	120	17	14.2%	$429,790
Others	64	5	7.8%	$436,260
TOTAL	**7,114**	1,349	**19.0%**	**$62,196,960**

[1]Includes Slight, Moderate, Extensive, and Complete Damage
[2]Includes Building, Content, and Inventory

In addition to the infrastructural damage, Hazus also calculated the potential societal impact of a Category 2 and Category 4 hurricane on the community. This calculation included business interruption loss; monetary wage, capital-related, rental and relocation costs; as well as displaced households and persons seeking temporary shelter. Additional property damage and business interruption loss were calculated as well, and a full Hazus risk report for each hurricane category can be found in Appendix B.

Hurricanes are a town-wide hazard in Stoneham and are considered a high-frequency event. As defined by the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, this hazard will occur on average once every other year.

4.3.2 Tornadoes

A tornado is a narrow, violently rotating column of air that extends from the base of a cloud to the ground. Tornadoes are the most violent of all atmospheric storms.[53] Effects of a tornado include very strong winds in the middle and upper levels of the atmosphere which turn clockwise. Tornadoes can be spawned by tropical cyclones or the remnants thereof, and weak tornadoes can even form from little more than a rain shower if the air is converging and spinning upward. The most common months for tornadoes to occur are June, July, and August. There are exceptions: The Great Barrington, Massachusetts tornado in 1995 occurred in May and the Windsor Locks, Connecticut tornado in 1979 occurred in October.[54]

The Fujita Tornado Scale measures tornado severity through estimated wind speed and damage. The National Weather Service began using the Enhanced Fujita-scale (EF-scale) in 2007, which led to increasingly accurate estimates of tornado severity. Table 4-17 provides more detailed information on the EF Scale.

Table 4-9. Enhanced Fujita Scale[55]

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

Massachusetts experiences an average of 1.7 tornadoes per year. The most tornado-prone areas of the state are the central counties. Tornadoes are comparatively rare in eastern Massachusetts, although Middlesex County is considered an at-risk location.[56] The most devastating tornado in Massachusetts in the history of recorded weather occurred in Worcester in 1953, killing 94 people, injuring more than 1,000, and causing more than $52 million in damages (more than $460 million in current dollars). The most recent tornadoes in Massachusetts occurred in 2011 in Springfield, 2014 in Revere, and 2016 in

[53] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."
[54] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA).
[55] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[56] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."

Concord.[57] There have been 18 recorded tornados in Middlesex County since 1955. One fatality and six injuries were reported.[58] Table 4-18 below provides additional information.

Table 4-10. Tornado Records for Middlesex County, 1955 to 2020[59]

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
10/24/1955	1	0	0	10	0.1	$500-$5000
6/19/1957	1	0	0	17	1	$5K-$50K
6/19/1957	1	0	0	100	0.5	$50-$500
7/11/1958	2	0	0	17	1.5	$50K-$500K
8/25/1958	2	0	0	50	1	$500-$5000
7/3/1961	0	0	0	10	0.5	$5K-$50K
7/18/1963	1	0	0	50	1	$5K-$50K
8/28/1965	2	0	0	10	2	$50K-$500K
7/11/1970	1	0	0	50	0.1	$5K-$50K
10/3/1970	3	1	0	60	35.4	$50K-$500K
7/1/1971	1	0	1	10	25.2	$5K-$50K
11/7/1971	1	0	0	10	0.1	$50-$500
7/21/1972	2	0	4	37	7.6	$500K-$5M
9/29/1974	3	0	1	33	0.1	$50K-$500K
7/18/1983	0	0	0	20	0.4	$50-$500K
9/27/1985	1	0	0	40	0.1	$50-$500K
8/7/1986	1	0	0	73	4	$50K-$500K
8/22/2016	1	0	0	400	.85	$10K

If a tornado were to occur in Stoneham, damages would depend on the track of the tornado and would be most likely be high due to the prevalence of older construction and the density of development. Structures built before current building codes may be more vulnerable. Evacuation, sheltering, debris

[57] Morrison, "Tornadoes of Massachusetts Past"; Epstein, "This Morning's Tornado in Concord, Explained."
[58] Lietz, "Tornado History Project: Middlesex County, Massachusetts."
[59] National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA), "Storm Events Database: Middlesex County."

clearance, distribution of food and other supplies, search and rescue, and emergency fire and medical services may be required. Critical evacuation and transportation routes may be impassable due to downed trees and debris, and recovery efforts may be complicated by power outages.

Tornado events in Stoneham are low-frequency events. As defined by the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, Massachusetts experiences an average of 1.7 tornados per year. Tornados are difficult to simulate well in climate models because of their small size. However, it is predicted that an increase in frequency and intensity of severe thunderstorms may increase the risk of tornadoes.

4.3.3 Nor'easters

A nor'easter is characterized by large counterclockwise wind circulation around a low-pressure center that often results in heavy snow, high winds, waves, and rain along the east coast of North America. The term nor'easter refers to their strong northeasterly winds blowing in from the ocean. These winter weather events are among the season's most ferocious storms, often causing beach erosion, flooding, and structural damage.[60]

Nor'easters generally occur on at least an annual basis, typically in late fall and early winter. Some years bringing up to four nor'easter events. This is currently the most frequently occurring natural hazard in the state. The storm radius is often as much as 100 miles and sustained wind speeds of 20 to 40 mph are common, with short-term gusts of up to 50 to 60 mph. Nor'easters are commonly accompanied by a storm surge equal to or greater than two feet. High surges and winds during a hurricane can last from 6 to 12 hours, while these conditions during a nor'easter can last from 12 hours to three days. Previous nor'easters events are listed in Table 4-19. Notably, the severe Coastal Storm in 1991 led to a federal disaster declaration.

Some of the historic events described in Section 4.2: Flood-Related Hazards were preceded by Nor'easters, including the 1991 "Perfect Storm." More recently, the blizzard of 2013 left nearly 400,000 Massachusetts residents without power.[61] A series of winter storms in March 2018 also caused significant snowfall amounts (including Winter Storm Riley on March 2, Winter Storm Quinn on March 8, and Winter Storm Skylar on March 13). A FEMA Major Disaster Declaration was issued to provide recovery assistance to Massachusetts counties including Middlesex.[62]

Table 4-11. Nor'easter Events for Massachusetts, 1978 to 2020[63]

Nor'easter Event	Date
Blizzard of 1978	February 1978
Severe Coastal Storm ("Perfect Storm")	October 1991
Great Nor'easter of 1992	December 1992

[60] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."
[61] Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "MA Climate Change Clearinghouse."
[62] Federal Emergency Management Agency (FEMA), "FEMA-DR-4379-MA-March 13-14, 2018 Severe Winter Storm."
[63] National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA), "Storm Events Database: Middlesex County."

Nor'easter Event	Date
Blizzard, Nor'easter	January 2005
Coastal Storm, Nor'easter	October 2005
Severe Storms, Inland and Coastal Flooding	April 2007
Winter Storm and Nor'easter	January 2011
Severe Storm and Snowstorm	October 2011
Severe Winter Storm, Snowstorm, and Flooding	April 2013
Severe Winter Storm, Snowstorm, and Flooding	April 2015
Severe Winter Storm and Flooding	March 2018
Severe Winter Storm and Snowstorm	March 2018

The Town of Stoneham is vulnerable to high winds, snow, and extreme rain during Nor'easters. These impacts can lead to property damage, downed trees, power service disruptions, surcharged drainage systems, and localized flooding. These conditions can impact evacuation and transportation routes and complicate emergency response efforts. Due to its inland location, Stoneham is not subject to the coastal hazards often associated with nor'easters. Nor'easters in Stoneham are high-frequency events. As noted by the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, Nor'easters are currently the most frequently occurring natural hazards in the state.

4.3.4 Severe Thunderstorms

Thunderstorms in Massachusetts are usually accompanied by rainfall; however, during periods of drought, lightning from thunderstorm cells can result in fire ignition. Thunderstorms with little or no rainfall are rare in New England but have occurred.

Thunderstorms are typically less severe than other events discussed in this section. However, thunderstorms can cause local damage and are a town-wide risk in Stoneham. Thunderstorms can include lightning, strong winds, heavy rain, hail, and sometimes tornados. Thunderstorms typically last for about 30 minutes and can generate winds of up to 60 mph.

Table 4-12. Previous Federal and State Disaster Declarations - Thunderstorms[64]

Disaster Name and Date of Event	Disaster Number	Type of Assistance	Counties Under Declaration
Severe Storms/Flooding October 20-25, 1996	DR-1142	FEMA Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
Heavy Rain and Flooding June 13-July 6, 1998	DR-1224	FEMA Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester

[64] National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA), "Storm Events Database: Middlesex County."

Table 4-12. Previous Federal and State Disaster Declarations - Thunderstorms[64]

Disaster Name and Date of Event	Disaster Number	Type of Assistance	Counties Under Declaration
Severe Storms & Flooding March 5-April 16, 2001	DR-1364	FEMA Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Severe Storms and Flooding October 7-16, 2005	DR-1614	FEMA Public Assistance; FEMA Individual & Households Program; FEMA Hazard Mitigation Grant Program	All 14 Massachusetts Counties
Severe Storms and Flooding May 12-23, 2006	DR-1642	FEMA Public Assistance; FEMA Individual & Households Program; FEMA Hazard Mitigation Grant Program	Middlesex, Essex, Suffolk
Severe Storm and Flooding March 12-April 26, 2010	DR-1895	FEMA Public Assistance; FEMA Individual & Households Program; FEMA Hazard Mitigation Grant Program	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester

NOAA's National Centers for Environmental Information offers thunderstorm data for Middlesex County, which includes Stoneham. Between 2009 and 2019, 248 thunderstorm events caused $3,014,000 in property damages. Two injuries and no deaths were reported. Thunderstorms are considered high-frequency events in Stoneham. According to the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, Massachusetts experiences 20-30 thunderstorm days per year. Winds associated with thunderstorms can knock down trees resulting in power outages and blocked evacuation and transportation routes. Extreme rain during thunderstorms can cause inland flooding around water bodies or due to surcharged drainage systems.

4.3.5 Climate Change Impacts: High Winds

While Stoneham's current 100-year wind speed is 98 mph,[65] climate change will likely increase the number of extreme wind events and their severity. Additionally, rising sea temperature could lengthen the hurricane season and fuel stronger hurricane events. The National Climate Assessment Report notes that hurricane "intensity, frequency, and duration have all increased since the early 1980s." This source predicts the continuing intensity and associated rainfall with rising temperatures. This would result in greater losses due to increased flooding, associated building damages, and business interruption

[65] American Society of Civil Engineers (ASCE), "ASCE 7 Hazard Tool: Stoneham, Massachusetts."

impacts.[66] The anticipated increase in frequency and intensity of severe thunderstorms may also increase the risk of tornadoes.[67]

4.4 Winter Storms

Winter storm events are atmospheric and can impact the entire planning area. All current and future buildings and populations are considered to be at risk of winter storms, which have a variety of potential impacts. Heavy snow loads may cause roofs and trees to collapse leading to structural damage. Deaths and injury are also possible impacts. Additional impacts can include road closures, power outages, business interruption, business losses (i.e., due to road closures), hazardous driving conditions, frozen pipes, fires due to improper heating, and second-hand health impacts caused by shoveling (such as a heart attack). Public safety issues are also a concern, as streets and sidewalks can become difficult to pass. This issue may be especially difficult for vulnerable populations such as elderly people who may have trouble crossing at intersections due to large accumulations of snow. Impassable streets can also complicate emergency response efforts during an extreme event.

Winter storms are a potential town-wide hazard in Stoneham. These events can include wind, heavy snow, blizzards, and ice storms. Blizzards and ice storms in Massachusetts can range from an inconvenience to extreme events that cause significant impacts and require a large-scale, coordinated response. Examples of winter storms that warranted disaster declarations are summarized in Table 4-21 below.

Table 4-13. Previous Federal and State Disaster Declarations[68]

Disaster Name and Date of Event	Disaster Number	Type of Assistance	Counties Under Declaration
Blizzard January 7-13, 1996	DR-1090	No funding reported	All 14 Massachusetts Counties
Severe Winter Storm and Flooding December 11-18, 2008	DR-1813	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	All 14 Massachusetts Counties
Severe Winter Storm and Snowstorm January 11-12, 2011	DR-1959	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	Berkshire, Essex, Hampden, Hampshire, **Middlesex**, Norfolk, Suffolk

[66] Walsh and Wuebbles, "National Climate Assessment - Chapter 2: Our Changing Climate."
[67] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."
[68] Federal Emergency Management Agency (FEMA), "Disasters: Total Number of Declared Disasters."

Table 4-13. Previous Federal and State Disaster Declarations[68]

Disaster Name and Date of Event	Disaster Number	Type of Assistance	Counties Under Declaration
Severe Storm and Snowstorm October 29-30, 2011	DR-4051	FEMA Public Assistance; FEMA Public Assistance Snow Removal; FEMA Hazard Mitigation Grant Program	Berkshire, Franklin, Hampden, Hampshire, **Middlesex**, Worcester
Severe Winter Storm, Snowstorm, and Flooding February 8-9, 2013	DR-4110	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	All 14 Massachusetts Counties
Severe Winter Storm, Snowstorm, and Flooding January 26-28, 2015	DR-4214	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	Barnstable, Bristol, Dukes, Essex, **Middlesex**, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Severe Winter Storm and Snowstorm March 13-14, 2018	DR-4379	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	Essex, **Middlesex**, Norfolk, Suffolk, Worcester

4.4.1 Heavy Snow and Blizzards

A blizzard is a winter snowstorm with sustained wind or frequent wind gusts of 35 mph or more, accompanied by falling or blowing snow that reduces visibility to or below a quarter of a mile. These conditions must be the predominant condition over 3 hours. Extremely cold temperatures are often associated with blizzard conditions but are not a formal part of the criteria. However, the hazard created by the combination of snow, wind, and low visibility increases significantly with temperatures below 20°F. A severe blizzard is categorized as having temperatures near or below 10°F, winds exceeding 45 mph, and visibility reduced by snow to near zero.[69]

Winter storms include multiple risks, such as wind, ice, and heavy snow. The National Weather Service defines "heavy snow" as snowfall accumulating to 4" or more in 12 hours or less, or snowfall accumulating to 6" or more in 24 hours or less.[70] Please refer to Section 4.3.3: nor'easters for more information on another example of severe winter weather.

[69] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."
[70] National Oceanic and Atmospheric Administration (NOAA) and National Weather Service, "Glossary: Heavy Snow."

No widely used scale exists to classify snowstorms. The Northeast Snowfall Impact Scale (NESIS) developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service[71] characterizes and ranks high-impact northeast snowstorms. These storms have large areas of 10-inch snowfall accumulations and greater. NESIS has five categories, as shown in Table 4-22. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS indicates a storm's societal impacts. This scale was developed because of the impact northeast snowstorms can have on the rest of the country in terms of transportation and economics. NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. The aerial distribution of snowfall and population information are combined in an equation that calculates a NESIS score, which varies from 1 for smaller storms to over 10 for extreme storms. The raw score is converted into one of the five NESIS categories. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers. NOAA began using the NESIS in 2005 to determine the impact from snow events.[72]

Table 4-14. NESIS Categories[73]

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

The current winter snowfall record in eastern Massachusetts is 108.6 inches during the 2014-2015 season.[74] NOAA data demonstrates that the 30-year average snowfall for the City of Boston (based on data from 1981-2010) is 32.8 inches.[75] NOAA's National Centers for Environmental Information Storm Events Database provide information for blizzards, winter weather, heavy snow, and winter storms. There were 250 winter events between 2000 and 2019 in Middlesex County totaling $2,059,000 of damage. The greatest damage was during this time frame was a storm in 2011 causing $926,000 of damage.

The Town provides standard snow plowing, sanding, and salting operations. During Stoneham's MVP Workshop in December 2020, participants discussed severe winter weather and mitigation opportunities including updating the snow management plan, providing accessible warming centers, tree trimming, and studying renewable power alternatives including solar power or battery backup. Backup power sources are imperative to the Town in the event of power outages due to severe winter weather.

[71] Kocin and Uccellini, "The Northeast Snowfall Impact Scale (NESIS)."
[72] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[73] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."
[74] National Oceanic and Atmospheric Administration (NOAA) and National Weather Service, "Boston Breaks Record Seasonal Snowfall."
[75] National Oceanic and Atmospheric Administration (NOAA) and National Centers for Environmental Information (NCEI), "National Climate Report - February 201 9- Winter Snowfall Departure from Average."

Blizzards are classified as high-frequency events in Stoneham. As defined by the 2013 Massachusetts State Hazard Mitigation Plan, this hazard can occur more than once in five years (a greater than 20% chance of occurring each year).

4.4.2 Ice Storms

Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects creating ice build-ups of ¼ inch or more that can cause severe damage. An ice storm warning, now included in the criterion for a winter storm warning, is for severe icing and is issued when a half-inch or more of accretion of freezing rain is expected. This situation may lead to dangerous walking or driving conditions and excessive weight on power lines and trees. Icy roads can also complicate emergency response efforts during an extreme event. Ice storms are classified as high-frequency events in Stoneham. As defined by the 2013 Massachusetts State Hazard Mitigation Plan, this hazard can occur 1.5 times per year.

Sleet occurs when raindrops fall into subfreezing air thick enough that the raindrops refreeze into ice before hitting the ground. Sleet differs from hail: sleet is a wintertime phenomenon, while hail usually falls during thunderstorms in the spring and summer.[76]

NOAA's National Centers for Environmental Information Storm Events Database offers data on hail events, ice storms, and sleet Middlesex County. There were 131 hail events, 3 ice storms, and no reported sleet hazards between 2000 and 2019. No deaths or injuries were reported. Over $6.2 million in damages were incurred.

4.4.3 Climate Change Impacts: Winter Storms

Some evidence suggests that nor'easters along the Atlantic coast are increasing in frequency and intensity. Future nor'easters may become more concentrated during the coldest winter months when atmospheric temperatures are still low enough to result in snowfall rather than rain. [77]

Climate projections indicate that climate change will result in more precipitation during the winter in the Northeast. This trend may result in more frequent and/or more severe winter storms.

4.5 Geological Hazards

Geologic hazards can include earthquakes, landslides, sinkholes, and subsidence. Town officials did not identify any local areas that were previously recorded as being vulnerable to geologic hazards, which included landslide areas and previous damage from earthquakes.

4.5.1 Earthquakes

An earthquake is a vibration, sometimes violent, of the earth's surface that follows a release of energy in the earth's crust due to fault fracture and movement. The magnitude or extent of an earthquake is a seismograph-measured value of the amplitude of the seismic waves. The Richter magnitude scale (Richter scale) was developed in 1932 as a mathematical device to compare the size of earthquakes. The Richter scale is the most widely known scale that measures earthquake magnitude. It has no upper limit and is not a direct indication of damage. An earthquake in a densely populated area, which results

[76] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[77] Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "MA Climate Change Clearinghouse."

in many deaths and considerable damage, can have the same magnitude as an earthquake in a remote area that causes no damage. Table 4-23 summarizes Richter scale magnitudes and corresponding earthquake effects.[78]

Table 4-15. Richter Scale and Effects[79]

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

Earthquakes occur occasionally in New England as compared to other parts of the country but are oftentimes so small that they are not felt. The first recorded earthquake was noted by the Plymouth Pilgrims and other early settlers in 1638. Of the over 5,000 earthquakes recorded in the Northeast Earthquake Catalog through 2008, 1,530 occurred within the boundaries of the six New England States, with 366 earthquakes recorded for Massachusetts between 1627 and 2008. Historically, moderately damaging earthquakes strike somewhere in the region every few decades, and smaller earthquakes are felt approximately twice per year.[80] A summary of historic earthquakes in the Boston area is included in Table 4-24 below:

Table 4-16. Historical Earthquakes in Massachusetts and Surrounding Area, 1727-2020[81]

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA

[78] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[79] Louie, "What Is Richter Magnitude?"
[80] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[81] United States Geological Survey (USGS), "Earthquake Hazards Program."

Table 4-16. Historical Earthquakes in Massachusetts and Surrounding Area, 1727-2020[81]

Location	Date	Magnitude
MA - Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA - Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA - Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA - Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA - Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA - Brewster	8/8/1847	4.2
MA - Boxford	5/12/1880	NA
MA - Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
MA - Nantucket	10/25/1965	NA
MA - Boston	12/27/1974	2.3
VA - Mineral	8/23/2011	5.8
MA - Nantucket	4/12/2012	4.5
ME - Hollis	10/17/2012	4.0
MA – Newburyport	2/20/2013	2.3
NH – Contoocook	10/11/2013	2.6
MA – Freetown	1/9/2014	2.0
MA – Bliss Corner	2/11/2014	2.2
MA – off Northshore	8/18/2014	2.0
CT - Deep River Center	8/14/2014	2.7
CT – Wauregan	1/12/2015	3.3

Table 4-16. Historical Earthquakes in Massachusetts and Surrounding Area, 1727-2020[81]

Location	Date	Magnitude
CT – Wauregan	1/13/2015	2.6
RI – Newport	2/3/2015	2.0
NH – Epsom	8/2/2015	2.2
NH – Contoocook	3/21/2016	2.8
MA – Rockport Coast	6/1/2016	2.2
NH – Bedford	2/11/2017	2.2
NH – East Kingston	2/15/2018	2.7
ME – Cape Neddick	7/16/2018	2.1
MA – Nantucket	8/18/2018	2.4
MA – Templeton	12/21/2018	2.1
MA – Gardner	12/23/2018	2.2
RI – Charlestown	3/1/2019	2.3
MA – Rockport	4/27/2019	2.1
MA – North Plymouth	12/3/2019	2.1

Ground shaking or ground motion is the primary cause of earthquake damage to man-made structures. Ground motion from earthquakes is amplified by soft soils and reduced by hard rock. Ground motion is measured by maximum peak horizontal acceleration expressed as a percentage of gravity (%g). Peak ground acceleration in the state ranges from 10 %g to 20 %g, with a 2% probability of exceedance in 50 years. Figure 4-8 provides additional information.

Stoneham is located in an area with a PGA of 16 %g with a 2% probability of exceedance in 50 years (please refer to Figure 4-8). Compared to the rest of the United States, Massachusetts overall has a low risk of earthquakes.

No earthquake epicenters have been recorded within Stoneham. Although new construction under the most recent building codes generally will be built to seismic standards, much of the development in the town pre-dates the current building code. If an earthquake occurs, the entire region, not just the town, would face significant challenges. Earthquakes often trigger fires. The water distribution system may be disrupted, thus posing a risk for public health and safety.

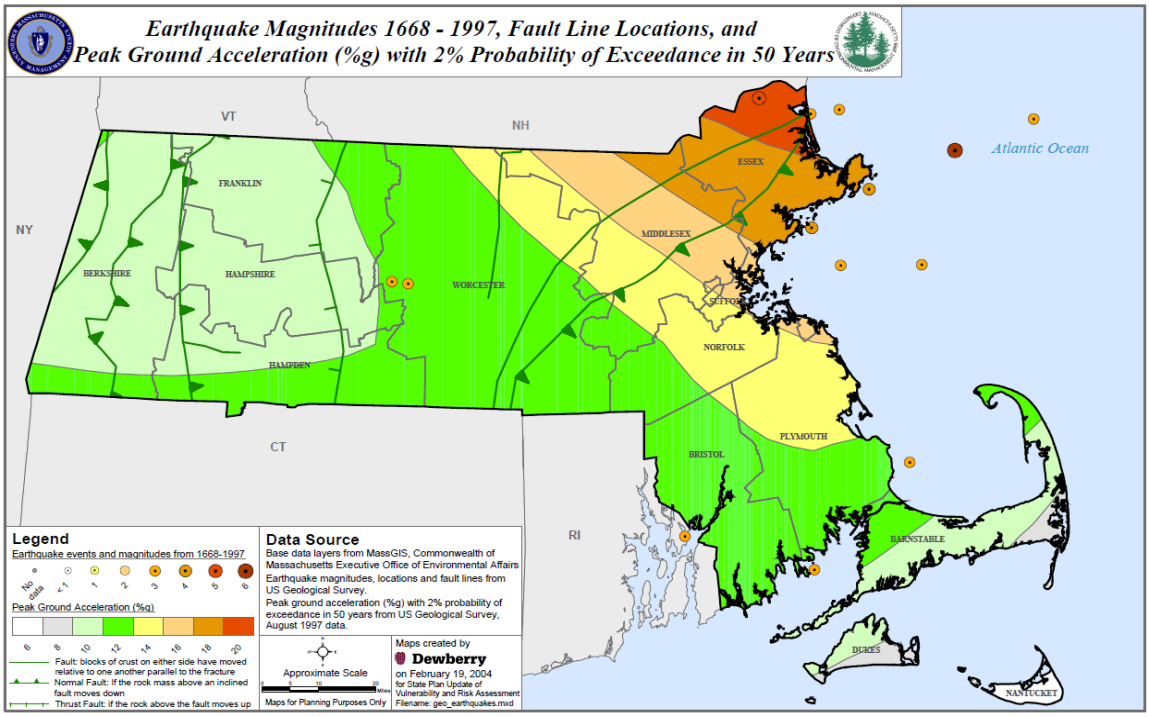


Figure 4-5. State of Massachusetts Earthquake Probability Map

Source: Massachusetts State Hazard Mitigation Plan

While there is no established correlation between earthquakes and climate change, an earthquake can still have catastrophic impacts on a community. A serious earthquake in Massachusetts is possible. These events can strike without warning and can have a devastating impact on infrastructure and buildings constructed before earthquake-resistant design considerations.

It can be assumed that all existing and future buildings and populations are at risk of an earthquake hazard. Impacts from earthquakes can be from slight to moderate building damage, to catastrophic damage and fatalities, depending on the severity of the earthquake event. Events may cause minor damage such as cracked plaster and chimneys, or broken windows, or major damage resulting in a building collapse. Based on the Massachusetts State Hazard Mitigation and Climate Adaptation Plan, the degree of exposure "depends on many factors, including the age and construction type of the structures where people live, work, and go to school; the soil type these buildings are constructed on; and the proximity of these building to the fault location." Furthermore, the time of day exposes different sectors of the community to the hazard. Earthquakes can lead to business interruptions, loss of utilities, and road closures which may isolate populations. People who reside or work in unreinforced masonry buildings are vulnerable to liquefaction (liquefaction is the phenomenon that occurs when the strength and stiffness of soil are reduced by an earthquake).

Potential earthquake damage was modeled for Stoneham. Hazus Multi-Hazard (Hazus) is a GIS model developed by FEMA to estimate losses in a defined area due to a specified natural hazard. The Hazus earthquake model allows users to input specific parameters to model a defined earthquake magnitude, with the epicenter located at the center of the municipality. In this analysis, two earthquakes were

modeled: a magnitude 5.0 and a magnitude 7.0 earthquake. While large earthquakes are rare in Massachusetts, there was a magnitude 5.0 earthquake recorded in 1963. Larger scale earthquakes can occur in Massachusetts at some point, therefore a magnitude 7.0 earthquake was modeled as well to demonstrate the damage that could occur.

To model each of these earthquakes, the study region must first be defined. The Town of Stoneham was outlined by the census tracts in the Town. The arbitrary event scenario was used for Stoneham. This scenario allows the user to input the magnitude, depth, and epicenter of the earthquake. This must be done for each earthquake magnitude chosen. The output shows the potential impact that could occur in Stoneham if either a magnitude 5.0 or a magnitude 7.0 earthquake occurred with the epicenter located in the center of Stoneham. HAZUS is based on 2010 census data and 2014 dollars. The tables below show the estimated damage from both a magnitude 5.0 and a magnitude 7.0 earthquake in the municipality.

Table 4-17. Infrastructural Damage from a Magnitude 5.0 Earthquake on Buildings in Stoneham

Land Use Type	Total Number of Buildings	Total Number of Buildings Damaged[1]	Percent of Buildings Damaged[1]	Total Value of Building Damage[2]
Residential	6,440	3,084	47.9%	$245,068,400
Commercial	490	382	78.0%	$110,143,500
Industrial	120	95	79.2%	$14,515,600
Others	64	47	73.4%	$13,896,100
TOTAL	**7,114**	**3,608**	**50.7%**	**$383,623,600**

[1]Includes Slight, Moderate, Extensive, and Complete Damage
[2]Includes Building, Content and Inventory

Table 4-18. Infrastructural Damage from a Magnitude 7.0 Earthquake on Buildings in Stoneham

Land Use Type	Total Number of Buildings	Total Number of Buildings Damaged[1]	Percent of Buildings Damaged[1]	Total Value of Building Damage[1]
Residential	6,440	6,431	99.9%	$2,144,331,300
Commercial	490	490	100%	$678,428,600
Industrial	120	120	100%	$86,869,400
Others	64	64	100%	$86,759,100
TOTAL	**7,114**	**7,105**	**99.9%**	**$2,966,388,400**

[1]Includes Slight, Moderate, Extensive, and Complete Damage
[2]Includes Building, Content and Inventory

In addition to the infrastructural damage, Hazus also calculated the potential social impact of a magnitude 5.0 and magnitude 7.0 earthquake on the community. This calculation included business interruption loss; monetary wage, capital-related, rental and relocation costs; as well as displaced households and persons seeking temporary shelter. Additional property damage and business interruption loss were calculated as well, and a full HAZUS risk response report for each earthquake category can be found in Appendix B.

Earthquakes are classified as a high-frequency event in Stoneham. As defined by the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, the probability of a magnitude 5.0 or greater earthquake centered in New England is about 10-15% in 10 years.

4.5.2 Landslides

Landslides include a wide range of ground movements, such as rockfalls, deep failure of slopes, and shallow debris flows. Although gravity, acting on an over steepened slope, is the primary reason for a landslide, there are other contributing factors. These contributing factors can include erosion by rivers or ocean waves over steepened slopes; rock and soil slopes weakened through saturation by snowmelt or heavy rains; earthquake created stresses that make weak slopes fail; excess weight from the accumulation of rain or snow; and stockpiling of rock or ore from waste piles or man-made structures (USGS 2019a).

Landslides occur throughout the United States, causing an estimated $1 billion in damages and 25-50 deaths each year. Any area composed of very weak or fractured materials resting on a steep slope will likely experience landslides. Although the physical cause of many landslides cannot be removed, geologic investigations, good engineering practices, and effective enforcement of land-use management regulations can reduce landslide hazards (USGS 2019a). Landslides can damage buildings and infrastructure and cause sedimentation of water bodies.

Landslide intensity can be measured in terms of destructiveness, as demonstrated by Table 4-28 below.

Table 4-19. Landslide Volume and Velocity

Estimate Volume (m^3)	Expected Landslide Velocity		
	Fast-moving (rockfall)	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

Source: Cardinali et al. 2002

No significant landslides have been recorded for Stoneham or Middlesex County (Appendix B of EEA and EOPSS 2018). Landslides are classified as low-frequency events in Stoneham. These events can occur once in 50 to 100 years (a 1% to 2% chance of occurring each year).

4.6 Fire Related Hazards

Fire risk is influenced by fuel (the type of material), terrain, and weather. Strong winds can exacerbate extreme fire conditions, especially wind events that persist for long periods, or ones with significant sustained wind speeds that quickly promote fire spread through the movement of embers or exposure within tree crowns. Fires can spread quickly into developed areas.

A wildfire can be defined as any non-structure fire that occurs in the vegetative wildland, including grass, shrub, leaf litter, and forested tree fuels. Wildfires can be caused by natural events, human activity, or in an intentionally controlled manner, and often begin unnoticed, but spread quickly, igniting brush, trees, and homes (MEMA and DCR 2013, 252). The State Hazard Mitigation and Climate Adaptation Plan (EEA and EOPPS, 2018) states:

> *"The ecosystems that are most susceptible to the wildfire hazard are pitch pine, scrub oak, and oak forests, as these areas contain the most flammable vegetative fuels. Other portions of the Commonwealth are also susceptible to wildfire, particularly at the urban-wildland interface…. Interface communities are defined as those in the vicinity of contiguous vegetation, with more than one house per 40 acres and less than 50 percent vegetation, and within 1.5 miles of an area of more than 500 hectares (approximately 202 acres) that is more than 75 percent vegetated."*

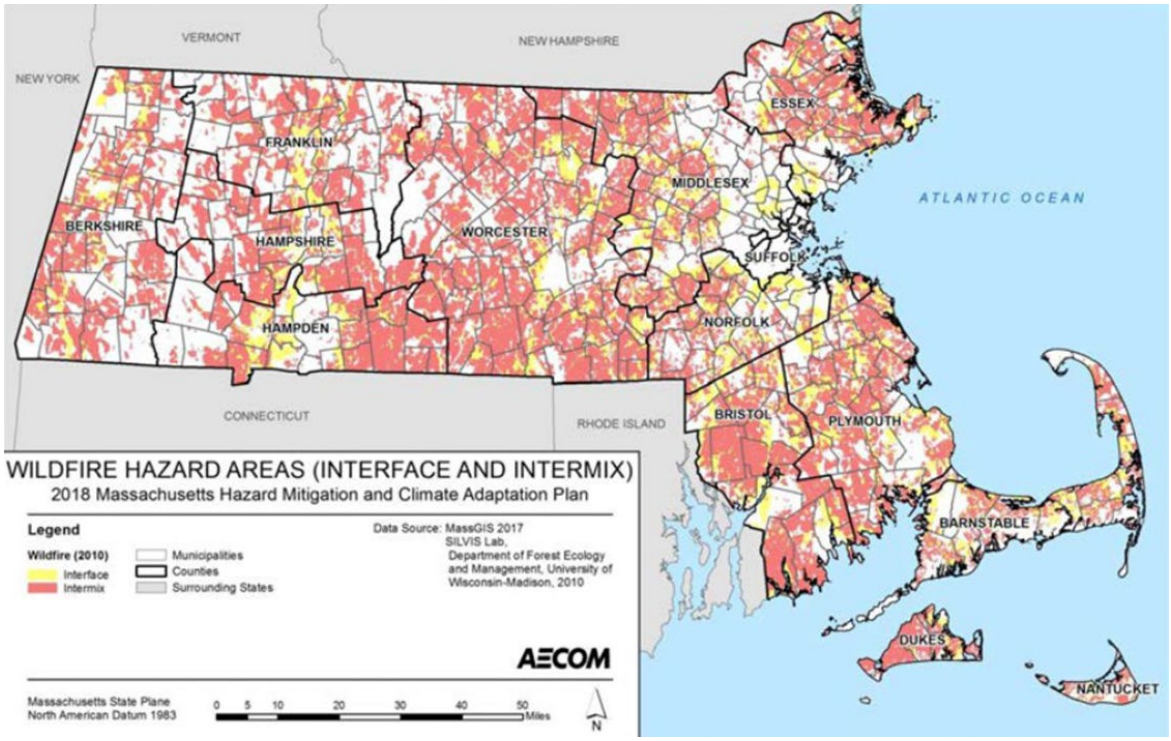


Figure 4-6: Wildfire Hazard Areas Statewide (above) and in Stoneham (below)

Since wildfires are not common in Massachusetts, this plan focuses on brush and urban fires. Brush fires can lead to property damage and even death, although they have not resulted in any major property damage or deaths in Stoneham. All individuals whose homes or workplaces are located in brush fire

hazard zones are exposed to this hazard. The most vulnerable members of this population are those who would be unable to evacuate quickly, including those over the age of 65, households with young children under the age of 5, people with mobility limitations, and people with low socioeconomic status (EEA and EOPSS 2018, 4-180). Secondary effects from brush fire include contamination of reservoirs; destroyed power, gas, water, broadband, and oil transmission lines. Brush fires can also contribute to flooding as they strip slopes of vegetation, thereby exposing them to greater amounts of runoff which may cause soil erosion and ultimately the chance of flooding. Additionally, subsequent rains can worsen erosion because brush fires burn ground vegetation and ground cover.

4.6.1 Potential Brush Fire Hazard Areas

Four hundred brush fires were reported in Stoneham over three years. The areas surrounding the Stoneham State Hospital and the Great Swamp are at a higher degree of a fire risk than other parts of town. After a dry winter and spring in 2012, a field caught fire near Main Street and spread quickly before being extinguished by the Stoneham Fire Department.[82] Brush fires are classified as low-frequency events in Stoneham.

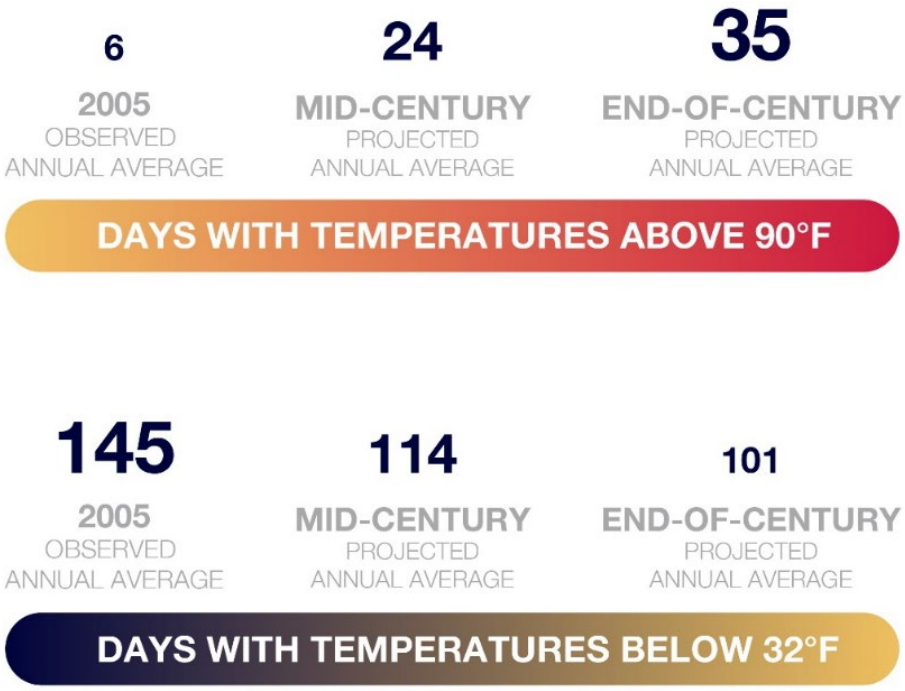
4.7 Extreme Temperatures

Extreme temperatures are considered a town-wide hazard in Stoneham. These events can include both temperatures over and under seasonal averages. These extreme temperature events can range from brief to lengthy.

Middlesex County has four clearly defined seasons. Extreme temperatures fall outside of the ranges typically experienced during these seasons. Middlesex County's most recent observed summer temperature was 71.33°F in 2005. The County's most recent observed winter temperature was 26.97°F in 2005.[83]

[82] Northern Middlesex Council of Governments (NMCOG), "Hazard Mitigation Plan for the Northern Middlesex Region: 2015 Update."
[83] Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Average Temperature: Middlesex County, MA."

Figure 4-7: Anticipated Temperature Changes in Massachusetts



4.7.1 Extreme Cold

Extremely cold temperatures are measured using the Wind Chill Temperature Index provided by the National Weather Service (NWS). The updated index was implemented in 2001 and helps explain the impact of cold temperatures on unexposed skin. Figure 4-11 below provides more information.

Extremely cold temperatures can create dangerous conditions for vulnerable populations. The homeless, the elderly, and people with disabilities are often most vulnerable. In Stoneham, 20.0% of the population are over 65 years old and 4.7% of the population has a disability.[84] Cold weather events can also have significant health impacts such as frostbite and hypothermia. Furthermore, power outages during cold weather may result in inappropriate use of combustion heaters, cooking appliances, and generators in poorly ventilated areas which can lead to an increased risk of carbon monoxide poisoning.

[84] United States Census Bureau, "QuickFacts: Stoneham Town, Middlesex County, Massachusetts."

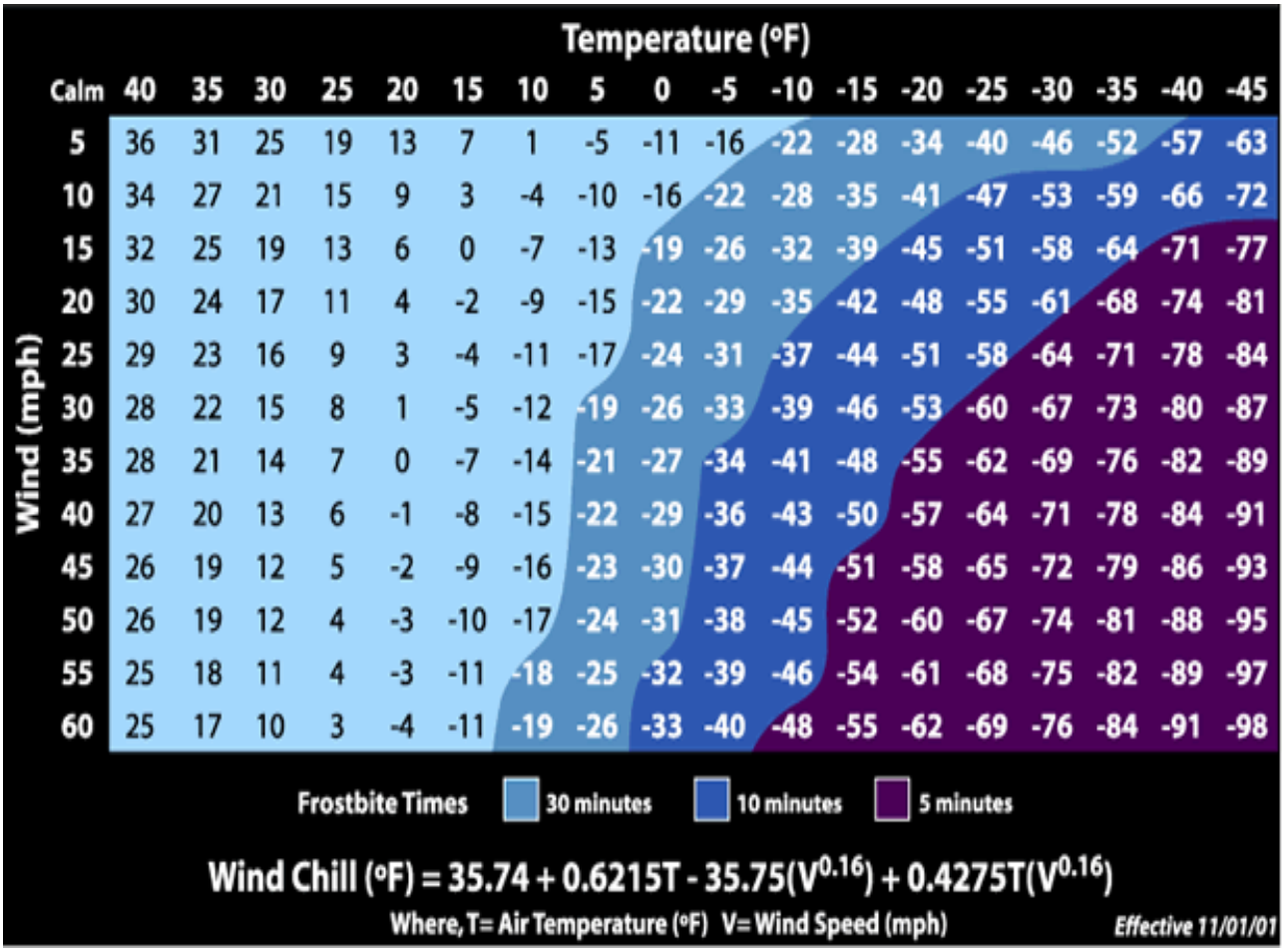


Figure 4-8. Windchill Temperature Index and Frostbite Risk
Source: National Weather Service

NOAA's National Centers for Environmental Information Storm Events Database provides data for extreme cold events. Between 2000 and 2018, Middlesex County experienced three extreme cold and will chill events, which luckily caused no deaths, injuries, or property damage, as illustrated in Table 4-28.

Table 4-20. Middlesex County Extreme Cold and Wind Chill Occurrences, 2000-2018[85]

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

[85] National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA), "Storm Events Database: Middlesex County."

4.7.2 Extreme Heat

Increased temperatures will impact all locations within Stoneham. Projected heat days and heatwaves can have an increased impact in densely settled urban areas. These can become "heat islands" as dark-colored asphalt and roofs store the heat from the sun. According to the Centers for Disease Control and Prevention, the populations most vulnerable to extreme heat impacts include the following:

- People over the age of 65 (e.g., with limited mobility),
- Children under the age of five,
- Individuals with pre-existing medical conditions that impair heat tolerance,
- Low-income individuals who cannot afford proper cooling,
- Individuals with respiratory conditions,
- The general public may overexert themselves during extreme heat events.

Homeless people are increasingly vulnerable to extreme heat. The capacity of homeless shelters is typically limited. Impacts from heat stress can exacerbate pre-existing respiratory and cardiovascular conditions. The NWS issues a Heat Advisory when the Heat Index (Figure 4-13) is forecast to reach 100-104˚ F for two or more hours (https://www.weather.gov/bgm/heat). The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach or exceed 105˚F for two or more hours. Heatwaves cause more fatalities in the U.S. than the total of all other meteorological events combined. In Boston, over 50 people die each year due to heat-related illnesses. From 1979-2012, excessive heat exposure caused over 8,000 deaths in the United States.[86] During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

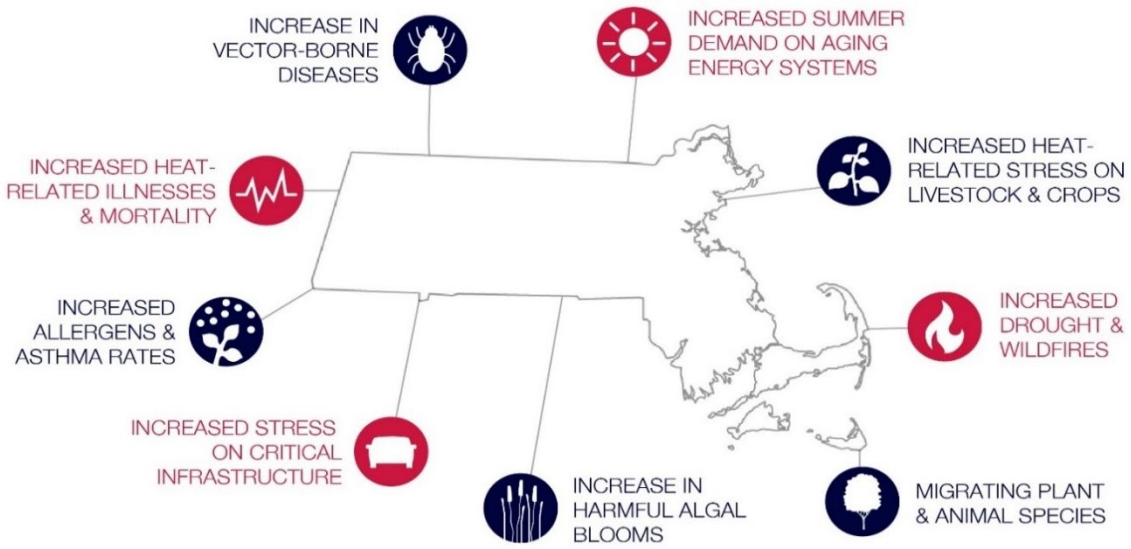


Figure 4-9: Potential Impacts from Increasing Temperatures

[86] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."

On July 6, 2013, a postal worker in MA collapsed and died as the Heat Index reached 100°F.[87] Because most heat-related deaths occur during the summer, people should be aware of who is at the greatest risk and what actions can be taken to prevent a heat-related illness or death. The populations at greater risk are the elderly, children, and people with certain medical conditions, such as heart disease. In Stoneham, children under eighteen years old make up 17.7% of the population, and 20.0% are over 65 years old.[88] However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. Some behaviors also put people at greater risk: drinking alcohol, taking part in strenuous outdoor physical activities in hot weather, and taking medications that impair the body's ability to regulate its temperature or that inhibit perspiration.[89]

Increased temperatures can lead to a longer growing season, which in turn leads to a longer pollen season. Warmer weather can also support the migration of invasive species and lead to an increase in vector-borne diseases. Increasing temperatures can also worsen air pollution, which can lead to negative health impacts such as respiratory problems.

The Town of Stoneham does not collect data on heat occurrences. The best available local data are for Middlesex County, through the National Environmental Information Center. NOAA's National Centers for Environmental Information Storm Events Database provides data on excessive heat. Between 1998 and 2018, Middlesex County experienced three extreme heat days, which did not result in injury or property damage. One event did result in a single death in 2013. Please refer to Table 4-30 for more information.

Table 4-21. Middlesex County Heat Occurrences, 1998-2018

Date	Deaths	Injuries	Damage ($)
7/6/2010*	0	0	0
7/7/2010	0	0	0
7/5/2013	1	0	0
Total	**1**	**0**	**0**

**Excess Heat Occurrences (105°F+)*[90]

Based on Figure 4-13 below, compiled in 2019 by the Massachusetts Department of Public Health Bureau of Environmental Health (BEH), Stoneham has a population density of 3,246 residents per square mile. The BEH measures population vulnerability by looking at four indicators: income, English proficiency, non-white population, and age. Details of how these indicators are applied are visible on

[87] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."
[88] United States Census Bureau, "QuickFacts: Stoneham Town, Middlesex County, Massachusetts."
[89] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[90] National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA), "Storm Events Database: Middlesex County."

the chart below. For Stoneham, the total number of population vulnerability measures in each Census Tract (2010) is 2.

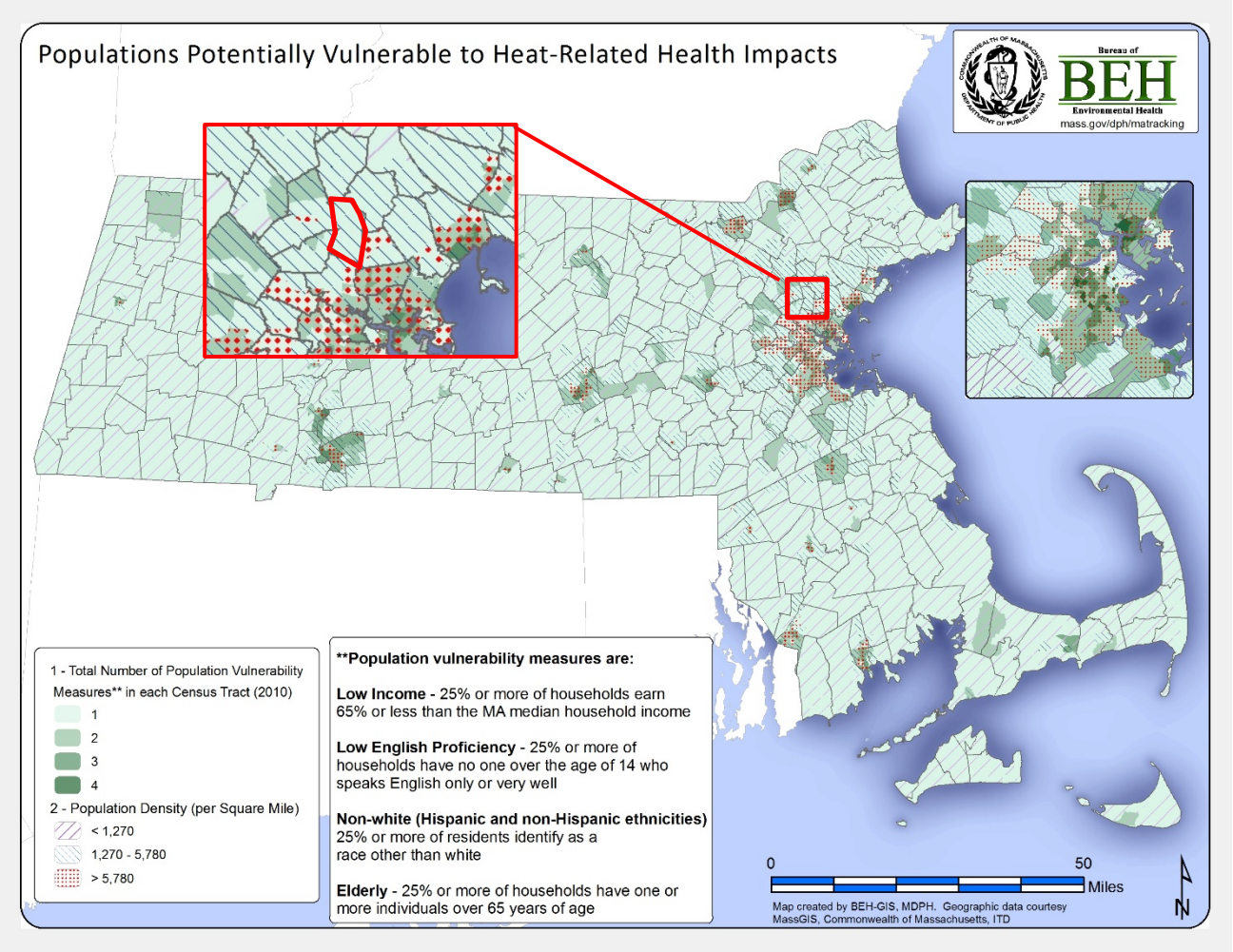


Figure 4-3: Populations Potentially Vulnerable to Heat-Related Health Impacts. Stoneham is outlined in red.
Image by the Massachusetts Department of Public Health, Bureau of Environmental Health, 2019

Extreme temperatures are classified as medium frequency events. According to the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, between four and five heat waves (3 or more consecutive days of 90˚F+ temperatures) occur annually in Massachusetts.[91]

[91] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."

4.7.3 Climate Change Impacts: Extreme Temperatures

Between 1961 and 1990, Boston experienced an average of one day per year over 100°F. That could increase to six days per year by 2070, and 24 days per year by 2099. Under these conditions by the end of the century, Massachusetts's climate would more closely resemble that of Maryland or the Carolinas

Relative Humidity (%) \ Temperature (°F)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke or Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.

Figure 4-2. Heat Index Chart

(Source: https://www.weather.gov/safety/heat-index)

(refer to Figure 4-15 below). These temperature changes would also have a detrimental impact on air quality and public health concerns including asthma and other respiratory conditions.[92]

[92] Frumhoff et al., "Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions."

Figure 4-12. Massachusetts Extreme Heat Scenarios. Image by MassAudubon.

4.8 Drought

Drought is an extended period of deficient precipitation. Drought conditions occur in virtually all climatic zones, yet its characteristics vary significantly from one region to another since it is relative to the normal precipitation in that region. Agriculture, the water supply, aquatic ecosystems, wildlife, and the economy are vulnerable to the impacts of drought.[93]

Middlesex County's observed annual precipitation in 2005 was 56.17 inches.[94] Although Massachusetts is relatively small, it has several distinct regions that experience significantly different weather patterns and react differently to the amounts of precipitation they receive. Following the Massachusetts Drought Management Plan, the Drought Management Task Force will make recommendations to the Secretary of Energy & Environmental Affairs about the location and severity of drought in the Commonwealth. The Drought Management Plan divides the state into six regions: Western, Central, Connecticut River Valley, Northeast, Southeast, Cape Cod, and Islands Region.[95] Stoneham is part of the Northeast region.

Five levels of drought have been developed to characterize drought severity: Normal, Advisory, Watch, Warning, and Emergency; these correspond to Level 0 – Normal, Level 1 - Mild Drought, Level 2 - Significant Drought, Level 3 - Critical Drought (was Warning), and Level 4 - Emergency Drought (was

[93] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."
[94] Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Annual Total Precipitation: Middlesex County, MA."
[95] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."

Emergency), respectively, of the draft Drought Management Plan update. The drought levels are based on the severity of drought conditions and their impacts on natural resources and public water supplies.

The Drought Management Plan specifies the agency response and interagency coordination and communication corresponding to the various drought levels. During normal conditions, data are routinely collected and distributed. There is heightened vigilance with additional data collection during an advisory, and increased assessment and proactive education during a watch. Water restrictions might be appropriate at the watch or warning stage, depending on the capacity of each water supply system. A warning level indicates a severe situation and the possibility that a drought emergency may be necessary. A drought emergency is one in which the use of emergency supplies becomes necessary or in which the Governor may exercise his authority to require mandatory water restrictions.[96]

A variety of drought indices are available to assess the various impacts of dry conditions. The Commonwealth uses a multi-index system to determine the severity of a drought or extended period of dry conditions. A determination of drought level is based on seven indices: Standardized Precipitation Index, Precipitation (percent of normal), Crop Moisture Index, Keetch-Byram Drought Index (KBDI), Groundwater levels, Streamflow levels, and Index Reservoir levels. (In its draft updated Drought Management Plan, the Drought Management Trask Force has proposed to eliminate the precipitation index that is based on the percent of normal precipitation.)

Drought level is determined monthly based on the number of indices that have reached a given drought level. A majority of the indices would need to be triggered in a region for a drought designation to move to a more severe level. Drought levels are declared on a regional basis for each of the six regions in Massachusetts. Drought levels may also be made county by county or be watershed-specific. The end of a drought is determined by precipitation and groundwater levels since these have the greatest long-term impact on streamflow, water supply, reservoir levels, soil moisture, and potential for forest fires.[97]

[96] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR).
[97] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR).

Figure 4-16 illustrates statewide drought levels in Massachusetts from 1850 to 2012, using the Standardized Precipitation Index (SPI). Table 4-30 below summarizes a history of Massachusetts droughts between 1879 and 2017.[98]

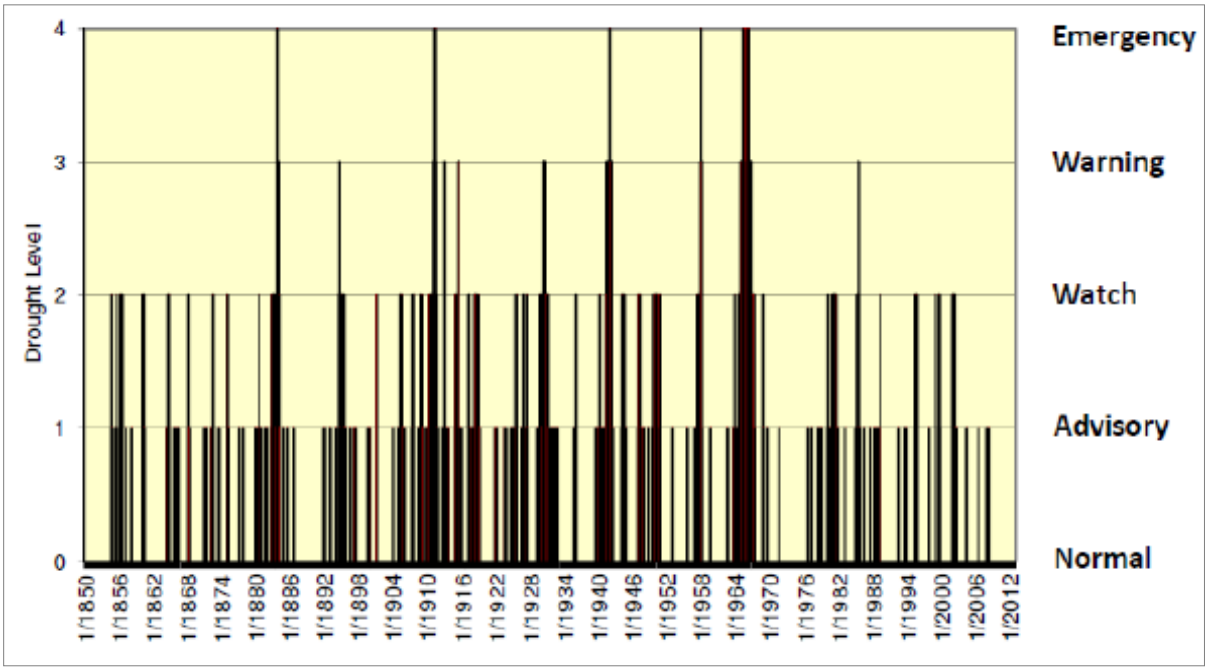


Figure 4-7: Statewide Drought Levels Using SPI Thresholds, 1850 to 2012.

Table 4-22. Droughts in Massachusetts Based on Instrumental Records[99]

Date	Area Affected	Recurrence Interval (years)	Remarks
1879 to 1883	–	–	–
1908 to 1912	–	–	–
1929 to 1932	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.
1939 to 1944	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.
1957 to 1959	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.

[98] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR).

[99] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."

Table 4-22. Droughts in Massachusetts Based on Instrumental Records[99]

Date	Area Affected	Recurrence Interval (years)	Remarks
1961 to 1969	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.
1980 to 1983	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.
1985 to 1988	Housatonic River Basin	25	Duration and severity unknown. Streamflow showed mixed trends elsewhere.
1995	–	–	Based on statewide average precipitation.
1998 to 1999	–	–	Based on statewide average precipitation.
2001 to 2003	Statewide	–	Level 2 drought (out of 4 levels) was reached statewide for several months.
2007 to 2008	Statewide except West and Cape and Islands regions	–	Level 1 drought (out of 4 levels)
2010	Connecticut River Valley, Central and Northeast regions	–	Level 1 drought (out of 4 levels)
2014	Southeast and Cape and Islands regions	–	Level 1 drought (out of 4 levels)
2016-2017	Statewide	–	Level 3 drought (out of 4 levels).

There are five drought emergencies on record in Massachusetts: 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought is considered the most severe Massachusetts drought in modern times, given its length. Every month over the 162 years of record, there is a one percent chance of a drought emergency.[100]

[100] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."

Drought warning levels not associated with drought emergencies would have occurred in 1894, 1915, 1930,1985, 2016, and 2017. Every month over the 162 years of record, there is a two percent chance of a drought warning level.[101]

Drought watches not associated with higher levels of drought generally would have occurred three to four times per decade between 1850 and 1950. The drought emergency declarations dominated the 1960s. There were no drought watches or above in the 1970s. In the 1980s, there was a lengthy drought watch level of precipitation between 1980 and 1981, followed by a drought warning in 1985. A frequency of drought watches at a rate of three years per decade resumed in the 1990s (1995, 1998, 1999). In the 2000s, drought watches occurred in 2001 and 2002. The overall frequency of being in a drought watch is eight percent every month over the 162 years of record.[102] There were six drought watches in Massachusetts in 2002, five drought watches in 2016, and two drought watches in 2017.[103] Figure 4-17 presents an example of drought conditions in the six drought regions.

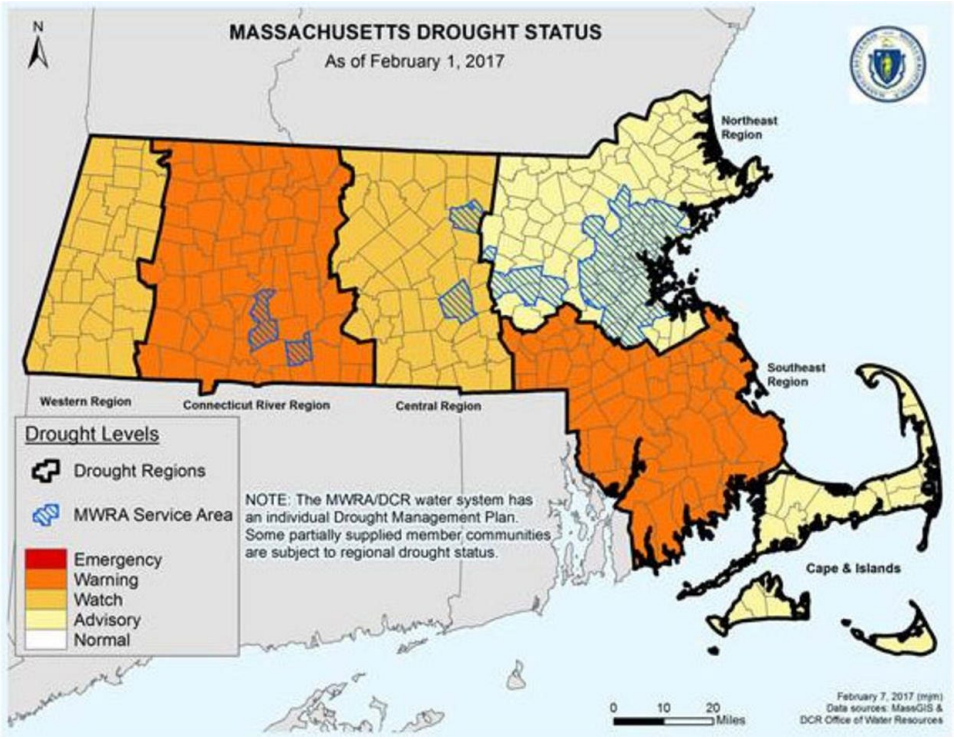


Figure 4-14. Massachusetts Drought Status, February 2017.
Image by the Massachusetts Department of Conservation and Recreation

[101] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR); Massachusetts Department of Conservation and Recreation (DCR), "Recent Drought History."
[102] Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR), "Commonwealth of Massachusetts State Hazard Mitigation Plan."
[103] Massachusetts Department of Conservation and Recreation (DCR), "Recent Drought History."

Drought is a potential town-wide hazard in Stoneham and is a concern among stakeholders. As noted previously, the temperature is projected to increase and may lead to exacerbated drought conditions, especially in the summer and fall months. Droughts can also increase fire risk: fires can be caused by lightning, and a 2014 study found that the frequency of lightning strikes could increase by more than 10% for every degree Celsius of warming.[104]

A long-term drought could lead to impacts on Stoneham's wetlands, rivers, streams, and ponds. Stoneham purchases its water from the Massachusetts Water Resources Authority (MWRA) and is delivered utilizing aqueducts from the Quabbin Reservoir. Droughts are classified as a medium frequency natural hazard event in Stoneham.

4.8.1 Climate Change Impacts: Drought

Under climate change, drought conditions will be exacerbated with projected increasing air temperatures and changes in precipitation. Between 1970 and 2000, the median number of consecutive dry fall days in Massachusetts was 11.4 days. This is in comparison to a projected median of 13.5 consecutive days by the end of the century.[105]

[104] Commonwealth of Massachusetts, Massachusetts Emergency Management Agency (MEMA), and Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan."

[105] Massachusetts Executive Office of Energy & Environmental Affairs (EOEEA), "MA Climate Change Clearinghouse."

5 EXISTING MITIGATION MEASURES

FEMA categorizes hazard mitigation measures into four types as displayed in Table 5-1. The existing protective measures are already being implemented in the Town of Stoneham including zoning and regulations, community outreach and engagement, and infrastructural projects and maintenance. Infrastructure maintenance generally addresses localized drainage problems, while large-scale capacity problems may require pipe replacement or invert elevation modifications. These more expensive projects are subject to the capital budget process. The Town's existing mitigation measures are described by hazard type here and are summarized in Table 5-2 below. Many upgrades to existing measures are noted in the following sections.

Table 5-1. FEMA Mitigation Action Types[106]

Measure	Action	Examples
Local Plans and Regulations	These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.	• Comprehensive plans • Land use ordinances • Subdivision regulations • Development review • Building codes and enforcement • NFIP Community Rating System • Capital improvement programs • Open space preservation • Stormwater management regulations and master plans
Structure and Infrastructure Projects	These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.	• Acquisitions and elevations of structures in flood-prone areas • Utility undergrounding • Structural retrofits. • Floodwalls and retaining walls • Detention and retention structures • Culverts • Safe rooms
Natural Systems Protection	These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.	• Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements • Wetland restoration and preservation
Education and Awareness Programs	These are actions to inform and educate citizens, elected officials, and property owners about hazards and	• Radio or television spots • Websites with maps and information • Real estate disclosure

[106] Federal Emergency Management Agency (FEMA), "Local Mitigation Planning Handbook. Table 6.1: Types of Mitigation Actions."

Measure	Action	Examples
	potential ways to mitigate them. A greater understanding and awareness of hazards and risks among local officials, stakeholders, and the public is more likely to lead to direct actions.	• Presentations to school groups or neighborhood organizations • Mailings to residents in hazard-prone areas. • StormReady • Firewise Communities

These existing mitigation measures are organized by climate hazard and described in more detail below.

5.1 Summary of Existing Multi-Hazard Mitigation Measures

Numerous existing natural hazard mitigation measures are already in place in Stoneham. These were identified through feedback from the Core Team, CRB Workshop participants, and additional stakeholder interviews. These mitigation measures are summarized below.

Multi-Hazard Mitigation Measures	Recommended Improvements
Green Community Designation: The Town has been designated by the Department of Energy Resources as a Green Community. The Town received a grant to implement energy efficiency projects aimed at reducing municipal energy consumption.	None.
Capital Improvement Program: The town has a capital improvement program that includes projects that will benefit natural hazard mitigation, such as the implementation of stormwater management improvements.	None.
Mystic Region Local Emergency Planning Committee: The Mystic Region LEPC serves as the LEPC for the following communities: Chelsea, Everett, Lynnfield, Malden, Medford, Melrose, North Reading, Reading, Saugus, Stoneham, Wakefield, Winchester, Winthrop, and Woburn. Stoneham's Emergency Management is represented at these meetings and attends regularly.	None.
Emergency generators: The Stoneham Central Middle School is the Town's main shelter facility and has a generator.	Secure a generator for the Senior Center.
Smart 911: This system allows citizens to create a safety profile for their household. This profile provides information to 911 and response teams specific to the household's profile. When the citizen makes a 911 call, their Safety Profile is automatically displayed to the 911 call taker. Additionally, individuals can opt-in to receive notifications about emergencies or critical situations and receive alerts regarding necessary actions, such as evacuations and shelter-in-place.	None.

Multi-Hazard Mitigation Measures	Recommended Improvements
CodeRED: The Town utilizes the CodeRED Emergency Notification System, which is an ultra-high-speed telephone communication service for emergency notifications. The system allows public safety officials to telephones all or targeted areas of the Town in the case of an emergency that requires immediate action.	None.
Emergency Shelters: The Town's emergency shelters include the following locations: Stoneham Central Middle School and (secondarily), Stoneham High School.	Secure a generator for the Senior Center so it can be used as a shelter facility. Make public where emergency shelters are for each type of emergency (warming/cooling stations, etc.)
Senior Center: The Senior Center has kitchen and shower facilities and could be used as a shelter if a generator were installed. The Center can act as a cooling station.	Secure a generator for the Senior Center so it can be used as a shelter facility.
Stoneham High School: The high school is a secondary shelter facility and acts as the Town's inoculation site.	
First Congregational Church of Stoneham: The Church provides a free meal once a week and is open to the public and anyone hungry. The Church maintains a food pantry for Stoneham residents once a month by appointment.	
Energy Efficiency at Housing Authority Properties: The State requires an energy assessment of Housing Authority properties every 5 years. The Authority has switched lighting to LED, installed air source heat pumps in many units, changed out refrigerators and air conditioning in many units, and completed weatherization including caulking, changing weather stripping on main doors, and adding blown-in/foam insulation.	Work with Housing Authority managers to distribute fact sheets and available programs to support residents in case of an emergency.
Traffic Support and Escort: The Police Department provides traffic support and administers an "At Risk Persons Recognition Program" which enables residents to inform the Police of people who may be at risk of wandering from their residence.	None.
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	None.

Multi-Hazard Mitigation Measures	Recommended Improvements
contain important information regarding flooding, hurricanes, tornadoes, dam failures, earthquakes, and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to all the hazards discussed in this plan.	
Emergency Alert: Residents may sign up to receive notifications about road closures and emergency conditions on the Town's website.	None.
Public Education: Emergency Preparedness public education is available on the Fire Department's Emergency Management page. Additionally, the Stoneham Board of Health's webpage links to information related to mosquito control, virus outbreak information, and other resources. The Stoneham Coalition, available on the Town's website, also offers health and safety information. The Town also maintains a social media platform on Facebook, which is used to advertise public meetings and share information. Additionally, the Fire and Police Departments host collaborative public open houses at their stations.	None.
Multi-Department Review of Developments: Multiple Town departments, such as Planning, Zoning, Health, Public Works, Engineering, Fire, Police, Emergency Management, and Conservation, review all subdivision and site plans before approval.	None.
Massachusetts State Building Code: The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake-resistant design, flood-proofing, and snow loads.	None.
Medical Reserve Corps (MRC) Volunteers: The Mystic Valley MRC is a volunteer program serving the communities of Medford, Malden, Melrose, Stoneham, and Wakefield. The Mystic Valley MRC partners with other local law enforcement, public health, and public safety agencies to prepare our communities for natural disasters, man-made emergencies, and outbreaks of infectious illness.	None.

5.2 Existing Town-Wide Mitigation for Flood Related Hazards

Stoneham employs many practices to help minimize potential flooding, reduce impacts from flooding, and proactively maintain existing drainage infrastructure. Existing Town-wide mitigation measures include the following:

Flood Mitigation Measure	Recommended Improvement
Participation in the NFIP – Stoneham participates in the National Flood Insurance Program (NFIP). The NFIP is a Federal program administered by FEMA enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. NFIP offers flood insurance to communities that comply with the minimum standards for floodplain management.[107] FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at fema.gov/policy-claim-statistics-flood-insurance. Additionally, the Massachusetts Department of Conservation and Recreation (DCR) shared the information below for the Town of Stoneham, related to flood insurance and repetitive loss. As defined by FEMA and the NFIP, a repetitive loss property is any insured property in which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978.[108] According to DCR, there are no repetitive loss properties in Stoneham. The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.	There are currently 5 policies in force. The Town should encourage all eligible homeowners to obtain insurance.
Floodplain Overlay District Bylaw: Section 6.9.1.1 establishes a Flood Plain Overlay District. This requires that all uses meet the provisions of 6.9 as well as the Massachusetts State Building Code provisions for construction in the floodplains. The Flood Plain Overlay District includes all special flood hazard areas as designated on the most recent FEMA Flood Insurance Rate Maps (FIRM).	None.
Rules and Regulations Regarding the Use of Public Storm Drains: Includes enforcement by the DPW on illicit connections to prevent pollutants from entering the system.	None.

[107] Federal Emergency Management Agency (FEMA), "The National Flood Insurance Program."
[108] Federal Emergency Management Agency (FEMA), "Definitions: Repetitive Loss Structure."

Flood Mitigation Measure	Recommended Improvement
Local Wetlands Protection Bylaw: The Town has a local wetlands protection bylaw which states that no person shall alter land within 100 feet of any resource area.	None.
Stormwater Management and Erosion Control Bylaw: The Town employs requirements related to stormwater management and erosion control. These are designed to reduce the impacts of soil erosions and sedimentation, which can impair water quality and flow in lakes, ponds, streams, rivers, wetlands, and groundwater; contamination of drinking water supplies; alteration or destruction of aquatic and wildlife habitat; and overloading or clogging of municipal catch basins and storm drainage systems. Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. Stormwater and all other unpolluted drainage shall be discharged to Storm Drains, or to a natural outlet approved by the Director, and, when required by law, the Town of Stoneham Conservation Commission, the Commonwealth of Massachusetts Department of Environmental Protection (DEP), and/or USEPA.	None.
Subdivision Regulations: Regulations address drainage systems and have additional standards for the floodplain district. The design shall be based on the Natural Resource Conservation Service (NRCS) hydrologic method, TR-20, and/or TR-55 for a 10-year design storm (minimum). All designs shall conform to the Massachusetts Department of Environmental Protection's stormwater management standards of 1997 (or more recent revisions). Roadway storm drainage will be provided to remove surface water and accept sub-surface water.	None.
Massachusetts Stormwater Regulations: These regulations are applied to developments within the jurisdiction of the Conservation Commission.	None.
Wetlands Protection Act: The Stoneham Conservation Commission administers the state's Wetlands Protection Act (Chapter 131, Section 40 MGL) to protect resource areas in and around wetlands, including land subject to flooding.	None.
Street Sweeping Program: As part of the Town's program, street sweeping is conducted once a year, and twice a year in some areas. The existing street sweeper is old and replacement is projected sometime in the next 2 years.	Replace street sweeper with an updated and more effective model.

Flood Mitigation Measure	Recommended Improvement
Cleaning Catch Basins and Culverts: As part of the Town's program, all catch basins are cleaned annually.	None.

5.3 Existing Dam Mitigation Measures

Dam Mitigation Measure	Recommended Improvements
DCR Dam Safety Regulations: All jurisdictional dams are subject to the Division of Conservation and Recreation's dam safety regulations (302 CMR 10.00). The dams must be inspected regularly, and reports filed with the DCR Office of Dam Safety. The Town communicates with the DCR Office of Dam Safety to confirm regular maintenance is performed to make sure the dams in Stoneham are stable.	None.
Dam Maintenance: DCR and the Massachusetts Water Resources Authority (MWRA) have a memorandum of understanding to all the MWRA to perform maintenance on the more critical dam structures.	None.
Permits Required for Construction: State law requires a permit for the construction of any dam.	None.
Dam Inspection Report – Fells Reservoir Dam Nos. 2, 3,4, 6, & 8. May 2006: The inspection report includes recommended maintenance and repair measures and recommendations for further investigation.	None.

5.4 Existing Town-Wide Mitigation for Wind-Related Hazards

Wind-Related Mitigation Measures	Recommended Improvements
Massachusetts State Building Code: The Town enforces the Massachusetts State Building Code whose provisions are generally adequate to protect against most wind damage. The code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence. If a tornado were to occur, the potential for severe damages would be extremely high.	None.
Tree Maintenance by Energy Utility National Grid: National Grid trims along power lines every five years.	

Tree-Trimming Program: The Town has a tree warden but no tree department. There is a minimal budget to allow for emergency tree removal. This work is put out to bid once a year. The DPW does regular tree maintenance throughout the year.	None.

5.5 Existing Town-Wide Mitigation for Winter-Related Hazards

Winter-Related Mitigation Measures	Recommended Improvements
Snow Removal: The Town conducts snow plowing operations and provides standard sanding and salting. The Town contracts with about 50 private contractors for snow removal. The Housing Authority also conducts snow removal operations on their properties.	None.

5.6 Existing Town-Wide Mitigation for Fire-Related Hazards

Fire-Related Mitigation Measures	Recommended Improvements
Measures to Address Wildfire Risk: The Town requires fireproof roofing shingles. Vegetative fuel under power lines is also removed to reduce fire risk.	None.
Backup Generators: The Fire Department has one generator on the fire truck, which is used for emergencies.	None.
Road Maintenance: This includes removing road debris that poses a fire risk.	None.
Public Education: The Stoneham Fire Department's Student Awareness of Fire Education (SAFE) Coordinator conducts events at schools. The SAFE Coordinator also works with the Police Educator on community events. For example, the Fire and Police Departments host collaborative public open houses at their stations. Stoneham also hosts a "Safe Halloween" event annually. The Fire Department Secretary keeps the Department's Twitter page up to date.	None.
GPS Units for Hydrants: The Fire Department located fire hydrants through GPS, which assists responders in finding hydrants if they are covered by snowdrifts.	None.

Fire-Related Mitigation Measures	Recommended Improvements
Open Burning Permits Required: The Town allows controlled open burning following state regulations, but a permit is required from the Fire Department. Open burning is allowed from January 15th to May 1st between 10:00 a.m. and 4:00 p.m. Residents must call on the day of the desired burn and provide information on where the burning will take place. Decisions about outdoor burning are made on a day-to-day basis, depending on wind and how dry the weather has been.	None.
Fire Department Review of Proposed Development: The Fire Department reviews all subdivision and site plans for compliance with site access, water supply needs, and other applicable regulations within their jurisdiction.	None.
Statewide Fire Mobilization Plan: The State has a fire mobilization plan for brush fires. The Stoneham Fire Chief participates in this plan.	None.
Fire Prevention Association of Massachusetts: Stoneham's Fire Prevention officers attend monthly meetings in conjunction with the State Fire Marshall's office.	

5.7 Existing Town-Wide Mitigation for Extreme Temperature-Related Hazards

Extreme Temperature Mitigation Measures	Recommended Improvements
Water Use at Housing Authority Properties: The Housing Authority monitors water consumption at their properties.	None.
Backup Water Supply: A three million gallon water tank was built on Colonial Drive ten years ago, for additional water supply.	None.
Public Alerts: The Stoneham Police Department issues public cold weather alerts.	None.
Emergency Shelters: The Town's emergency shelters include the Senior Center and the Stoneham Congregational Church, both of which have been used as warming stations in the past. Please refer to Section 5.2: Existing Multi-Hazard Mitigation Measures for more information on Stoneham's emergency shelters.	None.

5.8 Existing Town-Wide Mitigation for Geologic Hazards

Geologic Mitigation Measures

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

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

Recommended Improvements

None.

5.9 Mitigation Capabilities and Local Capacity for Implementation

Under the Massachusetts system of "Home Rule," the Town of Stoneham is authorized to adopt and amend any local bylaws and regulations that support the Town's capabilities to mitigate natural hazards. These include the Zoning Ordinance, Stormwater Ordinance, Subdivision and Site Plan Review Regulations, Wetlands Ordinance, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Ordinances may be amended by the Town Board of Selectmen to improve the Town's capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission. The Town of Stoneham has recognized several existing mitigation measures that require implementation or improvements and has the capacity based on these Home Rule powers within its local boards and departments to address them. The Town also can expand on and improve the existing policies and programs listed in the sections above.

6 STATUS OF MITIGATION MEASURES FROM THE 2010 HMP

6.1 Implementation Progress on the Previous Plan

The Town of Stonehamhas taken steps to implement findings from the 2010 Hazard Mitigation Plan into the following policy, programmatic areas, and plans: the 2012 Open Space and Recreation Plan and the Housing Production Plan. During expert interviews and a Stoneham Core Team meeting, Town staff reviewed the proposed mitigation measures identified in the Town's 2010 Hazard Mitigation Plan. The Core Team recognized that it was important to determine which mitigation measures were still relevant and whether each measure had been implemented or deferred. Of those measures that had been deferred, the Committee evaluated whether the measure should be deleted or carried forward into this 2021 HMP-MVP Plan. The decision on whether to remove or retain a particular measure was based on the Committee's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the Town to take action on the measure. Table 6-1 summarizes the status of the mitigation measures, along with the priority of these measures.

Table 6-1: Status of Mitigation Measures from the 2010 HMP

2010 Mitigation Priority	2010 Priority	Current Status	Carry Forward?	2021 Priority
MacArthur Road Drainage Improvements	High	This work has been completed.	No	NA
Spring Street Drainage Improvements	High	This work has been completed.	No	NA
Prepare a drainage study of Montvale Avenue	High	In process (design is 95% complete).	Yes	High
Upgrade drainage on Park Street at the Marble Street drain	High	In process. The Town initiated an investigation of the existing drainage in that intersection.	Yes	High
Review and revise local bylaws and regulations on stormwater and floodplains to ensure continued compliance with NFIP	Medium	Not Completed. Bylaw review is anticipated to be completed in the next year or two.	Yes	Medium
Land acquisition and protection of open space	Medium	Ongoing. The Open Space and Recreation Plan was updated in 2018. Because so much land is open space, better management practices are a focus of the strategy, with strategic land aquisitions to protect vaulable natural resources.	Yes	Medium
Purchase a new street sweeper	Medium	Not Completed. The Town has a street sweeper, but will need a newer model in the next year or two.	Yes	Medium
Widen access roads to the Middlesex Fells to improve firefighting access	Medium	The roads at Middlesex Fells are owned by the DCR. The Town is willing to partner on this.	No	Medium
Install water service at the Middlesex Fells	Medium	Any water service at Middlesex Fells must be installed by the owner, the DCR.	No	Medium

Additionally, several mitigation measures from the 2010 HMP were identified as ongoing, high priority action items, including:

- Montvale Avenue drainage study
- Drainage upgrades for Park Street (at Marble Street drain)
- Continued compliance with NFIP.

As the Town moves forward into the next five-year plan implementation period; identifying and incorporating hazard mitigation into the Town's decision-making process will be a high priority. Limited staffing and financial resources are the biggest challenges the Town faces in implementing the mitigations measure identified in this plan. This plan is intended to assist the Town in prioritizing the proposed measures, which will assist in allocating available grant or funding sources.

7 HAZARD MITIGATION AND CLIMATE ADAPTATION STRATEGY

7.1 Identification of Hazard Mitigation and Climate Adaptation Strategies

The Town developed a list of priority hazard mitigation and climate adaptation strategies through a multi-faceted approach. Strategies were discussed and developed upon review of the:

- Community profile, including the Town's strengths and vulnerabilities;
- Hazard and climate change risk assessment;
- Existing measures;
- Previously identified action items; and
- Input from stakeholders.

Stakeholders were engaged through Core Team meetings, the CRB Workshop, and the public input session. The full list of all the action items from the CRB Workshop is available in Appendix C and was integrated into the final list of action items developed by the Core Team. Table 7-1 below represents the Town's recommended hazard mitigation measures, including "highest-high" and "high" priority action items. These action items are organized using five feature categories:

1. Infrastructural
2. Societal
3. Environmental
4. Planning & Regulation
5. Communication & Coordination

Although the recommendations are grouped using this framework, many action items can relate to multiple categories. Similarly, although adaptation strategies often protect against more than one climate impact, the main hazard addressed by each action is identified in Table 7-1 using a series of icons.

Each mitigation measure is paired with an estimated cost, timeframe, and implementation responsibility. These considerations also informed the prioritization of the mitigation measures. A description of the prioritization categories used in Table 7-1 is included below.

Mitigation Action – A brief description of each mitigation measure that was identified in this plan.

Implementation Responsibility – Most mitigation measures will require a multi-department approach where several Town departments share responsibility. This determination is at the discretion of the governing body of the community. The designation of implementation responsibility in the table was assigned based on general knowledge of the responsibilities of each municipal department. The lead responsible party is identified in bold.

Time Frame – The time frames represented below are assigned based on the complexity of the measure, the overall priority of the measure, and at what stage of the design and/or funding has been attained. Because the time frame for this plan is five years, the timing for all mitigation measures has been kept within this framework. The identification of time frames is not meant to

prevent a community from actively seeking out and taking advantage of funding opportunities as they arise.

Approximate Implementation Cost – Approximate implementation costs are given for all mitigation measures. All cost data would need to be updated at the time of design and construction and is only provided as an estimate as follows:

$: <$10,000
$$: <$50,000
$$$: <$100,000

Priority – Designation of a high, medium, or low priority was based on overall potential benefits, areas affected, and estimated project costs. A High Priority action is very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure. A Medium Priority action may have political and public support and necessary maintenance had the potential to occur following the project. A Low Priority action may still have implementation support but is not currently a high priority for the Town.

Table 7-1 Hazard Icon Legend:


All hazards


Heavy precipitation and flooding


Severe thunderstorms, wind, nor'easters, tornado


Severe snow, ice, extreme cold


Extreme heat, drought, wildfire

Table 7-1: Recommended Hazard Mitigation Measures

Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
			Infrastructural			
	Reduce inflow and filtration into the sewer system	DPW	Medium	$$	M	Municipal General Fund, State, Grants (as available)
	Improve catchbasin cleaning	DPW	Short	$	H	Municipal funds, State, HMPG Grants(as available)
	Identify opportunities for water storage	DPW Conservation Commission	Medium	$	H	Municipal General Fund, DEP, MVP Action Grant, HMPG/Other Grants (as available)
	Assess stormwater infrastructure for erosion/stabilization measures.	DPW Conservation Commission	Medium	$	H	Municipal General Fund, DEP, MVP Action Grant, HMPG/Other Grants (as available)

Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
	Assess and prioritize conducting stream cleanouts and invasive species removal to prevent flooding issues.	**Conservation Commission** DPW	Short	$	H	Municipal General Fund, DEP, MVP Action Grant, HMPG/Other Grants (as available)
	Re-evaluate greenway infrastructure for flood mitigation in the Maple Street area.	**DPW**	Medium	$$	H	Municipal General Fund, DEP, MVP Action Grant, HMPG/Other Grants (as available)
	Address roadway parking conflicts	**DPW** Planning Department	Medium	$$$	L	Municipal General Fund, MassWorks, MassDOT, Other Grants (as available)
	Design and implement curbing improvements in areas of poor street drainage to assist in reducing street flooding issues.	**DPW** Planning Department	Long	$$$	H	Municipal General Fund, MassWorks, MVP Action Grants, Other Grants (as available)

Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
	Assess town roadways and implement opportunities to introduce green space to reduce flooding and reduce the heat island effect.	**DPW** Planning Department	Medium	$$$	H	Municipal General Fund, DEP, MVP Action Grants, Other Grants (as available)
	Assess existing drainage pipes and streams at the high school site and upgrade as needed.	**School Department** Facilities Conservation Commission	Short	$$$	H	Municipal General Fund, DEP, Other Grants (as available)
	Maximize the use of the high school site in the following ways: • Green infrastructure • Solar and renewable energy • Energy efficiency • Drought tolerant landscaping	**School Department** Facilities Conservation Commission	Short	$$$	H	Municipal General Fund, DEP, MVP Action Grants, Other Grants (as available)

Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
	Conduct an assessment of town-owned buildings, including a roof inventor and assessment of generator capacity/installation requirements, and provide for any necessary structural upgrades.	**Facilities**	L	$$$	H	Municipal General Fund, DEP, MVP Action Grants, BRIC, Other Grants (as available)
	Conduct a building assessment of the senior center and the surrounding area for consideration of current basement flooding in an attempt to install measures that will reduce impacts during heavy rain events.	**Facilities**	M	$$	H	Municipal General Fund, MVP Action Grants, Other Grants (as available)
Societal						
	Provide a location that can store and distribute necessary medical vaccinations during emergencies.	**Board of Health** Emergency Management Facilities	Short	$$	H	Municipal General Fund, Other Grants (as available)
	Conduct an assessment of shelter facilities to determine a deficiency in facilities and supplies and complete a facility life cycle inventory. Provide upgrades as needed.	**Emergency Management** Facilities Council on Aging	Medium	$$-$$$	M	Municipal General Fund, MVP Action Grants, Other Grants (as available)

Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
	Increase the supply of safe, structurally sound, and easily accessible affordable housing to ensure vulnerable populations can secure reliable housing.	**Planning & Community Development Director** Housing Authority Planning Board	Ongoing	$$$	H	Municipal General Fund, HUD CDBG, OHCD, Other Grants (as available)

Environmental						
Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
	Inventory and audit the drainage system as a mechanism to identify opportunities for green infrastructure improvements.	**DPW** Planning Department	Medium	$$	M	Municipal General Fund, MVP Action Grants, Other Grants (as available)
	Adopt a tree management plan that discusses storm damage and debris and a post-storm assessment mechanism to streamline response efforts after hazard events.	**DPW** Conservation Commission	Short	$	M	Municipal General Fund, MVP Action Grants, Other Grants (as available)
	Assess poor drainage areas for mosquito habitat and develop and perform mitigation actions.	**DPW** Conservation Commission Board of Health	Short	$$	M	Municipal General Fund, MVP Action Grants, Other Grants (as available)
	Assess tree damage due to temperature variations	**DPW** Conservation Commission	Medium	$	M	Municipal General Fund, MVP Action Grants, Other Grants (as available)

Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
	Conduct a roadway and parking lot assessment for opportunities for the installation of green infrastructure.	**DPW** Planning Department	Long	$$$	M	Municipal General Fund, MVP Action Grants, Other Grants (as available)
	Increase opportunities for rideshare, public transportation, alternative modes of transportation, and electric vehicle use.	**DPW,** Planning Department State Legislators	Long	$$$	L	Municipal General Fund, MassWorks, MassDOT Grants, Other Grants (as available)
	Establish a tree planting program	**Tree Commission** DPW	Short	$	H	Municipal General Fund, DEP, Other Grants (as available)
Planning & Regulation						
	Conduct a watershed analysis study	**DPW** Conservation Commission	Short	$$	H	Municipal General Fund, MVP Action Grants, Other Grants (as available)

Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
	Review and update the snow management plan	DPW Fire Police	Short	$	L	Municipal General Fund, HMPG, Other Grants (as available)
	Review and improve roadway design standards for drainage, cleaning, and catch basin maintenance	DPW	Medium	$	H	Municipal General Fund, MVP Action Grants, HMPG, Other Grants (as available)

	Update the town's development regulations (master plan, bylaws, and other regulations) to ensure that they do not exacerbate climate change impacts or place unsustainable stress on municipal services and supplies (such as water supply or fire services). Regulations should include: • Require nature-based design solutions for stormwater controls. • Conserve/add street trees or replace dying trees. • Require green infrastructure methods into construction and site design. • Require energy efficiency components in all new development and re-development. • Strategies and recommendations for alternate modes of transportation. • Requirements for tree-trimming and maintenance program. • Incentivize cluster development.	Planning Department	Short	$	H	Municipal General Fund, MVP Action Grants, MAPC and Other Grants (as available)

Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
⚠	Develop standards for solar and renewable energy and determine appropriate locations for installation.	**Planning Department**	Short	$	H	Municipal General Fund, MVP Action Grants, Other Grants (as available)
⚠	Review and update parking requirements.	**Planning Department**	Short	$	M	Municipal General Fund, MassDOT, Other Grants (as available)
Communication & Coordination						
⚠	Increase awareness and education surrounding energy efficiency measures and strategies.	**Planning Department** Town Administrator DPW	Ongoing	$	H	Municipal General Fund, MVP Action Grants, Other Grants (as available)
⚠	Analyze ways to increase communications with vulnerable populations and reach more people regarding important information related to emergency preparedness and response.	**Emergency Management** Council on Aging Town Administrator	Short	$	H	Municipal General Fund, MVP Action Grants, HMPG, CDBG, Other Grants (as available)

Hazard Type	Mitigation Action	Implementation Responsibility	Time Frame Short = 1-2 years Medium = 2-3 years Long = 4-5 years	Approximate Cost	Priority	Possible Funding Sources
	Improve communication and relationships with facilities tailored to vulnerable populations (elderly housing, disabled facilities, substance abuse facilities).	**Board of Health** Town Administrator	Short	$	H	Municipal General Fund, MVP Action Grants, CDBG, Other Grants (as available)
	Develop regional partnerships for fire hazards and actions for public education on fire hazards and safety	**Fire Department**	Short	$	H	Municipal General Fund, MVP Action Grants, HMPG, BRIC, Other Grants (as available)

Of these action items, two emerged as immediate priorities for the Town:

Table 7-2: Priority Projects

Hazard	Mitigation Action	Implementation Responsibility	Time Frame	Cost
	Municipal Manpower/Mutual Aid/Regional Coordination. Establish and improve upon regional coordination efforts to address the needs of vulnerable populations such as the elderly and non-English speaking residents. Create cooperative agreements with non-profits, agencies, and surrounding municipalities to establish a support network.	**Emergency Management** Council on Aging Town Manager	Short	$
	Update the town's development regulations (master plan, bylaws, and other regulations) to ensure that they do not exacerbate climate change impacts or place unsustainable stress on municipal services and supplies (such as water supply or fire services). Regulations should include: • Require nature-based design solutions for stormwater controls. • Conserve/add street trees or replace dying trees. • Require green infrastructure methods into construction and site design. • Require energy efficiency components in all new development and re-development. • Strategies and recommendations for alternate modes of transportation. • Requirements for tree-trimming and maintenance program. • Incentivize cluster development.	**Planning Department**	Short	$

7.2 Potential Grant Funding Options

There is a great variety of funding available for Massachusetts municipalities, both through the state and federal governments. A full list of funding opportunities can be found on the Community Grant Finder webpage. The Community Grant finder provides a streamlined interface where municipalities can easily learn about grant opportunities. Specific funding options related to Action Items developed by Townsend are listed below.

Table 7-3: Funding Opportunities for Resiliency Projects

Category	Grant	Description	Limitations & Stipulations
Community Development	MassWorks Infrastructure Program	Provides grants to communities to help them prepare for success and contribute to the long-term strength and sustainability of the Commonwealth.	None
Emergency Management and Planning	Flood Mitigation Assistance Grant Program (FMA)	Implement cost-effective measures that reduce or eliminate the long-term risk of flood damage	building and other structures insured under the National Flood Insurance Program (NFIP).
Emergency Management and Planning	Hazard Mitigation Grant Program	Provides funding after a disaster to significantly reduce or permanently eliminate future risk to lives and property from natural hazards	None
Emergency Management and Planning	Pre-Disaster Mitigation (PDM) Grant Program	Provides funds for hazard mitigation planning and the implementation of mitigation projects before a disaster event	None
Energy	DOER	The DOER provides grant funding for clean energy-related programs	None
Energy	Green Communities Designation and Grant Program	Provides a road map along with financial and technical support to municipalities that pledge to cut municipal energy and meet other criteria	None
Energy	MassEVIP Fleet Incentives	Helps eligible public entities acquire electric vehicles and install charging stations	None
Environment	Community Forest Grant Program	Funding to establish community forests	None
Environment	Culvert Replacement Municipal Assistance Grant Program	Grant to replace undersized, perched, and/or degraded culverts located in an area of high ecological value	None
Environment	Dam and Seawall Program	Grants for the repair or removal of dams, seawalls, and levees	None

Category	Grant	Description	Limitations & Stipulations
Environment	Drinking Water Supply Protection Grant Program	Financial assistance to public water systems and municipal water departments for the purchase of land or interests in land	50% reimbursable
Environment	604b Grant Program	Water quality assessment and management planning	None
Environment	Land Use Planning Grants	Support effort to plan, regulate, and act to conserve and develop land consistent with Massachusetts' Sustainable Development Principles	None
Environment	LAND Grant Program	Helps cities and towns acquire land for conservation and passive recreation	Reimbursement rate: 52-70%
Environment	Federal Land & Water Conservation Fund	Funding for the acquisition, development, and renovation of parks, trails, and conservation areas.	A municipality must have an OSRP
Environment	MassTrails Program	Trail protection, construction, and stewardship projects	None
Environment	Municipal Vulnerability Preparedness (MVP) Program	Provides support implement climate change resiliency priority projects	None
Environment	Natural Resource Damages Program	Funding for restoration projects. Funding comes from settlements, so it does not follow a set schedule.	None
Environment	MS4 Grant Program	Meeting the requirements of the 2016 MS4 permit and reduce stormwater pollution through partnerships	Two or more municipalities subject to the 2016 Small MS4 General Permit (must apply together)
Public Safety	Emergency Management Performance Grant (EMPG)	Reimbursable grant program to assist local emergency management departments to build and maintain an all-hazards emergency preparedness system	Reimbursable
Public Safety	Public Assistance Program	The state reimburses governments and other	75% reimbursable

Category	Grant	Description	Limitations & Stipulations
		applicants for disaster-related costs	
Public Safety	Senior SAFE	Supports fire and life safety education for seniors	None
Public Safety	Student Awareness of Fire Education (S.A.F.E.)	Grants for local fire departments to teach fire and life safety to schools	None
Public Works and Transportation	Chapter 90 Program	Reimbursable grants on approved projects	None
Public Works and Transportation	Community Transit Grant Program	Funding to meet the transportation and mobility needs of seniors and people with disabilities	None
Public Works and Transportation	Complete Streets Funding Program	Technical assistance and construction funding	Eligible communities must pass a Complete Streets Policy and develop a Prioritization Plan
Public Works and Transportation	Municipal Small Bridge Program	Funding for small bridge replacement, preservation, and rehab projects	Bridges with spans between 10' and 20'

While the mitigation actions outlined in Table 7-1 were generated during the MVP Planning process, several items related to recommendations were included in the 2010 HMP. Table 7-3 below provides a comparison of previous action items included in the 2010 HMP and highest-high/high priority action items generated during the 2020 CRB Workshop. Please refer to Chapter 6 for a full list of proposed mitigation actions included in the previous HMP, along with corresponding status updates.

7.3 Regional Partnerships

Mitigating natural hazards is not confined to a local issue. The drainage systems that serve communities are often complex systems of storm drains, roadway drainage infrastructure, pump stations, dams, and other facilities owned and operated by a wide variety of agencies including the Massachusetts Department of Transportation (MassDOT) and the Department of Conservation and Recreation (DCR). The planning, construction, operation, and maintenance of these structures are integral to the hazard mitigation efforts of communities. These agencies are the Town's regional partners in hazard mitigation efforts.

These agencies also operate under the same constraints as communities do including budgetary and staffing limitations. And as all communities do, they must make decisions about numerous competing priorities. To implement many of these mitigation measures, all parties will need to work together towards a mutually beneficial solution.

8 PLAN ADOPTION AND MAINTENANCE

8.1 Plan Adoption

The Town of Stoneham 2021 HMP-MVP Plan was adopted by the Board of Selectmen on *[ADD DATE]*. Please refer to Appendix D for related documentation. The plan was approved by FEMA on [*ADD DATE*] for a five-year period that will expire on [*ADD DATE*].

8.2 Plan Implementation

The Core Team will use Table 7-1 as a guide for taking action to mitigate hazards and improve the Town's climate resilience. The time frame, implementation responsibility, and funding mechanisms in Table 7-1 layout an implementation plan for the Core Team. The Core Team will be held accountable through the tracking mechanisms explained in the following sections. The HMP-MVP Plan will also inform future planning and budgeting processes.

8.3 Plan Maintenance

8.3.1 Tracking Progress and Updates

FEMA's initial approval of this plan is valid for five years. During that time, the Town will need to continue to track progress, document hazards, and identify future mitigation efforts. This can be achieved through a combination of two methods:

1. Meetings: The Core Team, coordinated by Town Planner Erin Wortman, will meet once a quarter during regularly scheduled Tuesday morning project meetings to monitor plan implementation. The Core Team will be amended as needed but will include representatives from the Department of Public Works, Police, Fire, the Building Commissioner, FEMA Coordinator, and others. These meetings will provide an opportunity for regular check-ins, identifying overlaps and capital planning needs related to hazard mitigation, and forward-looking discussions regarding the next steps.
2. Surveys: The coordinator of the Core Team, Erin Wortman, will also prepare and distribute a survey every year. The survey will be made available to all Core Team members and any other interested local stakeholders. The questions in the survey will reference the tables of existing and proposed action items listed in the HMP-MVP Plan. The survey will assist in determining any necessary changes or revisions to the plan that may be needed. In addition, it will provide written documentation of status updates, accomplishments, and progress related to the action items listed in the HMP-MVP Plan. The surveys will also help document new hazards or problem areas that have been identified since the 2020 Plan. The information collected through the survey will be used to formulate an update and/or addendum to the plan.

8.3.2 Continuing Public Participation

The adopted plan will be posted on the Town's website. The posting of the plan on the Town's website will provide a mechanism for citizen feedback, such as an e-mail address for interested parties to send comments. The Town will encourage local participation whenever possible during the next five-year planning and implementation cycle. The Core Team will incorporate engagement into the implementation of the priority action items. All updates to the plan, including implementation progress,

will be placed on the Town's website. All public meetings related to the HMP-MVP Plan will be publicly noticed under Town and State open meeting laws.

8.3.3 Integration of the Plans with Other Planning Initiatives

Upon approval of the Town of Stoneham 2021 HMP-MVP Plan by FEMA, the Core Team will make the plan available to all interested parties and all departments with an implementation responsibility. The group will initiate a discussion with those various departments regarding how the plan can be integrated into their ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

Planning Department

Department of Public Works

Conservation Commission

Building Department

Housing Authority

Police Department

Fire Department

Open Space & Recreation Plan Committee

Appropriate sections of the HMP-MVP Plan will be integrated into other plans, policies, and documents as those are updated and renewed, including the writing of, or updates to, the Town's Master Plan, Open Space and Recreation Plan, Comprehensive Emergency Management Plan, and Capital Investment Program. Coordination with the Metropolitan Area Planning Council (MAPC), local organizations, businesses, watershed groups, and state agencies will be required for successful implementation and continuous updating.

8.4 Plan Update Process

By maintaining the Town of Stoneham 2021 HMP-MVP Plan, the Town will have a competitive application when applying to FEMA for funding to update the plan. If the Core Team decides to update the plan itself, the group will need to review the current FEMA hazard mitigation plan guidelines for any change in the requirements. The update to the Town of Stoneham 2021 HMP-MVP Plan will be forwarded to MEMA for review and to FEMA for ultimate approval. When appropriate, the Core Team will begin drafting the full update of the plan. This will help the Town avoid a lapse in its approved plan status and grant eligibility when the current plan expires at the end of year five.

APPENDIX A

Documentation of
Plan Preparation

Stoneham HMP/MVP Engagement Checklist

Completed?	Required MVP Task	Resources Needed	Options	Lead
✓	Kick Off Meeting	• Phone call/introductory meeting to go over process and next steps	Phone call, in-person or virtual meeting	• Town/WSE
✓	Core Team Meeting	• Core team meeting scheduled • Presentation by consultant giving overview of process • Decisions made about stakeholders, etc.	In-person or virtual meeting	• Town coordinates meeting time/location/staff • WSE prepares presentation and gives options for next steps
	Listening Session 1 (during planning process)	• Presentation of HMP/MVP project during the planning process	Standalone meeting (online) or item at the end of an existing agenda	• Town – place item on agenda • WSE – prepare presentation
Was scheduled for 3/23/20; cancelled	Community Resilience Building Workshop (CRB Workshop)	• Invitee-only workshop of key community stakeholders (staff, board members, community leaders) • Usually 8 hours (shortened for online post-COVID19 events)	• 1 or 2 day online workshop • WSE recommends that we do a pre-workshop video and survey to prepare attendees • Ideally, uses engagement tools (maps, whiteboard, etc.)	• WSE prepares event materials and runs workshop • Town identifies attendees • Invitation list should be representative • Hours count toward Town time commitment
	Listening Session 2 (after completion of plan)	• Presentation of the findings from the planning process, data and research, community engagement	Standalone meeting (online) or item at the end of an existing agenda	• Town – place item on agenda • WSE – prepare presentation
OPTIONAL Recommended by EEA	Community outreach to older students	• Agreement on target group and cooperation with schools • WSE can prepare for Town review	• Video • ESRI Story Map • PDF of printed booklet or poster	• Town chooses format and makes needed contacts with schools • WSE prepares media • Town reviews/distributes

Municipal Vulnerability Preparedness and Hazard Mitigation Planning Grant Project

Tuesday, February 18th, 2020
1:30 pm – 2:30 pm

1. Introductions
   Town Staff:
   - Dennis Sheehan
   - Erin Wortman
   - Brett Gonsalves

   W&S:
   - Caroline Wells
   - Amanda Kohn

2. Project Overview. Caroline gave a summary of the anticipated project. MVP planning projects begin with fact-finding about Stoneham's known hazards, and the anticipated effects of climate change. Because this process also includes a Hazard Mitigation Plan, we will also look for data on the town's critical infrastructure, floodplain, etc. We will schedule a Core Team Meeting with the Town where we will discuss technical issues, share information, and outline the process going forward (especially the CRB Workshop). The Core Team serves as the steering committee for the MVP process, and we may outreach to team members to gather information throughout the planning process. The Core Team is tasked with thinking through the correct invitees for the CRB workshop (and attending). The CRB Workshop is either an 8-hour day or two consecutive 4-hour days. At the workshop, we will present our preliminary data findings and discuss what climate change impacts that we expect globally, statewide and in Stoneham. We will also offer examples of potential nature-based solutions to issues like stormwater. We will break out the workshop into groups of about 5-6 people per table and they will be tasked with identifying significant features in the community, the most likely hazards that will impact the town, and actions that will increase resiliency. When the workshop is complete, will incorporate all of the input, data, and other information into a Summary of Findings. Once we have a draft Summary of Findings, we can begin our listening sessions. As Amanda pointed out, we will hold two sessions. One is preliminarily set for the Stoneham 101 event, and the other can be at a board meeting or standalone meeting. We will incorporate any input from the listening sessions into the final draft of the Summary of Findings, which will be sent to the EEA for approval.

3. Schedule. Tentative dates have been set in bold and will be confirmed by Stoneham:
   - Early March – **Core Team Meeting, March 3rd from 1-3 PM**
   - March – Interviews and information gathering
   - Early April – CRB Workshop
   - Prior to April 20th – Listening Session
   - April – Optional 2nd Core Team Meeting
     - **Stoneham 101- 10 AM-12 PM, Library, Saturday, April 4th;** table set up and people can come and interactive with staff; could do a separate small meeting with Conservation Commission

- Prior to June 15th – Report

Notes
- Department head meeting (March 18th) might be an option for a Core Team meeting

4. Core Team

Tentative List:
- Dennis Sheehan, Town Administrator
- Erin Wortman, Director of Planning and Community Development
- Brett Gonsalves, Director of Public Works
- Debbie Pettengill, Assistant to the Town Administrator
- Fire Department
- Police Department
- Building Department
- Board of Health
- Conservation Commission
- Recreation
- IT
- Schools
- Council on Aging

5. Stakeholders- CRB Workshop Participants

Tentative List:
- Boards and Committees
- Local Organizations
- DCR – own most of the land in Stoneham
- MWRA
    - Spot Pond is a backup for the Quabbin

6. Wrap Up and Next Steps. The following actions were identified:

Action Items	W&S	Town
Critical Infrastructure List	Follow up with data request	Email Fire Chief and Emergency Manager
Stakeholder List	Send a list of regional contacts and help develop other contacts with the Town	Develop a list of contacts with W&S
Send agendas for Core Team Meeting and CRB Workshop	X	
Develop materials for the Core Team Meeting and CRB Workshop	X	

TOWN OF STONEHAM

Municipal Vulnerability Preparedness Planning Grant Project

Core Team Meeting

Police Training Room
Tuesday, March 3, 2020
1:00 pm – 3:00 pm

AGENDA

Introductions — 5 minutes

In Attendance:

- Lindsey Adams
- Caroline Wells
- Dennis Sheehan
- Erin Wortman
- John Fralick
- Cheryl Noble
- Brian McNeil
- Maureen Canova
- Thomas Cicatelli
- James McIntyre
- Stephen Angelo

Project Overview — 20 minutes

1. MVP Program Overview
    a. Brief Introduction to Climate Change in Stoneham
    b. MVP Planning Process
    c. MVP Action Grants – Confirm: are we going for April's round of action grants?
        i. Listening session has been tentatively scheduled for April 4 at the Library, another later at a con com meeting
    d. Hazard Mitigation Overlap

Core Team Role — 5 minutes

1. Develop/approve list of stakeholders

   Core Team reviewed stakeholders list and provided names and organizations to invite. Stakeholder list will be posted to google drive and the core team will continue to update it this week.

2. Active participants in the Community Resilience Building Workshop
3. Promote the listening session/attend listening session

   There is a nursing home in the southwest corner of town which shows up as an environmental justice community. There is potential to do additional outreach with this group.

4. Inform community priorities/Determine how decisions from Workshop will be used

Goal Setting and Endorsement — 20 minutes

1. Large group activity on what a successful hazard mitigation and climate preparedness plan means to them.
2. Presentation of goals and large group discussion on how to incorporate comments

Core Team would like the goals to be posted on the Google drive so that Mike Rourke (asst. emergency manager) can review

Community Resilience Building Workshop and Review of Materials — 40 minutes

1. Goal of workshop, specific objectives

Core team reviewed hazards in Stoneham and will wait until the workshop to come up with final hazards

2. Core Team Role at Workshop
3. MVP Risk Matrix
    - Discuss hazards and key features (infrastructure, society, environment)

Environmental: there is a rat problem in town, potentially related to precipitation

~~4. Review map of key resources/assets~~

5. Prioritization Process MVP Key Actions

Potential Action Item: Creating Storage Capacity for downstream communities

6. Workshop Schedule
    - One 8-hour or two 4-hour meetings

Monday, March 23, 8:30 – 4:30 Location TBD

    - Weekday or weekend
    - Day or evening
7. Presentation Feedback

W&S Action Item: Finalize Workshop materials based on Core Team input
Stoneham Action Item: Help to fill mapping and PowerPoint gaps

Data Sources — 5 minutes

1. Interviews with municipal officials
   Interview Mike Rourke
2. Applicable reports and materials
3. Ask:
    a. Other ongoing efforts?
    b. Local hazards/experiences to highlight? - previous flood events, issue areas

W&S Action Item: Review materials and incorporate into Workshop and Report(s)
Stoneham Action Item: Identify and provide any additional resources

Workshop Participants — 15 minutes

1. Respond to a list of workshop invitees
   Send Google document to Core Team Today (Tuesday, 3/3);

Core Team will review and update stakeholders list by end of week (3/6);
Send draft invitation to Dennis by end of week (3/6);
Dennis to send out invitation Monday (3/9)
W&S Action Item: Draft invitation to stakeholders
Stoneham Action Item: Finalize list of invitees; send invitation and track RSVPs, assign participants to tables

Wrap Up and Next Steps 10 minutes

1. Confirm draft schedule

CRB Workshop Steps and Schedule:

3/9 Send out Invitation

3/16 Final RSVP

3/13 Draft Core Team materials completed EOD

3/16 Workshop Materials to Core Team for Review (agenda, critical facilities list, map, powerpoint)

3/16 Order Food

3/18 Deadline for workshop material edits

3/20 Complete workshop material edits

3/20 Print Materials

3/23 CRB Workshop

Next Steps:

In order to be eligible for April's grant round, we will need to complete a listening session before grants come out (mid-April?). If this is the case, we will need to start preparing for the listening session.

http://homenewshere.com/middlesex_east/article_15414a7e-ca06-11eb-a1fa-17a5d8919108.html

STONEHAM PEPARES FOR FLOODING, CLIMATE CHANGE

By PAT BLAIS
Jun 11, 2021

MUNICIPAL VULNERABILITY PREPAREDNESS

MIDDLESEX - A number Stonehamites and town officials believe a changing climate could worsen area flooding hazards, including by Montvale Avenue and within neighborhoods by various streams.

Based upon a draft version of a joint hazard mitigation and Municipal Vulnerability Preparedness (MVP) plan, those residing within the town have reason to be concerned about extreme temperature swings creating intense rain and wind storms capable of knocking out electricity and flooding various town neighborhoods bordering the Sweetwater Brook and numerous other wetlands areas.

In early May, during a Stoneham Select Board meeting, Town Planner Erin Wortman and Weston and Sampson project manager Caroline Wells outlined the findings of the joint report and a community resilience building (CRB) workshop led by Weston and Sampson in November of 2020 as part of Stoneham's quest to tap into millions of dollars in potential infrastructure restoration and development grants.

The March of 2021 MVP plan narrative suggests that Stoneham should coordinate with surrounding communities and other advocacy groups to deal with future flooding issues in and around a series of newer large-scale housing developments on Stoneham's borders.

Because climate change is also expected to drive drought conditions, which could similarly weaken and kill off trees within the vast conservation land spaces contained within Stoneham, the preparedness and hazard mitigation outlooks also seek to prepare for electricity and infrastructure damage caused by dead and dying trees.

Nearly one-third of Stoneham's land mass is designated as parkland, most of which is part of the state managed Fells Reservation. The conservation land borders part of Malden, Medford, Melrose and Winchester.

"We look at hazards that are most likely to impact Stoneham. From the historical data, we looked at how [events] like hurricanes and droughts have effected the town. We also look at the data projected for the town," Wells explained during a virtual presentation to the Select Board.

"Some things we are already seeing...for example, increased temperatures and flooding and inundation," the engineer continued. "Stoneham is generally in a really good position. It's not a coastal area and doesn't have a lot of areas that cause concern. There are however, a few areas of localized fooding and those are near some newer developments."

Now, local officials and consultants from engineering firm Weston and Sampson want to know whether there's widespread community consensus about the findings.

Those interested in commenting on the plan are being encouraged by Wortman to download a copy of it via the Town of Stoneham's website.

"The Town of Stoneham received a grant from the MA Office of Energy and Environmental Affairs (EEA) to research and prepare a plan to mitigate natural hazards and to prepare the town for climate changes. The draft plan is posted for public review and comment," Wortman and other town officials explained in a recent news blurb release.

According to Wells, in the coming months — an exact timeline has not yet been finalized —Stoneham's leaders hope to seek out funding based upon the 142-page climate change report.

"This plan really puts the town in a good position for future funding for hazards and climate change issues," the Weston and Sampson consultant told the Select Board, which will likely have to produce matching funding to obtain some of the numerous state grants available upon approval of the document. "The task now is to really refine your budget."

During the MVP workshop in March, the Weston and Sampson team circulated climate change models that forecast potentially devastating environmental and public safety risks arising from more severe winter storms and rainy seasons, as well as cyclical drought events.

According to workshop facilitators, climatologists are already worried about present day temperature spikes, which have reportedly increased each decade by an average of a half degree Fahrenheit (F). Winter temperatures have grown warmer at a more aggressive average rate of 1.3 degrees per decade.

"We want to think about maintenance and design for more frequent and severe storms. In relation to droughts, we predicted people will be using more energy. The may be using air conditioners more and relying more heavily on utilities," Wells told town officials.

“We can design [development features like parking lots] differently when we’re talking about increased temperatures. For example, can we break up heat islands by strategically planting trees [and other landscaping buffers]?” the engineer later asked.

Worried about worse flooding events in areas around Spot Pond and various other water bodies in and around the Fells Reservation, MVP report stakeholders also suggested that Stoneham’s major thoroughfares and side streets could also be rendered impassible by more frequent tree damage and power outages.

Of particular concern are a series of new developments that have been built on Stoneham’s borders during the past decade. For example, a 200-unit apartment complex by I-93 and the Winchester line off of Fallon Road is situated right by one of Stoneham’s two flood zones.

A second flood plain is situated along Montvale Avenue, one of the community’s busiest traffic corridors that processes commuters heading to and from I-93.

By the Malden, Medford, and Melrose lines, situated within the Fells Reservation, another 300-unit housing project came online in 2018. Also by the Melrose line, a new 264-unit housing development at the former Weiss Farm property off of Franklin Street, situated by a series of delicate wetlands areas that have historically been prone to flooding, is also likely to take root in the coming years.

Ultimately, the group recommended Stoneham take various immediate actions to address those potential hazards, including coordinating a strong mutual assistance plan with abutting towns and cleaning out a series of streams, stormwater drains, and culverts situated within residential neighborhoods.

Citizens and local leaders are also eyeing a potential high school rebuilding project by Franklin Street as an opportunity to do the following:

• Create a new and larger emergency shelter area for vulnerable populations;

• Improve surrounding drainage culverts and stormwater management systems;

• and create a model building with energy efficient building materials and HVAC systems.

“In building the new high school and working on the flooding issues we already have, we want to make sure we do this right,” said Select Board member Raymie Parker in response to the 142-page report. “We want to keep this conversation fresh.”

Stoneham officials were able to retain Weston and Sampson and complete the draft MVP plan thanks to a $15,000 grant obtained in the January of 2020.

Established in 2017, the MVP program has helped more than 200 communities across Massachusetts with the development of similar climate change strategies.

As of the spring of 2018, nearly $10 million was allocated to the handful of cities and towns that have applied for funding and obtained approval of MVP action plans.

According to Wells, with an increasing number of cities and towns now in pursuit of that limited pool of annual funding, the grant application process has become quite competitive in recent years.

APPENDIX B

Critical Facilities List

CRITICAL FACILITIES and VULNERABLE POPULATIONS

A Critical Facility is defined as a building, structure, or location which:

- Is vital to the hazard response effort.
- Maintains an existing level of protection from hazards for the community.
- Would create a secondary disaster if a hazard were to impact it.

Critical facilities in the Town of Stoneham have been identified with help from knowledgeable Town staff, MassGIS data, and existing Town and Regional Plans.

Critical facilities and vulnerable populations have been broken into four categories: Emergency Response, Non-Emergency Response, Dangerous/Hazard Materials and Facilities, and Facilities and Populations to Protect.

Category 1 – Emergency Response Facilities

Emergency response facilities that are necessary for the Town in the event of a disaster.

1. Police and Fire Department

Police Department	47 Central Street
Fire Department	25 Central Street

2. Town Facilities

Department of Public Works	16 Pine Street

3. Pump Stations

North West Sewer Pump Station	North Street opposite Crosby Road
South Side Sewer Pump Station	Fallon Road
East Side Sewer Pump Station	Rita Road
Citation Avenue Sewer Pump Station	Citation Avenue (between)
Upland Road Sewer Pump Station	Upland Road (between)
Gillis Water Pump Station	2 Woodland Road

4. Primary Evacuation Routes
   - I-93
   - Route 28

Category 2 – Non-Emergency Response Facilities

The Town has identified these facilities as non-emergency facilities; however, they are considered essential for the everyday operation of Stoneham.

5. Town Facilities

Town Hall	35 Central Street
Stoneham Public Library	431 Main Street
Senior Center	136 Elm Street
Housing Authority	11 Parker Chase Road

6. Natural Resources
   - Spot Pond

North Reservoir
Middle Reservoir
Dikes Pond
Doleful Pond
Buckman Pond
Fells Reservoir
Quarter Mile Pond
Winchester Reservoir
Crystal Lake Watershed
FEMA National Flood Hazards
DEP Wetlands
Open Space & Conservation Land

7. Religious Centers

St Patrick's Parish	71 Central Street
Vine39	39 Pleasant Street
St James United Methodist Church	50 Central Street
First Congregational Church in Stoneham	1 Church Street
Seventh Day Adventist	9 Gerry Street
Stoneham Memorial Seventh-day Adventist Church	29 Maple Street
Boston Korean SDA Church	4 Spring Street

Category 3 – Dangerous/Hazardous Materials and Facilities

8. Dams

Fells Reservoir Dam - #1
Fells Reservoir Dam - #2
Fells Reservoir Dam - #3
Fells Reservoir Dam - #4
Fells Reservoir Dam - #6
Fells Reservoir Dam - #7
Fells Reservoir Dam - #8
Spot Pond Dam
Spot Pond Dike #2
Spot Pond Dike #3
Spot Pond Dike #4
Spot Pond Dike #5
Spot Pond Dike #10
Spot Pond Dike #12

9. Landfill

Stevens Street Recycling Center	49 Stevens Street

10. Underground Storage Tanks

Ryder Truck Rental	150 Fallon Road
Beacon Service Center	311 Beacon Street
Beacon Service Center	426 Main Street
Love's Furniture Warehouse Inc	5 Spencer Street
SJM Reality Trust	20 Gould Street
George Mann Co Inc	105 Central Street
JLJ 128 Enterprises Inc	151 Main Street

New England Auto Leasing Inc	80 Montvale Ave
Plymouth Rock Transportation Corp	95 Maple Street
Town of Stoneham	35 Central Street
Stoneham Motor Co Inc.	185 Main Street
Vacon & Son Oil Co Inc.	13 Gould Street
Mobil Facility 01-JEF	250 Main Street
Commonwealth of Massachusetts DPWMDC	164 Pond Street
Ackerley Communication	89 Maple Street
Cris Coviello & Sons Inc	30 Pine Street
01-019 Mobil Oil	2 South Street
Shell Oil Co	308 Main Street
Merit Stoneham	163 Main Street
Mobil Oil Corp	96 Montvale Ave
Reilly's Citgo	492 Main Street
Leda Management	2 Lynn Fells Pkwy
Public Works Department	16 Pine Street
Wheels Corporation DBA Sunoco	490 Main Street
New England Memorial Hospital	5 Woodland Road
Cumberland Farms Inc	86 Main Street
Mobil Facility #01-412	225 Main Street
Bear Hill Golf Course	5 North Street
Jerome F Terminiello Jr	249 Main Street
Waterworks Construction Office	4 Woodland Road
Spot Pond Pumping Station	2 Woodland Road

11. Gas Station

12. Hazardous Materials Site

109 Central Street
430 Main Street
105 Central Street
308 Main Street
15 Rustic Road
41 Pleasant Street
101 Central Street
128 Franklin Street
30 Pine Street

Category 4 – Vulnerable Populations and Community Facilities

13. Housing Authority Properties

Washington Avenue
11 Parker Chase Road
Duncklee Avenue
Calthea Street & Washington Street
Washington Avenue & Prospect Street

Washington Street & Avenue Veterans Houses

14. Nursing Homes

Life Care Center of Stoneham	25 Woodland Road
Arnold House Nursing Home	490 William Street
Fuller House of Stoneham Rest Home	32 Franklin Street
Bear Hill Nursing Center at Wakefield	11 North Street

15. Schools/Daycare

Stoneham High School	149 Franklin Street
Stoneham Central Middle School	101 Central Street
Robin Hood Elementary School	70 Oak Street
South Elementary School	7 Summer Street
Colonial Park School	30 Avalon Road
Central Elementary School	36 Pomeworth Street
St Patrick Elementary School	20 Pleasant Street
Greater Boston Academy	108 Pond Street
Purpose Pre-Kindergarten School	1 Church Street
SEEM Collaborative-Seem Middle School	25 William Street
SEEM Collaborative–SEEM Therapeutic Lea	175 Collincote Street
SEEM Collaborative–Therapeutic Learn/EA	12 Beacon Street
Stoneham Special Education	149 Franklin Street
Stoneham Community School Age	39 Pleasant Street

16. Grocery Stores

Stop & Shop	259 Main Street

17. Youth Services

Y Academy Stoneham	39 Pleasant Street
Boys & Girls Club of Stoneham & Wakefield	15 Dale Court

18. Food Pantry

First Congregation Church of Stoneham	1 Church Street

19. Census Tracts with 25% of people who are >65

20. Census Tracts with 25% of people who are <18

21. Environmental Justice Census Tracts

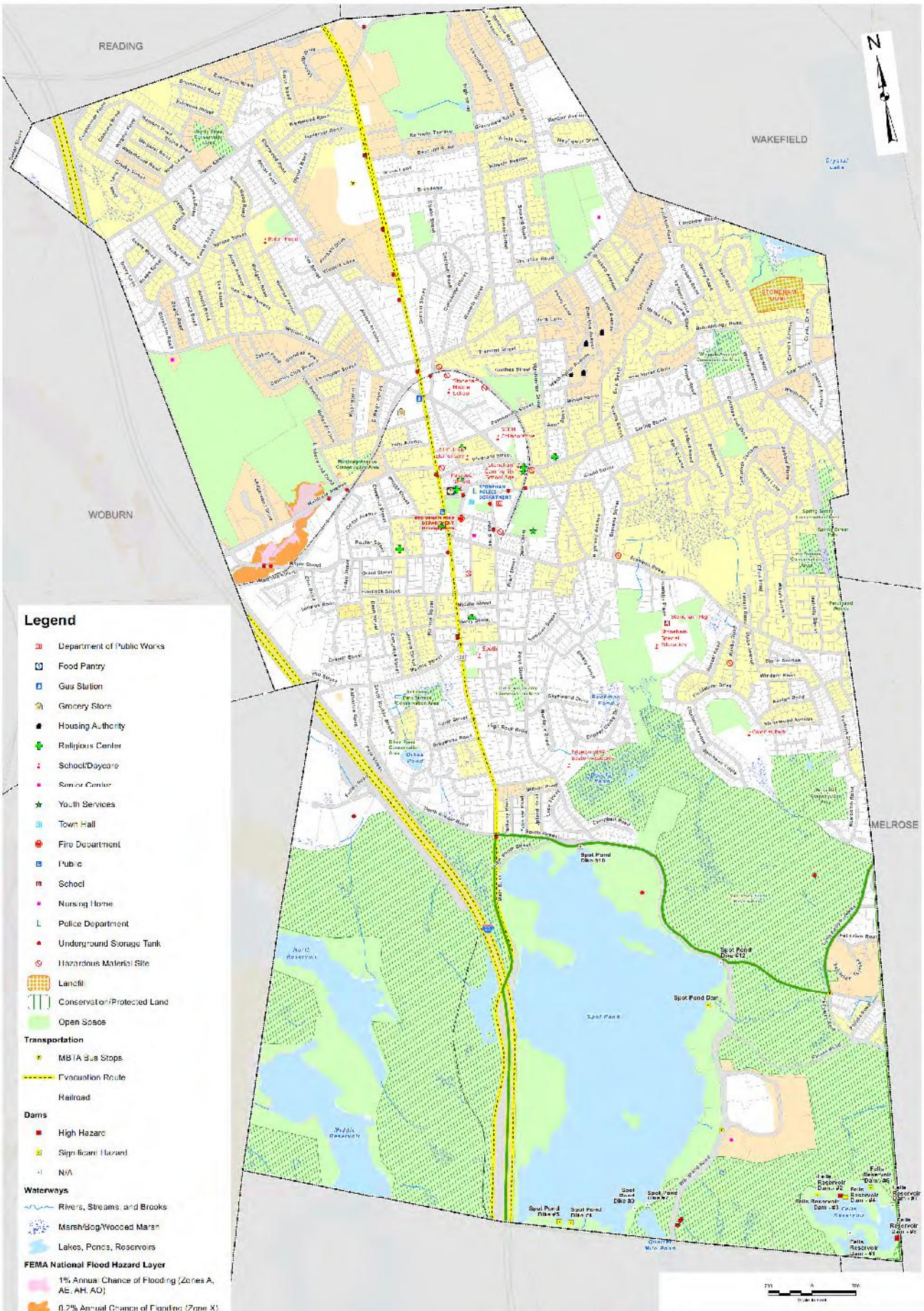


FIGURE 1

TOWN OF STONEHAM, MASSACHUSETTS

MUNICIPAL VULNERABILITY PREPARDNESS HAZARD AND FEATURE MAP

AUGUST 2020 SCALE: NOTED

Weston & Sampson

APPENDIX C

Community Resources Building Matrices

Community Resilience Building Risk Matrix 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	INCREASED PRECIPITATION	INCREASED TEMPERATURES	WIND	DROUGHT		Priority H - M - L	Time Short Long Ongoing
Infrastructural										
Sewer pump stations			V	reduce inflow/infiltration into system,	N/A	N/A	N/A			
stormwater drainage system (cleanout)			V	improve catchbasin cleaning, inventory and audit of drainage system, identify opportunities for green infrastructure improvements, identify opportunities for water storage, watershed analysis,	Assess stormwater infrastructure for erosion/stabilization, assess poor drainage areas for mosquitos, assess tree damage due to temp variations,					
River/stream system			V	stream cleanouts, identify opportunities for stream management plans, look at regional impacts of development, look at smart growth/development regulations/design guidelines		tree damage and debris, stream cleanout and management plan, post storm assessment, preliminary stream mitigation, invasive species removal,	stream cleanouts, invasive species removal,			
Downtown street system/local roads			V	snow management plan updates, address roadway parking conflicts, curbing improvements for drainage, upgrade roadway designs for drainage, cleaning catchbasins,	assess trees for damage, improve streetscape/pavement removal, assess roadways for intro of roadway greenspace, downtown tree inventory/redesign, reduce heat island effect,	assess trees for damage, assess building damage	falling trees			
Dense neighborhoods/roadway layout (narrow)			V							
New High School Construction			S	install green infrasturure, ensure existing drainage pipe is adequate and structurally sound, balance impervious and pervious, solar and renewable energy, energy efficient building, pervious pavement installation,	solar and renewable energy,	wind generator(turbine), reinforce electrical and lighting to withstand winds,	assess landscape plan for drought tolerance/impacts, water storage			
Municipal buildings (generators)			V	maximize high school site, overall building assessment, roof inventory and infrastructure upgrades,	maximize high school site for green infrastructure/energy efficiency, cooling station ability, temperature set controls, upgrade hot water systems, refrigeration (freezer)/energy supply for medical,	assess utility connections to buildings, generator feasibility,	water storage,			
Shelter facilities (middle school/high school/senior cnt/arena)			V	review existing drainage structures, overall building assessments, roof assessments and replacements, facility life cycle inventory,	generator assessments,	assess utility connections to buildings, generator feasibility,				

Overhead electrical wire network			V	proactive tree maintenance around power lines,	sufficient load capacity, energy efficiency public education,	asses utility pole infrastructure, asses ability to bury lines, proactive tree maintenance,	tree assessment and maintenance			
Lack of greenspace along roadways (roadway design for stormwater)			V	Roadway and parking lot assessment for opportunities for installation of green infrastructure, review and update parking requirements,	Roadway and parking lot assessment for opportunities for installation of green infrastructure, review and update parking requirements,	tree inventory/assessment, opportunities to introduce more trees				
Development Regulations			V	assess development regs for green infrastructure, energy efficiency, update and incentivize regulations for cluster development	assess development regs for green infrastructure, energy efficiency, update and incentivize regulations for cluster development	assess development regs for green infrastructure, energy efficiency, update and incentivize regulations for cluster development	assess development regs for green infrastructure, energy efficiency, update and incentivize regulations for cluster development			
Senior center basement flooding			V	building assessment, drainage upgrades on the site/within building, drainage assessment of surrounding area,	assessment for cooling/heating upgrades for swing in temperatures	N/A	N/A			
Societal										
Manpower/Mutual Aid Support/Regional										
Senior Housing facitilies				building inventory/assessment, increase affordable housing supply,						
Preschool facilities				building inventory/assessment,	assess building ventilation systems,	N/A	N/A			
Private day schools (2)				Establish communications to determine needs/issues,						
Public Housing				building inventory/assessment, increase affordable housing supply,	building inventory/assessment, increase affordable housing supply, upgrades for heating/cooling, energy efficiency upgrades in publicly supported housing,	building inventory/assessment, increase affordable housing supply,	building inventory/assessment, increase affordable housing supply,			
Social isolation/information networks				consolidate information distribution, analyze ways to reach more people (language, access to internet, modality),	consolidate information distribution, analyze ways to reach more people (language, access to internet, modality)	consolidate information distribution, analyze ways to reach more people (language, access to internet, modality)	consolidate information distribution, analyze ways to reach more people (language, access to internet, modality)			
Non-profit facilities/multi-family buildings				look into substance abuse/disability facility on Maple St., improve communications with facilities/identify points of contact,	look into substance abuse/disability facility on Maple St., improve communications with facilities/identify points of contact,					
Environmental										
Air quality				Increase opportunities for rideshare/public transportation/shared transportation/alternative modes, support electric vehicle use, natural gas leakages (effect on trees, public health)	plant trees					

1/3 is State owned land (the Fells)						develop regional partnership for fire hazards, actions for public education on fire hazards and safety,	develop regional partnership for fire hazards, actions for public education on fire hazards and safety,			
Lack of adequate tree/landscaping							ways to assist with water supply			
Maple Street area flood/stream issues				reevaluate greenway insfrastructure for flood mitigation,						

Stoneham Municipal Vulnerability Preparedness Plan Workshop Invitees

Group	Invitee	Title	Organization	Email	Attend CRB?
Town Staff	Jen DeCourcy		Conservation	jdecourcy@stoneham-ma.gov	Yes
Town Staff	Parker Rayme	Records Department	Police Department	rparker@stoneham-ma.gov	Yes
Town Staff	Melanie Mendel	Veteran Services Officer	Veterans Services	mmendel@stoneham-ma.gov	Yes
Town Staff	Officer Joseph Ponzo	Safety Officer	Police		Yes
Town Staff	Officer Michael Colotti	School Resource Officer	Police		Yes
Town Staff	Captain Dave Eastman	Fire Prevention	Fire		Yes
Town Staff	Eric Richard	Deputy Director	Department of Public Works		Yes
State and Regional	Jason Lewis	State Senator	Massachusetts Senate	jason.lewis@masenate.gov	Yes
State and Regional	Emily Granoff	Dist. Director - Senator Lewis' Office	Massachusetts Senate	Emily.Granoff@masenate.gov	Yes
State and Regional	Megan Day	Executive Director	Stoneham Chamber of Commerce	megan@stonehamchamber.org	Yes
State and Regional	Carolyn Mecklenburg	Regional Coordinator	EEA	carolyn.meklenburg@state.ma.us	Yes
State and Regional	Mike Day	State Representative	Massachusetts House of Representatives		Yes
State and Regional	Ed Markety	Senator	US Senate		Yes
State and Regional	Elizabeth Warren	Senator	US Senate		Yes
State and Regional	Katherine Clark	Congressmen	US House of Representatives		Yes
State and Regional	Terrence W Kennedy	Representative	Governor's Council Sixth District	twkennedylaw@gmail.com	Yes
State and Regional	Julie Wormser	Deputy Director	Mystic River Watershed Association	julie.wormser@mysticriver.org	Yes
State and Regional	Jeffrey Zukowski	Hazard Mitigation Planner	MEMA	jeffrey.zukowski@state.ma.us	
Core Team	Dennis Sheehan	Town Administrator	Adminstration	DSheehan@stoneham-ma.gov	
Core Team	Brett Gonsalves	Town Engineer	Department of Public Works	BGonsalves@stoneham-ma.gov	
Core Team	Brian McNeil	Facilities Director	School Department	bmcneil@stonehamschools.org	
Core Team	Maureen Canova	Director	Council on Aging	mcanova@stoneham-ma.gov	
Core Team	Erin Wortman	Director	Planning and Community Development	ewortman@stoneham-ma.gov	
Core Team	Matthew Grafton	Chief of Fire	Fire	mgrafton@stoneham-ma.gov	
Core Team	Cheryl Noble	Building Commissioner	Building Department		
Core Team	James T. McIntyre	Chief of Police	Police		
Core Team	Debbie Pettengill	Assistant to the Town Administrator	Adminstration	dpettengill@stoneham-ma.gov	
Core Team	Thomas Cicatelli	Chief Information Officer	Information Technology		
Core Team	Stephen Angelo	Director of Recreation	Stoneham Recreation Department		
Community Services	Rachel Overbeck	Head of Youth Services	Stoneham Public Library		
Community Services	Nicole Langley	Director	Stoneham Public Library		
Commissions/Boards	Gus Neiwanhous	Board Member	Planning Board	aniewenhous@comcast.net	
Commissions/Boards	Terry Dean	Board Member	Board of Health	teresa.dean@mcphs.edu	
Commissions/Boards	Shelly MacNeill	Select	Select Board	smacneill@stoneham-ma.gov	
Commissions/Boards	Heidi Bilbo	Select	Select Board	Bilbo, Heidi <HBilbo@stoneham-ma.gov>	
Commissions/Boards	George Seibold	Select	Select Board	gseibold@stoneham-ma.gov	
Commissions/Boards	Caroline Colarusso	Select	Select Board	ccolarusso@stoneham-ma.gov	
Commissions/Boards	Paul Condon	Board Member	Board of Health	pcondon@stoneham-ma.gov	
Commissions/Boards	Ellen McBride	Commissioner	Conservation Commission	emm4256@gmail.com	
Commissions/Boards	Robert Parsons	Commissioner	Conservation Commission	parsonsra@cdsmith.com	
Adjacent Towns	Martha Grover	Sustainability Manager	Melrose	mgrover@CityofMelrose.org	
Adjacent Towns	Andrew MacNichol	Staff Planner	Reading	amacnichol@ci.reading.ma.us	
Adjacent Towns	Jay Corey	City Engineer	Woburn	jaycorey@cityofwoburn.com	
Adjacent Towns	Beth Rudolph	Town Engineer	Winchester	brudolph@winchester.us	
Adjacent Towns	Alicia L. Hunt	Environmental Agent	Medford	ahunt@medford-ma.gov	
Adjacent Towns	Richard Stinson	Public Works Director	Melrose	rstinson@cityofmelrose.org	
Adjacent Towns	Steven Fitzpatrick	Sewer and Water Divisions Supervisor	Wakefield		
Adjacent Towns	Michelle Romero	City Planner	Malden	mromero@cityofmalden.org	

APPENDIX D

Listening Sessions

PREPARING STONEHAM FOR CLIMATE CHANGE

Hazard Mitigation and Municipal Vulnerability Preparedness

photo by Ran Crui, Unsplash

Online Presentation & Discussion: NOVEMBER 10, 2020 at 7:00 P.M.

The Town of Stoneham is planning for the impacts of climate change, which will affect public health and safety, municipal services and facilities, property values, and our overall quality of life.

At this session, we will present how climate change may impact Stoneham, describe the Hazard Mitigation and Municipal Vulnerability Preparedness planning process, and opportunities for public participating in the process on **November 10, 2020, at 7:00 p.m.** GoTo Meeting instructions are below.

The public will be invited to comment at this meeting, and we will launch a survey to collect people's observations, comments, and ideas that will help the Town build resiliency to climate change.

GoTo Meeting Instructions:

https://global.gotomeeting.com/join/247901901
Dial in: +1 -408-650-3123
Access Code: 247 901 901

DENNIS SHEEHAN
Stoneham Town Administrator

BUILDING STONEHAM'S RESILIENCY

HAZARD MITIGATION &
MUNICIPAL VULNERABILITY PREPAREDNESS

Caroline Wells, AICP, Certified MVP Provider

1

OUTLINE

1. Overview of the MVP program
2. Projected Climate Change Impacts
3. Survey

Photo: Li-An Lim, Unsplash.com

2

MUNICIPAL VULNERABILITY PREPAREDNESS (MVP)

PHASE 1 - PLANNING

- Receive Planning Grant
- Engage the Community
- Assess Vulnerabilities and Strengths
- Prioritize Action Items
- Submit Final Report for Approval
- **Become MVP Certified**

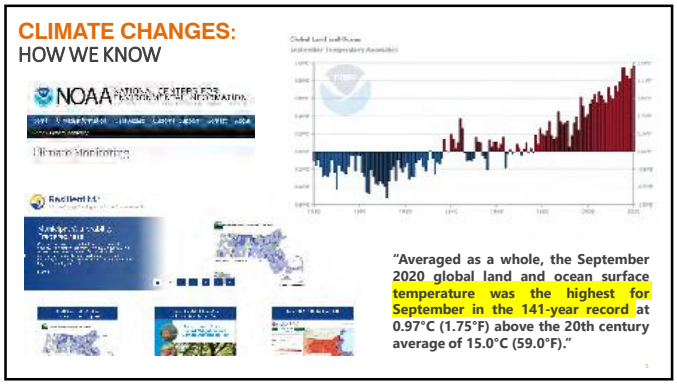
PHASE 2 - ACTION

- Select an Action Item from Planning Phase
- Apply for Action Grant Funding
- Up to $2 million for planning, design, permitting, construction
- 25% grant match in cash or in-kind
- **$10-15 million available**

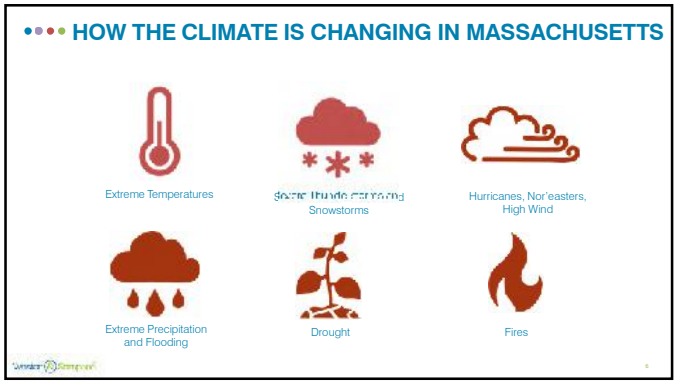
3


Photo by GoogleEarth
Hazard Mitigation Planning (MHP):
We look backward at natural hazard events that have occurred throughout history and we estimate how likely they are to reoccur and what is at risk when they do (lives, property, tax dollars, etc).
2020
Municipal Vulnerability Preparedness (MVP):
We look at recent trends in climate changes globally, regionally, state and town levels, and how they may affect the town in terms of infrastructure, society, and the environment.
What actions can the Town now take to reduce risks in the future?

4

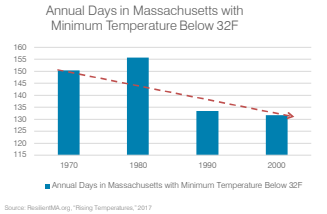

CLIMATE CHANGES:
HOW WE KNOW
NOAA
"Averaged as a whole, the September 2020 global land and ocean surface temperature was the highest for September in the 141-year record at 0.97°C (1.75°F) above the 20th century average of 15.0°C (59.0°F)."

5


HOW THE CLIMATE IS CHANGING IN MASSACHUSETTS
Extreme Temperatures
Snowstorms
Hurricanes, Nor'easters, High Wind
Extreme Precipitation and Flooding
Drought
Fires

6

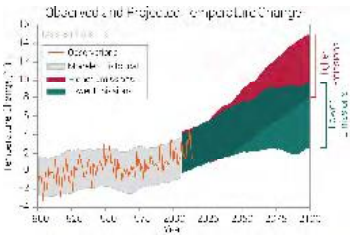
EXTREME TEMPERATURES: COLD



Winter temperatures have been warming at an average rate of 1.3°F per decade

7

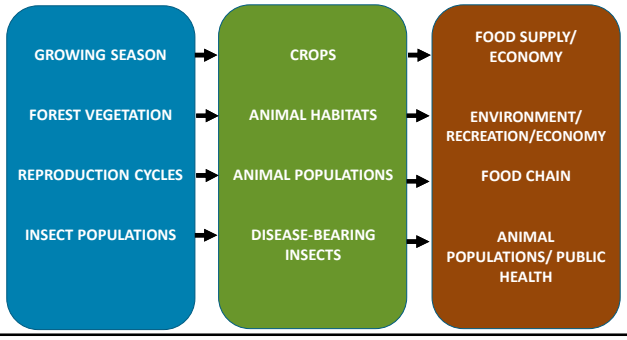
EXTREME TEMPERATURES: HEAT



Since 1970, annual temperatures in the Northeast have been warming at an average rate of 0.5°F per decade

8

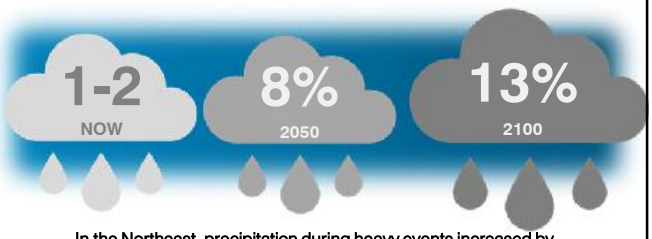
EXTREME TEMPERATURES: CHAIN REACTIONS



9

EXTREME PRECIPITATION (RAIN OR SNOW 2" PER DAY)

Average number of days per year with extreme precipitation:



In the Northeast, precipitation during heavy events increased by more than 70% between 1958 and 2010.

10

FLOOD MAPS

By 2050, Massachusetts could experience the current 100-year riverine flood every two to three years on average

ZONE	ANNUAL CHANCE	FLOODPLAIN
A, AE, A1-A30	1% ANNUAL CHANCE	100-YEAR FLOODPLAIN
X	0.2% ANNUAL CHANCE	500-YEAR FLOODPLAIN

11

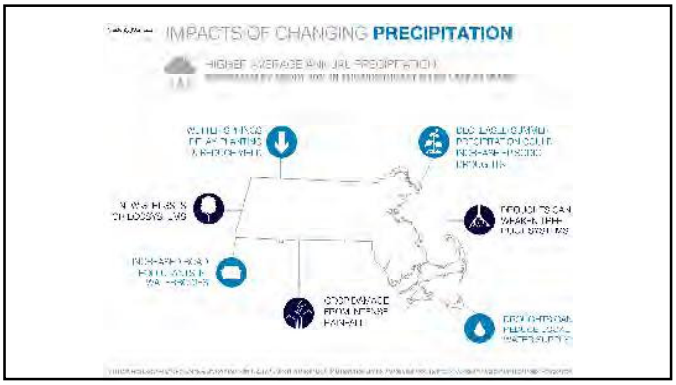
STORMWATER FLOODING: What Have You Observed?

Areas with:

- Poor drainage
- High amounts of impervious surface
- Undersized culverts

Projects that reduce stormwater flooding can be MVP Action grant eligible – especially if they use nature-based solutions.

12



13

HURRICANES AND NOR'EASTERS

Upward trend in North Atlantic hurricane activity since 1970

2012: Hurricane Sandy
2017: Hurricane Jose
2018: Hurricane Florence
2019: Hurricane Dorian

Nor'easters along the Atlantic coast are increasing in frequency and intensity

Jan 3-4, 2018: Winter Storm Grayson
March 2, 2018: Winter Storm Riley
March 8, 2018: Winter Storm Quinn
March 13, 2018: Winter Storm Skylar

Source: Climate Science Special Report, Fourth National Climate Assessment (NCA4), Volume prepared by the U.S. Global Change Research Program (USGCRP) Northern Middlesex

14

14

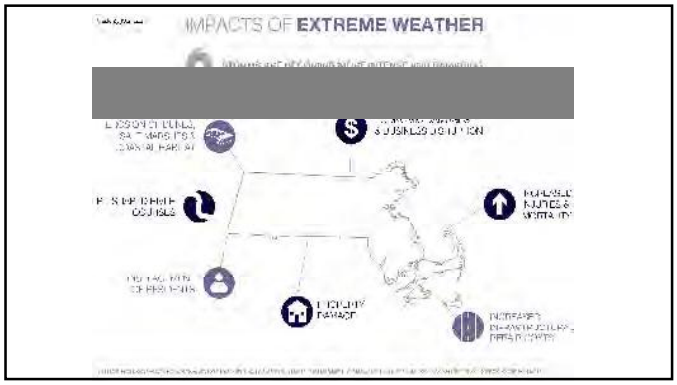
WIND-RELATED HAZARDS

Photo: Town of Reading, MA Facebook

Increase in intensity of severe thunderstorms

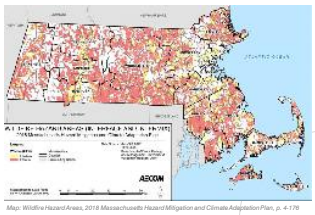
Tree damage
Downed power line

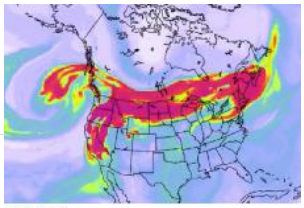
15



16

BRUSH FIRE





Map: Wildfire Hazard Areas, 2018 Massachusetts Hazard Mitigation and Climate Adaptation Plan, p. 4-176

17

17

BRINGING IT ALL TOGETHER

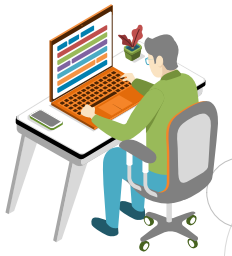
We are asking the public to:

- Remember climate changes and/or natural hazards that you have seen in Stoneham
- Think about areas around town that you have worried might be vulnerable – including people (children, seniors, etc.)
- Think about areas that are especially important to you (roads, parks, etc.)
- Give us your ideas for ACTIONS that might be worth considering in the plan

18

18

NEXT STEPS



TAKE THE SURVEY:

https://tinyurl.com/StonehamMVPSurvey

Caroline Wells, AICP
Certified MVP Provider
Weston & Sampson
wells.caroline@wseinc.com

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THANK YOU

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APPENDIX E

Online Survey

Is Stoneham ready for climate change?

Climate change is happening now. The Town of Stoneham received a grant to plan for worsening conditions, such as rising temperatures, extreme weather, flooding, drought, and wildfires.

Help us prepare. Take the survey and give us your observations and ideas.

survey

https://tinyurl.com/StonehamMVPSurvey

or scan with your phone!

Stoneham Municipal Vulnerability Preparedness and Hazard Mitigation Survey

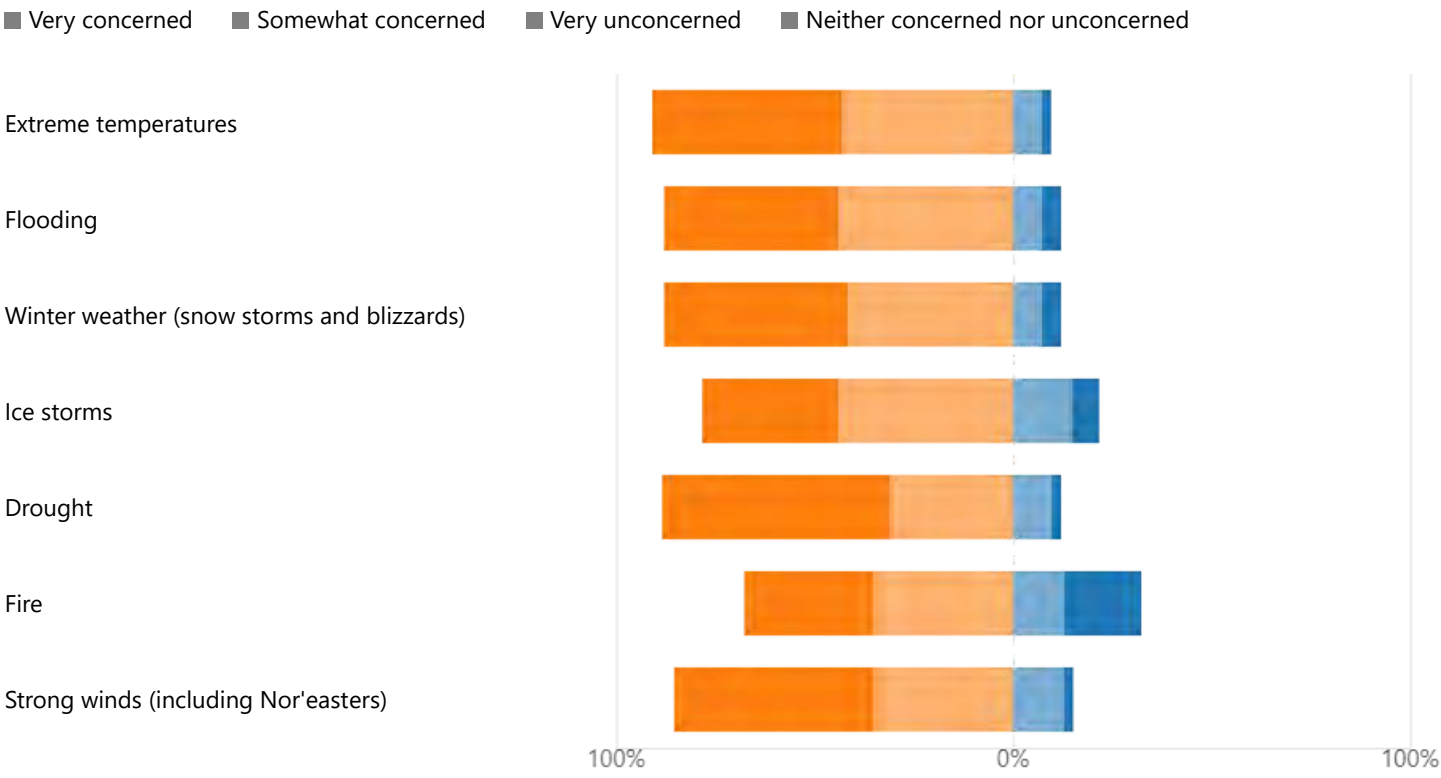
42	178:18	Active
Responses	Average time to complete	Status

1. On a scale of 1-5 (5 being very knowledgeable), how would you rate your knowledge of local hazard and climate impacts?

Insights

41	3.17
Responses	Average Number

2. What climate hazards are you most concerned about?



3. Are there any other hazards that concern you?

17

Responses

Latest Responses

4. How have these climate hazards impacted you, or what impacts have you seen in your community? Memories of recent climate hazards could include: - flooding of local roads - four Nor'easters in one month in 2018 - heat waves with multiple days over 90 degrees F - drought conditions this year

34

Responses

Latest Responses

"*Difficulty getting to work, work closed, gas & electric bills*"

"*Continued experience of 100 year storms within months of each other...*

"*All of the above, rising temperatures are the most obvious* "

5. How prepared do you think Stoneham is for future climate hazard events?

Very prepared	1
Somewhat prepared	3
Not prepared	12
I'm not sure	23
Other	3

6. Please explain your reason for selecting your answer in Question 5.

37

Responses

Latest Responses

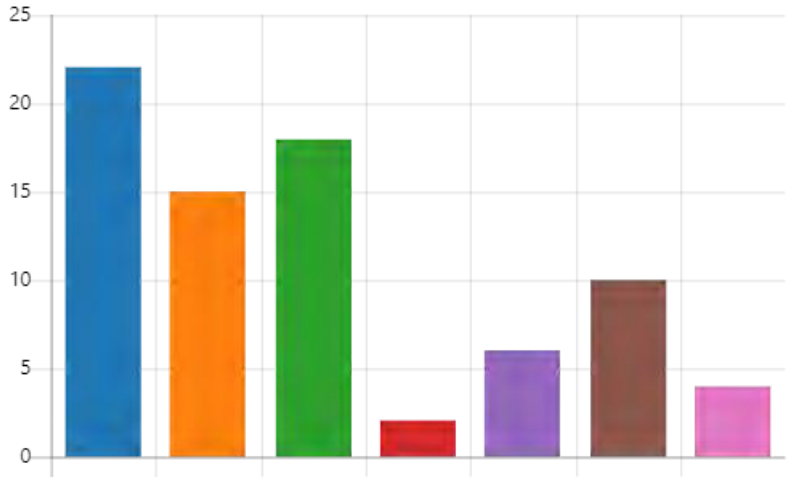
"*I haven't heard much*"

""

"*I am not aware of any efforts.* "

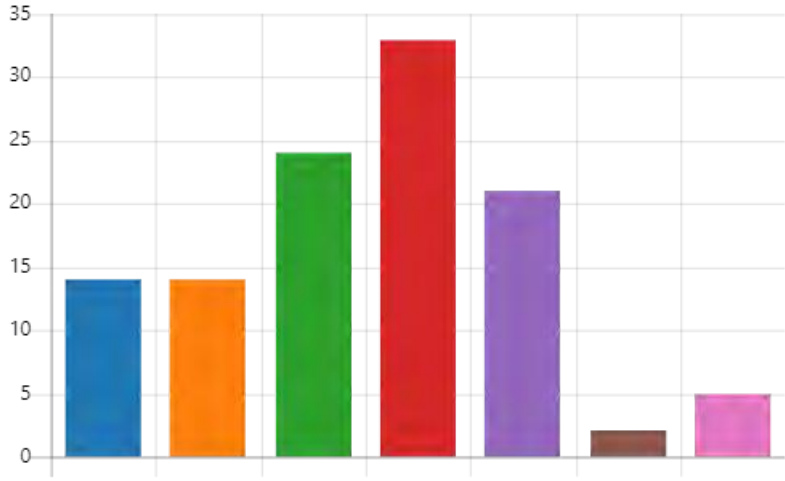
7. What steps have you already taken to prepare for extreme climate hazard events? Check all that apply.

I have a kit in case of emergen...	22
I am familiar with climate chan...	15
I receive news, updates, and in...	18
I know where the nearest eme...	2
I have reached out to neighbo...	6
I have not made any preparati...	10
Other	4



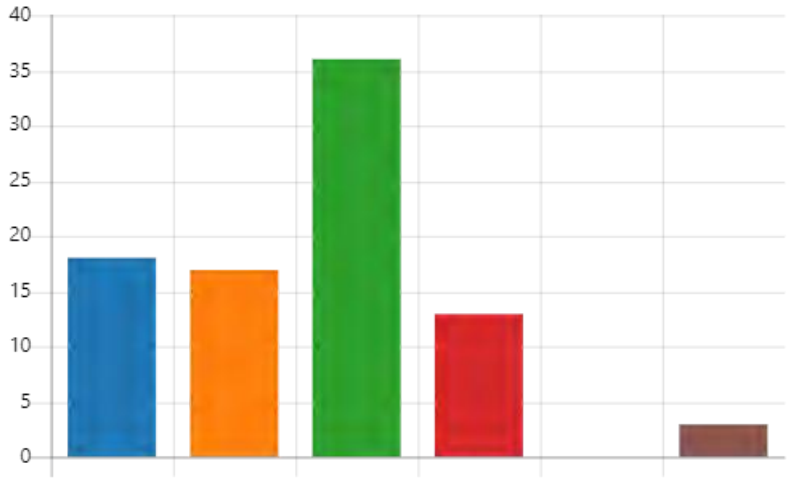
8. What resources do you need to feel more prepared? Check all that apply.

Training on how to be better ...	14
The financial resources to take...	14
More information on what I ca...	24
Community resources that mi...	33
Web resources so I can stay u...	21
I do not feel that I need any re...	2
Other	5



9. How would you like to receive information about resiliency projects and actions in Stoneham? Check all that apply.

Public events, including virtual...	18
Printed media, including repor...	17
Online, including through the ...	36
Local groups and organization...	13
I do not want to receive any in...	0
Other	3



10. We recognize the preparation and response to any challenge in our community has overlapping strategies and challenges. We are interested in documenting the community experience of COVID-19. What worked well, and what could improve?

25
Responses

Latest Responses
"Can't say as most of my information with regard to Covid came from ...
"More available asymptomatic and Symptomatic testing for all comm...

11. Are there any additional comments or questions that you would like to share with the project team?

8
Responses

Latest Responses

12. Thank you for completing this survey. If you are interested in receiving additional updates related to climate initiatives in Stoneham, please enter your email below.

21
Responses

Latest Responses
"sarah.callahan87@gmail.com"

13. How old are you?

Under 18	0
18 to 25	0
26 to 49	0
50 to 65	0
66 to 85	0
Over 85	0

14. Including yourself, how many people live in your household?

1	0
2-3	0
4-6	0
6 or more	0

15. Are there children under the age of 13 in your household on most days?

Yes	0
No	0
Other	0

16. Please check all that apply to you:

I am a renter.	0
I own a business in Stoneham.	0
I am a veteran.	0
My household speaks besides ...	0

APPENDIX F

Plan Approval

CERTIFICATE OF ADOPTION
SELECT BOARD

TOWN OF STONEHAM, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF STONEHAM HAZARD MITIGATION PLAN

WHEREAS, the Town of Stoneham established a Committee to prepare the Town of Stoneham Hazard Mitigation Plan; and

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

WHEREAS, duly-noticed public meetings were held by the LOCAL HAZARD MITIGATION PLANNING TEAM on March 3rd, 2020, November 10th, 2020, December 1st and 3rd, 2020 and May 11, 2021,

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

NOW, THEREFORE BE IT RESOLVED that the Town of Stoneham SELECT BOARD adopts the Town of Stoneham Hazard Mitigation Plan, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Stoneham.

ADOPTED AND SIGNED this Date: _____

Name(s)

Title(s)

Signature(s)