TOWN OF HOPKINTON

2020 HAZARD MITIGATION – MUNICIPAL VULNERABILITY PREPAREDNESS PLAN

It all starts here Hopkinton

Prepared by:

Weston & Sampson

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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. Within the communities of Middlesex County, hazard mitigation planning tends to focus on flooding, which is the most likely natural hazard to impact these communities. The Federal Disaster Mitigation Act of 2000 requires all municipalities to adopt a local multi-hazard mitigation plan (HMP) and update their plan every five years in order to be eligible for FEMA funding for hazard mitigation grants.

The Massachusetts Executive Office of Energy and Environmental Affairs' Municipal Vulnerability Preparedness (MVP) grant program helps communities plan and take action towards becoming more resilient to the impacts of climate change. The program provides MVP Planning Grants to assist municipalities in preparing for the impacts of climate change through participation in a Community Resilience Building (CRB) Workshop and development of a climate change action plan. MVP Action Grants are available to communities that complete the planning process to fund the implementation of priority climate change adaptation actions identified in their final report.

The Town of Hopkinton completed a planning process to fulfill the requirement for both a hazard mitigation plan as well as an MVP planning grant. This approach recognizes that climate change will exacerbate the vulnerabilities and risks associated with natural hazards and provides a robust assessment and implementation plan to build the Town's resilience.

Planning Process

Planning for the Hazard Mitigation Plan and Municipal Vulnerability Preparedness Plan (HMP-MVP Plan) was led by Hopkinton's Municipal Vulnerability Preparedness/Hazard Mitigation Core Team ("Core Team"). This Core Team was composed of staff from a number of different Town Departments. The Core Team initially met on October 24, 2019. Additionally, a CRB Workshop was held on December 10, 2019. During these meetings, the group planned for the CRB Workshop, reviewed public comments, discussed where the impacts of natural hazards most affect the Town, endorsed goals for addressing these impacts, developed the mitigation plan, and transitioned towards implementation of the plan's mitigation strategies.

A public listening session was scheduled to present the findings of the CRB workshop and get feedback from the public. However, the listening session was then canceled due to public health concerns surrounding COVID-19. The Town's Core Team reformatted the listening session in a way that enabled the community to safely access and comment on findings. The listening session was formatted as an online evening webinar, and the recorded video was posted to Hopkinton's YouTube channel, HCAM on March 24. The video, presentation, and a survey were presented to the public via a link on the Town's website, and an email was sent to stakeholders. Additionally, the draft plan was posted on the Town's website for public review between the dates of April 2020 and May 2020. Key Town stakeholders and neighboring communities were notified of the public meetings and invited to submit comments on the draft plan.

Risk Assessment

The Hopkinton HMP-MVP Plan assesses the potential impacts to the Town from a variety of natural disasters including:

- Extreme Temperatures
- Thunderstorms and Heavy Precipitation
- Severe Wind and Snowstorms
- Drought

Hopkinton's Core Team identified 116 critical facilities. These facilities are also shown in the map series and listed in Table 3-8 through 3-11, identifying which facilities are located within the mapped hazard zones.

Hazard Mitigation Goals

The 2015 update of the Town of Hopkinton Hazard Mitigation Plan included four mitigation goals. This list provided a starting point for Hopkinton's more thorough set of seven hazard mitigation goals, which are included in more detail below.

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

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

3. Increase cooperation and coordination among private entities, Town officials and Boards, neighboring communities, State agencies and Federal agencies to build local and regional resilience

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

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

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

7. Integrate hazard mitigation planning and climate resilience into the operations of all relevant municipal departments, committees and boards.

Hazard Mitigation Strategy

The Core Team identified and discussed several mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. Overall, the hazard mitigation strategy recognizes that mitigating hazards for Hopkinton will be an ongoing process as our understanding of natural hazards and the steps that can be taken to mitigate their damages change over time. Climate change and a variety of other factors impact the Town's vulnerability. In the future, local officials will need to work

together across municipal lines, and with state and federal agencies, to understand and address these changes. The hazard mitigation strategy will be incorporated into the Town's other related plans and policies. This will ensure that all areas of planning and development within the Town will recognize and incorporate hazard mitigation measures.

Plan Development Process

Hopkinton's existing Hazard Mitigation Plan was drafted by the Metropolitan Area Planning Council for the Town in 2015.

Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision-making processes.

The Town will document actions taken, challenges met, and mitigation actions successfully adopted within this iteration of the HMP-MVP Plan. This will serve as part of the ongoing plan maintenance to be conducted by the Core Team, as described in Section 8: Plan Adoption and Maintenance.

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1.0 INTRODUCTION

The Town of Hopkinton prepared a joint Hazard Mitigation Plan and Municipal Vulnerability Preparedness Plan (HMP-MVP Plan) to create an action roadmap to reduce the impacts of natural hazards and climate change within the community and the region. The Hopkinton HMP-MVP Plan was adopted by the Select Board on December 1st, 2020 to update and replace the Town of Hopkinton Hazard Mitigation Plan 2015.

1.1 What is a Hazard Mitigation Plan?

Natural disasters 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 (FEMA, 2020a). Hazard mitigation planning uses a stepped process with 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 hazard mitigation plan (HMP) and implementation saves lives and money. For every dollar spent on federal hazard mitigation grants, an average of six dollars are saved (FEMA, 2018). There are many additional benefits of mitigation planning. 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. The vulnerability assessment of an HMP documents data related to the National Flood Insurance Program (NFIP), such as repetitive loss sites and ongoing work by the community related to floodplain management.

Figure 1-1. FEMA Hazard Mitigation Planning Saves Money Graphic (FEMA, 2018)

By completing an HMP, municipalities also become eligible for specific federal funding and allow potential funding sources to understand a community's priorities (FEMA, 2019a). Hazard mitigation funding is available through the Federal Emergency Management Agency (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.

Table 1-1. FEMA Grants

FEMA Grants	Purpose
Hazard Mitigation Grant Program (HMGP)	Helps communities implement hazard mitigation measures following a Presidential Major Disaster Declaration.
Pre-Disaster Mitigation Program (PDM)	Assists in implementing a sustained pre-disaster natural hazard mitigation program, in order to reduce risk to the population and structures from future hazard events.
Public Assistance Grant Program (PA)	Provides supplemental grants so that communities can quickly respond and recover from major disasters or emergencies.
Fire Management Assistance Grant Program (FMAG) (FEMA, 2020b)	Available for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands.

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. Since these action grants are only distributed to Massachusetts municipalities, they are much less competitive than a similar grant awarded at the national level.

1.3 Hazard Mitigation and Municipal Vulnerability Preparedness Planning in Hopkinton

The Town of Hopkinton 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 updating an HMP. As a result, the Town prepared this joint HMP-MVP Plan in accordance with FEMA guidelines for hazard mitigation planning (FEMA, 2020a) and with the Massachusetts Executive Office of Energy & Environmental Affairs' (EEA) requirements to follow the CRB Workshop Guidance, developed by The Nature Conservancy. This enabled Hopkinton 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 (MEMA, 2018b).

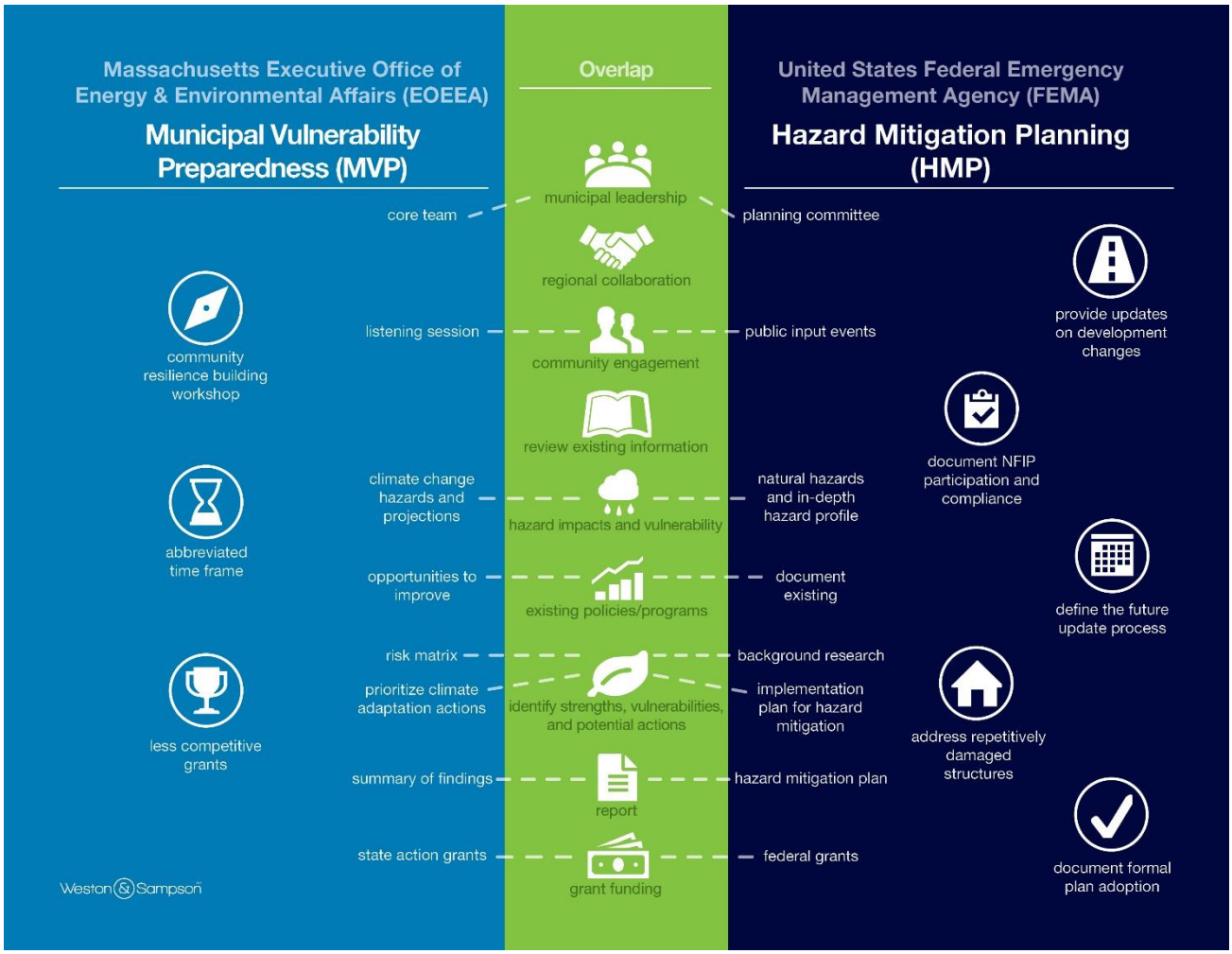


Figure 1-2. Comparison of the MVP and HMP Process (Weston & Sampson)

The joint HMP- MVP Plan convened a Core Team of municipal leaders to lead the process and provide local expertise. The Core team met once and corresponded via email and contributed through interviews. Stakeholder engagement was conducted through the CRB Workshops and a public listening session. 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 Plan, the Town of Hopkinton (the Town) followed the process described in the CRB Workshop Guidebook (herein "the Guidebook"), which was developed by The Nature Conservancy (TNC). The Guidebook (The Nature Conservancy, n.d.) 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 reflects the Town of Hopkinton's values and priorities is likely to produce greater community support and result in greater success in implementing mitigation strategies that reduce risk.

CRB Workshop Guidebook

The CRB Workshop Guidebook provides a process for developing resilience action plans. The process has been implemented and successful in over one hundred communities. The process, outlined below, is rich in information and dialogue and results in actionable plans and strong collaboration.

The CRB 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 are provided 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 Hopkinton, 2) stakeholders who could be vulnerable to, or provide strength against, natural hazards and/or climate change, and 3) the public, who live and work in the Town.

1.4.1 Core Team

The Town of Hopkinton convened the Core Team to act as a steering committee for the development of the HMP-MVP Plan. The Core Team met on October 24, 2019 to plan for the Workshop, review public comments, 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 established goals for the plan, 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.

Table 1-2. Hopkinton's Core Team

Name	Title
John Gelcich	Principal Planner/Project Lead
Ben Sweeney	Procurement and Grants Manager
John Westerling	DPW Director
Don MacAdam	Conservation Administrator
Elaine Lazarus	Assistant Town Manager
Steve Slaman	Fire Chief
Dave Daltorio	Town Engineer

The Core Team developed the invitation list for the CRB 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, 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 Hopkinton. These included:

- 2013 Hopkinton Open Space & Recreation Plan (Hopkinton, 2013)
- Town of Hopkinton Master Plan 2017 (Hopkinton, 2017)
- Town of Hopkinton Hazard Mitigation Plan 2015 Update (Hopkinton, 2015)
- Town of Hopkinton Design Review Board Design Guidelines (Hopkinton, 1996)
- 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 Planning Handbook, (FEMA, 2013)
- Flood Insurance Rate Maps for Hopkinton, MA (FEMA, 2016)
- National Center for Environmental Information (NOAA)
- National Water Information System (USGS)
- US Census, 2010 and American Community Survey, 2017

1.4.2 Stakeholder Involvement: CRB Workshop

Stakeholders with subject matter expertise and 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 on December 10, 2019. During the first part of the CRB Workshop, Weston & Sampson provided information about natural hazards and climate change and participants identified top hazards; infrastructural, societal and environmental features in Town that are vulnerable to or provide strength against these challenges. During the second part of the CRB Workshop, participants identified and prioritized key actions that would improve the Town's resiliency to natural and climate-related hazards. There were multiple representatives present at the workshop that could provide regional input, including members of the Sudbury Valley Trustees, Charles River Watershed Association, and the Department of Environmental Protection. Additionally, there were members of agencies that have the authority to regulate development, including the conservation commission and planning board. The MVP Regional Program Director was able to attend

and observe the Hopkinton CRB Workshop. Leadership from neighboring communities of Westborough, Holliston, Ashland, Milford, and Upton were invited to participate in the Workshop but were unable to attend. Table 1-3 notes the names and positions of those stakeholders who were invited to and those who attended the Workshop. This broad representation of local and regional entities ensures the HMP-MVP Plan aligns with the operational policies and any hazard mitigation strategies at different levels of government and implementation.

Table 1-3. Stakeholders Invited to Hopkinton's CRB Workshop

	Name	Title	Affiliation
✓	John Gelcich	Principal Planner	Town of Hopkinton
✓	Steve Slaman	Fire Chief	Hopkinton Fire Department
✓	John Westerling	DPW Director	Town of Hopkinton
	Ben Sweeney	Procurement and Grants Manager	Town of Hopkinton
✓	Don MacAdam	Conservation Administrator	Town of Hopkinton
✓	Elaine Lazarus	Assistant Town Manager	Town of Hopkinton
✓	Bill Miller	Deputy Fire Chief	Hopkinton Fire Department
	Dave Daltorio	Town Engineer/Facilities Coordinator	Town of Hopkinton
✓	Timothy Persson	Director of Buildings and Grounds	Town of Hopkinton
✓	Shaun McAuliffe	Director of Health	Town of Hopkinton
	Susan Rothermich	Director of Finance	Town of Hopkinton
	Norman Khumalo	Town Manager	Town of Hopkinton
✓	Deb Fein-Brug	Planning Board Member	Town of Hopkinton
✓	Edward Lee	Chief of Police	Hopkinton Police Department
✓	Joe Bennett	Deputy Chief of Police	Hopkinton Police Department
	Charles E. Kadlik	Director of Municipal Inspection	Town of Hopkinton
	Josh Grossetti	Director of Technology	Town of Hopkinton
	Jay Guelfi	Parks Recreation Department Director	Town of Hopkinton
	Heather Backman	Hopkinton Public Library Director	Hopkinton Public Library
	Dr. Carol Cavanaugh	Superintendent of Schools	Hopkinton Public Schools
	Tim O'Leary	Chief Financial Officer	Town of Hopkinton
✓	Eric Carty	Water and Sewer Superintendent	Town of Hopkinton
	Mike Mansir	Highway Manager	Town of Hopkinton
✓	Amy Beck	Senior Center Director	Town of Hopkinton
✓	Dawn Alcott, LICSW	Director of Youth and Family Services	Town of Hopkinton
	Sarah Bateman	Director of Veterans Services	Town of Hopkinton
	Beth Maloy	Chair	Affordable Housing Trust Fund Board
	Elizabeth Whittemore	Chair	Board of Health
	Alton Chen	Chair	Capital Improvement Committee
	Henry Kunicki	Chair	Community Preservations Committee
	Jeff Barnes	Chair	Conservation Commission
	Don Wolf	Chair	Council on Aging

	Name	Title	Affiliation
	Sterling Worrell	Chair	Cultural Council
	Jeffrey Doherty	Chair	Design Review Committee
	No Name	ADA Coordinator	Disability Access Commission
	Joe Markey	Chair	Educational Facilities Committee
	No Name	Chair	Energy Management Committee
	Mike Manning	Chair	Appropriation Committee
	Amy Ritterbusch	Chair	Growth Study Committee
	Michael Roughan	Chair	Historical Commission
	Linda Strand	Chair	Housing Authority
	Rebekah Hoffman	Chair	Housing Authority
✓	Ed Harrow	Chair	Open Space Preservation Committee
	Daniel Terry	Liaison	Parks and Recreation Committee
	Dan McIntyre	Chair	Permanent Building Committee
	Muriel Kramer	Chair	Planning Board
✓	Meenakshi Bharath	Chair	School Committee
	Brendan Tedstone	Chair	Select Board
	Dawn Ronan	Chair	Youth Commission
	Mary Larson-Marlowe	Chair	Zoning Advisory Committee
	No Name	Member	Hopkinton Trails Club
✓	Alexandra Vecchio	Climate Change Program Manager	Mass Audubon
✓	Hillary King	Regional Coordinator	MVP Program
✓	Lisa Vernegaard	Executive Director	Sudbury Valley Trustees
	Peter Regan	President	Friends of Whitehall
	Cynthia Esthimer	Chair	Lake Maspenock Preservation Assoc.
	Adrienne Principe	Founder	Turning Life On
✓	Morrie Gasser	President	Hopkinton Area Land Trust
	Zofia Bibeault	Director of Risk Management	Milford Regional Physicians Group
	Kelley Ratcliffe	Camp Director	YMCA Family Outdoor Center
	Dale Danahy	Director	Project Just Because
	Karen E. Spilka	State Senator	Massachusetts Senate
	Joseph P. Kennedy III	Congressmen	US House of Representatives
	Carolyn C. Dykema	State Representative	MA House of Representatives
	Martin Pillsbury	Environmental Planning Director	MAPC
	Emily Norton	Executive Director	Charles River Watershed Association
✓	Julie Dyer Wood	Deputy Director	Charles River Watershed Association
	Tim Kilduff	Executive Director	Hopkinton Chamber of Commerce
	Sarah White	Hazard Mitigation Unit Supervisor	MEMA
✓	Kimberly Roth	Circuit Rider	DEP
	Jim Robbins	Town Planner	Town of Westborough

Name	Title	Affiliation
Karen Sherman	Town Planner	Town of Holliston
Peter Matchak	Town Planner	Town of Ashland
Larry Dunkin	Town Planner	Town of Milford
Denise Smith	Planning Board Coordinator	Town of Upton

✓ indicates invitee also attended the Workshop

1.4.3 Listening Session

A public listening session was scheduled to present the findings of the CRB workshop and get feedback from the public. However, the listening session was then canceled due to public health concerns surrounding COVID-19. The Town's Core Team reformatted the listening session in a way that enabled the community to safely access and comment on findings. The listening session was formatted as an online evening webinar, and the recorded video was posted to Hopkinton's YouTube channel, HCAM on March 24. The video, presentation, and a survey were presented to the public via a link on the Town's website, and an email was sent to stakeholders who work with vulnerable populations. Community members provided individual feedback on the hazards, strengths, and vulnerabilities in Hopkinton, and how the Town can be adapting to and mitigating climate change. Additionally, the draft plan was posted on the Town's website for public review between the dates of April 2020 and May 2020. Key Town stakeholders and neighboring communities were notified of the public meetings and invited to submit comments on the draft plan. More information about the meetings and public comments are available in Appendix C (CRB Workshop) and Appendix D (Listening Session).

1.4.4 Report Layout

The report presents the results and input derived from the Core Team, CRB Workshop, and Listening Session in addition to the documentation of features, hazard profiles, and a vulnerability assessment. Features are assets or characteristics of the Town that may contribute to the Towns resilience or may be a considered a vulnerability. Features are categorized into several types: societal, economic, infrastructure, land use, and environmental. The strength and vulnerability of these features are generally documented in Chapter 3, but Chapter 4 provides a more detailed assessment of the Town's vulnerability and strengths by hazard type. The hazard types cover the following: flooding, wind-related risk (hurricanes, tropical storms, tornadoes, nor'easters, and severe thunderstorms), winter storms, geological hazards (earthquakes and landslides), brush fires, extreme temperatures, and drought. Each hazard type's historic occurrences and impact, frequency, level of risk, and climate change projections are also described in each hazard profile. Chapter 5 lays out the existing mitigation measures the Town is already taking. Chapter 6 provides an update of the progress made since the last HMP and Chapter 7 provides the action plan for moving forward. Chapter 8 describes the plan adoption and maintenance, and details on implementation.

1.5 Planning Timeline

The HMP-MVP planning process proceed according to the timeline below.

2.0 HAZARD MITIGATION AND CLIMATE ADAPTATION GOALS

The Town of Hopkinton's Core Team convened on October 24, 2019 to reviewed and discussed the hazard mitigation goals for the HMP-MVP Plan. The following seven goals were developed and endorsed by the Core Team.

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

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

3. Increase cooperation and coordination among private entities, Town officials and Boards, neighboring communities, State agencies and Federal agencies to build local and regional resilience

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

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

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

7. Integrate hazard mitigation planning and climate resilience into the operations of all relevant municipal departments, committees and boards.

3.0 COMMUNITY PROFILE, LAND USE AND DEVELOPMENT TRENDS

3.1 Community Profile

Hopkinton's community is full of involved, proud citizens. During conversation at the workshop, multiple participants commented on how their love for the Town stems from the fact that both the residents and staff care deeply about their community. The Town prides itself in being a family-oriented community, boasting an excellent school system, spacious single-family homes, and ample open space. In order to balance the natural, residential, and commercial aspects of Hopkinton, the Town has become resilient in the face of change; regulating it in a way that will allow the Hopkinton to continue to grow and develop while conserving what people have come to know and love.

Present throughout Hopkinton are recent subdivisions, historic villages such as Woodville, wooded areas and remnants of the rolling hills and farms that once covered the area. Additionally, the compact downtown brings witness to the commercial center that is Hopkinton. Long roadways branch out from the Town center, leading from the central hub to the more secluded areas of Town, and beyond into the neighboring Towns of Southborough, Ashland, Holliston, Milford, Upton, and Westborough. Hopkinton itself is known nationwide as being the host to the start of the Boston Marathon every April.

Hopkinton is part of the MetroWest region and is located just 26 miles west of Boston. The Town of Hopkinton is a 28 square mile community located in the southern section of Middlesex County, Massachusetts. The Town is governed by a Select Board and a Town Manager. The Town operates under the Open Town Meeting format. In 2018, the population was 18,269 people (U.S. Census Bureau, 2018), which is approximately a 23% increase from 2010 (U.S. Census Bureau, 2010). The Town maintains a website at http://www.hopkintonma.gov .

Table 3-1. Population Demographics

2018	Hopkinton	Massachusetts
Population	18,269	6,602,149
Under Age 18	26.9%	20%
Over Age 65	11%	17%
Bachelor's Degree or Higher	68.6%	42.1%
Median Household income	$166,156	$77,378
Living Below the Poverty Line	23.2%	10.5%
With a Disability	3.8%	7.9%
Limited English-Speaking Skills	3.8%	18.1%
Housing Units	5,927	2.864.989
Renter-Occupancy Rate	14.2%	37.6%
Burdened by Housing Cost	37.4%	50.1%

(U.S. Census Bureau, 2018)

3.1.1. CRB Workshop Discussion of Societal Features

Workshop participants identified those key societal aspects of Hopkinton that are most vulnerable to, or provide protection against, natural hazards and climate change impacts. Following the public listening session, community members completed a survey to provide feedback to the Town. In the survey, one of the greatest strengths that was noted in Hopkinton was the volunteer community and citizens groups in Town.

Table 3-2. Societal Features and Natural Hazards/Climate Change in Hopkinton

Both Vulnerability and Strength	Strengths	Vulnerabilities
• Limited English Speaking • Businesses (EMC) • Seniors/Assisted Living • Low-income population • School/Youth • Large Events (Marathon) • Support for Other Communities in Town	• Places of Worship • Grocery and Supply Stores • Volunteer Community/Citizens Groups	• Isolated Rural Areas • Communications • Vulnerable populations (daycares, autism, respite center) • Legacy Farms Residents • Commuter Populations

3.2 Economic Features

As a suburb of Boston, Hopkinton sees its fair share of commuters, some traveling into Hopkinton, others travelling out, while others just passing through the Town on their daily commute. Hopkinton is home to the Dell-EMC, global manufacturer of software and systems for information management and storage, which employs many residents of the Town. Other top employment industries in the Town include educational services, healthcare, and social assistance (United States Census Bureau, 2019). Communication between businesses and the Town will be key when moving forward the hazard mitigation planning efforts and ensuring large employers have emergency protocols in place. Future development will also need to consider hazard mitigation planning as it relates to residents and employees.

Table 3-3. Economic Demographic Statistics

2017	Hopkinton	Massachusetts
Labor Force	9,062	3,755,481
Unemployment Rate	3.1%	6.0%
Employed in Top Employment Industry	26.5%	28.2%
Commuters who drove to work	81%	78.1%
Commuters with > 30 min travel time to work	41%	45.1%

(US Census Bureau, 2018)

3.3 Infrastructure Features

Hopkinton is divided east to west by Interstate Route 495, and the northern corner of Town hosts the busy I-495 and I-90 interchange. Close proximity to Route 9 and Route 30 in Westborough provides additional access to east and west direction. Hopkinton is serviced by the Southborough MBTA station, which is located on the border of Hopkinton and Southborough on Route 85 at Southville Road. Roads

and bridges are impacted by snow, ice, downed trees, and in some cases flooding. Thirty-five percent (35%) of the Town is currently serviced by public drinking water while the remaining sixty-five percent (65%) are served by on-site private wells. The Town also has the option of receiving water from the Ashland Regional Treatment Plant, which gets water from Echo Lake. Hopkinton sources water from eight public supply wells: four on Fruit Street, two off Charles McIntyre Lane and Donna Pass, and two off Alprilla Farm Road. Water supply redundancy and the impact of drought is a concern, especially for private wells. Approximately 40% of the population has access to the public sewer system and the remaining is supported by on-site septic. Septic systems can be vulnerable to rising groundwater. Backup power of all critical facilities providing water and sewer is essential. See Section 3.7 for more information on critical facilities in Hopkinton.

3.3.1. CRB Workshop Discussion of Existing Infrastructure

Workshop participants identified those key infrastructure features in Hopkinton that are most vulnerable to, or provide protection against, natural hazards and climate change impacts. As noted below, the majority of the existing infrastructure features were determined to be both a vulnerability and a strength. The strengths and vulnerabilities developed at the CRB workshop were also presented to community members during the public listening session, and a survey followed where viewers could give feedback. The top infrastructural vulnerabilities noted by community members in the survey was the stormwater drainage in Hopkinton. Community members also noted that one of the greatest strengths that Hopkinton has in Town is the capacity of its Department of Public Works.

Table 3-4. Infrastructural Features and Natural Hazards/Climate Change in Hopkinton

Both Vulnerability and Strength	Vulnerabilities
• Dams • LNG Plant • Fire/Police Stations • DPW/Equipment/Labor • State Highway • Power Grid/ Electric & Gas • Schools • Town Facilities • Sewage Disposal • Energy Distribution Alternative Sources • Communication	• Drainage (including cisterns) • Building maintenance issues: weather related and age • Access – roadways • Water supply/Wells • Powerlines/Pipelines

3.4 Land Use and Environmental Features

Hopkinton has a total land area of just over 28 square miles and lies within three major watersheds. About 75% of the Town lies within the Concord River watershed, while the remaining 25% is split between the Charles River watershed and Blackstone River watershed. The Town of Hopkinton is home to many ponds, lakes, and reservoirs, including Echo Lake, which is the waterbody that starts the Charles River. Other waterbodies in the Town which are a source of localized flooding in the Town include Lake Maspenock, Whitehall Reservoir, and Waseeka Sanctuary Pond. Perennial steams in the Town, which are a source of riverine flooding, include Whitehall Brook, Sudbury River, Indian Brook, and Piccadolly Brook. Nonpoint source pollution is a concern within many of the waterbodies (stormwater runoff, yard fertilizers, etc.). Hopkinton primarily depends on groundwater for its drinking water supply, which comes from the 902 acres of identified aquifers in Hopkinton. Most of these aquifers are medium yield, except

for an area around Fruit Street which is a high yield aquifer (Hopkinton, 2017). According to the Massachusetts Natural Heritage and Endangered Species Program there is one Aquatic Core Habitat (Whitehall Reservoir) and one Coldwater Fishery resource Streams (Piccadilly Brook). Hopkinton also has a portion of the Cedar Swamp Area of Critical Environmental Concern, as well as the Miscoe, Warren, and Whitehall Watersheds, as designated by MA EOEEA. Whitehall Reservoir is located within an NHESP Priority Habitat of Rare Species, and some other isolated areas in Hopkinton are NHESP Estimated Habitats of Rare Wildlife.

Unlike many New England municipalities, Hopkinton does not have any major environmental concerns from past industrial uses. There are no superfund sites in Hopkinton. The Emergency Manager is aware of all hazardous materials sites and underground storage tanks.

The Land Use Summary Statistics table displays land use in the Town of Hopkinton. The most recent land use statistics available are based on 2020 digital ortho imagery. Table 3-5 displays the land use categories within Hopkinton, the total acreage within each of the seven categories, as well as the percent cover of each category within the Town (See Appendix B). Total residential land use makes up 38% of the Town land. Commercial use makes of 4% of the Town land. Open space makes up a total of 28% of the Town. This does not account for open water, which is categorized in the "Other" category.

Table 3-5. 2020 Hopkinton Land Use

Land Use Category	Total Acres in Town	Percent of Total Acreage
Residential	6,790	38%
Agricultural	225	1%
Commercial	645	4%
Industrial	415	2%
Institutional	3,365	19%
Open Space	5,040	28%
Other *(open water, right of ways)*	1,530	8%
Total	18,010	100%

(MassGIS, 2020)

3.4.1. CRB Workshop Discussion of the Environment

Workshop participants identified those key environmental features in Hopkinton that are most vulnerable to, or provide protection against, natural hazards and climate change impacts. In the survey that followed the public listening session, community members expressed their concern about vector-borne diseases in Town. Community members also noted that one of Hopkinton's greatest strengths was the wetlands and waterbodies in Town.

Table 3-6. Environmental Features and Natural Hazards/Climate Change in Hopkinton

Both Vulnerability and Strength	Vulnerabilities
• Wetlands • Topography • Wetlands and waterbodies	• Wildlife population • Vector-borne diseases • Water bodies (cyanobacteria and aquatic vegetation)

Table 3-6. Environmental Features and Natural Hazards/Climate Change in Hopkinton

Both Vulnerability and Strength	Vulnerabilities
• Water quality and quantity (wells and land protection) • Natural resources • Open space/trails	• Floodplain • Landfills • LNG • Impervious surfaces • Hazardous sites

3.5 Recent and Potential Development

The Hopkinton Principal Planner reviewed recent and potential future development within the Town. Recent development has mainly been residential and has occurred within the already developed area of downtown Hopkinton, through the cluster subdivision bylaw. The goal is that in concentrating development within a smaller area of Town, open space throughout the rest of the Town will be protected. The remaining privately owned, forested land on the northern side of Hopkinton may be attractive for development. There is potential for zoning updates to preserve the forested areas of Town. Besides loss of natural habitat, stormwater impacts are a growing concern and new regulatory updates may be necessary to reduce polluted runoff from entering waterways.

In addition, developments were identified using MAPC's MassBuilds Database, which provides an inventory of recent, future, and potential development. This table was cross checked for accuracy by the Town's Principal Planner. The final database included eleven residential developments, five industrial/commercial developments and one educational development in the recent years in Hopkinton. Also included in the MassBuilds Database are several attributes of the new development, including development acreage, number of housing units, commercial area, and project type for recent, in construction, and planning-phase development (Table 3-7).

Table 3-7. Current and Future Development in Hopkinton

Name	Status Year Completed	Housing Units	Commercial Square Feet	Project Type
E. L. Harvey & Sons	Completed 2015	N/A	125,300	Industrial
Highland Park IV	In Construction 2020	21	N/A	Single-Family Residential
Highland Park III	Completed 2016	3	N/A	Single-Family Residential
Legacy Farms – the Trails in Hopkinton	In Construction 2022	18	N/A	Age-Restricted Multi-Family Residential
Legacy Farms – Legacy Farms North	In Construction 2021	425	N/A	Residential Units
Legacy Farms	Planned 2027	N/A	334,000	Commercial
Weston Nurseries	Completed 2019	N/A	11	Commercial
42 Main Street	Completed	N/A	14	Commercial

	2016			
Tall Pines Estates	In Construction 2019	12	N/A	Single-Family Residential
Bridle Path	Completed 2014	6	N/A	Single-Family Residential
Whisper Way/Whisper Ridge	Planned 2025	24	N/A	Single-Family Residential
Christian Way	Completed 2015	3	N/A	Single Family Residential
203 Pond Street	In Construction 2019	12	N/A	Single-Family Residential
Spring Hill Estates	In Construction 2020	5	N/A	Single-Family Residential
Maspenock Woods	In Construction 2020	31	N/A	Multi-Family Residential
Perkin Elmer Campus Expansion	Completed 2013	N/A	85,000	Industrial Redevelopment
78 West Main Street	Completed 2018	N/A	N/A	N/A
85 West Main Street	Completed 2015	N/A	7,430	Commercial
Golden Pond Assisted Living	In Construction 2018	54	N/A	Assisted Living
Lumber St. – West Main St. Development	Planned 2025	N/A	175,000	Commercial
Modera Hopkinton/ Hopkinton Mews	Completed 2018	280 units +70 affordable units	N/A	Multi-family Residential and Affordable Housing
Hopkinton Tennis Club	Planned 2022	N/A	39,086	Swim & Tennis Club
Chamberlain Street-Whalen Rd. Subdivision	In Construction 2023	32 units + 3 affordable units	N/A	Single-Family Residential
Hopkinton Square	Completed 2012	N/A	70,000	Commercial
Deerfield Estates	Completed 2012	47	N/A	Age-Restricted Residential
Box Mill Road	Completion 2018	3	N/A	Single-Family Residential
Hopkinton School Project	Completed 2018	N/A	83,250	Educational
Elmwoods Farms III	Planned 2025	15	N/A	Single-Family Residential

Davenport Village	Completed 2018	18	N/A	Multi-Family Residential
Connelly Hill Estates	Completed 2016	60	N/A	Single-Family Residential
Hunters Ridge	Completed 2019	19	N/A	Single-Family Residential
Penny Meadow Lane	Completed 2019	5	N/A	Single-Family Residential
Peloquin Estates	Completed 2016	9	N/A	Single-Family Residential
Legacy Farms South Villages (Pulte)	Completed 2018	275	N/A	Single and Multi-Family Residential
Woodview at Legacy Farms	Completed 2014	240 Multi-Family 60 Affordable Housing	N/A	Multi-Family and Affordable Housing
Fairview Estates	Completed 2018	127	N/A	Multi-Family
Total		263	178,200	

(MAPC, 2020; Gelcich, 2020)

3.6 Critical Facilities and Vulnerable Populations

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; and 3) hazardous sites that could be dangerous if it is compromised during a natural disaster. Critical facilities in the Town of Hopkinton have been identified with help from knowledgeable Town staff, MassGIS data, existing Town and Regional Plans, and the assessment of other Town features presented in previous sections. 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.

Table 3-8. Category 1 - Emergency Response Facilities

Type	Name	Location
Public Safety	Police Department	74 Main Street
	Fire Department Headquarters	73 Main Street
	Fire Station 2	234 Wood Street
Town Facilities	Hopkinton Highway Department Water Department	83 Wood Street 85 Wood Street
Emergency Shelters and Warming Centers	Senior Center	28 Mayhew Street
	Hopkinton Middle School	88 Hayden Rowe Street
	Hopkinton Public Library	13 Main Street
	Faith Community Church of Hopkinton	146 East Main Street
Pump Stations		Lake Shore Drive
		Main Street

		Hayden Rowe
		Front Street
		Ash Street
		Wood Street
		Joseph Road
		South Street
Drinking Water Facilities	Well 1	Fruit Street
	Well 2	Fruit Street
	Well 3	Fruit Street
	Well 4	Fruit Street
	Well 5	Fruit Street
	Well 6	Fruit Street
	Water Tank	West Main Street
	Water Tank 1	Grove Street
	Water Tank 2	Grove Street
	Wells 7 & 8	Alprilla Farm
	Ashland Treatment Facility	Howe Street
Evacuation Routes	I-495	
	I-90	
	Main Street (Route 135)	
	Route 85	
	Wood Street (Route 135)	

Table 3-9. Category 2 - Non-Emergency Response Facilities

Type	Name	Location
Town Facilities	Town Hall	18 Main Street
	Hopkinton Public Library	13 Main Street
	Senior Center	28 Mayhew Street
	DPW Garage	85 Wood Street
	IT Office	Fruit Street
	Center School	11 Ash Street
Natural Resources	Whitehall Reservoir	
	Hopkinton Reservoir	
	Maspenock Lake	
	Echo Lake	
	Waseeka Sanctuary Pond	
	North Pond	
	Whitehall Brook	
	Sudbury River	
	Sudbury River	
	Indian Brook	
	Piccadilly Brook	
	Charles River	
	FEMA National Flood Hazards	
	DEP Wetlands	

Religious Centers	Islamic Masumeen Center	115 Wood Street
	St. John the Evangelist Parish Center	20 Church Street
	Faith Community Church of Hopkinton	146 E Main Street
	The Sanctuary at Woodville	249 Wood Street
	Vineyard Church Hopkinton	84 South Street
	St Paul's Episcopal Church	61 Wood Street
	Community Covenant Church	2 W Elm Street

Table 3-10. Category 3 - Dangerous/Hazardous Materials and Facilities

Type	*Name*	*Location*
Dams	Whitehall Reservoir Dam	
	Echo Lake Dam	
	Bloods Pond Dam	
	Grist Mill Dam	
	Ice House Pond Dam	
	Whitehall Lower Pond Dam	
	Whitehall Upper Pond Dam	
	Whitehall Reservoir Dike	
	Whitehall Reservoir Distribution Dam	
	Lake Maspenock Dam	
Landfills	MassDOT Highway Division 33	4 West Elm Street
	El Harvey Hopkinton Landfill	394 Wood Street
Underground Storage Tanks	Mobile Oil Corp. NO 01-323	92 West Main Street
	Exxon #3-6265	60 Main Street
	Hopkinton United	1 Grove Street
	Cumberland Farms	91 W Main St
Hazardous Materials Sites	At Int Fenton St	35 Hayden Rowe
	Mobile Service Station 01-323	92 West Main Street
	Kenney's Service Station	91 Grove St

Table 3-11. Category 4 - Vulnerable Populations and Community Facilities

Type	Name	Location
Housing Authority Properties	Brampton Circle	Davis Road
	Bisson Rue	Davis Road
	Mayhew Court	off Mayhew Street
Elderly Housing & Assisted Living	Golden Pond/Compass at Hopkinton	50 W Main Street
	Hearthstone at Golden Pond	50 W Main Street
	Fairview Estates	132 E Main Street
Schools & Daycares	Hopkinton High	90 Hayden Rowe Street
	Hopkinton Middle School	88 Hayden Rowe Street
	Elmwood	14 Elm Street
	Hopkinton Pre-School	88-B Hayden Rowe Street
	Hopkinton Public School	89 Hayden Rowe St
	Edward J. Hopkins Elementary School	104 Hayden Rowe St

	Marathon Elementary School	129 Hayden Rowe St
	Daycare	2 Wood St
	Daycare	88 Elm St
	Daycare	59 Wood St
	Daycare	26 Clinton St
	Daycare	26 Wood St
	Daycare	6 W Elm St
	Daycare	42 South St
	Daycare	7 Mayhew St
	Daycare	65 South St
	Daycare	1 Briarcliff Dr
	Daycare	34 Hayden Rowe
	Daycare	146 E Main St
	Daycare	63 Pennock Rd
	Daycare	5 Alexander Rd
Grocery & Supply Stores	Price Chopper	167 W Main St
	Country Farms	3 Cedar St
	Hopkinton Lumber Co.	118 Main St
	Hopkinton Drug	52 Main Street
	CVS Pharmacy	61 Main Street
	Integrity Pharmacy Services	45 South Street #2
Family and Youth Services	YMCA Family Outdoor Center	45 East Street
	Project Just Because	109 South Street
Census Block	25% are greater than age 65	
	35% are younger than age 18	

4.0 HAZARD PROFILES, RISK ASSESSMENT & VULNERABILITIES

Each hazard profile contains information on the areas vulnerable to the hazard, documentation of historic events, a risk assessment, and projected climate risk. The hazard profiles were updated with information from the 2013 Massachusetts State Hazard Mitigation Plan (MEMA and DCR, 2013); the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) (MA EOEEA EOPSS, 2018) and additional research and assessment. The Core Team, CRB Workshop, and Listening Session results provided local accounts of each hazard. A GIS Assessment was conducted to determine the risk in Hopkinton related to future flooding, hurricane, and earthquake events.

4.1 State-wide Overview of Hazards

4.1.1 Massachusetts State Hazard Mitigation and Climate Adaptation

The 2013 Massachusetts State Hazard Mitigation Plan (MEMA and DCR, 2013) and the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) (EOEEA and EOPSS, 2018) examined the 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 are listed as a 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 Hopkinton 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

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.

Table 4-1. Hazard Risk Summary

Hazard	Frequency		Severity	
	Massachusetts	Hopkinton	Massachusetts	Hopkinton
Inland Flooding	High (1 flood disaster declaration event every 3 years; 43 floods per year of lesser magnitude)	High	Serious to Catastrophic	Minor
Dam failures	Very Low	Very Low	Extensive to Catastrophic	Serious
Coastal Hazards	High (6 events per year over past 10 years)	N/A (Not a coastal community)	Serious to Extensive	N/A (Not a coastal community)
Tsunami	Very Low (1 event every 39 years on East Coast, 0 in MA)	N/A (Not a coastal community)	Extensive to Catastrophic	N/A (Not a coastal community)

Table 4-1. Hazard Risk Summary

Hazard	Frequency		Severity	
	Massachusetts	Hopkinton	Massachusetts	Hopkinton
Hurricane/Tropical Storm	High (1 storm every other year)	Medium	Serious to Catastrophic	Serious
High Wind (Severe Weather)	High (43.5 events per year)	High	Minor to Extensive	Minor to Extensive
Tornadoes (Severe Weather)	High (1.7 events per year)	Low	Serious to Extensive	Serious
Thunderstorms	High (20 to 30 events per year)	High	Minor to Extensive	Low
Nor'easter	High (1 to 4 events per year)	High	Minor to Extensive	Serious
Snow and Blizzard (Severe Winter Weather)	High (1 per year)	High	Minor to Extensive	Minor
Ice Storms (Severe Winter Weather)	High (1.5 per year)	Medium	Minor to Extensive	Minor
Earthquake	Very Low (10-15% probability of magnitude 5.0 or greater in New England in 10 years)	Low	Minor to Catastrophic	Extensive
Landslide	Low (once every two years in western MA)	Low	Minor to Extensive	Minor
Brushfires	High (at least 1 per year)	Medium	Minor to Extensive	Minor
Extreme Temperatures	High (1.5 cold weather and 2 hot weather events per year)	Medium	Minor to Serious	Minor
Drought	High (8% chance of "Watch" level drought per month	Low	Minor to Serious	Minor

Table 4-1. Hazard Risk Summary

Hazard	Frequency		Severity	
	Massachusetts	Hopkinton	Massachusetts	Hopkinton
	[recent droughts in 2016 and 1960s])			

(MEMA and DCR, 2013; EOEEA and EOPSS, 2018)

Not all hazards included in the 2018 State Hazard Mitigation and Climate Adaptation Plan or the 2013 Massachusetts State Hazard Mitigation Plan apply to the Town of Hopkinton. Given Hopkinton's inland location, coastal hazards and tsunamis are unlikely to directly affect the Town. Given the type of fires that have occurred in Hopkinton's history, the Town will focus on brush fires rather than broad wildfires. It is assumed that the entire Town of Hopkinton 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 22 storms in Massachusetts that resulted in federal or state disaster declarations. Sixteen disaster declarations occurred in Middlesex County. Federally declared disaster open additional FEMA grant opportunities for regional recovery and mitigation projects. The hazard profiles contain further information about federally declared disasters.

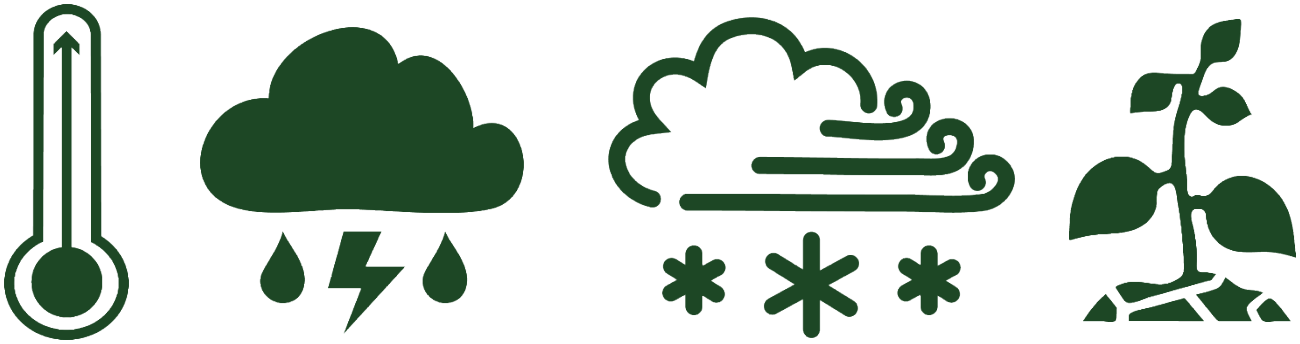
4.1.3 Impacts of Climate Change

Many of the hazards that Hopkinton is currently experiencing are projected to worsened by climate change. Climate change is caused by the warming of the Earth's atmosphere. The Earth's atmosphere has naturally occurring greenhouse gases, like carbon dioxide (CO_2), that 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), the Earth's temperature increases. The global temperature increase impacts jet streams and climate patterns. The Massachusetts climate is expected to reflect historic climate patterns of states south of New England depending upon GHG emission scenarios. Climate change is likely to change Massachusetts's typically precipitation cycle, leading to more intense rainfall and storms and more episodic or flash droughts. Temperatures will increase in both summer and winter. Each hazard profiles includes more details on how the frequency and intensity of the hazard will shift with climate change and the anticipated impacts.

4.1.4 Top Hazards as Defined in the CRB Workshop

Workshop participants were asked to identify the four top hazards/climate change impacts that Hopkinton faces. They were: 1) Extreme Temperatures, 2) Thunderstorms and Heavy Precipitation, 3) Severe Wind and Snowstorms, and 4) Drought. There was extensive discussion that lead to the selection of these top hazards. These hazards were presented to community members during the public listening session, and in the survey that followed the listening session, participants noted the hazard that

concerns then the most was extreme precipitation and flooding, followed closely by severe storms and extreme temperatures.



Discussion about drought causing the Town to lose their drinking water supply took place during the portion of the workshop that introduced known and potential natural hazards and climate change impacts that occur or are predicted to occur in Hopkinton. Stakeholders described how the Town's drinking water is supplied by groundwater, which is often at-risk during times of flash droughts. Sixty-five percent (65%) of the Town is on private wells, while the remaining thirty-five percent (35%) is on Town supplied well water, the majority of which comes from medium-yield aquifers. There was lengthy discussion between stakeholders on solutions that would keep Hopkinton resilient during times of drought. Potential solutions included additional water storage, including drinking water storage tanks as well as stormwater capture.

Another prevalent natural hazard for Hopkinton was identified as thunderstorms and heavy precipitation. Workshop participants expressed concern that poorly designed stormwater management systems can cause localized flooding during extreme precipitation events. Attendees annotated the maps noting areas that were prone to flooding. These areas included Cranberry Lane, Alprilla Farm Road, Main Street, and the Cedar Swamp Area, among others. Stakeholders agreed that an updated inventory of drainage and stormwater infrastructure was necessary to address and mitigate the issue. There was also discussion around incorporating green infrastructure, including stormwater capture and management, into the revitalization of Hopkinton Center.

The topic of severe winds and snowstorms was mentioned as a hazard of concern in the Town. As a town with isolated residential areas, one of the biggest concerns that may arise during a snowstorm or extreme wind event is limited access. This topic was high in stakeholders' minds as the workshop followed a snowstorm which left nearly a foot and a half of snow in Hopkinton over a two-day period. During high winds and snowstorms, situation have arisen when trees and power lines blocked the roads and prevented emergency vehicles from accessing entire areas of town. Some streets that have been affected in the past include Wood Street and Clinton Street. These areas have also been blocked from accessing the highway. Stakeholders believe that it is important to strengthen relationships with utility companies and work with other companies that have tree removal equipment.

There were discussions on the impacts that the Town faces as they experience more days of extreme temperatures. There is concern in particular for the elderly population, many of whom do not have air conditioning, as there are more consecutive days above 90 degrees. While there are cooling stations in Town, not all residents are aware of these facilities and may not be able to easily get them. Participants

came up with a solution that would involve creating a team of volunteers and a communication and response plan so that they could easily identify and support vulnerable populations.

Figure 4-1. Participants identify hazards and vulnerabilities during Hopkinton's CRB Workshop

4.2 Flood-Related Hazards

Flooding was a component of one of the four main hazards identified by participants during Hopkinton's MVP workshop. Flooding can be caused by various weather events including hurricanes, extreme precipitation, thunderstorms, nor'easters, and winter storms. While Hopkinton currently experiences these events, the impacts of climate change will likely lead to increasingly severe storms and, therefore, increasingly severe impacts. The impacts of flooding include injury or death, property damage, and traffic disruption. Areas within the FEMA Flood Zones, repetitive loss sites, and local areas identified as flood prone are more vulnerable to the impacts of flooding. The following sub-sections provide more information on historic flooding events, potential flood hazards, a vulnerability assessment, locally identified areas of flooding, and information on the risk of dam failures. This analysis of flood hazard areas was informed by the FEMA NFIP Flood Insurance Rate Maps (FIRMs), a GIS vulnerability analysis, information from Hopkinton town staff, and accounts of past flood events provided by participants during the Hopkinton MVP Workshop.

The topography in Hopkinton ranges from sharp slopes descending into lakes and reservoirs, to rolling hills, to expansive wetlands. This variation in topography, combined with shallow bedrock and a hardpan in much of the town, feeds heavily into the flooding that occurs throughout Hopkinton. Limited infiltration

in locations with shallow bedrock lead to increased runoff which then creates riverine flooding. Hopkinton is home to many bodies of water, including lakes, rivers, reservoirs, ponds, streams. There is a vast network of wetlands throughout the town, all of which are beneficial to the town but can also become a risk during heavy precipitation. Additional riverine and stormwater flooding in Hopkinton is due to undersized culverts, insufficient stormwater detention and drainage, and beaver activity. The Town is continuously upgrading culverts so that they are sized more appropriately for the stormwater volume they are receiving.

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

4.2.1 Areas Vulnerable to Flooding

Flooding can be both riverine (topping the banks of streams, rivers, ponds) and from stormwater that is not properly infiltrated into the ground.

Riverine Flooding

Hopkinton is home to the Charles River headwaters, which begins at Echo Lake at the southern side of town. A series of lakes, ponds, river, and smaller waterbodies dot the landscape of the town. These include:

- Whitehall Reservoir
- Hopkinton Reservoir
- Lake Maspenock
- Echo Lake
- Waseeka Sanctuary Pond
- North Pond
- Whitehall Brook
- Sudbury River
- Indian Brook
- Piccadilly Brook
- Charles River

FEMA Flood Zones and Repetitive Loss Sites

FEMA-designated flood zones from the NFIP FIRM are included in Map 3 in Appendix B are more vulnerable to flood events. The definitions of these flood zones are provided below. The FEMA flood zone surrounds most of the water bodies listed above, in addition to other large wetland areas, including Cedar Swamp, the southern end of Indian Brook, and areas expanding out from Bloods Pond.

Flood Insurance Rate Map Zone Definitions

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.

(FEMA, 2019b)

As defined by FEMA and the NFIP, a repetitive loss property is any insured property which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978 (FEMA, 2019e). There continue to be no repetitive loss structures in Hopkinton.

It is important to remember that although there are not any reportative loss structures in Hopkinton, this does not fully represent the damage that Hopkinton sees due to flooding. Repetitive loss data only includes buildings that qualify for the repetitive loss designation, which does not include all buildings that have uncured damage due to flooding.

Flooding events in Hopkinton have been classified as a high frequency event. As defined by the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (EEA and EOPSS, 2018) this hazard occurs once every three years (33% chance per year).

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 system or due debris in the system which would cause it to function below its design standard. Stormwater flooding can occur anywhere in Town and is not limited to areas surrounding water bodies. The stormwater management system becomes overwhelmed, causing water to inundate roadways and properties. Typical characteristics of areas that are subject to stormwater flooding include poor drainage, high amounts of impervious surface, and undersized culverts.

Locally Identified Areas of Flooding

Town staff and CRB Workshop participants helped identify local areas of flooding, summarized in Table 4-2 below. These areas may or may not directly overlap with the FEMA-designated flood zones

previously discussed; however, these areas have been noted to flood during a significant rain event. This is often due to topography and/or insufficient stormwater drainage.

Table 4-2. Locally Identified Areas of Flooding

Name	Description
Cranberry Lane/North Mill	Low lying area contain 30-40 homes that are impacted by flooding caused by beaver activity
Alprilla Farm Road	Flooding caused by Blood's Pond Dam
32 Granite Street	Undersized culvert – upgrade in progress
Main Street	Undersized drainage system and high impervious area
Cedar Swamp	Beaver activity is creating flooding in adjacent areas
West Elm Street	Undersized culvert
4th Street and Berry Acres	Undersized culvert
Chestnut Street	Undersized culvert

Middlesex Flooding Events

NOAA's National Centers for Environmental Information Storm Events Database (NOAA, 2018a) provides information on previous flood events for Middlesex County, detailing the areas of the county that were affected. Hopkinton is in the southern Middlesex zone. The storms are categorized by event type, which include flood and flash flood events. 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" (NOAA, 2018a).

Middlesex County had 160 flood events between 2000 and 2019. Thirty of these events were flash floods. No deaths or injuries were reported. The property damage totaled $53.439 million dollars (not adjusted for inflation). Incredibly, flooding during March 2010 caused more than 80% of the total property damage reported during this time period (over $35 million dollars). 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. Although not all the flooding documented in the database directly affected Hopkinton, monetary cost that flooding can have on an area is a proxy for the potential damage that could occur. Damages that occur regionally can also have an indirect impact on Hopkinton, especially because many of Hopkinton's utilities are regionally dependent.

Of the 160 flood events that occurred in Middlesex County between 2000 and 2019, nine of them directly affected Hopkinton. The dates and details of major flood events that affected the Town are listed below:

Table 4-3. Flooding Events in Hopkinton

Date of Flooding Event	Description
March 22, 2001	Widespread flooding occurred as a result of melting snow and heavy rainfall
April 1, 2004	Widespread flooding occurred due to heavy rain over a three-day period
July 6, 2005	Showers and thunderstorms produced locally heavy downpours, creating flash flooding
October 15, 2005	A low-pressure system resulted in excessive rain and flooding
May 13, 2006	Heavy rain of between 8 to 12 inches over 3 days resulted in major damage to infrastructure.
April 16, 2007	Heavy rain and winds caused flooding and downed trees and power lines.
March 29, 2010	A low-pressure system brought heavy rain over a two-day period.
August 1, 2014	2 to 4 inches of rain fell in less than an hour
April 16, 2018	Snow, freezing rain, and rain caused road closures in Hopkinton

(NOAA, 2020c)

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 is 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

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

Table 4-4.Previous Federal and State Disaster Declarations - Flooding

Disaster Name and Date of Event	Disaster Number	Type of Assistance	Counties Under Declaration
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 December 11-18, 2008	DR-1813	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	All 14 Massachusetts Counties
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

(FEMA, 2019d)

4.2.2 GIS Flooding Exposure Analysis

Hazard location and extent of riverine flooding was determined using the current effective FEMA Flood Insurance Rate Map (FIRM) data for Hopkinton dated 2014. 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 NFIP. This includes high risk areas that have a one percent chance of being flooded in any year (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 percent chance of flooding in any year (often referred to as the "500-year floodplain"). For purposes of this exposure analysis, the following special flood hazard areas as identified in the Town of Hopkinton's current FIRMs were 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 utilizing MassGIS data, FEMA flood maps, and information gathered from the municipality. Table 4-5 below displays critical facilities in Hopkinton that are located within either the 100-year or 500-year FEMA flood zone, and Table 4-6 shows all census blocks in Hopkinton that contain a high concentration of a vulnerable population.

Table 4-5. Critical Facilities Located within the FEMA Flood Zone

Facility	Address	100-Year Flood Zone	500-Year Flood Zone
Capped Landfill	4 West Elm Street		X
Capped Landfill	394 Wood Street	X	

As can be seen in the table, the only critical facilities in Hopkinton that are located within a FEMA flood zone are two capped landfills. One is located within the 100-year FEMA flood zone and one is located within the 500-year FEMA flood zone. It is important to protect these facilities from flooding, which could threaten the integrity of the landfill and potentially cause water quality and contamination issues downstream if the site were to leach or erode.

During the workshop, stakeholders discussed concern around the location of vulnerable populations. Some of these community members rely on assistance and it is important that someone can access them if needed. It becomes a concern if the vulnerable populations are located within a flood zone or in an area that extreme flooding could isolate them from the rest of the town. Of the 352 census blocks with a high percentage of vulnerable populations, 19 located partially within a FEMA flood zone.

Table 4-6. Vulnerable Populations Located within the FEMA Flood Zone

Census Block Number	High Concentration of Vulnerable Population	Total Area (acres)	Area in 100-Year Flood Zone (acres)	Area in 500-Year Flood Zone (acres)
250173201021009	Minor (< 18 years)	129.0	6.9	0.0
250173201021012	Minor (< 18 years)	1867.7	56.1	0.0
250173201021018	Minor (< 18 years)	139.6	15.5	1.1
250173201021019	Minor (< 18 years)	1091.4	50.0	2.4
250173201021034	Minor (< 18 years)	161.1	0.0	25.0
250173201023026	Minor (< 18 years)	162.3	10.6	0.1
250173201023065	Minor (< 18 years)	54.2	8.7	0.0
250173201031022	Minor (< 18 years)	1112.0	210.0	0.0
250173201031035	Minor (< 18 years)	301.8	14.5	0.0
250173201031049	Minor (< 18 years)	216.2	25.3	0.0
250173201031054	Minor (< 18 years)	15.5	2.4	0.0
250173201041014	Minor (< 18 years)	1798.6	0.0	48.4
250173201041045	Minor (< 18 years)	84.2	7.2	0.0
250173201042003	Minor (< 18 years)	10832.3	195.3	0.0

250173201042010	Minor (<18 years)	315.9	18.2	0.2
250173201042020	Elderly (65+ years)	827.7	23.8	16.2
250173201023064	Elderly (65+ years)	10.2	1.5	0.0
250173201042043	Elderly (65+ years)	4.0	0.6	0.0
250173201043010	Elderly (65+ years)	52.9	5.5	0.1
250173201043026	Elderly (65+ years)	15.5	0.0	0.5

As seen in Table 4-6, census blocks vary greatly by size. Census blocks which are larger in size with only a small percentage of the total area residing in a flood zone may be less vulnerable than a smaller census block with the same percentage of total area in a flood zone. This is due to the greater availability of space for infrastructure outside of the flood zone in the larger parcel. For example, 18.9% of the census block ending in 31022 is located withing the 100-year flood zone. In comparison, 15.5% of the census block ending in 31054 is in the 100-year flood zone. However, the total areas of the census blocks are 1112 and 15.5 acres, respectively. In census block 31022, this leaves over 900 acres of land outside of the flood zone that could be developed, while only 13 acres outside of the flood zone in census block 31054.

While this may not be true for all census blocks, this goes to show that it is important to pay close attention to vulnerable populations within a community. Depending on developments within an area, vulnerable populations could be increasingly at-risk to flooding or other natural hazards dur to their surrounding and landscape.

The Town's existing tax parcel and property value data, obtained from MassGIS, were used to estimate the number of parcels (developed and undeveloped) and buildings located in identified hazard areas along with their respective assessed values. The parcel data set provides information about the parcel size, land use type, and assessed value among other characteristics. The parcel data was also classified into various land use types based on the Massachusetts Department of Revenue's Property Type Classification Code, 2016.

An analysis was conducted on all developed parcels in the Town. To determine the vulnerability of each parcel and building, a GIS overlay analysis was conducted in which the flood hazard extent zones were overlaid with the parcel data and existing building footprint data. These developments were overlaid with historic flood zones to determine these parcels vulnerability to flooding. They were categorized by land use type, and the exposure of each land use type was documented by the total area and percentage of parcels that overlap with a flood zone. The risk or impact of potential flooding was captured by summarizing the total property value in each parcel.

Approximately 24% of the developed parcels in Hopkinton are located within a flood zone. Residential properties have the greatest building value located in both the 100-year flood zone and the 500-year flood zone. Commercial parcels also have a high risk, with nearly one-third of these parcels located in the 100-year flood zone. This is consistent with comments from stakeholders which noted that Main Street in Hopkinton often floods, which is where many commercial buildings are located.

The tables below show the exposure of developed parcels in the Town of Hopkinton.

Table 4-7. Developed Parcels in 100-Year FEMA Flood Zone

Exposure of Developed Parcels to the 100-Year Flood Zone						
Land Use Type	Total Number of Parcels	Total Area of Parcels (acres)	Number of Parcels in the Flood Zone	Area of Parcels in the Flood Zone (acres)	Percentage of Parcels in the Flood Zone	Property Value in the Flood Zone
Residential	4634	6312.4	246.0	517.6	8.2	$128,315,200.00
Commercial	73	261.8	3.0	85.1	32.5	$648,800.00
Industrial	42	549.6	2.0	59.9	10.9	$1,210,300.00
Institutional	45	648.4	7.0	1214.1	187.2	$32,628,200.00
Agricultural	2	195.9	N/A	N/A	N/A	N/A
Recreation & Open Space	5	219.0	1.0	63.3	28.9	$1,258,300.00
Total	**4801**	**8187.1**	**259.0**	**1940.0**	**23.7**	**$164,060,800.00**

Table 4-8. Developed Parcels in 500-Year FEMA Flood Zone

Exposure of Developed Parcels to the 500-Year Flood Zone						
Land Use Type	Total Number of Parcels	Total Area of Parcels (acres)	Number of Parcels in the Flood Zone	Area of Parcels in the Flood Zone (acres)	Percentage of Parcels in the Flood Zone	Property Value in the Flood Zone
Residential	4634.0	6312.4	72.0	250.7	4.0	$81,732,500.00
Commercial	73.0	261.8	2.0	23.4	8.9	$21,769,500.00
Industrial	42.0	549.6	2.0	14.8	2.7	$4,777,800.00
Institutional	45.0	648.4	6.0	427.5	65.9	$16,204,400.00
Agricultural	2.0	195.9	1.0	140.8	71.9	$364,500.00
Recreation & Open Space	5.0	219.0	1.0	27.5	12.6	N/A
Total	**4801**	**8187.1**	**84.0**	**884.7**	**10.8**	**$124,848,700.00**

Information about recent developments, or redevelopments, within the past 10 years (2010 – 2020) was obtained from MassBuilds (MAPC, 2019) and verified by the Town's Principal Planner (Gelcich, 2020). An exposure analysis was done on these parcels. To determine the vulnerability of each parcel and building, a GIS overlay analysis was conducted in which the flood hazard extent zones were overlaid with the parcel data for recent developments and building footprint data (when available). These developments were overlaid with historic flood zones to determine these parcels vulnerability to flooding. They were categorized by land use type, and the exposure of each land use type was documented by the total area and percentage of parcels that overlap with a flood zone. The risk or impact of potential flooding was captured by summarizing the total property value in each parcel.

Although MassGIS parcel data is dated 2020, not all property values have been updated to reflect the most recent developments. Some limitations exist in the accuracy of the data resulting from delay in updates to the building and property value.

Table 4-9. Recently Developed Parcels in the 100-Year FEMA Flood Zone

Exposure of Recently Developed Parcels to the 100-Year Flood Zone						
Development Name	Development Address	Development Type	Total Area of Parcel (acres)	Area of Parcel in the Flood Zone (acres)	Percentage of the Parcels in the Flood Zone	Property Value in the Flood Zone
E. L. Harvey & Sons	412 MA-135	Industrial	46.1	8.9	19.3	N/A[1]
Golden Pond Assisted Living	58 West Main Street	Institutional	11.0	3.9	35.7	$16,198,400.00
Christian Way	189 Pond St	Residential	6.3	0.3	5.1	$547,900.00
Maspenock Woods	11 W Elm St	Residential	13.5	0.4	2.9	N/A[1]
Woodview at Legacy Farms, formerly Legacy Farms (Alta) - Wood partners	3 Woodview Way	Residential	18.2	0.0	0.0	$41,606,500.00
Penny Meadow Lane	9 Penny Meadow Lane	Residential	5.5	4.1	74.4	$713,400.00
Total			100.7	17.6	17.5	$59,066,200.00

[1]Building and property values have not yet been updated

Table 4-10. Recently Developed Parcels in the 500-Year Flood Zone

Exposure of Recently Developed Parcels to the 500-Year Flood Zone						
Development Name	Development Address	Development Type	Total Area of Parcel (acres)	Area of Parcel in the Flood Zone (acres)	Percentage of the Parcels in the Flood Zone	Property Value in the Flood Zone
Modera Hopkinton/Hopkinton Mews	89-93 Lumber St	Open Space	27.5	5.5	20.2	N/A[1]
Penny Meadow Lane	9 Penny Meadow Lane	Residential	5.5	0.7	11.9	$713,400.00
Total			33.0	6.2	18.8	$713,400.00

[1]Building and property values have not yet been updated

Hopkinton is a growing community and as the population grows, so does the demand for additional facilities in the town. In recent years, the Town has updated zoning bylaws to limit development in forested and open space. To further resiliency in the Town, a flood exposure analysis was completed on all vacant, developable parcels. The analysis was conducted utilizing MassGIS data, FEMA flood

maps, and information from the Town. The result of this analysis will bring light to future flooding that could occur on these parcels if they were to be developed.

The output of the ArcGIS overlay analysis showed all vacant, developable parcels that intersected with a flood zone. The number of parcels was totaled for each land use type within each of FEMA Flood Zones. While 655 acres of land in Hopkinton are vacant and developable, 39% of that land is located within the 100-year flood zone and an additional 18% in the 500-year flood zone. It is recommended that as the Town expands development, additional analysis be conducted on these parcels to reduce damage from flooding.

Table 4-11. Developable, Vacant Land in the 100-Year FEMA Flood Zone

Exposure of Developable, Vacant Land to the 100-Year Flood Zone					
Land Use Category	Total Number of Parcels	Total Area of Parcels (acres)	Number of Parcels in Flood Zone	Area of Parcels in Flood Zone (acres)	Percentage of Parcels in the Flood Zone
Residential	191	938.7	17.0	255.0	27.2
Commercial	18	122.4	1.0	23.6	19.3
Industrial	13	163.5	2.0	59.3	36.2
Institutional	181	2504.9	34.0	1411.2	56.3
Agricultural	22	234.6	2.0	24.3	10.3
Recreation & Open Space	230	2003.2	22.0	559.3	27.9
Total	**655**	**5967.4**	**78.0**	**2332.5**	**39.1**

Table 4-12. Developable, Vacant Land in the 500-Year FEMA Flood Zone

Exposure of Developable, Vacant Land to the 500-Year Flood Zone					
Land Use Category	Total Number of Parcels	Total Area of Parcels (acres)	Number of Parcels in Flood Zone	Area of Parcels in Flood Zone (acres)	Percentage of Parcels in the Flood Zone
Residential	191	938.7	10.0	71.7	7.6
Commercial	18	122.4	3.0	21.1	17.2
Industrial	13	163.5	N/A	N/A	N/A
Institutional	181	2504.9	11.0	656.3	26.2
Agricultural	22	234.6	2.0	49.9	21.3
Recreation & Open Space	230	2003.2	13.0	295.4	14.7
Total	**655**	**5967.4**	**39.0**	**1094.4**	**18.3**

Planned development noted by MassBuilds (MAPC, 2020) were reviewed and updated by the Principal Planner (Gelcich, 2020). These parcels were overlaid with FEMA flood zone maps to determine the vulnerability to flooding. They were categorized by development type. The exposure of potential development within each land use type was documented by the area and percentage of parcels that overlap with a flood zone.

Of the five planned developments in Hopkinton, none are in the 100-year flood zone and two developments are located in the 500-year flood zone. This can be seen in Tables 4-13 and 4-14 below.

Table 4-13. Planned Development in the 100-Year FEMA Flood Zone

Exposure of Locally Identified Areas for Potential Development to the 100-Year Flood Zone					
Development Name	Development Address	Development Type	Area of Parcel (acres)	Area of Parcel in Flood Zone (acres)	Percentage of Parcel in the Flood Zone
N/A	N/A	N/A	N/A	N/A	N/A

Table 4-14. Planned Development in the 500-Year FEMA Flood Zone

Exposure of Locally Identified Areas for Potential Development to the 500-Year Flood Zone					
Development Name	Development Address	Development Type	Area of Parcel (acres)	Area of Parcel in Flood Zone (acres)	Percentage of Parcel in the Flood Zone
Lumber St. - West Main St. Development	77 West Main Plaza	Commercial	7.8	0.7	9.6
Hopkinton Tennis Club	Freedom Way	Commercial	8.2	1.0	12.5
Total			**16.0**	**1.8**	**11.1**

Both planned developments located in the 500-year flood zone are in downtown Hopkinton, directly off of Main Street. It has been noted that Main Street and the infrastructure along this street frequently floods. During the CRB Workshop, stakeholders made note of this issue and developed action items to mitigate flooding in the Main Street area. As the Town upgrades drainage and implements additional stormwater BMPs in the area the planned developments will be protected from future flood damage.

4.2.3 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 (DCR, 2017). Dam failures during flood events are of concern in Massachusetts, given the high density of dams constructed in the 19th century (MEMA and DCR, 2013).

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 (MEMA and DCR, 2013). 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 (MEMA and DCR, 2013).

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 increases in water, such as slowly releasing water. It is advised that these events are monitored as it can add additional stress on the dam infrastructure.

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

In Hopkinton, dam failure is classified as a very low frequency event, which is defined by the 2018 State Hazard Mitigation and Climate Adaptation Plan (MA EOEEA EOPSS, 2018) as occurring less frequently than once every 100 years (less that a 1% chance per year). Although there have been no recorded dam failures in Hopkinton, 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 nine dams in Hopkinton. Information related to these dams is summarized in Table 4-15. 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 4-15. Inventory of Dams in Hopkinton

Dam Name	Impoundment	Dam Owner	Hazard Potential Classification
Whitehall Reservoir Dam	Whitehall Brook	MA/DCR	Significant
Echo Lake Dam	Chares River	Milford Water Co.	High
Bloods Pond Dam	Cold Spring Brook	Hopkinton	Significant
Grist Mill Dam	Cold Spring Brook	Hopkinton	Low
Ice House Pond Dam	Indian Brook	Hopkinton	Small, unregulated
Whitehall Lower Pond Dam	Whitehall Brook	MA/DCR	Small, unregulated
Whitehall Upper Pond Dam	Whitehall Brook	MA/DCR	Significant
Whitehall Reservoir Dike	Whitehall Brook	MA/DCR	Small, unregulated
Whitehall Reservoir Distribution Dam	Whitehall Brook	MA/DCR	Significant

(ACOE, 2020)

As of February 2017, all dams classified as high hazard potential or significant hazard potential were required to have an Emergency Action Plan (EAP) (MA, 2020). 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.

4.2.4 Climate Change Impacts: Flooding

Boston's average annual precipitation is 53.32 inches (NOAA 2020a). Extreme rain and snow events are becoming increasingly common and severe particularly in the Northeast region of the country (Figure 4-2). 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 frequency of extreme rain and snow events. These events now occur 85% more frequently than they did 60 years ago (Madsen and Willcox, 2012).

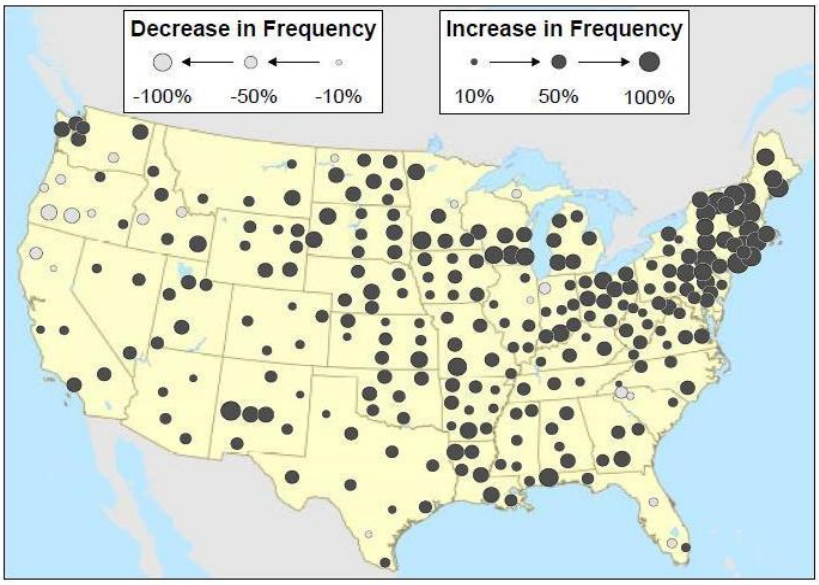


Figure 4-2. Changes in Frequency of Extreme Downpours
(Madsen and Willcox, 2012)

4.3 Wind Related Hazard

High winds can occur during hurricanes, tropical storms, tornadoes, nor'easters, and thunderstorms. The entire area of Hopkinton 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 Hopkinton's current 100-year wind speed is 98 mph (ASCE, 2018), 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 Hopkinton is the damage to power lines from overhanging trees. Currently, the Town fully relies fully on Eversource to trim and maintain trees surrounding power lines. Eversource has internal planning documents and emergency response procedures that are not often coordinated with local agencies or the Town. This can often leave the Town vulnerable if maintenance is not conducted in a timely manner. Stakeholders discussed options of working with other companies that have tree trimming equipment in order to tend to immediate needs and mitigate potential road blockages that occur from downed trees or power lines. Additionally, the utility's tree maintenance program should be upgraded to reduce the risk associated with tree damage to utility lines.

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 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 (MEMA and DCR, 2013).

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 to the hurricane and tropical storm hazard. 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 (MEMA and DCR, 2013). The region has been impacted by hurricanes throughout its history, the earliest recorded in 1635. Between 2000 and 2020, Massachusetts experienced two hurricanes, Hurricane Sandy and Hurricane Irene and three tropical storms, named Tropical Storm Jose, Tropical Storm Florence, and Tropical Storm Dorien. Both Hurricane Sandy and Hurricane Irene led to a federal disaster declaration. Hurricanes that have occurred in the region since 1938 are listed in Table 4-16 below.

Table 4-16. Hurricane Records for Eastern Massachusetts, 1938 to 2019

Hurricane Event	Date
Great New England Hurricane*	September 21, 1938
Great Atlantic Hurricane*	September 14-15, 1944
Hurricane Doug	September 11-12, 1950
Hurricane Carol*	August 31, 1954
Hurricane Edna*	September 11, 1954
Hurricane Diane	August 17-19, 1955
Hurricane Donna	September 12, 1960
Hurricane Gloria	September 27, 1985
Hurricane Bob	August 19, 1991

Hurricane Event	Date
Hurricane Earl	September 4, 2010
Hurricane Irene	August 28, 2011
Hurricane Sandy	October 29-30, 2012
Tropical Storm Jose	September 20, 2017
Tropical Storm Florence	September 18, 2018
Tropical Storm Dorian	September 7, 2019

* Category 3 (NOAA, 2020b)

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 (EOEEA and EOPSS, 2018). More information is included in Table 4-17 below:

Table 4-17. Saffir/Simpson Scale

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.

(MEMA and DCR, 2013) (table originally created by NOAA)

Hurricane damage in Hopkinton was estimated using a 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 in order 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 the purpose of this analysis, in order 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, storm was modeled to show the impact that could occur from an extreme scenario, something that could possibly 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. In order to model each of these hurricanes, the study region must first be defined. The Town of Hopkinton was outlined by the census tracts in the Town. The probabilistic scenario was used for Hopkinton. 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 Hopkinton if either a Category 2 or a Category 4 hurricane passed by. 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.

Table 4-18. Category 2 Hurricane Damage

Infrastructural Damage from a Category 2 Hurricane on Buildings in Hopkinton				
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	4,903	133	2.7%	$14,724,650
Commercial	332	7	2.1%	$289,830
Industrial	129	3	2.1%	$55,040
Others	199	1	2.6%	$35,410
TOTAL	**5,434**	**145**	**2.7%**	**$15,104,930**

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

Table 4-19. Category 4 Hurricane Damage

Infrastructural Damage from a Category 4 Hurricane on Buildings in Hopkinton				
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	4,903	893	18.2%	$49,552,170
Commercial	332	45	13.5%	$2,137,210
Industrial	129	17	13.4%	$875,430
Others	199	10	5.1%	$310,890
TOTAL	**5,434**	**145**	**2.7%**	**$52,875,700**

[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. 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 Hopkinton and are considered a medium frequency event. As defined by the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, this hazard will occur on average once every two years (a 50% chance per 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 (MA EOEEA EOPSS, 2018). Effects of a tornado include very strong winds in the middle and upper level 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 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 occurred in May 1995, and the Windsor Locks, Connecticut, tornado occurred in October 1979 (MA EOEEA EOPSS, 2018).

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 4-20 provides more detailed information on the EF Scale.

Table 4-20. Enhanced Fujita Scale

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

(MEMA and DCR, 2013)

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 (MA EOEEA EOPSS, 2018). 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 Concord (Morrison, 2014; Epstein, 2016).

There have been 18 recorded tornadoes in Middlesex County since 1955. One fatality and six injuries were reported (NOAA, 2020c). Table 4-21 below provides additional information.

Table 4-21. Tornado Records for Middlesex County, 1955 to 2020

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

(NOAA 2019a)

Although tornadoes are a potential town-wide hazard in Hopkinton, there have been no recorded tornadoes in the Town. If a tornado were to occur in Hopkinton, 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 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 Hopkinton are a very low frequency event. As defined by the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, Massachusetts experiences an average of 1.7 tornadoes per year. Tornadoes 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 counter-clockwise 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 (MA EOEEA EOPSS, 2018).

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 surge 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 (MA EOEEA EOPSS, 2018). Previous nor'easters events are listed in Table 4-22 below. The severe Coastal Storm in 1991 led to a federal disaster declaration.

Table 4-22. Nor'easter Events for Massachusetts, 1978 to 2020

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

(NOAA, 2019b)

Some of the historic events described in the "Flood-Related Hazards" section of this report were preceded by nor'easters, including the 1991 "Perfect Storm." The Blizzard of '78 was a notable storm. More recently, winter storms in 2015 and 2018 caused significant snowfall amounts. The March 2018 snowstorm still weighed heavily in stakeholders' minds, as they recalled damage from the storm and the clean up during and after the storm. The 2018 storm prompted a state of emergency, and areas of town were isolated for four to five days.

The Town of Hopkinton 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, Hopkinton is not subject to the coastal hazards often associated with nor'easters.

Nor'easters in Hopkinton 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 (MA EOEEA EOPSS, 2018).

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 Hopkinton. 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 4-23. Previous Federal and State Disaster Declarations - Thunderstorms

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
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

(FEMA, 2019d)

NOAA's National Centers for Environmental Information offers thunderstorm data for Middlesex County, which includes Hopkinton. Between 2008 and 2018, 278 thunderstorm events caused $3,208,000 in property damages. Three injuries and no deaths were reported.

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 waterbodies or due to surcharged drainage systems.

Thunderstorms are considered high frequency events in Hopkinton. According to the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, Massachusetts experiences 20-30 thunderstorm days per year.

4.3.5 Climate Change Impacts: High Winds

While Hopkinton's current 100-year wind speed is 98 mph (ASCE, 2018), 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 impacts (Walsh and Wuebbles, 2014). The anticipated increase in frequency and intensity of severe thunderstorms may also increase the risk of tornadoes (MA EOEEA EOPSS, 2018).

4.4 Winter Storms

Winter storm events are atmospheric in nature and can impact the entire planning area. All current and future buildings and populations are 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 Hopkinton. 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.

Table 4-24. Previous Federal and State Disaster Declarations

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

Table 4-24. Previous Federal and State Disaster Declarations

Disaster Name and Date of Event	Disaster Number	Type of Assistance	Counties Under Declaration
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
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

(FEMA 2019d)

4.4.1 Heavy Snow and Blizzards

Photo: Blizzard of 2015. Photo by Hopkinton Police Department, Twitter, 2015.

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 a 3-hour period. 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 (MA EOEEA EOPSS, 2018).

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 (NOAA, 2019). Winter storms can be combined with the nor'easters discussed previously in the "Wind-Related Hazards" section.

There is no widely used scale 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 (NOAA, 2004) 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 4-25. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS gives an indication of 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 impact from snow events (MEMA and DCR, 2013).

Table 4-25. NESIS Categories

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

(MA EOEEA EOPSS, 2018)

The current winter snowfall record in Eastern Massachusetts is 108.6 inches during the 2014-2015 season ((NOAA, 2015). The town provides standard snow plowing operations and clearing snow has not posed any significant challenges.

The "Blizzard of 1978" is a well-known winter storm that deposited more than three feet of snow and led to multi-day closures of roads, businesses, and schools. Table 4-22 in Section 4.3.3 provides additional information on significant snow events.

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 dollars of damage. The greatest damage was during this time frame was a storm in 2011 causing $926,000 of damage. None of the storms were specific to Central Middlesex.

During Hopkinton's MVP Workshop in December 2019, participants discussed past examples of severe winter weather, including the recent snowstorm which left 16 inches of snow in Town. Participants discussed the opportunity for additional snow maintenance personnel and equipment. Backup power sources are imperative to the Town in the event of power outages due to severe winter weather.

Blizzards are classified as high frequency events in town. 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 criteria for a winter storm warning, is for severe icing. This is issued when ½ inch or more of accretion of freezing rain is expected. This may lead to dangerous walking or driving conditions and the weighing down of power lines and trees. Icy roads can also complicate emergency response efforts during an extreme event. Ice storms are classified as medium frequency events in Hopkinton. As defined by the 2013 Massachusetts State Hazard Mitigation Plan, this hazard can occur between once in five years and once in 50 years (a 2% to 20% chance of occurring each 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 (MEMA and DCR, 2013).

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, three ice storms, and no reported sleet hazards between 2000 and 219. No deaths or injuries were reported. Over $6.2 million dollars in damages were incurred.

4.4.3 Climate Change Impacts: Winter Storms

There is evidence suggesting 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 (MA EOEEA EOPSS, 2018).

Climate projections indicate that climate change will result in more precipitation during the winter in the Northeast (MA EOEEA EOPSS, 2018). 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. It was noted that while there have been reported brushfires in Hopkinton, it is not a large occurrence and the Town is not overly concerned about the potential for brushfires.

4.5.1 Earthquakes

An earthquake is the 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 in many deaths and considerable damage, can have the same magnitude as an earthquake in a remote area that causes no damage. Table 4-26 summarizes Richter scale magnitudes and corresponding earthquake effects (MEMA and DCR, 2013).

Table 4-26. Richter Scale and Effects

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

(Louie, 1996)

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. (MEMA and DCR, 2013). A summary of historic earthquakes in the Boston area is included in Table 4-27 below:

Table 4-27. Historical Earthquakes in Massachusetts and Surrounding Area, 1727-2020

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA - Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA - Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA - Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA - Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA - Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
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
CT – Wauregan	1/13/2015	2.6
RI – Newport	2/3/2015	2.0

Table 4-27. Historical Earthquakes in Massachusetts and Surrounding Area, 1727-2020

Location	Date	Magnitude
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

(USGS, 2020)

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 4-3 provides additional information.

Hopkinton is in an area with a PGA of 12%g with a 2% probability of exceedance in 50 years (Figure 4-3). Compared to the rest of the United States, Massachusetts overall has a low risk of earthquakes.

No earthquake epicenters have been recorded within Hopkinton. 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.

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 prior to earthquake resistant design considerations.

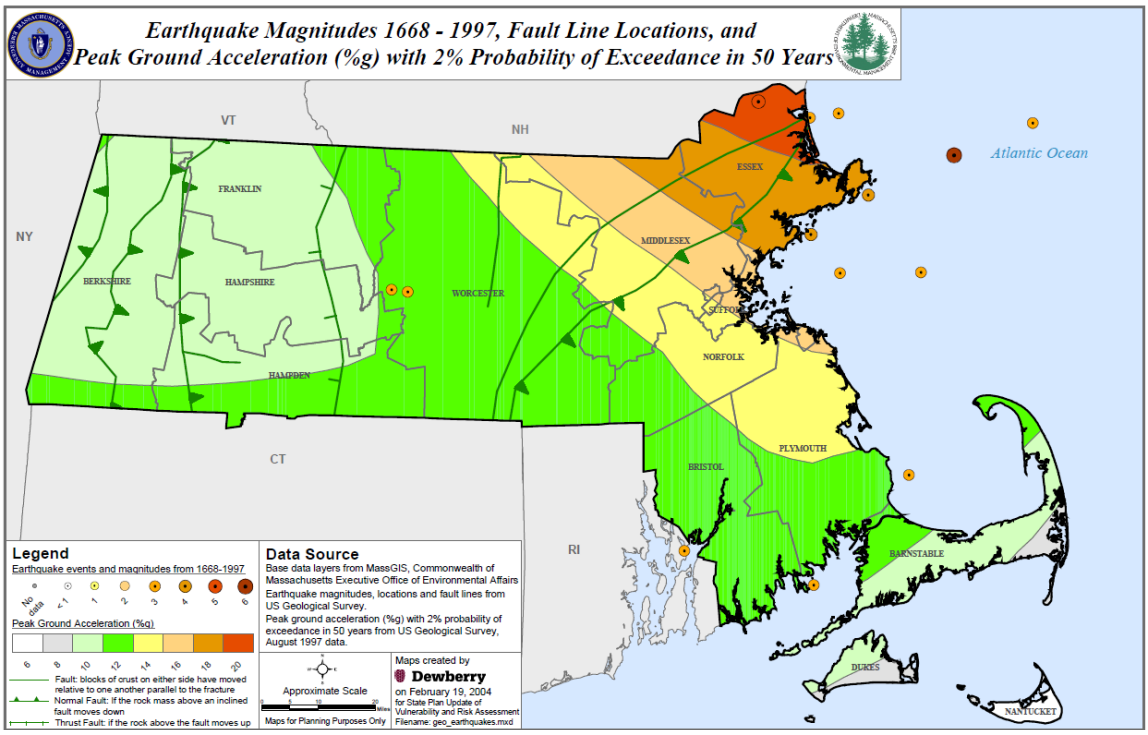


Figure 4-3. State of Massachusetts Earthquake Probability Map

(EOEEA and EOPSS, 2018)

It can be assumed that all existing and future buildings and populations are at risk to 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 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 a soil is reduced by earthquake).

Potential earthquake damage was modeled for Hopkinton using Hazus. The Hazus earthquake model allows users to input specific parameters in order 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. There is a possibility for larger scale earthquakes to occur in Massachusetts at some point, therefore a magnitude 7.0 earthquake was modeled as well to demonstrate the damage that could occur.

In order to model each of these earthquakes, the study region must first be defined. The Town of Hopkinton was outlined by the census tracts in the Town. The arbitrary event scenario was used for Hopkinton. This scenario allows the user to input the magnitude, depth, with, and epicenter of the earthquake. This must be done for each earthquake magnitude chosen. The output shows the potential impact that could occur in Hopkinton if either a magnitude 5.0 or a magnitude 7.0 earthquake occurred with the epicenter located in the center of Hopkinton. 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 4-28. Magnitude 5.0 Earthquake Damage

Infrastructural Damage from a Magnitude 5.0 Earthquake on Buildings in Hopkinton				
Land Use Type	Total Number of Buildings	Total Number of Buildings Damaged	Percent of Buildings Damaged	Total Value of Building Damage[1]
Residential	4,903	2,284	46.6%	$172,800,200
Commercial	332	257	77.4%	$70,287,000
Industrial	129	102	79%	$23,552,400
Others	199	28	14.2%	$9,316,300
TOTAL	**5,434**	**2,671**	**49.2%**	**$275,955,900**

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

Table 4-29. Magnitude 7.0 Earthquake Damage

Infrastructural Damage from a Magnitude 7.0 Earthquake on Buildings in Hopkinton				
Land Use Type	Total Number of Buildings	Total Number of Buildings Damaged	Percent of Buildings Damaged	Total Value of Building Damage[1]
Residential	4,903	4,890	99.7%	$1,528,375,200
Commercial	332	332	100%	$444,080,200
Industrial	129	129	100%	$143,731,700
Others	199	129	100%	$59,863,200
TOTAL	**5,434**	**5,421**	**99.8%**	**$2,176,050,300**

[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. 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 low frequency event in Hopkinton. 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 a 10-year period.

4.5.2 Landslides

Landslide include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity, acting on an over steepened slope, is the primary reason for a landslide, there are other contributing factors. 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 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 4-30 below.

Table 4-30. Landslide Volume and Velocity

Estimate Volume (m^3)	Expected Landslide Velocity		
	Fast moving (rock fall)	Rapid moving (debris flow)	Slow moving (slide)
<0.001	Slight intensity	--	--
<0.5	Medium intensity	--	--
>0.5	High intensity	---	--
<500	High intensity	Slight intensity	--
500-10,000	High intensity	Medium intensity	Slight intensity
10,000 – 50,000	Very high intensity	High intensity	Medium intensity
>500,000	--	Very high intensity	High intensity
>>500,000	--	--	Very high intensity

(Cardinali et al., 2002)

No significant landslides have been recorded for Hopkinton or Middlesex County (MA EOEEA EOPSS, 2018). Local officials indicate that there are occasionally localized issues of erosion during construction, as a result of development, or as a result of clearing vegetation. Landslides are classified as low frequency events in Hopkinton. 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 intentional controlled manner, and often begin unnoticed, but spread quickly, igniting brush, trees, and homes (MEMA and DCR, 2013). The State Hazard Mitigation and Climate Adaptation Plan (MA EOEEA EOPSS, 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."*

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 Hopkinton. 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 (MA EOEEA EOPSS, 2018). 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

Although they are usually minor, the Hopkinton Fire Department responds to a fair amount of brush fires annually. In 2018, Hopkinton experienced 58 fires, which included 20 structure fires, 16 vehicle fires, and the remaining 22 were brush fires or other. This number was slightly higher than the 42 fires experienced in 2017. The total monetary loss due to fires in 2017 was $136,600, and in 2018 was $337,200.

The areas of Hopkinton most vulnerable to brush fire are primarily heavily wooded areas. These locations include the corridor along I-495, Hopkinton State Park, Peppercorn Hill, Saddle Hill, Upton State Park, and along the Mass Turnpike. Although these areas tend to see occasional brushfires, usually originating from humans, the Hopkinton Fire Department is not overly concerned with potential brush fires. The fire department has enough equipment and resources, and most at-risk areas are accessible, that they are confident in their ability to control the fire before it escalated too far.

Figure 4-4 below shows the locations of historical brush fires and the number of acres burned in Massachusetts between 2001 and 2009.

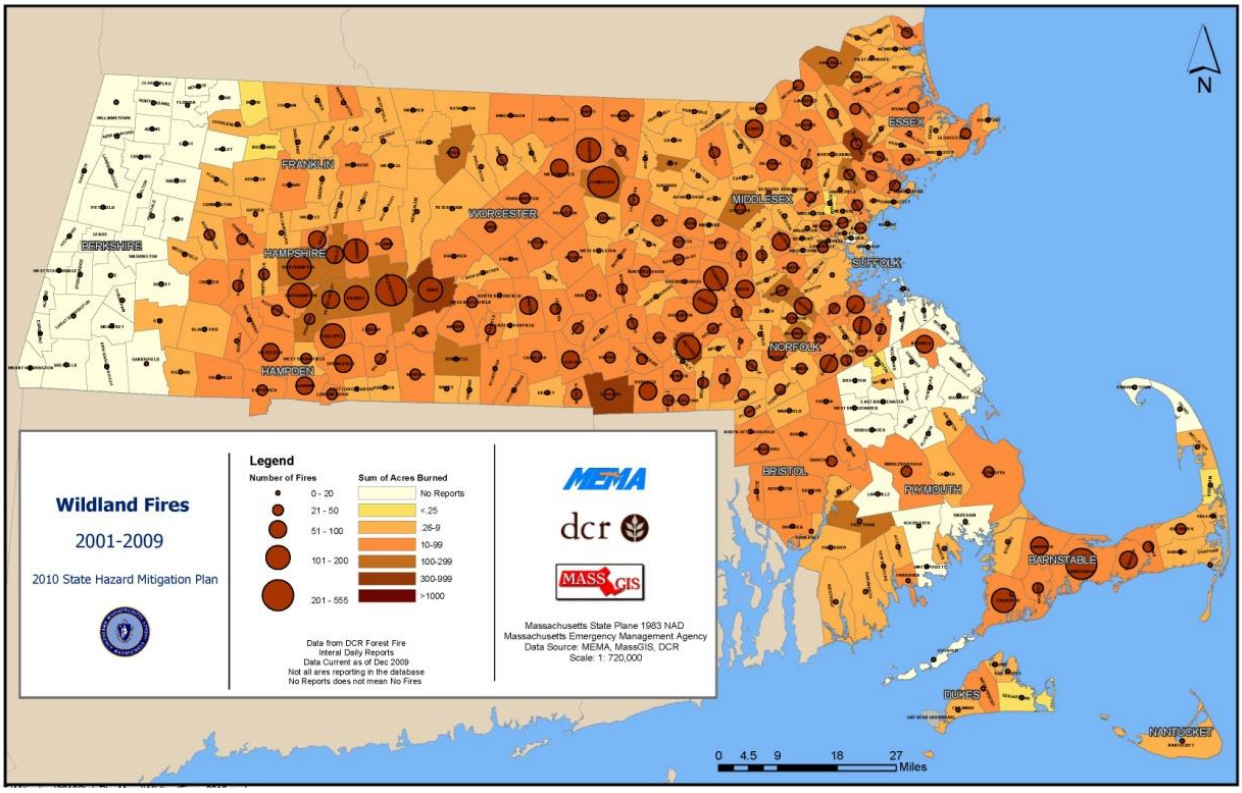


Figure 4-4. Massachusetts Brush Fires, 2001 to 2009
(MEMA and DCR, 2013)

Brush fires are classified as medium frequency events in Hopkinton. As defined by the 2013 State Hazard Mitigation Plan, these events occur between once in five years to once in 50 years (a 2% to 20% chance of occurring per year).

4.7 Extreme Temperatures

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

The Boston area has four clearly defined seasons. Extreme temperatures fall outside of the ranges typically experienced during these seasons. Boston's average winter temperature, from December to February, is 32.2°F. Boston's average summer temperature, from June to August, is 73.8°F (NOAA 2018b).

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 4-5 below provides more information.

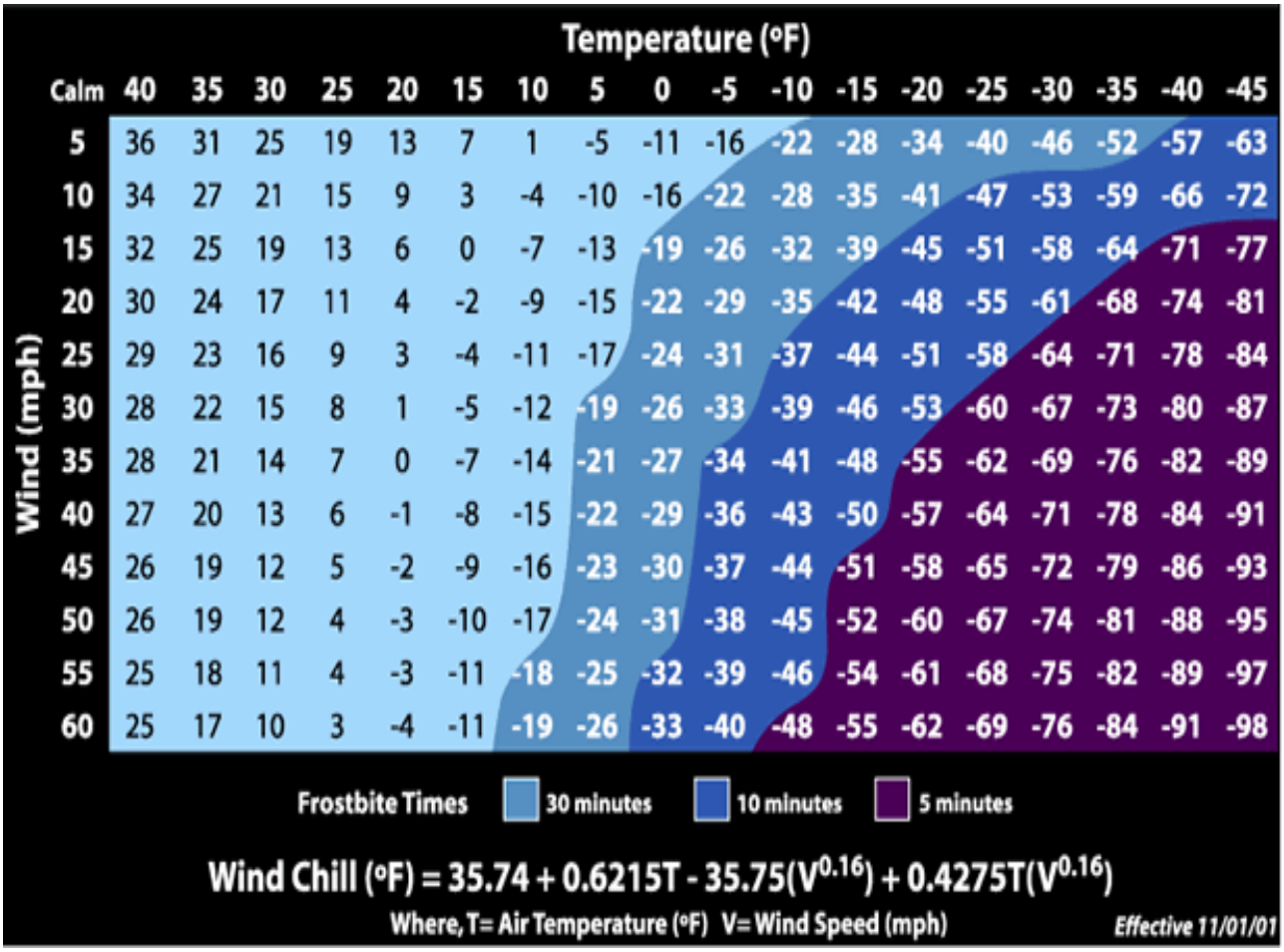


Figure 4-5. Windchill Temperature Index and Frostbite Risk
(NOAA, n.d.)

Extremely cold temperatures can create dangerous conditions for vulnerable populations. The homeless, the elderly, and people with disabilities are often most vulnerable. In Hopkinton, 9.8% of the population are over 65 years old and 4.1% of the population has a disability (US Census, 2018). 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 increased risk of carbon monoxide poisoning.

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.

4.7.2 Extreme Heat

Increased temperatures will impact all locations within Hopkinton. Projected heat days and heat waves 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 who 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.

Based on Figure 4-6 below, compiled by the Massachusetts Department of Public Health Bureau of Environmental Health (MA DPH 2019), Hopkinton has a population density of 620 per square mile. The total number of vulnerable populations in each Census Tract (2010) varies between 2 and 3. These vulnerable populations include: low income, low English proficiency, non-white (Hispanic and non-Hispanic ethnicities), and elderly.

The NWS issues a Heat Advisory when the Heat Index (Figure 4-7) 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. Heat waves 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 in excess of 8,000 deaths in the United States (MEMA and DCR, 2013). During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

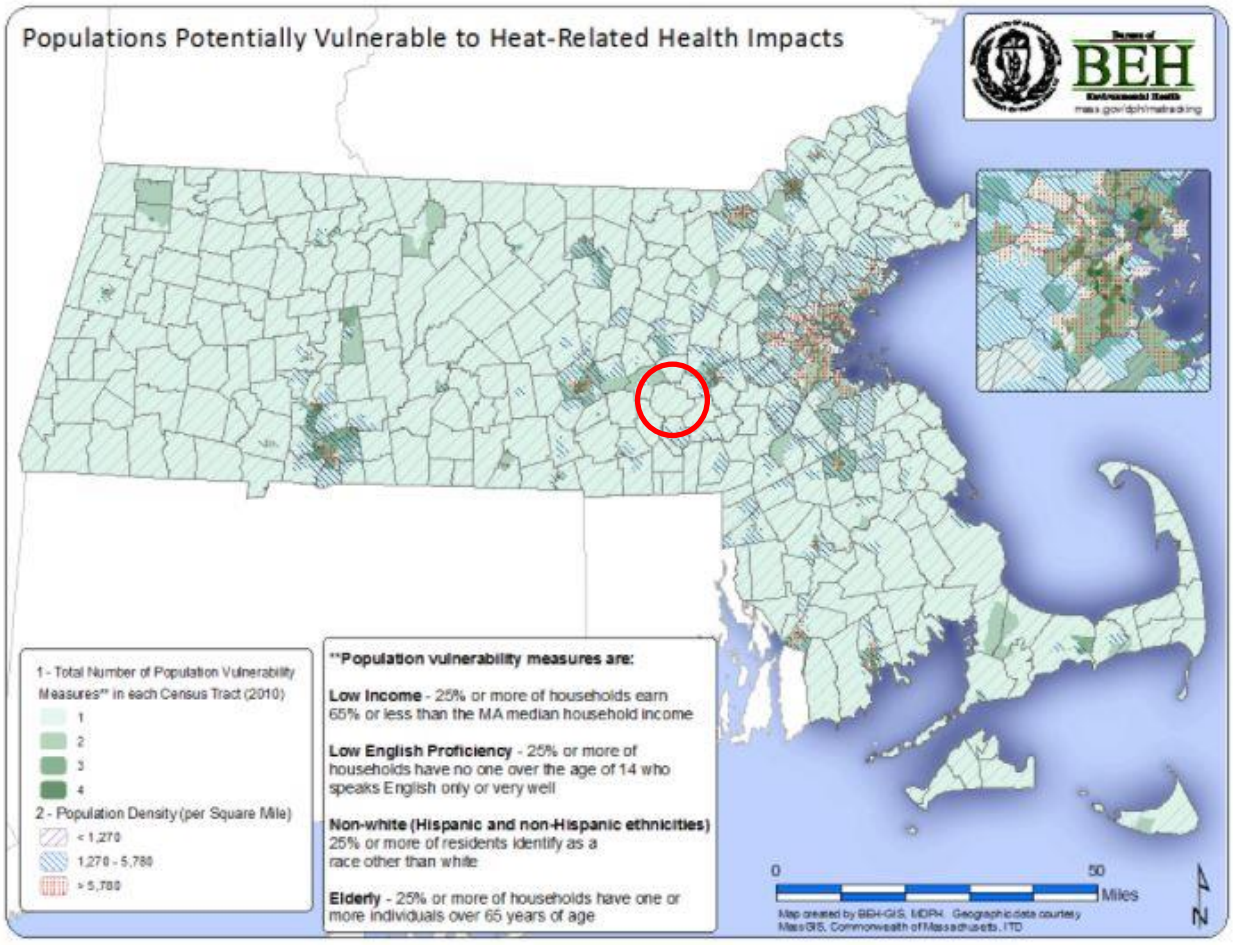


Figure 4-6. Populations Potentially Vulnerable to Heat Related Health Impacts

(Hopkinton is shown as a red circle).

(DPH, 2019)

On July 6, 2013, a postal worker in MA collapsed and died as the Heat Index reached 100°F (EEA and EOPSS 2018). Because most heat-related deaths occur during the summer, people should be aware of who is at 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 Hopkinton, children under five years old make up 5.8% of the population, and 11.0% are over 65 years old. 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 (MEMA and DCR, 2013; ACS, 2013-2017).

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 4-7. Heat Index Chart

(NOAA, n.d.)

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 Hopkinton 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 resulted in a single death in 2013.

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

4.7.3 Climate Change Impacts: Extreme Temperatures

Between 1961 and 1990, Boston experienced an average of one day per year in excess of 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 (refer to Figure 4-8 below). These changes in temperature would also have a detrimental impact on air quality and public health concerns including asthma and other respiratory conditions (Frumhoff et al. 2007).

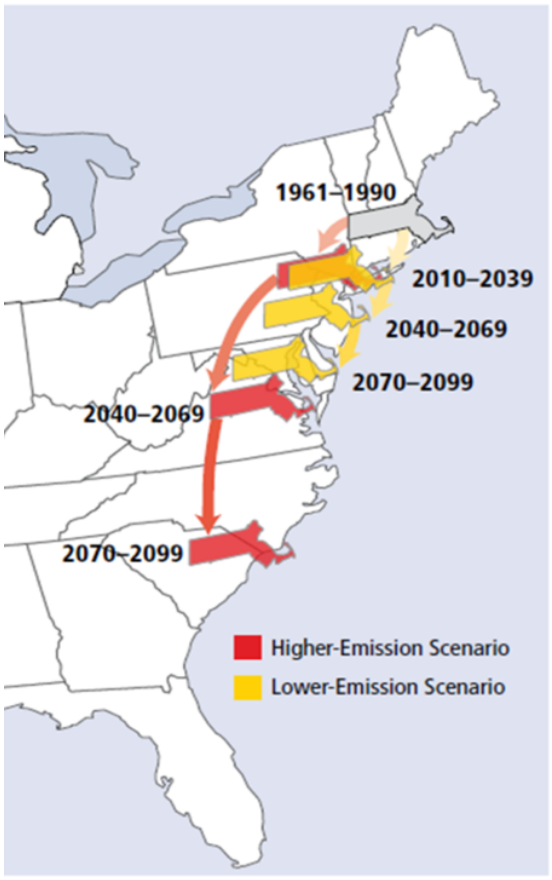


Figure 4-8. Massachusetts Extreme Heat Scenarios
(Frumhoff et al., 2007)

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 (EEA and EOPSS 2018).

Average annual precipitation in Boston is 53.32 inches per year, with approximately two to five-inch average amounts for each month of the year (NOAA 2019c). Although Massachusetts is relatively small, it has a number of distinct regions that experience significantly different weather patterns and react differently to the amounts of precipitation they receive. In accordance with 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. Hopkinton is located within the Northeast region (MA EOEEA EOPSS, 2018).

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 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 individual 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 use of emergency supplies become necessary or in which the Governor may exercise his authority to require mandatory water restrictions or (MEMA and DCR, 2013).

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, Stream flow 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 percent of normal precipitation.)

Drought level is determined monthly based on the number of indices which have reached a given drought level. A majority of the indices would need to be triggered in a region in order 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 (MEMA and DCR, 2013).

Figure 4-9 illustrates statewide drought levels in Massachusetts from 1850 to 2012, using the Standardized Precipitation Index (SPI). Table 4-31 below summarizes a history of Massachusetts droughts between 1879 and 2017.

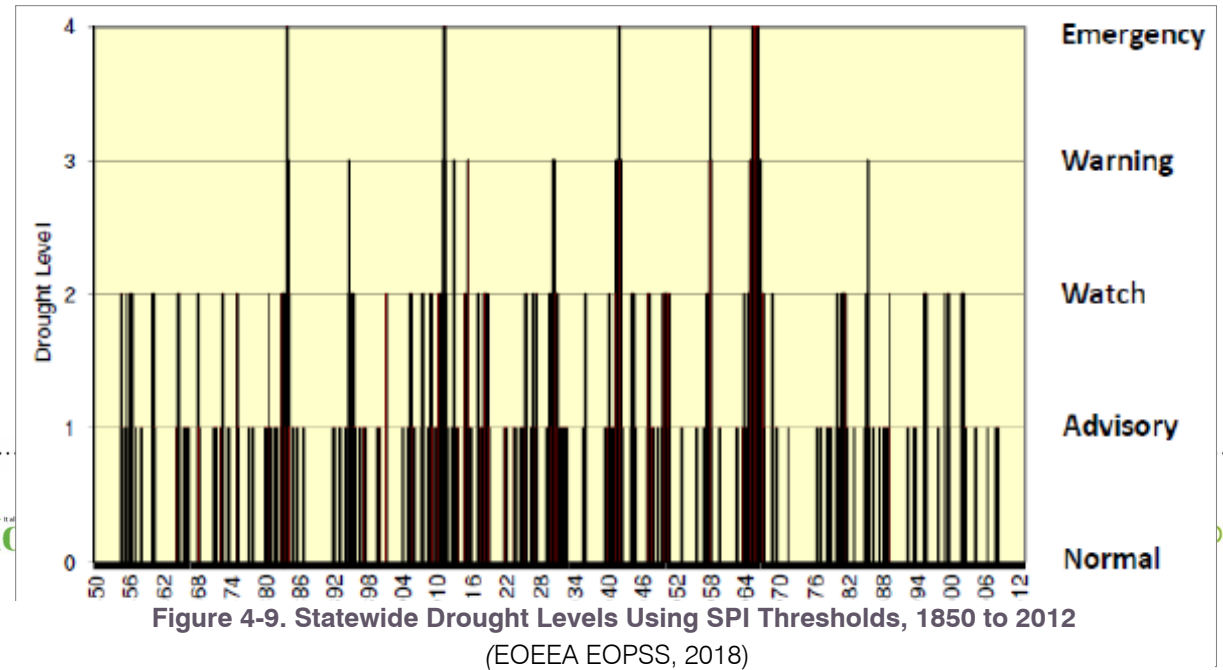


Figure 4-9. Statewide Drought Levels Using SPI Thresholds, 1850 to 2012

(EOEEA EOPSS, 2018)

Table 4-31. Droughts in Massachusetts Based on Instrumental Records

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.
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)

Table 4-31. Droughts in Massachusetts Based on Instrumental Records

Date	Area Affected	Recurrence Interval (years)	Remarks
2016-2017	Statewide	–	Level 3 drought (out of 4 levels).

(EEA and EOPSS, 2018)

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. On a monthly basis over the 162-year period of record, there is a one percent chance of being in a Drought Emergency (MEMA and DCR, 2013).

Drought Warning levels not associated with Drought Emergencies would have occurred in 1894, 1915, 1930,1985, 2016, and 2017. On a monthly basis over the 162-year period of record, there is a two percent chance of being in a drought Warning level (MEMA and DCR, 2013; DCR, 2017b).

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 on a monthly basis over the 162-year period of record (MEMA and DCR, 2013). There were six drought watches in Massachusetts in 2002, five drought watches in 2016, and two drought watches in 2017 (DCR, 2017b). Figure 4-10 presents an example of drought conditions in the six drought regions.

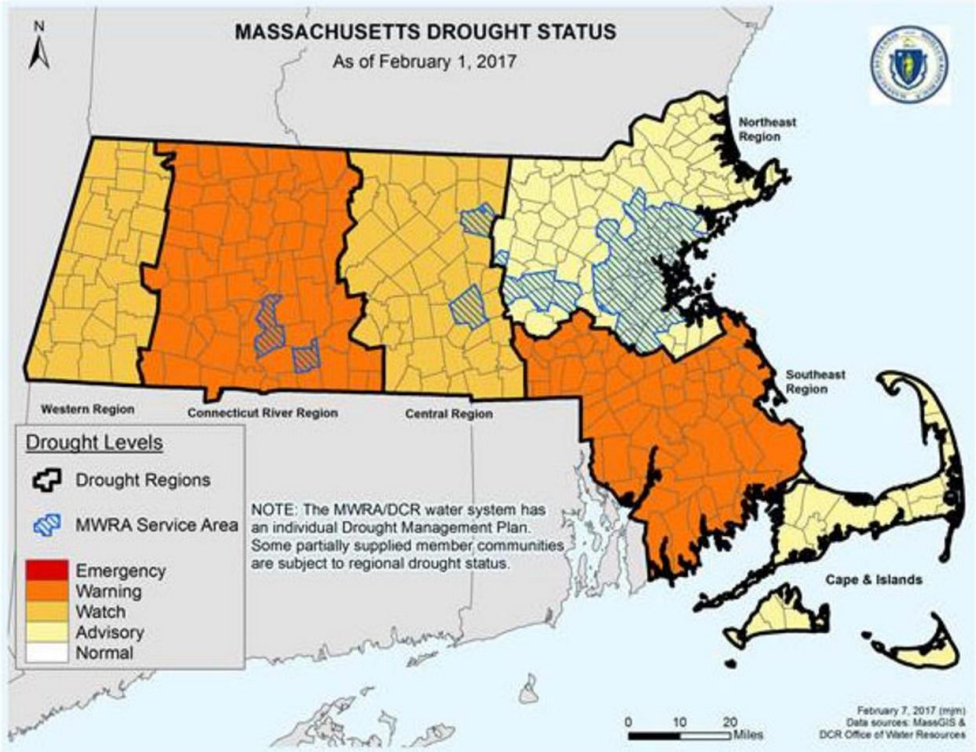


Figure 4-10. Massachusetts Drought Status, February 2017
(DCR, 2017b)

Drought is a potential town-wide hazard in Hopkinton and is a high concern among stakeholders. As noted previously, temperature is projected to increase and may lead to exacerbated drought conditions especially in 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 (EEA and EOPSS, 2018). During Hopkinton's MVP Workshop in February 2019, workshop participants discussed the connections between multiple hazards and their potential impact on the town. One example given was the potential for a severe drought to increase the risk of brush fires.

A long-term drought could lead to impacts to Hopkinton's wetlands and streams, and to the Merrimack River. Hopkinton relies on ground water for its drinking water source, which makes it vulnerable during times of drought. The Town currently works with its residents to conserve water, especially during times of drought or low water levels.

Droughts are classified as a low frequency natural hazard event. According to the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, there is an 8% chance of a watch level drought in any given month.

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 (EEA, 2018a).

5.0 EXISTING MITIGATION MEASURES

FEMA categorizes hazard mitigation measures into four types as displayed in Table 5-1 (FEMA, 2013). The existing protective measures available to the Town of Hopkinton are a combination of zoning, land use, and environmental regulations, infrastructure maintenance, and drainage infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage clogging problems, while large scale capacity problems may require pipe replacement or invert elevation modifications. These more expensive projects are subject to the capital budget process. The Town's existing mitigation measures are described by hazard type here and are detailed in Section 5.2. Upgrades to existing measures are also noted in the following sections.

Table 5-1. FEMA's Types of Mitigation Actions

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 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 potential ways to mitigate them.	• Radio or television spots • Websites with maps and information

	A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.	• Real estate disclosure • Presentations to school groups or neighborhood organizations • Mailings to residents in hazard-prone areas. • StormReady • Firewise Communities

(FEMA, 2013)

5.1 Summary of Existing Mitigation

There are numerous existing natural hazard mitigation measures already in place in Hopkinton. These were identified through feedback from the Core Team, CRB Workshop participants, and additional stakeholders. These mitigation measures are summarized in Table 5-3.

Table 5-2. Existing Mitigation Measures

Type of Existing Mitigation Measures	Area Covered	Effectiveness/ Enforcement	Improvements/ Changes Needed
MULTIPLE HAZARDS			
Hopkinton Emergency Management Group	Town-wide	Effective	None
Metro West Regional Emergency Planning Committee	Region-Wide	Effective	None
Comprehensive Emergency Management Plan (CEMP)	Town-Wide	Effective	Needs to be updated periodically
Public Education	Town-wide	Effective	Continue to expand outreach; potential for additional fire risk public education
CodeRED	Town-wide	Effective	None
Town Facilities as Emergency Shelters	Town-wide	Effective	None
Backup Generators	Critical Town Buildings	Effective	None
Buried Utilities	New Development, Town-wide	Effective	None
Multi-Department Review of Development	Town-wide	Effective	None
Massachusetts State Building Code	State-wide	Effective	None
Salvation Army Emergency Assistance and Disaster Services	Town-wide	Effective	None
FEMA Deployment	State-wide	Effective	None
Boston Marathon Action Plan	Town-wide	Effective	None
Master Plan	Town-wide	Effective	None
Emergency Management Training	Town-wide	Effective	None

Table 5-2. Existing Mitigation Measures

Type of Existing Mitigation Measures	Area Covered	Effectiveness/ Enforcement	Improvements/ Changes Needed
FLOOD HAZARDS			
Participation in the National Flood Insurance Program (NFIP). The Town actively enforces the floodplain regulations.	Areas identified on the FIRM maps	Effective	None
Stormwater System and Outfalls Mapped in GIS	Town-wide	Effecting	Should be periodically updated
IDDE Program Implementation	Town-wide	Effective	Continue Implementation
Street sweeping	Town-wide	Effective	None
Catch basin cleaning	Town-wide	Effective	None
Ongoing Drainage Improvement Program	Town-wide	Effective	Ongoing improvements needed
Zoning – Floodplain District	Floodplain District	Effective	None
Zoning – Residence Lakefront District	Lakefront District	Effective	None
Zoning – Water Resources Protection Overlay District	Water Resources District	Effective	None
Subdivision Regulations	Town-wide	Effective	None
Stormwater Management and Erosion Control Regulations	Town-wide	Effective	None
Wetlands Protection Act	Wetland Resource Areas	Effective	None
Massachusetts Stormwater Regulations	Conservation Commission jurisdictional areas	Effective	None
Prevention of Sanitary Sewer Overflows	Town-wide	Effective	None
Hopkinton Open Space and Recreation Plan	Town-wide	Effective	In process of updating
Site Plan Review	Town-wide	Effective	None
Public Education on Stormwater	Town-wide	Effective	Continue to update and inform the public
NPDES Phase II Stormwater Program	Town-wide	Effective	Continue implementation
DAM HAZARDS			
DCR dam safety regulations and permitting	State-wide.	Somewhat effective	Improvements to the statewide system for dam inspections.
Permits required for construction.	State-wide	Effective	None.

Table 5-2. Existing Mitigation Measures

Type of Existing Mitigation Measures	Area Covered	Effectiveness/ Enforcement	Improvements/ Changes Needed
Maspenock Dam upgrades	Lake Maspenock Outlet	Effective	Upgrades to be completed 2025
WIND HAZARDS			
The Massachusetts State Building Code	State-wide	Effective	None
Tree Maintenance by the Town	Town-wide	Effective	None
Tree Maintenance by Electric Utility (Eversource Energy)	Town-wide	Effective	Further maintenance of trees along power lines would be beneficial
WINTER HAZARDS			
Snow-Plowing Operations	Town-wide	Effective	None
Snow Removal Requirements in the General Bylaw	Town-wide	Effective	None
BRUSH FIRE HAZARDS			
Open Burning Permits Required	Town-wide	Effective	None
Public Education	Town-wide	Effective	None
Fire Department Review of Proposal Developments	Town-wide	Effective	None
Backup Firefighting Water Supplies	Town-wide	Effective	None
Statewide Fire Mobilization Plan	State-wide	Effective	None
Fire District 14 Coordination	District-wide	Effective	None
"Senior SAFE" Program	Town-wide	Effective	In process of developing program
GEOLOGIC HAZARDS			
The Massachusetts State Building Code	Town-wide	Effective	None
EXTREME TEMPERATURE RELATED HAZARD			
Tree Maintenance by Town	Town-wide	Effective	None
Heating and Cooling Shelter	Public Library	Effective	None

5.2 Existing Multi-Hazard Mitigation Measures

Hopkinton Emergency Management Group – Under the Emergency Planning and Community Right to Know Act of 1986, communities are required to establish Local Emergency Planning Committees to develop a response plan for chemical emergencies. In accordance with this legislation, the Town of Hopkinton has identified locations where hazardous materials are stored, used, and transported.

Metro West Regional Emergency Planning Committee - Under the Emergency Planning and Community Right to Know Act of 1986, communities are required to establish Local Emergency

Planning Committees to develop a response plan for chemical emergencies. In accordance with this legislation, the region has created a regional emergency planning committee, which includes Town of Hopkinton has identified locations where hazardous materials are stored, used, and transported.

Comprehensive Emergency Management Plan (CEMP) – Hopkinton is in the process of updating their CEMP, which will be available in 2020. Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. This plan addresses mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. Included in this plan is important information regarding flooding, hurricanes, tornadoes, dam failures, earthquakes, and winter storms.

Public Education – Emergency Preparedness public education is available on the Town's website, via the Fire Department, Police Department, Health Department, and the Emergency Management Department. The Emergency Management Department is also highly involved in public outreach with vulnerable populations. The department hands out emergency preparedness kits to vulnerable populations and helps these residents prepare for an emergency. The Health Department is developing public outreach materials regarding vector-borne diseases.

CodeRED – The Town of Hopkinton has the CodeRED system, which provides Town officials the ability to deliver messages to targeted areas or the entire Town quickly. Residents may update their CodeRED information on the Town website.

Town Facilities as Emergency Shelters – The Senior Center and Middle School would serve as shelters in the event of a disaster. The Faith Community Church of Hopkinton has also volunteered its space as an emergency shelter and reunification facility. The Hopkinton Public Library may also be used as a warming and cooling facility.

Multi-Department Review of Developments – Multiple departments, including the Design Review Board, Board of Appeals, Conservation Commission, Board of Health, Public Works, Building Department, Police Department, Fire Department, and the Historic District Commissions have roles in reviewing and approving developments in Hopkinton.

Backup Generators – In the event of power outages, the Town does have backup generators at critical Town buildings and facilities, including the Town Hall, Main Street Fire Department, Main Street Police Department, Department of Public Works Facility, Schools, Senior Center, and Library.

Buried Utilities – New subdivision developments are required to install underground utilities.

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

Salvation Army Emergency Assistance and Disaster Services – Assistance is offered by Salvation Army Emergency Assistance for families and individuals experiencing financial hardships, including food, clothing, and utility/heating assistance. Additionally, Service Units volunteers act as first responders and assist those impacted by fires, flood and other disasters using mobile kitchen truck, as part of the Salvation Army Disaster Services.

FEMA/MEMA Response – MEMA can provide the Town with resources during an emergency, and can request additional support from FEMA in extraordinary circumstances.

Boston Marathon Action Plan – the Town of Hopkinton has an emergency response plan to prepare for the inflated number of visitors to the Town every year during the Boston Marathon.

Hopkinton Master Plan (2017) - identifies the need to develop a climate resilience and sustainability strategy in addition to a discussion of the Floodplain Overlay District.

Emergency Management Training – the Emergency Manager has attended Texas A&M "TEEX" emergency management training.

5.3 Existing Town-Wide Mitigation for Flood Related Hazards

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

Participation in the NFIP – Hopkinton participates in the National Flood Insurance Program (NFIP) (FEMA, 2019e). 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.

NFIP uses a Community Rating System (CRS) to award communities that go beyond the minimum standards with lower flood insurance premiums for property owners. The incentives are awarded upon a credit system for various activities. Points are awarded to communities that prepare, adopt, implement, and update a comprehensive flood hazard mitigation plan using a standard planning process. Hopkinton is not currently eligible to participate in the CRS Program (as of May 2019)(FEMA, 2019e).

Hopkinton participates in the NFIP with 19 policies in force as of September 30, 2019 (DCR, 2019) . FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at s://www.fema.gov/policy-claim-statistics-flood-insurance.

The following information is provided for the Town of Hopkinton:

Table 5-3. National Flood Insurance Program in Hopkinton

Flood Insurance Data		Repetitive Loss (RL) Data	
Total Number of Policies	19	RL Buildings	0
Total Premiums	$9,066	RL Losses	0
Insurance in Force	$4,253,000	RL Payments (total)	0
Total Number of Closed Paid Losses	0	RL Payments (building)	0
# of Closed Paid Losses	0	PL Payments (contents)	0

(DCR, 2019)

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

Street Sweeping – The Town performs street sweeping at a minimum of once per year on all roads. Any streets with drainage that is located within the Blackstone River Watershed, including the area around the Whitehall Reservoir, are being swept twice per year. Upon completion of the Phosphorus control plan, the Town will also be sweeping all streets within the Charles River Watershed twice per year.

Catch basin cleaning – The Town clears debris from its catch basins. Approximately 2,600 catch basins, which are part of the approximately 3,600 inlets in Hopkinton, are identified as Town-owned and maintained.

Ongoing Drainage Improvement Program – The Public Works Department provides maintenance to culverts, drainage pipes, and other drainage infrastructure on an as-needed basis.

Stormwater System and Outfalls Mapped in GIS – The Town is in currently creating a drainage system inventory and integrated the data into the Town's Geographical Information System (GIS), as part of the MS4 process.

Illicit Discharge Detection and Elimination (IDDE) Program Implementation – The Town's written IDDE Program was created in 2019 and will be implemented over the next few years. The Town will complete a storm system map and sample all outfalls for water quality.

Zoning Regulations – Zoning is intended to protect public health and safety through the regulation of land use. The Hopkinton Zoning Bylaws includes a Residence Lakefront District (Zoning Bylaws Chapter 210, Article IV) a Floodplain District (Zoning Bylaws Chapter 210, Article X), and a Water Resources Protection Overlay District (Zoning Bylaws Chapter 210, Article XII),

Subdivision Regulations – Subdivision regulations require that the quantity of runoff shall not exceed peak runoff from the site prior to development.

Floodplain Overlay District – The Town's Floodplain District (Zoning Bylaw Chapter 210, Article X) is defined by the 100-year floodplain as designated by FEMA. The Floodplain Overlay District regulates certain activities within a flood zone.

Massachusetts Stormwater Regulations – These regulations are applied to developments within the jurisdiction of the Conservation Commission.

Hopkinton Stormwater Management and Erosion Control Regulations – The Town has a Stormwater Management and Erosion Control Bylaw and that establishes minimum requirements and procedures to control the adverse effects of increased post-development stormwater runoff and nonpoint source pollution associated with new development and redevelopment. The Town also has a Stormwater Management Plan as part of their Small Municipal Separate Storm Sewer Systems (MS4) permit.

Prevention of Sanitary Sewer Overflows – Hopkinton will maintain and annually update and inventory that identifies all known locations where Sanitary Sewer Overflows (SSO) have discharged to the MS4, and will monitor and mitigate each SSO.

Wetlands Protection Act – The Hopkinton 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.

Wetlands Protection Bylaw – The Town's Wetlands Protection Bylaw prohibits disturbance of any wetland or abutting land, as described in the Town of Hopkinton General Bylaw, Chapter 206.

Hopkinton Open Space and Recreation Plan (OSRP) – The Town has a wealth of conservation areas and recreation spaces, and the OSRP aims to maintain, promote use, and increase the number of these spaces.

Site Plan Review – Multiple Town staff and boards provide reviews of new developments. The Planning Board will transmit copies of the application to the Director of Municipal Inspections, Conservation Commission, Board of Health, Design Review Board, and Director of Public Works for comments and recommendations for all construction project that requires new construction or will result in a change in the outside appearance or change of use of a building (Zoning Bylaws Chapter 210, Article XX)

Public Education on Stormwater – The Town continues to implement its NPDES Phase II stormwater program, which includes public education programs. In addition, the Town provides educational stormwater materials on the Town website and annual mailings.

NPDES Phase II Stormwater Program – The Town continues to implement an aggressive NPDES stormwater program that includes measures for public education and outreach, illicit discharge detection and elimination, construction and post-construction controls, and Town-wide good housekeeping and stormwater maintenance procedures.

5.4 Existing Dam Mitigation Measures

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.

Permits Required for Construction – State law requires a permit for the construction of any dam.

Emergency Action Plans – DCR requires that all dams classified or reclassified as high hazard potential and significant hazard potential have an Emergency Action Plan.

In addition to the above Town-wide mitigation measures, there are also several measures that focus on specific sites or areas of the Town:

Maspenock Dam – The Town is in the process of complete upgrades to the dam, which will be completed between 2021 and 2025.

5.5 Existing Town-Wide Mitigation for Wind-Related Hazards

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.

Tree Maintenance by Town – The Town maintains street trees and numerous trees on public grounds, historic sites, conservation areas, park areas and cemeteries.

Tree Trimming by Eversource – Eversource trims trees along the power lines.

5.6 Existing Town-Wide Mitigation for Winter-Related Hazards

Snow Removal Requirements in the General Bylaw – No person shall pile, push, throw, shovel, plow, or by any other method or means cause snow to be deposited or placed on any public roadway or sidewalk of the Town so as to impede, obstruct, or interrupt or otherwise adversely affect the unrestricted flow of traffic or the safe travel of any pedestrian on such roadway or sidewalk (General Bylaw, Article V).

Snow-Plowing Operations – The Public Works Department provides standard snow plowing operations, including salting.

5.7 Existing Town-Wide Mitigation for Fire-Related Hazards

Open Burning Permits Required – The Town allows controlled open burning in accordance with state regulations, but a permit is required from the Fire Department for each day of intended burning. Burning is only allowed during the burning season, typically January through April each year.

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.

Public Education – The Fire Department provides some public education on fire prevention by way of the burning season regulations.

Backup Firefighting Water Supplies – There are currently two fire stations in Hopkinton, one which is staffed and one which is used for storage. Additionally, the Town has portable water pumps that are available for firefighting.

Statewide Fire Mobilization Plan – The state has a fire mobilization plan for brush fires, as well as a separate plan for Hopkinton's Fire District.

Fire District 14 Coordination – Ongoing coordination with all Towns in Hopkinton's Fire District – Central Region 3, District 14.

"Senior SAFE" program – Hopkinton received grant funding for the Senior SAFE Program, which aids in providing fire safety to seniors through the fire department. It also aims to improve safety in senior housing.

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

Tree Maintenance by Town – The Town maintains street trees and numerous trees on public grounds, historic sites, conservation areas, park areas and cemeteries.

Heating and Cooling Shelter – The Hopkinton Public Library can be used as a heating or cooling facility.

5.9 Existing Town-Wide Mitigation for Geologic Hazards

Massachusetts State Building Code – The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). 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 a Table 1612.2.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which are required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.

5.10 Mitigation Capabilities and Local Capacity for Implementation

Under the Massachusetts system of "Home Rule," the Town of Hopkinton is authorized to adopt and from time to time amend a number of local bylaws and regulations that support the Town's capabilities to mitigate natural hazards. These include the Zoning Bylaw, Stormwater Bylaw, Subdivision and Site Plan Review Regulations, Wetlands Bylaw, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local bylaws may be amended 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 Hopkinton 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 has the ability to expand on and improve the existing policies and programs listed above.

6.0 STATUS OF MITIGATION MEASURES FROM THE 2015 HMP

6.1 Implementation Progress on the Previous Plan

During interviews with Weston & Sampson, Hopkinton staff and core team members reviewed the mitigation measures identified in the 2015 Hopkinton Hazard Mitigation Plan. These members felt 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, they were then evaluated to determine whether the measure should be deleted or carried forward into this 2020 HMP-MVP Plan. The decision on whether to delete or retain a particular measure was based on the members' 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. The breakdown of high and medium priority measures, along with any other possible measures, are provided in the table. The priority "NFIP" refers to potential mitigation measures that would ensure continued compliance with the National Flood Insurance Program.

Table 6-1. Status of Mitigation Measures from the 2015 HMP

Hazard Area	Mitigation Measure	Implementation Responsibility	Cost Estimate	Current Status	Include in 2020 Plan? Priority?
HIGH PRIORITY					
Lake Maspenock Dam	Dam Restoration.	Hopkinton	$1.5M	Partially Completed	Yes - High See Lake Maspenock Dam Operation & Maintenance Manual
Sand and Salt Storage	Expand sand and salt storage to meet capacity demands	Hopkinton	$25,000-$200,000	Completed	No
DPW Facility	Upgrade to meet capacity needs	Hopkinton	$1M	Completed	No
Protection of Open Space	Continue more purchases of prioritized open space parcels	Hopkinton	N/A	Not Completed	Yes - High
	Negotiate additional conservation restrictions and easements				
Revisions to Development Bylaws and Regulations	Revise and strengthen existing regulations and bylaws	Hopkinton	N/A	Not Complete	Yes - High

Table 6-1. Status of Mitigation Measures from the 2015 HMP

Hazard Area	Mitigation Measure	Implementation Responsibility	Cost Estimate	Current Status	Include in 2020 Plan? Priority?
MEDIUM PRIORITY					
Fuel Storage and Dispensing	Expand fuel storage and dispensing capabilities	Hopkinton	$20,000-$50,000	Completed	No
Brush Fire Regulations	Backyard setback requirements for fire protection	Hopkinton	N/A	Statewide regulations require a 75-foot setback	No
	Public education on brushfire prevention			"Senior SAFE" provides education to elderly. Continue ongoing outreach.	Yes - Low
Alprilla Farm Road	Develop an operation plan for Blood's Pond Dam	Hopkinton	$10,000-$30,000	Completed	No

As indicated in Table 6-1, the Town completed several mitigation measures including upgrading the DPW facility, constructing an additional salt storage shed, and developing an operational plan for Blood's Pond Dam.

Several of mitigation measures noted above are being carried over into the 2020 Plan. Core Team members identified and prioritized their ongoing status in this plan, including continuing upgrades to Lake Maspenock Dam, continuing open space protection and acquisition in Hopkinton, protecting open space in Hopkinton, revising and updating development bylaws and regulations, as well as continued public education and outreach regarding brush fire prevention. The items are included in Table 7-1, and their current status is described in greater detail below.

The upgrades to Lake Maspenock Dam are currently in progress. The Town has completed updates on the spillway and the dam gate will be replaced this year. More detail on the remaining work can be referenced in the Lake Maspenock Operation and Maintenance Manual. Open space protection and acquisition is ongoing, as parcels are donated directly to the Hopkinton Area Land Trust (HALT) and the Sudbury Valley Trustees (SVT). This land is now and will continue to be protected as part of the Open Space and Land Preservation District. Additionally, the Town has applied to update the bylaws and regulations.

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. The plan is intended to assist the Town in prioritizing the proposed measures, which will provide guidance on how to best allocate the Town's limited resources.

7.0 HAZARD MITIGATION 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;
- Progress on the previous plan; and
- Input from stakeholders.

Stakeholders were engaged through Core Team meetings, the CRB Workshop, and the public input session. Following the public listening session, a survey was posted online to receive feedback from the public on the outcome of the CRB workshop. Community members were asked to give input on prioritization of the action items. Community members noted the importance of working regionally to solve problems, build solutions, and share resources. Climate mitigation and adaptation is not exclusive to Hopkinton, and surrounding Towns are likely dealing with similar problems. It may be in the best interest of communities to work together to solve these problems regionally.

The full list of action items from the CRB Workshop are available in Appendix C and were integrated into the final list of action items vetted by the Core Team. Table 7-1 below represents the Town's high priority action items. Each of these action items was analyzed by the Core Team for its overall benefit, the estimated cost, timeframe, and implementation responsibility to inform prioritization. A description of each prioritization category is described below.

Priority – Designation of high or medium priority was based on overall potential benefits. A high priority action is very likely to have political and public support and necessary maintenance can occur following the project. A medium priority action may have political and public support and necessary maintenance had potential to occur following the project.

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

Primary Responsibility – Most mitigation measures will require a multi-department approach where several Town departments share responsibility. The designation of implementation responsibility in the table was assigned based on general knowledge of the responsibilities of each municipal department. The lead department for each action item is bolded.

Implementation Timeframe – The timeframes represented below are assigned based on the length of time necessary to complete the project. The timeframe is noted in years. Projects that involve multiple phases, maintenance, or don't have a definitive end date will are classified as "ongoing".

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.

Table 7-1 Hazard Icon Legend:

 Severe Wind and Snowstorms

 Extreme Temperatures

 Drought

 Thunderstorms and Heavy Precipitation

 Multiple Hazards

Table 7-1. High Priority Action Items

Hazard	Mitigation Action	Implementation Responsibility	Timeframe	Approximate Implementation Cost
	Incorporate nature-based solutions and climate projections into existing projects, such as the Main Street improvements project and planned stormwater/culvert upgrades.	Engineering & Facilities, Highway, Planning	1-3 years per project	$10,000 to $100,000 per design update
	Conduct asset management study to develop a capital planning system that incorporates climate resilience and ensures municipal projects consider co-benefits.	Engineering & Facilities, Finance, Town Manager	1-3 years	$10,000 to $100,000
	Develop a comprehensive communication plan to reach vulnerable audiences about adapting to, preparing for, and mitigating climate change impacts.	Health, Planning, Town Manager, Council on Aging, IT Department, Fire, Police	1-3 years	$10,000 to $100,000
	Review and update zoning, bylaws, and regulations to protect open space, floodplains, and water resources to incorporate climate change and hazard mitigation.*	Conservation, Planning, Zoning Advisory Committee	1-3 years	$10,000 to $100,000
	Incorporate resiliency measures into the action items from the 2017 Hopkinton Master Plan and implement measures with overlapping priorities.	Planning, Town Manager	3-5 years	$1,000 to $10,000
	Document an internal communication plan between Town staff to be used during emergencies.	Fire, Town Manager	0-1 years	$1,000 to $10,000

Table 7-1. High Priority Action Items

Hazard	Mitigation Action	Implementation Responsibility	Timeframe	Approximate Implementation Cost
	Assess risks to Town communications infrastructure and improvements, such as hardening the emergency tower and adding repeaters to improve redundancies.	Engineering & Facilities, Fire, Police, Eversource	1-3 years	$10,000 to $100,000
	Regularly conduct test runs of the procedures in the School Environmental Management plans (SEMP), including tests of generators	School Department	Ongoing	$1,000 to $10,000
	Evaluate the Senior Center and Housing Authority capacity to shelter people in place and function during an emergency.	Engineering & Facilities, Fire, Housing Authority, Council on Aging	1-3 years	$10,000 to $100,000
	Develop a tick and mosquito management program with a demonstration area for tick management in yards and on trails.	Health	In progress	$1,000 to $10,000
	Leverage the MVP program to incorporate climate resilience into MS4 requirements.	Highway, Water & Sewer, Engineering & Facilities, Planning	1-3 years	$10,000 to $100,000
	Town wide analysis to evaluate opportunities to include on drought resistance vegetation that will withstand drought conditions and warmer temperatures.	Engineering & Facilities, Highway, Planning	1-3 years	$10,000 to $100,000
	Provide training to Town staff on the operation and maintenance of stormwater BMPs and green infrastructure, potentially coinciding with MS4 annual permit.	Engineering & Facilities	1-3 years	$1,000 to $10,000
	Strengthen relationships with utility companies to improve emergency response and development of microgrids.	Engineering & Facilities, Planning, Zoning Advisory Committee	1-3 years	$10,000 to $100,000
	Provide public education on stormwater BMPs including green infrastructure as part of annual MS4 report.	Engineering & Facilities	1-3 years	$1,000 to $10,000

Table 7-1. High Priority Action Items

Hazard	Mitigation Action	Implementation Responsibility	Timeframe	Approximate Implementation Cost
	Develop an incentive program for low impact development construction and retrofits or sustainable building practices.	Engineering & Facilities, Planning	3-5 years	$10,000 to $100,000
	Conduct a needs assessment for social services, (fuel assistance, food pantry expansion, etc.)	Fire, Housing Authority	3-5 years	$10,000 to $100,000
	Replace existing water tank and construct a high-service water distribution area.	Water & Sewer, Engineering & Facilities	1-3 years	$500,000+
	Conduct a town-wide drainage study to assess and identify opportunities to apply nature-based solutions.	Engineering & Facilities, Highway, Planning	1-3 years	$10,000 to $100,000
	Complete Lake Maspenock Dam restoration and updates in the Lake Maspenock Dam Operations and Maintenance Manual.*	Engineering & Facilities, State Agencies	1-3 years	$100,000 to $500,000

* Mitigation actions carried over from the 2015 HMP

Table 7-2. Medium Priority Action Items

Hazard	Mitigation Action	Implementation Responsibility	Timeframe	Approximate Implementation Cost
	Develop a robust tree management plan with an outreach component.	Conservation, Highway, Eversource	3-5 years	$10,000 to $100,000
	Conduct a town wide study to assess and inventory stream crossings town wide such as culverts and bridges; prioritize/rank these assets based on vulnerability.	Conservation, Highway	1-3 years	$10,000 to $100,000
	Develop a strategy for priority of land acquisition for issues such as flood control, wildlife habitat/corridors, and to protect wetland and open space.*	Conservation, Town Manager, Planning, Open Space Preservation Committee	3-5 years	$10,000 to $100,000
	Consider opportunities to make athletic fields double as stormwater BMPs.	School Department	5-10 years	$10,000 - $100,000
	Develop ability to offer virtual classes to students.	School Department, IT Department	1-3 years	$10,000 to $100,000

Table 7-2. Medium Priority Action Items

Hazard	Mitigation Action	Implementation Responsibility	Timeframe	Approximate Implementation Cost
⚠	Increase Town staff capacity by hiring a sustainability planner (1) and DPW personnel (2).	Town Manager, Department of Public Works, Planning	3-5 years	$100,000 to $500,000
⚠	Create a neighbor-to-neighbor program to provide services to elderly, such as: transportation, lawn mowing, and shoveling.	Town Manager, Council on Aging, IT Department	3-5 years	$1,000 to $10,000
⚠	In the Open Space Plan update include climate resilience and identify opportunities to incorporate climate adaptation strategies on Town-owned property.	Planning, Open Space Advisory Committee	0-1 years	$10,000 to $100,000
⚠	Expand the public transportation route and pick-up services to low-income, elderly and youth, to within ½ mile.	MetroWest Town Manager, Regional Transit Authority, Council on Aging, Housing Authority, School Department	3-5 years	$100,000 to $500,000
⛈	Develop a beaver management plan.	Conservation, Planning	1-3 years	$10,000 to $100,000
⛈	Evaluate the need for a program, such as a stormwater utility, to maintain, enlarge, and upgrade subdivision detention ponds in dense residential and commercial areas.	Conservation, Engineering & Facilities, Planning, Zoning Advisory Committee	10+ years	$10,000 to $100,000
⛈	Set up a structured project for collaboration between the State, land trusts, Sudbury Trustees, and Charles River Compact, on joint projects with communities downstream.	Conservation, Planning, Regional Organizations	3-5 years	$1,000 to $10,000
❄	Increase the resilience of the power grid by creating a solar overlay district and adding solar canopies within the Town.	Engineering & Facilities, Planning, Zoning Advisory Committee	3-5 years	$100,000 to $500,000 per project

* Mitigation actions carried over from the 2015 HMP

7.2 Potential Funding Sources

The identification of potential funding sources in is preliminary and may vary depending on numerous factors. These factors include, but are not limited to, if a mitigation measure is conceptual or has been studied, evaluated or designed. In most cases, the measure will require an assemblage of funding sources. The funding sources identified are not a guarantee that a specific project will be eligible for or receive funding. Upon adoption of this plan, the local representatives responsible for implementation should begin to explore the funding sources in more detail.

Traditional funding sources within the Town of Hopkinton, such as funding from the operating and capital budgets, may be able to cover some of the costs of the action items detailed in Tables 7-1 and 7-2. The addition of a stormwater utility in Hopkinton could provide funding for many stormwater-related projects. State revolving funds and other no or low-interest loans may also be of interest. 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 opportunities related to the priority action items developed by Hopkinton are listed in Table 7-3.

Table 7-3. Potential Funding Sources

Source	Grant	Description of Funding
Department of Housing and Community Development (DHCD)	Massachusetts Downtown Initiative	Offers services and assistance to communities seeking help on how to revitalize their downtowns
Executive Office of Housing and Economic 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.
MEMA	Flood Mitigation Assistance Grant Program	Implements cost-effective measures that reduce or eliminate the long-term risk of flood damage
MEMA	Hazard Mitigation Grant Program	Provides funding after a disaster to significantly reduce or permanently eliminate future risk to lives and property from natural hazards
MEMA	Pre-Disaster Mitigation (PDM) Grant Program	Provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event
Massachusetts Department of Energy Resources (DOER)	DOER Grants	The DOER provides grant funding for clean energy-related programs

Table 7-3. Potential Funding Sources

Source	Grant	Description of Funding
Department of Conservation and Recreation (DCR)	Community Forest Grant Program	Funding to establish community forests
Division of Ecological Restoration	Culvert Replacement Municipal Assistance Grant Program	Grant to replace undersized, perched, and/or degraded culverts located in an area of high ecological value
Executive Office of Energy and Environmental Affairs (EEA)	Dam and Seawall Program	Grants for the repair or removal of dams, seawalls, and levees
EEA	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
MA Department of Environmental Protection (DEP)	604b Grant Program	Water quality assessment and management planning
EEA	Land Use Planning Grants	Support effort to plan, regulate, and act to conserve and develop land consistent with the Massachusetts' Sustainable Development Principles
EEA	LAND Grant Program	Helps cities and towns acquire land for conservation and passive recreation
EEA	Federal Land & Water Conservation Fund	Funding for the acquisition, development, and renovation of parks, trails, and conservation areas.
EEA	MassTrails Program	Trail protection, construction, and stewardship projects
EEA	MVP Program	Provides support in implanting climate change resiliency priority projects
DEP	MS4 Grant Program	Meeting the requirements of the 2016 MS4 permit and reduce stormwater pollution through partnerships
MEMA	Emergency Management Performance Grant (EMPG)	Reimbursable grant program to assist local emergency management departments to build and maintain an all-hazards emergency preparedness system

Table 7-3. Potential Funding Sources

Source	Grant	Description of Funding
MEMA	Public Assistance Program	The state reimburses governments and other applicants for disaster related costs
Department of Fire Services	Senior SAFE	Supports fire and life safety education for seniors
Department of Fire Services	Student Awareness of Fire Education (S.A.F.E.)	Grants for local fire departments to teach fire and life safety to schools
MA Department of Transportation (DOT)	Chapter 90 Program	Reimbursable grants on approved projects
MA DOT	Community Transit Grant Program	Funding to the transportation and mobility needs of seniors and people with disabilities
MADOT	Complete Streets Funding Program	Technical assistance and construction funding
MADOT		
MADOT	Municipal Small Bridge Program	Funding for small bridge replacement, preservation and rehab projects
EDA	Disaster Supplemental Funding	Funding available to communities impacted by natural disasters and flooding
USDA NRCS	Watershed and Flood Prevention Operations Program	Helps municipalities protect and restore watersheds
USDA NRCS	Emergency Watershed Protection Program	Funds to help communities quickly address serious and long-lasting damages to infrastructure and the land
USDA NRCS	Regional Conservation Partnership Program	NRCS seeks to co-invest with partners to implement projects that demonstrate innovative solutions
U.S. Department of the Interior	Land and Water Conservation Fund	Secures public access, improves recreational opportunities, and preserves ecosystem benefits for local communities (multiple funding options)
EPA	Healthy Communities Grant Program	Reduce environmental risk to protect and improve human health and the quality of life

7.3 Regional Partnerships

Mitigating natural hazards is not confined to a local issue. The drainage systems that service 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 hazard mitigation efforts of communities. These agencies are the Town's regional partners in hazard mitigation efforts. Mitigation measures for the following regional issues should be considered as Hopkinton develops its own local plan:

- Assess, prioritize, and upgrade bridges, including the State-owned Bridge Street bridge
- Work regionally with communities and watershed groups to reduce pollution in waterbodies and drinking water, including the Blackstone River Watershed, Whitehall Reservoir, and the Charles River
- Address water quality in concert with MS4 updates
- Coordinate meetings or policy with surrounding towns to increase public education and reduce pollutants in the water supply
- Explore alternative treatment and remediation strategies for vector-borne illness
- Add staff to coordinate open communication between Hopkinton, neighboring communities, and regional organizations

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. In order to implement many of these mitigation measures, all parties will need to work together towards a mutually beneficial solution.

8.0 PLAN ADOPTION AND MAINTENANCE

8.1 Plan Adoption

The Town of Hopkinton's 2020 HMP-MVP Plan was adopted by the Town's Select Board on Dec 1st, 2020. See Appendix E for documentation. The plan was approved by FEMA on Dec 8th, 2020 for a five-year period that will expire on Dec 7th, 2025. See Appendix F for FEMA approval.

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, responsible department, and funding mechanisms in Table 7-1 layout out 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

The Land Use and Fire Department will serve as co-coordinators or the champions of ensuring plan maintenance and implementation is completed. The Core Team that originally convened will transition its work to updating and keeping the HMP-MVP Plan current. The Core Team will be responsible for tracking information on the implementation progress and the impacts of hazards that have been identified since the plan drafting. The Core Team will meet twice a year or on an as-needed basis, whichever is most frequent, to monitor plan implementation. The information collected through the annual meetings will be used to formulate future edits to the plan. Online document sharing of the action item tables among others will be used to collaboratively track progress, hazard damage, and changes in the Town's existing mitigation measures. The Core Team will be amended as needed and may add additional members from local businesses, non-profits, and institutions.

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 in accordance with Town and State open meeting laws.

8.3.3 Integration of the Plan with Other Planning Initiatives

Upon approval of the Town of Hopkinton's 2020 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: Fire Department, Police Department, Public Works Department, Department of Land Use, Planning & Permitting, Conservation Commission, Parks and Recreation Department, Health Department.

Appropriate sections of the HMP-MVP Plan will be integrated into other Town plans, policies, and documents as those are updated and renewed, including the Open Space and Recreation Plan, Comprehensive Emergency Management Plan, Capital Investment Plans, and the Master Plan. Coordination with state and regional organizations such as MassDOT, land conservation organizations, businesses, and watershed groups will be required for successful implementation and continued updating.

8.4 Process of Updating

By maintaining the Town of Hopkinton 2020 HMP-MVP Plan, the Town will have a competitive application when applying to FEMA for funding to update the plan. Once the resources have been secured to update the plan, the Core Team will need to determine whether to undertake the update itself or hire a consultant. 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 Hopkinton 2020 HMP-MVP Plan will be forwarded to MEMA for review and to FEMA for ultimate approval. The Core Team will begin drafting the full update of the plan in four years. 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. Potential sources of funding in the future may include FEMA Pre-Disaster Mitigation grants and the Hazard Mitigation Grant Program. Both grant programs are eligible to pay for 75% of a planning project, with a 25% local cost share requirement.

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APPENDIX A

Core Team Materials

Municipal Vulnerability Preparedness Planning Grant and Hazard Mitigation Plan Update

Core Team Meeting

Select Board Meeting Room, Town Hall

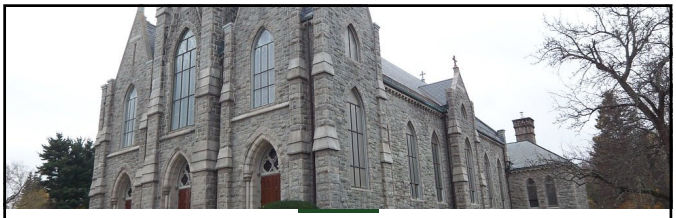
Thursday, October 24th, 2019

10:00 am – 11:30 am

Introductions	5 minutes
Project Overview	15 minutes
Core Team Role	2 minutes
Goal Setting and Endorsement	15 minutes
Community Resilience Building Workshop and Review of Materials	35 minutes
Data Sources	3 minutes
Workshop Participants	10 minutes
Wrap Up and Next Steps	5 minutes

Municipal Vulnerability Preparedness Planning Grant Project
Tuesday, October 24, 2019 10:00 am – 11:30 am

Name	Title
Ben Sweeney	Procurement and Grants Manager
John Westerling	Director of Public Works
Don MacAdam	Conservation Administrator
Steve Slaman	Fire Chief
Elaine Lazarus	Assistant Town Manager
John Gelcich	Principal Planner



TOWN OF HOPKINTON

Core Team Meeting

Thursday, October 24th, 2019

Photo: St. Johns Catholic Church. Photo From: Flickr, Michael Lefebvre, 2006

1

WELCOME CORE TEAM

Ben Sweeney	John Westerling
Don MacAdam	Steve Slaman
Elaine Lazarus	John Gelchick

Photo: Hopkinton State Park. Photo from Yelp.com

2

CORE TEAM

ROLE

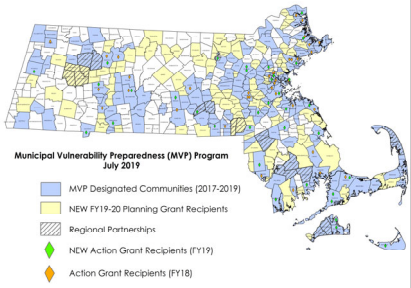
- Confirm framework for process
- Provide data and local expertise
- Participate in the stakeholder workshop
- Finalize priority actions for the final report
- Interviews

TODAY'S OBJECTIVES

- Review Process
- Set Goals
- Prepare for Stakeholder Meeting

3

MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM (MVP)



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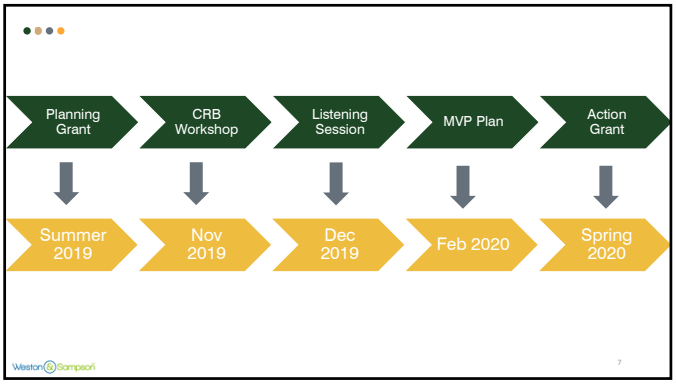

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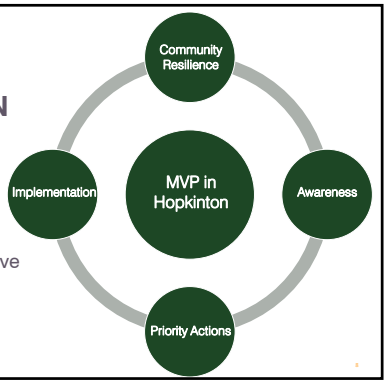
MVP IN HOPKINTON

- Increase resilience of community
- Raise awareness of climate threats
- Identify priority actions to move forward
- Create implementation pathways



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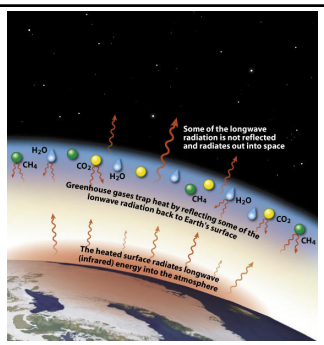
GREENHOUSE GASES (GHG)

- Naturally occurring
- Act as a blanket
- Examples: carbon dioxide and methane

Climate mitigation ensures there is less to adapt to and is a key component of our community's resilience



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MASSACHUSETTS GHG GOALS

- Established by the Global Warming Solutions Act (GWSA) of 2008
- 25% reduction in GHG emissions by 2020
- 80% reduction in GHG emissions by 2050
- 1990 is the baseline year

Weston & Sampson Source: Commonwealth of Massachusetts. 2019. "Global Warming Solutions Act 10-year Progress Report," 10. 10

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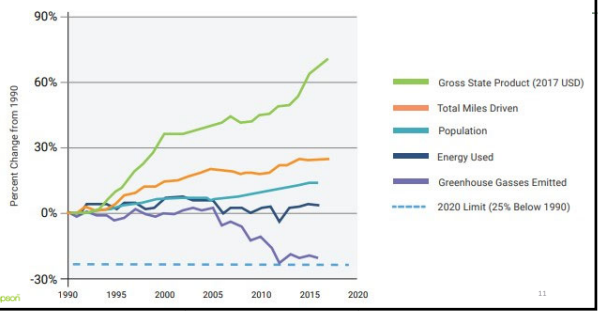
FIGURE 3 | TRENDS OF GROWTH IN GSP, VMT, AND POPULATION WHILE GHG EMISSIONS ARE DECREASING AND ENERGY USE HAS BEEN STABLE



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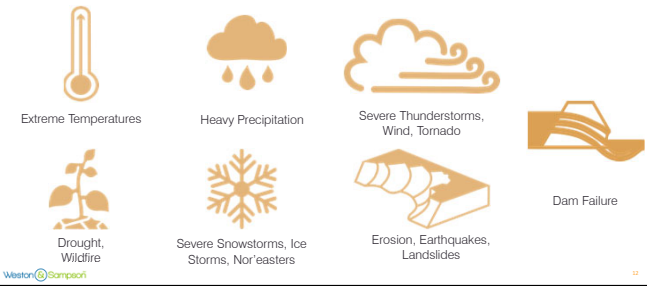
HAZARDS IN HOPKINTON



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EXTREME TEMPERATURES

WARMER ANNUAL AIR TEMPERATURES
UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

WARMER WINTERS
UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE

14

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EXTREME TEMPERATURES IN MASSACHUSETTS

2005 OBSERVED ANNUAL AVERAGE	MID-CENTURY PROJECTED ANNUAL AVERAGE	END-OF-CENTURY PROJECTED ANNUAL AVERAGE
6	24	35
DAYS WITH TEMPERATURES ABOVE 90°F		
145	114	101
DAYS WITH TEMPERATURES BELOW 32°F		

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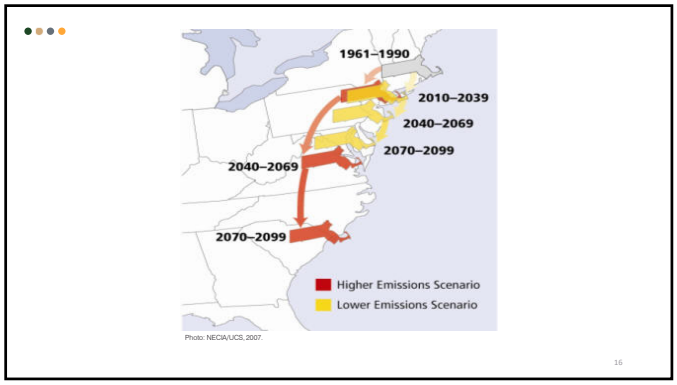

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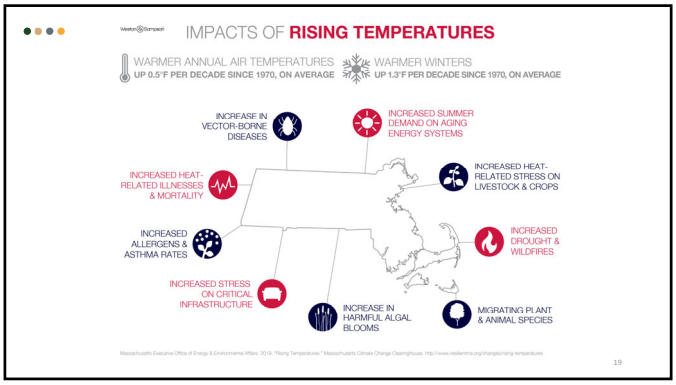

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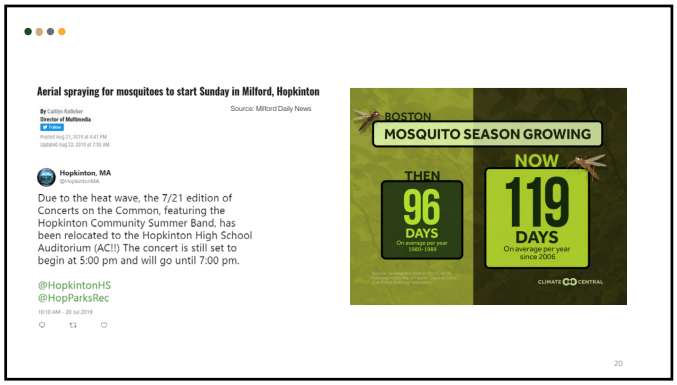

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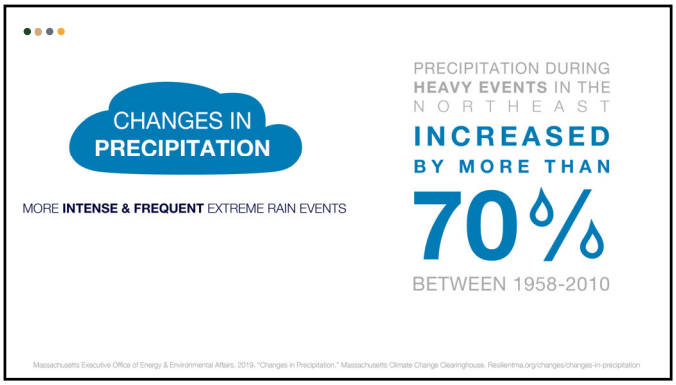

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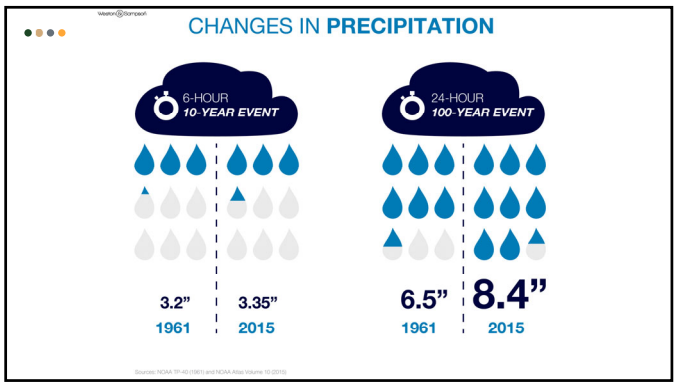

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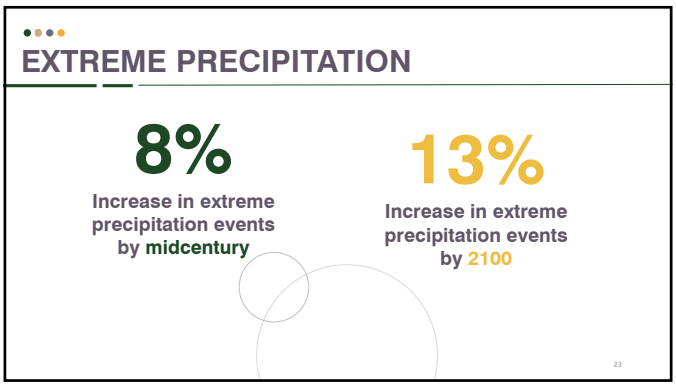

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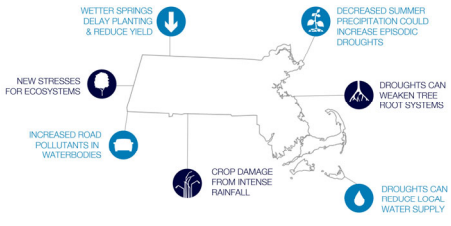
IMPACTS OF CHANGING **PRECIPITATION**

HIGHER AVERAGE ANNUAL PRECIPITATION
INCREASED BY ABOUT 10% IN THE NORTHEAST INTHE LAST 50 YEARS



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FLOODING

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

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

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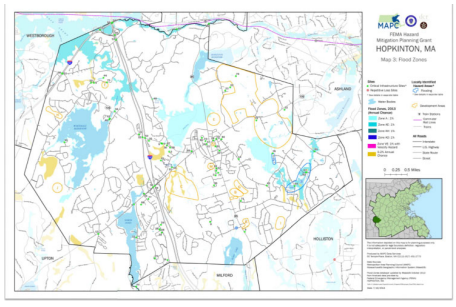
Riverine Flood Prone Areas

Charles River
Sudbury River
Lake Maspenock
Echo Lake
Whitehall Lake
Hopkinton Reservoir
North Pond
Blood's Pond
Indian Brook
Cold Spring Brook
Whitehall Brook



1. Town of Hopkinton Hazard Mitigation Plan

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FLOODING

Locally Identified Areas of Flooding

Cranberry Lane/North Hill
Alprilla Farm Road
32 Granite Street

Stormwater Flooding Typical Characteristics

Poor drainage
High amounts of impervious surface
Undersized culverts

Source: Hopkinton Hazard Mitigation Plan, 2015.

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WINTER STORMS

The blizzard of 2013 left nearly **400,000 Massachusetts residents without power**

"Heavy blizzards are among the **most costly and disruptive** weather events for Massachusetts communities."

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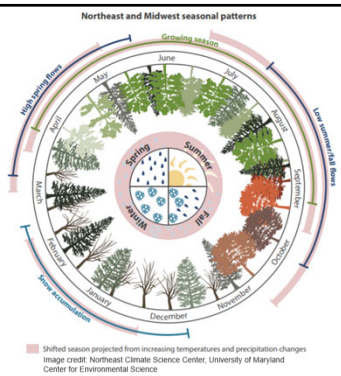

The most notable recent drought event was in
2016

The occurrence of droughts **lasting 1 to 3 months** could go up by as much as **75% over existing conditions** by the end of the century, under the high emissions scenario

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EROSION

- Caused by riverine flow & stormwater.
- Increased precipitation, including winter rains, could increase erosion.
- Drier soils will reduce resistance to erosion

1. Executive Office of Energy and Environmental Affairs, Adaptation Advisory Committee. 2011. "Massachusetts Climate Change Adaptation Report." 42.

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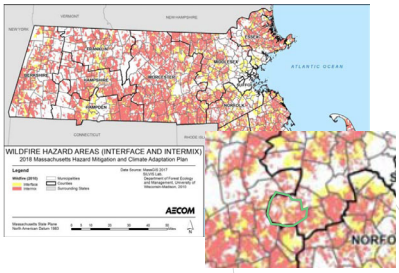
WILDFIRE



15-20

brush fires annually on average

Interstate 495 Corridor
Hopkinton State Park
Peppercorn Hill
Saddle Hill
Upton State Park
MA Turnpike

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HURRICANES AND EARTHQUAKES

HURRICANE
Sandy
and nor'easters
cause downed trees and power lines

Upward trend in North Atlantic hurricane activity since 1970

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

EARTHQUAKE
30-40
Earthquakes occur in New England each year, although most are not felt.

Source: Climate Science Special Report, Fourth National Climate Assessment (NCA4). Volume prepared by the U.S. Global Change Research Program (USGCRP)Northern Middlesex Council of Governments. 2015. "Hazard Mitigation Plan for the Northern Middlesex Region." 159-160.

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IMPACTS OF EXTREME WEATHER

Massachusetts Executive Office of Energy & Environmental Affairs. 2018. "Extreme Weather." Massachusetts Climate Change Clearinghouse. http://www.resilientma.org/changes/extreme-weather

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HAZARD POTENTIAL OF DAMS

Hazard Classification of Hopkinton Dams			
Dam Name	**Impoundment Name**	**Hazard Class**	**Ownership**
Dams in Hopkinton			
Whitehall Reservoir Dam	Whitehall Brook	Significant	MA/DCR
Echo Lake Dam	Charles River	High	Milford Water Co.
Bloods Pond Dam	Cold Spring Brook	Significant	Hopkinton
Grist Mill Dam	Cold Spring Brook	Low	Hopkinton
Ice House Pond Dam	Indian Brook	Small, Unregulated	Hopkinton
Whitehall Lower Pond Dam	Whitehall Brook	Small, Unregulated	MA/DCR
Whitehall Upper Pond Dam	Whitehall Brook	Significant	MA/DCR
Whitehall Reservoir Dike	Whitehall Brook	Small, Unregulated	MA/DCR
Whitehall Reservoir Distribution Dam	Whitehall Brook	Significant	MA/DCR

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As an FYI: Boston Sea Level Rise Projections (ft)

Increased coastal flooding

Permanently inundated low-lying coastal areas

Increased shoreline erosion

Emission Scenario	2030	2050	2070	2100
Intermediate	0.7	1.4	2.3	4.0
Intermediate-High	0.8	1.7	2.9	5.0
High	1.2	2.4	4.2	7.6
Extreme	1.4	3.1	5.4	10.2

(Source: Northeast Climate Adaption Science Center)

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WORKSHOP OUTLINE

PRESENTATION:
- Overview of Science & Data
- Characterization of Hazards

- BREAK -

INDIVIDUAL TABLES:
- Identify Community Features

- LUNCH -

INDIVIDUAL TABLES:
- Identify and Prioritize Actions

- BREAK -

LARGE GROUP DISCUSSION:
- Determine Overall Priority Actions

Photo: Hopkinton Town Common. Activerain.com

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RISK MATRIX

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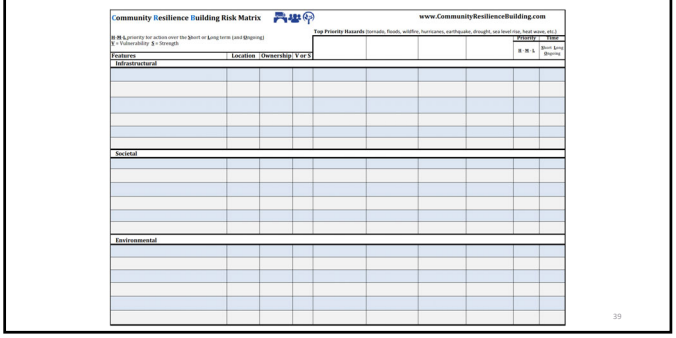
RISK MATRIX



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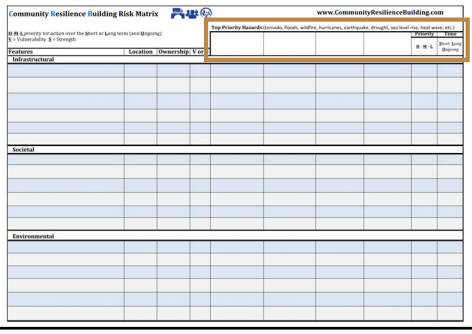
RISK MATRIX: HAZARDS



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IDENTIFY HAZARDS

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HAZARDS IN HOPKINTON

CHOOSE 4 FOR THE MVP ACTION PLAN

Extreme Temperatures

Heavy Precipitation

Severe Thunderstorms, Wind, Tornado

Dam Failure

Drought, Wildfire

Severe Snowstorms, Ice Storms, Nor'easters

Erosion, Earthquakes, Landslides

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15 MINUTE BREAK!

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RISK MATRIX: HAZARDS

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)				Priority H - M - L	Time Short Long Ongoing

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RISK MATRIX: FEATURES

Community Resilience Building Risk Matrix — www.CommunityResilienceBuilding.com

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Features	Location	Ownership	V or S	Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)						Priority H - M - L	Time Short Long Ongoing
Infrastructural											
Societal											
Environmental											

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RISK MATRIX: FEATURES

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Features	Location	Ownership	V or S
Infrastructural			
Societal			
Environmental			

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RISK MATRIX: FEATURES

FEATURES	LOCATION	OWNERSHIP	VULNERABILITY OR STRENGTH
Infrastructural	Town wide	State	Vulnerability
Societal	Multi- vs. Single-neighborhood	Town	Strength
Environmental	Specific location	Private	Both
		Shared	

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FEATURES IN HOPKINTON

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INFRASTRUCTURAL FEATURES

Police Department

Photo by Hopkinton Police Deparment

Fire Department

Photo by Hopkinton Fire Department

Wastewater Treatment & Collection

Dams

Echo Lake Dam. Photo from Tata and Howard

Roadways

Photo by ACOE

Water Supply

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SOCIETAL FEATURES

Population	Hopkinton	Massachusetts
2010	14,909 residents	6,547,790
2018	18,269 residents	6,902,149
Age		
Under 18 years:	28.1%	20%
65+ years:	9.8%	17%
Education		
Bachelor's degree or higher:	68.2%	42.1%
Additional Information		
Median household income:	$151,357	$74,167
Persons in poverty:	1.5%	10.5%
With a disability:	4.1%	7.9%
Language other than English spoken at home:	9%	23.1%

Source: U.S. Census Bureau, 2013-2017 ACS Estimates

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ENVIRONMENTAL FEATURES

Reservoirs

Trails

Photo 1: Hopkinton Reservoir, Wikipedia
Photo 2: Whitehall Reservoir Loop. Alltrails.com.

+50% of Hopkinton is Open Land

- Over half is privately owned
- Open spaces include:
  - Hopkinton State Park
  - Whitehall State Park
  - Land Trusts (Mass Audubon, Sudbury Valley Trustees, Hopkinton Area Land Trust)

Whitehall Lake

Sudbury River

Source: Hopkinton Master Plan. 2017. p11-12

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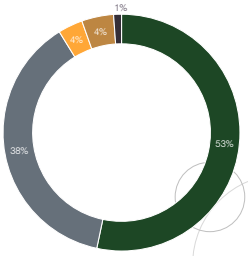
Hopkinton's Land Use



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Source: Hopkinton Master Plan. 2017, pg 9-12.

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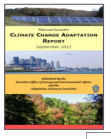
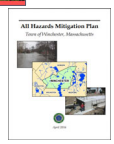
DATA RESOURCES





Within Hopkinton and Throughout Massachusetts

Massachusetts Climate Change Projections, 2018)

Massachusetts State Hazard and Climate Adaptation Plan, 2018

Massachusetts Climate Change Adaptation Report, 2011

Town of Hopkinton Hazard Mitigation Plan

2015 Update

US Census, American Community Survey, 2013-2017

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LUNCH

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ADAPTATION STRATEGIES

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EXISTING HAZARD PROTECTION

- Comprehensive Emergency Management Plan
- Enforce MA State Building Code
- Multi-Department Review of Developments
- FEMA Tankers
- Participation in the National Flood Insurance Program
- Street Sweeping
- Catch Basin Cleaning
- Enforce MA Stormwater Regulations
- Community Preservation Act
- Infrastructure Improvements
- Regulations, By-Laws and Plans
- Portable Water Pumps
- Tree-trimming
- Roadway Treatments
- Snow Removal & Disposal
- Cooling Stations
- Dam Safety Permits and Regulations
- Permits for Outdoor Burning
- Fire Hydrant Regulations

Weston & Sampson Source: TOWN OF HOPKINTON HAZARD MITIGATION PLAN 36

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15 MINUTE BREAK!

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DEFINE COMMUNITY ACTIONS

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IDENTIFY PRIORITY ACTIONS

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WRAP-UP & CLOSING REMARKS

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Municipal Vulnerability Preparedness Planning Grant and Hazard Mitigation Plan Update

Core Team Meeting
Select Board Meeting Room, Town Hall
Thursday, October 24th, 2019
10:00 am – 11:30 am

Introductions — 5 minutes

Project Overview — 15 minutes

1. MVP Program Overview
    a. Brief Introduction to Climate Change in Hopkinton
    b. MVP Planning Process
    c. MVP Action Grants
    d. Hazard Mitigation Plan Overlap
    e. Master Plan Chapter

Core Team Role — 2 minutes

1. Develop/approve list of stakeholders
2. Active participants in the Community Resilience Building Workshop
3. Promote the listening session/attend listening session
4. Inform community priorities/Determine how decisions from Workshop will be used

Feedback: Keep Fire Chief involved – works on hazard mitigation planning. Interview?

Goal Setting and Endorsement — 15 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

Feedback: Focus on Resilience & Preparedness

Community Resilience Building Workshop and Review of Materials — 35 minutes

1. MVP Risk Matrix
    a. Discuss hazards and key features (infrastructure, society, environment)
2. Review map of key resources/assets
3. Prioritization Process MVP Key Actions
4. Workshop Schedule
    b. One 8-hour or two 4-hour meetings
    c. Weekday or weekend
    d. Day or evening
5. Presentation Feedback

Feedback:

- Add a theme/quote for branding

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- Present a success story where drought was chosen as a hazard. Updating water supply system? Related action grants: Belchertown (Enhancing water supply reliability: Resilient water storage and water conservation planning); Brockton (Integrated Water Infrastructure Vulnerability Assessment and Economic Development Plan for Climate Resiliency)
- Bring it back to current instead of looking towards the end of the century: focus on economic and community resiliency. Mid-century instead of 2100
- Dam at Echo Lake – ownership?
- Concerns in the town:
    - Extreme precipitation – choose as 1 hazard in workshop
    - EEE
    - Ticks
    - March storm a few years ago, areas of town were out of power. Similar impacts as storm in 1978
    - Trees down last week
    - Potential tree plan – scenic roads cannot be maintained by eversource
    - 2 culverts blew out in recent rain, road closed and trail closed
    - 4th & Berry Acres culvert
    - Collapse on West Elm Street forced a closure
    - Twin culvert on Chestnut Street, one blew out
    - Legacy Worth – detention basin
    - Runoff from construction sites
    - Drainage structures are rotten – pipes are getting replaced by same sized pipes
    - UNDERSIZED CULVERTS

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

Data Sources — 3 minutes

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

Feedback:

- Talk to Leah Stanton about water supply in Hopkinton and come up with solutions
- Hopkinton is working with neighboring communities on new water supply
- Emergency access in hindered during storms – are there any areas specifically that could be isolated during a storm?
- Review Open Space Plan, Master Plan

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

Workshop Participants — 10 minutes

1. Respond to a list of workshop invitees

W&S Action Item: Draft invitation to stakeholders

Hopkinton Action Item: Finalize list of invitees; send invitation and track RSVPs, assign participants to tables

Feedback: incorporate edits into stakeholders list.

Wrap Up and Next Steps — 5 minutes

1. Confirm draft schedule

Feedback: Tuesdays work best. Potentially December 10, 10:00am-6:00pm

APPENDIX B

Additional Hazard Data

Legend

- Day Care
- Emergency Shelters/Warming Center
- Fire Department
- Food/Grocery/Supply Store/Pharmacies
- Fruit Street Storage Garage
- Gas Station
- Hazardous Material Site
- Hopkinton Department of Public Works
- Hopkinton Town Hall
- IT Office
- Library
- LNG Facility
- Nursing Home
- Police Department
- Religious Center
- School
- Sewer Pump Station
- Water Tank
- Wells
- Youth Services
- Pipeline
- Powerline
- Capped Landfill
- Conservation/Protected Land
- Open Space

Dams

- High Hazard
- Significant Hazard
- Low Hazard
- N/A

Transportation

- Railroad
- Evacuation Route

Waterways

- Rivers, Streams, and Brooks
- Marsh/Bog/Wooded Marsh
- Lakes, Ponds, Reservoirs

Census

- > 35% of the population is < 18 (Census 2010)
- > 25% of the population is > 65 (Census 2010)

FEMA National Flood Hazard Layer

- 1% Annual Chance of Flooding (Zones A, AE, AH, AO)
- 0.2% Annual Chance of Flooding (Zone X)

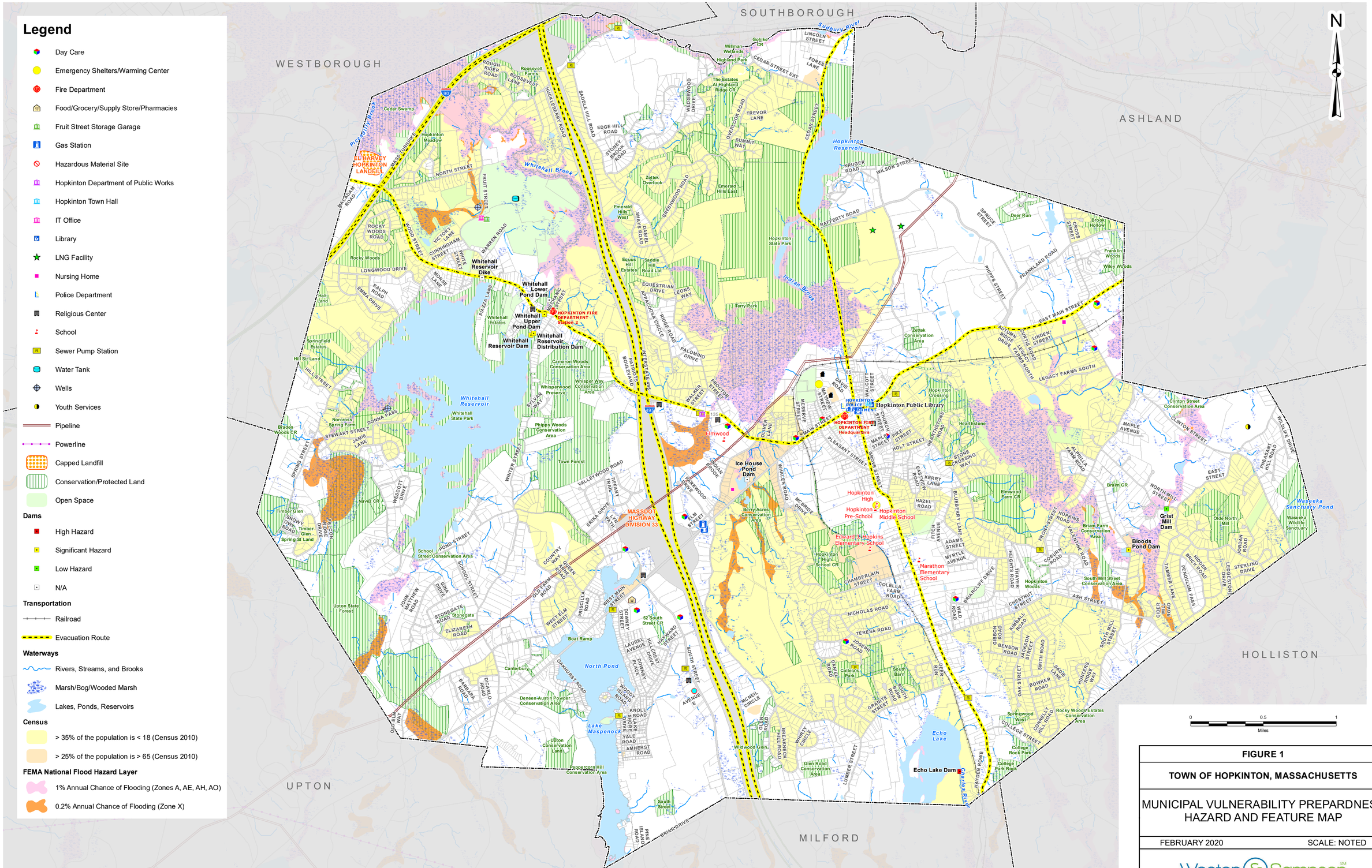


FIGURE 1

TOWN OF HOPKINTON, MASSACHUSETTS

MUNICIPAL VULNERABILITY PREPARDNESS HAZARD AND FEATURE MAP

FEBRUARY 2020 SCALE: NOTED

Weston & Sampson

Hazus: Hurricane Global Risk Report

Region Name: Hopkinton_HMP

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Thursday, February 6, 2020

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 27.89 square miles and contains 3 census tracts. There are over 4 thousand households in the region and a total population of 14,925 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,622 million dollars (2014 dollars). Approximately 90% of the buildings (and 81% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,434 buildings in the region which have an aggregate total replacement value of 2,622 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

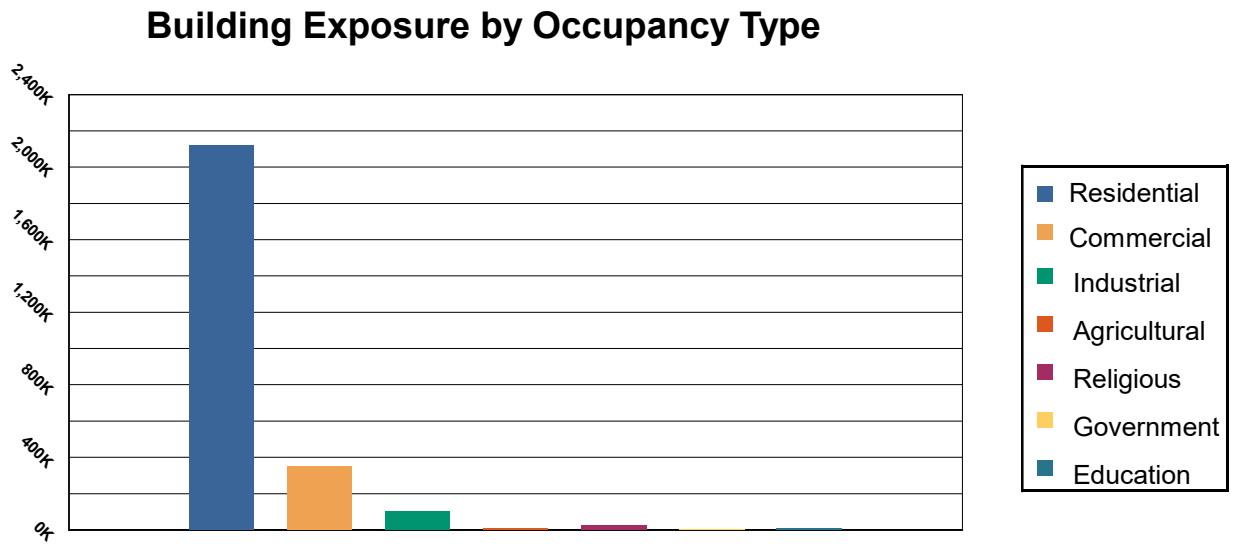


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	2,120,993	80.91 %
Commercial	349,871	13.35%
Industrial	100,329	3.83%
Agricultural	10,095	0.39%
Religious	23,516	0.90%
Government	5,369	0.20%
Education	11,399	0.43%
Total	**2,621,572**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 119 buildings will be at least moderately damaged. This is over 2% of the total number of buildings in the region. There are an estimated 3 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

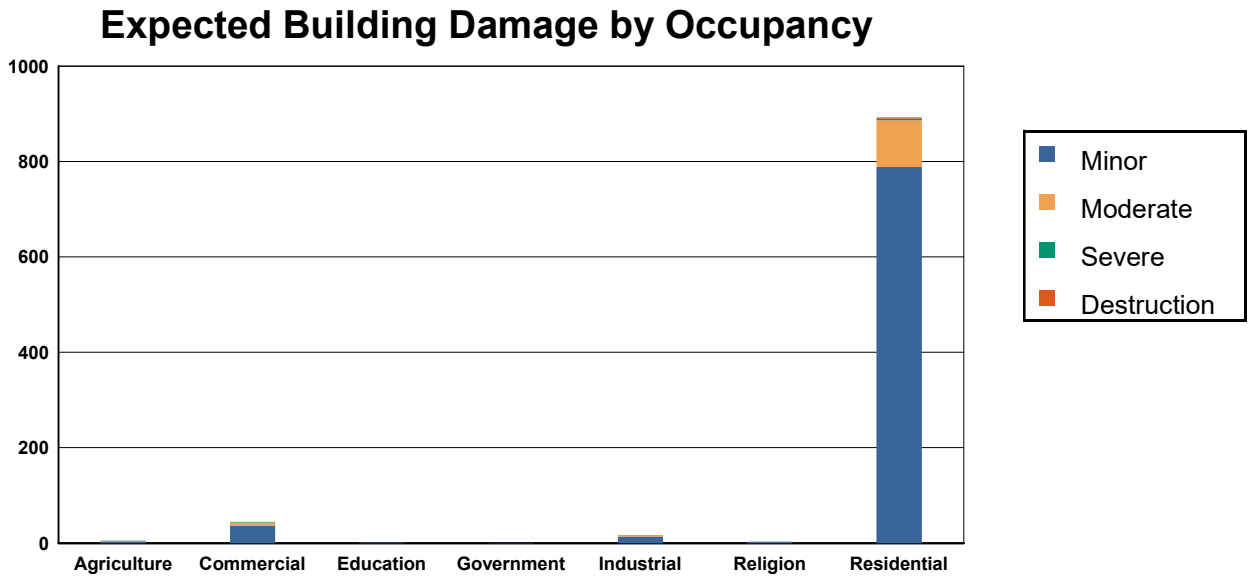


Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	23.90	82.40	3.71	12.81	0.91	3.13	0.44	1.51	0.04	0.15
Commercial	287.11	86.48	35.65	10.74	7.97	2.40	1.26	0.38	0.01	0.00
Education	9.78	88.93	1.07	9.73	0.14	1.28	0.01	0.06	0.00	0.00
Government	4.44	88.83	0.48	9.69	0.07	1.42	0.00	0.06	0.00	0.00
Industrial	111.66	86.56	13.62	10.55	3.02	2.34	0.65	0.50	0.05	0.04
Religion	21.69	86.76	2.91	11.63	0.38	1.53	0.02	0.08	0.00	0.00
Residential	4,010.41	81.80	788.68	16.09	97.43	1.99	3.90	0.08	2.57	0.05
Total	**4,468.99**		**846.12**		**109.93**		**6.28**		**2.67**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	21	86.79	3	10.88	1	2.24	0	0.08	0	0.00
Masonry	223	83.44	34	12.87	9	3.21	1	0.43	0	0.05
MH	2	94.08	0	3.84	0	1.64	0	0.04	0	0.41
Steel	188	87.79	20	9.43	5	2.31	1	0.47	0	0.00
Wood	3,862	81.92	758	16.08	88	1.87	4	0.08	2	0.05

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

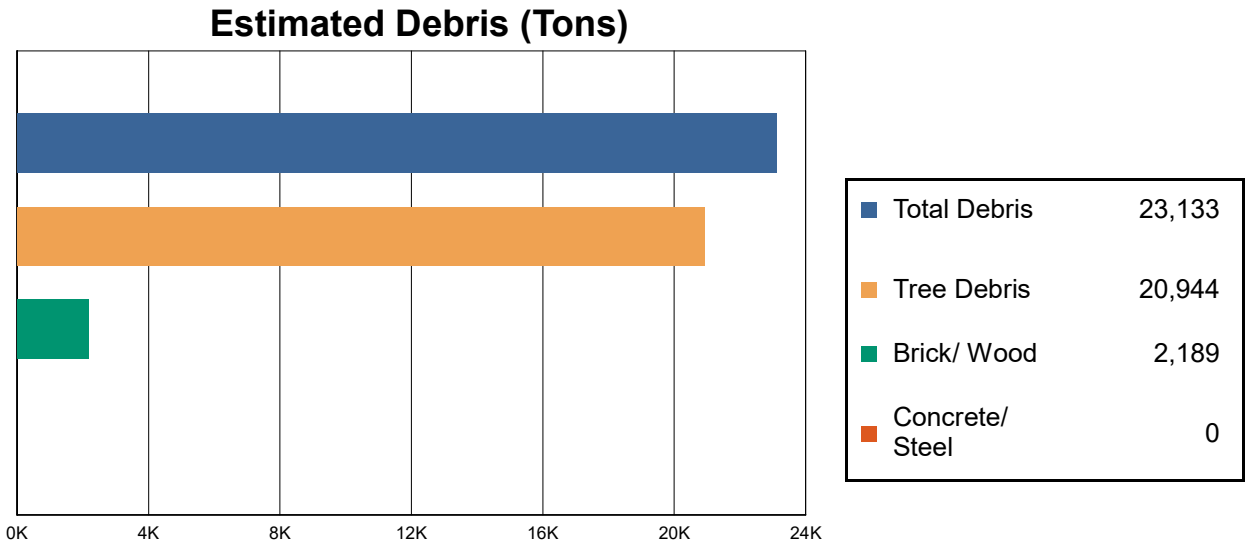
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	6	0	0	6

Induced Hurricane Damage

Debris Generation

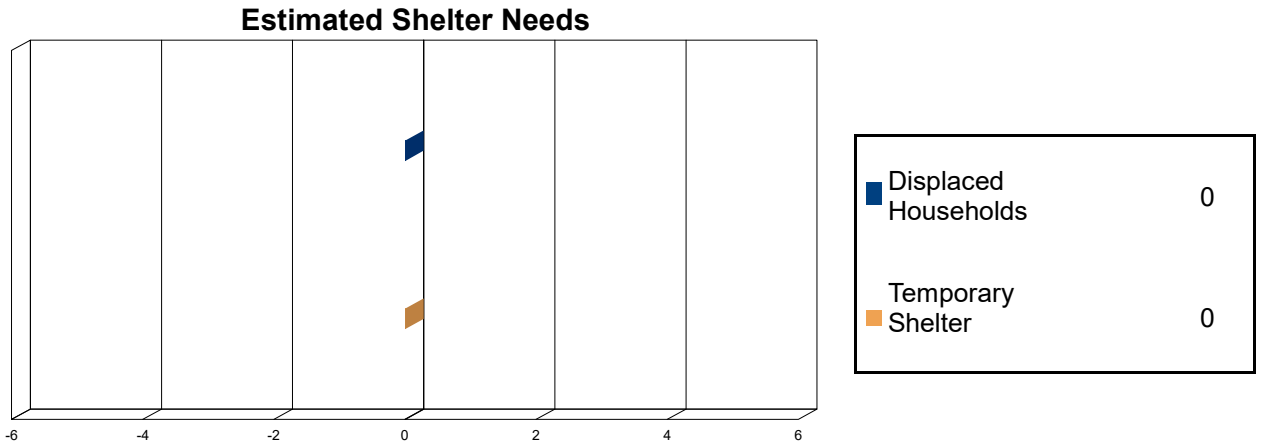


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 23,133 tons of debris will be generated. Of the total amount, 16,432 tons (71%) is Other Tree Debris. Of the remaining 6,701 tons, Brick/Wood comprises 33% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 88 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 4,512 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 14,925) will seek temporary shelter in public shelters.

Economic Loss

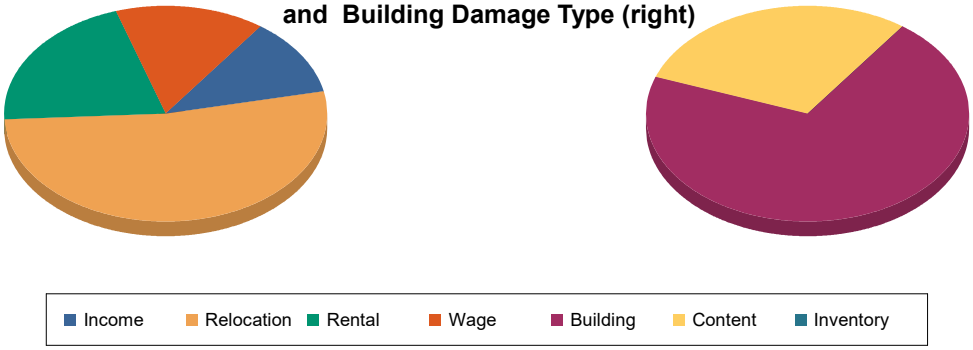
The total economic loss estimated for the hurricane is 55.2 million dollars, which represents 2.11 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 55 million dollars. 4% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 92% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

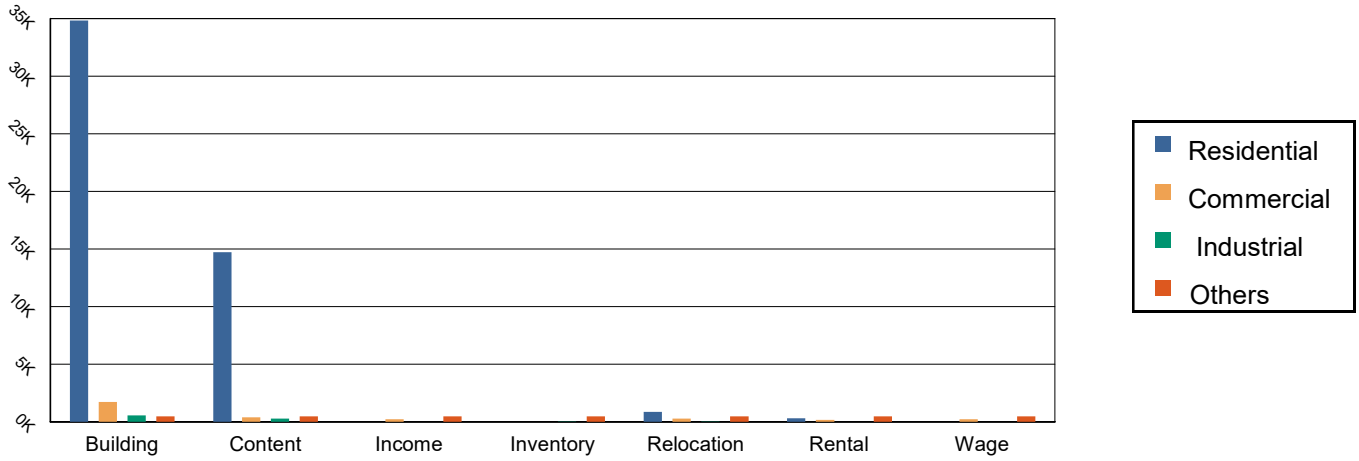


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	34,823.36	1,730.64	551.79	248.57	37,354.36
	Content	14,728.81	396.24	284.62	59.11	15,468.79
	Inventory	0.00	10.33	39.02	3.21	52.56
	Subtotal	**49,552.17**	**2,137.21**	**875.43**	**310.89**	**52,875.70**
Business Interruption Loss						
	Income	0.00	237.83	8.01	24.72	270.56
	Relocation	861.78	288.56	30.27	38.27	1,218.88
	Rental	307.00	172.14	5.86	3.26	488.27
	Wage	0.00	235.94	12.10	98.08	346.12
	Subtotal	**1,168.78**	**934.47**	**56.25**	**164.33**	**2,323.83**

Total

Total	**50,720.96**	**3,071.68**	**931.67**	**475.22**	**55,199.53**

Appendix A: County Listing for the Region

Massachusetts
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Middlesex	14,925	2,120,993	500,579	2,621,572
Total	**14,925**	**2,120,993**	**500,579**	**2,621,572**
Study Region Total	**14,925**	**2,120,993**	**500,579**	**2,621,572**

Hazus: Earthquake Global Risk Report

Region Name	Hopkinton_HMP
Earthquake Scenario:	Hopkinton Mag 5.0 Earthquake
Print Date:	February 06, 2020

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 27.88 square miles and contains 3 census tracts. There are over 4 thousand households in the region which has a total population of 14,925 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,621 (millions of dollars). Approximately 90.00 % of the buildings (and 81.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 444 and 97 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 5 thousand buildings in the region which have an aggregate total replacement value of 2,621 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 88% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 6 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 5 hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 541.00 (millions of dollars). This inventory includes over 20.51 miles of highways, 13 bridges, 595.27 miles of pipes.

Table 1: Transportation System Lifeline Inventory

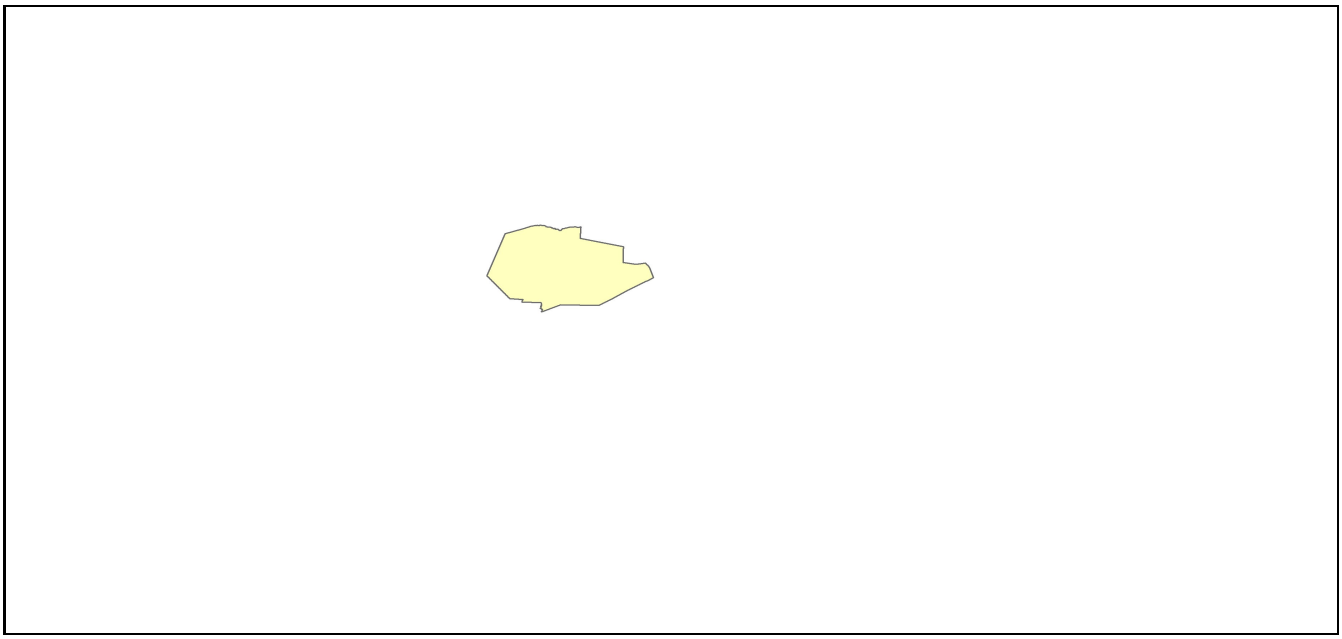
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	13	181.8407
	Segments	20	248.3959
	Tunnels	0	0.0000
		Subtotal	**430.2366**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	7.0207
	Tunnels	0	0.0000
		Subtotal	**7.0207**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	2	7.3448
	Tunnels	0	0.0000
		Subtotal	**7.3448**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**444.60**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	9.5870
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**9.5870**
Waste Water	Distribution Lines	NA	5.7522
	Facilities	1	77.2560
	Pipelines	0	0.0000
		Subtotal	**83.0082**
Natural Gas	Distribution Lines	NA	3.8348
	Facilities	1	1.2644
	Pipelines	0	0.0000
		Subtotal	**5.0992**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**97.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	Hopkinton Mag 5.0 Earthquake
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-71.55
Latitude of Epicenter	42.23
Earthquake Magnitude	5.00
Depth (km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 1,096 buildings will be at least moderately damaged. This is over 20.00 % of the buildings in the region. There are an estimated 52 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

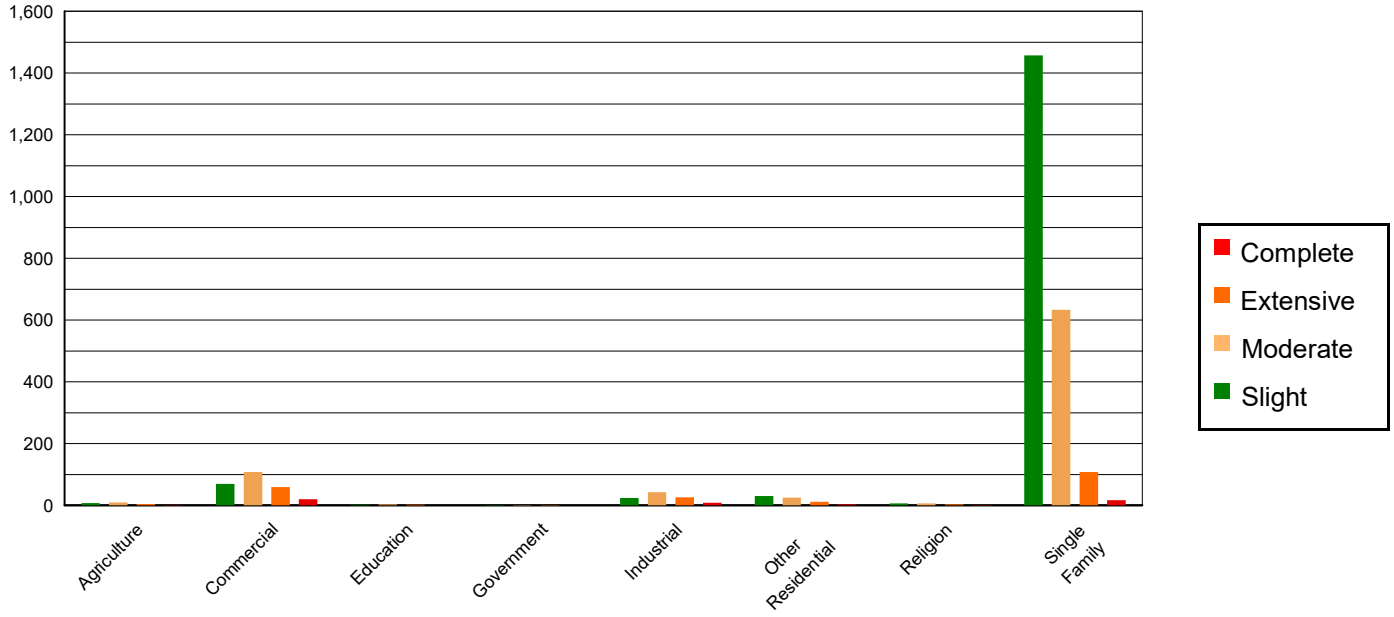


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	6.45	0.24	7.06	0.44	9.61	1.16	4.41	2.05	1.47	2.79
Commercial	75.20	2.74	69.59	4.36	107.71	12.99	59.46	27.64	20.03	37.98
Education	2.65	0.10	2.23	0.14	3.56	0.43	1.93	0.90	0.63	1.19
Government	1.08	0.04	0.93	0.06	1.66	0.20	1.00	0.46	0.33	0.63
Industrial	27.42	1.00	23.99	1.50	42.68	5.15	26.08	12.12	8.83	16.75
Other Residential	47.83	1.75	29.73	1.86	24.65	2.97	11.51	5.35	3.27	6.20
Religion	9.00	0.33	5.91	0.37	5.93	0.72	3.15	1.46	1.01	1.91
Single Family	2571.01	93.81	1457.08	91.27	633.18	76.38	107.57	50.01	17.17	32.55
Total	**2,741**		**1,597**		**829**		**215**		**53**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2583.16	94.25	1465.20	91.77	621.32	74.95	85.76	39.87	6.37	12.08
Steel	45.90	1.67	39.23	2.46	82.12	9.91	53.28	24.77	18.86	35.76
Concrete	6.48	0.24	5.70	0.36	13.41	1.62	8.55	3.97	2.58	4.90
Precast	2.72	0.10	1.96	0.12	4.98	0.60	4.94	2.30	1.48	2.81
RM	14.67	0.54	7.05	0.44	14.77	1.78	11.87	5.52	2.09	3.96
URM	86.68	3.16	75.93	4.76	89.41	10.79	48.66	22.62	20.85	39.53
MH	1.05	0.04	1.45	0.09	2.96	0.36	2.03	0.95	0.51	0.97
Total	**2,741**		**1,597**		**829**		**215**		**53**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	6	6	0	0
EOCs	0	0	0	0
PoliceStations	1	1	0	0
FireStations	1	1	0	0

Transportation Lifeline Damage

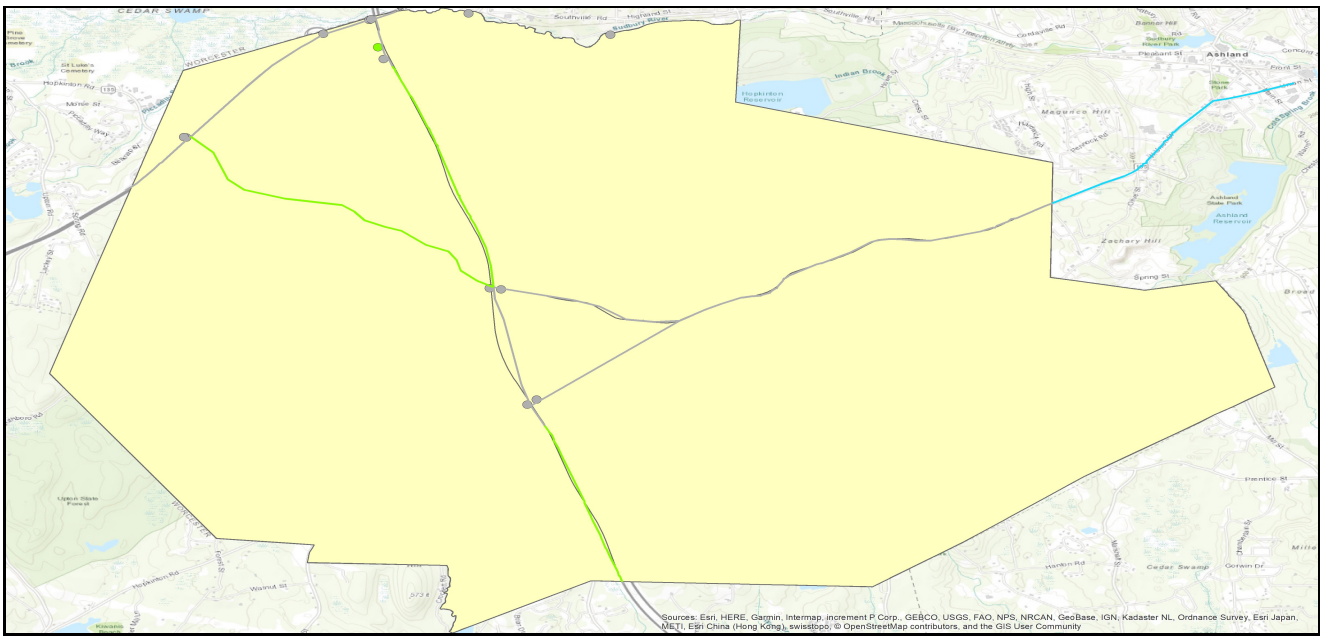


Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	20	0	0	20	20
	Bridges	13	6	1	7	12
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	2	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	1	0	0	1
Natural Gas	1	1	0	0	1
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	298	77	19
Waste Water	179	39	10
Natural Gas	119	13	3
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,957	0	0	0	0	0
Electric Power		4,145	2,723	1,119	196	5

Induced Earthquake Damage

Fire Following Earthquake

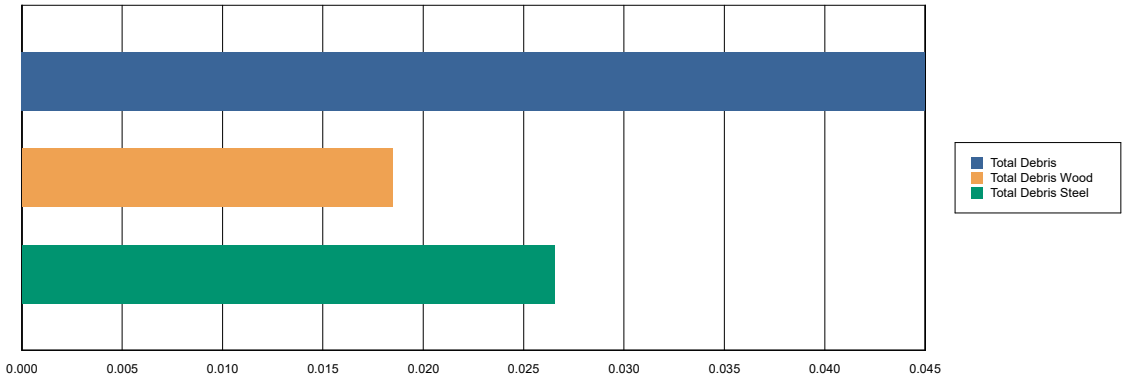
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 45,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 41.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 1,800 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



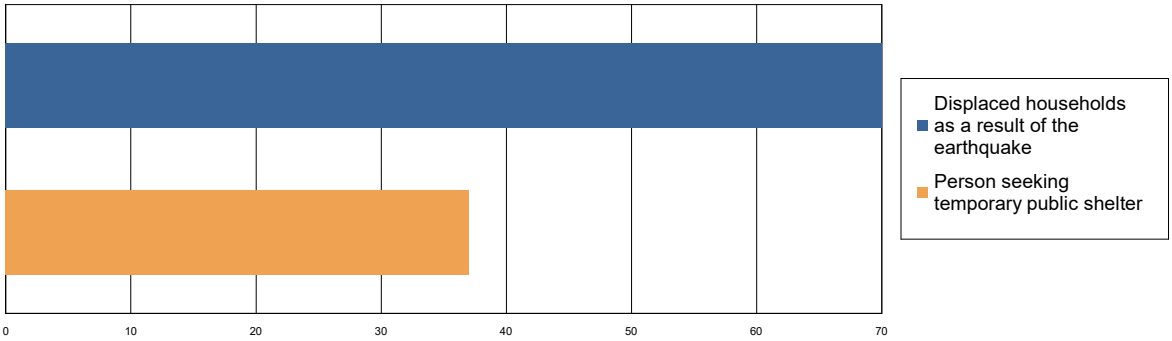
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.02	0.03	0.05	1,800 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 70 households to be displaced due to the earthquake. Of these, 37 people (out of a total population of 14,925) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
70	37

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0.97	0.24	0.03	0.06
	Commuting	0.01	0.02	0.03	0.01
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1.58	0.39	0.05	0.11
	Other-Residential	4.47	1.11	0.16	0.32
	Single Family	16.71	2.85	0.29	0.57
	Total	**24**	**5**	**1**	**1**
2 PM	Commercial	53.38	13.12	1.81	3.52
	Commuting	0.11	0.14	0.25	0.05
	Educational	26.62	6.77	1.01	1.96
	Hotels	0.00	0.00	0.00	0.00
	Industrial	11.67	2.92	0.41	0.79
	Other-Residential	0.67	0.17	0.03	0.05
	Single Family	2.46	0.44	0.05	0.09
	Total	**95**	**24**	**4**	**6**
5 PM	Commercial	39.00	9.62	1.34	2.57
	Commuting	2.08	2.50	4.56	0.87
	Educational	1.19	0.30	0.04	0.09
	Hotels	0.00	0.00	0.00	0.00
	Industrial	7.29	1.82	0.26	0.50
	Other-Residential	1.76	0.44	0.07	0.13
	Single Family	6.56	1.16	0.13	0.24
	Total	**58**	**16**	**6**	**4**

Economic Loss

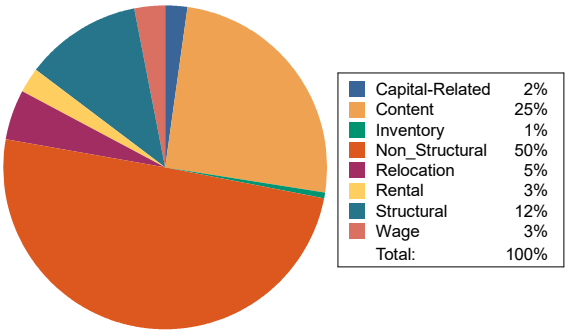
The total economic loss estimated for the earthquake is 376.04 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 316.44 (millions of dollars); 13 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 58 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

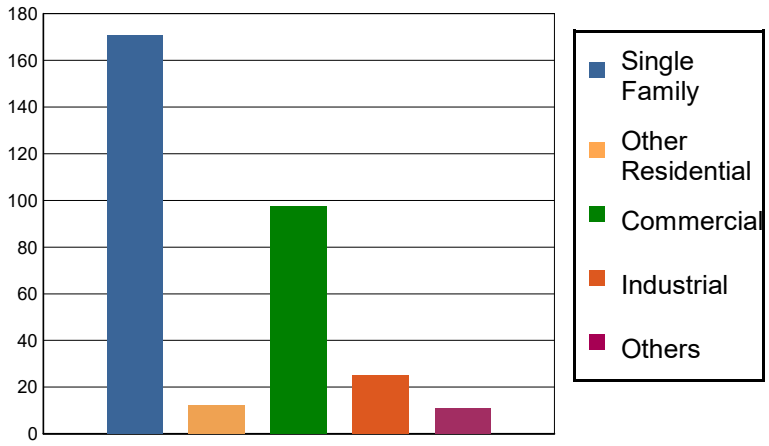


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.8249	7.7862	0.4015	0.2865	9.2991
	Capital-Related	0.0000	0.3492	6.5387	0.2556	0.0708	7.2143
	Rental	1.7011	0.7158	5.2052	0.1569	0.1322	7.9112
	Relocation	6.0934	0.3630	7.7103	0.7954	1.0979	16.0600
	Subtotal	**7.7945**	**2.2529**	**27.2404**	**1.6094**	**1.5874**	**40.4846**
Capital Stock Losses							
	Structural	16.4215	1.4391	13.9711	3.2769	1.9424	37.0510
	Non_Structural	98.9988	6.4915	36.1445	11.1366	4.5743	157.3457
	Content	47.5468	1.9025	19.6828	7.9591	2.7353	79.8265
	Inventory	0.0000	0.0000	0.4886	1.1798	0.0643	1.7327
	Subtotal	**162.9671**	**9.8331**	**70.2870**	**23.5524**	**9.3163**	**275.9559**
	Total	**170.76**	**12.09**	**97.53**	**25.16**	**10.90**	**316.44**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	248.3959	0.0000	0.00
	Bridges	181.8407	34.7516	19.11
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**430.2366**	**34.7516**	
Railways	Segments	7.0207	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**7.0207**	**0.0000**	
Light Rail	Segments	7.3448	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**7.3448**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**444.60**	**34.75**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	9.5870	0.3486	3.64
	Subtotal	**9.5870**	**0.3486**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	77.2560	23.8393	30.86
	Distribution Line	5.7522	0.1751	3.04
	Subtotal	**83.0082**	**24.0144**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	1.2644	0.4206	33.26
	Distribution Line	3.8348	0.0600	1.56
	Subtotal	**5.0992**	**0.4806**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**97.69**	**24.84**	

Appendix A: County Listing for the Region

Middlesex,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Middlesex	14,925	2,120	500	2,621
Total Region		**14,925**	**2,120**	**500**	**2,621**

Hazus: Earthquake Global Risk Report

Region Name	Hopkinton_HMP
Earthquake Scenario:	Hopkinton Magnitude 7.0 Earthquake
Print Date:	February 06, 2020

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 27.88 square miles and contains 3 census tracts. There are over 4 thousand households in the region which has a total population of 14,925 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,621 (millions of dollars). Approximately 90.00 % of the buildings (and 81.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 444 and 97 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 5 thousand buildings in the region which have an aggregate total replacement value of 2,621 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 88% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 6 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 5 hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 541.00 (millions of dollars). This inventory includes over 20.51 miles of highways, 13 bridges, 595.27 miles of pipes.

Table 1: Transportation System Lifeline Inventory

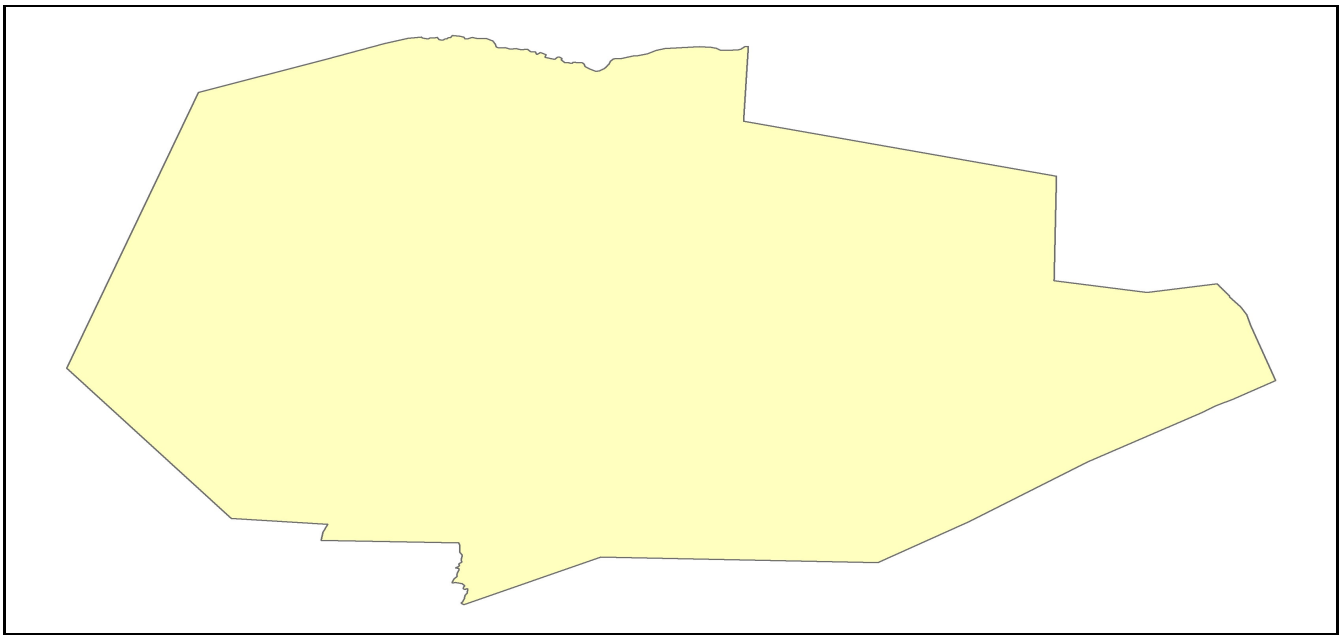
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	13	181.8407
	Segments	20	248.3959
	Tunnels	0	0.0000
		Subtotal	**430.2366**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	1	7.0207
	Tunnels	0	0.0000
		Subtotal	**7.0207**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	2	7.3448
	Tunnels	0	0.0000
		Subtotal	**7.3448**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**444.60**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	9.5870
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**9.5870**
Waste Water	Distribution Lines	NA	5.7522
	Facilities	1	77.2560
	Pipelines	0	0.0000
		Subtotal	**83.0082**
Natural Gas	Distribution Lines	NA	3.8348
	Facilities	1	1.2644
	Pipelines	0	0.0000
		Subtotal	**5.0992**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**97.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	Hopkinton Magnitude 7.0 Earthquake
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-71.54
Latitude of Epicenter	42.22
Earthquake Magnitude	7.00
Depth (km)	12.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 5,241 buildings will be at least moderately damaged. This is over 96.00 % of the buildings in the region. There are an estimated 2,458 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

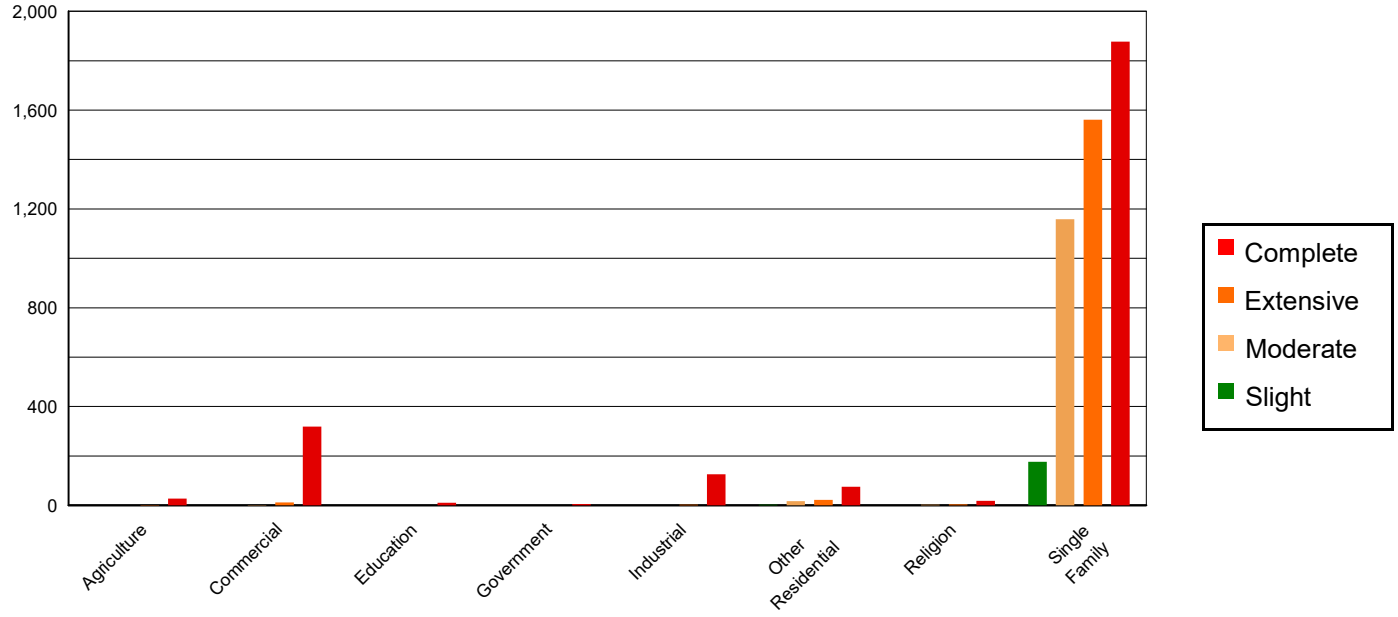


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0.00	0.01	0.01	0.00	0.15	0.01	1.56	0.10	27.28	1.11
Commercial	0.01	0.10	0.09	0.05	1.29	0.11	11.73	0.73	318.88	12.97
Education	0.00	0.00	0.00	0.00	0.04	0.00	0.34	0.02	10.62	0.43
Government	0.00	0.00	0.00	0.00	0.01	0.00	0.12	0.01	4.86	0.20
Industrial	0.01	0.04	0.02	0.01	0.33	0.03	3.28	0.20	125.36	5.10
Other Residential	0.19	1.51	2.63	1.47	16.67	1.41	22.75	1.42	74.76	3.04
Religion	0.03	0.20	0.36	0.20	2.36	0.20	3.43	0.21	18.83	0.77
Single Family	12.64	98.12	176.61	98.27	1158.12	98.23	1561.14	97.31	1877.48	76.38
Total	**13**		**180**		**1,179**		**1,604**		**2,458**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	12.86	99.81	179.50	99.88	1176.40	99.78	1588.46	99.01	1804.59	73.41
Steel	0.01	0.10	0.01	0.01	0.22	0.02	4.02	0.25	235.13	9.57
Concrete	0.00	0.00	0.00	0.00	0.04	0.00	0.49	0.03	36.19	1.47
Precast	0.00	0.00	0.00	0.00	0.03	0.00	0.11	0.01	15.94	0.65
RM	0.01	0.09	0.01	0.01	0.22	0.02	0.66	0.04	49.56	2.02
URM	0.00	0.00	0.19	0.11	2.05	0.17	10.39	0.65	308.90	12.57
MH	0.00	0.00	0.00	0.00	0.02	0.00	0.20	0.01	7.77	0.32
Total	**13**		**180**		**1,179**		**1,604**		**2,458**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	6	6	6	0
EOCs	0	0	0	0
PoliceStations	1	1	1	0
FireStations	1	1	1	0

Transportation Lifeline Damage

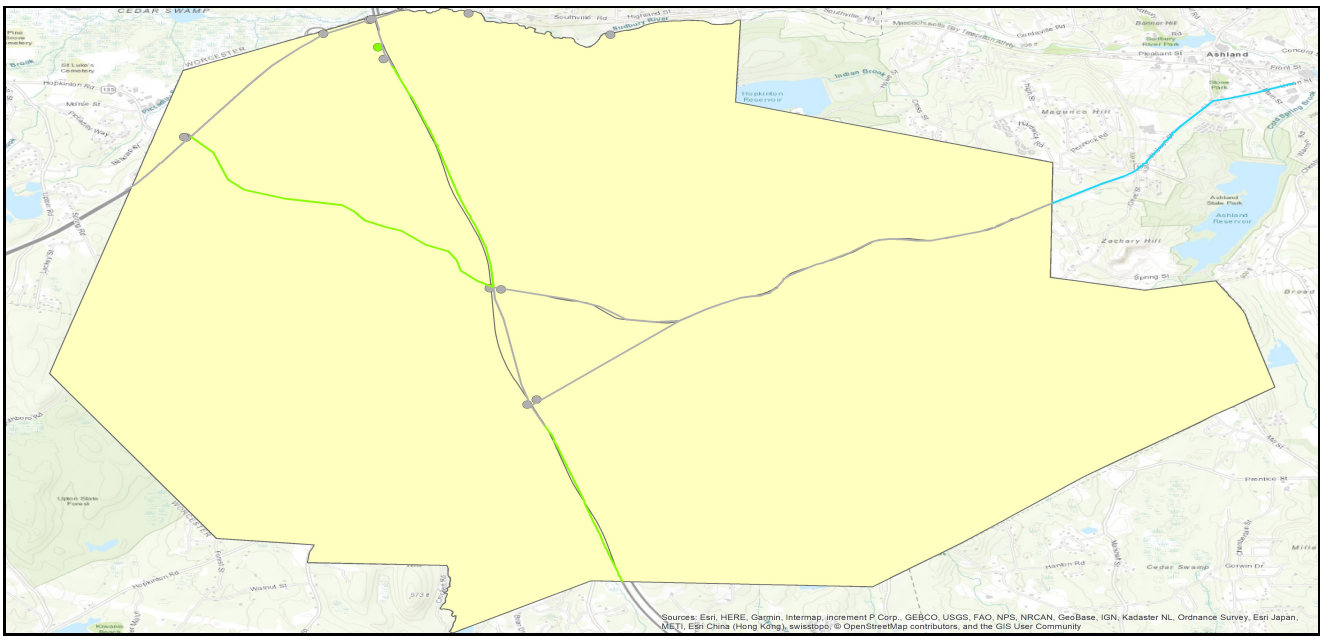


Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	20	0	0	20	20
	Bridges	13	13	13	0	0
	Tunnels	0	0	0	0	0
Railways	Segments	1	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	2	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	1	1	0	0
Natural Gas	1	1	1	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	298	2495	624
Waste Water	179	1253	313
Natural Gas	119	429	107
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	4,957	4,949	4,946	4,935	0	0
Electric Power		4,779	4,505	3,715	1,571	5

Induced Earthquake Damage

Fire Following Earthquake

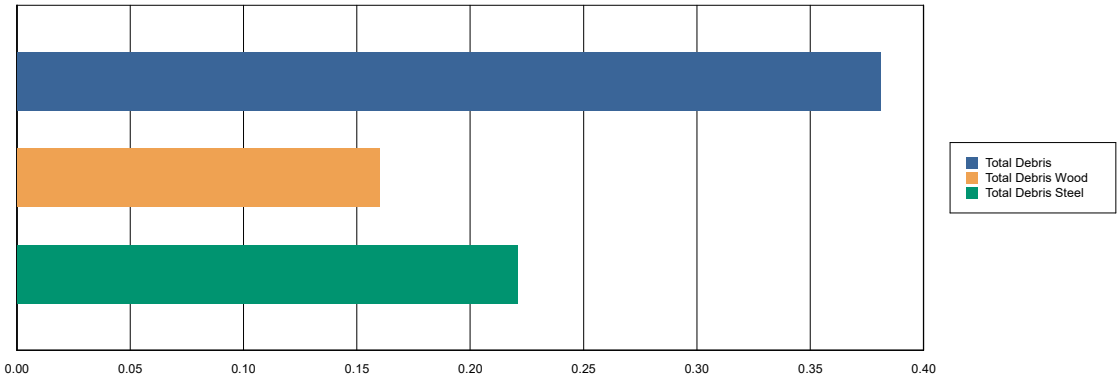
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 381,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 42.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 15,240 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



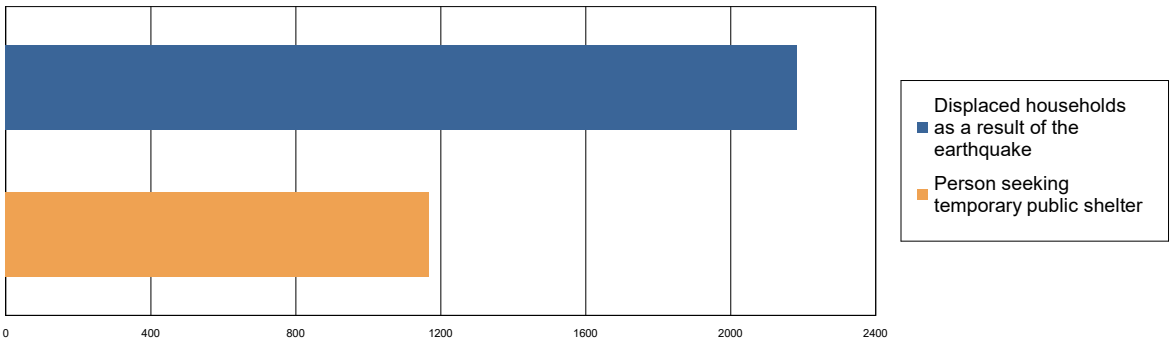
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.16	0.22	0.38	15,240 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 2,183 households to be displaced due to the earthquake. Of these, 1,168 people (out of a total population of 14,925) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
2,183	1,168

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	10.04	3.20	0.51	1.00
	Commuting	0.08	0.13	0.19	0.04
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	15.02	4.88	0.79	1.56
	Other-Residential	52.95	16.82	2.63	5.16
	Single Family	422.35	106.16	8.91	15.75
	Total	**500**	**131**	**13**	**24**
2 PM	Commercial	551.07	175.63	27.87	54.59
	Commuting	0.73	1.16	1.73	0.35
	Educational	278.34	91.17	15.26	29.78
	Hotels	0.00	0.00	0.00	0.00
	Industrial	111.49	36.17	5.91	11.52
	Other-Residential	8.01	2.55	0.41	0.77
	Single Family	63.91	16.15	1.58	2.41
	Total	**1,014**	**323**	**53**	**99**
5 PM	Commercial	404.69	129.09	20.69	39.83
	Commuting	13.38	21.39	31.82	6.38
	Educational	12.49	4.09	0.68	1.34
	Hotels	0.00	0.00	0.00	0.00
	Industrial	69.68	22.61	3.70	7.20
	Other-Residential	21.09	6.72	1.09	2.02
	Single Family	170.37	43.05	4.21	6.42
	Total	**692**	**227**	**62**	**63**

Economic Loss

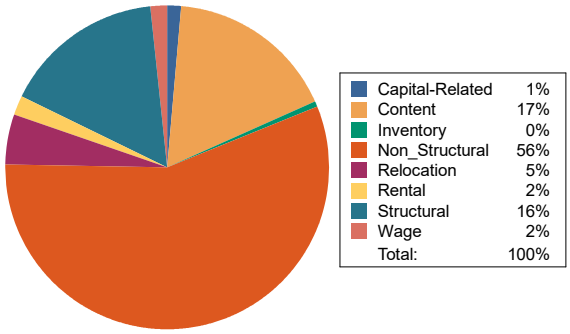
The total economic loss estimated for the earthquake is 2,638.64 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 2,427.07 (millions of dollars); 10 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 68 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

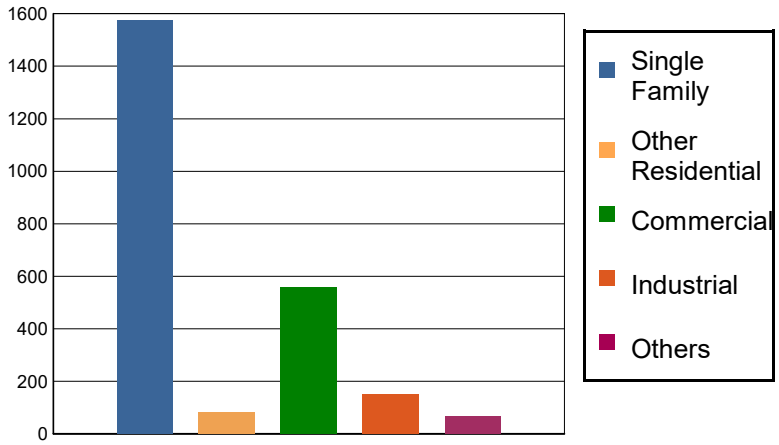


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	4.8893	35.1274	1.6906	1.2497	42.9570
	Capital-Related	0.0000	2.0701	31.3204	1.0772	0.4045	34.8722
	Rental	25.9927	4.5526	19.3810	0.5412	0.6299	51.0974
	Relocation	85.6306	2.1262	26.8039	2.2442	5.2926	122.0975
	Subtotal	**111.6233**	**13.6382**	**112.6327**	**5.5532**	**7.5767**	**251.0241**
Capital Stock Losses							
	Structural	277.0256	9.2353	73.3447	15.5198	11.3568	386.4822
	Non_Structural	966.5415	47.4712	247.7169	73.9098	32.0360	1,367.6754
	Content	217.8358	10.2658	120.0436	47.2810	16.0611	411.4873
	Inventory	0.0000	0.0000	2.9750	7.0211	0.4093	10.4054
	Subtotal	**1461.4029**	**66.9723**	**444.0802**	**143.7317**	**59.8632**	**2176.0503**
	Total	**1573.03**	**80.61**	**556.71**	**149.28**	**67.44**	**2427.07**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	248.3959	0.0000	0.00
	Bridges	181.8407	128.6183	70.73
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**430.2366**	**128.6183**	
Railways	Segments	7.0207	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**7.0207**	**0.0000**	
Light Rail	Segments	7.3448	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**7.3448**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**444.60**	**128.62**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	9.5870	11.2261	117.10
	Subtotal	**9.5870**	**11.2261**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	77.2560	63.1073	81.69
	Distribution Line	5.7522	5.6392	98.04
	Subtotal	**83.0082**	**68.7465**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	1.2644	1.0461	82.73
	Distribution Line	3.8348	1.9319	50.38
	Subtotal	**5.0992**	**2.9780**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**97.69**	**82.95**	

Appendix A: County Listing for the Region

Middlesex,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Middlesex	14,925	2,120	500	2,621
Total Region		**14,925**	**2,120**	**500**	**2,621**

Hazus: Hurricane Global Risk Report

Region Name: Hopkinton_HMP

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Thursday, February 6, 2020

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

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The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 27.89 square miles and contains 3 census tracts. There are over 4 thousand households in the region and a total population of 14,925 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 5 thousand buildings in the region with a total building replacement value (excluding contents) of 2,622 million dollars (2014 dollars). Approximately 90% of the buildings (and 81% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 5,434 buildings in the region which have an aggregate total replacement value of 2,622 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

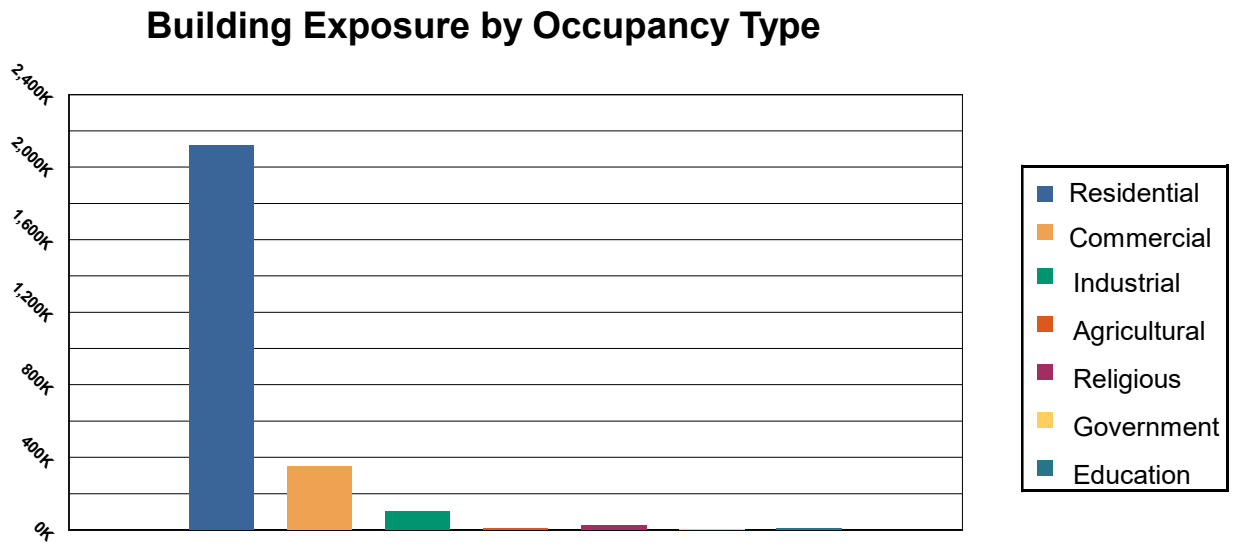


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	2,120,993	80.91 %
Commercial	349,871	13.35%
Industrial	100,329	3.83%
Agricultural	10,095	0.39%
Religious	23,516	0.90%
Government	5,369	0.20%
Education	11,399	0.43%
Total	**2,621,572**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 6 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

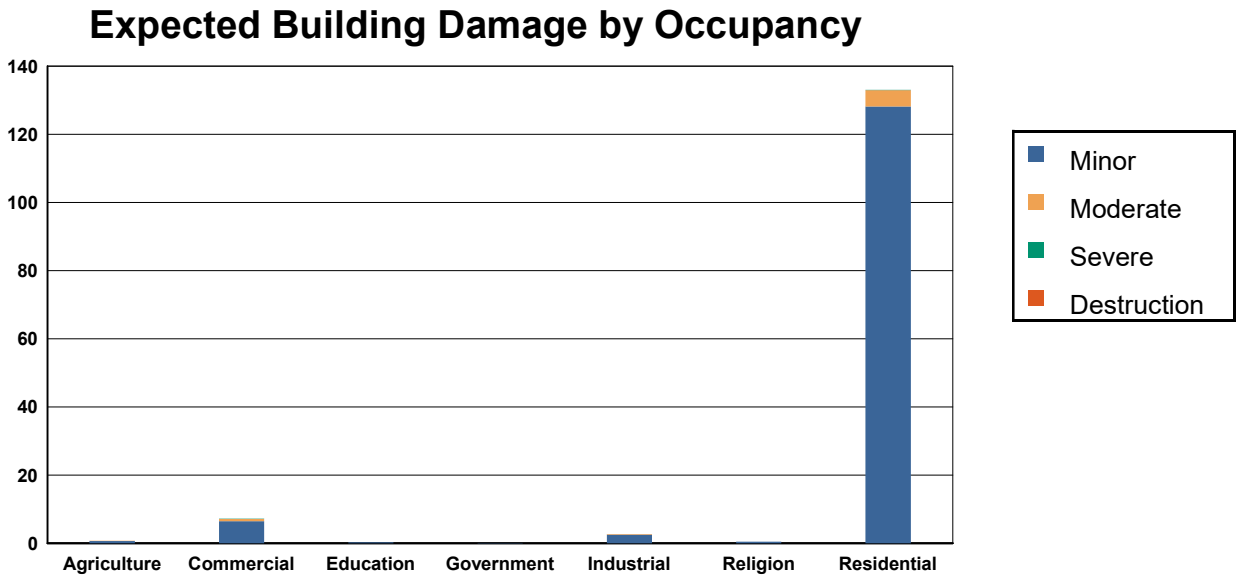


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	28.24	97.38	0.65	2.25	0.08	0.28	0.03	0.09	0.00	0.00
Commercial	324.85	97.85	6.43	1.94	0.69	0.21	0.03	0.01	0.00	0.00
Education	10.79	98.06	0.21	1.89	0.00	0.04	0.00	0.00	0.00	0.00
Government	4.90	98.06	0.10	1.90	0.00	0.04	0.00	0.00	0.00	0.00
Industrial	126.32	97.93	2.53	1.96	0.12	0.09	0.02	0.02	0.00	0.00
Religion	24.53	98.13	0.45	1.81	0.01	0.06	0.00	0.00	0.00	0.00
Residential	4,769.98	97.29	128.10	2.61	4.85	0.10	0.07	0.00	0.00	0.00
Total	**5,289.61**		**138.47**		**5.77**		**0.15**		**0.00**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	23	97.77	1	2.18	0	0.05	0	0.00	0	0.00
Masonry	259	97.05	7	2.62	1	0.31	0	0.02	0	0.00
MH	2	99.86	0	0.11	0	0.03	0	0.00	0	0.00
Steel	210	98.02	4	1.82	0	0.15	0	0.01	0	0.00
Wood	4,590	97.37	120	2.54	4	0.08	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

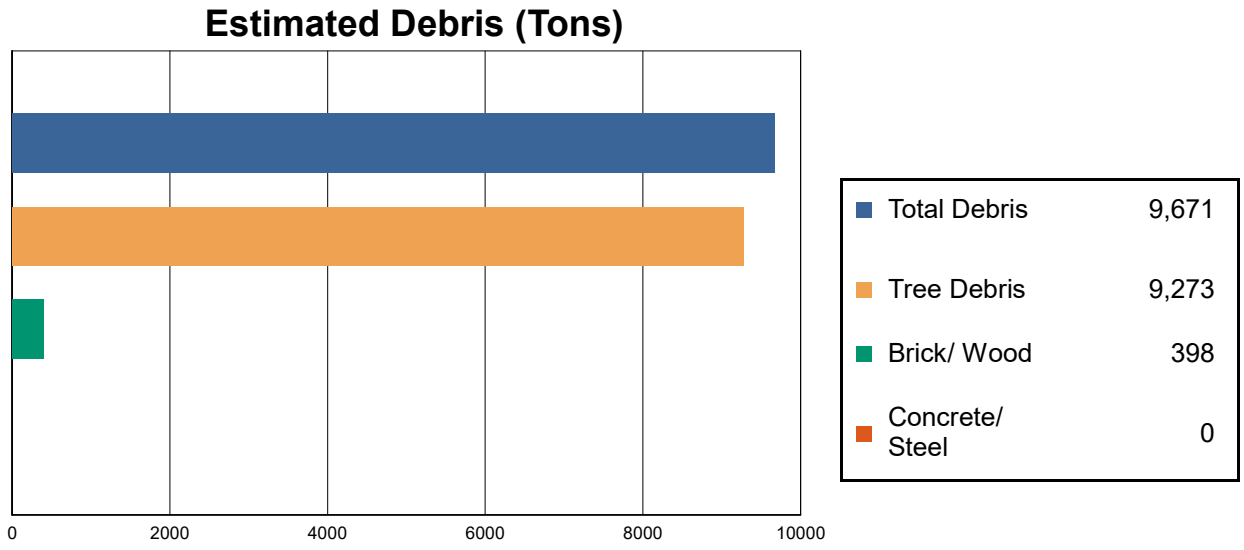
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	6	0	0	6

Induced Hurricane Damage

Debris Generation

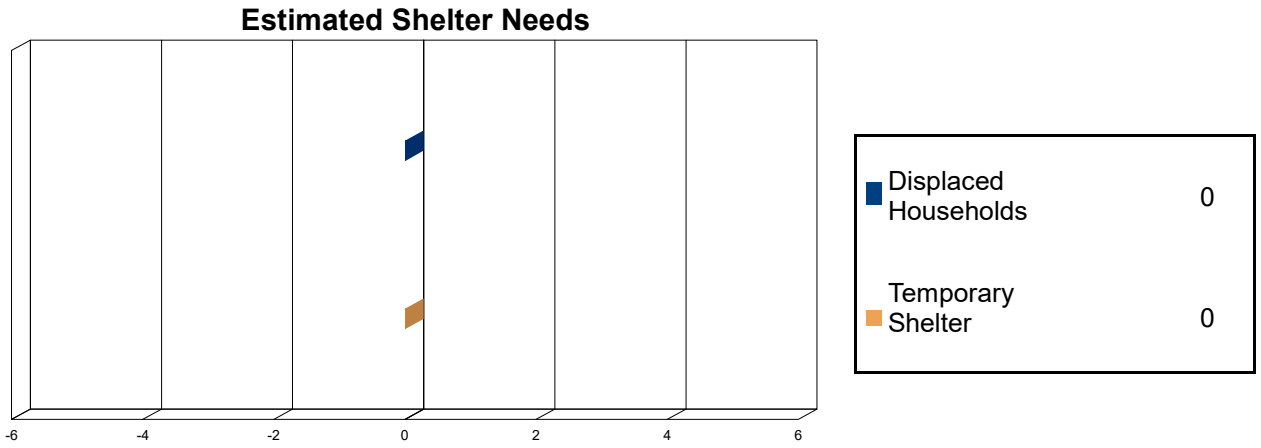


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 9,671 tons of debris will be generated. Of the total amount, 7,261 tons (75%) is Other Tree Debris. Of the remaining 2,410 tons, Brick/Wood comprises 17% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 16 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 2,012 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 14,925) will seek temporary shelter in public shelters.

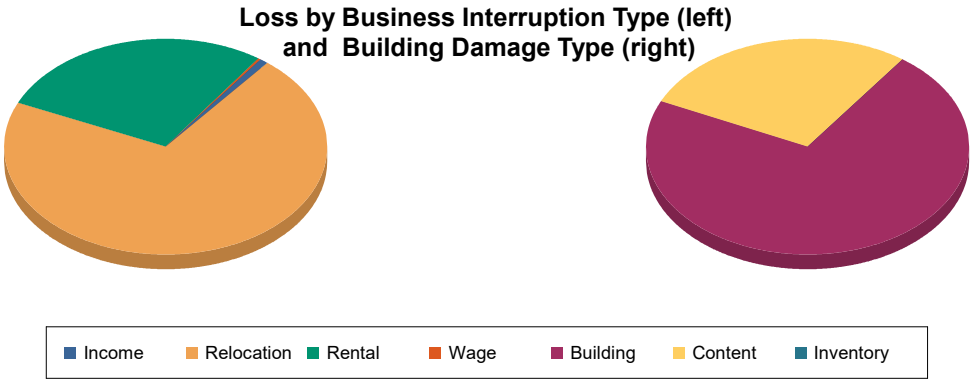
Economic Loss

The total economic loss estimated for the hurricane is 15.4 million dollars, which represents 0.59 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 15 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 97% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.



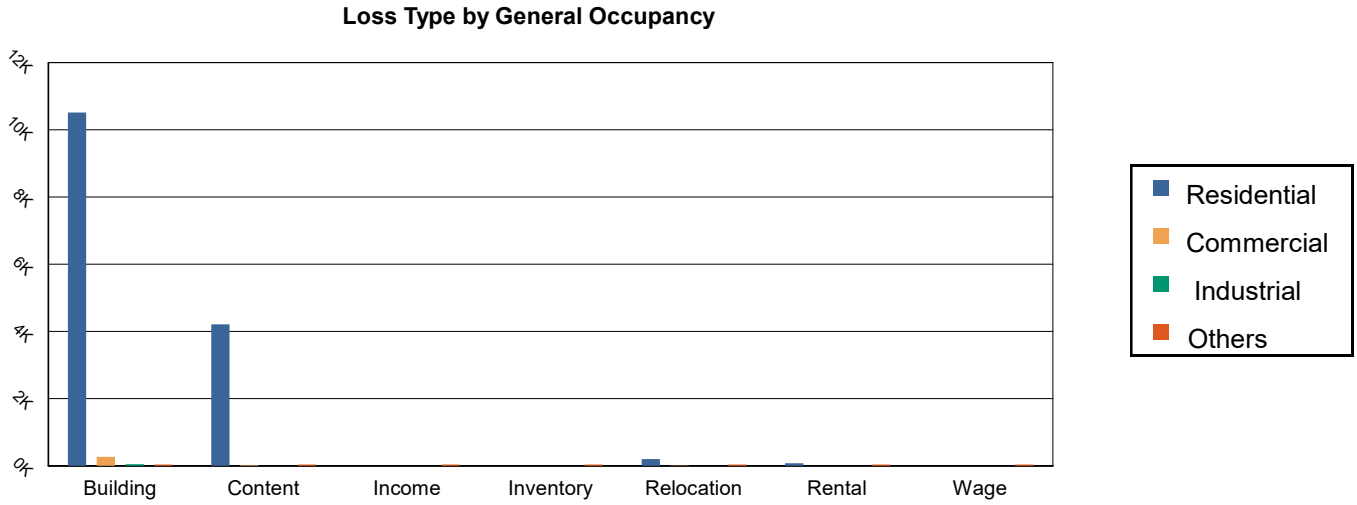


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	10,512.84	269.72	49.07	33.20	10,864.82
	Content	4,211.81	19.79	5.12	2.04	4,238.76
	Inventory	0.00	0.31	0.85	0.18	1.35
	Subtotal	**14,724.65**	**289.83**	**55.04**	**35.41**	**15,104.93**
Business Interruption Loss						
	Income	0.00	2.63	0.00	0.00	2.63
	Relocation	201.26	7.08	0.31	0.35	208.99
	Rental	81.84	1.19	0.00	0.00	83.03
	Wage	0.00	0.93	0.00	0.00	0.93
	Subtotal	**283.10**	**11.82**	**0.31**	**0.35**	**295.58**

Total

Total	**15,007.75**	**301.65**	**55.34**	**35.76**	**15,400.50**

Appendix A: County Listing for the Region

Massachusetts
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Middlesex	14,925	2,120,993	500,579	2,621,572
Total	**14,925**	**2,120,993**	**500,579**	**2,621,572**
Study Region Total	**14,925**	**2,120,993**	**500,579**	**2,621,572**

APPENDIX C

CRB Workshop

Municipal Vulnerability Preparedness Planning Grant Project
Thursday, December 5, 2019 8:30 am – 4:30 pm

HOPKINTON SIGN IN SHEET 12/5

Table Number	Name	Sign
1	Steve Slaman	
1	John Gelcich	
1	Ben Sweeney	
1	Timothy Persson	
1	Dawn Alcott	
1	Daniel Terry	
1	Hillary King	
1	Carolyn C. Dykema	
2	John Westerling	
2	Ben Miller	
2	Norman Khumalo	
2	Dr. Carol Cavanaugh	
2	Hopkinton Trails Club	
2	~~Lisa Vernegaard~~ Dan Stimson	dstimson@svtweb.org
3	Don MacAdam	dmacadam@hopkintonma.gov
3	Dave Daltorio	
3	Edward Lee	
3	Amy Beck	

Weston & Sampson

Municipal Vulnerability Preparedness Planning Grant Project
Thursday, December 5, 2019 8:30 am – 4:30 pm

Table Number	Name	Sign
3	Meenakshi Bharath	
3	Julie Dyer Wood	
4	Elaine Lazarus	
4	Shaun McAuliffe	
4	Eric Carty	
4	Jeff Barnes	
4	~~Alexandra Vecchio~~ Elissa Landra	elandra@massaudubon.org
4	Kimberly Roth	
4	ED HARROW	ed@harrow.org
1	MARIE GASSER	
1	DEB FEIN-BRUG	
	Heather Miller	hmiller@crwa.org
	John Porter	
3	Jay Porter	
2	Joe Bennett	jbennett@hopkintonma.org
	Dawn	

Weston & Sampson

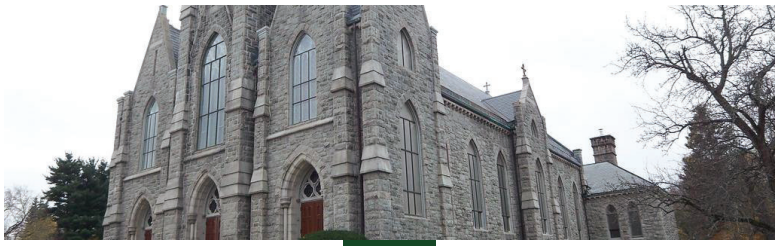
TOWN OF HOPKINTON

Municipal Vulnerability Preparedness Planning Grant Project

Community Resilience Building Workshop

Lower Level, Hopkinton Town Hall
Tuesday, December 10, 2019
10:00 am – 6:00 pm

10:00 am – 10:15 am	Registration and Refreshments
10:15 am – 10:30 am	Welcome and Introductions
10:30 am – 10:45 am	MVP Workshop Purpose and Overview
10:45 am – 11:30 am	Data Resources and Overview of Science
	Risk Matrix
11:30 am – 11:45 am	Large Group Exercise #1 – Identify Top Hazards
11:45 am – 12:45 pm	LUNCH
12:45 pm – 1:05 pm	Small Group Exercise #1 – Infrastructure Features
1:05 pm – 1:25 pm	Small Group Exercise #2 – Societal Features
1:25 pm – 1:45 pm	Small Group Exercise #3 – Environmental Features
1:45 pm – 2:15 pm	MVP Community Actions Presentation
2:15 pm – 2:30 pm	BREAK
2:30 pm – 3:15 pm	Small Group Exercise #4 – Infrastructure Actions
3:15 pm – 4:00 pm	Small Group Exercise #5 – Societal Actions
4:00 pm – 4:45 pm	Small Group Exercise #6 – Environmental Features
4:45 pm – 5:00 pm	BREAK
5:00 pm – 5:45 pm	Large Group Exercise #2 – Prioritization Process
5:45 pm – 6:00 pm	Wrap-up and Closing Remarks



TOWN OF HOPKINTON

Community Resilience Building Workshop

Tuesday, December 10th, 2019

HOPKINTON

RESILIENCY STARTS HERE

WELCOME W&S

Amanda Kohn
Steve Roy
Lindsey Adams
Leah Stanton

WELCOME CORE TEAM

Ben Sweeney
Don MacAdam
Elaine Lazarus
John Westerling
Steve Slaman
John Gelcich

WELCOME PARTICIPANTS

Your name
Organization/Relationship to Hopkinton
Favorite thing about Hopkinton

WORKSHOP OUTLINE

PRESENTATION:
- Overview of Science & Data
- Characterization of Hazards

- BREAK -

INDIVIDUAL TABLES:
- Identify Community Features

- LUNCH -

INDIVIDUAL TABLES:
- Identify and Prioritize Actions

- BREAK -

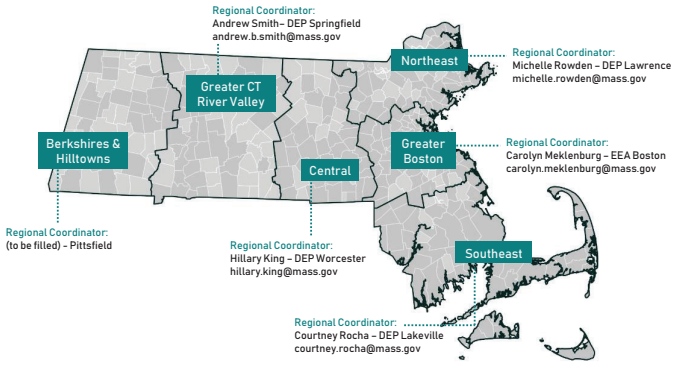
LARGE GROUP DISCUSSION:
- Determine Overall Priority Actions

Photo: Hopkinton Town Common. Activerain.com

Municipal Vulnerability Preparedness Program

Hillary King,
MVP Central Regional Coordinator
MA Executive Office of Energy and Environmental Affairs

MVP Regions & Regional Coordinators



MA CLIMATE PROJECTIONS

By end of century:

Changes in precipitation
- 18% increase in consecutive dry days
- 57% increase in days with > 1 in. rainfall
- 7.3 inches additional annual rainfall

Rising temperatures
- 10.8°F increase in average annual temperature
- 42% decrease in days/year with min. temperatures < 32° F
- 1,280% increase in 90-degree days/year

Sea level rise
- 4–10.5 feet along the MA coast

Extreme weather
- Increase in frequency and magnitude

Source: State Hazard Mitigation and Climate Adaptation Plan, September 2018 / resilientma.org / Northeast Climate Adaptation Science Center

BUILDING CLIMATE RESILIENCE IN THE COMMONWEALTH

RESILIENCE = **MITIGATION** + **ADAPTATION**

RESILIENCE
The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner.

MITIGATION
aims to reduce the causes of climate change

ADAPTATION
involves modifying our decisions, activities and ways of thinking to adjust to a changing climate

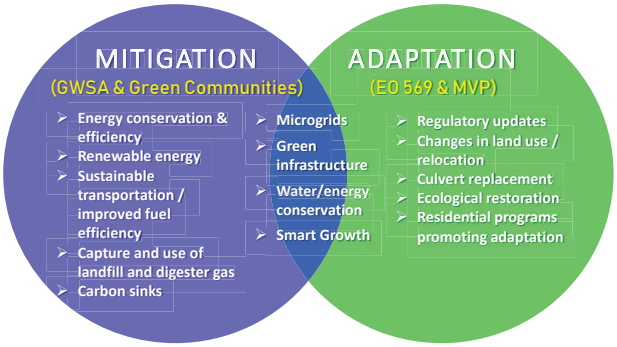
Definitions taken from the Massachusetts 2018 State Hazard Mitigation and Climate Adaptation Plan and Canada in a Changing Climate report (Adaptation.NRCan.gc.ca)

BUILDING CLIMATE RESILIENCE IN THE COMMONWEALTH

2008	Global Warming Solutions Act (GWSA)	➢ To set economy-wide greenhouse gas (GHG) emission reduction goals for Massachusetts that will achieve: • 25% reduction in GHG emissions by 2020 • 80% reduction in GHG emissions by 2050
2008	Green Communities Act (GCA)	➢ A comprehensive reform of the Massachusetts energy marketplace that will greatly improve the state's ability to meet the GWSA targets.
2016	Executive Order 569	➢ A comprehensive approach to reduce GHG emissions to combat climate change and prepare for the impacts of climate change with: • A State Adaptation Plan • Agency Climate Coordinators & Vulnerability Assessments • Municipal Support
2018	Environmental Bond Bill	➢ $2.4 billion bond bill with focus on climate change resiliency ➢ Over $200 million authorized for climate change adaptation ➢ Codifies EO 569, including the MVP Program

11

BUILDING CLIMATE RESILIENCE IN THE COMMONWEALTH



Venn Diagram based on the Natick (2017) Community Resilience Building Workshop Summary of Findings. MassAudubon and Stantec. Natick, Massachusetts .

BUILDING CLIMATE RESILIENCE IN THE COMMONWEALTH

Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) - September 2018

- Acknowledges that climate change is already worsening natural hazards, integrating information and planning elements for 14 natural hazards that affect the Commonwealth
- Uses best scientific data and projections to assess risk and vulnerability
- Evaluates the Commonwealth's existing capabilities to implement agency-specific and statewide activities to reduce risk and increase resilience

SHMCAP Key Risk Assessment Findings and Actions

14 hazards

Over $9.1M in damages/year, 2007-2014 — Inland flooding

On average, 6 events/year, 2009-2018 — Coastal flooding

200+ critical facilities in tornado hazard zones — Tornadoes

- Drought
- Landslide
- Coastal erosion
- Tsunami
- Extreme temperatures
- Wildfire
- Invasive species
- Hurricanes/ Tropical storms
- Severe winter storms / Nor'easters
- Other severe weather
- Earthquakes

108 actions,

including:

- Develop climate change design standards
- Maintain and enhance climate change projections
- Incorporate climate effects into capital planning functions
- Create MA Coastal Flood Risk Model

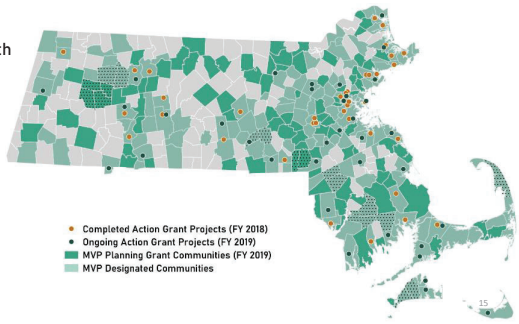
BUILDING CLIMATE RESILIENCE IN THE COMMONWEALTH

Municipal Vulnerability Preparedness (MVP) Program

MVP Designations
71% of the Commonwealth
249 communities

Action Grant Projects
FY 18: 37
FY 19: 36

Total Awards
$17M+ in planning and action grants to date



MVP PRINCIPLES

A community-led, accessible process that:

- Employs local knowledge and buy-in
- Utilizes partnerships and leverages existing efforts
- Is based in best available climate projections and data
- Incorporates principles of nature-based solutions
- Demonstrates pilot potential and is proactive
- Reaches and responds to risks faced by vulnerable populations

MVP PROCESS / GRANT TYPES

COMMUNITY RESILIENCE BUILDING WORKSHOP(S)

- Define and characterize hazards using latest science and data
- Identify existing and future community vulnerabilities and strengths
- Develop and prioritize community adaptation actions
- Determine overall priority actions
- Receive MVP designation

MVP Planning Grant

MVP Action Grant

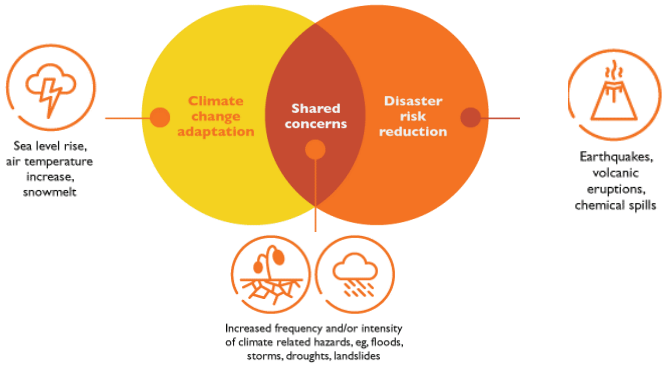
Implement priority adaptation actions identified through planning process

HAZARD MITIGATION AND CLIMATE ADAPTATION

HAZARD MITIGATION
The effort to reduce loss of life and property by lessening the impact of disasters.

CLIMATE ADAPTATION
involves modifying our decisions, activities and ways of thinking to adjust to a changing climate

HAZARD MITIGATION AND CLIMATE ADAPTATION



Referenced from: Turnbull, M. Sterrett, C., Hilleboe, A. (2013) Toward Resilience: A Guide to Disaster Risk Reduction and Climate Change Adaptation. Practical Action Publishing: Warwickshire. pp7
From <https://www.worldvision.com.au/global-issues/work-we-do/climate-change/climate-change-adaptation-and-disaster-risk-reduction>

HAZARD MITIGATION PLAN UPDATE

Aligns with MVP Process and adds:

- Extended hazard profiles and vulnerability assessment
- Update to previous mitigation measures table
- Update to previous priority action items
- Implementation plan

MVP Action Grants: Project Types

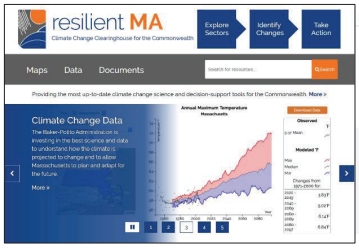
- Vulnerability and Risk Assessment
- Community Outreach and Education
- Local Bylaws, Ordinances, Plans, and Other Management Measures
- Redesigns and Retrofits
- Nature-Based Flood Protection, Drought Mitigation, Water Quality, and Water Infiltration Techniques
- Nature-Based, Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality
- Nature-Based Solutions to Reduce Vulnerability to other Climate Change Impacts
- Ecological Restoration and Habitat Management to Increase Resiliency
- Energy Resilience
- Chemical Safety
- Land Acquisition for Resilience
- Subsidized Low-Income Housing Resilience Strategies
- Mosquito Control Districts

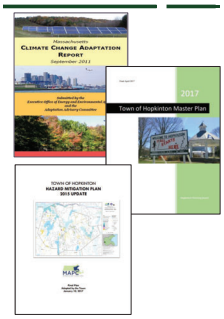
MVP Resources

hillary.king@mass.gov

https://www.mass.gov/municipal-vulnerability-preparedness-program

resilientma.org





RESOURCES

Massachusetts Climate Change Projections, 2018)

Massachusetts State Hazard and Climate Adaptation Plan, 2018

Massachusetts Climate Change Adaptation Report, 2011

US Census, American Community Survey, 2013-2017

Town of Hopkinton Hazard Mitigation Plan 2015 Update

Town of Hopkinton Master Plan, 2017

Open Space Plan, 2013

HAZARDS IN HOPKINTON

- Extreme Temperatures
- Heavy Precipitation, Flooding
- Severe Thunderstorms, Wind, Tornado
- Drought, Wildfire
- Severe Snowstorms, Ice Storms, Nor'easters
- Erosion, Earthquakes, Landslides

EXTREME TEMPERATURES

WARMER ANNUAL AIR TEMPERATURES
UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

WARMER WINTERS
UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE

Weston & Sampson

EXTREME TEMPERATURES IN MASSACHUSETTS

2005 OBSERVED ANNUAL AVERAGE	MID-CENTURY PROJECTED ANNUAL AVERAGE	END-OF-CENTURY PROJECTED ANNUAL AVERAGE
6	24	35
DAYS WITH TEMPERATURES ABOVE 90°F		
145	114	101
DAYS WITH TEMPERATURES BELOW 32°F		

Massachusetts Executive Office of Energy & Environmental Affairs. 2019. "ResilientMA Datagrapher." Massachusetts Climate Change Clearinghouse. Resilientma.org/datagrapher/?c=Temp:state:tx90:ANN:MA/
Notes: Mid-century projected annual averages use a 2040-2069 time range. End-of-century projact annual averages use a 2080-2097 time range.

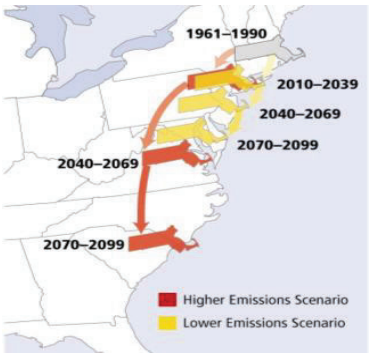


Photo: NECIA/UCS, 2007.

Aerial spraying for mosquitoes to start Sunday in Milford, Hopkinton

By Caitlyn Kelleher
Director of Multimedia
Follow
Posted Aug 21, 2019 at 4:41 PM
Updated Aug 22, 2019 at 7:53 AM

Source: Milford Daily News

Hopkinton, MA
@HopkintonMA

Due to the heat wave, the 7/21 edition of Concerts on the Common, featuring the Hopkinton Community Summer Band, has been relocated to the Hopkinton High School Auditorium (AC!!) The concert is still set to begin at 5:00 pm and will go until 7:00 pm.

@HopkintonHS
@HopParksRec

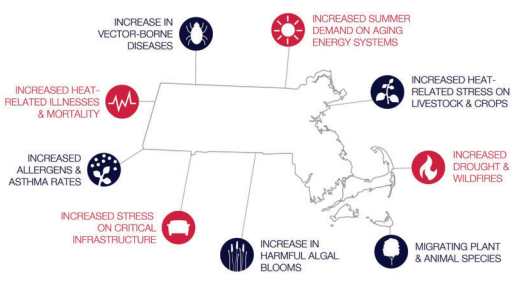
10:10 AM - 20 Jul 2019

Weston & Sampson

IMPACTS OF RISING TEMPERATURES

WARMER ANNUAL AIR TEMPERATURES
UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

WARMER WINTERS
UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE



Massachusetts Executive Office of Energy & Environmental Affairs. 2019. "Rising Temperatures." Massachusetts Climate Change Clearinghouse. http://www.resilientma.org/changes/rising-temperatures

CHANGES IN PRECIPITATION

MORE **INTENSE & FREQUENT** EXTREME RAIN EVENTS

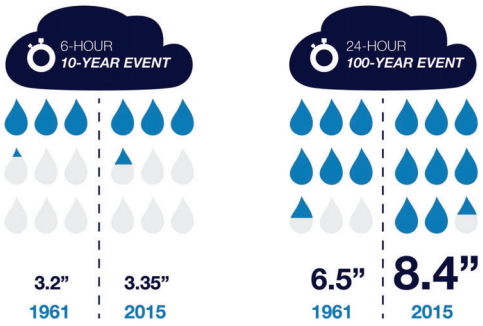
PRECIPITATION DURING **HEAVY EVENTS** IN THE NORTHEAST **INCREASED BY MORE THAN**

70%

BETWEEN 1958-2010

Massachusetts Executive Office of Energy & Environmental Affairs. 2019. "Changes in Precipitation." Massachusetts Climate Change Clearinghouse. Resilientma.org/changes/changes-in-precipitation

CHANGES IN **PRECIPITATION**



Sources: NOAA TP-40 (1961) and NOAA Atlas Volume 10 (2015)

EXTREME PRECIPITATION

8%

Increase in extreme precipitation events by midcentury

13%

Increase in extreme precipitation events by 2100

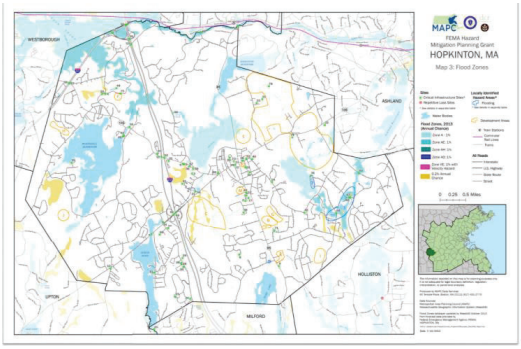
FLOODING

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

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

Riverine Flood Prone Areas

Charles River
Sudbury River
Lake Maspenock
Echo Lake
Whitehall Lake
Hopkinton Reservoir
North Pond
Blood’s Pond
Indian Brook
Cold Spring Brook
Whitehall Brook



1. Town of Hopkinton Hazard Mitigation Plan

FLOODING

Locally Identified Areas of Flooding

Cranberry Lane/North Mill
Alprilla Farm Road
32 Granite Street
Main Street
Cedar Swamp (beaver flooding)

Culverts throughout Town, including:
West Elm Street
4th and Berry Acres
Chestnut Street

Stormwater Flooding Typical Characteristics

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

Source: Hopkinton Hazard Mitigation Plan, 2015.

EROSION

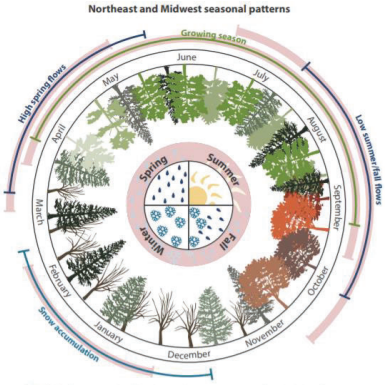
- Caused by riverine flow & stormwater.[1]
- Increased precipitation, including winter rains, could increase erosion.[1]
- Drier soils will reduce resistance to erosion

1. Executive Office of Energy and Environmental Affairs, Adaptation Advisory Committee. 2011. “Massachusetts Climate Change Adaptation Report.” 42.

WINTER STORMS

The blizzard of 2013 left nearly **400,000 Massachusetts residents without power**

"Heavy blizzards are among the **most costly and disruptive** weather events for Massachusetts communities."

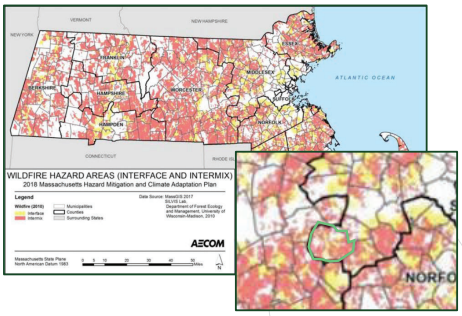


The most notable recent drought event was in

2016

The occurrence of droughts **lasting 1 to 3 months** could go up by as much as **75% over existing conditions** by the end of the century, under the high emissions scenario

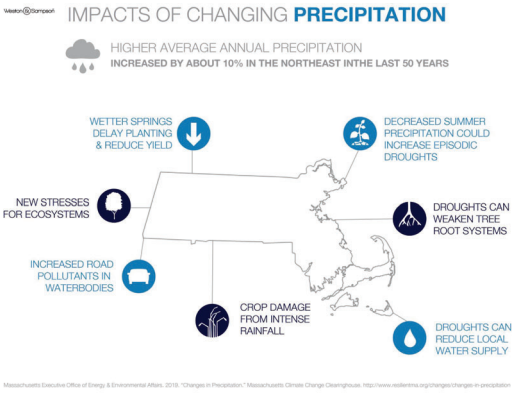
WILDFIRE



15-20

brush fires annually on average

Interstate 495 Corridor
Hopkinton State Park
Peppercorn Hill
Saddle Hill
Upton State Park
MA Turnpike



HURRICANES AND EARTHQUAKES

HURRICANE
Sandy
and nor'easters
cause downed trees and power lines

Upward trend in North Atlantic hurricane activity since 1970

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

EARTHQUAKE

30-40
Earthquakes occur in New England each year, although most are not felt.

Source: Climate Science Special Report, Fourth National Climate Assessment (NCA4), Volume prepared by the U.S. Global Change Research Program (USGCRP)Northern Middlesex Council of Governments. 2015. "Hazard Mitigation Plan for the Northern Middlesex Region." 159-160.

As an FYI: Boston Sea Level Rise Projections (ft)

Increased coastal flooding

Permanently inundated low-lying coastal areas

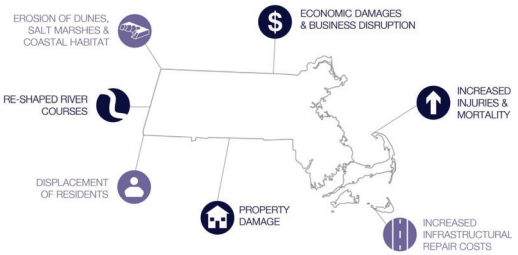
Increased shoreline erosion

Emission Scenario	2030	2050	2070	2100
Intermediate	0.7	1.4	2.3	4.0
Intermediate-High	0.8	1.7	2.9	5.0
High	1.2	2.4	4.2	7.6
Extreme	1.4	3.1	5.4	10.2

(Source: Northeast Climate Adaption Science Center)

IMPACTS OF **EXTREME WEATHER**

STORMS ARE BECOMING MORE INTENSE AND DAMAGING



Massachusetts Executive Office of Energy & Environmental Affairs. 2019. "Extreme Weather." Massachusetts Climate Change Clearinghouse. http://www.resilientma.org/changes/extreme-weather

RISK MATRIX

Photo: [illegible]

RISK MATRIX

Community Resilience Building Risk Matrix — www.CommunityResilienceBuilding.com

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

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

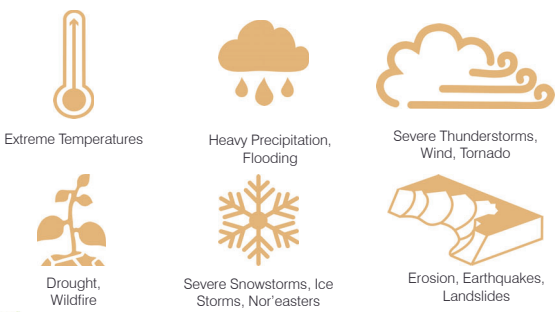
Features	Location	Ownership	V or S					Priority H-M-L	Time Short Long Ongoing
Infrastructural									
Societal									
Environmental									

IDENTIFY HAZARDS

Photo: [illegible]

HAZARDS IN HOPKINTON

CHOOSE 4 FOR THE MVP ACTION PLAN



Weston & Sampson

RISK MATRIX: HAZARDS

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Infrastructural									
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15 MINUTE BREAK!

RISK MATRIX: FEATURES

Community Resilience Building Risk Matrix — www.CommunityResilienceBuilding.com

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Infrastructural									
Societal									
Environmental									

RISK MATRIX: FEATURES

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Features	Location	Ownership	V or S
Infrastructural			
Societal			
Environmental			

FEATURES IN HOPKINTON

INFRASTRUCTURAL FEATURES

Police Department
Photo by Hopkinton Police Department

Fire Department
Photo by Hopkinton Fire Department

Wastewater Treatment & Collection

Dams
Echo Lake Dam. Photo from Tata and Howard

Roadways
Photo by ACOE

Water Supply

HAZARD POTENTIAL OF DAMS

Hazard Classification of Hopkinton Dams			
Dam Name	**Impoundment Name**	**Hazard Class**	**Ownership**
Dams in Hopkinton			
Whitehall Reservoir Dam	Whitehall Brook	Significant	MA/DCR
Echo Lake Dam	Charles River	High	Milford Water Co.
Bloods Pond Dam	Cold Spring Brook	Significant	Hopkinton
Grist Mill Dam	Cold Spring Brook	Low	Hopkinton
Ice House Pond Dam	Indian Brook	Small, Unregulated	Hopkinton
Whitehall Lower Pond Dam	Whitehall Brook	Small, Unregulated	MA/DCR
Whitehall Upper Pond Dam	Whitehall Brook	Significant	MA/DCR
Whitehall Reservoir Dike	Whitehall Brook	Small, Unregulated	MA/DCR
Whitehall Reservoir Distribution Dam	Whitehall Brook	Significant	MA/DCR

HOPKINTON WATER DEPARTMENT

65%

of Hopkinton's population is served by Hopkinton Water Department

Connected to the Town of Ashland Water Treatment Plant

Can connect to Milford Water Distribution Systems

SOCIETAL FEATURES

Population	Hopkinton	Massachusetts
2010	14,909 residents	6,547,790
2018	18,269 residents	6,902,149
Age		
Under 18 years:	28.1%	20%
65+ years:	9.8%	17%
Education		
Bachelor's degree or higher:	68.2%	42.1%
Additional Information		
Median household income:	$151,357	$74,167
Persons in poverty:	1.5%	10.5%
With a disability:	4.1%	7.9%
Language other than English spoken at home:	9%	23.1%

Source: U.S. Census Bureau, 2013-2017 ACS Estimates

ENVIRONMENTAL FEATURES

Reservoirs

Trails

Photo 1: Hopkinton Reservoir, Wikipedia
Photo 2: Whitehall Reservoir Loop. Alltrails.com.

+50% of Hopkinton is Open Land

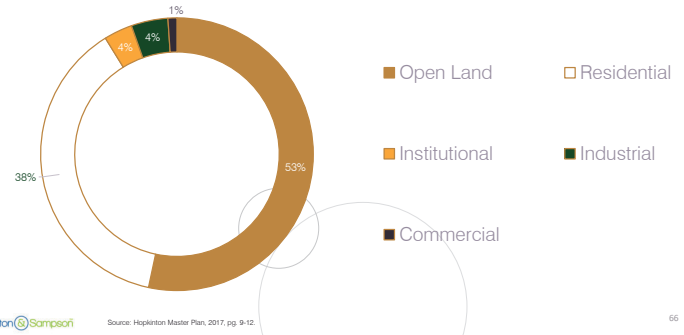
- Over half is privately owned
- Open spaces include:
  - Hopkinton State Park
  - Whitehall State Park
  - Land Trusts (Mass Audubon, Sudbury Valley Trustees, Hopkinton Area Land Trust)

Whitehall Lake

Sudbury River

Source: Hopkinton Master Plan. 2017. p11-12

Hopkinton's Land Use



Weston & Sampson

Source: Hopkinton Master Plan, 2017, pg. 9-12.

RISK MATRIX: FEATURES

FEATURES	LOCATION	OWNERSHIP	VULNERABILITY OR STRENGTH
Infrastructural	Town wide	State	Vulnerability
Societal	Multi- vs. Single-neighborhood	Town	Strength
Environmental	Specific location	Private	Both
		Shared	

LUNCH

Photo: Doughboy Monument, Town of Hopkinton Website

ADAPTATION STRATEGIES

Photo: Hopkinton Public Library, Town of Hopkinton

EXISTING HAZARD PROTECTION

- Comprehensive Emergency Management Plan
- Enforce MA State Building Code
- Multi-Department Review of Developments
- Participation in the National Flood Insurance Program
- Street Sweeping
- Catch Basin Cleaning
- Enforce MA Stormwater Regulations
- Community Preservation Act
- Infrastructure Improvements
- Regulations, By-Laws and Plans
- Portable Water Pumps
- Tree-trimming
- Roadway Treatments
- Snow Removal & Disposal
- Comfort (Cooling and Heating) Stations
- Dam Safety Permits and Regulations
- Permits for Outdoor Burning
- Fire Hydrant Regulations

Weston & Sampson

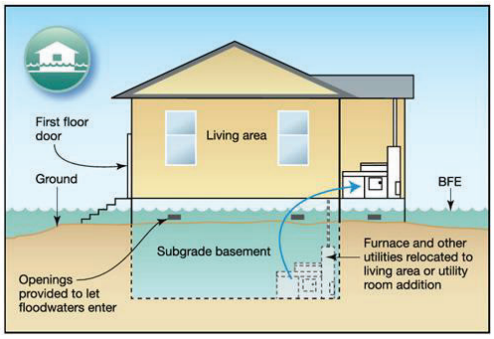
Source: TOWN OF HOPKINTON HAZARD MITIGATION PLAN

ADAPTATION STRATEGY ACTIONS

- Vulnerability and Risk Assessment
- Community Outreach and Education
- Local Bylaws, Ordinances, Plans, and Other Management Measures
- Redesigns and Retrofits
- Ecological Restoration and Habitat Management
- Energy Resilience
- Chemical Safety
- Land Acquisition
- Subsidized Low-Income Housing Resilience
- Mosquito Control Districts
- Nature-Based Solutions for:
  - Flood Protection
  - Drought Mitigation
  - Water Quality / Infiltration
  - Infrastructure and Technology
  - Cooling
  - Air Quality

COMMUNITY ACTIONS

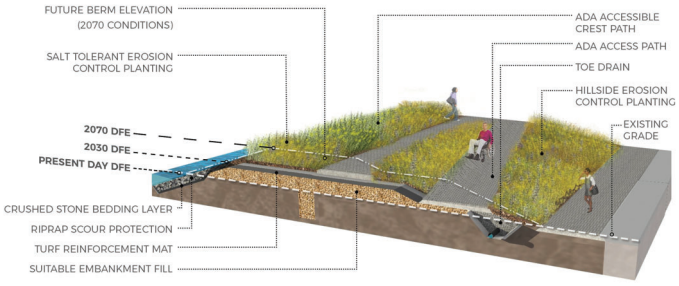
WET FLOODPROOFING



RAISED BUILDINGS

PREVENTING SEWER BACKFLOW

VEGETATED BERM

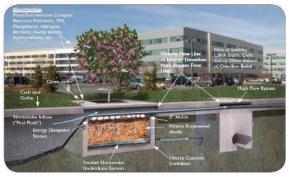


MULTI-PURPOSE FLOOD STORAGE

LOW IMPACT DEVELOPMENT (LID)

Stormwater infiltration / rain gardens

Porous asphalt & permeable pavers



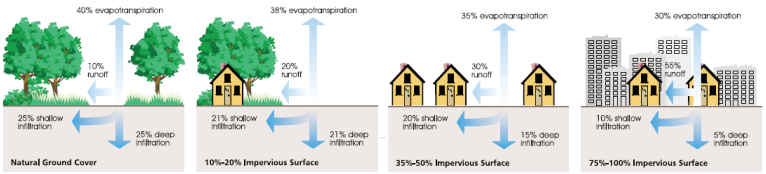
Street trees & tree box filters

STORMWATER DETENTION & RETENTION

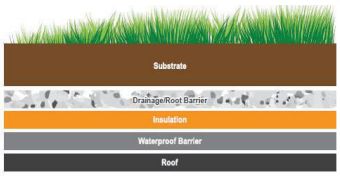
CULVERT WIDENING TO IMPROVE HABITAT & FLOW

CLOUDBURST STREETS

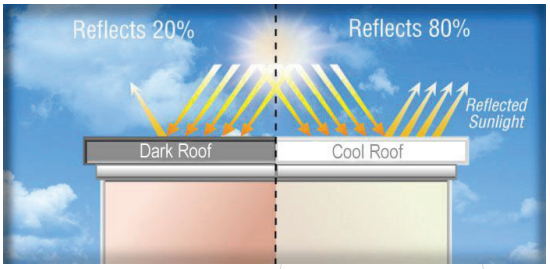
REDUCE IMPERVIOUS AREAS



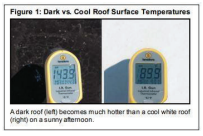
GREEN ROOFS



COOL ROOFS



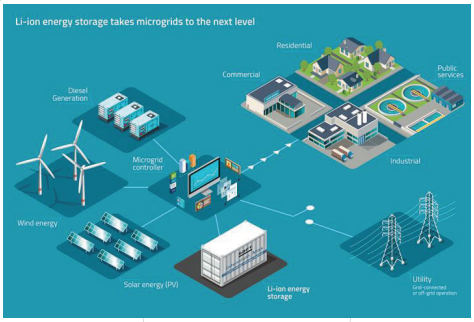
Source: Heat Island Group at Lawrence Berkeley National Laboratory



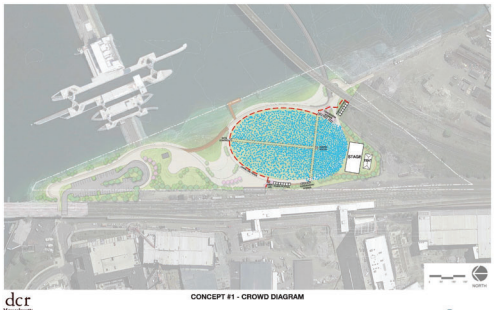
Source: U.S. Department of Energy Guidelines for Selecting Cool Roofs

COOLING CENTERS

RENEWABLE MICRO-GRIDS



LANDSCAPE DESIGN TO ACCOMMODATE WATER



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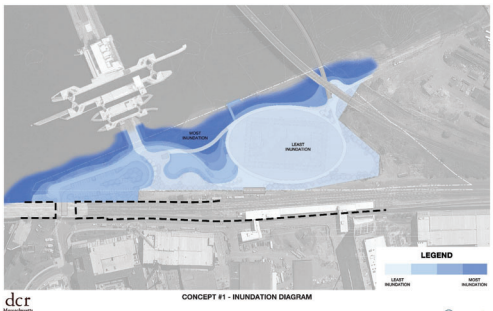
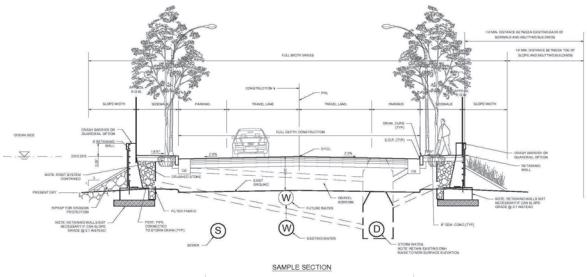


RAISED ROADWAYS



RETROFITTED FLOODPROOF DOORWAYS

RE-EVALUATE LOCAL REGULATIONS & POLICIES

Example MVP Action Grant Projects

Nature-Based Flood Protection, Drought Prevention, Water Quality, and Water Infiltration Techniques

Millbury

Utilizing green infrastructure like stormwater planters, bioretention bump outs, rain gardens, and other measures like porous pavers and pervious pavement to reduce heat island effects and stormwater runoff into the Blackstone River.

Nature-based solutions

Example MVP Action Grant Projects

Local Bylaws, Ordinances, Plans, and Other Management Measures
Redesigns and Retrofits

Boston

Developing its first ever resilient building code so that development in the future floodplain is prepared for at least three feet of sea level rise, the likely scenario by late century.

Proactive
Pilot potential

Retrofitting a major waterfront park into a legacy park that uses nature-based solutions to address climate vulnerabilities while providing important access to recreation for residents.

Nature-based solutions
Community co-benefits

Example MVP Action Grant Projects

Redesigns and Retrofits

Salisbury

Increasing the resilience of the neighborhood of Ring's Island by raising its access/egress roads and by improving tidal flushing through culvert replacements

Vulnerable communities

Example MVP Action Grant Projects

Nature-Based Flood Protection, Drought Mitigation, Water Quality, and Water Infiltration Techniques

Belchertown

Designing and permitting for a replacement water storage tank that would increase storage capacity and resiliency to drought, and completing a feasibility/ concept design of a rainwater harvesting system at Belchertown High School to irrigate the athletic fields.

Nature-based solutions
Pilot potential

Example MVP Action Grant Projects

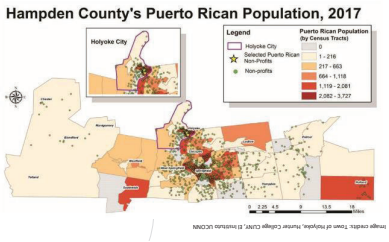
Detailed Vulnerability and Risk Assessment, Further Planning

Holyoke

Conducted a detailed demographic analysis of individuals who arrived in Holyoke from Puerto Rico as a result of Hurricane Maria and develop recommendations for planning for future climate change migrants in Holyoke

Informational graphics from Holyoke's final report

How did the Holyoke municipal government respond to your needs? Was the response...	Freq.	Percent
Helpful	28	63.4
I don't know	7	17.1
Neither helpful nor unhelpful	2	4.9
There was no response from this resource	6	14.6
Total	41	100

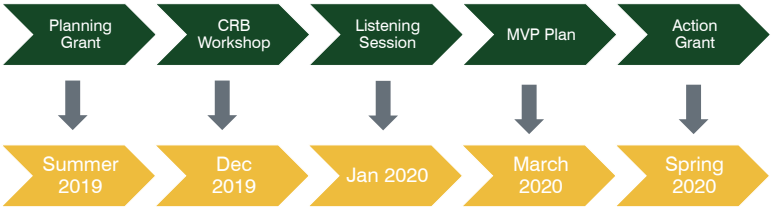


DEFINE COMMUNITY ACTIONS

15 MINUTE BREAK!

IDENTIFY PRIORITY ACTIONS

WRAP-UP & CLOSING REMARKS

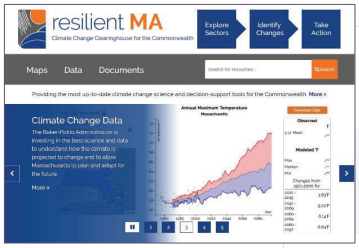


MVP Resources

hillary.king@mass.gov

https://www.mass.gov/municipal-vulnerability-preparedness-program

resilientma.org



Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

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

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

Features	Location	Ownership	V or S	Snow Storms, Intense Storms, & Wind	Thunderstorms & Heavy Precipitation (Flooding)	Extreme Temperatures	Drought	Priority H - M - L	Time S Short L Long O Ongoing
Infrastructural									
Drainage (including cisterns)	Townwide	Town/Private	V	Detailed inventory and assessment of who is responsible for maintainence Review and ID capacity				H	Short Ongoing
Communications infrastructure (tower in wetlands at middle school, code red is opt in, intercommunity)	Townwide	Town	V	Assess risks to Town infrastructure Harden the Emergency Tower Perform study to assess how to harden				H	Short
Building Maintenance issues: Weather related and age (schools, fire station-flat roof, town hall, senior center)	Townwide	Town	V	Perform assessment of impact of climate change on public buildings - schools, DPW building, Look at HVAC systems for high & low temperatures perform inventory of all public buildings - create asset management program including capital				M	Long
Access - Roadway (Hopkinton elementary, high school, rural areas)	Townwide	Town/State	V	ID vulnerabilities assess tree removal, snow removal, culverts ID a resource to use between department to ease in flow of information	strengthen relationship with utility maintainance put agreement in place with utility for emergency response - improve internal tree maintenance capabilities			M	Short
Dams	Townwide	Public/Private	V/S	refresh evacuation and alerting plan for Town				L	Long
LNG Plant - currently in emergency planning	northeast	eversource	V/S					L	
Fire/Police Station		town	V/S	Include climate change into redistricting - coordinate plans				H	Long
Societal									
Isolated rural areas	Wood Street and East Hopkinton	Town/Private	V	Need a study to ID how each population wants to be communicated with - best form of media				H	Short
communications - type (digital/analog)	Regional	Town/Private	V					H	Short
support for other communities (faith community, church during marathon)			V/S					H	Short
Seniors/Assisted Living Facilities	Golden Pond Senior Center Fairview Estates		V/S				A good communication plan could solve a lot of societal issues	H	Short
Non-English Speakers (spanish population, indian, portuguese, chinese)			V/S	Town to ID Resources for language services and emergency response				H	Short
volunteer community/citizens groups			S	Identify citizens groups - how do we get to volunteers build on caring community theme				H	Short
Vulnerable Populations (day cares, low-income, autism, respite center)			V					H	Short
large events (marathon)			V/S					H	Short
Environmetal									
Wetlands	Townwide		V/S		Need someone to help with meshing of priorities within town - sustainable planner/coordinator? Regional solutions or consultant		Wetland are imprtant and need to be protected but can't stand in the way of progress	H	Short
Topography (top of several watersheds)	Townwide		V/S	Update Open Space Plan to include climate change hazards				M	Short
water bodies (new development near hopkinton reservoir, road salt)	Townwide		V/S						
wildlife populations (deer -> ticks, beavers, habitat destruction)	Townwide		V						
water quality & quantity (wells and land protection)	Townwide		V/S		Look at incentive programs for LID construction/retrofits or sustainable building practices			M	Long
Natural resources (competing interests, new development)	Townwide		V/S						

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

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

Features	Location	Ownership	V or S	Snow Storms, Intense Storms, & Wind	Thunderstorms & Heavy Precipitation (Flooding)	Extreme Temperatures	Droughts	Priority H - M - L	Time S Short L Long O Ongoing
Infrastructural									
Drainage Infrastructure	Townwide	Town	V	Get management Improvements Implementation		control icing coditions		H	O
Dams	Specific Locations	Town	V		implement identified improvements			M	O
Water Supply/Wells	Townwide	Town	V				zoning, conservation, use restriction	H	O
DPW/ Equipment / Labor	Townwide	Town	Both	increase staffing More local supplies				H	O
State Highway	90/495	State	Both	participate and coordinate on 90/495 upgrade				H	O
Power Grid / Electric & Gas	Townwide	Eversource	Both	tree removal / trimming partnering		cold / power outages		H	O
Societal									
Senior Populations	Davis Road 50/60 West Main 132 East Main	Mixed	V	Test emergency plans/drills		evaluate needs of each facility		H	O
Low Income	Specific Locations	Private/State	V	increase refridgeration partnerships with market		access to cooling centers supplies for emergencies		M	O
Schools	5 Facilities	Town	S	testing of generators evaluating SEMP for schools		Evaluate AC at middle school		H	O
Language Other than English	Townwide		V	emergency messaging planning coordinating with DPH / State agencies				M	O
Youth	Townwide		V	Communication /messaging plans for shelters	ensure adequate supplies / plans during emergencies			M	O
Senior Center		Town	S	Evaluate shelter plans				M	O
Environmental									
Vector-Borne / EEE	Townwide / Drainage		V		Improved outreach plan funding for education/outreach materials/interns	Comprehensive outreach and communication plan promote regional mosquito control		H	O
Open Space / Parks / Rec Ballfields	Specific Locations	Town / State	Both		develop plan for climate resilience at parks (2 new)			H	O
Water Bodies / Cyanobacteria / Aq Vegetation Issues		Town / State	V		Implement MS4 program nutrient control			H	O
Open Space/Preservation	Townwide	Town / State Land and Trusts	Both		Acquisitions management plan/coordination	review development regs		H	O
Floodplain		Mixed	V	Regulation review for development				H	O

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	snow storms/intense storms/wind	thunderstorms and heavy precipitation	extreme temperatures	droughts	Priority H - M - L	Time S Long O ngoing
Infrastructural									
Schools	multiple	town	V/S	virtual/take home school during snow/heat	capture and store stormwater to water athletic fields	virtual/take home school during snow/heat cooling in schools using stored stormwater		M	L/O
Dams	multiple	town/state/private	V		Updating dams			L	O
Wells/Groundwater	townwide	town/private	V/S				new water tower. Stormwater collection, give out rain barrels.	L	S/O
Drainage Infrastructure	townwide	town/state	V		upgrade culverts where perenn streams cross important roadways			H	L/O
Power Lines/Pipelines	townwide	private/town	V	roadway tree maintenance. Out reach to public on tree maintenance				H	O
Town Facilities	townwide	town	V/S	outreach/provide emergency preparedness plans for town on website				M	S/O
Societal									
Legacy Farms Residents	northest town	private	V						
Plances of Worship	multiple	private	S	many are registered emergency shelters- is their emergency management plan updated?				H	S/O
Businesses (grocery/supply)	multiple	private	S	work with price chopper to provide food during a hazard				L	S/O
Vulnerable Populations	townwide		V	designated people in communities to check on vulnerable populations				H	L/O
Children	schools/town		V	sending out hazard and emergency preparedness flyers to parents so they are aware of measures in place at schools				M	O
Commuter Population	townwide		V		satelite parking lots, can also be used for flood control	provide more public transportation		H	S/O
Environmental									
Water Bodies			V/S		Upgrade culverts at perenial streams			H	L/O
Beavers	flooding areas		V		beaver management at perenial streams			H	L/O
Landfills			V						
Vector Borne Diseases			V		continued public out reach - post signage around town			H	O
Open Space/Trails			V/S				trail maintenance brush clearing	H	O
LNG		private	V						O

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

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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	extreme temperatures	thunderstorms and heavy precipitation (flooding)	severe storms (wind and snow)	Droughts	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
LNG	specific	private	V	emergency response and evacuation	coordination assessment of impact on tanks and pipes near dikes		prepare for H2O availability in case of explosion	H	O
Stormwater (culverts, drainage system) *follow up with highway department*	town-wide	town - some private	V	updated data, main street upgraded, upgrade old detention ponds, larger systems and imfiltrationinto ground in dense residential and commercial, with suitable vegetation to withstand drought. Upgrade culverts.				H	S/L/O
water supply (2015, 2016 - droughts)	town wide	65% of town is on private well	B		increase recharge		assessment of options for supply and conservation	H	S
sewage disposal (designed for recharge, 30 years old)	townwide	1 - town. Several private	B		continues I/I and update to plan (CWMP) implement priority actions			M	S/O
energy distrucution (after 80s underground lines) alternative sources	townwide	eversource	B	coordination with eversource to reduce energy use	backup generator/alternate sources for when power trips and don't have access plant trees. Alternate source incentives - peak hour/technology			M	L
Communications - reverse 911	town-wide	town, private	B	system to communicate to vulnerable populations	internal communications plan add repeaters to improve redundancy			H	O
Societal									
limited english speakers	town wide		B	ID needs during emergency situtation Translation on communtinos and ability to take info about emergencies				H	O
businesses (EMC) - large H2O on cooling towers	south st 495 interchange	Private	B	host community buildings (vacent) as facilities/ benefit agreement shelters			assess option for storage and reduce H2O	L	S
seniors	certain neighborhoods		B	communications through senior center and packages/resources for self resilience		senior assistance prgram (shovel, mow lawn)		H	O
low-income. S - concentrated resources. V- isolated	housing authority		V/S	ID needs database (H) increase access t otech and bring in mass save landlords connect to programs - assistance inventives --> partner with existing services				M	O
transportation	townwide	Regionl Transportation Authority	V	check on evacuation shelters	expand pick-up services to low-income within in 1/2 mile and youth. Expand route system			M	L
schools - youth. S- resources	higher in certain neighborhoods		B	comms package for self-resilience				H	O
Environmental									
vector-borne diseases	town-wide/near habitat		V	pesticide program to reduce mosquitos improve infiltration capabilities at detention and retention and improving vernal pool health more edication and communication, demo areas for tick managemetn in yards and trails				H	O
topography	townwide		B	preserve open space on steep topography				L	L
wetlands and water bodies	townwide		B	whitehall and legacy farms:beaver maagement. Better understanding on capacity and how does it drive town finances	build meander coordinrs , keep development away from waterbodies	update local bylaws and regs with climate change. Rainfall -> checklist, also with fire protection. Site development/subdivision review, wetlands protection		H	S/O
open space (natural areas, conservation and trees)	speciic	town state private	S	work with land trusts, state, sudbury trustees, charles river compact, joint project with downstream communities. To protect watershed /infiltration/preserve land. Prioritize parcels for corridors and wildlife. Plan to balance solar farms and tree canopy				H	O
impervious surfaces	townwide	town state private	V		retrofit areas with impervious surfaces; need training on maintenance. Demo and comms on gree infrasturure, porous pavement, construction and maintenance.			H	S/O
hazardous sites	specific. DPW, state - salt shed old gas stations	town state private	V		monitor plan				


Legend
Day Care
Department of Public Works
Fire Department
Food/Grocery/Supply Store
Gas Station
Hazardous Material Site
Homeless Shelter
Hopkinton Town Hall
Library
LNG Facility
Nursing Home
Police Department
Religious Center
School
Sewer Pump Station
Underground Storage Tank
Water Tank
Wells
Youth Services
Pipeline
Powerline
Landfill
Conservation/Protected Land
Open Space
Dams
High Hazard
Significant Hazard
Low Hazard
N/A
Transportation
Railroad
Evacuation Route
Waterways
Rivers, Streams, and Brooks
Marsh/Bog/Wooded Marsh
Lakes, Ponds, Reservoirs
Census
> 35% of the population is < 18 (Census 2010)
> 25% of the population is > 65 (Census 2010)
FEMA National Flood Hazard Layer
1% Annual Chance of Flooding (Zones A, AE, AH, AO)
0.2% Annual Chance of Flooding (Zone X)
SOUTHBOROUGH
ASHLAND
HOLLISTON
UPTON
MILFORD
N
FIGURE 1
TOWN OF HOPKINTON, MASSACHUSETTS
MUNICIPAL VULNERABILITY PREPARDNESS
HAZARD AND FEATURE MAP
NOVEMBER 2019
SCALE: NOTED
Weston & Sampson


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NOVEMBER 2019
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HAZARD AND FEATURE MAP
NOVEMBER 2019
SCALE: NOTED
Weston & Sampson

Highest High Priority Actions

1. Conduct a resilient drainage assessment to identify opportunities to apply nature-based solutions, reduce impervious surfaces, and incorporate climate projections to stormwater system and culvert upgrades. Develop priority projects that would reduce flash flooding along perennial streams by increasing infiltration of stormwater.
2. Incorporate nature-based solutions and climate projections into existing projects, such as the Main Street improvements project and planned stormwater/culvert upgrades.
3. Install solar canopies to strategically reduce power grid vulnerability to critical facilities and add a solar overlay district that considers the protection of natural resources.
4. Develop a robust tree management plan with an outreach component on tree maintenance on private property and planting plan to reduce urban heat island effect.
5. Create an asset management and capital planning system that incorporates climate resilience and ensures municipal projects considers co-benefits, such as creating a commuter rail parking lot to encourage public transit, to reduce road traffic and pollution, and will also provide flood storage.
6. Acquire land for flood control, wildlife habitat/corridors, and to protect wetland and open space.*
7. Develop a comprehensive communication plan to reach vulnerable audiences about adapting to, preparing for, and mitigating climate. The communication plan would cover topics related to public health, available resources (emergency shelters, cooling stations, etc.), self-resilience, and brushfire prevention. The communication plan would identify specific outreach strategies to reach seniors, youth, isolated rural areas, and limited English speakers, such as creating a team of volunteers (MVP Marshalls), using regular communication through the Senior Center, Housing Authority and schools, and translating materials.*
8. Review and update zoning, bylaws, and regulations to protect open space, floodplains, and water resources to incorporate climate change and hazard mitigation; and to reduce erosion on steep slopes.*

High Priority Actions

1. Complete action items listed in the 2017 Hopkinton Master Plan related to climate change.
2. Complete Lake Maspenock Dam restoration and updates in the Lake Maspenock Dam Operation and Maintenance Manual.*
3. Document an internal communications plan between Town staff to be used during emergencies.
4. Assess risks to Town communications infrastructure and improvements, such as hardening the emergency tower and adding repeaters to improve redundancies.
5. Regularly practice and evaluate the School Environmental Management Plans (SEMP), test generators, and expand capacity to shelter in place.
6. Incorporate multi-use green infrastructure resiliency into schools by capturing stormwater, which can be used to water athletic fields.
7. Develop ability to offer virtual classes to students during extreme weather.
8. Increase Town staff capacity by hiring a sustainability planner and DPW personnel.
9. Evaluate the Senior Center and Housing Authority capacity to shelter people in place and function during emergencies.

* Action items carried over from the previous Hazard Mitigation Plan

10. Create a senior assistance program to provide services, such as: transportation, lawn mowing and shoveling.
11. Develop a tick and mosquito management program with a demonstration area for tick management in yards and on trails.
12. Update the Open Space Plan to include climate resilience and identity opportunities to incorporate climate adaptation strategies on Town-owned property.
13. Leverage the MVP program to incorporate climate resilience into MS4 requirements.
14. Expand the public transportation route system and pick-up services to low-income, elderly and youth, to within ½ mile.
15. Develop a beaver management plan.
16. Upgrade and enlarge subdivision detention ponds in dense residential and commercial areas.
17. Use vegetation in public projects that will withstand drought conditions and warmer temperatures.
18. Provide training to Town staff and residents on the operation and maintenance of pervious surfaces and green infrastructure, possibly using demonstration sites.
19. Work with State, land trusts, Sudbury Trustees, Charles River Compact, on joint projects with communities downstream.

Medium Priority Actions

1. Perform an inventory of public buildings and an assessment of the impact of climate change on public buildings, in particular the schools and DPW building, and studying how the HVAC systems' function during extreme temperatures.
2. Identify roadway vulnerabilities and capacity needs to keep roadways clear.
3. Strengthen relationships with utility companies to improve emergency response and development of microgrids.
4. Coordinate with the owner of the liquid nitrogen gas (LNG) plant to develop a resilience plan with a vulnerability assessment and confirmed emergency and evacuation response.
5. Develop an incentive program for low impact development construction and retrofits or sustainable building practices.
6. Update emergency shelter plans and increase availability of refrigeration for medication.
7. Update the Comprehensive Water Management Plan and implement priority actions.
8. Increase infiltration and inflow (I/I) assessment and implementation of findings.
9. Coordinate with Eversource to reduce energy usage through technology and incentives during peak usage and to invest in renewable energy.
10. Conduct a needs assessment for social services (fuel assistance, food pantry expansion, etc.).
11. Work with tenants and landlords to expand the reach of MassSave incentives.
12. Work with MassDOT to address needed upgrades on I-90 and I-495.

Additional Priority Actions

1. Construct a new water tower or tank.
2. Give out rain barrels to residents and businesses.
3. Work with local grocery stores to provide food to emergency shelters.
4. Assess if any vacant community buildings could serve as emergency shelters.
5. Assess options for water reduction and storage.

* Action items carried over from the previous Hazard Mitigation Plan

Hopkinton CRB Workshop Notes
December 10, 2019

Why do you love Hopkinton?

- Trails
- Town Facilities
- People in Town
- The Town cares for its Citizens
- School System
- Open Space and Natural Resources
- Public Engagement

Potential Projects:

- Cleaning out culverts for mosquito control
- Emergency management plan?
- Local transportation
- Procter and Main Street culvert updates
- "snow day bags"

Existing Mitigation Measures:

- Use projected rainfall data for culvert design (not TP40)
- Interconnections to Ashland
- Senior center is emergency shelter
- Public buildings are well distributed through town
- Code Red
- All Schools & churches are certified for shelters
- Collecting rainwater at senior center
- Underground power at Legacy Farms
- Faith community church – shelter for 3k people

Top Hazards in Hopkinton:

1. Snowstorms, Intense Storms & Wind
2. Thunderstorms and Heavy Precipitation
3. Extreme Temperatures
4. Drought

Local Hazard Areas in Town:

- Washout on 4th Road → cut off access
- 16 inches of snow last week
- Updating pipeline (section of pipe is too small)

Local flooding areas Identified in 2015 HMP:

- 32 Granite Street – Culvert upgrade in progress
- Alprilla Farm Road – in process of developing Blood's Pond Dam Operation Plan
- Cranberry Lane/North Holl Neighborhood: Low lying area of 30-40 homes impacted by flooding caused by beaver activity

Current local flooding areas:

- Cranberry Lane/North Mill
- Alprilla Farm Road
- 32 Granite Street
- Main Street
- Cedar Swamp (beaver flooding)
- Culverts throughout Town, including:
- West Elm Street
- 4th and Berry Acres
- Chestnut Street

Features in Town

Infrastructural:

- LNG Facility
- Dams (Ice house pond – privately owned, Echo lake dam)
- Wells
- Powerlines
- Drainage infrastructure (culverts)
- Pipeline
- Town facilities (town buildings/places of workshop, fire department)
- Elmwood is isolated
- Stormwater Retention/Detention Ponds – ownership, maintenance, capacity, inventory of storms and flooding.
- Fire Cisterns – inventory (already being done), tested annually, ownership, maintenance/fire protection
- Drainage/Stormwater inventory – drainage swales, capacity. Specific areas:
    - Downtown drainage
    - School street – culvert collapsed
- Town owned- buildings/facilities – maintenance issues. Leaks, heavy precipitation, floor drains
- Schools/ access to critical facilities ie high school
- Fire stations, fire protection capacity
- Isolated rural areas – access vulnerabilities. Limited access to highway
    - Have regional agreements to access from other municipalities
    - When roads are blocked all ways – how do we get to them
    - Prioritize areas to get roads open first
        - Strengthen relationships with certain utilities, others with tree removal equipment

    - Wood street
    - Clinton street
- Cooling center – asset. Senior center, library. Schools and other facilities without A/C
- Communication infrastructure
    - code red opt in.
    - coordination between emergency response, DPW, school transportation, etc.?
    - asset management or identifying hazard areas with communications software?
- Police/fire districting?
- Mike SKOOG → Salvation Army Emergency Response. Mobilize citizen corp to help in storm events
- Evacuation routes
- Dams
- Inter-community regional coordination
- Assisted living facilities
- LNG Plant
- Water supply
- Sewage disposal
- Alternative energy sources → electric district
- Town center roadway project – April 2020 construction

Societal:

- Places of worship
- Businesses (South Street; EMC: #1 tax payer and employer)
- Legacy Farms
- [communications to] Vulnerable Populations (Elderly, Group Homes, Children, Low income)
    - All age groups: senior, school age,
    - Cultural groups
    - Social services
    - Translation needs
    - Cell phones (digital vs. analog)
    - "caring community" → leverage great volunteer resources
- Schools – at capacity
- Modera, Davenport
- Public transportation/access → commuter population. Colab with adjacent towns? Satellite parking
- Autistic
- Respite center
- Day cares
- Elderly population
- Large population influx – like marathon day
- South Asian cultural group

Environmental:

- Water Bodies (Blood Pond, Cold Spring, Indian Brook)
    - Storage
    - Wetlands/marshes (only 1 is town owned) – wetlands with competing values
- Topography – SW – no flooding, but lack of watershed. West higher in elevation. Lumber Street highest
- Hazard sites
- Landfills
- State Park undergrowth – clearing for brushfires
- Roadway trees
- Open space/trails → fire roads
- Conservation land: topography: soil – rock. Cliffs, ravines
- Solar farms – impact on open space and building residential
- Impervious surfaces
- Wildlife population – deer, ticks. Mosquitos, beavers.
- Continue and encourage work of con com
- MS4 – water conservation and restriction efforts

<u>Top Action Items</u>

Drainage Infrastructure:

- Stormwater
- Assessment – inventory
- Culverts
- Perennial streams

Power Grid

- Tree trimming

Commuter populations (satellite parking and flood storage)

Vector-borne diseases → outreach materials

Communication plan (MVP Marshalls) to vulnerable populations

Wetlands → sustainability

Open Space → acquire land for flood control and wildlife habitat/corridors

APPENDIX D

Listening Session

RESILIENCY STARTS HERE

The Town of Hopkinton was a awarded a grant from the Commonwealth's Municipal Vulnerability Preparedness (MVP) Program to create a list of priority ction items to advance the community's resilience to projected climate change impacts and to update the Town's Hazard Mitigation Plan. In December, a group of stakeholders met to identify strengths, vulnerabilities, and actions to further build the Town's resilience. We'll be reporting the results of this workshop and seeking public feedback. The input from this session will be captured in the final MVP report.

March 24, 2020
5:00-6:00

Presentation
followed by questions
and discussion

Join Online

Register to receive link to the webinar at https://tinyurl.com/hopkintonMVP

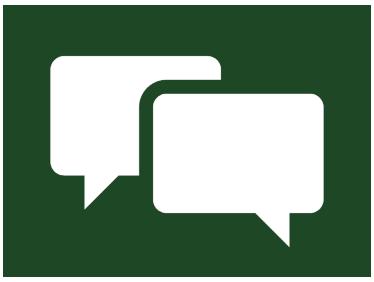
We recommend logging on early to download the Skype application and ensure everything is working properly. A video will be posted after the live presentation to the Town's website with a survey to collect additional input.

Please contact us with questions or concerns:
John Gelcich, AICP
jgelcich@hopkintonma.gov
(508) 497-9745

Weston & Sampson

RESILIENCY STARTS HERE

Help us plan for a future with a changing climate



ONLINE PRESENTATION + QUESTIONS

TUESDAY

MARCH 24

5:00-6:00PM

Hazard Mitigation and Municipal Vulnerability Preparedness Plan Webinar

Register for Online Event at
https://tinyurl.com/hopkintonMVP

Please contact us if you have any questions or concerns. A video recording of the presentation will be available following the event.

John Gelcich, AICP
Principal Planner
Town of Hopkinton
(508) 497-9745
jgelcich@hopkintonma.gov

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hopkintonma.gov

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HOPKINTON

RESILIENCY STARTS HERE

MAR
24

Hopkinton Municipal Vulnerability Preparedness Public Listening Session

by Town of Hopkinton and Weston & Sampson

Follow

Free

Register

Due to the ongoing COVID-19 crisis, we have moved the public listening session online.

About this Event

As part of the MVP Planning process, we are required to hold a public listening session to solicit public input for resiliency to climate change. Given the ongoing COVID-19 crisis, we have opted to move the listening session online as a webinar.

Tags

Online Events | Online Seminars | Online Government Seminars

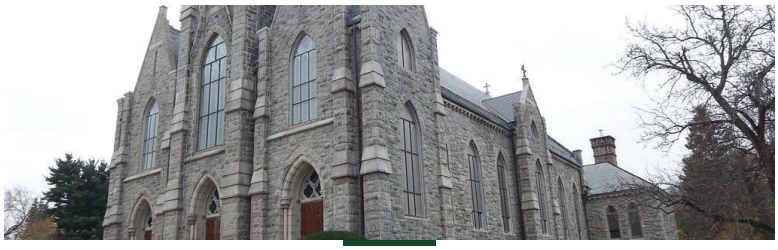
Date And Time

Tue, March 24, 2020
5:00 PM - 6:00 PM EDT
Add to Calendar

Hazard Mitigation and Municipal Vulnerability Preparedness Plan
Listening Session

3/24/2019 – 5:00-6:00
Skype Event – Registration on Eventbrite

Introductions	5 minutes
Municipal Vulnerability Preparedness (MVP) Program Overview	10 minutes
Climate Change in Hopkinton	15 minutes
Strengths in Hopkinton	15 minutes
Vulnerabilities in Hopkinton	15 minutes
Summary of Existing Mitigation Measures in Hopkinton	10 minutes
Priority Action Items in Hopkinton	15 minutes
Wrap-up	5 minutes



TOWN OF HOPKINTON

Listening Session

Tues, March 24th, 2020

Photo: St. Johns Catholic Church. Photo From: Flickr, Michael Lefebvre, 2006

PRESENTATION LOGISTICS

- Presentation is being recorded
- Comments and questions during the presentation can be submitted through the chat
- Survey online for folks to fill out to provide more feedback (link at the end of the presentation)

WELCOME

Members of the Public **Elected Officials**

Core Team Members

Ben Sweeney	Steve Slaman
Don MacAdam	John Gelcich
Elaine Lazarus	Dave Daltorio
John Westerling	

HOPKINTON

RESILIENCY STARTS HERE

Photo: Hopkinton State Park. Photo from Yelp.com

AGENDA

PRESENTATION AND DISCUSSION:

- Overview of Climate Change
- Strengths and Vulnerabilities
- Priority Action Items
- Next Steps

Photo: Hopkinton Town Common. Activerain.com

MVP PRINCIPLES

A community-led, accessible process that:

- Employs local knowledge and buy-in
- Utilizes partnerships and leverages existing efforts
- Is based in best available climate projections and data
- Incorporates principles of nature-based solutions
- Demonstrates pilot potential and is proactive
- Reaches and responds to risks faced by vulnerable populations

MVP PROCESS / GRANT TYPES

COMMUNITY RESILIENCE BUILDING WORKSHOP(S)

- Define and characterize hazards using latest science and data
- Identify existing and future community vulnerabilities and strengths
- Develop and prioritize community adaptation actions
- Determine overall priority actions
- Receive MVP designation

MVP Planning Grant

MVP Action Grant

Implement priority adaptation actions identified through planning process

MVP Action Grants: Project Types

- Vulnerability and Risk Assessment
- Community Outreach and Education
- Local Bylaws, Ordinances, Plans, and Other Management Measures
- Redesigns and Retrofits
- Nature-Based Flood Protection, Drought Mitigation, Water Quality, and Water Infiltration Techniques
- Nature-Based, Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality
- Nature-Based Solutions to Reduce Vulnerability to other Climate Change Impacts
- Ecological Restoration and Habitat Management to Increase Resiliency
- Energy Resilience
- Chemical Safety
- Land Acquisition for Resilience
- Subsidized Low-Income Housing Resilience Strategies
- Mosquito Control Districts

HAZARD MITIGATION PLAN UPDATE

Aligns with MVP Process and adds:

- Extended hazard profiles and vulnerability assessment
- Update to previous mitigation measures table
- Update to previous priority action items
- Implementation plan

COMMUNITY RESILIENCE BUILDING WORKSHOP

Focus on 4 Hazards

Identify:

- Vulnerabilities
- Strengths
- Priority Action Items

Across 3 Categories

- Infrastructure
- Societal
- Environmental

Weston & Sampson

TOP HAZARDS IN HOPKINTON

- Extreme Temperatures
- Thunderstorms, Heavy Precipitation, Flooding
- Drought
- Severe Storms (Wind and Snow)

Weston & Sampson

EXTREME TEMPERATURES

WARMER ANNUAL AIR TEMPERATURES

UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

WARMER WINTERS

UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE

EXTREME TEMPERATURES
IN MASSACHUSETTS

2005 OBSERVED ANNUAL AVERAGE	MID-CENTURY PROJECTED ANNUAL AVERAGE	END-OF-CENTURY PROJECTED ANNUAL AVERAGE
6	24	35
DAYS WITH TEMPERATURES ABOVE 90°F		
145	114	101
DAYS WITH TEMPERATURES BELOW 32°F		

Massachusetts Executive Office of Energy & Environmental Affairs. 2019. "ResilientMA Datagrapher." Massachusetts Climate Change Clearinghouse. Resilientma.org/datagrapher/?cv-Temp/state/tx90/ANN/MA/
Notes: Mid-century projected annual averages use a 2040-2069 time range. End-of-century project annual averages use a 2080-2097 time range.

Aerial spraying for mosquitoes to start Sunday in Milford, Hopkinton

By Caitlyn Kelleher
Director of Multimedia
Follow
Posted Aug 21, 2019 at 4:41 PM
Updated Aug 22, 2019 at 7:53 AM

Source: Milford Daily News

Hopkinton, MA
@HopkintonMA

Due to the heat wave, the 7/21 edition of Concerts on the Common, featuring the Hopkinton Community Summer Band, has been relocated to the Hopkinton High School Auditorium (AC!!) The concert is still set to begin at 5:00 pm and will go until 7:00 pm.

@HopkintonHS
@HopParksRec

10:10 AM - 20 Jul 2019

CHANGES IN PRECIPITATION

MORE **INTENSE & FREQUENT** EXTREME RAIN EVENTS

PRECIPITATION DURING **HEAVY EVENTS** IN THE NORTHEAST **INCREASED BY MORE THAN**

70%

BETWEEN 1958-2010

Massachusetts Executive Office of Energy & Environmental Affairs. 2019. "Changes in Precipitation." Massachusetts Climate Change Clearinghouse. Resilientma.org/changes/changes-in-precipitation

EXTREME PRECIPITATION

8%

Increase in extreme precipitation events by midcentury

13%

Increase in extreme precipitation events by 2100

Riverine Flood Prone Areas

Charles River
Sudbury River
Lake Maspenock
Echo Lake
Whitehall Lake
Hopkinton Reservoir
North Pond
Blood's Pond
Indian Brook
Cold Spring Brook
Whitehall Brook

Locally Identified Areas of Flooding

Cranberry Lane/North Mill
Alprilla Farm Road
32 Granite Street
Main Street
Cedar Swamp (beaver flooding)

Culverts throughout Town, including:
West Elm Street
4th and Berry Acres
Chestnut Street

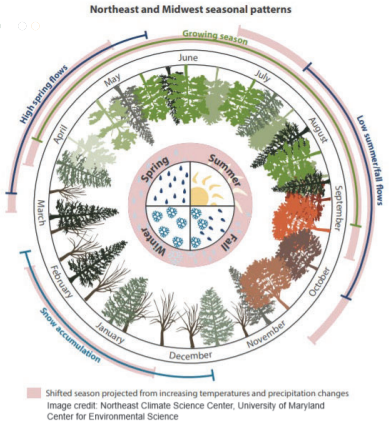
SEVERE STORMS

Heavy blizzards are among the **most costly and disruptive** weather events for Massachusetts communities.

Upward trend in North Atlantic hurricane activity since 1970

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

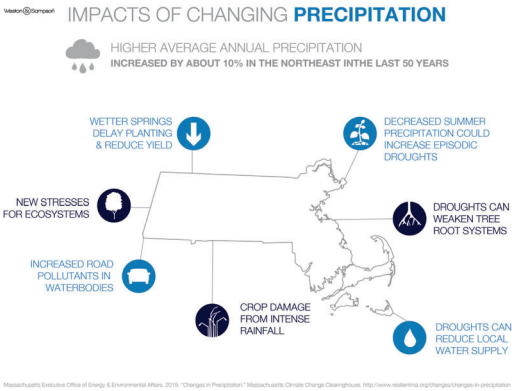
The blizzard of 2013 left nearly **400,000 Massachusetts residents without power**



The most notable recent drought event was in

2016

The occurrence of droughts **lasting 1 to 3 months** could go up by as much as **75% over existing conditions** by the end of the century, under the high emissions scenario



STRENGTHS & VULNERABILITIES

INFRASTRUCTURE

Both Vulnerability and Strength	Vulnerabilities
• Dams • **Fire/Police Stations** • **DPW/Equipment/Labor** • State Highway • Power Grid/ Electric & Gas • **Schools** • Town Facilities • Sewage Disposal • Energy Distribution Alternative Sources • **Communication Infrastructure**	• Drainage (including cisterns) • Building maintenance issues: weather related and age • Access – roadways • **Water supply/Wells** • **Powerlines/Pipelines**

SOCIETAL

Vulnerabilities	Both Vulnerability and Strength	Strength
• **Isolated Rural Areas** • Communications to **vulnerable populations** • Legacy Farms Residents • Commuter Populations	• Limited English Speaking • Businesses (EMC) • Seniors/Assisted Living • Low-income population • School/Youth • Large Events (Marathon) • Support for Other Communities in Town	• Places of Worship • Grocery and Supply Stores • **Volunteer Community/Citizens Groups**

ENVIRONMENTAL

Both Vulnerability and Strength	Vulnerabilities
• Wetlands • Topography • Water quality and quantity (wells and land protection) • Natural resources • Open space/trails	• Wildlife population • Vector-borne diseases • Water bodies (cyanobacteria and aquatic vegetation) • Floodplain • Landfills • LNG • Impervious surfaces • Hazardous sites

EXISTING HAZARD PROTECTION

- Comprehensive Emergency Management Plan
- Enforce MA State Building Code
- Multi-Department Review of Developments
- Participation in the National Flood Insurance Program
- Street Sweeping
- Catch Basin Cleaning
- Enforce MA Stormwater Regulations
- Community Preservation Act
- Infrastructure Improvements
- Regulations, By-Laws and Plans
- Portable Water Pumps
- Tree-trimming
- Roadway Treatments
- Snow Removal & Disposal
- Comfort (Cooling and Heating) Stations
- Dam Safety Permits and Regulations
- Permits for Outdoor Burning
- Fire Hydrant Regulations

HIGHEST PRIORITIES

- Incorporate nature-based solutions and climate projections into existing projects (the Main Street improvements stormwater upgrades).
- Assess and inventory stream crossings and rank these assets based on vulnerability.
- Create an asset management and capital planning system that incorporates climate resilience and ensures projects consider co-benefits.
- Incorporate resiliency measures into the action items from the 2017 Hopkinton Master Plan and implement measures with overlapping priorities.

HIGHEST PRIORITIES

- Evaluate the Senior Center and Housing Authority capacity to shelter in place.
- Acquire land for flood control, wildlife habitat/corridors, and to protect wetland and open space.
- Adding solar canopies and create a solar overlay district.
- Review and update zoning, bylaws, and regulations to incorporate climate change and hazard mitigation.
- Develop a comprehensive communication plan to reach vulnerable audiences.

INFRASTRUCTURE PRIORITIES

- Conduct a resilient drainage assessment
- Complete Lake Maspenock Dam restoration
- Incorporate multi-use green infrastructure resiliency into schools
- Provide training to Town staff on green infrastructure and increase Town staff capacity

SOCIETAL PRIORITIES

- Regularly practice and evaluate the School Environmental Management plans (SEMP), test generators, and expand capacity to shelter in place.
- Expand the public transportation route system and pick-up services to low-income, elderly and youth, to within ½ mile.
- Develop ability to offer virtual classes to students during extreme weather.
- Create a senior assistance program to provide services, such as: transportation, lawn mowing, and shoveling.

ENVIRONMENTAL PRIORITIES

- Maintain and upgrade subdivision detention ponds
- Use vegetation that will withstand drought conditions and warmer temperatures.
- Develop a tick and mosquito management program.
- Incorporate climate resilience into MS4 requirements.
- Develop beaver management plans.
- Work with State, land trusts, Sudbury Trustees, and Charles River Compact, on joint projects with communities downstream.
- Develop a robust tree management plan
- Update the Open Space Plan

QUESTIONS OR COMMENTS

PLEASE TAKE OUR SURVEY FOR INPUT
RELATED TO THIS PRESENTATION
OR SUBMIT FEEDBACK AT

https://tinyurl.com/hopkintonMVPsurvey

PUBLIC COMMENT ON REPORT

- **DRAFT AVAILABLE ONLINE APRIL 3RD-17TH**

- **SEND COMMENTS TO:**

John Gelcich, AICP
Principal Planner
Town of Hopkinton
(508) 497-9745
jgelcich@hopkintonma.gov

THANK YOU

Weston & Sampson

Hazard Mitigation and Municipal Vulnerability Preparedness Plan
Listening Session

3/24/2019 – 5:00-6:00
Skype Event – Registration on Eventbrite

Introductions	5 minutes

- Dawn Alcott
- John Gelrich
- Steve Roy
- Amanda Kohn
- Connor
- Amy Ritterbusch
- Chad

Municipal Vulnerability Preparedness (MVP) Program Overview	10 minutes
Climate Change in Hopkinton	15 minutes
Strengths in Hopkinton	15 minutes
Vulnerabilities in Hopkinton	15 minutes
Summary of Existing Mitigation Measures in Hopkinton	10 minutes
Priority Action Items in Hopkinton	15 minutes
Wrap-up	5 minutes

Comments:

- Need to be sure that any moquisto mitigation does not impact the bee populations
- Need more public transit connecting senior housing to grocery store. There used to be a super market that was within walking distance of senior housing, but it closed.
- There is a strong tie between hazard mitigation and climate adaptation to the sustainability of the economy.
- Land use and regulations play a key role in future development.
- Timely considering the recent public health concerns and isolation as it relates to impact on the economy, finding ways to work and have school at home.

Town of Hopkinton

The Town of Hopkinton was a awarded a grant from the Commonwealth's Municipal Vulnerability Preparedness (MVP) Program to create a list of priority action items to advance the community's resilience to projected climate change impacts and to update the Town's Hazard Mitigation Plan. In December, a group of stakeholders met to identify strengths, vulnerabilities, and actions to further build the Town's resilience. In March, we hosted an online presentation (recording to be available soon). We'd like to continue to receive feedback for the report through the survey below.

1. What hazard most concerns you?

- ○ Extreme Temperatures
- ○ Extreme Precipitation (and Flooding)
- ○ Severe Storms (Snow and Wind)
- ○ Drought
- ○ Other

2. What would you consider Hopkinton's greatest vulnerability?

- ○ Water supply and private wells
- ○ Vulnerable populations and facilities (daycares, people prone to isolation)
- ○ Vector-borne diseases
- ○ Stormwater drainage
- ○ Other

3. What is Hopkinton's greatest strength considering climate resilience?

- Department of Public Works (DPW) capacity
- Volunteer Community/Citizens Groups
- Wetlands and waterbodies
- Schools and Town Facilities
- Other

4. How should Hopkinton prioritize climate adaptation measures?

- Based on funding
- Time frame
- Asset type (i.e., infrastructure, buildings, or natural systems)
- Impact on public safety
- Other

5. Rank the following priorities from highest priority to lowest priority.

Develop a comprehensive communication plan to reach vulnerable audiences.

Adding solar canopies and create a solar overlay district

Review and update zoning, bylaws, and regulations to incorporate climate change and hazard mitigation.

Acquire land for flood control, wildlife habitat/corridors, and to protect wetland and open space.

Incorporate resiliency measures into the action items from the 2017 Hopkinton Master Plan and implement measures with overlapping priorities

Assess and inventory stream crossings and rank these assets based on vulnerability.

Evaluate the Senior Center and Housing Authority capacity to shelter in place.

Incorporate nature-based solutions and climate projections into existing projects, such as the Main Street improvements project and planned stormwater/culvert upgrades.

Create an asset management and capital planning system that incorporates climate resilience and ensures projects consider co-benefits.

6. What other climate adaptation or hazard mitigation measures should be taken in Hopkinton in the next five years?

Enter your answer

7. Do you have any other questions or comments?

Enter your answer

8. First Name

Enter your answer

9. Last Name

Enter your answer

10. Email (in you'd like to receive updates)

Enter your answer

Submit

Never give out your password. Report abuse

1. What hazard most concerns you?

More Details

Extreme Temperatures	2
Extreme Precipitation (and Flo...	3
Severe Storms (Snow and Wind)	2
Drought	0
Other	1

2. What would you consider Hopkinton's greatest vulnerability?

More Details

Water supply and private wells	0
Vulnerable populations and fa...	1
Vector-borne diseases	4
Stormwater drainage	3
Other	0

3. What is Hopkinton's greatest strength considering climate resilience?

More Details

Department of Public Works (...	2
Volunteer Community/Citizen...	2
Wetlands and waterbodies	2
Schools and Town Facilities	0
Other	2

4. How should Hopkinton prioritize climate adaptation measures?

More Details

Based on funding	1
Time frame	1
Asset type (i.e., infrastructure, ...	3
Impact on public safety	3
Other	0

5. Rank the following priorities from highest priority to lowest priority.

1. Incorporate nature-based solutions and climate projections into existing projects, such as the Main Street improvements project and planned stormwater/culvert upgrades.
2. Incorporate resiliency measures into the action items from the 2017 Hopkinton Master Plan and implement measures with overlapping priorities
3. Develop a comprehensive communication plan to reach vulnerable audiences.
4. Create an asset management and capital planning system that incorporates climate resilience and ensures projects consider co-benefits.
5. Evaluate the Senior Center and Housing Authority capacity to shelter in place.
6. Adding solar canopies and create a solar overlay district
7. Acquire land for flood control, wildlife habitat/corridors, and to protect wetland and open space.
8. Review and update zoning, bylaws, and regulations to incorporate climate change and hazard mitigation.
9. Assess and inventory stream crossings and rank these assets based on vulnerability.

6. What other climate adaptation or hazard mitigation measures should be taken in Hopkinton in the next five years?

- Awareness campaign and regional work....as Hopkinton does not exist in a vacuum...coming together with other communities to build solutions and share resources.
- Water Run Off through properties around Lake Maspenock
- Mosquito prevention and control with emphasis on reducing ponding water unnaturally.

7. Do you have any other questions or comments?

- Keep up the great work
- Excellent job at making this happen!

Question 8-10 provided the names and emails of the survey participants. Four participants provided their email out of eight.

55 Walkers Brook Drive, Suite 100, Reading, MA 01867
Tel: 978.532.1900

MEMORANDUM

TO:	Shaun McAuliffe, Health Director, Town of Hopkinton
	John Gelcich, Principal Planner, Town of Hopkinton
FROM:	Amanda Kohn, Project Planner, Weston & Sampson
	Adria Boynton, Resiliency Specialist, Weston & Sampson
DATE:	February 3, 2020
SUBJECT:	Town of Hopkinton Hazard Mitigation Plan Update and Municipal Vulnerability Preparedness Plan Project: Social Media & Public Education Recommendations Memorandum

Weston & Sampson is working with the Town of Hopkinton to update its Hazard Mitigation Plan and complete the Municipal Vulnerability Preparedness Planning process. This project includes expanded public outreach to address the risks associated with a warmer climate and increasing exposure to ticks. As part of this work, the project team prepared a fact sheet for public distribution summarizing tick-related information in a series of visual infographics. This fact sheet was informed by ten years' worth of data collected by the Town's Health Department. Research has found that 40% of viewers will have a more positive reaction to information presented in images rather than text alone.[1] Additionally, audiences are thirty times more likely to read an infographic than narrative text.[2] Therefore, a public education strategy that focuses on visual information and social media use is a critical part of sharing hazard mitigation and vulnerability preparedness information with community members.

This memorandum summarizes the Town's existing practices related to public education and sharing tick information; general recommendations for public education, social media use, and website content; free social media resources; and specific recommendations for distribution of the fact sheet. The "Climate Change & Tick-Borne Illness" fact sheet, and examples of related social media posts, are included as attachments to this document.

[1] WMG SEO & Digital Marketing Agency, "Why Every SEO Strategy Needs Infographics," WMG, February 12, 2014, wmgagency.co.uk/why-every-seo-strategy-needs-infographics/.
[2] Customer Magnetism Internet Marketing Agency, "What Is An Infographic?," accessed January 31, 2020, customermagnetism.com/what-is-an-infographic/.

Hopkinton's Existing Practices for Public Education and Sharing Tick Information

- Hopkinton maintains a Town Website, Facebook page, and Twitter account. Some Town departments maintain their own Instagram page, including the Hopkinton Police Department.
- The Health Department maintains its own webpage on the Town website, which it uses to share contact information and links to health-related resources.
- The Town collaborates with local organizations and community partners to share information with their members, including the Real Housewives of Hopkinton and the Hopkinton Trails Club. Collaboration with these groups allows the Town to reach thousands of viewers on social media.
- The Town is partnering with local trail groups to install brochure boxes. These boxes will include signage on two sides, along with a box for informational brochures and tick identification cards.

General Recommendations for Public Education

Including presentations, webpages, and social media use

- Follow a 3-step approach:
  - Attention: Grab your audience's attention ("Be smart!")
  - Information: provide easily digestible information ("Ticks can live in some of our favorite trails and parks.")
  - Call to Action: share actions that your intended audience could reasonably complete ("Share tick-related information with the hikers in your life.")
- Consider your audience and avoid using industry-specific jargon.
- Define acronyms and technical terms, including unfamiliar names of tick diseases.
- Recent census data shows that 11.7% of Hopkinton residents speak a language other than English at home.[3] Work with translators to provide information in languages other than English.
- Be succinct. One paragraph of information is more likely to be read than one page.
- Keep language positive, accessible, engaging, and upbeat.

General Recommendations for Social Media Use

- Include an image in every social media post. Include a title related to the intended topic, in case the image is shared further or used out of context.
- Consider the different opportunities and audiences offered by various social media platforms, including Facebook, Twitter, and Instagram. Tailor posts to meet each platform's requirements, including Instagram's 1:1 aspect ratio and Twitter's 280-character limit.
- Recommendations for how frequently to post on social media vary by platform:
  - Twitter: frequency is key, more posts leads to more views.[4]
  - Facebook: post between two to five times a week.[5]

[3] United States Census Bureau, "Quick Facts: Hopkinton Town, Middlesex County, Massachusetts; United States," 2019, census.gov/quickfacts/fact/table/hopkintontownmiddlesexcountymassachusetts,US/PST045219.
[4] Daria Marmer, "How Frequently Should I Publish on Social Media? A HubSpot Experiment," Blog, HubSpot, September 14, 2017, blog.hubspot.com/marketing/how-frequently-should-i-publish-on-social-media.
[5] Marmer.

    - Instagram: the average Instagram platform posts six times a week. More than 50% of Instagram users sign on daily, so new content keeps audiences engaged.[6]
- Consider purchasing a social media scheduling tool, which would allow the Town to select content in advance and schedule automatic posts as needed.
- The Town could make social media posts announcing the creation of a new webpage specific to information on vector-borne illnesses.
- The Town could post photos of the trail brochure boxes once completed.
- The Town could make official Hopkinton Health Department Instagram, Facebook, and Twitter accounts, to share information related to vector-borne illnesses and preventative strategies.
- The Town can post sections of the "Climate Change & Tick-Borne Illness" fact sheet on its social media platforms. As an incentive, the Town could enter people into a giveaway for a free Tick Identification card if they share these posts.
- Consider including videos on social media platforms. Posts with videos see a 40% increase in views. Videos are particularly successful on Facebook, where images boost views by 65%.[7]

Free Social Media Resources

- Canva: formats Instagram-sized posts
- Twitter Character Counter: checks that posts are within Twitter's 280-character limit
- Tiny URL: shortens web links to create cleaner and more succinct social media posts
- Hubspot Blog: general news and recommendations related to marketing and social media use
- Hubspot Interactive Video Guide: recommendations for making videos for social media

Recommendations for Public Education and Distribution of the Fact Sheet

- The Town already plans to include a copy of the fact sheet in the next set of tax bills distributed to all residents. In the next quarter, residents will receive information on Triple E.
- The Town can continue to collaborate with community partners to distribute the "Climate Change & Tick-Borne Illness" fact sheet, particularly organizations with a high level of potential exposure to ticks, such as local trail groups.
- The Town can print the fact sheet and provide copies in public locations including Town Hall, schools, and the local library.

[6] Alicia Collins, "Instagram Marketing: The Ultimate Guide," HubSpot, accessed February 3, 2020, hubspot.com/instagram-marketing.
[7] HubSpot, "How to Create High-Quality Videos for Social Media," accessed February 3, 2020, offers.hubspot.com/video-social-media-marketing.

General Recommendations for Webpage Content

- Hopkinton could add a dedicated webpage for vector-borne illnesses to the Town's website. This webpage could host the following information:
    - Information on the public health impacts of Triple E and tick-borne illnesses.
    - Contact information so that residents can reach out with questions.
    - The "Climate Change & Tick-Borne Illness" fact sheet and related citations.
        - Use the text and images from the fact sheet to build a dynamic webpage.
        - Post a link to download the fact sheet as a PDF for those who would also like a printed copy.
    - A list of locations in Hopkinton where DEET and Permethrin are sold.
    - The Town plans to offer a program to treat employee's clothing with Permethrin during March and April. This program could be advertised on this new webpage.
    - Tick research posters created by Hopkinton's summer interns.
    - Related information regarding Hopkinton's MS4 work, Hazard Mitigation Plan, and Municipal Vulnerability Preparedness planning process.

References

Collins, Alicia. "Instagram Marketing: The Ultimate Guide." HubSpot. Accessed February 3, 2020. hubspot.com/instagram-marketing.

Customer Magnetism Internet Marketing Agency. "What Is An Infographic?" Accessed January 31, 2020. customermagnetism.com/what-is-an-infographic/.

HubSpot. "How to Create High-Quality Videos for Social Media." Accessed February 3, 2020. offers.hubspot.com/video-social-media-marketing.

Marmer, Daria. "How Frequently Should I Publish on Social Media? A HubSpot Experiment." Blog. HubSpot, September 14, 2017. blog.hubspot.com/marketing/how-frequently-should-i-publish-on-social-media.

United States Census Bureau. "Quick Facts: Hopkinton Town, Middlesex County, Massachusetts; United States," 2019. census.gov/quickfacts/fact/table/hopkintontownmiddlesexcountymassachusetts,US/PST045219.

WMG SEO & Digital Marketing Agency. "Why Every SEO Strategy Needs Infographics." WMG, February 12, 2014. wmgagency.co.uk/why-every-seo-strategy-needs-infographics/.

Attachments:

Attachment A: Climate Change & Tick-Borne Illness Fact Sheet

Attachment B: Social Media Post Examples

CLIMATE CHANGE & TICK-BORNE ILLNESS

IN HOPKINTON, MASSACHUSETTS

What Ticks are Common?

The Black Legged (Deer) Tick

- Both adult and nymph (young) Deer Ticks can bite and infect their hosts
- Adults are the size of a sesame seed
- Nymphs are the size of a poppy seed
- Spring, summer, and fall pose the highest risk

The Dog Tick

- Only adults have been known to bite
- Adults are the size of a watermelon seed
- Spring and summer pose the highest risk

Tick Exposure

Tick activity can occur throughout the year, often in the areas described below.

- Wooded areas
- Trails
- Tall grass and brush
- Residential areas
- Recreational areas
- Pets

Tick-Borne Disease in Hopkinton

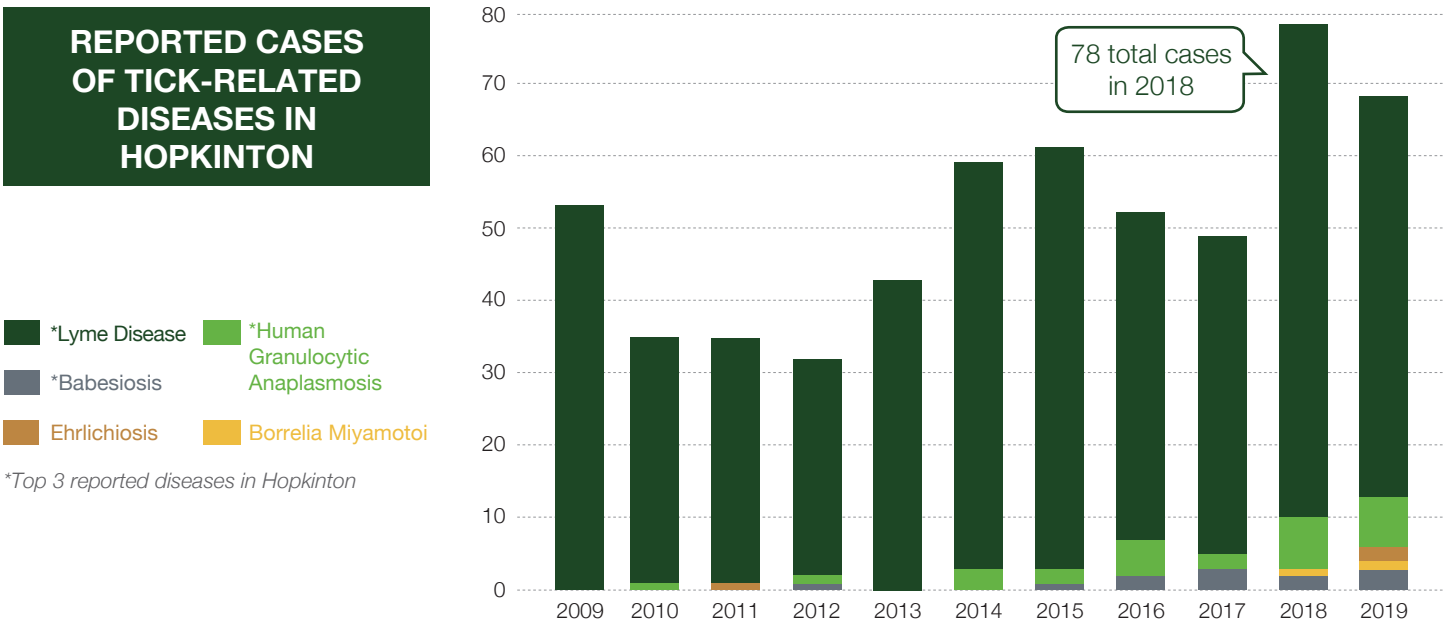
Exposure to ticks can cause the diseases shown in the chart below. Symptoms can include:

- Mild flu-like symptoms
- Headaches
- Fever and chills
- Fatigue
- Rash
- Achy joints

Lyme Disease is the most common tick-borne illness in Hopkinton. If not treated, it can cause chronic arthritis, meningitis, and heart conditions.

$786M *Est. annual healthcare cost of Lyme disease in the United States*

REPORTED CASES OF TICK-RELATED DISEASES IN HOPKINTON



*Top 3 reported diseases in Hopkinton

Citations, additional resources, and contact information can be found on the Town website at hopkintonma.gov/departments/health_department.php

How Can I Reduce My Risk?

Tick Protection Strategies

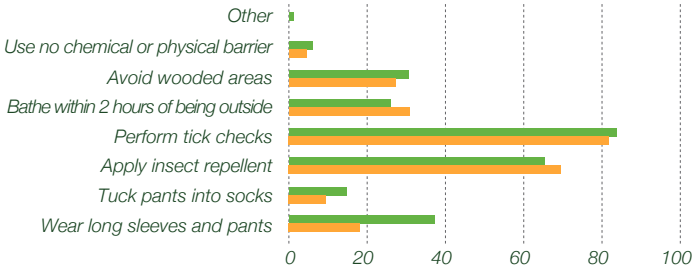
- Bathe within two hours of being outside
- Apply tick repellent such as DEET or Permethrin
- Perform tick checks on people and pets
- Wear long sleeves and pants
- Tuck pants into socks
- Stay on designated paths
- Avoid tall grass and brush
- Put clothes in the dryer for 10 minutes on high

If You Find a Tick Attached

1. Remove tick with clean tweezers by grasping the tick's head and slowly pulling it out
2. Wash the bite area with soap or alcohol-based sanitizer
3. Note the date and save tick in a bag for potential testing
4. Talk to your doctor if you develop a rash or other symptoms of tick-borne diseases

Awareness

Tick Protection Used in Hopkinton, 2019



As the chart above demonstrates, the majority of Hopkinton residents are proactive in protecting themselves from ticks.

Who is Vulnerable?

- Individuals over 45 years old
- Those who identify as male
- School-aged children
- Elderly residents

Warmer Weather Promotes Tick Populations

HISTORIC CLIMATE CHANGE

WARMER ANNUAL AIR TEMPERATURES

UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

WARMER WINTERS

UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE

CLIMATE IMPACT ON TICKS

- Higher average temperatures and longer periods of high temperatures can increase tick populations and the numbers of vector-borne diseases
- Shorter winters and higher temperatures extend the typical tick lifespan
- Increasing temperatures allow ticks to expand into areas where they would not have survived previously
- Massachusetts now reports 50-100 more cases of Lyme Disease per 100,000 people than in 1991

FUTURE CLIMATE CHANGE

2005 OBSERVED ANNUAL AVERAGE	MID-CENTURY PROJECTED ANNUAL AVERAGE	END-OF-CENTURY PROJECTED ANNUAL AVERAGE
48.13°F	53.43°F	55.32°F
INCREASING AVERAGE TEMPERATURE		
6	24	35
DAYS WITH TEMPERATURES ABOVE 90°F		
145	114	101
DAYS WITH TEMPERATURES BELOW 32°F		

Weston & Sampson℠

Climate Change and Tick-Borne Illness in Hopkinton, Massachusetts

Example Social Media Posts

The following posts could be used on the Town's Facebook and/or Twitter pages. Each post is designed to fit within Twitter's 280-character limit.

Example Post 1: Tick Exposure

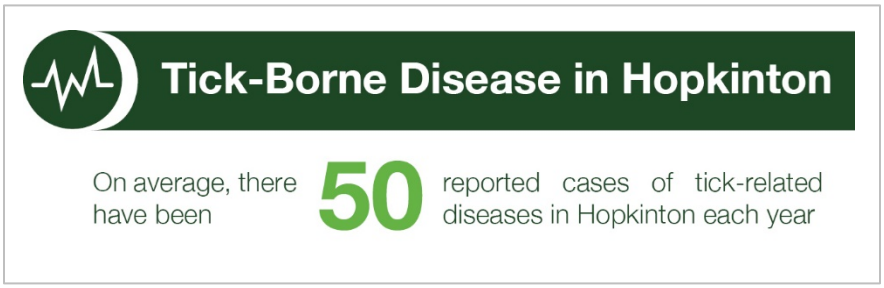
Tick activity can occur throughout the year – stay informed and keep your family protected! Visit the Town's website for more information about Ticks in Hopkinton (*recommend inserting a link to the Town's website).*

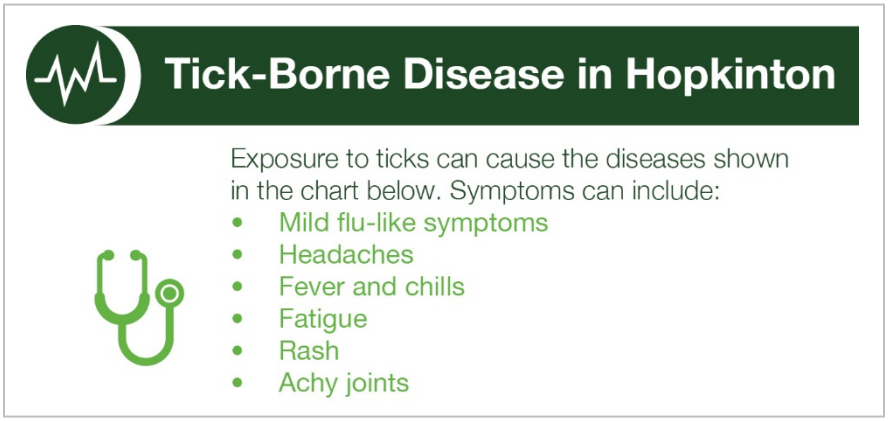
Example Post 2: What Ticks are Common?

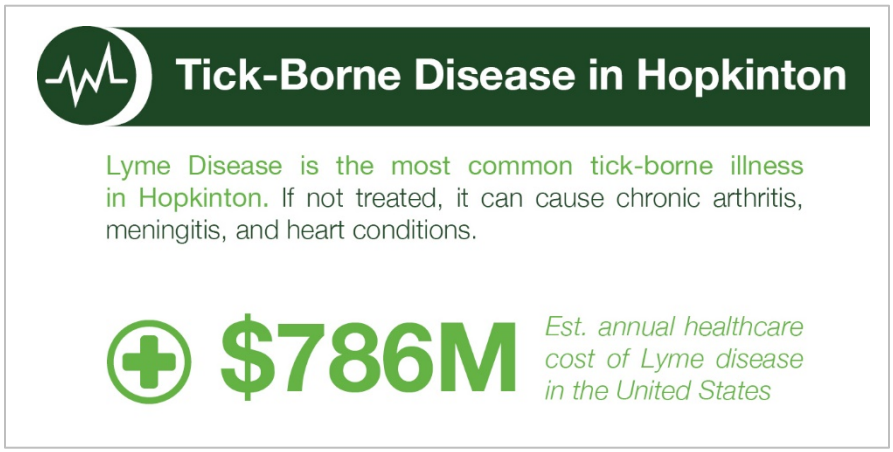
Did you know that Deer Ticks and Dog Ticks are among the most common ticks in this area? Visit the Town's website for more information about Ticks in Hopkinton (*recommend inserting a link to the Town's website).*

Example Post 3: Tick-Borne Disease in Hopkinton

Did you know that there's an average of 50 reported cases of tick-related diseases in Hopkinton each year? The Town has tracked tick-related data for more than a decade. Visit the Town's website for more information (*recommend inserting a link to the Town's website).*





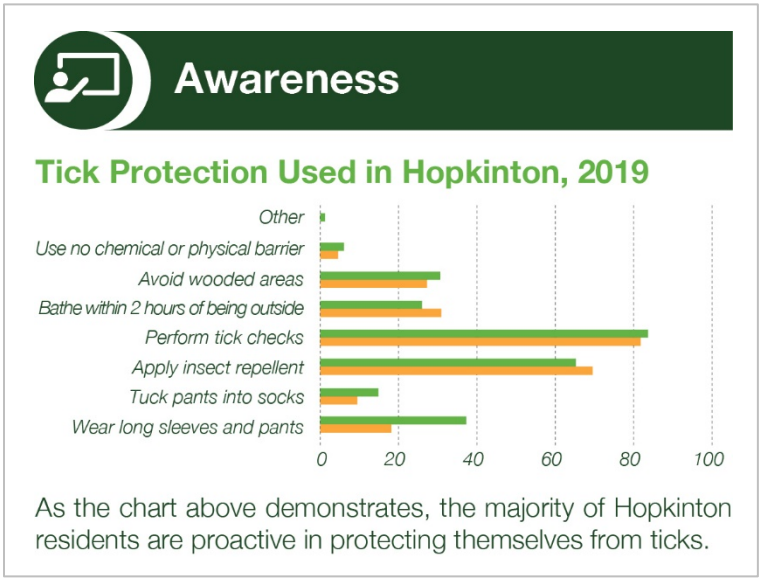


Example Post 4: Reduce Your Risk

Be smart! Ticks can live in some of our favorite trails and parks. Reduce your risk of being bitten with the tips below. Visit the Town's website for more information about ticks in Hopkinton (*recommend inserting a link to the Town's website).*

Example Post 5: Tick Vulnerability Awareness

What do you and your family do to prevent tick-borne illnesses? School-aged children and the elderly are among our most vulnerable residents in Hopkinton. Visit the Town's website for more information (*recommend inserting a link to the Town's website).*



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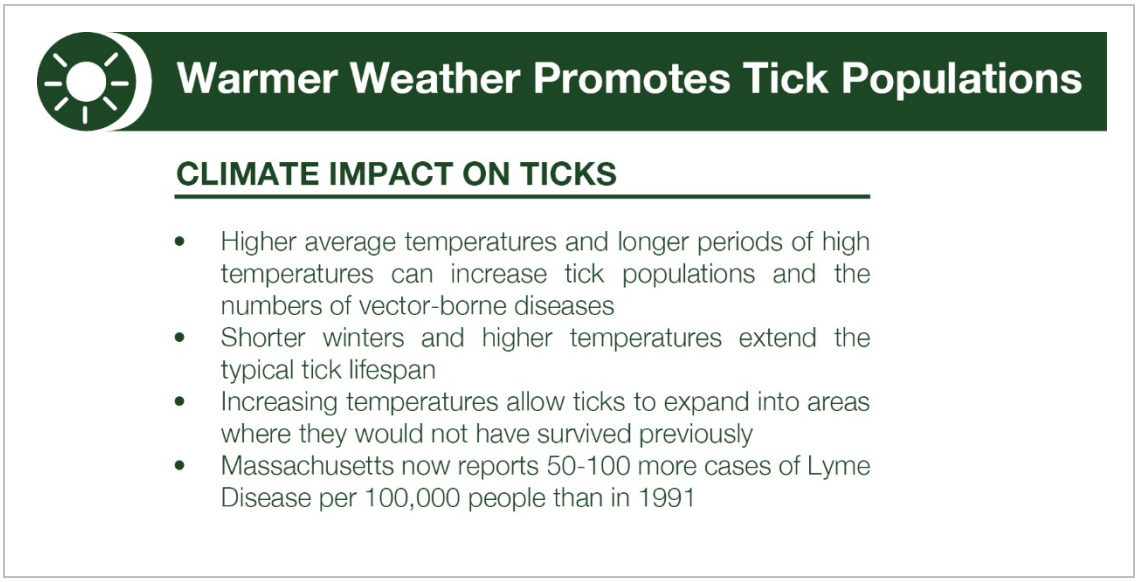

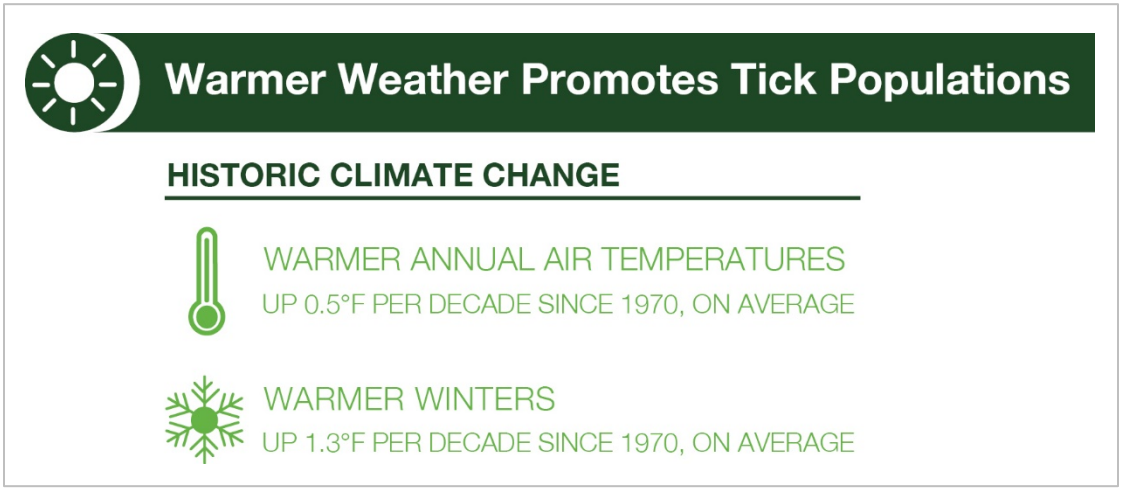

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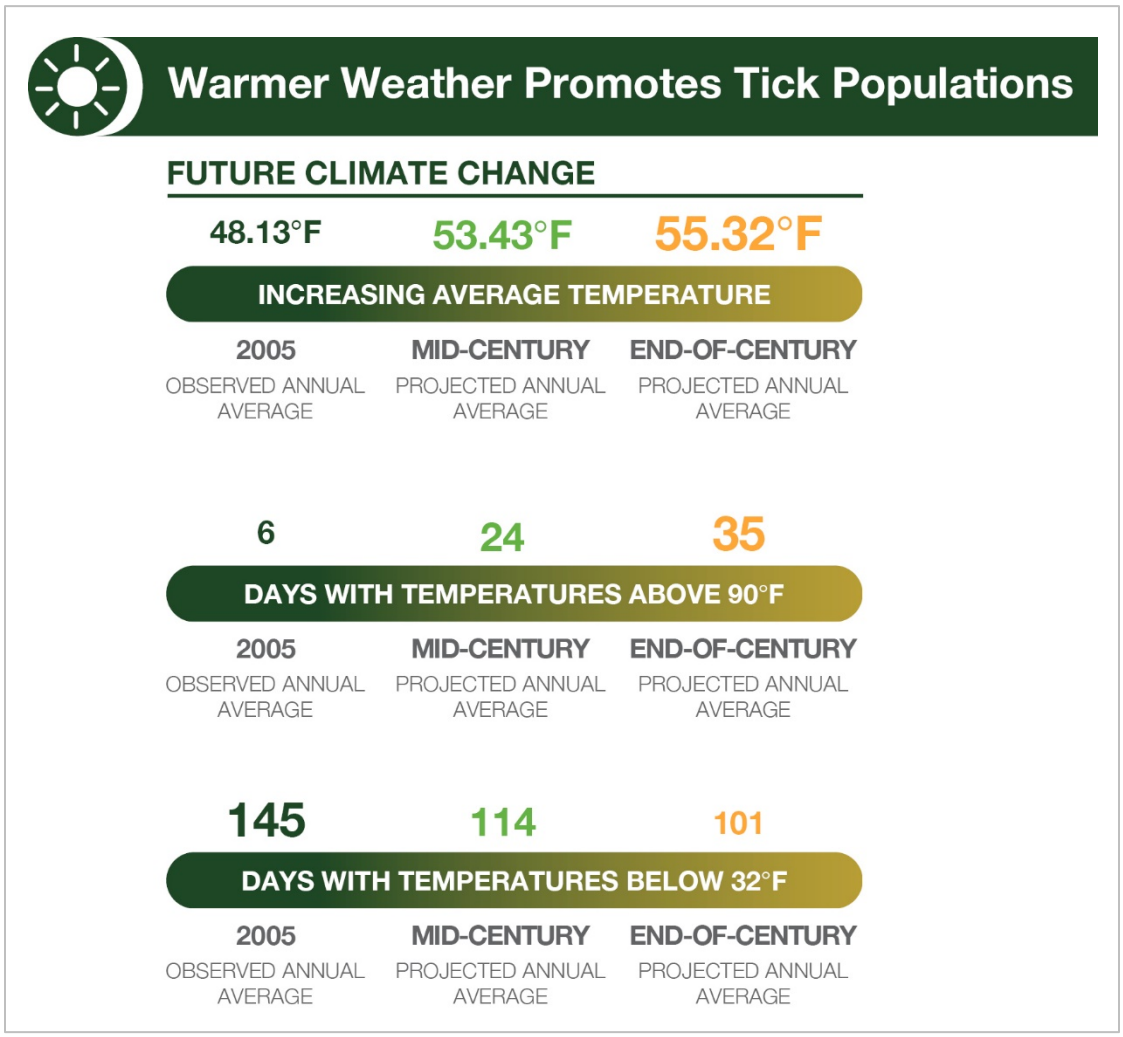

CLIMATE CHANGE & TICK-BORNE ILLNESS

IN HOPKINTON, MASSACHUSETTS

What Ticks are Common?

The Black Legged (Deer) Tick

- Both adult and nymph (young) Deer Ticks can bite and infect their hosts
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- Only adults have been known to bite
- Adults are the size of a watermelon seed
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Tick Exposure

Tick activity can occur throughout the year, often in the areas described below.

- Wooded areas
- Trails
- Tall grass and brush
- Residential areas
- Recreational areas
- Pets

Tick-Borne Disease in Hopkinton

Exposure to ticks can cause the diseases shown in the chart below. Symptoms can include:

- Mild flu-like symptoms
- Headaches
- Fever and chills
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Lyme Disease is the most common tick-borne illness in Hopkinton. If not treated, it can cause chronic arthritis, meningitis, and heart conditions.

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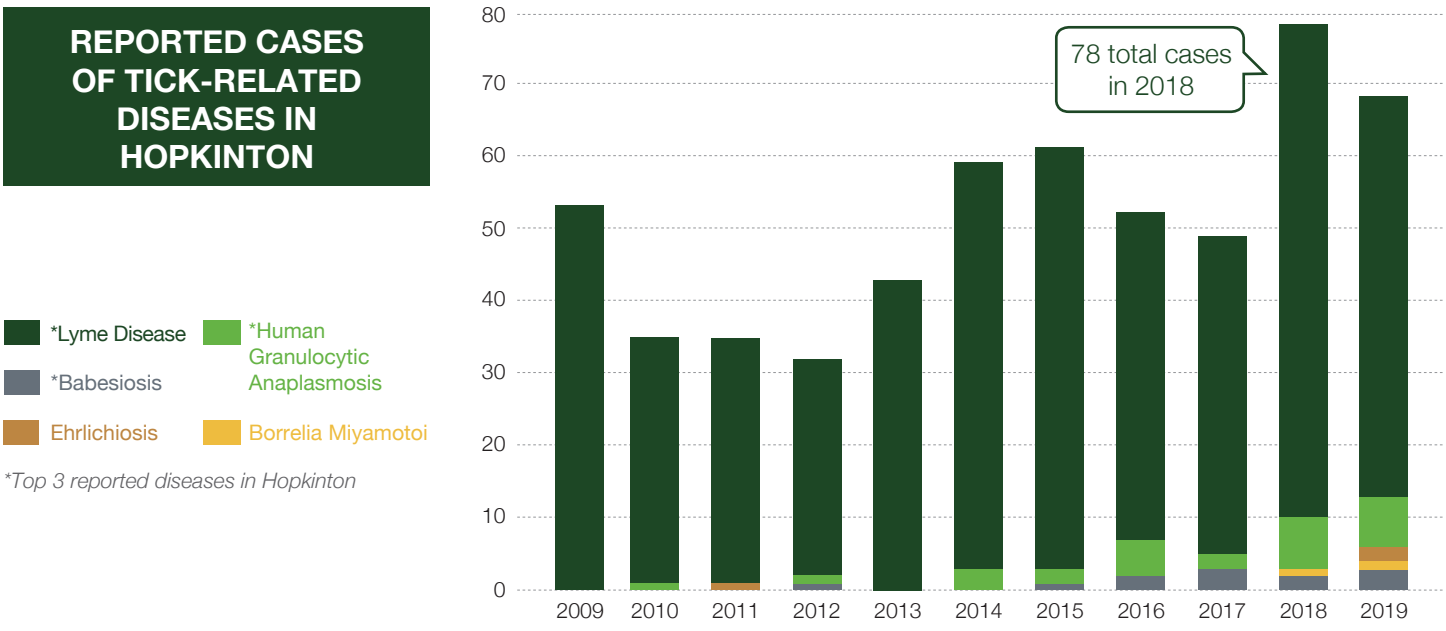

*Top 3 reported diseases in Hopkinton

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How Can I Reduce My Risk?

Tick Protection Strategies

- Bathe within two hours of being outside
- Apply tick repellent such as DEET or Permethrin
- Perform tick checks on people and pets
- Wear long sleeves and pants
- Tuck pants into socks
- Stay on designated paths
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If You Find a Tick Attached

1. Remove tick with clean tweezers by grasping the tick's head and slowly pulling it out
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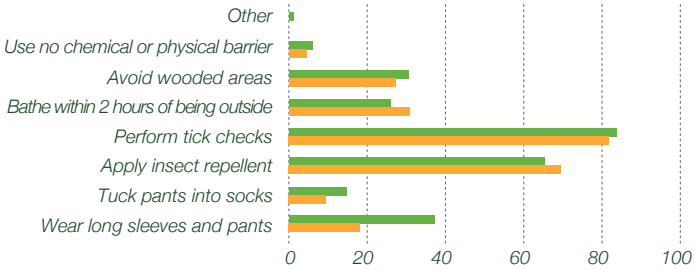
Tick Protection Used in Hopkinton, 2019



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Who is Vulnerable?

- Individuals over 45 years old
- Those who identify as male
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Warmer Weather Promotes Tick Populations

HISTORIC CLIMATE CHANGE

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UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

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CLIMATE IMPACT ON TICKS

- Higher average temperatures and longer periods of high temperatures can increase tick populations and the numbers of vector-borne diseases
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Weston & Sampson℠

Climate Change and Tick-Borne Illness in Hopkinton, Massachusetts

Example Social Media Posts

The following posts could be used on the Town's Facebook and/or Twitter pages. Each post is designed to fit within Twitter's 280-character limit.

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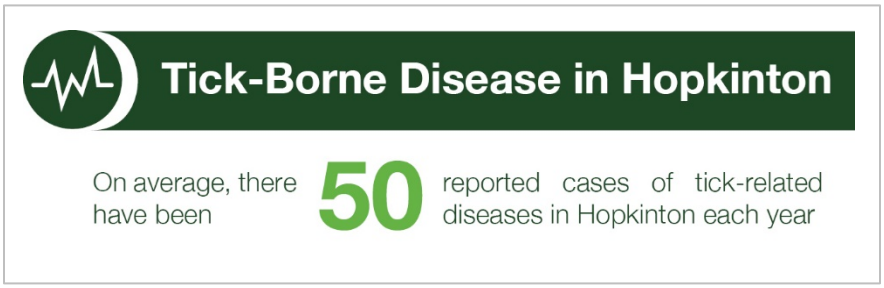

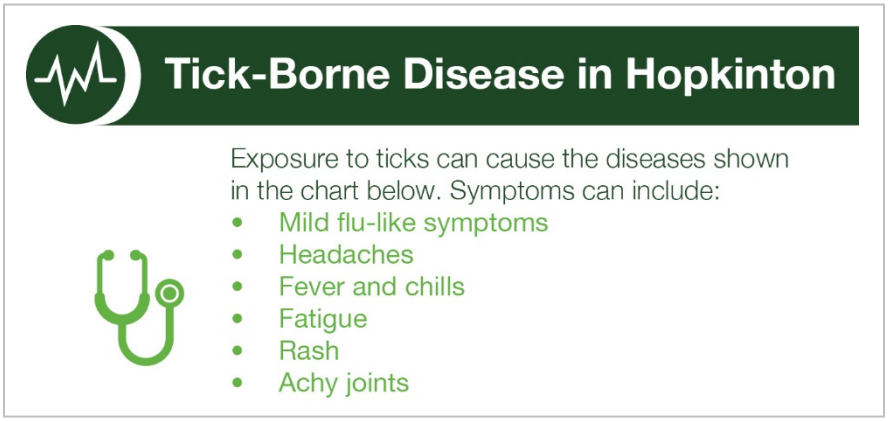

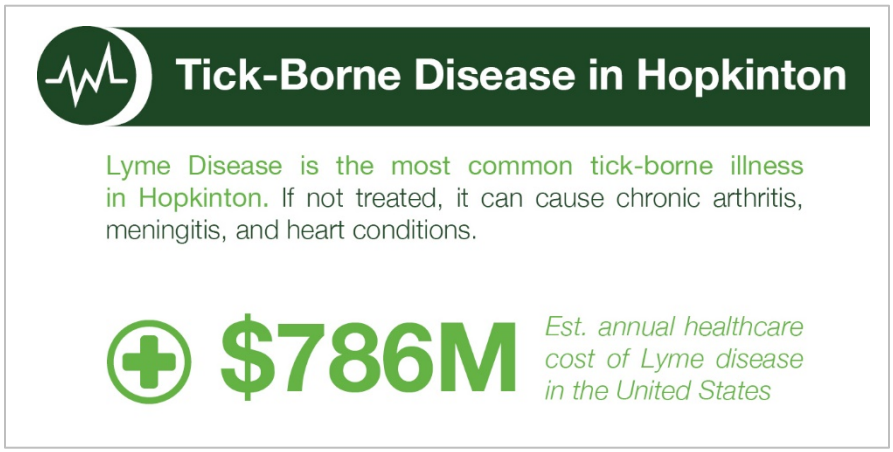

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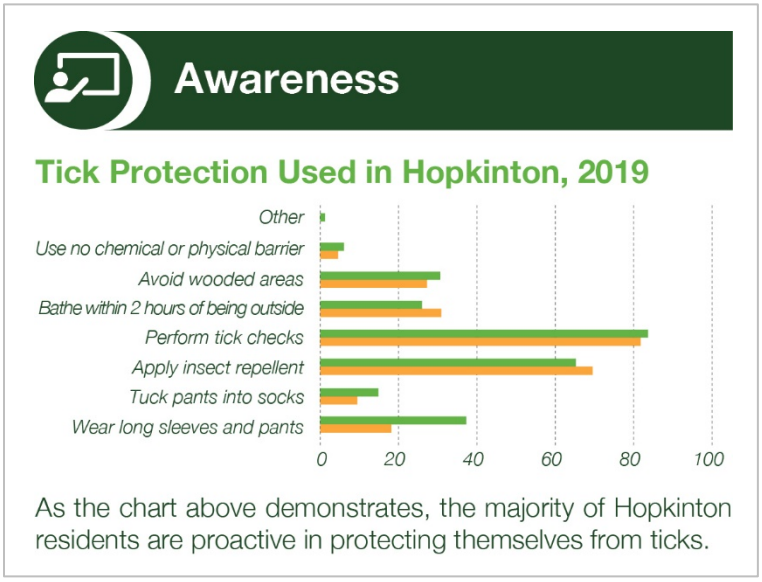

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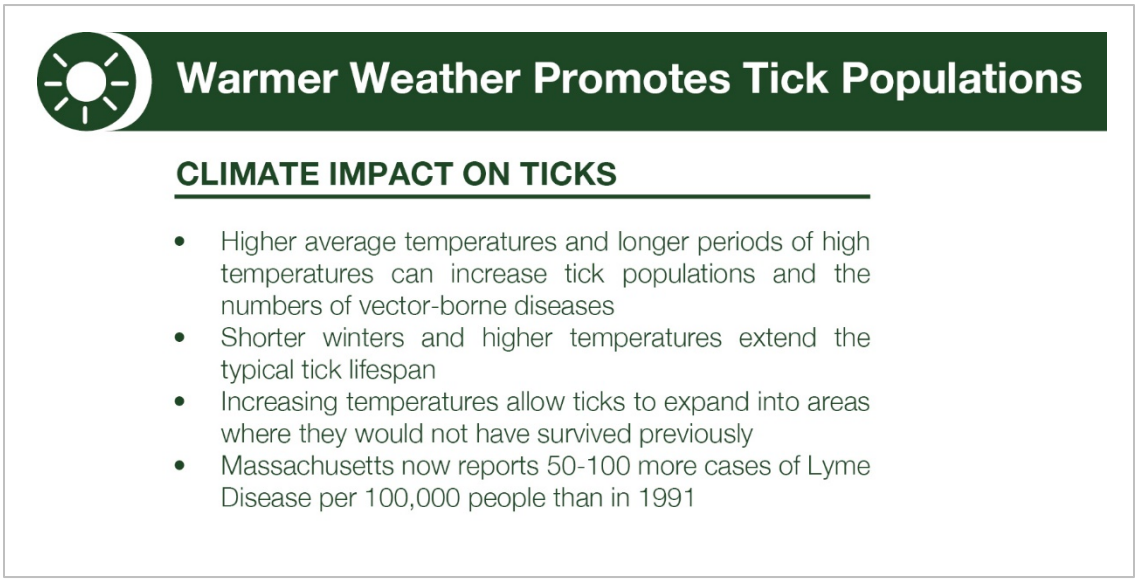

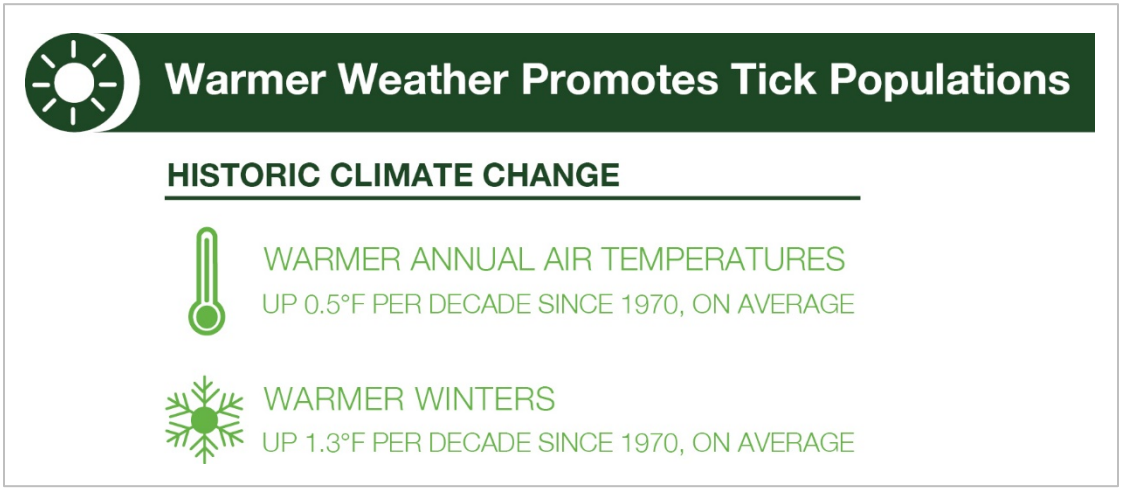

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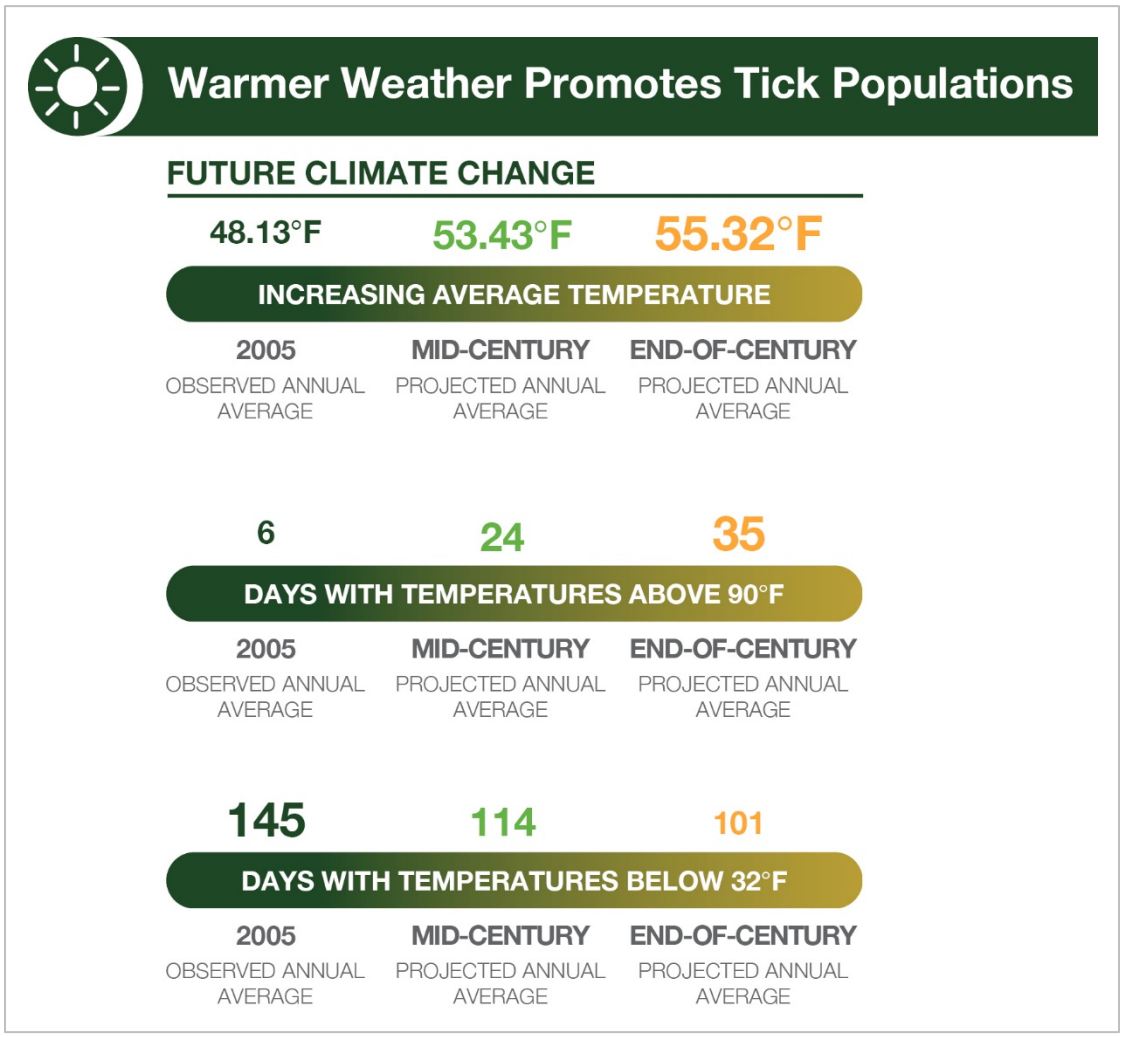

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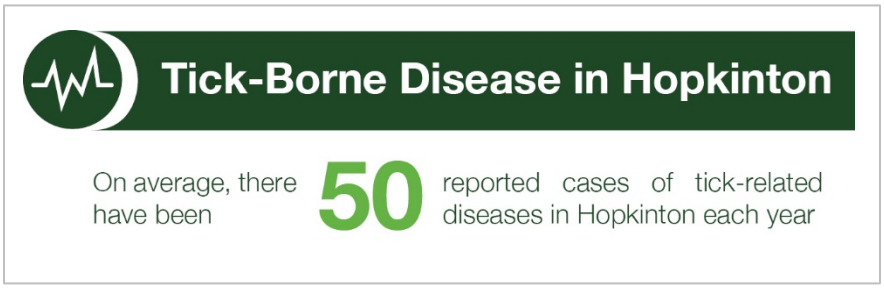

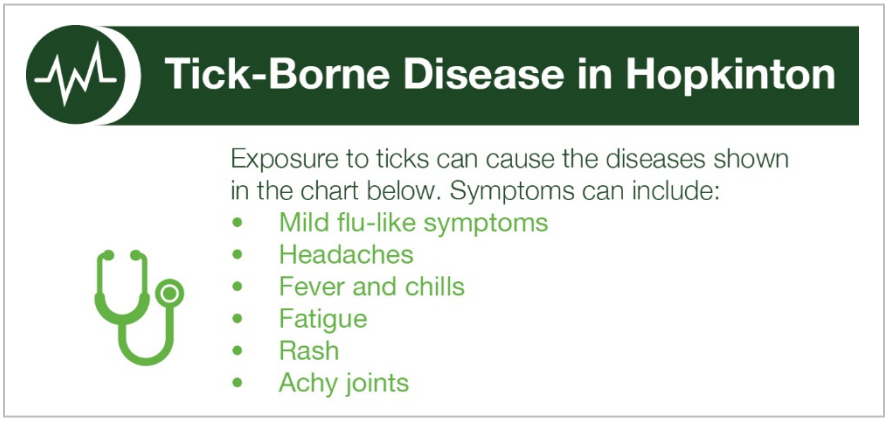

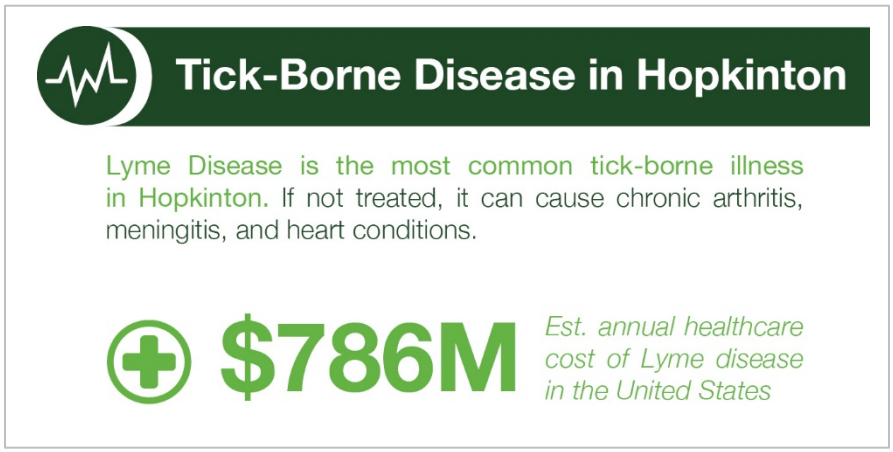

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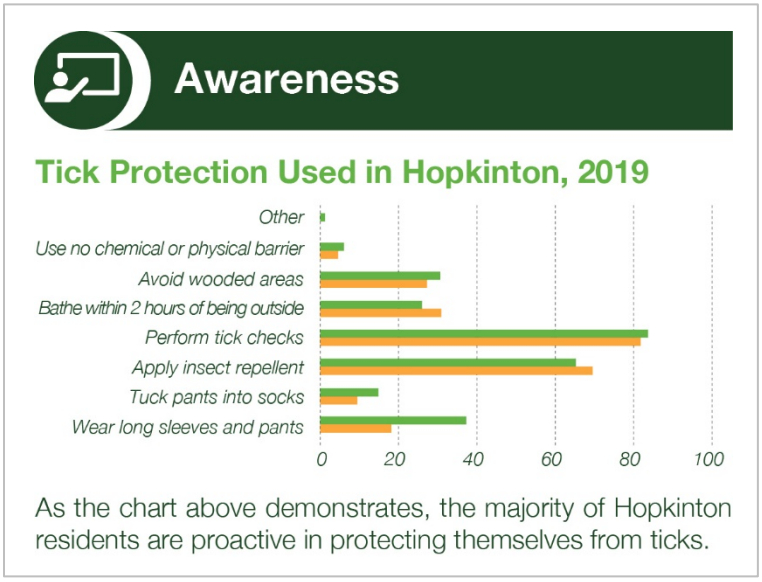

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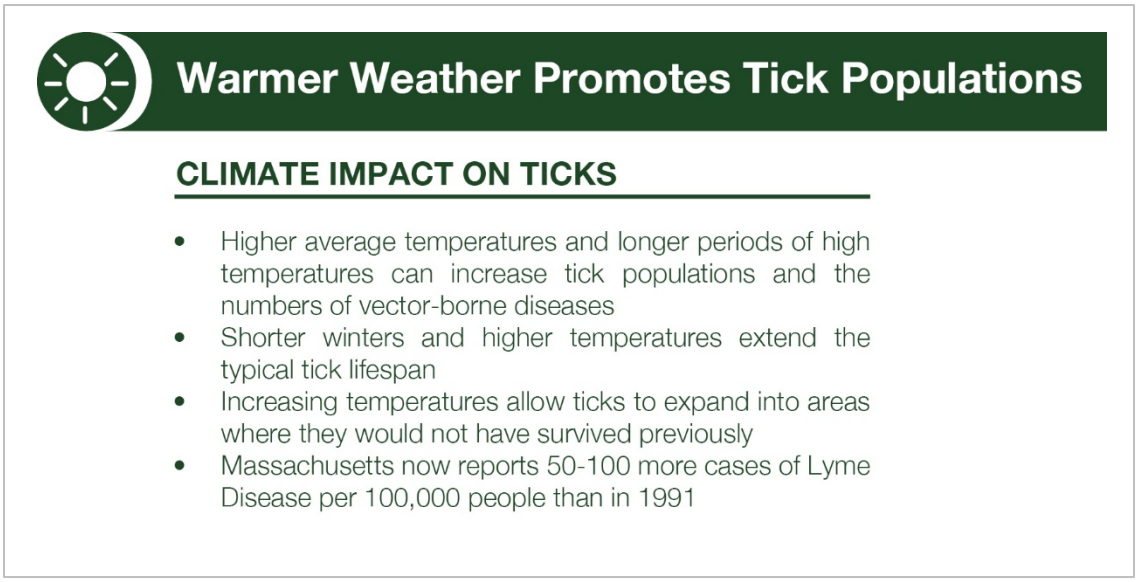

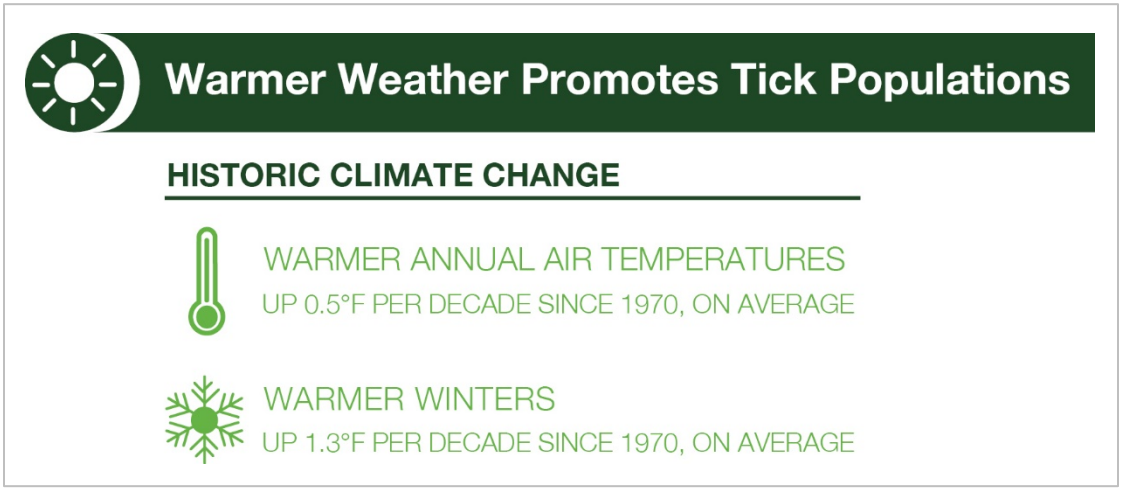

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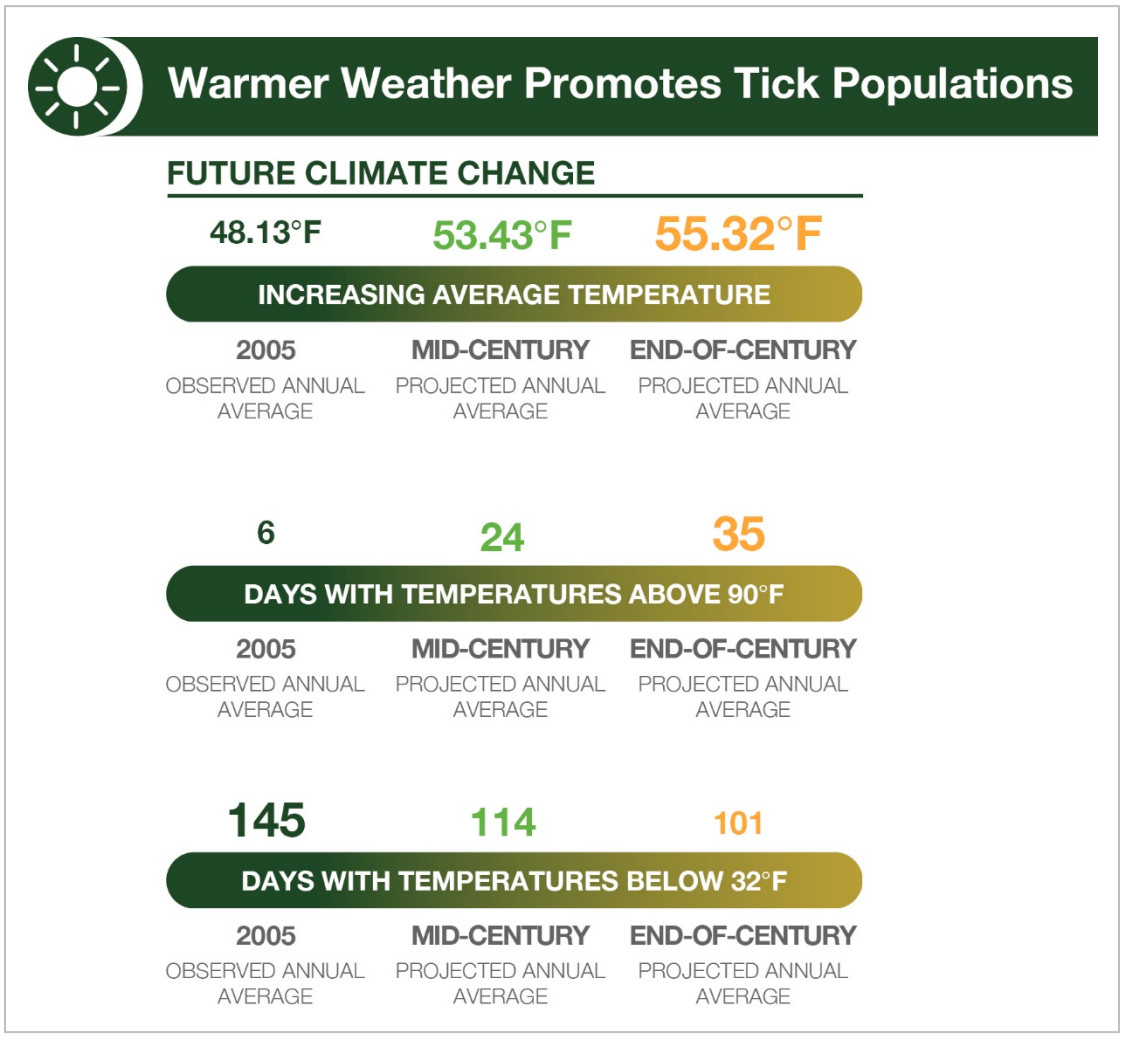

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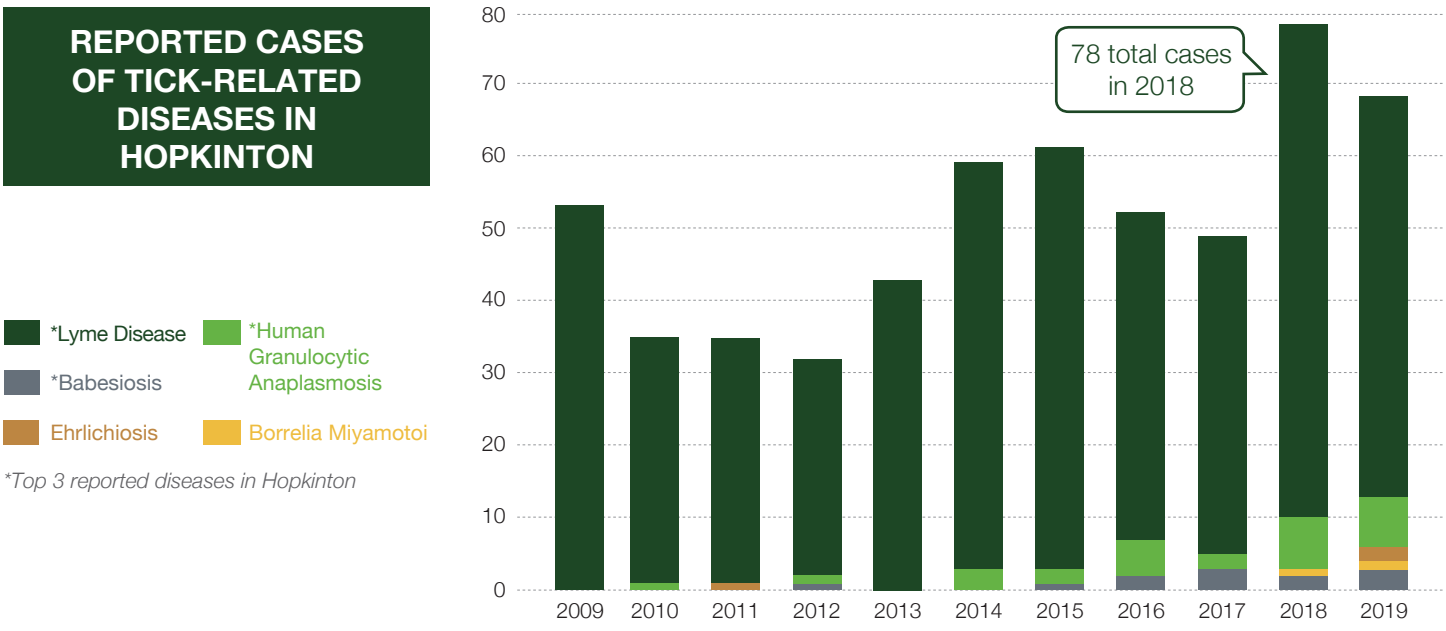

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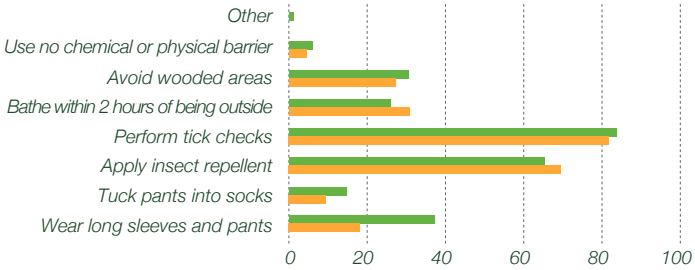

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Weston & Sampson℠

APPENDIX E

Town Approval

TOWN OF HOPKINTON

Office of
TOWN CLERK
18 MAIN STREET • HOPKINTON, MASSACHUSETTS 01748
Tel: (508) 497-9710 Fax: (508) 497-9786
townclerk@hopkintonma.gov

CERTIFICATE OF ADOPTION
SELECT BOARD

TOWN OF HOPKINTON, MASSACHUSETTS
A RESOLUTION ADOPTING THE
TOWN OF HOPKINTON
HAZARD MITIGATION PLAN and MUNICIPAL VULNERABILITY PREPAREDNESS
PLAN 2020

WHEREAS, the Town of Hopkinton established a Committee to prepare the Town of Hopkinton Hazard Mitigation Plan and Municipal Vulnerability Preparedness Plan 2020 Update; and
WHEREAS, the Town of Hopkinton Hazard Mitigation Plan and Municipal Vulnerability Preparedness Plan 2020 Update contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Hopkinton, and
WHEREAS, a duly-noticed public meeting was held by the Core Team on March 24, 2020 and WHEREAS, the Town of Hopkinton authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Town of Hopkinton SELECT BOARD adopts the Town of Hopkinton Hazard Mitigation Plan and Municipal Vulnerability Preparedness Plan 2020 Update, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Hopkinton.

ADOPTED AND SIGNED December 1st, 2020.

Connor B. Degan
Town Clerk

APPENDIX F

FEMA Approval

U.S. Department of Homeland Security
FEMA Region I
99 High Street, Sixth Floor
Boston, MA 02110-2132

FEMA

December 9, 2020

Samantha C. Phillips, Director
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, Massachusetts 01702-5399

Dear Director Phillips:

The U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) Region I Mitigation Division has approved the Town of Hopkinton 2020 Hazard Mitigation and Municipal Vulnerability Preparedness Plan effective **December 8, 2020** through **December 7, 2025** in accordance with the planning requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended, the National Flood Insurance Act of 1968, as amended, and Title 44 Code of Federal Regulations (CFR) Part 201.

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

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

Thank you for your continued commitment and dedication to risk reduction demonstrated by preparing and adopting a strategy for reducing future disaster losses. Should you have any questions, please contact Melissa Surette at (617) 956-7559 or Melissa.Surette@fema.dhs.gov.

Sincerely,

PAUL F FORD Digitally signed by PAUL F FORD
Date: 2020.12.09 07:42:43 -05'00'

Captain W. Russ Webster, USCG (Ret.), CEM
Regional Administrator
FEMA Region I

WRW:ms

cc: Sarah White, State Hazard Mitigation Officer, MEMA
Jeffrey Zukowski, Hazard Mitigation Planner, MEMA
Beth Dubrawski, Hazard Mitigation Contract Specialist, MEMA