TOWN OF TOPSFIELD

HAZARD MITIGATION PLAN

FINAL PLAN
APPROVED BY FEMA
November 29, 2021

U.S. Department of Homeland Security
FEMA Region I
99 High Street, Sixth Floor
Boston, MA 02110-2132

FEMA

November 30, 2021

Dawn Brantley, Acting Director
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, Massachusetts 01702-5399

Dear Acting Director Brantley:

The U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) Region I Mitigation Division has approved the Town of Topsfield Hazard Mitigation Plan effective **November 29, 2021** through **November 28, 2026** 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 Brigitte Ndikum-Nyada at (617) 378-7951 or brigitte.ndikum-nyada@fema.dhs.gov.

Sincerely,

Paul F. Ford
Acting Regional Administrator
DHS, FEMA Region I

PFF: bnn

cc: Jeffrey Zukowski, Hazard Mitigation Planner, MEMA
Marybeth Groff, CFM, Hazard Mitigation & Climate Adaptation Coordinator
Beth Dubrawski, Hazard Mitigation Contract Specialist, MEMA

ACKNOWLEDGEMENTS & CREDITS

This plan was prepared for the Town of Topsfield by the Metropolitan Area Planning Council (MAPC) under the guidance of the Massachusetts Emergency Management Agency (MEMA). The plan was funded by a FEMA Pre-Disaster Mitigation Grant administered by MEMA.

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President, Erin Wortman, Town of Stoneham
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Topsfield Hazard Mitigation and Municipal Vulnerability Preparedness Core Team

Jen Collins-Brown	Fire Chief, Emergency Management Director, Core Team Leader
David Bond	Former Highway Superintendent
Heidi Gaffney	Conservation Agent
Wendy Hansbury	Health Agent
Greg Krom	Water Superintendent
Jim MacDougall	Environmental expert, Resident member of many boards
Martha Morrison	Zoning and Planning Board

Cover flooding photo: Jim MacDougall

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SECTION 1: EXECUTIVE SUMMARY

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

In 2017, the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) inaugurated the Municipal Vulnerability Preparedness (MVP) program to assist municipalities in planning for and implementing strategies to adapt to predicted changes in our warming climate. The predicted changes include both increased flooding from large rain events and a greater likelihood of drought, increased extreme heat days and heat waves, and increased flooding from sea level rise.

The Town of Topsfield received a FEMA Pre-Disaster Mitigation grant in 2020 from the Massachusetts Emergency Management Agency to prepare this local Hazard Mitigation Plan, the first for Topsfield. The Town also received an MVP grant from the state in 2020, which supported the town's participation in a Community Resilience Building (CRB) Workshop held on April 14, 2021. The Town closely coordinated both projects, as they address similar topics of natural hazards and climate change The findings of the CRB workshop are published in a companion volume, *Topsfield Community Resilience Building Report*, and the high priority actions identified in the workshop are summarized in Appendix E of this plan. Some of those actions have been incorporated into this plan where appropriate. Communities that complete the MVP project become certified as an MVP Community and are eligible for follow-up funding through MVP Action Grants to implement some of the actions identified.

Taken together, this Hazard Mitigation Plan and the accompanying MVP report provide the Town with a holistic assessment and a strategy for actions moving forward for both hazard mitigation and climate change resiliency.

HAZARD MITIGATION PLANNING PROCESS

This the first Hazard Mitigation Plan prepared by the Town of Topsfield. The preparation of this plan was coordinated by the Topsfield Hazard Mitigation and Municipal Vulnerability Preparedness Core Team (HMP/MVP Core Team; see Table 5). The HMP/MVP Core Team concurrently led the Town's Municipal Vulnerability Project under a state MVP grant and coordinated the two related projects. The Town procured planning assistance from its Regional Planning Agency, the Metropolitan Area Planning Council, to conduct both projects concurrently.

The Topsfield HMP/MVP Core Team met five times on the following dates: July 15, 2020, November 4, 2020, February 26, 2021, April 8, 2021, and May 20, 2021. During these meetings, the team reviewed where the impacts of natural hazards most affect the town,

developed the inventory of the town's Critical Facilities and development sites, reviewed the Town's existing mitigation measures, and developed and prioritized the recommended mitigation measures for the plan's mitigation strategy.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the Town takes to mitigate them. The Topsfield HMP/MVP Core Team hosted two public meetings, the first on October 19, 2020, hosted by the Topsfield Select Board, and the second on June 24, 2021 (see Appendix B). As part of the related MVP project, the town also hosted a Community Resilience Building workshop on April 14, 2021, where 30 participants identified climate resilience vulnerabilities and mitigation strategies. After the workshop, a Public Listening Session was held in conjunction with the second Hazard Mitigation Plan public meeting on June 24, 2021. Key town stakeholders and neighboring communities were notified and invited to review the draft plan and MVP Report and submit comments. The draft *Topsfield Hazard Mitigation Plan* and the *Topsfield Community Resilience Building Report* were posted on the MAPC website for public review at the June 24, 2021, public meeting.

RISK ASSESSMENT

The Topsfield Hazard Mitigation Plan assesses the potential impacts to the town from flooding, high winds, winter storms, wildfires, geologic hazards, extreme temperatures, and drought. For each risk, the assessment identifies the current hazards as well as projected future impacts of a warming climate. These hazards are also shown in the hazards map series in Appendix A. The Topsfield HMP/MVP Core Team identified 42 Critical Facilities. These are also shown on the map series and listed in Table 35, identifying which facilities are located within the mapped hazard areas.

MAPC used Hazards U.S.– Multihazards (HAZUS-MH), a standardized computer methodology developed by FEMA that utilizes Geographic Information Systems (GIS), to estimate physical, economic, and social impacts of disasters. The HAZUS-MH analysis for Topsfield estimates property damages from Hurricanes of 100 year and 500-year magnitude ($5.55 million to $18.97 million), earthquakes of magnitudes 5 and 7 ($150.9 million to $613.6 million), and the 1% and 0.2% chance of flooding ($3.03 million to $6.74 million).

HAZARD MITIGATION GOALS

The following mitigation goals are intended to guide this plan and the Town's implementation of its mitigation strategy after the plan is adopted:

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

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

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

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

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

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

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

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

9. Educate the public about natural hazards, climate change, and mitigation measures.

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

HAZARD MITIGATION STRATEGY

The Topsfield HMP/MVP Core Team identified 25 mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events (see Table 42). Overall, the hazard mitigation strategy recognizes that mitigating hazards for Topsfield will be an ongoing process as our understanding of natural hazards and the steps that can be taken to mitigate their damages changes over time. Global climate change and a variety of other factors will impact the Town's vulnerability in the future, and local officials will need to work together and with state and federal agencies in order to understand and address these changes. The Hazard Mitigation Strategy will be incorporated into the Town's other related plans and policies.

PLAN REVIEW PROCESS

The process for developing the Topsfield Hazard Mitigation Plan is summarized in Table 1.

Table 1 Plan Review Process:

Section of Plan	Processes and Tasks
Section 3: Public Participation	The Topfield HMP/MVP Core Team placed an emphasis on public participation for the preparation of this Hazard Mitigation Plan. During plan development, the plan was discussed at two public meetings hosted by the Select Board on October 19, 2020 and by the Topsfield

Section of Plan	Processes and Tasks
	HMP/MVP Core Team June 24, 2021. The draft plan was also available on the MAPC website for public comment after the second meeting. In addition, as part of the concurrent MVP project, a Community Resilience Building Workshop was held on April 14, 2021, and a Public Listening Session was held on June 24, 2021 in conjunction with the second Hazard Mitigation public meeting
Section 4: Risk Assessment	MAPC gathered the most recently available hazard and land use data and met with town staff to identify local hazard areas and development trends. Town staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list and GIS mapping. The Risk Assessment integrates projected climate impacts. MAPC also used the most recently available version of HAZUS to assess the potential impacts of flooding, hurricanes, and earthquakes on the Town.
Section 5: Goals	The Hazard Mitigation Goals were prepared to include a focus on mitigating local hazards as well as climate change.
Section 6: Existing Mitigation Measures	A list of existing mitigation measures was prepared to reflect the current status mitigation activities in the town and help identify gaps or areas of potential improvement.
Sections 7 Hazard Mitigation Strategy	The Plan's hazard mitigation strategy reflects both measures developed by the Topsfield HMP/MVP Core Team, and resilience actions identified by the Community Resilience Building workshop from the MVP project. The mitigation measures were prioritized based on current conditions.
Section 8: Plan Adoption & Maintenance	This section of the plan presents a process for ongoing implementation, maintenance, and updating of the plan over its five-year term. This process will assist the Town in incorporating hazard mitigation measures into other Town planning and regulatory processes and better prepare the Town for the next comprehensive plan update in 5 years.

Moving forward into the next five-year plan implementation period there will be many opportunities to incorporate hazard mitigation into the Town's decision-making processes. The Town will document any actions taken within this five-year cycle of the Hazard Mitigation Plan and take note of challenges met and actions successfully adopted as part of the ongoing plan implementation and maintenance to be conducted by the Topsfield Hazard Mitigation Implementation Committee, as described in Section 8, Plan Adoption and Maintenance.

SECTION 2 INTRODUCTION

PLANNING REQUIREMENTS UNDER THE FEDERAL DISASTER MITIGATION ACT

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

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

Massachusetts has taken a regional approach and has encouraged regional planning agencies like MAPC to prepare plans for their member communities. The Town of Topsfield contracted with the Metropolitan Area Planning Council (MAPC) to assist the Town in preparing its Hazard Mitigation Plan. This plan is designed to meet the requirements of the Disaster Mitigation Act for the Town of Topsfield while also addressing climate change impacts through the closely related Municipal Vulnerability Preparedness (MVP) project also prepared by MAPC in conjunction with this plan.

WHAT IS A HAZARD MITIGATION PLAN?

Natural hazard mitigation planning is the process of determining how to systematically reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities.

The Town of Topsfield received an MVP Planning Grant to conduct a Municipal Vulnerability Preparedness project concurrently with the preparation of this plan. Many of the required steps of the MVP process also satisfy requirements for updating an HMP. As a result, the Town with assistance from MAPC prepared this Hazard Mitigation Plan in accordance with FEMA guidelines for hazard mitigation planning (Title 44 Code of Regulations (CFR) 201.6) and an MVP Final Report according to the Community Resilience Building (CRB) guidance provided by the Massachusetts Executive Office of Energy & Environmental Affairs' (EEA). This enabled Topsfield to consider the effects of a warming climate more robustly in its hazard mitigation planning, following the lead established by the Commonwealth when it adopted the first-ever Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018).

PREVIOUS FEDERAL/STATE DISASTERS

The Town of Topsfield, a part of Essex County, has experienced 28 natural hazards that triggered federal or state disaster declarations since 1991. These are listed in Table 2 below. The majority of these events involved flooding, while five were due to hurricanes or nor'easters, and four were due to severe winter weather.

Table 2: Previous Federal/State Disaster Declarations

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
Hurricane Bob (August 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (16 projects)
No-Name Storm (October 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	FEMA Individual Household Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (10 projects)
December Blizzard (December 1992)	FEMA Public Assistance Project Grants	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk (7 projects)
March Blizzard (March 1993)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 1996)	FEMA Public Assistance Project Grants	All 14 Counties
May Windstorm (May 1996)	State Public Assistance Project Grants	Counties of Plymouth, Norfolk, Bristol (27 communities)
October Flood (October 1996)	FEMA Public Assistance Project Grants	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	FEMA Individual Household Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk (36 projects)

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
1997	Community Development Block Grant-HUD	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
June Flood (June 1998)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (19 projects)
(1998)	Community Development Block Grant-HUD	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
March Flood (March 2001)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (16 projects)
February Snowstorm (Feb 17-18, 2003)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
Hurricane Katrina (August 29, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
May Rainstorm/Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide
April Nor'easter (April 15-27, 2007)	Hard Mitigation Grant Program	Statewide
Flooding (March 2010)	FEMA Public Assistance FEMA Individuals and Households Program SBA Loan	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Statewide
Hurricane Earl (September 2010)	FEMA Public Assistance Project Grants	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, and Worcester
Tropical Storm Irene (August 27-28, 2011)	FEMA Public Assistance	Statewide
Hurricane Sandy (October 27-30, 2012)	FEMA Public Assistance	Statewide

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
Severe snowstorm and Flooding (February 8-09, 2013)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Blizzard of 2015 (January 26-28, 2015)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Severe Winter Storm (March 2-3, 2018)	FEMA Public Assistance; Hazard Mitigation Grant Program	Salem, Suffolk, Norfolk, Bristol, Plymouth, Barnstable Counties
Severe Winter Storm (March 13-14, 2018)	FEMA Public Assistance; Hazard Mitigation Grant Program	Salem, Suffolk, Norfolk, Worcester Counties

Source: database provided by MEMA

FEMA FUNDED MITIGATION PROJECTS

The Town of Topsfield has not applied for or received funding from FEMA for hazard mitigation or flood mitigation projects under the Hazard Mitigation Assistance (HMA) program.

COMMUNITY PROFILE

Topsfield is located in Essex County and is bordered by Danvers and Middleton on the south, Boxford on the west, Ipswich on the north, and Hamilton and Wenham on the east. Topsfield is about 25 miles north of Boston and 15 miles south of Newburyport. It is home to two state roadways, Route 1 and Route 97, and a segment of Interstate Route 95, which has several exits onto local roads that connect directly to Topsfield. Public transportation is not provided in Topsfield, although commuter rail stations are located in the neighboring communities of Hamilton, Wenham, and Ipswich.

The town is governed by a Select Board and a Town Administrator. The town operates under the open town meeting format. The Town Administrator, appointed by the Select Board, carries out the day-to-day governing functions of the town.

Topsfield has a rich history. The Town was initially home to the Agawam tribe. The land for the Town was deeded by Chief Masconomet to John Winthrop in 1638 for twenty sterling pounds, following the reduction in the indigenous population after a smallpox epidemic. The Town of Topsfield was officially incorporated in 1650. For most of the eighteenth century, the local economy was primarily supported by independent farmers who also engaged in blacksmithing and gristmill operating. The 1800s saw new industry and business in Topsfield, such as shoe factories, stores, and inns.

The completion of the Newburyport Turnpike in 1805 and railroad in 1854, gave Topsfield the new status of a commuter-friendly town. As the Town moved towards the twentieth century, farming and shoe manufacturing slowly disappeared, and the Town gradually became a predominantly single-family residential community with a small downtown primarily serving residents. The town's character changed yet again after World War II, when construction of Interstate Route 95 and other highway improvements made the town much more accessible and helped its population to grow to its present size of about 6,568. *(from Topsfield Historical Society)*

Topsfield values its history and is home to a National Register Historic District that is also a local Historic District. The Topsfield Town Commons, one of the best-preserved town commons in New England, features historic municipal and private structures from a number of eras of American architecture surrounding an open green area, including the Veterans' Memorial Green with commemorative war memorials. Among the structures around the Common are the Parson Capen House, a National Register Landmark maintained by the Topsfield Historical Society, the 1842 archetypal white steepled meetinghouse and the Federal-style Emerson Center belonging to the Congregational Church, and the Town's Victorian Gothic Town Hall, Georgian Revival Library and Proctor School. *(from Topsfield Open Space and Recreation Plan, 2019)*

Today Topsfield remains a predominantly residential community. According to the US Census, 6,568 people live in the town. Other demographic features are summarized in Table 3.

Table 3: Topsfield Demographic Characteristics

Population = 6,568 people

- 6.2% are under age 5
- 23.3% are over age 65
- 10.2 % have a disability
- 6.7 % are over 65 with a disability
- 5.6% of householders are living alone
- 4.5% of householders are over 65 living alone
- 1.4% speak English less than very well
- 3.1% of households have no vehicle available
- Over 97% of the population is White
- 2% of the population is Asian

Number of Housing Units = 2,287

- 2,206 occupied housing units
- 15.7% of housing units were built before 1950
- 90.3% are owner-occupied housing units
- 9.7% are renter-occupied housing units

Source: 2019 American Community Survey

The Ipswich River is one of the most important natural features in the Town. However, in 2003 and again in 2021the Ipswich River was designated by the environmental group, American Rivers, as one of the country's ten most endangered rivers. The river's source is in Wilmington, Massachusetts, and it flows in a northeast direction for about forty-five miles to Ipswich, where it empties into the Atlantic Ocean. More than seven miles of the river flows through Topsfield. The river also has several tributaries throughout Town, namely, Fish, Mile, School, Pye, and Howlett Brooks. In recent history, sections of the Ipswich River upstream of Topsfield have reported to have been "pumped dry" in the summer to meet increasing water demands of some of the 14 communities drawing from its watershed. The restriction of water use based on river flow has helped improve the condition of the Ipswich River, though continuing development in the watershed communities continues to pressure the river's water levels, endangering its quality, and the river's ability to sustain its native fish and wildlife population. *(from Topsfield Open Space and Recreation Plan, 2019)*

Topsfield has several unique characteristics to keep in mind while planning for natural hazards:

- Topsfield is a relatively small community in a suburban/rural setting yet is located within commuting distance to Boston and the Route 128 corridor.
- One third of the land is protected open space and the town has extensive tree cover.
- The public water system relies on wells that withdraw from the Ipswich River watershed; about 20% of the town is not on the public water system and uses private wells.
- There is no public sewer system; all development uses on-site septic systems.
- There are no hospitals in Topsfield – the closest are the Beverly Hospital and the ER at Lahey in Peabody.

The Town of Topsfield maintains a website at www.topsfield-ma.gov

SECTION 3 PLANNING PROCESS & PUBLIC PARTICIPATION

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

PLANNING PROCESS SUMMARY

The six-step planning process outlined in Figure 1 below is based on the guidance provided by FEMA's Local Multi-Hazard Mitigation Planning Guidance. Public participation is a central element of this process, which attempts to focus on local problem areas and identify needed mitigation measures based on where gaps occur in the existing mitigation efforts of the municipality. The process described below allows MAPC to bring the most recent hazard information into the plan, including hazard occurrence data, critical facilities, and the municipality's existing mitigation measures.

Figure 1:Six-Step Planning Process

1. **Map the Hazards** – MAPC relies on data from a number of different federal, state, and local sources in order to map the areas with the potential to experience natural hazards, including FEMA and the Northeast States Emergency Consortium (NESEC). This mapping represents a multi-hazard assessment of the municipality and is used as a set of base maps for the remainder of the planning process. A particularly important source of information is the knowledge drawn from local municipal staff on where natural hazard impacts have occurred. These maps can be found in Appendix A.

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

    - General Bylaws of the Town of Topsfield
    - Zoning By-law of the Town of Topsfield
    - Wetlands Bylaw of the Town of Topsfield
    - Groundwater Protection Bylaw of the Town of Topsfield
    - Low Impact Development Guidelines, Topsfield Planning Board
    - Town of Topsfield Open Space and Recreation Plan, 2019
    - Downtown Topsfield Revitalization Plan, MAPC, 2019
    - Blue Hill Observatory
    - FEMA, Flood Insurance Rate Maps for Essex County, MA, 2013
    - FEMA, Hazards U.S. Multi-Hazard
    - FEMA, Local Mitigation Plan Review Guide, October 2011
    - Fourth National Climate Assessment, 2018
    - Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams 2018
    - Massachusetts State Hazard Mitigation Plan, 2013
    - Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data
    - National Weather Service
    - New England Seismic Network, Boston College Weston Observatory, http://aki.bc.edu/index.htm
    - NOAA National Centers for Environmental Information, http://www.ncdc.noaa.gov/
    - Northeast Climate Adaptation Science Center
    - Northeast States Emergency Consortium, http://www.nesec.org/
    - Salem and Beverly Water Supply Board, Putnamville Dam Emergency Action Plan
    - Tornado History Project
    - US Census, 2010 and American Community Survey 2019 5-Year Estimates
    - USDA Forest Service, Wildfire Risk to Communities, www.wildfirerisk.org

- USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis
- Topsfield Historical Society, http://www.topsfieldhistory.org

3. **Review Existing Mitigation** – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as most have adopted flood plain zoning districts, wetlands protection programs, and other measures as well as enforcing the State building code, which has strong provisions related to hazard resistant building requirements. All current municipal mitigation measures are documented in the plan (Section 6).

4. **Develop Mitigation Strategies** – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Section 7.

5. **Plan Approval & Adoption** – Once a final draft of the plan is complete it is sent to MEMA for the state level review and, following that, to FEMA for approval. Typically, once FEMA has approved the plan the agency issues a conditional approval (Approval Pending Adoption), with the condition being adoption of the plan by the municipality. More information on plan adoption can be found in Section 9 and documentation of plan adoption can be found in Appendix D.

6. **Implement & Update the Plan** – Implementation is the final and most important part of any planning process. Hazard Mitigation Plans must also be updated on a five-year basis making preparation for the next plan update an important on-going activity. Section 8 includes more detailed information on plan implementation.

THE HAZARD MITIGATION PLANNING AND MVP CORE TEAM

MAPC worked with community representatives to convene a Topsfield HMP/MVP Core Team. Since the Town conducted a Municipal Vulnerability Preparedness project concurrently with this plan, both projects were coordinated by the Topsfield HMP/MVP Core Team. MAPC briefed the local representatives as to the desired composition of that team as well as the need for public participation in the local planning process.

The Topsfield HMP/MVP Core Team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The local team was tasked with working with MAPC to provide information on critical facilities and the hazards that impact the town, existing mitigation measures, and helping to develop new mitigation measures for this plan. The HMP/MVP Core Team membership can be found in Table 4.

The Topsfield HMP/MVP Core Team met on the following four dates: July 15, 2020, November 4, 2020, February 26, 2021, April 8, 2021, and May 20, 2021. The purpose of the meetings was to introduce the FEMA Hazard Mitigation planning program and the Municipal Vulnerability Preparedness project and gather information on local hazard mitigation issues and sites or areas

related to these. The team also coordinated the Community Resilience Building Workshop under the Town's MVP grant. Earlier Core Team meetings focused on preparation for that event.

Table 4: Topsfield HMP/MVP Core Team Members

Name	Title
Jen Collins-Brown	Fire Chief, Emergency Management Director, Core Team Leader
David Bond	Former Highway Superintendent
Heidi Gaffney	Conservation Agent
Wendy Hansbury	Health Agent
Greg Krom	Water Superintendent
Jim MacDougall	Environmental expert, Resident member of many boards
Martha Morrison	Zoning and Planning Board

Later meetings of the Core Team focused on verifying information gathered by MAPC staff for the Hazard Mitigation Plan, updating existing mitigation practices, and developing recommended mitigation measures for this plan. The agendas for these meetings are included in Appendix B.

The Topsfield Planning Board, Zoning Board, and Conservation Commission are the primary entities responsible for regulating development in town. Feedback from the Planning and Zoning Boards and the Conservation Commission was assured through the participation of a member of the Planning and Zoning Boards as well as a representative of the Conservation Commission on the HMP/MVP Core Team. In addition, MAPC, the State-designated regional planning authority for Topsfield, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as the MassDOT (which includes MassHighway and MBTA) and the Department of Conservation and Recreation (responsible for open space and dams). This involvement ensured that during the development of the Topsfield Hazard Mitigation Plan, the operational policies and any mitigation strategies or identified hazards from these entities were considered.

PUBLIC MEETINGS

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

To gather this information and educate residents on hazard mitigation, the Town held two public meetings, one hosted by the Select Board on October 19, 2020, during the planning process, and one held on June24, 2021, when the draft plan was available for review.

In addition to the two public meetings, Topsfield held a Municipal Vulnerability Preparedness workshop attended by 30 people, including town staff, board and committee members, representatives of local businesses, farms, and community organizations, and state legislators. The workshop focused on climate impacts on infrastructure, natural resources, and society. The priority actions identified at the workshop are presented in Appendix E.

The public had an opportunity to provide input to the Topsfield hazard mitigation planning process during a public meeting held remotely via Zoom by the Topsfield Select Board on October19, 2020. The draft plan was presented at a remote public meeting via Zoom on June 24, 2021in conjunction with a public listening session on the Community Resilience Building workshop. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. The meeting announcements, press advisories, and meeting agendas can be found in Appendix C.

LOCAL STAKEHOLDER INVOLVEMENT

The Topsfield HMP/MVP Core Team was encouraged to reach out to local stakeholders that might have an interest in the Hazard Mitigation Plan including neighboring communities, agencies, businesses, nonprofits, and other interested parties. Notice was sent to the following organizations and neighboring municipalities inviting them to attend the public meeting to review the Hazard Mitigation Plan and submit comments to the Town:

- Topsfield Conservation Administrator
- Council on Aging/Senior Services
- Topsfield Public Works Department
- Fire Department/Emergency Mngt.
- Topsfield Health Agent
- Topsfield Health Board Chair
- Topsfield Open Space Comm.
- Planning/Community Development
- Topsfield Water Department
- Congregational Church minister
- Trinity Church, Interim Rector
- Topsfield Historical Society
- Essex County Greenbelt Association
- Economic Community Develop. Comm.
- Ebsco
- Topsfield Fair
- GREEN Topsfield
- Rep. Brad Hill's office
- District Director for Sen. Joan B. Lovely
- Chief of Staff for Sen. Joan B. Lovely
- National Grid
- Salem-Beverly Water Supply Board
- Ipswich River Watershed Association
- Essex County Trail Association
- MVP Regional Coordinator
- Police Department
- Town of Boxford
- Town of Danvers
- Town of Hamilton
- Town of Ipswich
- Town of Middleton
- Town of Wenham

See Appendix C for public meeting notices.

PUBLIC COMMENT

The draft *Topsfield Hazard Mitigation Plan* was posted on the MAPC website for the second public meeting on June 24, 2021. Members of the public could access the draft plan and submit comments or questions to the Town. Participants in the Hazard Mitigation Plan public meeting / MVP Listening Session on June 24, 2021, had an opportunity to comment on the draft Hazard Mitigation Plan as well as the Community Resilience Building Workshop recommendations. Both documents were available on the MAPC website for public review and comment.

CONTINUING PUBLIC PARTICIPATION

Following the approval and adoption of the Topsfield Hazard Mitigation Plan, the Topsfield Hazard Mitigation Implementation Committee will continue to provide residents, businesses, and other stakeholders the opportunity to learn about the hazard mitigation planning process and to contribute information that will update the town's understanding of local hazards.

Over the next five-year planning cycle, as updates and a review of the plan are conducted by the Topsfield HMP/MVP Core Team, these will be placed on the Town's website, and any meetings of the Topsfield HMP/MVP Core Team will be publicly noticed in accordance with state open meeting laws.

PLANNING TIMELINE

July 15, 2020	Meeting#1 of the Topsfield Hazard Mitigation and MVP Core Planning Team
October 19, 2020	First Public Meeting hosted by the Topsfield Select Board (Virtually)
November 4, 2020	Meeting#2 of the Topsfield Hazard Mitigation and MVP Core Planning Team
February 26, 2021	Meeting#3 of the Topsfield Hazard Mitigation and MVP Core Planning Team
April 8, 2021	Meeting#4 of the Topsfield Hazard Mitigation and MVP Core Planning Team
April 14, 2021	Community Resilience Building Workshop (MVP project)
May 20, 2021	Meeting#5 of the Topsfield Hazard Mitigation and MVP Core Planning Team
June 24, 2021	Hazard Mitigation Plan Public Meeting and MVP Listening Session (Virtually)
August 2, 2021	Draft *Topsfield Hazard Mitigation Plan* submitted to MEMA
September 15, 2021	Revised Draft Topsfield Hazard Mitigation Plan submitted to MEMA
October 22, 2021	Revised Draft Topsfield Hazard Mitigation Plan submitted to MEMA
October 28, 2021	Notice of plan Approvable Pending Adoption sent by FEMA
November 22, 2021	Final Plan Adopted by the Topsfield Select Board
November 29, 2021	FEMA final approval of the Plan for 5 years, until November 28, 2026

POST-PLAN APPROVAL IMPLEMENTATION TIMELINE

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

If the Town wishes to apply for a FEMA grant to prepare the next plan update, due in 2026, a grant application should be submitted approximately two years before this plan expires, in order to allow time for the grant to be approved (about 1 year), and the next plan update to be completed (about 9 months to 1 year), before this plan expires. See Section 8 for more details on plan adoption and maintenance.

2023	Conduct Mid-Term Plan Survey on Progress
2024	Seek FEMA grant to prepare next plan 5-year update
2025	Begin process to update the plan
2026	Submit Draft 2026 Plan Update to MEMA and FEMA
2026	FEMA approval of 2026 Plan Update

SECTION 4: RISK ASSESSMENT

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

In this 2021 plan, the projected impacts of our warming climate on natural hazards are integrated throughout the risk assessment. Key impacts include rising temperatures, which in turn affect precipitation patterns, sea level, and extreme weather.

> *"Global climate is changing rapidly compared to the pace of natural variations in climate that have occurred throughout Earth's history. Global average temperature has increased by about 1.8°F from 1901 to 2016, and observational evidence does not support any credible natural explanations for this amount of warming; instead, the evidence consistently points to human activities, especially emissions of greenhouse or heat-trapping gases, as the dominant cause."*
>
> *Fourth National Climate Assessment, 2018 (Chapter 2-1)*

Climate Change Observations and Projections

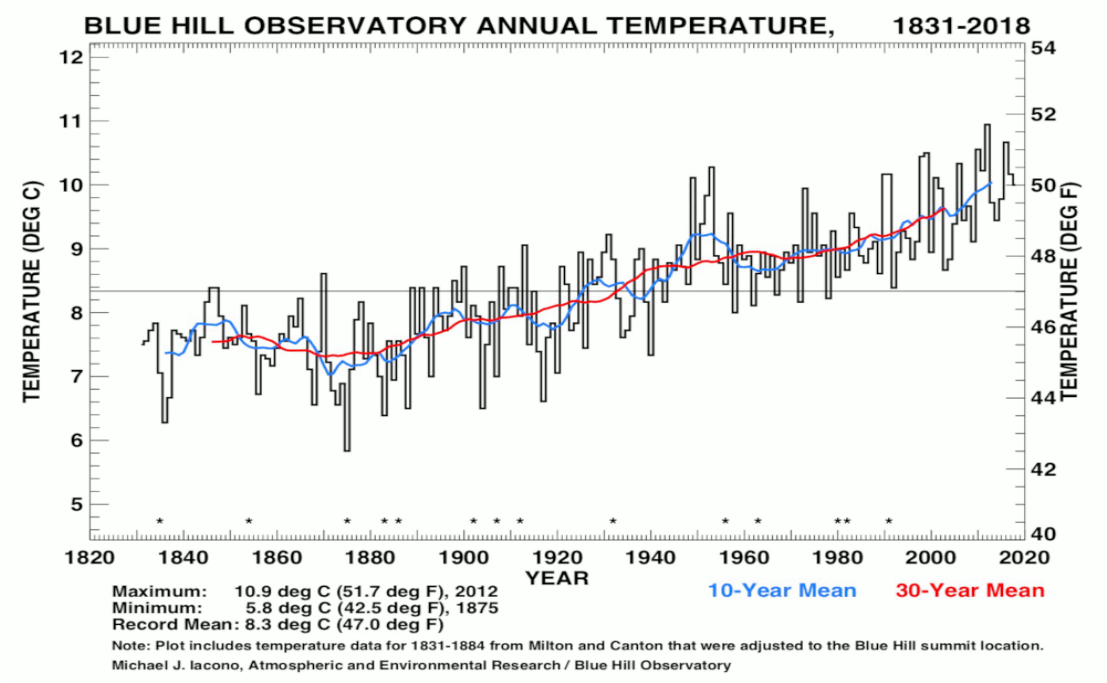
Climate change observations come from a variety of data sources that have measured and recorded changes in recent decades and centuries. Climate change projections, however, predict future climate impacts and by their nature cannot be observed or measured. As a result of the inherent uncertainty in predicting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

Temperature

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

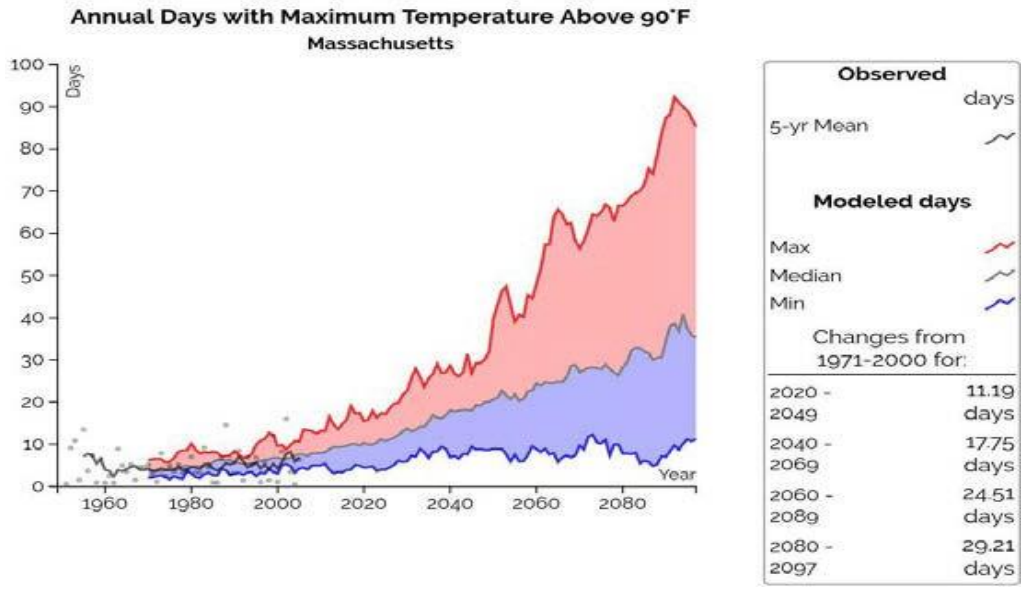
Records from the Blue Hill Observatory in Milton, MA show that average temperatures (30-year mean) have risen approximately 3 degrees (F) in the almost 200 years since record keeping began in 1831(Figure 2).

Figure 2: Observed Increase in Temperature



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

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

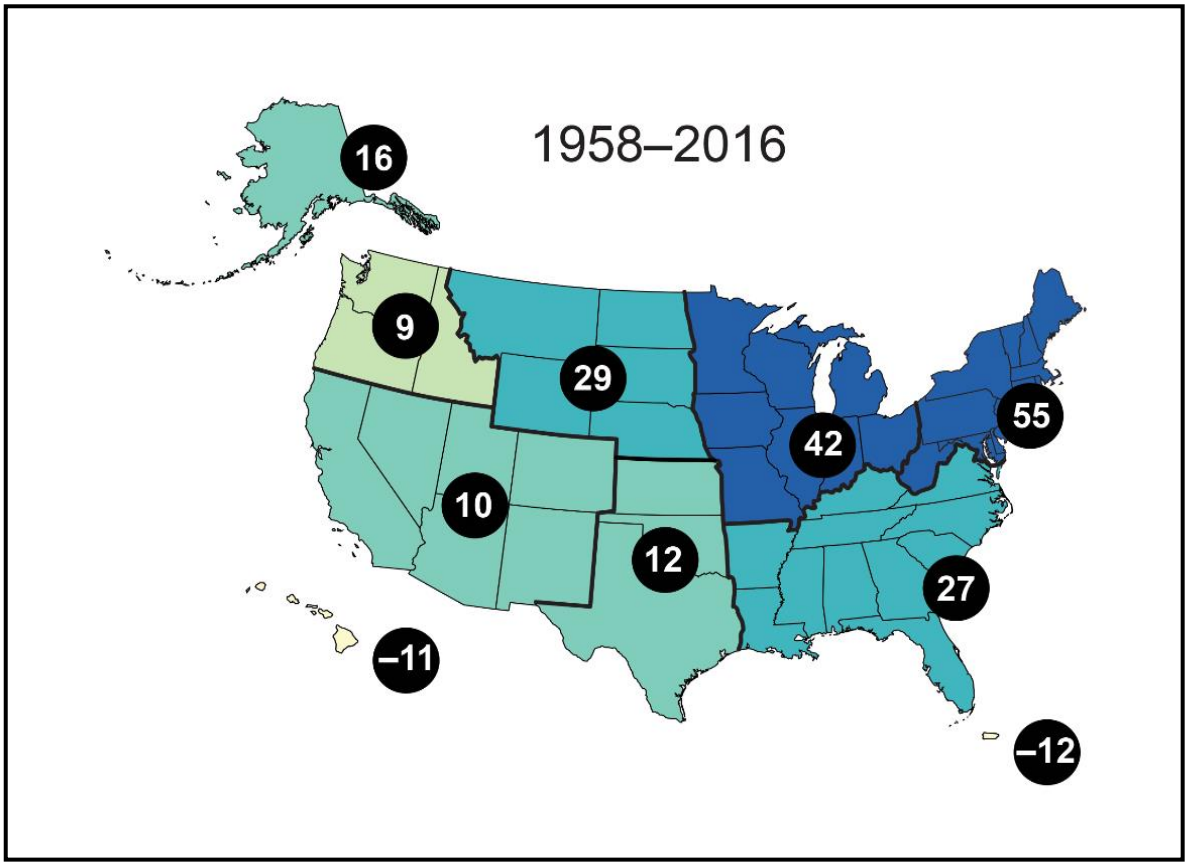


Source: Northeast Climate Adaptation Science Center

Precipitation Patterns

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

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



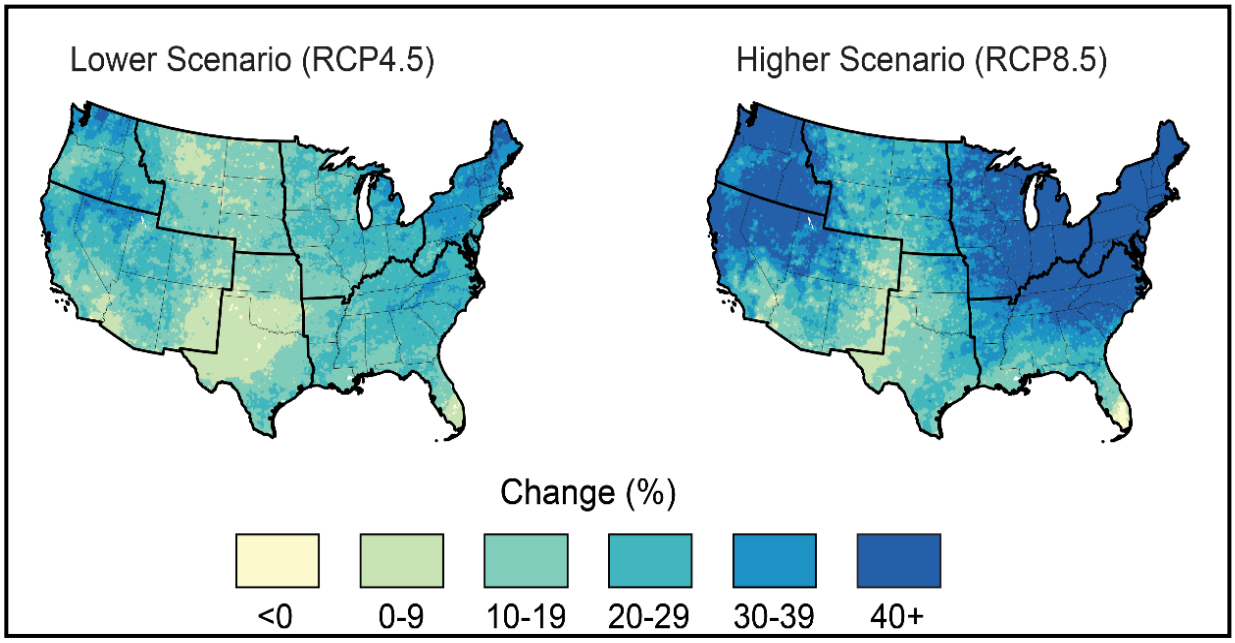
Circled numbers indicate % change.

Source: Fourth National Climate Assessment, 2018

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

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

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



Source: Fourth National Climate Assessment, 2018

Sea Level Rise

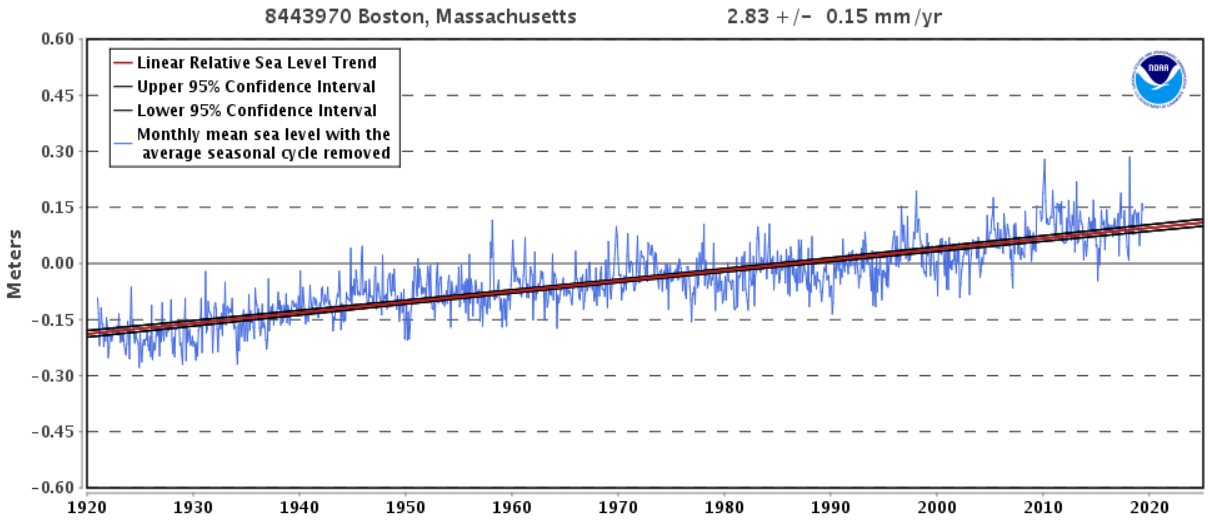
Although Topsfield is not a coastal community, information on sea level rise is included in the plan as some Topsfield residents may have jobs in Boston or other coastal communities, and the greater metropolitan regional economy may be impacted by sea level rise in the future.

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

Projections of sea level rise through 2100 vary significantly depending on future greenhouse gas emissions and melting of land-based glaciers. Currently sea levels are rising at an increasing rate. Figure 7 shows projections for the current rate of sea level rise, as well as for lower and higher greenhouse gas emission scenarios and a higher scenario with greater ice melt. Projections for

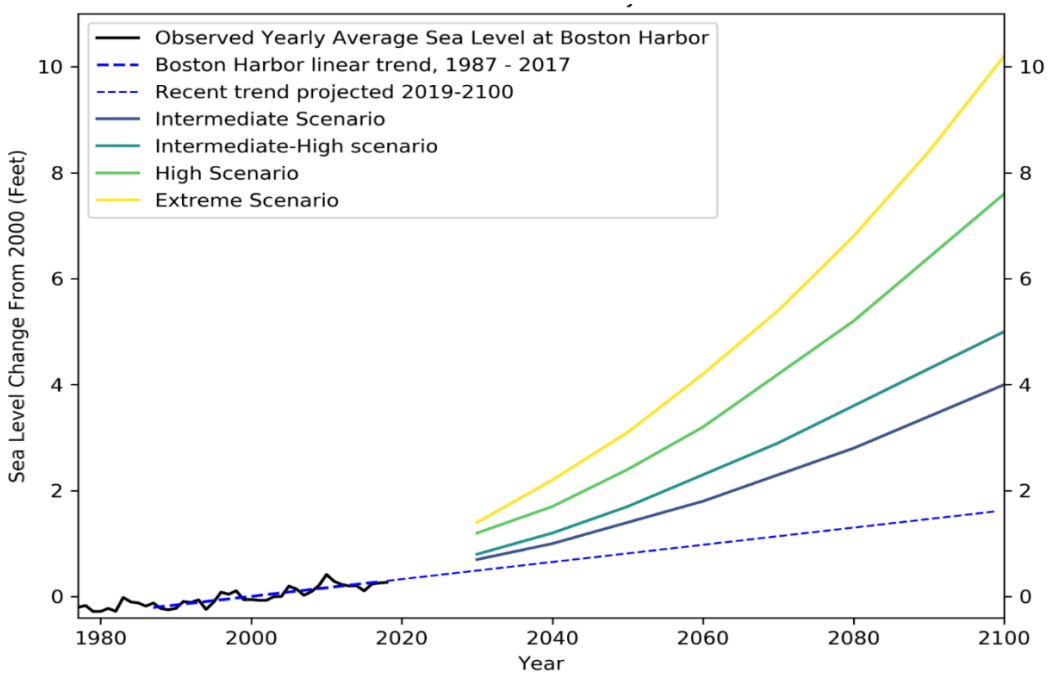
2100 range from 2 feet to 5 feet, to almost 9 feet for the most extreme scenario. However, by 2050 all of the scenarios suggest roughly one foot of sea level rise above the year 2000.

Figure 6:Observed Increase in Sea Level Rise



Source: NOAA

Figure 7: Recent and Projected Increase in Sea Level Rise

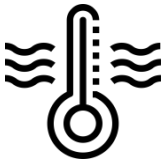


Source: Adapted from the Northeast Climate Adaptation Center data

Following the general outline of the Massachusetts State Hazard Mitigation and Climate Adaptation Plan, this local hazard mitigation plan organizes consideration of natural hazards based on their relationship to projected climate changes. The one exception is that where coastal

and inland flooding are interrelated, they will be considered together. Table 5 below, from the SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts.

Table 5: Climate Change and Natural Hazards

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

OVERVIEW OF HAZARDS AND IMPACTS

Table 6 summarizes the hazard risks for the state and the Town of Topsfield. This evaluation takes into account the frequency of the hazard, historical records such as the National Climatic Data Center data for Essex County, the Topsfield HMP/MVP Core Team, and variations in geography and local climate. The statewide assessment was modified to reflect local conditions in Topsfield using the definitions for hazard frequency and severity listed below.

Table 6: Hazards Risk Summary

Hazard	Frequency		Severity	
	Massachusetts	Topsfield	Massachusetts	Topsfield
Inland Flooding	High	High	Serious	Serious
Drought	Medium	Medium	Minor	Minor
Landslides	Low	Very Low	Minor	Minor
Coastal Flooding	High	N/A	Serious	N/A
Coastal Erosion	Highly variable	N/A	Serious	N/A
Tsunami	Very Low	N/A	Extensive	N/A
Extreme Temperatures	High	High	Minor	Minor
Wildfires	High	High	Minor	Serious
Hurricane/Tropical Storm	Medium	Medium	Serious	Serious
Severe Winter Storms/Nor'easters	High	High	Extensive	Serious
Tornadoes	Medium	Very Low	Serious	Serious
Severe Weather Thunderstorms/Winds	High	High	Minor	Minor
Earthquake	Very Low	Very Low	Extensive	Extensive

Frequency

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

Severity

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

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

- **Coastal Flooding, Coastal Erosion, and Tsunami** are not applicable to Topsfield since is not a coastal community
  .
- **Ice jams** are not a hazard in Topsfield. The US Army Corps Ice Jam Database shows no record of ice jams on the Ipswich River in Topsfield, and the Town did not identify this as an issue of concern.

FLOOD-RELATED HAZARDS

Flooding was one of the most prevalent natural hazards identified by local officials in Topsfield. The town is subject to two kinds of flooding, riverine flooding, generally within FEMA designated flood hazard areas, and localized flooding caused by stormwater drainage problems, which is not necessarily located within FEMA flood hazard areas.

Both kinds of flooding are generally caused by severe rainstorms, thunderstorms, Nor'easters, and hurricanes. Spring snowmelt may exacerbate flooding during storm events. Nor'easters are most common in winter. Hurricanes are most common in the summer and early fall, as are thunderstorms.

The Town's major waterways are the Ipswich River and its tributaries Fish Brook, Howlett Brook, Mile Brook and Pye Brook. Floodplains in the town generally border these major waterbodies, adjacent low-lying areas, and ponds formed naturally and from man-made dams. Topsfield has an area of extensive wetlands, resulting in a moderate risk of flooding. The FEMA Flood Insurance Rate Maps (FIRM) for Essex County delineate the areas subject to a 1% annual chance of flooding (formerly "100 year" floodplains) and those subject to a 0.2% annual chance of flooding ("500 year" floodplains). See Map 3 in Appendix A for these delineated flood hazard areas.

However, Topsfield has a significant amount of open space and strict land use controls that minimize development and impervious area that might otherwise exacerbate any flooding.

Flooding in Topsfield is occasional, with most flooding related to drainage in low-lying areas, stormwater, and beaver activity. The terrain may cause occasional street flooding as well as undersized drainage infrastructure. Damage is generally property-related and consists of flooded lawns, basements, farms, and roads.

Topsfield has a public water supply system that serves about 80 percent of the town, with the remaining properties using private wells. The Town does not have a municipal wastewater system, so all residences and businesses use on-site septic system. In some cases, flooding of septic systems may be a concern.

Regionally Significant Storms

There have been a number of major rainstorms that have resulted in significant flooding in northeastern Massachusetts over the last fifty years. Significant storms include:

- March 1968
- January 1979
- April 1987
- October 1991
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- March 2013
- January 2018
- March 2018

The best available local data on previous flooding events are for Essex County through the National Centers for Environmental Information. Essex County experienced 40 flood events from 2006 to 2020 (see Table 7). There were 2 deaths and 3 injuries reported and the total property damage in the county was over $20.6 million dollars. The March 2010 storms account for $13.1 million of those total damages from 2010 to 2020.

The impacts of flooding on the Town of Topsfield are not quite as severe as many neighboring communities, but still may be locally significant. Potential damages from flooding in the town were estimated using FEMA's HAZUS-MH program. The results, shown in Table 38, indicate potential damages from a 1% Annual Chance Flood (100-year) at $3.03 million and from a 0.2% Annual Chance Flood (500-year) at $6.74 million. Localized areas of flood vulnerability are listed below.

Table 7: Essex County Flood Events, 2006- 2020

Date	Deaths	Injuries	Property Damage ($)
07/11/2006	0	0	10.00K
07/28/2006	0	0	20.00K
03/02/2007	0	0	20.00K
04/16/2007	0	0	45.00K
02/13/2008	0	0	30.00K
08/08/2008	0	0	25.00K
09/06/2008	0	0	5.00K
03/14/2010	0	1	9.800M
03/30/2010	0	2	3.270M
04/01/2010	0	0	0.00K
08/05/2010	0	0	7.00K
08/25/2010	0	0	0.00K
10/04/2011	0	0	305.00K
06/23/2012	0	0	0.00K
08/10/2012	0	0	0.00K
06/24/2013	0	0	5.00K

Date	Deaths	Injuries	Property Damage ($)
07/01/2013	0	0	0.00K
07/27/2014	0	0	0.00K
10/23/2014	0	0	30.00K
12/09/2014	0	0	0.00K
08/18/2015	0	0	0.00K
09/30/2015	0	0	0.00K
06/29/2016	0	0	0.00K
04/06/2017	0	0	0.00K
06/27/2017	0	0	2.00K
07/08/2017	0	0	0.00K
07/18/2017	0	0	0.00K
09/06/2017	0	0	0.00K
09/15/2017	0	0	10.00K
09/30/2017	0	0	4.00K
10/25/2017	0	0	0.00K
01/13/2018	0	0	5.00K
08/11/2018	0	0	10.00K
11/03/2018	0	0	0.00K
04/15/2019	0	0	0.00K
07/31/2019	0	0	3.00K
09/02/2019	0	0	10.50K
7/13/20	0	0	1.00K
7/23/20	0	0	0.00K
9/10/20	0	0	1.00K
TOTAL	2	3	**20.62 M**

Source: NOAA, National Centers for Environmental Information

Based on the record of previous occurrences flooding events in Topsfield are a high frequency event as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in five years, or a greater than 20% chance per year.

LOCALLY IDENTIFIED AREAS OF FLOODING

Information on potential flood hazard areas was taken from two sources. The first was the National Flood Insurance Rate Maps, mentioned above. Secondly, the Topsfield HMP/MVP Core Team provided their local knowledge to delineate the "Locally Identified Areas of Flooding" where local flooding is known to occur. These areas do not necessarily coincide with the flood hazard zones from the FIRM maps. Flood sources may include inadequate drainage systems, undersized culverts, beaver activity, high groundwater, or other local conditions.
These sites are listed in Table 8 and mapped on Map 8 in Appendix A. The site numbers in Table 8 correspond to the numbers on Map 8, "Local Hazard Areas."

Table 8: Topsfield Locally Identified Areas of Flooding

1	Ipswich Road at Howlett Brook
2	Asbury Street river flooding
3	Boston Street
4	Salem Road at Ipswich River
5	High Street at Ipswich River
6	Rail Trail at Ipswich River
7	Rowley Bridge at Ipswich River
8	Washington Street at Fish Brook
9	River Street at Fish Brook
10	Lockwood Lane culvert
11	Maple Street
12	Wheatland Field
14	Topsfield Fairgrounds
13	Boston Street (1)
15	Boston Street (2)
16	Boston Street (3)
17	Garden Street
18	Perkins Row
19	Driveway to Audubon Sanctuary
23	Haverhill Road at Pye Brook culvert
24	Boxford Road culvert

Members of the Topsfield Core Team provided background information on some of these sites.

1. **Ipswich Road at Howlett Brook:** Formerly there was a culvert at this site, which was modified to a bridge when it was reconstructed following the damages of the2007 Mother's Day storm. There was a sinkhole the granite double culvert, and an eight-inch concrete slab was installed over the whole facility to stabilize it. This is considered to be an interim repair; a longer-term solution would be to raise the road at this location.

2. **Asbury Street river flooding:** the roadway was replaced in 2008. Water overtops the road at the northern end at the Ipswich River. Raising the road here would not be a feasible option.

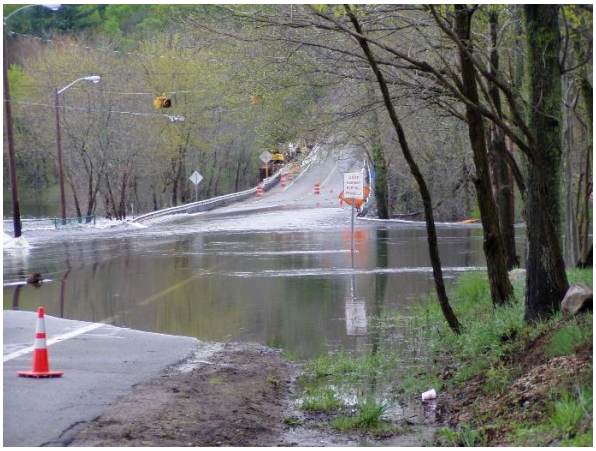
3. **Boston Street (Route 1)** near Topsfield Fairgrounds: a few homes have experienced flooding in extreme rainfall events such as the 2007 Mother's Day storm and the storms of 2010. The bridge here is 50 feet over the river, so elevation would not be practical.

4. **Salem Road and River Road**: the roadway can flood at this location; water overtops the road before the bridge, but no homes are affected. No practical mitigation project was identified for this site.

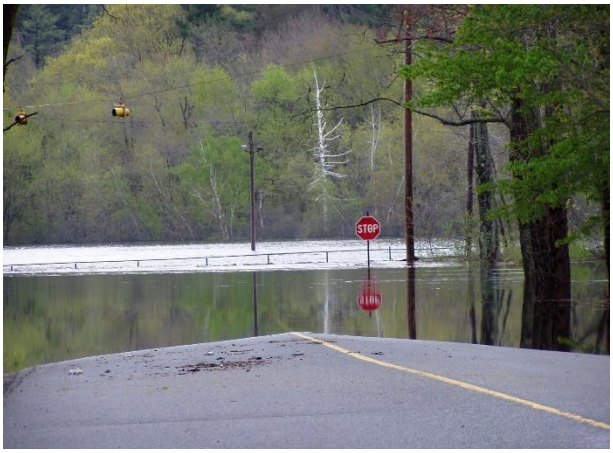
Figure 8: Topsfield Locally Identified Areas of Flooding

Asbury Street

Howlett Brook at Ipswich Road



Route 1



Main Street at Route1

Photo credit: Jim MacDougall

5. **High Street at Ipswich Road (Route 97**): this only floods in extreme precipitation events. It's a state-owned facility, so the Town would not be involved with any project here.

7. **Rowley Bridge Road**: a new pile-driven understructure and new bridge beams have been installed at this bridge.

8. **Washington Street at Fish Brook:** this is a two-channel granite culvert. The facility straddles the municipal boundary with Boxford. A potential upgrade for this site might be installation of a box culvert. The two towns developed a proposed project to upgrade this facility a few years ago, but the need for emergency repairs at other locations in Boxford had to take priority over this project. There is still the potential for a joint improvement project between the two towns in the future; this is included in the mitigation strategy.

9. **River Street at Fish Brook:** This is a bridge constructed of pre-stressed concrete slabs. The road floods on both sides of the bridge. The Town has not identified a feasible mitigation project for this site.

10. **Lockwood Land culvert:** this culvert appears to act as a choke point in local drainage. Replacement of this culvert appears to be a feasible mitigation option and is included in this plan's mitigation strategy.

11. **Maple Street culvert:** this is next to the Topsfield Fairgrounds. The culvert is in bad condition and likely is restricting flow at this site. A culvert replacement appears to be a feasible mitigation option and is included in this plan's mitigation strategy.

12. **Wheatland Field:** low lying land subject to occasional flooding. No feasible mitigation project was identified at this location.

13. **Topsfield Fairgrounds parking lot:** low lying land subject to occasional flooding. No feasible mitigation project was identified at this location.

Repetitive Loss Structures

As defined by FEMA, a repetitive loss property is a NFIP-insured structure that has had two or more paid flood losses of $1,000 or more in any given 10-year period since 1978. For more information on repetitive losses see https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt and https://www.fema.gov/repetitive-flood-claims-grant-program-fact-sheet.

According to FEMA records, there are 8 Repetitive Loss structures in Topsfield, which are summarized in Table 9. These 8 properties had 16 flood losses which totaled $316,719 in claims, of which $220,393 was damage to buildings and $141,325 was damage to contents. Of the 8 Repetitive Loss properties, 6 are located in a 1% annual chance of flooding zone, and 2 are in a 0.2% annual chance of flooding zone. Seven of the 8 Repetitive Loss structures are classified as Single Family Residential, and one structure is classified as Non-Residential.

Table 9: Repetitive Loss Properties in Topsfield

Community	State	Regional	National		
		AE, A1-30, AO, AH, A	VE, V1-30, V	B, C, X	TOTAL
RL Buildings (Total)		6	0	2	8
RL Buildings (Insured)		0	0	0	0
RL Losses (Total)		12	0	4	16
RL Losses (Insured)		0	0	0	0
RL Payments (Total)		$277,003.44	$.00	$84,715.67	$361,719.11
Building		$158,001.33	$.00	$62,392.02	$220,393.35
Contents		$119,002.11	$.00	$22,323.65	$141,325.76

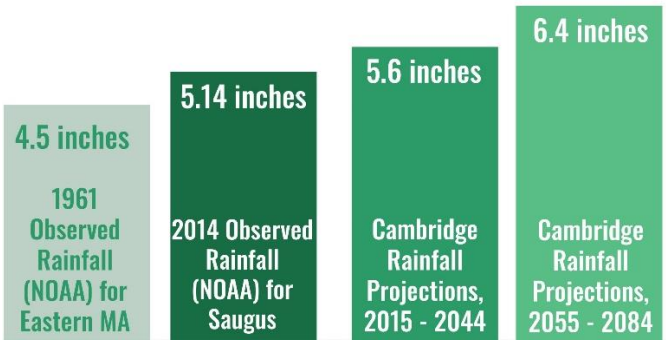
Source: FEMA Flood Insurance Program

FLOODING AND CLIMATE CHANGE

Due to climate change, scientists project an increase in severity and frequency of precipitation events. Because of its location in the Ipswich River watershed, extreme precipitation events and changing precipitation patterns could increase the frequency and severity of flooding in Topsfield. Annual precipitation in Massachusetts has already increased by approximately 10% in the fifty-year period from 1960 to 2010 (MA Climate Change Adaptation Report 2011). Moreover, for the Northeast US, according to the U.S. National Climate Assessment, 2014, there was a 71% increase in the amount of rain that falls in the top 1% of storm events for the period 1958-2012.

Precipitation frequency estimates, which are used to derive stormwater design standards, were published in 196l by the U.S. Commerce Department in a document known as TP-40 (Technical Paper 40). The 10-year, 24-hour storm for eastern Massachusetts was calculated as a 4.5-inch event. Recently the National Oceanic and Atmospheric Administration published updated estimates (NOAA Atlas 14), which increased this design storm by 0.6 inches to 5.14 inches for eastern Massachusetts. In the future, based on projections developed for the City of Cambridge, the region will likely experience more frequent and intense precipitation events, including an increase in the standard "design storm" from historic levels of 4.5 inches to 6.4 inches by the late 21st century (Figure 9). According to data on ResilientMA.org, by mid- to late century, the region can anticipate 9-10 days with precipitation events with greater than one inch of rain, and an increase in total annual precipitation from 46 to 50 inches.

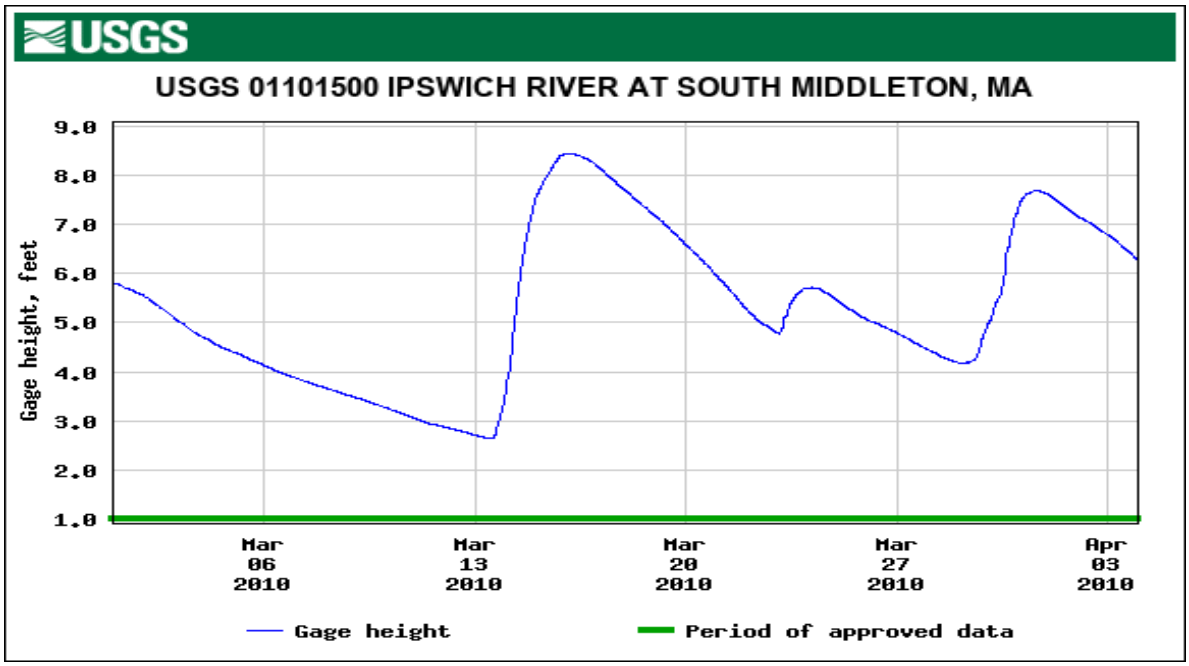
Figure 9: Design Storm Trends and Projections for the 10-year, 24-hour Storm



Sources: NOAA; Cambridge Climate Vulnerability Assessment. Part 1. April 2017

The March 2010 rainstorms in Massachusetts fit the profile of a type of event expected to increase in frequency as the climate warms. That is, significant precipitation, falling in late winter, on frozen ground, as rain rather than snow. The Blue Hill Observatory in Milton recorded 17.7 inches of rain from three storms in the 19 days from March 13 to 31. As shown in the USGS Ipswich River gage at South Middleton (Figure 10), the closest gage to Topsfield, river levels surged with each storm . The river's level peaked at 8.4 feet after the first storm on March 13 and peaked again to about 7.8 feet after the March 29 storm. By comparison, the normal river level at this time of year is 3 to 4 feet.

Figure 10: March 2010 USGS Ipswich River Gage



Source: USGS National Water Information System

The March 2010 storms were a federally declared disaster making federal assistance available to property owners who did not carry flood insurance. Based on the flood damage claims, Topsfield experienced moderate flood damage from the March 2010 storms. There were 65 flood insurance and 5 disaster claims, 90% of which were outside of FEMA Special Flood Hazard Areas (1% or 0.2% annual chance of flooding). The greatest concentration of claims was located in the western part of town, between Washington Street Fish Brook. (see Map 3 in Appendix A).

DAM FAILURE

Dam failure can arise from two types of situations. Dams can fail because of structural problems or age, independent of any storm event. Dam failure can follow an earthquake by causing structural damage. Dams can fail structurally because of flooding arising from a storm or they can overspill due to flooding.

In the event of a dam failure, the energy of the water stored behind a dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the area in the path of the dam's floodwaters.

An issue for dams in Massachusetts is that many were built in the 19th century without the benefits of modern engineering or construction oversight. In addition, some dams have not been properly maintained. The increasing intensity of precipitation is the primary climate concern for dams, as they were most likely designed based on historic weather patterns.

Dam failure is a highly infrequent occurrence, but a severe incident could result in loss of lives and significant property damage. According to the Association of State Dam Safety Officials, three dams have failed in Massachusetts since 1984, one of which resulted in a death.

The Department of Conservation and Recreation (DCR) Office of Dam Safety lists 10 dams in Topsfield (Table 10). Two of the dams are owned by the Town of Topsfield, four are owned by the state (DCR), three are small privately owned dams, and one is owned by the Salem and Beverly Water Supply Board.

DCR classifies dam hazards as shown below. It should be noted that the DCR Hazard Classification is not based on the condition of a dam or its likelihood of failing, but rather on the potential damages that could be incurred should the dam fail, based on its location and the downstream properties that could be impacted. There are no high hazard dams in Topsfield. Nine of the ten dams in town are not significant enough to have a hazard rating from DCR. Only one dam, the Bethune Pond Dam owned by the Salem and Beverly Water Supply Board, is rated significant.

DCR Dam Hazard Classification

The Massachusetts DCR has three hazard classifications for dams:

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

However, there is a dam in the neighboring Town of Danvers that Topsfield takes note of because it is upstream on the Ipswich River, and the area of potential impact in the event of a dam failure would include parts of Topsfield. This is the Putnamville Reservoir dam, owned by the Salem and Beverly Water Supply Board. It is classified by DCR as a high hazard dam, and an Emergency Action Plan (EAP) has been prepared by the dam owner and shared with the Town of Topsfield.

According to the EAP, the Putnamville Reservoir is impounded by a main dam and three dikes. The location of these is shown in Figure 11. The Main Dam is a zoned earth fill dam that is approximately 1,400 feet long, with a maximum height of 37.4 feet, and has maximum water surface elevation of 83.8 feet above MSL The upstream face is a 2.5:1 (horizontal: vertical) slope covered with riprap. The downstream face is a 2:1 slope covered with vegetation. A concrete spillway and discharge channel are located 475 feet north of the south abutment of the main

dam. The spillway design flood is 462 cubic feet per second (cfs) and spillway capacity is 960 cfs, discharging to an unnamed tributary of the Ipswich River.

Table 10: Inventory of Dams in Topsfield

Dam Name	River	Impoundment Name	Owner	Owner Type	Hazard Potential Classification
Mile Brook Dam	Tributary of Ipswich River	Mile Brook	Massachusetts Audubon Society	Private	Low
Hood Pond Dam	Pye Brook	Hood Pond	Town of Topsfield, Select Board	Municipality	N/A
Howlett Brook Dam	Howlett Brook	Howlett Brook	Unregulated dam	Private	N/A
Pleasure Pond Dam	Mile Brook	Mile Brook	Unregulated dam	Private	N/A
Peirce Pond Dam		Peirce Pond	Salem-Beverly Water Supply Bd.	Municipality	N/A
Bethune Pond Dam	Tributary to Ipswich River	Bethune Pond	145 Salem Road Realty Trust	Private	Significant
Ipswich Pond Dam	Tributary of Ipswich River	Ipswich Pond	Dept. of Conservation & Recreation	State-DCR MassParks	N/A
Farm Trail Pond	Tributary of Ipswich River	Farm Trail Pond	Dept. of Conservation & Recreation	State-DCR MassParks	N/A
Otter Pond Dam	Tributary of Ipswich River	Otter Pond	Dept. of Conservation & Recreation	State-DCR MassParks	N/A
Bradley Palmer Entrance Dam	Tributary of Ipswich River	Entrance Pool	Dept. of Conservation & Recreation	State-DCR MassParks	N/A
Putnamville Reservoir Dam (in Danvers)	Tributary of Ipswich River	Putnamville Reservoir	Salem-Beverly Water Supply Bd	Municipality	High

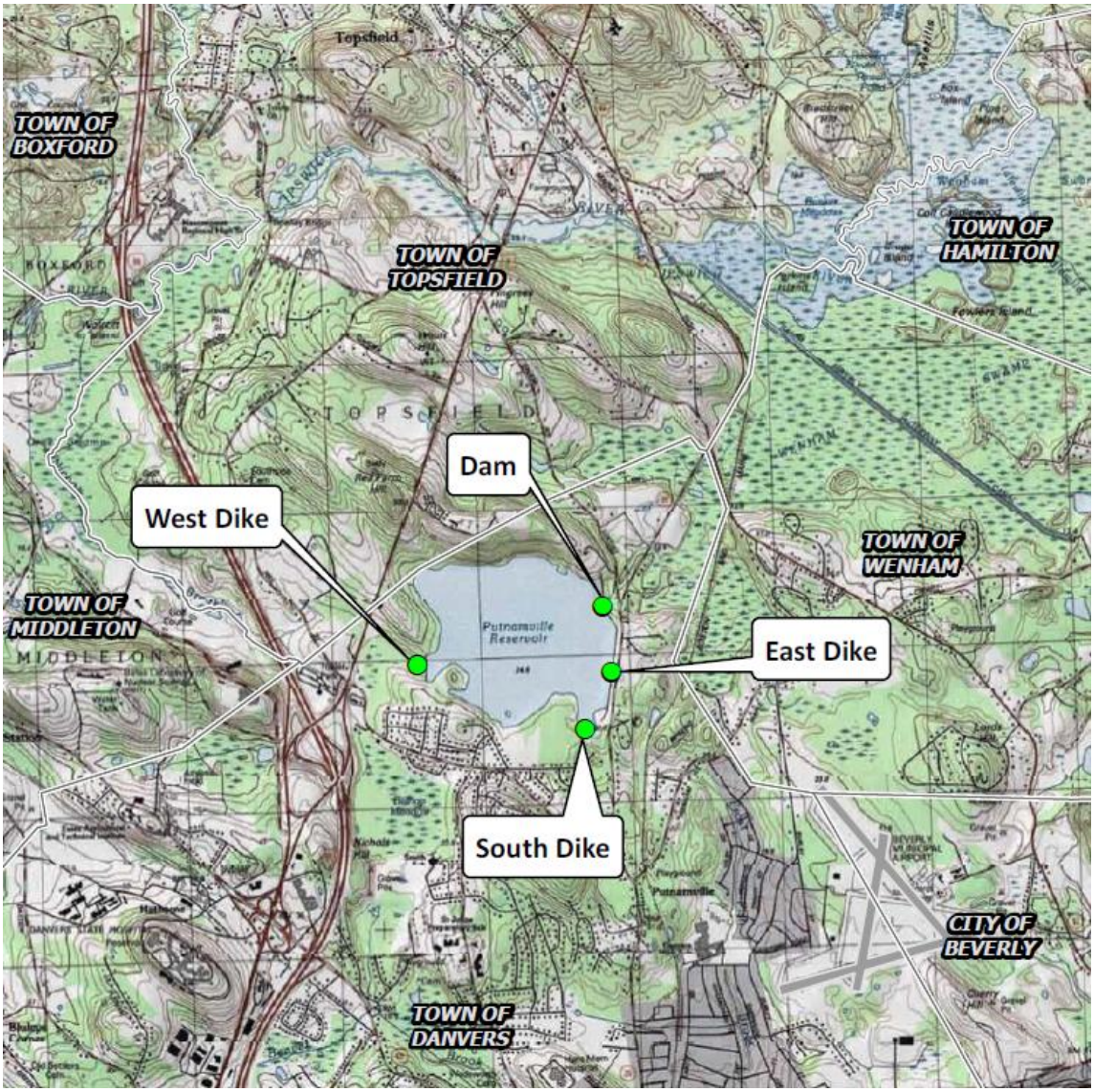
Source: DCR, Office of Dam Safety

The **East dike** is a 2,100-foot-long earth fill embankment immediately south of the dam. The maximum height of the east dike is 23.6 feet. The top is a concrete parapet wall, similar to that on the main dam, is located at approximately 84 feet. The top of the earth embankment varies from 80.2 to 81.3 feet and is covered with vegetation. The upstream face is a 2.5:1 slope covered with riprap, and the downstream slope is 2:1 covered with grass.

The **West dike** is a 700-foot-long embankment with a maximum height of 26.1 feet. The top is the same type of concrete parapet wall as at the other embankments. The top of the parapet is at 84.2 feet. The top of the embankment is at 81.2 feet and is covered with grass. The upstream face is a 2.5:1 slope covered with riprap, and the downstream slope is 2:1covered with vegetation.

The **South dike** is a 360-foot long 5-foot-high earth fill embankment that was raised in 1977 instead of adding a concrete parapet. The top is 12 feet wide and varies from 83.8 to 84.0 feet. The side slopes are 2.5:1 upstream and downstream.

Figure 11: Location of Putnamville Reservoir Dam and Dikes in Danvers, MA



Source: Putnamville Dam Emergency Action Plan, 2020

The EAP includes a delineation of the areas downstream of the Main Dam and the three dikes that could be impacted by a failure of these facilities. The analysis includes scenarios for dam failure during dry weather, and during stormy weather when river levels are higher than normal.

The EAP's potential inundation maps from failure of the main dam in stormy weather are shown for the north and south sections of Topsfield in Appendix A. The inundation area extends from the dam, across Locust Street and Valley and Topsfield Roads in Danvers and then spreads out across

Wenham Swamp in Wenham, Topsfield, and Hamilton where it would affect properties along the fringes of the swamp. It would then follow the Ipswich River valley where it would impact properties, overtop Asbury St. in Topsfield, and then overtop Winthrop and Mill Road in Ipswich. Beyond Mill Road the flooding depths would have dissipated and not be damaging to areas further downstream. The EAP lists about 80 properties in Topsfield that could be impacted by the failure of the main dam in stormy weather. It also shows areas potentially impacted by the failure of each of the three dikes.

The EAC includes detailed emergency procedures to be followed in the event of a failure of the main dam or dikes. Contacts in all affected communities are listed, with a protocol for communications. Available heavy equipment that could be used for emergency response are inventoried.

For the smaller dams within the Town of Topsfield, there has been just one failure experienced; a dam on Salem Road was overtopped in the 1980's. No significant damage resulted from this. Based on the record of previous occurrences dam failure in Topsfield is considered to be a Very Low frequency event. This hazard may occur less frequently than once in 100 years (less than 1% chance per year).

Dams and Climate Change

Climate change could further increase the risk of dam failure in several ways. More intense or frequent precipitation events could alter the river discharge rates, creating greater structural stress to the dam, increasing scouring and erosion, and causing loss of flood storage capacity in nearby spillways or floodplain wetlands.

DROUGHT

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

Average annual precipitation in Massachusetts is 44 inches per year, with approximately three to four-inch average amounts for each month of the year. In Massachusetts, droughts are caused by the prevalence of dry northern continental air and a decrease in coastal- and tropical-cyclone activity. During the 1960s, a cool drought occurred because dry air from the north caused lower temperatures in the springs and summers of 1962 through 1965. The northerly winds drove frontal systems to sea along the southeast coast and prevented the northeastern states from receiving the normal amount of moisture (U.S. Geological Survey). In the driest year (1965), the statewide precipitation total of 30 inches was only 68% of the average total.

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. The 2019 Massachusetts Drought Management Plan divides the state into seven regions: Western, Central, Connecticut River Valley, Northeast, Southeast, and Cape Cod, and Islands. Topsfield is located in the Northeast region. Drought is a potential town-wide hazard in Topsfield.

The MA Drought Management Plan was revised in 2019 to change the state's classification of droughts by establishing four levels to characterize drought severity: Mild Drought, Significant Drought, Critical Drought, and Emergency. These levels are based on conditions of natural resources and provide information on the current status of water resources. The levels provide a framework from which to take actions to assess, communicate, and respond to drought conditions. The Massachusetts drought levels are shown in comparison to the U.S. Drought Monitor levels in Table 11. The two sets of drought indices are similar, but Massachusetts combines the USDM's level D2 and D3 into one category, Critical Drought.

Table 11: MA Statewide Drought Levels Compared to US Drought Monitor

USDM Names	Recurrence	Percentile Ranges	MA DMP Levels	MA Percentile Ranges	MA DMP Names
D0: Abnormally Dry	once per 3 to 5 years	21 to 30	1	>20 and ≤30%	Mild Drought
D1: Moderate	once per 5 to 10 years	11 to 20	2	>10 and ≤20%	Significant Drought
D2: Severe Drought	once per 10 to 20 years	6 to 10	3	>2 and ≤10%	Critical Drought
D3: Extreme Drought	once per 20 to 50 years	3 to 5			
D4: Exceptional Drought	once per 50 to 100 years	0 to 2	4	≤2%	Emergency

Source: Massachusetts Drought Management Plan, 2019

As dry conditions can have a range of different impacts, a number of drought indices are available to assess these various impacts. Massachusetts uses a multi-index system that takes advantage of several of these indices to determine the severity of a given drought or extended period of dry conditions. Drought level is determined monthly based on the number of indices which have reached a given drought level. Drought levels are declared on a regional basis for each of the seven regions in Massachusetts. County by county or watershed-specific determinations may also be made. A determination of drought level is based on six indices:

1. Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. The Stream flow Index is based on the number of consecutive months that stream flow levels are below normal.

3. The Lakes and Impoundments Index is based on the water levels of small, medium, and large index reservoirs across the state, relative to normal conditions for each month.
4. The Groundwater Level Index is based on the number of consecutive month's groundwater levels below normal.
5. Keetch Byram Drought Index (KBDI) is designed for fire-potential assessment.
6. Crop Moisture Index (CMI) reflects soil moisture conditions for agriculture.

Table 12 shows the range of values for each of the indices associated with the drought levels.

Because drought tends to be a regional natural hazard, this plan references state data as the best available data for previous drought occurrences.

Table 12: Indices Values Corresponding to Drought Index Severity Levels

Index Severity Level	Standardized Precipitation Index	Streamflow	Lakes and Impoundments	Groundwater	Keetch-Byram Drought Index	Crop Moisture Index
0	>30th percentile				< 200	> -1.0
1	≤30 and >20				200-400	≤-1.0 and > -2.0
2	≤20 and >10				400-600	≤-2.0 and < -3.0
3	≤10 and >2				600-700	≤ -3.0 and > -4.0
4	≤2				700-800	≤-4.0

Source: MA Drought Management Plan, 2019

Drought Emergencies have been declared infrequently, with five events occurring in the period between 1850 and 2020: 1883, 1911, 1941, 1957, and 1965 to 1966. The drought period between 1965 and 1966 is viewed as the most severe drought to have occurred in modern times in Massachusetts because of its long duration. On a monthly basis over the 162-year period of record, there is a 1% chance of being in a drought emergency.

Drought Warning levels not associated with drought emergencies have occurred six times, in 1894, 1915, 1930, 1985, and 2016, and 2020. On a monthly basis over the 162-year period of record, there is a 2% chance of being in a Drought Warning.

Drought Watches not associated with higher levels of drought generally have occurred in three to four years per decade between 1850 and 1950. In the 1980s, there was a lengthy drought watch between 1980 and 1981, followed by a drought warning in 1985. The overall frequency of being in a Drought Watch level is 8% on a monthly basis over the 162-year period of record.

Based on the record since 1850, the SHMCAP calculates that statewide there is a 1% chance of being in a drought emergency in any given month. For drought warning and watch levels, the chance is 2% and 8% respectively in any given month (Table 13).

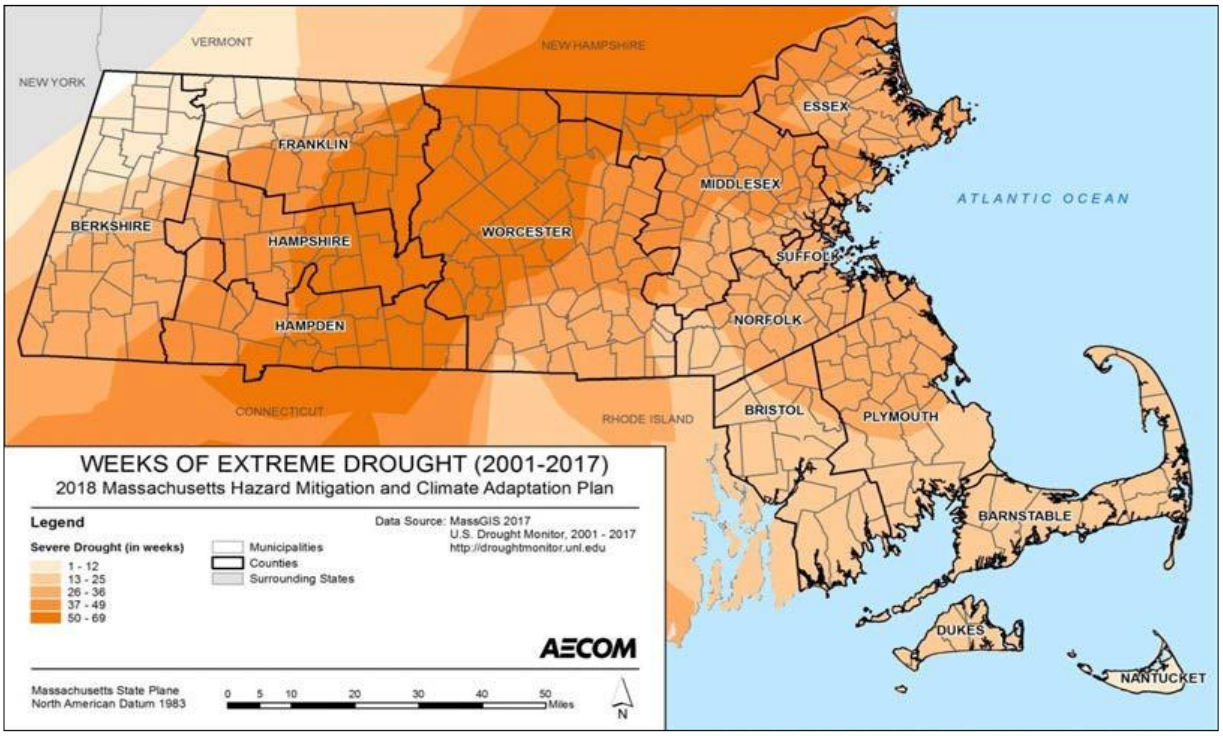
Table 13: Frequency of Massachusetts Drought Levels

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

Source: SHMCAP

The U.S. Drought Monitor characterizes droughts as abnormally dry, moderate, severe, extreme, or exceptional. As shown in Figure 12, Topsfield experienced between 26 and 36 weeks of severe drought between 2001 and 2017.

Figure 12: Weeks of Severe Drought (2001-2017)

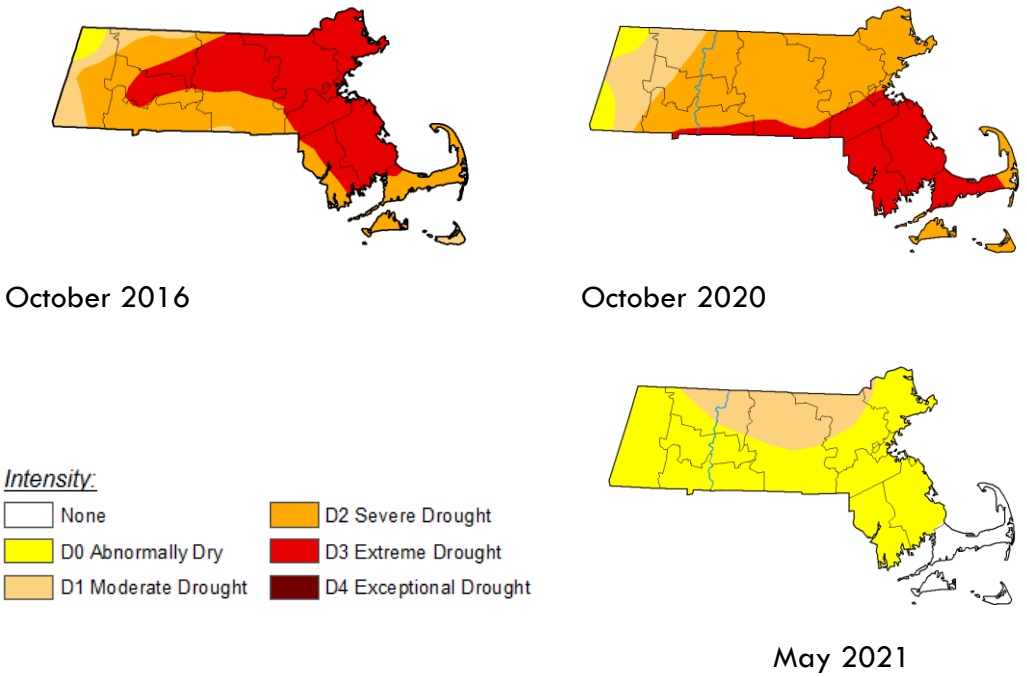


Source: MA SHMCAP

In the last five years there have been three droughts in Massachusetts. The drought of 2016 was the worst one since 1985, with more than half of the state reaching the Extreme Drought stage for several months (Figure 13). This was followed by another drought just four years later in 2020, which was most severe in Southeastern Massachusetts and somewhat less so in Topsfield. Finally, in

the early spring of 2021 a third, milder, drought was declared. By the summer of 2021 conditions in the northeast region improved.

Figure 13: Recent Drought Events (2016-2021)



Source: US Drought Monitor

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

Drought impacts can include reduced groundwater and surface water levels, affecting water quality and quantity, streamflow, and wetlands levels, and negatively impacting aquatic organisms that rely on riverine and wetland habitats. Drought also increases stress on plant communities, weakening trees, and increasing the likelihood of forest and brush fires.

Potential damages of a severe drought include increased risk of wildfires, which is important in Topsfield since the town has extensive forested land (over 56%). Extended drought could also cause losses of landscaped areas if outdoor watering is restricted for a long period, impacts to local agriculture, and potential loss of business revenues if water supplies were severely restricted for a prolonged period. Economic sectors impacted could potentially include commercial water users, recreation facilities, agriculture, landscaping, and forestry.

As a severe, prolonged drought has not occurred in the region since the mid-1960s, there are no data or estimates of potential financial damages, but under a severe long-term drought scenario it would be reasonable to expect a range of potential damages of several million dollars. If a

drought triggered severe and widespread wildfires that affected many residences or businesses, damages for the town could be in the range of tens of millions of dollars.

Given Topsfield's significant amount of forest cover, the entire town is vulnerable to the impacts of drought. Emergency drought conditions over the 162 period of record in Massachusetts are a low frequency natural hazard event that can occur from once in 50 years to once in 100 years (1% to 2% chance per year).

Drought and Climate Change

Changing precipitation patterns and the number of extreme weather events per year is difficult to project into the future. The Northeast Climate Science Center does report an anticipated increase in rainfall for Massachusetts in the spring and winter months and slightly decreased summer rainfall. Consequently, warming temperatures can cause greater evaporation in the summer and fall, as well as earlier snow melt. This, combined with projected higher summer temperatures, could increase the frequency of episodic droughts in the future.

EXTREME TEMPERATURES

AVERAGE AND EXTREME TEMPERATURES

Topsfield has four well-defined seasons, characterized mainly by seasonal temperatures. Extreme temperatures can be defined as those that are far outside of the normal seasonal ranges for Massachusetts. The average temperature for Winter (December to February) in Massachusetts is 31.8 degrees Fahrenheit. The average temperature for Summer (June to August) is 71 degrees F.

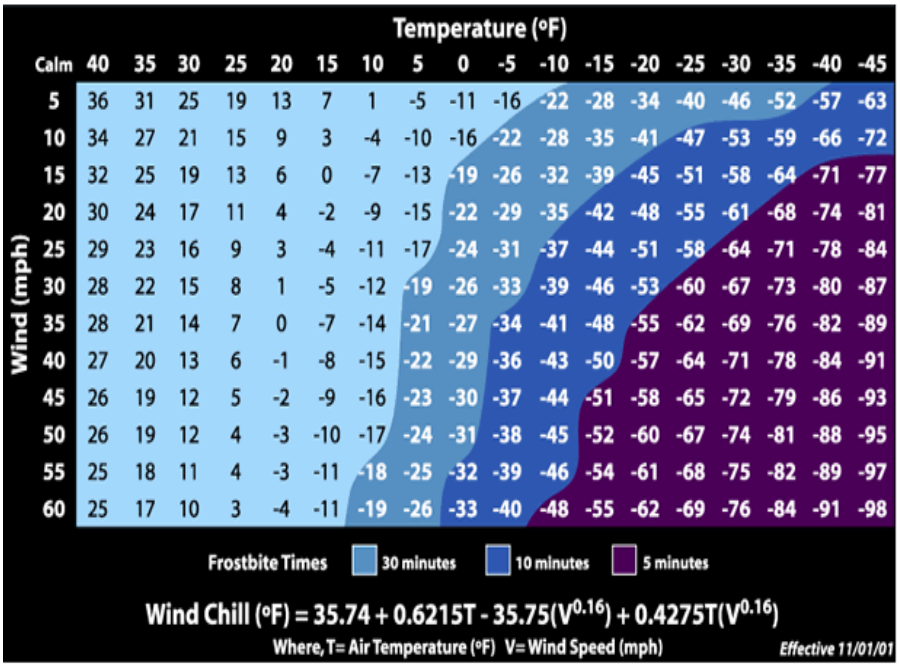
Extreme temperatures can occur for brief periods of time and be acute, or they can occur over longer periods of time when there is a long stretch of excessively hot or cold weather.

EXTREME COLD

For extreme cold, temperature is typically measured using the Wind Chill Temperature Index (Figure 14), which is provided by the National Weather Service (NWS). Wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed and is meant to show how cold conditions feel on unexposed skin and can lead to frostbite.

The best available local data on past occurrences of extreme cold in Topsfield are for Essex County, through the National Centers for Environmental Information (NCEI). There have been three extreme cold events in the past ten years, which caused no deaths, no injuries, or property damage (see Table 14).

Figure 14: Wind Chill Temperature Index and Frostbite Risk



Source: National Weather Service

Table 14: Essex County Extreme Cold and Wind Chill Occurrences, 2010-2020

Date	Deaths	Injuries	Damage
2/15/2015	0	0	0
2/16/2015	0	0	0
2/13/2016	0	0	0
TOTAL	**0**	**0**	**0**

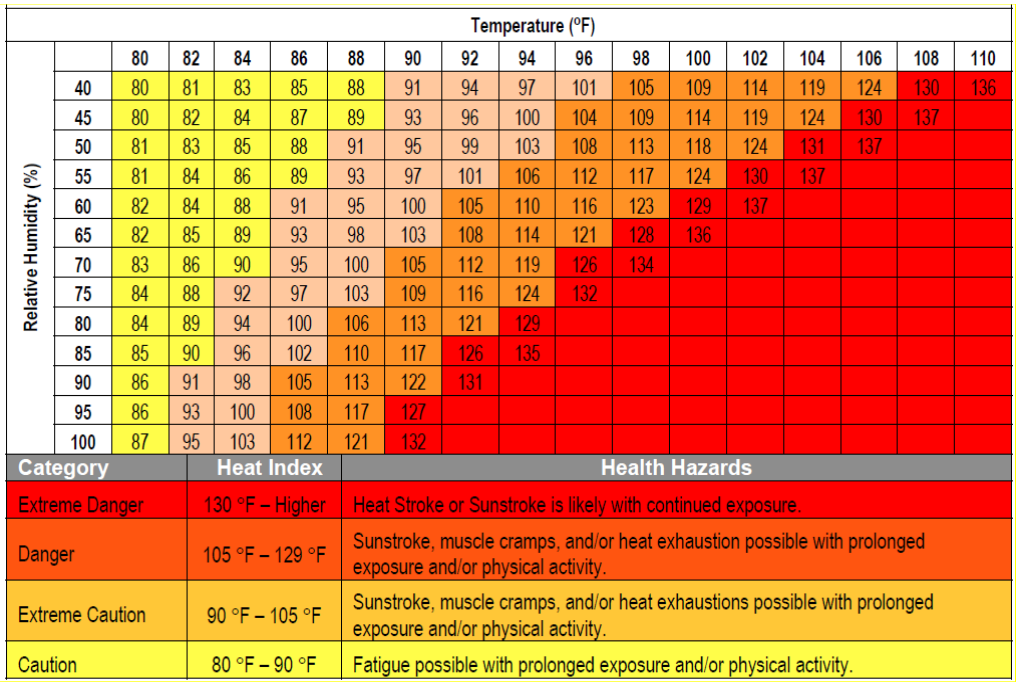
Source: NOAA, National Centers for Environmental Information

Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter, those who are stranded, or those who live in homes that are poorly insulated or without heat. In Topsfield 23.3 percent of the population is over age 65.

EXTREME HEAT

While a heat wave for Massachusetts is defined as three or more consecutive days above 90°F, another measure used for identifying extreme heat events is through a Heat Advisory from the National Weather Service (NWS). These advisories are issued when the heat index (Figure 15) is forecast to exceed 100°F for two or more hours; an excessive heat advisory is issued if the forecast predicts the temperature to rise above 105°F.

Figure 15: Heat Index Chart



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

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke or Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

Source: National Weather Service

The best available local data on past occurrences of extreme heat in Topsfield are for Essex County, through the National Centers for Environmental Information. From 2010 - 2020, there have been a total of three excessive heat events recorded, with one reported death, no injuries, and no property damage resulting from excessive heat (see Table 15).

Table 15: Essex County Extreme Heat Occurrences 2010 to 2020

Date	Deaths	Injuries	Damage
7/22/2011	0	0	0
7/1/2018	0	0	0
7/3/2018	0	0	0
Total	**1**	**0**	**0**

Source: NOAA, National Centers for Environmental Information

Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat exhaustion, heat stroke, and death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. People who perform manual labor, particularly those who work outdoors, are at increased risk for heat-related illnesses. Prolonged heat exposure and the poor air quality and high humidity that often accompany heat waves can also exacerbate pre-existing conditions, including respiratory illnesses, cardiovascular disease, and mental illnesses.

Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions. In Topsfield, 23.3 percent of the population is over the age of 65. People who live in older housing stock and in housing without air conditioning have increased vulnerability to heat-related illnesses. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage.

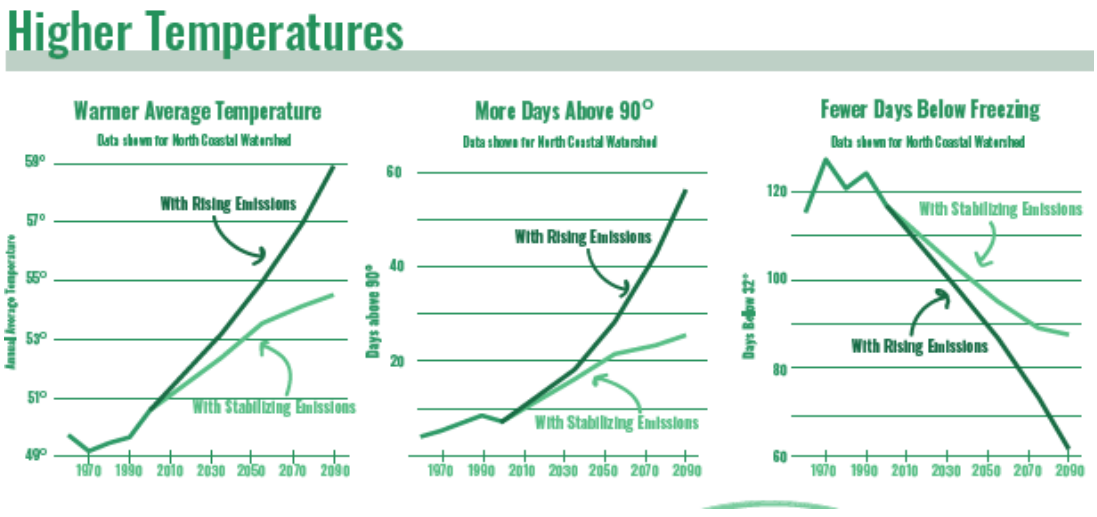
The Heat Island Effect and Hot Spots

Due to what is termed the "heat island effect", areas with less shade and more dark surfaces (pavement and roofs) will experience even hotter temperatures; these surfaces absorb heat during the day and release it in the evening, keeping nighttime temperatures warmer as well. Map 9 in Appendix A displays areas in Topsfield that are among the hottest 5% of land in the MAPC region based on land surface temperature derived from satellite imagery on July 13, 2016, when the high temperature at Logan Airport was 92°F. The map shows one small area around the Topsfield Fairgrounds parking lots, but due to the extensive tree cover and lack of large, paved areas, there are no significant urban heat "hot spots" in Topsfield.

Extreme Temperatures and Climate Change

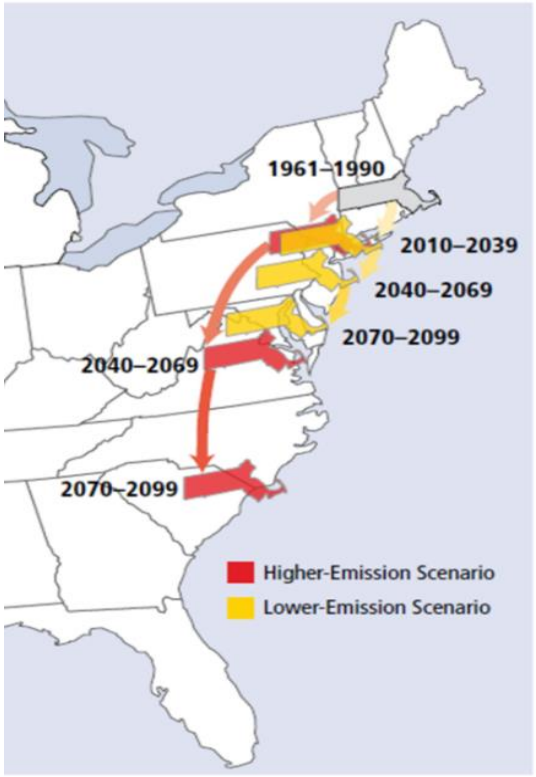
Extreme cold events are predicted to decrease in the future, while extreme heat, as well as average temperatures, are projected to increase. Global temperatures have increased by nearly 2 degrees in the last century and even small changes in temperature have widespread and significant changes to our climatic system. For example, the northeast has experienced a 10-day increase in the growing season in since 1980.

Figure 16: Projected Temperatures for Climate Scenarios to 2100



Source: ResilientMA.org

Figure 17 Temperature Scenarios Map



Source: Union of Concerned Scientists

Future temperature projections are shown in Figure 16. The projections are based on two future climate scenarios, with stabilizing and rising greenhouse gas emissions to the end of the century. The projections show an increase in average temperatures in the range of 4 to 8 degrees from the current 51 degrees to a range of 55 to 59 degrees. The annual number of days over 90 degrees is projected to increase from the current 10 days to a range of 25 to 55 days per year. This change represents the present-day climate from Virginia to South Carolina (Figure 17). The projected increase in extreme heat and heat waves is one of the key health concerns related to climate change.

WILDFIRE HAZARDS

A wildfire is a non-structure fire occurring in a forested, shrub or grassland area. In the Boston Metro region generally, these fires rarely grow to the size of a wildfire as seen more typically in the western U.S. However, with over 56% forested land, Topsfield has a much greater potential for wildfires than many other communities in the Boston metropolitan region.

There are three different classes of wildfires:

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

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

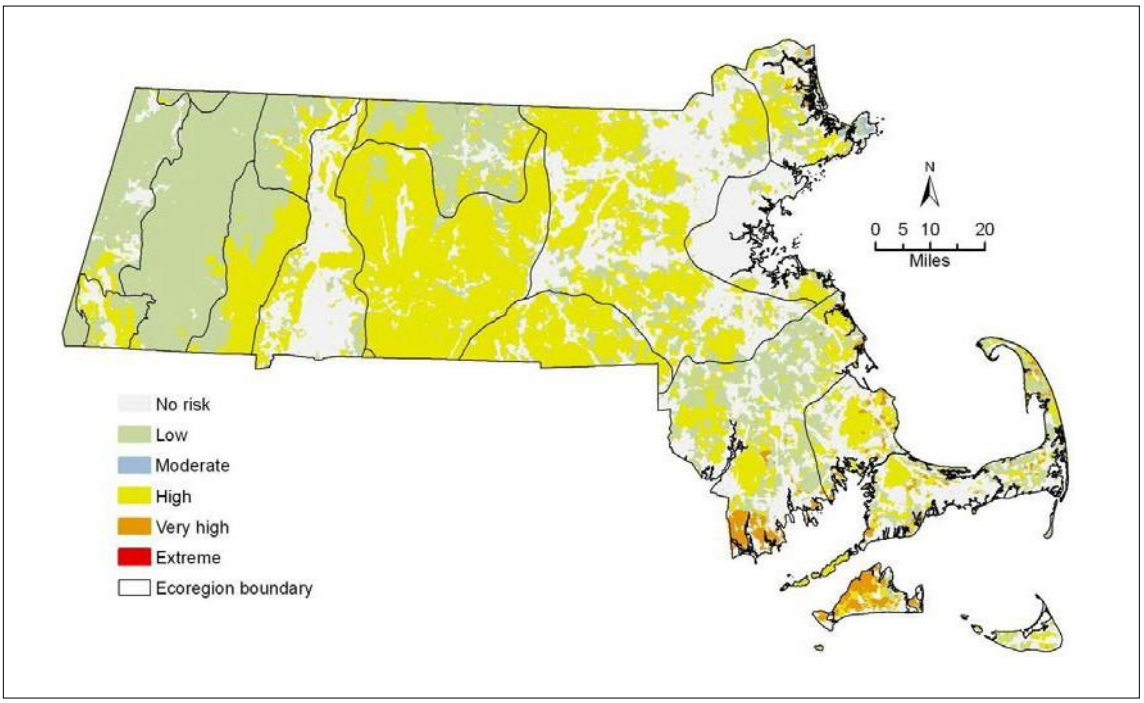
takes place in late May to early June, the fire danger usually is reduced somewhat. As the climate warms, drought and warmer temperatures may increase the risk of wildfire as vegetation dries out and becomes more flammable.

These fires can present a hazard where there is the potential for them to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials might exist to allow the fire the spread into homes. Protecting structures from fire poses special problems and can stretch firefighting resources to the limit. This is particularly true in Topsfield since many homes are located in or near to forested areas, and some area.

If heavy rains follow a fire, other impacts can occur, including landslides and mudflows. If a wildfire destroys the ground cover, then erosion becomes one of several potential problems.

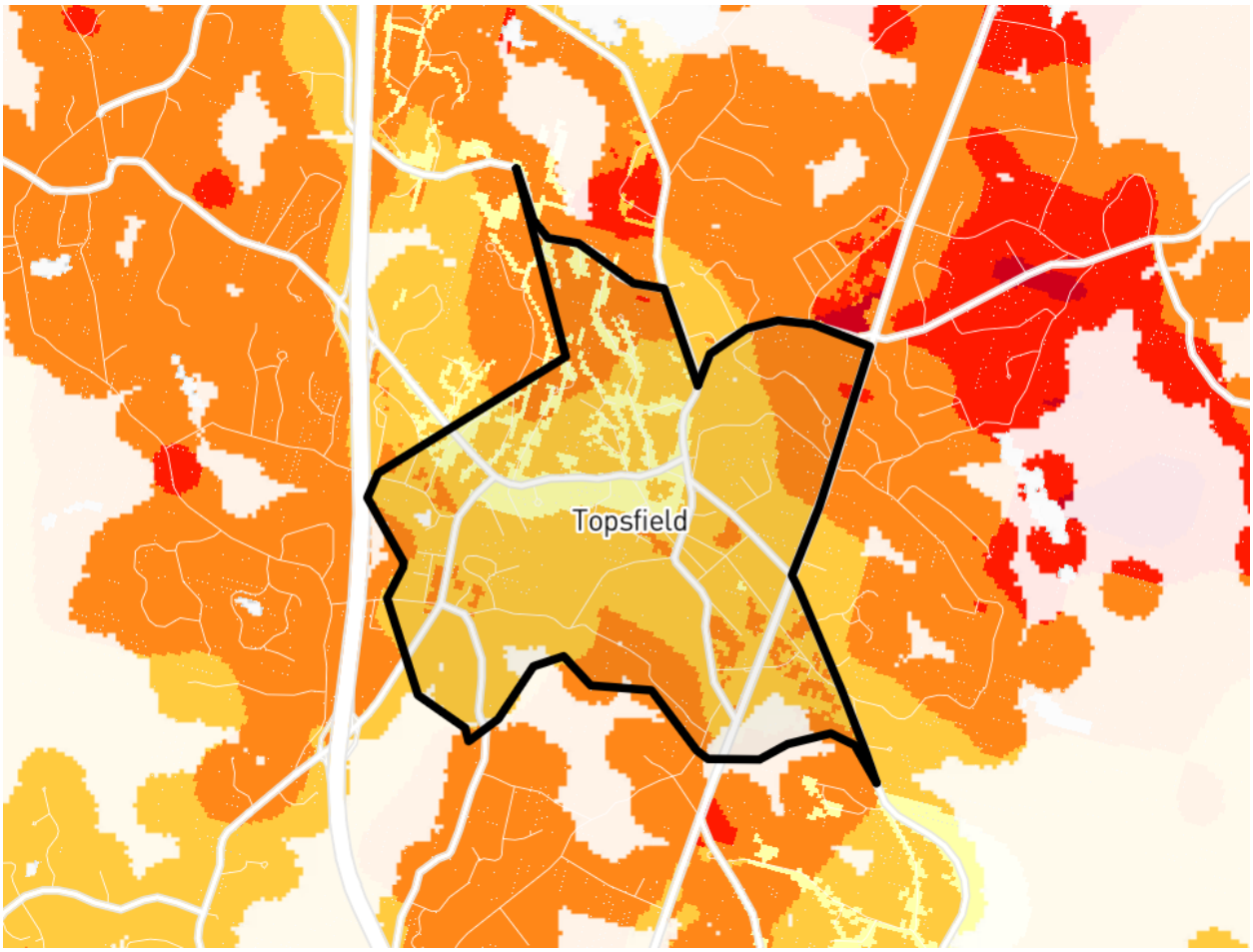
The MA State Hazard Mitigation and Climate Adaptation Plan depicts statewide fire risk incorporating three risk components: fuel, wildland-urban interface, and topography (Figure 18). The wildland-urban interface reflects communities where housing and vegetation intermingle, and fire can spread from structures to vegetated areas. The most susceptible fuels are pitch pine, scrub oak and oak forests. Topography can affect the behavior of fires, as fire spreads more easily uphill. Since Topsfield has some mixed oak forests and some hilly terrain, wildfires are considered a serious hazard in the Town. Topsfield is shown in the "High" wildfire risk area in the statewide map in Figure 18. The USDA Forest Service maps of "wildfire risk to homes" provide more detail at the county and municipal level. The map of wildfire risk to homes for Topsfield is shown in Figure 19. This map clearly shows that Topsfield has a moderately high wildfire risk.

Figure 18: Massachusetts Wildfire Risk Areas



Source: Mass SHMCAP

Figure 19: USDA Wildfire Risk to Homes, Essex County



Source: USDA Forest Service

Topsfield's Fire Chief has identified three areas of town with an elevated risk of potential wildfire. These are listed below in Table 16, and they are plotted on the local hazards map, Map 8 in Appendix A. The map ID numbers refer to the sites on the hazard maps.

Table 16: Locally Identified Wildfire Risk Areas

MAP ID	Potential Wildfire Areas
20	Route 1: Valley with brush
21	Bradley Palmer State Park
22	Willowdale State Forest

Topsfield Fire Department records show 28 incidents in the 20-year period from 2001 to 2018. These are listed in Table 17 below:

Table 17: Topsfield Fire Incident Records

Alm Date	Alm Time	Location
04/23/2008	14:45:00	4 Lake ST /Middleton, MA
11/12/2001	12:30:00	Liberty ST /Middleton, MA
04/22/2008	08:24:00	Mill Street Extension /Mi
04/20/2008	13:07:00	North Liberty ST /Middlet
04/21/2008	07:50:00	North Liberty Street /Mid
04/24/2016	14:14:50	65 Haverhill RD
08/21/2015	14:03:05	333 PERKINS ROW
05/24/2015	15:34:52	111 RIVER RD
07/04/2003	00:47:00	17 Andrews RD
10/22/2014	19:22:00	20 Asbury ST
04/29/2005	22:27:00	120 Asbury ST
11/16/2009	11:30:00	202 Haverhill RD
04/01/2007	10:03:00	163 High ST
04/26/2008	08:30:00	Liberty ST
07/23/2002	16:28:00	37 Lockwood LN
06/02/2007	16:14:00	60 Main ST
04/25/2008	14:08:00	N.Liberty
04/25/2008	12:30:00	North Liberty ST
04/30/2003	14:50:00	2 Perkins ROW
05/13/2008	19:01:00	6 Porter Meadow RD
04/25/2014	16:56:00	124 River RD
09/16/2010	15:38:00	146 South Main ST
05/28/2015	15:45:00	30 Wildes RD
04/09/2009	10:31:00	Boston ST & Wildes RD
04/21/2008	16:30:00	Fox Field behind Perkins
11/01/2001	07:38:00	Gravelly Brook Road Ipswi
09/22/2002	09:54:00	Town Forest
04/17/2005	16:13:00	Colt Island Ipswich River

Source: Topsfield Fire Department Incident Records

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

Wildfires and Climate Change

Warmer temperatures, more extended heat waves, and increasing drought due to climate change could increase the risk of wildfires in the future. With higher rates of evaporation and potential heat stress impacting vegetation, forests and brush lands could become more flammable, potentially leading to more frequent and/or more severe wildfires. While California and much of the western US have been an extreme example of this in recent years, shifting climate pattens could augment this risk in the northeastern US as well.

EXTREME WEATHER HAZARDS

HURRICANES AND TROPICAL STORMS

A hurricane is a violent wind and rainstorm with wind speeds of 74 to 200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal

property as the storm hits land. A tropical storm has similar characteristics, but wind speeds are below 74 miles per hour. Climate models suggest that hurricanes and tropical storms will become more intense as warmer ocean waters provide more fuel for the storms. In addition, rainfall amounts associated with hurricanes are predicted to increase because warmer air can hold more water vapor. Hurricanes in Massachusetts since 1938 are shown in Table 18.

Table 18: Hurricane Records for Massachusetts, 1938 to 2018

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

*Category 3 Source: National Oceanic and Atmospheric Administration

Hurricane intensity is measured according to the Saffir/Simpson scale, which categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. These are combined to estimate potential damage. Table 19 gives an overview of the wind speeds, surges, and range of damage caused by different hurricane categories.

Table 19: Saffir/Simpson Scale

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

Source: NOAA

The Town of Topsfield's entire area is vulnerable to hurricanes, which occur between June and November. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. No hurricanes have tracked directly through the Town of Topsfield. However, the town also experiences the impacts of the wind and rain from hurricanes and tropical storms in Massachusetts regardless of whether the storm track passes through the town. The hazard mapping indicates that the 100-year wind speed in Topsfield is 110 miles per hour.

Potential hurricane damages to Topsfield have been estimated using HAZUS-MH. Total damages are estimated at $5.55 million for a 100-year hurricane and $18.97 million for a 500-year hurricane. Other potential impacts such as debris disposal and sheltering needs are detailed in Table 36.

Tree damage during high winds has the potential to be a significant hazard in Topsfield because it has significant forested lands and tree canopy. Trees can knock out power lines and block major roadways, which hinders emergency response. Trees downed on the principal roads in town are a concern as this can block emergency access to large areas. It is not uncommon for tree limbs to come down resulting in road closures for periods up to several hours. Downed trees have also caused power outages since almost all of the electrical wires in town are overhead. Power outages can also lead to loss of water supply for some residents since about 20% of homes rely on private wells that require electricity to operate.

Based on records of previous occurrences, hurricanes in Topsfield are a medium frequency event. This hazard occurs from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

NOR'EASTERS

A northeast storm, known as a nor'easter, is typically a large counterclockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 10 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rain or snow, depending on temperatures.

Previous occurrences of nor'easters include the storm events shown on Table 20. Many of the historic flood events identified in the previous section were precipitated by nor'easters, including the "Perfect Storm" event in 1991. More recently, blizzards in February 2013, January 2015, and in March 2018 were large nor'easters that caused significant impacts on Massachusetts with heavy snowfall, high winds, and coastal flooding.

Topsfield is vulnerable to both the wind and precipitation that accompany nor'easters. High winds can cause damage to structures, fallen trees, and downed power lines leading to power outages. Intense rainfall can overwhelm drainage systems causing localized flooding of rivers and streams as well as stormwater ponding and localized flooding. Fallen tree limbs as well as heavy snow accumulation and intense rainfall can impede local transportation corridors, and block access for emergency vehicles. In Topsfield, the entire town is potentially at risk from the wind, rain, or snow impacts of a nor'easter.

Based on previous occurrences, nor'easters in Topsfield are high frequency events. This hazard may occur more frequently than once in five years (greater than 20% chance per year).

Table 20: Nor'easter Events for Massachusetts, 1978 to 2020

Date	Nor'easter Event
February 1978	Blizzard of 1978
October 1991	Severe Coastal Storm ("Perfect Storm")
December 1992	Great Nor'easter of 1992
January 2005	Blizzard/Nor'easter
October 2005	Coastal Storm/Nor'easter
April 2007	Severe Storms, Inland & Coastal Flooding/Nor'easter
January 2011	Winter Storm/Nor'easter
October 2011	Severe Storm/Nor'easter
February 2013	Blizzard of 2013
January 2015	Blizzard of 2015
March 2015	March 2015 Nor'easters
January 2018	January 2018
March 2018	March 2018

Nor'easters and Climate Change

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

HEAVY SNOW AND BLIZZARDS

Winter storms, including heavy snow, blizzards, and ice storms, are the most common and most familiar of the region's hazards that affect large geographic areas.

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

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

The Northeast Snowfall Impact Scale (NESIS), developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service (Kocin and Uccellini, 2004), characterizes and ranks high impact northeast snowstorms. These storms have large areas of 10-inch snowfall

accumulations and greater. NESIS has five categories: Extreme, Crippling, Major, Significant, and Notable. The NESIS categories are summarized in Table 21. 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.

Table 21: NESIS Categories

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

Source: Massachusetts State Hazard Mitigation Plan, 2013

The best available data on previous occurrences and impacts of heavy snow events in Topsfield are for Essex County, which includes Topsfield. According to National Centers for Environmental Information (NCEI) records, from 2010 to 2020, Essex County experienced 25 days with heavy snowfall events, resulting in no injuries, deaths, and property damage of $65,000 (Table 22).

Table 22: Heavy Snow events and Impacts in Essex County 2010 – 2020

Date	Deaths	Injuries	Damage-$
1/18/2010	0	0	0
2/16/2010	0	0	15,000
1/12/2011	0	0	0
1/26/2011	0	0	0
2/8/2013	0	0	0
3/7/2013	0	0	0
3/18/2013	0	0	0
12/14/2013	0	0	0
12/17/2013	0	0	0
1/2/2014	0	0	0
1/18/2014	0	0	10,000
2/5/2014	0	0	0
2/13/2014	0	0	0
2/18/2014	0	0	0
1/24/2015	0	0	0
1/26/2015	0	0	0
2/2/2015	0	0	0
2/8/2015	0	0	0
2/14/2015	0	0	0
2/5/2016	0	0	40,000
3/14/17	0	0	0
11/15/18	0	0	0
12/1/19	0	0	0
1/18/20	0	0	0
12/16/20	0	0	0
TOTAL	**0**	**0**	**$65,000**

Source: NOAA, National Centers for Environmental Information

The most significant severe winter storm in recent history was the "Blizzard of 1978," which resulted in over three feet of snowfall and multiple day closures of roadways, businesses, and schools. In Topsfield, blizzards and severe winter storms that were declared disasters have occurred in the following years (Table 23):

Table 23: Severe Weather Major Disaster Declarations in Eastern MA

Storm Event	Date
Severe Winter Storm and Snowstorm	March 2018
Severe Winter Storm, Snowstorm, and Flooding	January 2015
Severe Winter Storm, Snowstorm, and Flooding	February 2013
Hurricane Sandy	October/November 2012
Severe Storm and Snowstorm	October 2011
Tropical Storm Irene	August 2011
Severe Winter Storm and Snowstorm	January 2011
Severe Winter Storm and Flooding	December 2008
Severe Storms and Inland and Coastal Flooding	April 2007
Severe Storm and Flooding	October 2005
Severe Storms & Flooding	March 2001
Blizzard	December 1992
Winter Coastal Storm	October 1991
Hurricane Bob	August 1991
Hurricane Gloria	September 1985
Blizzard of 1978	February 1978
Coastal Storm, Flood, Ice, Snow	January 1966
Hurricane, floods	August 1955
Hurricane	September 1954

Winter storms are a potential town-wide hazard in Topsfield. Map 6 in Appendix A indicates that the average annual snowfall for the Town of Topsfield is 48-72 inches per year.

The town provides standard snow plowing operations and clearing snow has not posed any significant challenges. However, the town does experience roadway icing on some of the hilly parts of town. It can be a challenge, particularly on narrow roads or on the main roads during rush hour.

Most blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response. A number of public safety issues can arise during severe winter storms. Impassible streets are a challenge for emergency vehicles and affect residents and employers. Snow-covered sidewalks force people to walk in streets, which are already less safe due to snow, slush, puddles, and ice. Large piles of snow can also block sight lines for drivers, particularly at intersections. Refreezing of melting snow can cause dangerous roadway conditions. In addition, transit operations may be impacted, as they were in the 2015 blizzards which caused the closure of the MBTA system for one day and limited services on the commuter rail for several weeks.

Heavy snow and blizzards are considered to be high frequency events in Topsfield based on past occurrences. This hazard occurs more than once in five years, with a greater than 20 percent chance of occurring each year.

Severe Winter Storms and Climate Change

As with nor'easters, warmer ocean water and air will provide more fuel for severe winter storms. According to the SHMCAP changing atmospheric patterns favor the development of winter storms.

ICE STORMS AND HAIL EVENTS

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

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

Hail size refers to the diameter of the hailstones. Warnings may report hail size through comparisons with real-world objects that correspond to certain diameters shown in Table 24.

Table 24: Hail Size Comparisons

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

The greatest ice-related hazard is created by freezing rain conditions, which is rain that freezes on contact with hard surfaces leading to a layer of ice on roads, walkways, trees, and other surfaces. The conditions created by freezing rain can make driving particularly dangerous and

emergency response more difficult. The weight of ice on tree branches can also lead to falling branches causing power outages and blocking roadways. The impacts of winter storms may also include roof collapses and property damage and injuries related to the weight of snow and ice.

The best available local data on previous ice storm and hail occurrences in Topsfield are for Essex County through the National Environmental Information Center (NEIC). Essex County, which includes Topsfield, had one ice storm event recorded from 2008 to 2020 (see Table 25). No deaths or injuries were reported and the total reported property damage in the county was $2 million dollars.

Table 25: Essex County Ice Storm Events, 1998- 2020

Date	Deaths	Injuries	Property Damage
12/11/2008	0	0	$2,000,000
TOTAL	**0**	**0**	**$2,000,000**

Source: NOAA, National Centers for Environmental Information

Ice storms are considered to be medium frequency events based on past occurrences. This hazard occurs once in five years to once in 50 years, with a 2% to 20% chance of occurring each year. However, according to the Massachusetts State Hazard Mitigation Plan, ice storms occur more frequently in the higher elevations of Western and Central Massachusetts.

Compared to ice storms, hail events are much more frequent in Essex County. NCEI records show that Essex County experienced 14 hail events from 2010 to 2020, with no recorded property damage, injuries, or deaths (Table 26).

Table 64: Essex County Hail Events, 2010 through 2020

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

*Magnitude refers to diameter of hail stones in inches

Source: NOAA, National Centers for Environmental Information

Hail events are considered to be medium frequency events in Topsfield based on past occurrences. This hazard occurs once in five years to once in 50 years, with a 2% to 20% chance of occurring each year.

SEVERE THUNDERSTORMS

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. Generally defined as a storm that includes thunder, which always accompanies lightning, a thunderstorm is a storm event featuring lightning, strong winds, and rain and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 15 miles in diameter and last for about 30 minutes. A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding. The town's entire area is potentially subject to severe thunderstorms.

The best available data on previous occurrences of thunderstorms in Topsfield are for Essex County through the National Centers for Environmental Information (NCEI). Between the years 2010 and 2020, NCEI records show 49 thunderstorm events in Essex County (Table 27). These storms resulted in a total of $1.88 million in property damages. There were two injuries and no deaths reported.

Table 27: Essex County Thunderstorm Wind Events, 2010-2020

Date	Magnitude-(knots)	Deaths	Injuries	Damage-$
5/4/2010	50	0	0	30000
6/1/2010	50	0	0	5000
6/3/2010	50	0	0	20000
6/5/2010	50	0	0	40000
6/6/2010	50	0	1	100000
6/24/2010	50	0	0	30000
7/12/2010	50	0	0	50000
7/19/2010	50	0	0	25000
6/1/2011	50	0	0	5000
6/9/2011	50	0	0	15000
8/2/2011	50	0	0	1000
8/19/2011	50	0	0	15000
6/8/2012	50	0	0	25000
6/23/2012	45	0	0	5000
7/4/2012	50	0	0	10000
7/18/2012	70	0	0	350000
9/7/2012	50	0	0	10000
9/8/2012	40	0	0	3000
6/17/2013	50	0	0	25000
6/18/2013	45	0	0	10000
6/24/2013	45	0	0	3000
7/23/2013	50	0	0	20000
7/29/2013	50	0	0	5000
7/3/2014	50	0	0	75000
7/7/2014	87	0	0	100000
7/15/2014	50	0	0	25000
7/28/2014	50	0	0	50000
9/6/2014	50	0	1	15000
5/28/2015	45	0	0	5000
8/4/2015	50	0	0	40000
8/15/2015	50	0	0	25000

Date	Magnitude-(knots)	Deaths	Injuries	Damage-$
2/25/2016	50	0	0	30000
3/17/2016	45	0	0	5000
7/22/2016	50	0	0	14,000
7/23/2016	50	0	0	0
8/22/2016	50	0	0	0
9/11/2016	50	0	0	10,000
5/18/2017	50	0	0	0
6/13/2017	52	0	0	0
6/23/2017	52	0	0	1000
6/27/2017	50	0	0	0
7/12/2017	50	0	0	0
8/2/2017	50	0	0	0
9/6/2017	50	0	0	0
5/15/2018	40	0	0	0
6/18/2018	50	0	0	0
6/25/2018	43	0	0	0
7/17/2018	50	0	0	3000
7/26/2018	50	0	0	5000
8/7/2018	50	0	0	3000
8/17/2018	50	0	0	4000
9/6/2018	50	0	0	2000
10/23/2018	46	0	0	10,000
6/30/2019	50	0	0	800
7/17/2019	50	0	0	7250
7/31/2019	50	0	0	2500
8/7/2019	50	0	0	800
9/4/2019	55	0	0	26700
5/15/20	50	0	0	285,000
6/06/20	50	0	0	7000
6/21/20	50	0	0	38,200
6/28/20	55	0	0	6000
7/02/20	50	0	0	15300
7/05/20	50	0	0	12300
7/23/20	60	0	0	40600
7/30/20	50	0	0	3100
8/22/20	50	0	0	6000
8/23/20	50	0	0	25600
8/27/20	50	0	0	1600
10/07/20	61	0	5	6500
11/15/20	56	0	0	
TOTAL		**0**	**7**	**$3,336,000**
6/3/2010	50	0	0	71000
6/5/2010	50	0	0	60000
6/6/2010	52	0	0	79500
6/24/2010	50	0	0	65750
7/12/2010	50	0	0	30000
7/19/2010	50	0	0	25000
6/9/2011	50	0	0	207000
7/4/2011	50	0	0	31000
7/18/2011	39	0	0	20000
8/19/2011	50	0	0	60000
10/4/2011	50	0	0	10000
6/23/2012	50	0	0	75500
6/25/2012	40	0	0	5000
7/4/2012	50	0	0	5000

Date	Magnitude-(knots)	Deaths	Injuries	Damage-$
6/24/2013	50	0	0	25000
7/1/2013	50	0	0	18000
7/3/2014	50	0	0	100000
7/15/2014	50	0	0	15000
7/28/2014	50	0	0	15000
9/2/2014	45	0	0	5000
9/6/2014	50	0	0	2385000
5/28/2015	61	0	0	50000
5/28/2015	50	0	0	81000
6/23/2015	60	0	0	5000
7/27/2015	45	0	0	1000
8/4/2015	50	0	0	65000
2/25/2016	50	0	0	21000
6/29/2016	50	0	0	25000
7/1/2016	50	0	0	15000
7/18/2016	70	0	0	105000
7/23/2016	50	0	0	155000
9/11/2016	50	0	0	10000
05/18/2017	50	0	0	29000
06/23/2017	50	0	0	26500
06/27/2017	50	0	0	10.00K
06/18/2018	50	0	0	46500
09/18/2018	61	0	0	16000
06/30/2019	40	0	0	6000
07/17/2019	50	0	0	1750
07/31/2019	50	0	0	40000
08/21/2019	50	0	0	3.00K
6/6/2020	50	0	0	1500
7/5/2020	50	0	0	1300
7/13/2020	50	0	0	1000
7/23/2020	50	0	0	1800
7/30/2020	50	0	0	8500
8/23/2020	50	0	0	9600
TOTAL		**0**	**2**	**1.88 M**

Source: NOAA, National Centers for Environmental Information
Magnitude refers to maximum wind speed in knots.

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

Based on the record of previous occurrences, severe thunderstorms in Topsfield are high frequency events. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

Thunderstorms and Climate Change

As noted previously, the intensity of rainfall events has increased significantly, and those trends are expected to continue. The SHMCAP does not specifically address whether climate will affect the intensity or frequency of thunderstorms.

TORNADOS

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

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

Tornado damage severity is measured by the Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. As of February 1, 2007, the National Weather Service began rating tornados using the Enhanced Fujita-scale (EF-scale), which allows surveyors to create more precise assessments of tornado severity. The EF-scale is summarized in Table 28 below.

Table 28: Enhanced Fujita Scale

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

Source: Massachusetts State Hazard Mitigation Plan, 2013

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

On August 22, 2016, an F1 tornado passed through part of the Town of Concord. It impacted an area 0.85 miles long by 400 yards wide. According to the report from the National Centers for Environmental Information:

> "This tornado touched down near the Cambridge Turnpike and headed northeast. Most of the damage was concentrated in an area beginning near the intersection of Lexington Road and Alcott Road and continuing up to the neighborhood of Alcott and Independence Roads. Numerous trees were uprooted or had the tops sheared off. These subsequently blocked roads, damaged homes, and downed power lines, cutting off power to the neighborhood. In addition, utility poles were downed either from the wind or from the downed power lines. Thirty-nine houses in this area were damaged to some degree. Only one house suffered significant structural damage. The tornado continued for a short distance beyond this neighborhood before lifting. The historical home of Louisa May Alcott and her family was right next to the tornado path but was not damaged.

Since 1956, there have been 14 tornadoes in Essex County recorded by the NCEI. One tornado was F2, eight were F1, and two were F0. These 14 tornadoes resulted in no fatalities and four injuries and $560.280 million in damages, as summarized in Table 29.

Table 29: Tornado Records for Essex County

Date	Fujita Scale	Deaths	Injuries	Property Damage $	Length	Width
6/13/1956	F1	0	0	2500	1	10
11/21/1956	F2	0	0	25000	0.8	17
12/18/1956	F1	0	0	250	0.5	23
7/13/1960	F0	0	0	30	0.1	33
7/21/1962	F1	0	3	25000	2.7	33
5/19/1964	F0	0	0	2500	0.1	300
5/19/1964	F1	0	0	2500	2	300
8/10/1965	F1	0	0	0	3.6	33
7/1/1968	F1	0	1	250000	0.3	100
7/21/1972	F1	0	0	2500	0.3	20
8/15/1991	F1	0	0	250000	0.8	300
TOTAL		**0**	**4**	**$560,280**		

Source: NOAA, National Centers for Environmental Information

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

Although tornadoes are a potential town-wide hazard in Topsfield, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Topsfield would greatly depend on the track of the tornado. The greatest damages would be

cause if a tornado passed through the town center area, or along the Route 1 business district, which have the greatest density of buildings and population in town.

Based on the record of previous occurrences since 1956, Tornado events in Topsfield are a very low frequency event, as there is no record of tornado activity in Topsfield. This hazard occurs less frequently than once in 100 years (less than 1% per year).

Tornadoes and Climate Change

According to the SHMCAP, it is possible that severe thunderstorms which can include tornadoes may increase in frequency and intensity. However, scientists have less confidence in the models that seek to project future changes in tornado activity.

NON-CLIMATE INFLUENCED HAZARDS

Geologic hazards include earthquakes, landslides, sinkholes, subsidence, and unstable soils such as fill, peat, and clay. The HMP/MVP Core Team did not identify any problems with areas of geologic instability, such as sinkholes or subsidence. Although new construction under recent building codes generally will be built to seismic standards, there are still many structures in town which pre-date building code updates. Information on geologic hazards in Topsfield can be found on Map 4 in Appendix A.

EARTHQUAKES

Damage in an earthquake stems from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location. An earthquake in New England affects a much wider area than a similar earthquake in California due to New England's solid bedrock geology` (NESEC).

Seismologists use a magnitude scale known as the Richter scale to express the seismic energy released by each earthquake. The typical effects of earthquakes in various ranges are summarized in Table 30.

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2007, 355 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Ann fault located off the coast of Rockport. The region has experienced larger earthquakes in the distant past, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Ann. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940. A 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the

Boston area. Historic records of some of the more significant earthquakes in the region are shown in Table 31.

Table 30: 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. Serious damage in areas several hundred meters across.

Source: Nevada Seismological Library (NSL), 2005

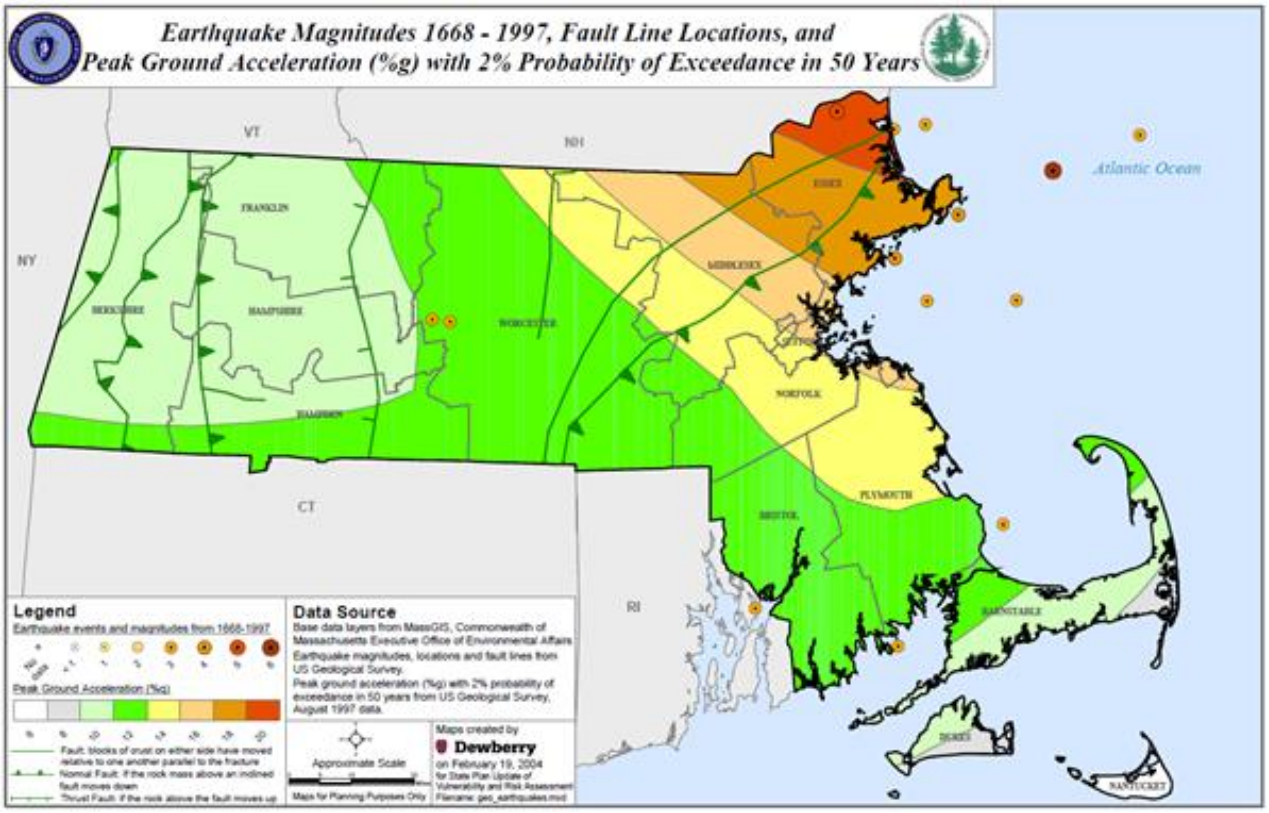
Table 31: Historical Earthquakes in Massachusetts or Surrounding Area

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA – Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA – Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA – Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA – Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA – Woburn	10/5/1817	4.3
MA – Marblehead	8/25/1846	4.3
MA – Brewster	8/8/1847	4.2
MA – Boxford	5/12/1880	NA
MA – Newbury	11/7/1907	NA
MA – Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
MA – Nantucket	10/25/1965	NA
MA – Boston	12/27/74	2.3
MA – Nantucket	4/12/12	4.5
ME – Hollis	10/17/12	4.0

Source: Boston HIRA

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

Figure 20: State of Massachusetts Earthquake Probability Map



Source: Massachusetts Hazard Mitigation Plan

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

Earthquakes are a hazard with multiple impacts beyond the obvious building collapse. Buildings may suffer structural damage which may or may not be readily apparent. Earthquakes can cause major damage to roadways, making emergency response difficult. Water lines and gas lines can

break, causing flooding and fires. Another potential vulnerability is equipment within structures. For example, a hospital may be structurally engineered to withstand an earthquake, but if the equipment inside the building is not properly secured, the operations at the hospital could be severely impacted during an earthquake. Earthquakes can also trigger landslides.

According to the Boston College Weston Observatory, in most parts of New England, there is a one in ten chance that a potentially damaging earthquake will occur in a 50-year time period. The Massachusetts State Hazard Mitigation Plan classifies earthquakes as "very low" frequency events that occur less frequently than once in 100 years, or a less than 1% chance per year.

Earthquakes are a potential town-wide hazard for Topsfield. Although new construction under the most recent building codes generally will be built to seismic standards, much of the development in the town pre-dates the most recent building code. Potential earthquake damages to Topsfield have been estimated using HAZUS-MH. Total building damages are estimated at $150.89 million for a 5.0 magnitude earthquake and $613.55 million for a 7.0 magnitude earthquake. Other potential impacts of earthquakes such as sheltering and debris generation, are detailed in Table 37.

LANDSLIDES

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

In Massachusetts, according to the SHMCAP, the most common cause of landslides are geologic conditions combined with steep slopes and/or heavy rains. Landslides associated with heavy rains typically occur on steep slopes with permeable soils underlain by till or bedrock.

Landslides can result from human activities that destabilize an area or can occur as a secondary impact from another natural hazard, such as flooding. In addition to structural damage to buildings and the blockage of transportation corridors, landslides can lead to sedimentation of water bodies. Typically, a landslide occurs when the condition of a slope changes from stable to unstable. Natural precipitation such as heavy snow accumulation, torrential rain, and run-off may saturate soil, creating instability enough to contribute to a landslide.

Changes in precipitation may increase the chance of landslides, as extreme rain events could result in more frequent saturated soils which are conducive to landslides. Drought may also increase the likelihood of landslides if loss of vegetation decreases soil stability.

There is no universally accepted measure of landslide extent, but it has been represented as a measure of the destructiveness. Table 32 summarizes the estimated intensity for a range of landslides. Fast moving rock falls have the highest intensity while slow moving landslides have the lowest intensity.

Topsfield is classified as having a low incidence of landslides, (see Map 4, Appendix A).

Table 32: Landslide Volume and Velocity

Estimated 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

Source: *A Geomorphological Approach to the Estimation of Landslide Hazards and Risks in Umbria, Central Italy*, M. Cardinali et al, 2002

There is no history of damaging landslides in Topsfield and the HMP/MVP Core Team did not identify any significant issues related to landslides. Should a landslide occur in the future, the type and degree of impacts would be highly localized. Although unlikely, the Town's vulnerabilities could include damage to structures, transportation and other infrastructure, and localized road closures. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Topsfield.

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

Based on past occurrences, landslides are considered to be a very low frequency events in Topsfield, events that occur less frequently than once in 100 years (less than 1% per year)

LAND USE AND DEVELOPMENT TRENDS

The most recent land use statistics available from the state are the MacConnell Land Use data based on aerial photography done in 2005. This data provides the most detailed town wide description of land use available. Table 33 shows the acreage and percentage of land in 26 categories.

The table indicates that Topsfield's predominant land cover is forest, comprising 56.7% of the town's area, including both the forest and forested wetland categories. The second largest land use in Topsfield is low-density housing, comprising 12.1% of the town's land area.

Table 33: Town of Topsfield Land Use

Land Type	Acres	Percent
Brushland/Successional	37.2	0.5
Cemetery	16.4	0.2
Commercial	73.2	0.9
Cropland	366.4	4.5
Forest	3809.9	46.5
Forested Wetland	833.6	10.2
Golf Course	89.1	1.1
High Density Residential	0.5	0.0
Industrial	19.6	0.2
Low Density Residential	986.5	12.1
Medium Density Residential	205.5	2.5
Mining	6.6	0.1
Multi-Family Residential	64.0	0.8
Non-Forested Wetland	719.6	8.8
Nursery	19.5	0.2
Open Land	144.0	1.8
Orchard	21.2	0.3
Participation Recreation	79.9	1.0
Pasture	195.4	2.4
Powerline/Utility	14.2	0.2
Spectator Recreation	51.5	0.6
Transitional	9.0	0.1
Transportation	41.7	0.5
Urban Public/Institutional	52.7	0.6
Very Low Density Residential	242.8	3.0
Water	84.3	1.0
TOTAL	**8,184.5**	100

Source: Mass GIS, MacConnell Land Use Data, 2005

When all categories of residential land are combined, the total land residential land is 18.4% Non-forested wetlands make of another 8.8% of the town, followed by 7.4% agricultural (combining cropland, pasture, orchard, and nursery).

Being a predominantly residential community, commercial uses make up only 0.9% of the town and only 0.2% is industrial land use. Approximately one-third of the Town's land is permanently protected open space.

For more information on how the land use statistics were developed and the definitions of the categories, please go to http://www.mass.gov/mgis/lus.htm

DEVELOPMENT TRENDS

To determine development trends, MAPC began by reviewing MassBuilds, the development database that provides an inventory of recent and planned development throughout the MAPC region. The Mass Builds database includes two projects in the Town of Topsfield, 333 Perkins Row and Rolling Green.

To supplement and update the local development data, MAPC consulted with the Topsfield HMP/MVP Core Team to identify recent and pending new developments. A total of six sites were identified and mapped. These areas are listed below in Table 34 and shown on Map 8 in Appendix A, using the Map ID letters in the first column.

Table 34 Recent and Pending New Development Projects:

Map ID	Name	Description	
A	6 Aaron Drive	Planned Solar Farm: Application/negotiation in process.	41.65% in AE: 1% Annual Chance of Flooding, with BFE
B	Rolling Green	Recent development, now occupied.	35.84% in A: 1% Annual Chance of Flooding, no BFE
C	The Meadows	Over 55 Housing	
D	57 Perkins Row	40B: 44 units planned.	11.59% in AE: 1% Annual Chance of Flooding, with BFE
E	12 Boston Street	Recent development; currently occupied.	
F	333 Perkins Row	12 Single Family Homes permitted; must establish security before selling lots.	

To understand any potential change in the Town's vulnerability to hazards due to new development, a GIS analysis was conducted on the location of these development sites with respect to mapped hazard areas such a flooding, landslide risk, annual snowfall, maximum wind speed, and hot spots. Three of the sites are partially within a designated flood zone, typically a

part of the site outside of the building envelope, given Topsfield's Floodplain Overlay Zoning restrictions. None of the sites are within the locally identified areas of flooding, nor are they within a hot spot. All other mapped hazards are uniform across the entire town, so all of the sites are within the area classified as "Low Incidence" for landslide, within the area of 48 to 72 inches of average annual snowfall, and all are within the zone of maximum wind speed of 110 miles per hour. The new development does not significantly increase the Town's vulnerability to natural hazards.

CRITICAL INFRASTRUCTURE IN HAZARD AREAS

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are 42 facilities identified by the Topsfield HMP/MVP Core Team. These are listed in Table 35 and are shown on the maps in Appendix A.

The purpose of mapping the natural hazards overlaying the critical facilities is to present an overview of hazards in the community and how they relate to critical facilities.

Much of the Critical infrastructure in Topsfield is clustered near the center of town, with several critical sites located on the outer edges of the town. The table shows that the only facilities located in a FEMA flood hazard zone are the dams, which is to be expected, and a National Grid facility. No town-owned facilities are in the flood hazard zone.

The only four sites listed within the brushfire hazard area are dams. Landslide risks are considered "low incidence" throughout the town for all facilities.

The entire town has an annual snow accumulation average of 48-72 inches and therefore all critical facilities fall within this category. This also holds true for maximum 100-year wind speeds, which are uniform at 110 mph throughout the town.

The breakdown of the critical facilities sites and how they relate to mapped hazard areas follows in Table 35.

Explanation of Columns in Table 35

- ***Column 1: ID #:*** The first column in Table 35 is an ID number which appears on the maps that are part of this plan. See Appendix A.
- ***Column 2: Name****:* The second column is the name of the site.
- ***Column 3: Type*****:** The third column indicates what type of site it is.
- ***Column 4: FEMA Flood Zone*****:** The fourth column addresses the risk of flooding. A "No" entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone. as follows: **Zone AE** (1% annual chance) **-** Zones AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by detailed methods. Mandatory flood insurance purchase requirements apply.

  Zone VE (1% annual chance) **-** Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

  Zone X (.2% annual chance) - Zones X is the flood insurance rate zone that corresponds to the 500-year floodplains.
- ***Column 5: Brush Fire Area:*** The sixth column indicates the risk of brush fire in local hazard areas. A "No" entry in this column means that the site is not within any of the mapped brush fire hazard zones. If there is an entry in this column, it indicates the local hazard area.
- ***Column 6:*** **Hot spots** indicates areas that are within the 5% of hottest areas in the MAPC region based on satellite data from 2016.
- ***Colum 7:*** **Landslides**: Infrastructure in areas of Low Incidence (Low) or Low Incidence/Moderate Susceptibility (Mod/Low)
- ***Column 8: Average Annual Snowfall***

Table 35: Critical Facilities and Relationship to Hazard Areas

MAP #	FACILITY NAME	FACILITY TYPE	FEMA FLOOD ZONE	BRUSH FIRE	HOT SPOT	LANDSLIDE	AVG. ANNUAL SNOWFALL
1	Topsfield Landfill	Waste Disposal Site	No	No	No	Low incidence	H 48.1 - 72.0
2	Topsfield Police Department	Public Safety	No	No	No	Low incidence	H 48.1 - 72.0
3	Topsfield Fire Department	Public Safety	No	No	No	Low incidence	H 48.1 - 72.0
4	Masconomet Healthcare Center	Nursing Home	No	No	No	Low incidence	H 48.1 - 72.0
5	Topsfield Town Hall	Town Hall	No	No	No	Low incidence	H 48.1 - 72.0
6	Perkins Row Tub Well	Water Supply	No	No	No	Low incidence	H 48.1 - 72.0
7	Ipswich River Wildlife Refuge	Water Supply	No	No	No	Low incidence	H 48.1 - 72.0
9	Bedrock Well	Water Supply	No	No	No	Low incidence	H 48.1 - 72.0
10	Sleepy Hollow Tub Well	Water Supply	No	No	No	Low incidence	H 48.1 - 72.0
11	Mile Brook Dam	Dam	A: 1% Annual Chance of Flooding; no BFE	No	No	Low incidence	H 48.1 - 72.0
12	Hood Pond Dam	Dam	A: 1% Annual Chance of Flooding; no BFE	No	No	Low incidence	H 48.1 - 72.0
13	Howlett's Brook Dam	Dam	AE: Regulatory Floodway	No	No	Low incidence	H 48.1 - 72.0
14	Pleasure Pond Dam	Dam	AE: Regulatory Floodway	No	No	Low incidence	H 48.1 - 72.0
15	Pierce Pond Dam	Dam	A: 1% Annual Chance of Flooding; no BFE	Route 1: Valley with brush	No	Low incidence	H 48.1 - 72.0
16	Bethune Pond Dam	Dam	A: 1% Annual Chance of Flooding; no BFE	No	No	Low incidence	H 48.1 - 72.0
17	Ipswich Pond Dam	Dam	AE: Regulatory Floodway	Bradley Palmer State Park	No	Low incidence	H 48.1 - 72.0

MAP #	FACILITY NAME	FACILITY TYPE	FEMA FLOOD ZONE	BRUSH FIRE	HOT SPOT	LANDSLIDE	AVG. ANNUAL SNOWFALL
18	Farm Trail Pond	Dam	No	Bradley Palmer State Park	No	Low incidence	H 48.1 - 72.0
19	Otter Pond Dam	Dam	No	Bradley Palmer State Park	No	Low incidence	H 48.1 - 72.0
20	Klock Park Dam	Dam	No	No	No	Low incidence	H 48.1 - 72.0
21	Bradley Palmer Entrance Dam	Dam	No	No	No	Low incidence	H 48.1 - 72.0
22	Topsfield Town Library	Library	No	No	No	Low incidence	H 48.1 - 72.0
23	Topsfield Historical Society/Library	Library	No	No	No	Low incidence	H 48.1 - 72.0
24	Proctor Elementary School	School	No	No	Yes	Low incidence	H 48.1 - 72.0
25	Steward Elementary School	School	No	No	No	Low incidence	H 48.1 - 72.0
26	Merrimack Alternative Vocational High School	School	No	No	No	Low incidence	H 48.1 - 72.0
27	Masconomet Regional Middle School	School	No	No	No	Low incidence	H 48.1 - 72.0
28	Trinity Preschool	Preschool	No	No	No	Low incidence	H 48.1 - 72.0
29	Joyful Noises Preschool	Preschool	No	No	No	Low incidence	H 48.1 - 72.0
30	Little Brook Village	60 Units of Elder and Disabled Housing	No	No	No	Low incidence	H 48.1 - 72.0
31	Washington Meadows	24 Units of senior rental housing.	No	No	No	Low incidence	H 48.1 - 72.0
32	National Grid Substation	Power Substation	AE: 1% Annual Chance of Flooding; with BFE	No	No	Low incidence	H 48.1 - 72.0
33	Scada	Radio Communication Tower	No	No	No	Low incidence	H 48.1 - 72.0
34	Cell Tower	Communications Tower	No	No	No	Low incidence	H 48.1 - 72.0
35	Water Treatment Plant	Water Supply Treatment Facility	No	No	No	Low incidence	H 48.1 - 72.0

MAP #	FACILITY NAME	FACILITY TYPE	FEMA FLOOD ZONE	BRUSH FIRE	HOT SPOT	LANDSLIDE	AVG. ANNUAL SNOWFALL
36	Boston Street Tank	Water Storage Tank	No	No	No	Low incidence	H 48.1 - 72.0
37	Garden Street Tank (0.5 million gallons)	Water Storage Tank	No	No	No	Low incidence	H 48.1 - 72.0
38	Nike Village	Residential facility: Eliot programs and victory programs, owned by Lahey health. Electricity from Danvers Electric Light Department, not National Grid.	No	No	No	Low incidence	H 48.1 - 72.0
39	Booster Pump Station	Underground water supply pump station. Serves Nike Village with drinking water.	No	No	No	Low incidence	H 48.1 - 72.0
40	The Meadows	Over-55 housing	No	No	No	Low incidence	H 48.1 - 72.0
41	Planned Solar Farm	Application/negotiation in process	No	No	No	Low incidence	H 48.1 - 72.0
42	Beverly-Salem Water Supply	Aqueduct from Ipswich River to Salem and Beverly water system	No	No	No	Low incidence	H 48.1 - 72.0

VULNERABILITY ASSESSMENT

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

Introduction to HAZUS-MH

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

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

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

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

Estimated Damages from Hurricanes

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

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

Table 36: Estimated Damages from Hurricanes

	100 Year	500 Year
Building Characteristics		
Estimated total number of buildings	2,321	
Estimated total building replacement value (2014 $)	$1,062,000,000	
Building Damages		
# of buildings sustaining minor damage	45	299
# of buildings sustaining moderate damage	2	36
# of buildings sustaining severe damage	0	2
# of buildings destroyed	0	1
Population Needs		
# of households displaced	0	0
# of people seeking public shelter	0	0
Debris		
Building debris generated (tons)	147	807
Tree debris generated (tons)	3,322	8,098
Total	**3,469**	**8,905**
# of truckloads to clear building debris		
Value of Damages		
Total property damage (buildings and content) (Thousands of dollars)	$5,334.74	$18,155.79
Total losses due to business interruption (Thousands of dollars)	$120.69	$824.02
Total	**$5,455.43**	**$18,979.82**

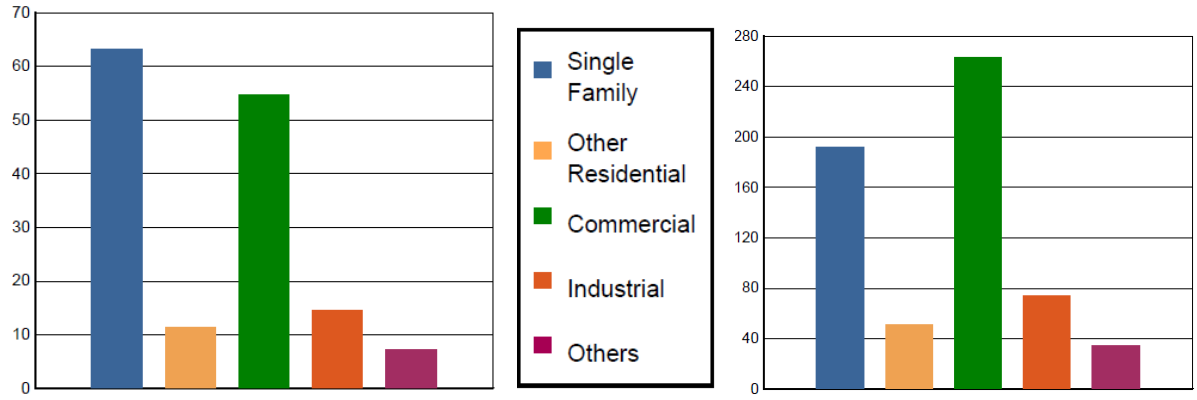
Estimated Damages from Earthquakes

The HAZUS earthquake module allows users to define an earthquake magnitude and model the potential damages caused by that earthquake as if its epicenter had been at the geographic center of the study area. For the purposes of this plan, two earthquakes were selected: magnitude 5.0 and a magnitude 7.0. Historically, major earthquakes are rare in New England, though a magnitude 5 event occurred in 1963.

Table 37: Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	2,321	
Estimated total building replacement value (2014 $) (Millions of dollars	$1,062,000,000	
Building Damages		
# of buildings sustaining slight damage	679	626
# of buildings sustaining moderate damage	383	725
# of buildings sustaining extensive damage	112	297
# of buildings completely damaged	30	391
Population Needs		
# of households displaced	49	286
# of people seeking public shelter	26	154
Debris		
Building debris generated (tons)	25,000	131,000
# of truckloads to clear debris (@ 25 tons/truck)	1,000	5,240
Value of Damages (Millions of dollars)		
Total property damage	$128.64	$529.73
Total losses due to business interruption	$22.24	$83.82
Total Losses	**$150.89**	**$613.55**

Earthquake Losses by Property Type for Magnitude 5.0 and 7.0



Estimated Damages from Flooding

The HAZUS flood risk module was used to estimate damages to the municipality at the 100 and 500 return periods. These return periods correspond to flooding events that have a 1% and a 0.2% likelihood of occurring in any given year.

Table 38: Estimated Damages from Flooding

	100 Year	500 Year
Building Characteristics		
Estimated total number of buildings	2,321	
Estimated total building replacement value (2014 $) (Millions of dollars)	$1,062,000,000	
Building Damages		
# of buildings sustaining slight damage (1-10%)	0	2
# of buildings sustaining moderate damage (11-50%)	0	0
# of buildings sustaining substantial damage (>50%)	0	0
Population Needs		
# of households displaced	0	91
# of people seeking public shelter	0-	0
Value of Damages (Millions of dollars)		
Total property damage (buildings and content)	$1.92	$4.31
Total losses due to business interruption	$1.11	$2.43
Total	**$3.03**	**$6.74**

SECTION 5: HAZARD MITIGATION GOALS

The following hazard mitigation goals are intended to guide the preparation of this plan and the Town's efforts for ongoing implementation of its hazard mitigation strategy. All of the goals are considered important for the Town, and they are not listed in order of importance.

GOAL 1: Prevent and reduce the loss of life, injury, public health impacts, and property damages resulting from all major natural hazards

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

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

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

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

GOAL 6: Work with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities.

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

GOAL 8: Take maximum advantage of resources from FEMA and MEMA and MA EEA to educate Town staff and the public about hazard mitigation

GOAL 9: Educate the public about natural hazards, climate change, and mitigation measures.

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

SECTION 6: EXISTING MITIGATION MEASURES

The existing protections in the Town of Topsfield are a combination of zoning, land use, and environmental regulations, open space preservation, infrastructure management, and drainage infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage problems.

Flooding is one of the most frequent and widespread hazard in Topsfield and the Town employs a number of practices to help minimize potential flooding its impacts. Active participation in the National Flood Insurance Program (NFIP) is one of the Town's key mitigation strategies. 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.

The Town has 38 flood insurance policies in force as of 2020. There is a total of $10,880,600 of insurance coverage in place. As shown in Table 39, about 25% of the insurance coverage is for properties in Flood Hazard Zone A, with about 75% in zone X. There were 25 flood losses paid in Topsfield, totaling $440,206.

Table 39: Topsfield Flood Insurance Policy Data, 2020

Flood insurance policies in force	38
Coverage amount of flood insurance policies, total	$10,880,600
Coverage in A Zone (11 policies)	$2,666,600
Coverage in X Zone (27 policies)	$8,214,000
Premiums paid	$42,955
Total losses (all losses submitted regardless of the status)	25
Closed losses (Losses that have been paid)	25
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	0
Total payments (Total amount paid on losses)	$440,206

COMPILATION OF EXISTING MITIGATION MEASURES

In addition to the NFIP, the Town of Topsfield implements a wide array of local mitigation measures across multiple Town Departments. Boards and Commissions. Table 40 summarizes the many existing natural hazard mitigation measures already in place in Topsfield.

Table 40: Existing Topsfield Mitigation Measures

Type of Mitigation	Description	Effectiveness	Changes Needed
FLOOD HAZARDS			
1) Participation in the National Flood Insurance Program (NFIP)	The town participates in the NFIP and has adopted the effective FIRM maps. The town actively enforces the floodplain regulations.	Effective. There are 38 policies in force in Topsfield	Encourage all eligible homeowners to obtain insurance.
2) Floodplain District	The town adopted a Floodplain District under Section VI the Zoning Bylaw that serves to reduce the risk of flooding for new development.	Effective	
3) Stormwater and Erosion Control Regulations	Chapter LI: Adopted by the Planning Board to regulate stormwater from new developments.	Effective	
4) Ipswich River Protection District	The town adopted the Ipswich River Protection District under Section VIII the Zoning Bylaw.	Effective	
5) Topsfield General Wetlands Bylaw (Ch. 62)	Chapter LXII: Any activity within 100 feet of any wetland resource area or 200 feet of a perennial stream requires review and may require a permit from the Conservation Commission.	Effective	
6) Low Impact Development (LID) guidelines	Adopted by the Planning Board in 2005 to encourage Low Impact Development designs and provide technical guidance for their implementation.	Effective	Periodically review to incorporate current best practices for LID.
7) Groundwater Protection District	Article XI: A Zoning District defined to overlay the zoning districts of the Town of Topsfield, covering both Zone I and Zone II areas of recharge to the Town's public water supply wells.	Effective	

8) Open Space and Recreation Plan	The Town adopted an updated Open Space and Recreation Plan in 2019.	Effective	Periodically update the plan and incorporate hazard mitigation considerations.
9) Street Sweeping	Every street gets swept twice a year or as needed (MS4 regulation).	Effective	
10) Catch Basin Cleaning	All catch basins are cleaned out when they become 50% full (MS4 regulation).	Effective	
11) Enforcement of the State Building Code	The town enforces the Massachusetts State Building Code, which regulates for flood-proofing	Effective for new construction	
12) Massachusetts Stormwater Regulations	This policy is applied to developments within the jurisdiction of the Conservation Commission	Effective	
DAM HAZARDS			
13) DCR Dam Safety Regulations	The state has dam safety regulations mandating inspections and emergency action plans	Enforcement can be an issue	
14) State permits required for dam construction	State law requires a permit for the construction of any dam	Effective for new construction.	
15) Comprehensive Emergency Management Plan (CEMP)	The CEMP addresses dam safety issues.	Effective, Emphasis is on emergency response	Periodically update the CEMP
16) Emergency Action Plan for the Putnamville Reservoir Dam	An Emergency Action Plan has been prepared for the Putnamville Reservoir Dam, which is located upstream from the town of Topsfield. The dam is owned by the Salem and Beverly Water Supply Board.	Effective	Coordinate with Salem and Beverly Water Supply Board as needed, review EAP updates

BRUSH FIRE HAZARDS			
17) Permits required for outdoor burning.	The Fire Department requires a permit for outdoor burning.		
18) Subdivision Review	The Fire Department is involved in reviewing new subdivision plans. Connections to town water are required if available, or cisterns are encouraged.	Effective	
GEOLOGIC HAZARDS			
19) The Massachusetts State Building Code	The Town enforces the Massachusetts State Building Code, which regulates for earthquake resilient design.	Effective for most situations	
20) Comprehensive Emergency Management Plan (CEMP)	Addresses mitigation, preparedness, response, and recovery from a variety of natural and man-made emergencies.	Emphasis is on emergency response	Periodically update the CEMP
WIND HAZARDS			
21) Massachusetts State Building Code	The town enforces the Massachusetts State Building Code, which regulates for wind loads	Most effective for new construction	
22) Tree-Trimming	The Tree Warden and local utility company (National Grid) conduct regular tree trimming.	Effective for most situations	Enhanced tree trimming needed due to increased wind events and power outages
WINTER HAZARDS			
23) Roadway Treatments	The Highway Department conducts winter roadway treatments with a salt/sand mix throughout the town during winter storms.	Effective for most situations	None.

24) Snow Plowing	The town conducts regular winter snow plowing operations.	Effective for most situations	None.
25) Massachusetts State Building Code	The town enforces the Massachusetts State Building Code, which regulates snow loads.	Most effective for new construction	
MULTI-HAZARDS			
26) Massachusetts State Building Code	Regulates wind loads, earthquake resistant design, flood-proofing and snow loads.	Most effective for new construction	
27) Multi-Department Review of Developments?	The Town conducts multiple department reviews of new development, for subdivisions and site plan review. The Planning Board, Conservation Commission, Board of Health, Fire Dept, Police Dept, and Highway Dept. participate in the reviews.	Effective	Refer to the Hazard Mitigation Plan when conducting reviews of new developments
28) Comprehensive Emergency Management Plan (CEMP)	Addresses mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies.	Emphasis is on emergency response	Periodically update the CEMP
DROUGHT			
29) Water Conservation Plan	The Town has adopted a water conservation plan.	Effective	Periodically review plan for changing conditions, incorporate hazard mitigation measures
30) Massachusetts Drought Management Plan 2019	The state updated its Drought Management Plan in 2019 with modified drought action levels and requirements for water restrictions in a drought.	Effective	

MITIGATION CAPABILITIES AND LOCAL CAPACITY FOR IMPLEMENTATION

Under the Massachusetts system of "Home Rule," the Town of Topsfield is authorized to adopt and from time to time amend local bylaws and regulations that support the town's capabilities to mitigate natural hazards. These include Zoning Bylaws, Subdivision and Site Plan Review Regulations, Wetlands Bylaws, Stormwater Bylaws, Health Regulations, Public Works regulations, and local enforcement of the State Building Code.

Local Bylaws may be amended by the Town Meeting to improve the town's capabilities, and changes to most regulations require a public hearing and a vote of the authorized board or commission. The Town of Topsfield has recognized several existing mitigation measures that require implementation or improvements and has the capacity within its local boards and departments to address these.

Several departments including Public Works, Planning, and Conservation will address the many planning and infrastructure improvements identified in this plan. The Public Works Department will pursue implementation an assessment of roads and culverts that are vulnerable to flooding and drainage problems and prioritize upgrades for implementation. The Town recently updated its Open Space and Recreation Plan in 1019, which identifies priorities that the Conservation Commission will implement.

The Town can improve its hazard mitigation capabilities with the following measures:

- Review and update the Low Impact Development best practices in the Town's LID guidelines and consider incorporating LID requirements more formally into a bylaw to ensure it becomes widely adopted in new developments and redevelopments.

- Update the Town's Master Plan and incorporate Hazard Mitigation and Climate Resilience as a formal component of the plan, equivalent to other components traditionally included in a Master Plan such as Land Use, Transportation, Housing, and Economic Development.

- Update the Town's Open Space plan and incorporate Hazard Mitigation and Climate Resilience as a formal component of the plan. Identify opportunities for open space protection and land acquisition that would have specific hazard mitigation co-benefits, such as managing stormwater to reduce flooding, protecting vegetation for shade to mitigate extreme heat, and managing forests to mitigate climate impacts.

- Expand the Town's tree trimming operations, in coordination with the utilities, to reduce vulnerability to high winds and winter storms and the Town's risk of power outages.

- In reviewing and permitting new development projects, refer to the Hazard Mitigation Plan for guidance to incorporate mitigation into site design and construction.

- Review and update the Town's water conservation plan to enable a more robust mitigation of drought, which has occurred more frequently in the last decade and is projected to increase in the future due to climate change.

- Regularly coordinate with the Salem and Beverly Water Supply Board on implementation and updates to the Emergency Action Plan for the Putnamville Reservoir Dam. Ensure that any developments downstream of the dam are prepared for any potential hazards in the event of dam failure.

- Manage risks to private wells by conducting an inventory or survey of private wells and review those at risk of flooding or contamination; provide public education and guidance on mitigating risks to wells.

- Financing the implementation of mitigation measures: the Town can incorporate a program of mitigation measures into its Capital Investment Program to ensure that these receive priority along with other categories of municipal investment such as roadways and municipal buildings.

- The Town can consider adopting a Stormwater Utility or stormwater user fee to provide a dedicated, predictable revenue stream to finance upgrades to the stormwater infrastructure, many of which are needed to mitigate flooding risks.

SECTION 7: HAZARD MITIGATION STRATEGY

WHAT IS HAZARD MITIGATION?

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

https://www.fema.gov/hazard-mitigation-grant-program
https://www.fema.gov/pre-disaster-mitigation-grant-program
https://www.fema.gov/flood-mitigation-assistance-grant-program

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

- **Prevention:** Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.

- **Property Protection:** Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter resistant glass.

- **Public Education & Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.

- **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

- **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (e.g., culverts), floodwalls, seawalls, retaining walls, and safe rooms.

- **Emergency Services Protection:** Actions that will protect emergency services before, during, and immediately after an occurrence. Examples of these actions include protection of warning system capability, protection of critical facilities, and protection of emergency response infrastructure. (Source: FEMA Local Multi-Hazard Mitigation Planning Guidance)

REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

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

REGIONAL PARTNERS

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

Following, is a brief overview of regional facilities found in Topsfield that should be taken into consideration as the Town implements its hazard mitigation strategy

OVERVIEW OF REGIONAL FACILITIES WITHIN TOPSFIELD

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

- I-95, Route 1 and Route 97 (MassDOT)
- Bradley Palmer State Park (Mass DCR)
- Willowdale State Forest (Mass DCR)
- Ipswich River Wildlife Sanctuary (Massachusetts Audubon Society)
- Topsfield Fairgrounds (Essex County Agricultural Society)
- Salem and Beverly Water Supply Board (dams, infrastructure, potential reservoir site)
- Masconomet Regional Middle School

INTER-COMMUNITY CONSIDERATIONS

Regional Climate Change Impacts

The potential future changes to the State's storm damage profile caused by climate change will likely be well outside of historic trends, making those trends uncertain predictors of future risk and vulnerability at best. Massachusetts has established a robust program to help communities address climate change through the Municipal Vulnerability Program (MVP). The state also launched a website providing the best available information to map and model climate change and sea level rise data in Massachusetts at www.resilientma.org. Topsfield and its neighboring communities have all participated in the MVP program, which raises the possibility of collaboration on issues of joint concern in the subregion.

NEW DEVELOPMENT AND INFRASTRUCTURE

As part of the process of developing recommendations for new mitigation measures for this plan, the Town considered the issues related to new development, redevelopment, and infrastructure needs in order to limit future risks.

Taking into consideration the town's Wetlands bylaw enforced by the Conservation Commission, the floodplain zoning overlay, the stormwater bylaw, the Low Impact Development Guidelines, the Grounder Protection district, the Open Space and Recreation Plan, and the Municipal Vulnerability Preparedness project, the town determined that existing regulatory measures are taking good advantage Home Rule land use regulatory authority to minimize natural hazard impacts of development. Priorities for the future include conducting a town-wide assessment of roads and culvers vulnerable to drainage problems and prioritize improvement projects.

PROCESS FOR SETTING PRIORITIES FOR MITIGATION MEASURES

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

Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events, the extent of the area impacted, and the relation of a given mitigation measure to the Town's goals. In addition, consideration was given to factors such as road closures and what impact closures have on delivery of emergency services and the local economy, critical facilities, homes, and businesses impacted by hazards, anticipated project costs, whether any environmental constraints existed, and whether the Town would be able to justify the costs relative to the anticipated benefits.

Table 41 below demonstrates the prioritization of the recommended hazard mitigation measures for the Town's mitigation strategy. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of the following criteria:

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event
Estimated Costs	
High	Estimated costs greater than $250,000
Medium	Estimated costs between $50,000 to $250,000
Low	Estimated costs less than $50,000 and/or staff time
Overall Priority	
High	Action very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure
Medium	Action may have political and public support and necessary maintenance has potential to occur following the project
Low	Not clear if action has political and public support and not certain that necessary maintenance can occur following the project

Table 41: Mitigation Measures Prioritization

Mitigation Type	Mitigation Actions	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
FLOODING – NON-STRUCTURAL					
1) Floodplain Zoning District	Amend floodplain map periodically to be consistent with FIRM changes and pending new FEMA requirements.	Town wide	MED	LOW	HIGH
2) Groundwater Protection Zoning	Update the bylaw's performance standards as needed to reflect current best practices.	Town wide	MED	LOW	MED
3) Low Impact Development	Update the LID Guidelines' performance standards as needed to reflect current best practices.	Town wide	HIGH	LOW	HIGH
4) Private Wells	Conduct an inventory or survey of private wells and review those at risk of flooding or contamination.	Town wide	MED	LOW	MED
5) Watershed Drainage Model	A watershed drainage model would be beneficial to understand flooding dynamics and it would be useful to include other towns in the watershed such as Ipswich to provide a comprehensive analysis.	Town wide/ Watershed	MED	MED	MED
6) Open Space acquisition	Target land purchases for flood storage, runoff reduction, and ecosystem services.	Town wide	MED	HIGH	MED
FLOODING HAZARDS – STRUCTURAL					
7) Ipswich Road at Howlett Brook	Address flooding of the roadway near the bridge over Howlett Brook. The bridge was rebuilt and raised after the 2007 Mother's Day storm, but the roadway on both sides of the	Ipswich Road	MED	MED	MED

Mitigation Type	Mitigation Actions	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
	bridge is lower and subject to flooding. Raising portions of the road should be evaluated.				
8) Washington Street at Fish Bk.	This 2-channel granite culvert in Fish Brook connects Topsfield to Boxford. The two towns collaborated on a potential upgrade, but Boxford had to use available funding for another priority project. Initial engineering work was done which could be reviewed and updated if necessary. Possible replacement with a box culvert.	Washington Street	HIGH	HIGH	HIGH
9) Lockwood Lane culvert	This culvert is a drainage choke point. Replacing and upgrading it would address this area of concern.	Lockwood Lane	LOW	MED	LOW
10) Maple Street	This culvert on Maple Street next to the Fairgrounds is in poor condition. Flow restrictions here would be addressed by an upgraded culvert replacement.	Maple Street	LOW	MED	LOW
11) Haverhill Road at Pye Brook culvert	Stone, gravel bottom culvert was damaged in the Mother's Day 2007 storm. Temporary repairs were made.	Haverhill Road	HIGH	HIGH	HIGH
12) Boxford Road culvert	Replacement of stone culvert on Boxford Road.	Boxford Road	HIGH	HIGH	HIGH
13) Rail Trail drainage	Address drainage concerns along the Rail Trail to prevent flooding in the area. Some abutting homes experience flooding.	Rail Trail	LOW	TBD	LOW

Mitigation Type	Mitigation Actions	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
DAM HAZARDS					
14) Dam inspection & maintenance	Conduct periodic inspections of the town's low hazard dam; implement any needed maintenance.	Hood Pond Dam	MED	LOW	MED
BRUSH FIRE HAZARDS					
15) Town-wide brush fire hazards	Provide public education on brush fire hazards, landscaping, and vegetation maintenance at the wildfire-urban interface.	Town wide	LOW	LOW	LOW
GEOLOGIC HAZARDS					
16) Town-wide Earthquake hazards	Identify public buildings that may be vulnerable to earthquakes and assess options to make them more resistant to earthquakes.	Public Buildings	MED	LOW	MED
WIND HAZARDS					
17) Tree management	Reconvene the town's Tree Planting Committee to address tree management and mitigate hazards. Enhance the Town's tree maintenance program and coordinate with National Grid. Conduct an inventory of trees, assess conditions. Identify trees that could pose a hazard due to their condition and/or location; prioritize for management.	Town wide	MED	LOW	LOW
WINTER HAZARDS					

Mitigation Type	Mitigation Actions	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
18) Town wide public building snow loads	Identify public buildings that may be vulnerable to damage from snow loads and conduct a structural assessment if needed.	Town wide	MED	LOW	LOW
DROUGHT HAZARDS					
19) Town-wide drought	Adopt guidelines for new development to promote drought tolerant landscaping and site design measures.	Town wide	LOW	LOW	LOW
20) Town-wide drought	Assess options for water service and fire protection if there is a drought. Determine feasibility of emergency connections to neighboring towns.	Town wide	MEDI	LOW	LOW
21) Town-wide drought	Review the local Water Conservation Plan that was adopted in 2005; update for consistency with the 2019 MA Drought Management Plan.	Town wide	MED	LOW	MED
EXTREME TEMPERATURES					
22) Town-wide: Extreme heat and cold	Conduct a public awareness on the risks of extreme temperatures and resources available to residents in the event of extreme temperatures.	Town wide	MED	LOW	LOW
MULTIHAZARDS					
23) Generators	Add a generator to Town Hall; assess generators in town facilities and identify any that need to be replaced.	Town Hall; public bldgs.	HIGH	LOW	HIGH
24) Communications	Develop a public communications plan for managing emergency events. Create a dedicated Emergency Management	Town wide	HIGH	LOW	HIGH

Mitigation Type	Mitigation Actions	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
	page on the Town's website with contacts and local information on preparing for natural hazards.				
25) Vulnerable Populations	Expand the existing program and database that identifies vulnerable citizens and how to provide services. Leverage recent research for COVID-19. Conduct an education campaign through a stakeholder/focus group.	Town wide	HIGH	LOW	HIGH

Introduction to Potential Mitigation Measures (Table 42)

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

- **Priority** – As described above and summarized in Table 41, the designation of high, medium, or low priority was done considering area covered by the mitigation measures and their potential benefits and preliminary estimated project costs.

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

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

- **Potential Funding Sources** – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated or designed, or if it is still in the conceptual stages. Each grant program and agency have specific eligibility requirements that would need to be taken into consideration. In most instances, the measure will require a number of different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for or selected for funding. Upon adoption of this plan, the local team responsible for its implementation should begin to explore the funding sources in more detail.

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

  Massachusetts Emergency Management Agency (MEMA) – The grants page https://www.mass.gov/hazard-mitigation-assistance-grant-programs describes the various Hazard Mitigation Assistance Program, including the FEMA's Building Resilient Infrastructure and Communities (BRIC) grant. Massachusetts Municipal Vulnerability

Preparedness Action Grants—Communities designated by the state as MVP certified are eligible to apply for MVP Action Grants. These grants are intended to assist with the implementation of mitigation and resilience actions identified in a community's MVP Report. Since Topsfield conducted an MVP project in conjunction with this Hazard Mitigation Plan, it is expected that the town should be eligible for MVP Action Grants in the next grant round of 2022. https://resilientma.org/mvp/

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

Table 42: Mitigation Measures Prioritization

Mitigation Measure Type, Location	Description	Priority (H, M, L)	Lead Dept.	Time Frame (2021-26)	Estimated Cost*	Potential Funding Sources
FLOODING HAZARDS - NON-STRUCTURAL PROJECTS						
1) Floodplain Zoning District	Amend floodplain map periodically to be consistent with FIRM changes and pending new FEMA requirements.	HIGH	Planning	2022-26	LOW	Town of Topsfield General Fund
2) Groundwater Protection Zoning	Review and update the bylaw's performance standards if needed to reflect current best practices.	HIGH	Planning	2022-23	LOW	Town of Topsfield General Fund
3) Low Impact Development Guidelines	Review and update the Low Impact Development performance standards if needed to reflect current best practices.	MED	Planning Conservation	2022-23	LOW	Town of Topsfield General Fund
4) Private Wells	Conduct an inventory or survey of private wells and review those at risk of flooding or contamination.	MED	Board of Health	2022-25	LOW	Town of Topsfield General Fund
5) Watershed Drainage Model	A watershed drainage model would be beneficial to understand flooding dynamics and would be useful to include other towns in the watershed such as Ipswich to provide a comprehensive analysis.	MED	Public Works Planning Conservation	2023-26	MED	BRIC, MVP. Town of Topsfield General Fund

Mitigation Measure Type, Location	Description	Priority (H, M, L)	Lead Dept.	Time Frame (2021-26)	Estimated Cost*	Potential Funding Sources
6) Open Space acquisition	Target land purchases for flood storage, runoff reduction, and ecosystem services.	MED	Conservation	2021-26	HIGH	Topsfield Budget/NGOs /Land Donations
FLOODING HAZARDS - STRUCTURAL PROJECTS						
7) Ipswich Road at Howlett Brook	Address flooding of the roadway near the bridge over Howlett Brook. The bridge was rebuilt and raised after the 2007 Mother's Day storm, but the roadway on both sides of the bridge is lower and subject to flooding. Raising portions of the road should be evaluated.	MED	Public Works	2023-26	MED	Topsfield Capital Budget/BRIC
8) Washington Street at Fish Bk.	This 2-channel granite culvert in Fish Brook connects Topsfield to Boxford. The two towns collaborated on a potential upgrade, but Boxford had to use available funding for another priority project. Initial engineering work was done, which could be reviewed updated if necessary. Possible replacement with a box culvert.	HIGH	Public Works	2023-26	HIGH	Topsfield Capital Budget/BRIC

Mitigation Measure Type, Location	Description	Priority (H, M, L)	Lead Dept.	Time Frame (2021-26)	Estimated Cost*	Potential Funding Sources
9) Lockwood Lane culvert	This culvert is a drainage choke point. Replacing and upgrading it would address this area of concern.	LOW	Public Works	2023-26	MED	Topsfield Capital Budget/BRIC
10) Maple Street culvert	This culvert on Maple Street next to the Fairgrounds is in poor condition. Flow restrictions here would be addressed by an upgraded culvert replacement.	LOW	Public Works	2023-26	MED	Topsfield Capital/BRIC
11) Haverhill Road culvert at Pye Brook	Stone, gravel bottom culvert was damaged in the Mother's Day 2007 storm. Temporary repairs were made.	HIGH	Public Works	2023-26	HIGH	Topsfield Capital Budget/BRIC
12) Boxford Road culvert	Replacement of stone culvert on Boxford Road.	HIGH	Public Works		HIGH	Topsfield Capital Budget/BRIC
13) Rail Trail drainage	Address drainage concerns along the Rail Trail to prevent flooding in the area. Abutting homes experience flooding.	LOW	Public Works		TBD	Topsfield Capital Budget/BRIC
DAM HAZARDS						
14) Dam inspection and maintenance	Conduct periodic inspections of the town's low hazard dam; implement any needed maintenance.	LOW	Public Works	2023-26	LOW	Town of Topsfield General Fund

Mitigation Measure Type, Location	Description	Priority (H, M, L)	Lead Dept.	Time Frame (2021-26)	Estimated Cost*	Potential Funding Sources
BRUSHFIRE HAZARDS						
15) Town-wide brush fire hazards	Provide public education on brush fire hazards, landscaping and vegetation maintenance at the wildfire-urban interface.	MED	Fire Dept.	2022-23	LOW	Town of Topsfield General Fund
GEOLOGIC HAZARDS						
16) Town-wide Public Buildings-Earthquake hazards	Identify public buildings that may be vulnerable to earthquakes and assess options to make them more resistant to earthquakes.	LOW	Public Works	2023-25	LOW	Town of Topsfield General Fund
WIND HAZARDS						
17) Tree management	Reconvene the town's Tree Planting Committee to address tree management and mitigate hazards. Enhance the Town's tree maintenance program and coordinate with National Grid. Conduct an inventory of trees, assess conditions. Identify trees that could pose a hazard; prioritize for management.	HIGH	Conservation Tree Warden	2021-25	MED	Town of Topsfield General Fund; BRIC; MVP

Mitigation Measure Type, Location	Description	Priority (H, M, L)	Lead Dept.	Time Frame (2021-26)	Estimated Cost*	Potential Funding Sources
WINTER HAZARDS						
18) Town wide public building snow loads	Identify public buildings that may be vulnerable to damage from snow loads and conduct a structural assessment if needed.	LOW	Public Works	2023-25	LOW	Town of Topsfield General Fund
DROUGHT HAZARDS						
19) Town-wide drought	Adopt guidelines for new development to promote drought tolerant landscaping and site design measures.	LOW	Planning Conservation	2022-23	LOW	Town of Topsfield General Fund
20) Town-wide drought	Assess options for water service and fire protection if there is a drought. Determine feasibility of emergency connections to neighboring towns.	MED	Public Works	2023-25	MED	Town of Topsfield General Fund
21) Town-wide drought	Review the local Water Conservation Plan that was adopted in 2005; update for consistency with the 2019 MA Drought Management Plan.	MED	Public Works	2022-24	LOW	Town of Topsfield General Fund' EEA Grant

Mitigation Measure Type, Location	Description	Priority (H, M, L)	Lead Dept.	Time Frame (2021-26)	Estimated Cost*	Potential Funding Sources
EXTREME TEMPERATURE HAZARDS						
22) Town-wide: Extreme heat and cold	Conduct a public awareness on the risks of extreme temperatures and resources available to residents in the event of extreme temperatures.	HIGH	Board of Health; Council on Aging	2021-26	LOW	Town of Topsfield General Fund
MULTI-HAZARDS						
23) Generators	Add a generator to Town Hall; assess generators in town facilities and identify any that need to be replaced.	HIGH	Public Works	2022-24	MED	BRIC, Town of Topsfield General Fund;
24) Communications	Develop a public communications plan for managing emergency events. Create a dedicated Emergency Management page on the Town's website with contacts and local information on preparing for natural hazards.	HIGH	Emergency Management	2022-25	MED	Town of Topsfield General Fund
25) Vulnerable Populations	Expand the existing program and database that identifies vulnerable citizens and how to provide services. Leverage research for COVID-19. Conduct an education campaign through a stakeholder/focus group.	HIGH	Board of Health; Council on Aging	2021-23	LOW-MED	Town of Topsfield General Fund

* COST ESTIMATES are defined by the following categories:

Low:	Less than $50,000
Medium:	$50,000 to $250,000
High:	More than $250,000

SECTION 8: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION

The *Topsfield Hazard Mitigation Plan* was adopted by the Topsfield Select Board on *November 22, 2021*. See Appendix D for the signed Certificate of Adoption. The plan was approved by FEMA on [*ADD DATE*] for a five-year period that will expire on November 29, 2021. See Appendix D for the FEMA Letter of Approval.

PLAN MAINTENANCE

MAPC worked with the Topsfield HMP/MVP Core Team to prepare this plan. After approval of the plan by FEMA, the Town of Topsfield will convene a Hazard Mitigation Implementation Committee to coordinate the implementation and evaluation of the Hazard Mitigation Plan and seek funding for mitigation projects in the plan. The committee will be coordinated by the Fire Chief/Emergency Management Director. Additional members may be added to the committee from local businesses, non-profits, and institutions. The Town will encourage public participation during the next 5-year planning cycle. As a mid-term review of the plan is conducted by the committee, this will be placed on the Town's web site, and any meetings of the committee will be publicly noticed in accordance with town and state open meeting laws.

IMPLEMENTATION AND EVALUATION SCHEDULE

Mid-Term Review of Progress – The Topsfield Hazard Mitigation Implementation Committee will prepare and distribute a survey in year three of the plan. The survey will be distributed to the members of the Topsfield HMP/MVP Core Team and other interested stakeholders in the Town. The survey will poll the participants on progress and accomplishments for implementation of the plan to date, changes or revisions to the plan that may be needed, and any new hazards or problem areas that have been identified.

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

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

The Hazard Mitigation Implementation Committee will use the information from the mid-term review to identify the needs and priorities for the plan update and seek funding for the plan update process. A potential source of funding an updated plan is the FEMA Building Resilient

Infrastructure and Communities grant (BRIC), which will pay for 75% of a planning project, with a 25% local cost share required.

Prepare and Adopt an Updated Local Hazard Mitigation Plan – Once the resources have been secured to update the plan, the Hazard Mitigation Implementation Committee will need to review the current FEMA hazard mitigation plan guidelines for any changes. When it is drafted, the next updated Topsfield Hazard Mitigation Plan will be forwarded to MEMA and FEMA for review and approval.

INTEGRATION OF THE PLANS WITH OTHER PLANNING INITIATIVES

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

- Town Administrator's office
- Fire Department
- Emergency Management
- Police Department
- Public Works Department
- Planning Board
- Conservation Commission
- Board of Health
- Building Commissioner

Other groups that will be coordinated with include large institutions, local businesses and farms, land conservation organizations and watershed groups. The plan will also be posted on the Town's website. The posting of the plan on the website will include a mechanism for citizen feedback such as an e-mail address to send comments.

The Hazard Mitigation Plan will be integrated into other Town plans and policies as they are updated and renewed, including the Comprehensive Emergency Management Plan, Master Plan, Open Space and Recreation Plan, and Capital Plan.

SECTION 9: LIST OF REFERENCES

Blue Hill Observatory

Cambridge Climate Vulnerability Assessment. Part 1. April 2017

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

FEMA, Local Mitigation Plan Review Guide, October 2011

FEMA, Flood Insurance Rate Maps for Essex County, MA

Massachusetts Drought Management Plan, 2019

Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams 2018

Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018

Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.

New England Seismic Network, Boston College Weston Observatory, http://aki.bc.edu/index.htm

NOAA National Centers for Environmental Information (NCEI), http://www.ncdc.noaa.gov/

Northeast Climate Center UMass Amherst. Mass. Climate Change Projections, 2017

Northeast States Emergency Consortium, http://www.nesec.org/
Topsfield Community Resilience Building Workshop Summary of Findings, June 2021

Topsfield Low Impact Development Guidelines, Planning Board

Topsfield Open Space and Recreation Plan

Topsfield Wetlands Bylaw

Topsfield Zoning Bylaws, Floodplain Protection District

Topsfield Zoning Bylaws, Groundwater Protection Bylaw

Salem and Beverly Water Supply Board, *Putnamville Dam Emergency Action Plan*, 2020

US Census, 2010 and American Community Survey 2019, 5-Year Estimates

USDA Forest Service, Wildfire Risk to Communities, www.wildfirerisk.org

USGCRP, Impacts, Risks, and Adaptation in the US: Fourth National Climate Assessment, 2018

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

APPENDIX A: HAZARD MAPPING

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

The map series consists of eight panels displaying the following information:

Map 1.	Population Density
Map 2.	Land Use
Map 3.	Flood Zones
Map 4.	Earthquakes and Landslides
Map 5.	Hurricanes and Tornadoes
Map 6.	Average Snowfall
Map 7.	Composite Natural Hazards
Map 8.	Composite Hazard Areas
Map 9	[Reserved for Sea Level Rise, N/A to Topsfield]
Map 10	High Land Surface Temperature and Tree Cover

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

Map 2: Land Use – This map shows the town's land use based on the state's MacConnell Land Use Statistics found on MassGIS. Land use is displayed in 28 categories, based on interpretation of statewide aerial photography.

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones for Essex County as its source. For more information, refer to the FEMA Map Service Center website http://www.msc.fema.gov. The definitions of the flood zones are described in detail on this site as well. The flood zone map for each community also shows critical infrastructure and municipally owned and protected open space.

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

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

Map 5: Hurricanes and Tornadoes – This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms. This information must be

viewed in context. A storm track only shows where the eye of the storm passed through. In most cases, the effects of the wind and rain from these storms were felt in other communities even if the track was not within that community. This map also shows the location of tornadoes with a classification as to the level of damages. What appears on the map varies by community since not all communities experience the same wind-related events. These maps also show the 100-year wind speed.

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

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

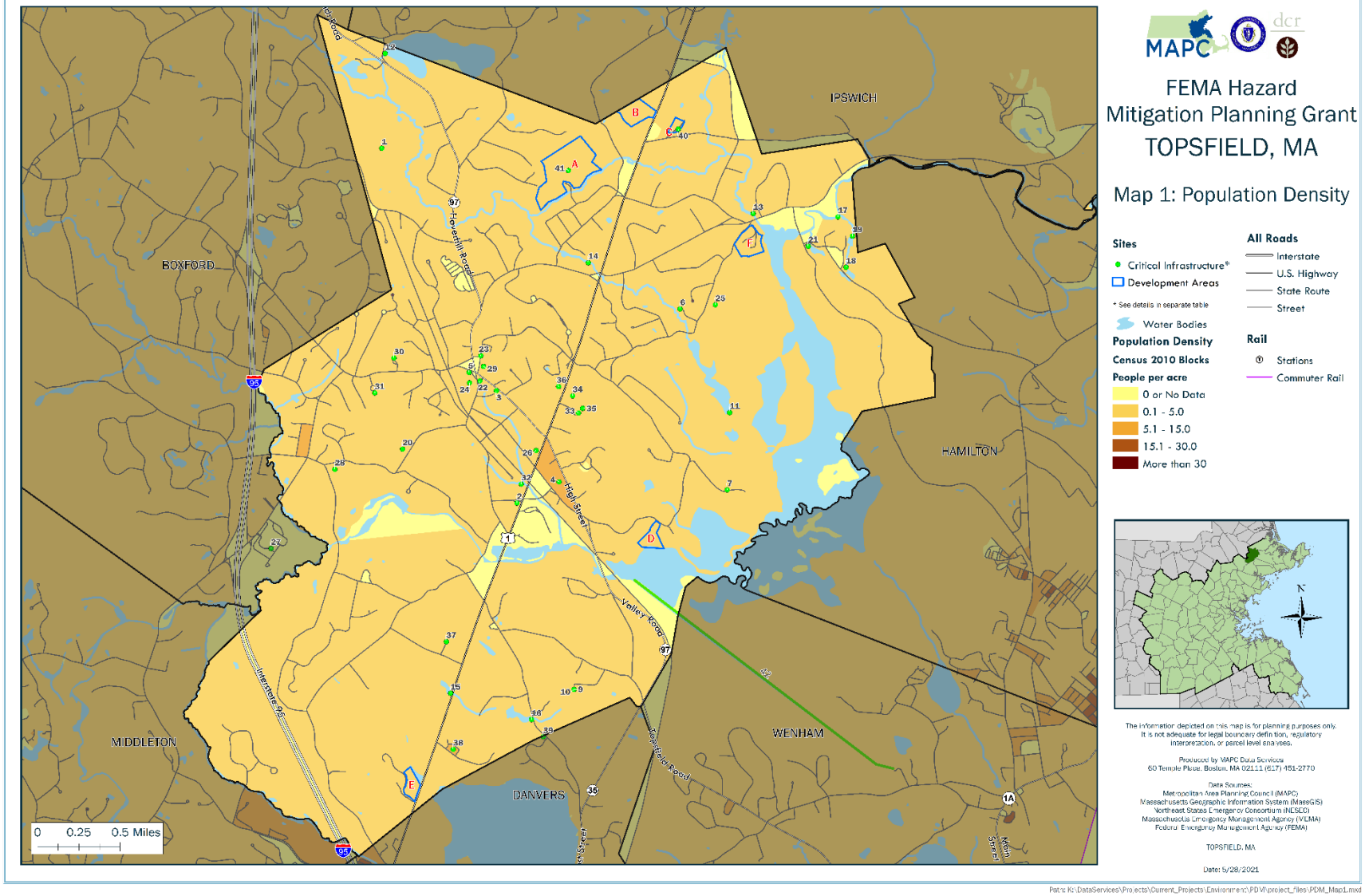
Map 8: Hazard Areas – For each community, locally identified hazard areas are overlaid on an aerial photograph. The critical infrastructure sites are also shown, as well as the recent and pending new development sites identified by the Town. The source of the aerial photograph is Mass GIS.

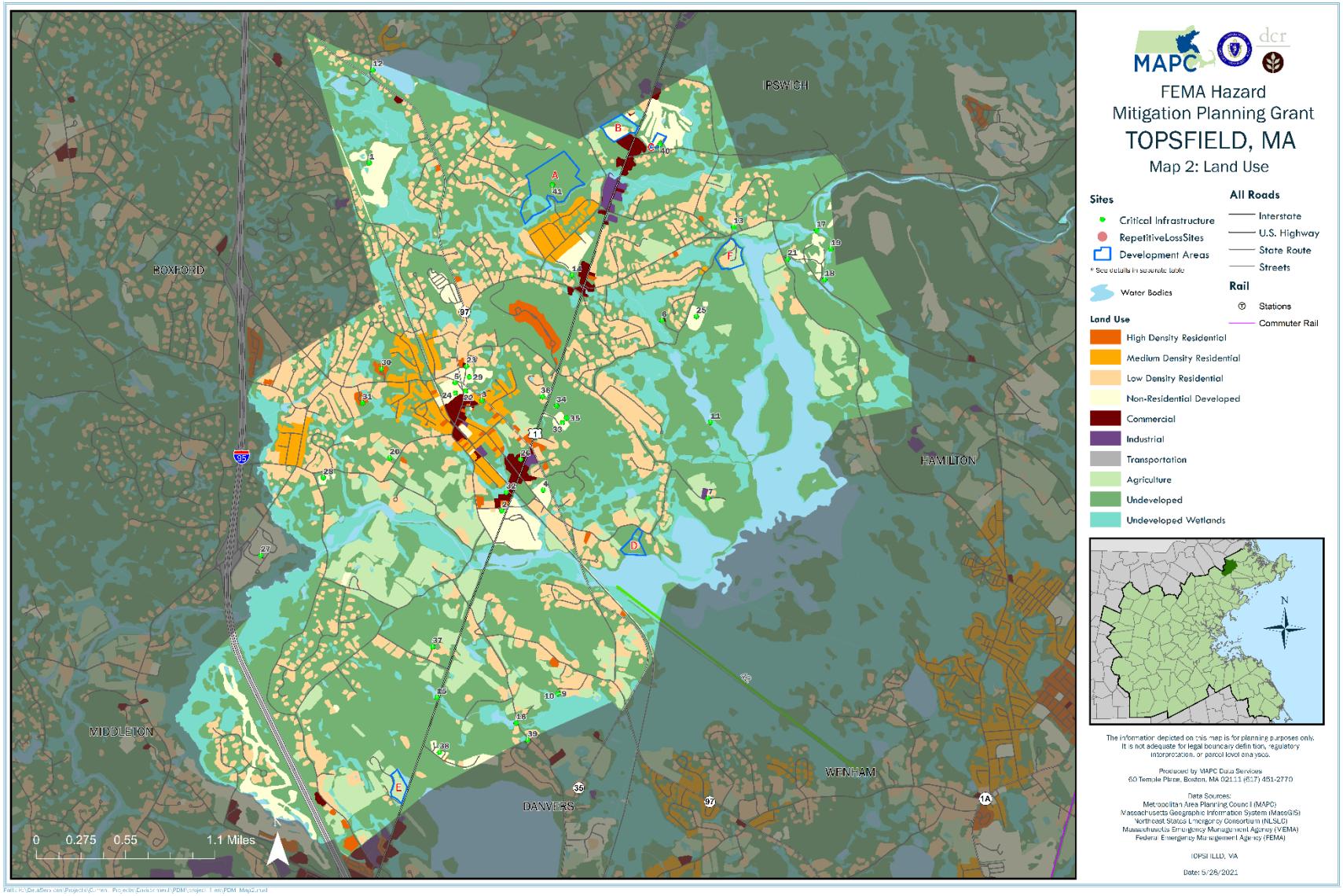
Map 9: Sea Level Rise– Not applicable to Topsfield, this map is not included.

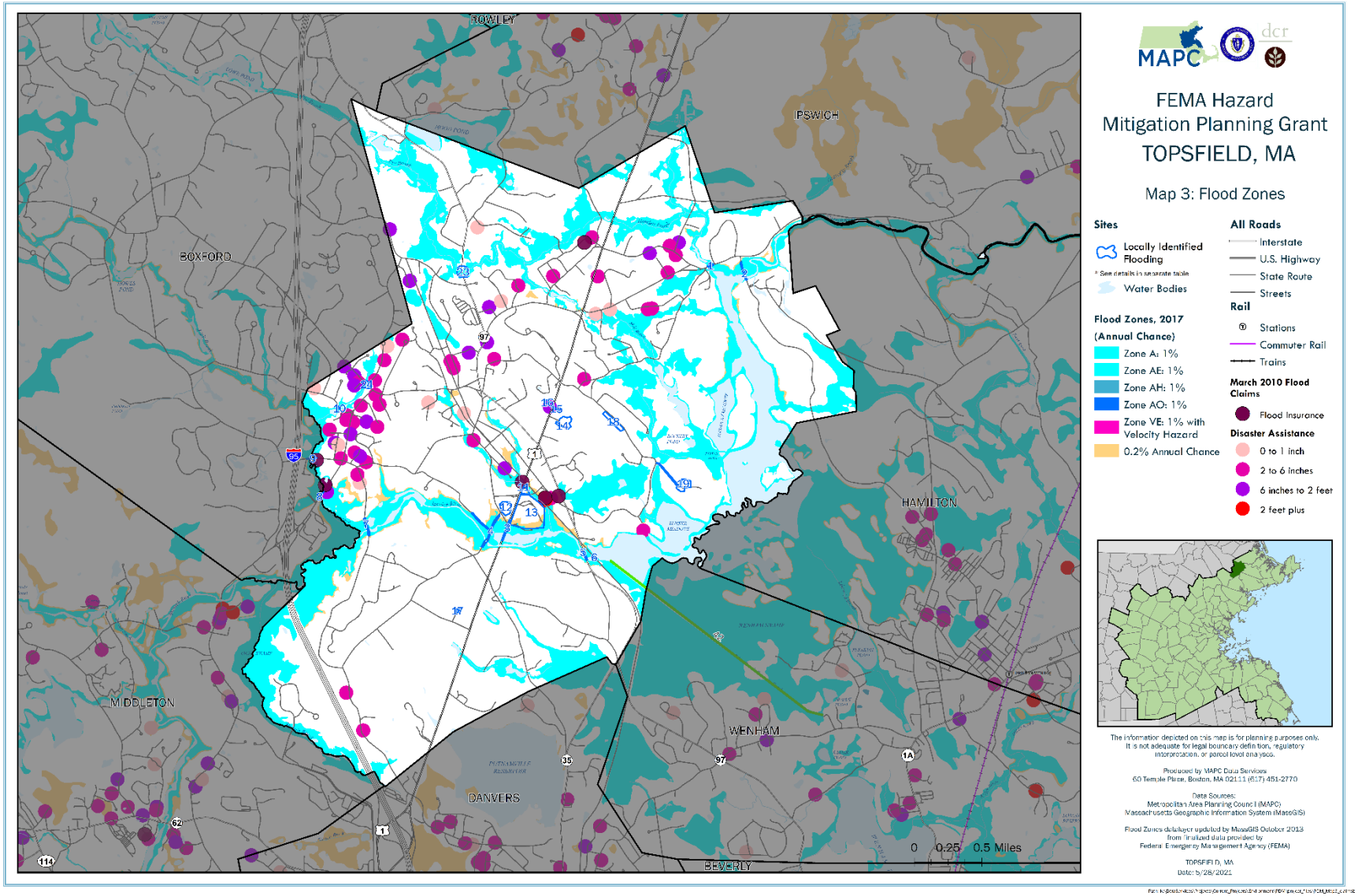
Map 10: High Land Surface Temperature - MAPC uses LANDSAT 30m spatial resolution satellite data to extract land surface temperature to assess a community's exposure to present-day extreme heat and any vulnerabilities to rising temperatures with climate change. The extreme heat analysis uses date from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

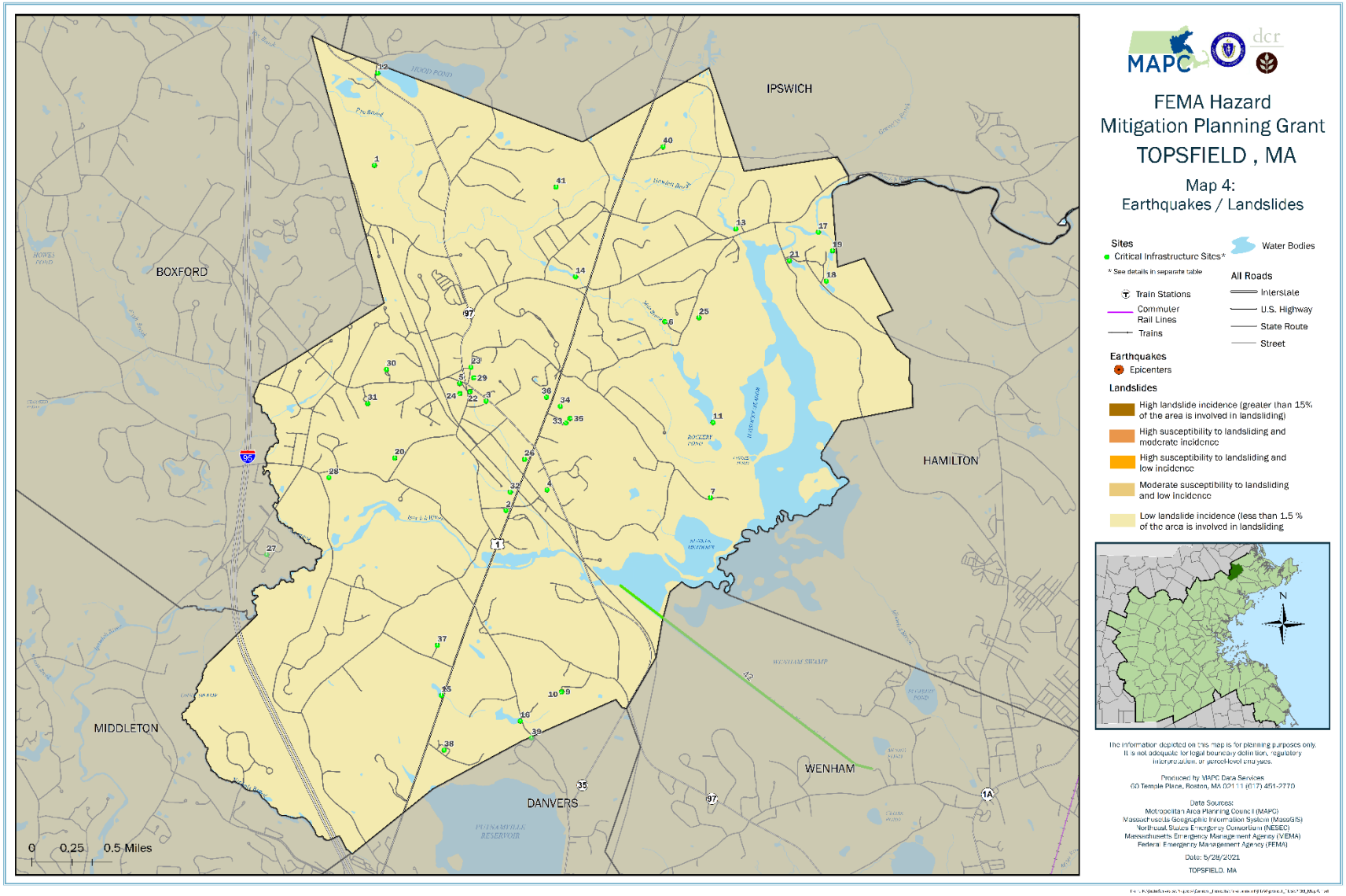
Inundation Maps for the Putnamville Dam

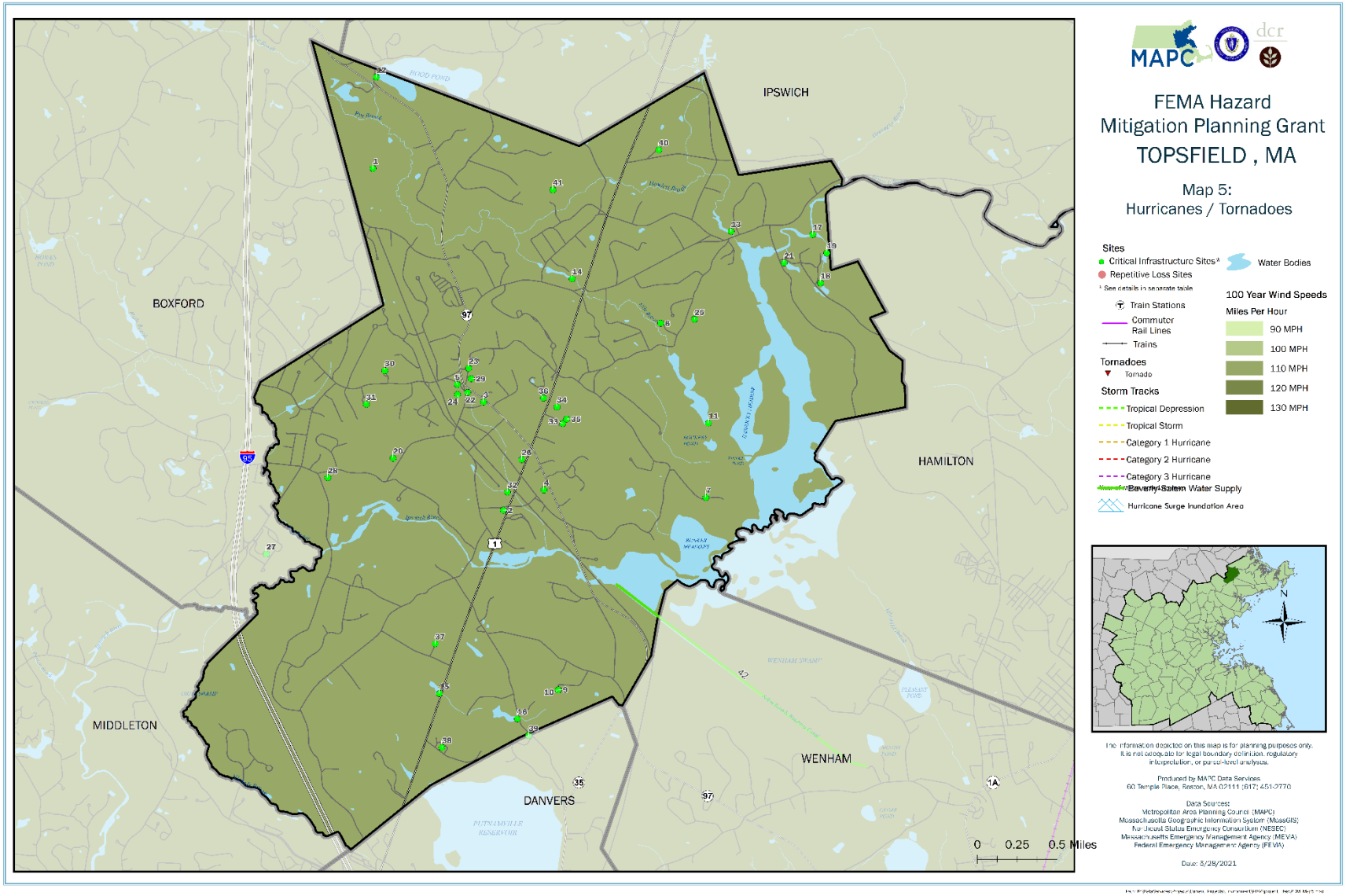
In addition to the hazard mitigation map series above, Appendix A includes two maps from the Putnamville Dam Emergency Management Plan(EAP). This dam is located in Danvers, but parts of Topsfield are in the area that would be inundated in the event of dam failure. The two maps show the potential inundation areas in the northern and southern sections of Topsfield.


FEMA Hazard
Mitigation Planning Grant
TOPSFIELD, MA
Map 1: Population Density
Sites
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Population Density
Census 2010 Blocks
People per acre
0 or No Data
0.1 - 5.0
5.1 - 15.0
15.1 - 30.0
More than 30
All Roads
Interstate
U.S. Highway
State Route
Street
Rail
Stations
Commuter Rail
IPSWICH
BOXFORD
HAMILTON
MIDDLETON
DANVERS
WENHAM
Haverhill Road
High Street
Interstate 95
Jeffreys Road
Main Street
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (VLMA)
Federal Emergency Management Agency (FEMA)
TOPSFIELD, MA
Date: 5/28/2021
Path: K:\DataServices\Projects\Current_Projects\Environment\PDM\project_files\PDM_Map1.mxd


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
TOPSFIELD, MA
Map 2: Land Use
Sites
Critical Infrastructure
RepetitiveLossSites
Development Areas
* See details in separate table
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Streets
Rail
Stations
Commuter Rail
Land Use
High Density Residential
Medium Density Residential
Low Density Residential
Non-Residential Developed
Commercial
Industrial
Transportation
Agriculture
Undeveloped
Undeveloped Wetlands
IPSWICH
BOXFORD
HAMILTON
MIDDLETON
DANVERS
WENHAM
0 0.275 0.55 1.1 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (VEMA)
Federal Emergency Management Agency (FEMA)
TOPSFIELD, MA
Date: 5/28/2021


FEMA Hazard
Mitigation Planning Grant
TOPSFIELD, MA
Map 3: Flood Zones
Sites
Locally Identified Flooding
* See details in separate table
Water Bodies
Flood Zones, 2017
(Annual Chance)
Zone A: 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone VE: 1% with Velocity Hazard
0.2% Annual Chance
All Roads
Interstate
U.S. Highway
State Route
Streets
Rail
Stations
Commuter Rail
Trains
March 2010 Flood Claims
Flood Insurance
Disaster Assistance
0 to 1 inch
2 to 6 inches
6 inches to 2 feet
2 feet plus
BOXFORD
IPSWICH
HAMILTON
MIDDLETON
WENHAM
DANVERS
BEVERLY
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Flood Zones datalayer updated by MassGIS October 2013
from finalized data provided by
Federal Emergency Management Agency (FEMA)
TOPSFIELD, MA
Date: 5/28/2021


IPSWICH
BOXFORD
HAMILTON
MIDDLETON
WENHAM
DANVERS
0 0.25 0.5 Miles
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
TOPSFIELD , MA
Map 4:
Earthquakes / Landslides
Sites
Critical Infrastructure Sites*
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Street
Earthquakes
Epicenters
Landslides
High landslide incidence (greater than 15% of the area is involved in landsliding)
High susceptibility to landsliding and moderate incidence
High susceptibility to landsliding and low incidence
Moderate susceptibility to landsliding and low incidence
Low landslide incidence (less than 1.5 % of the area is involved in landsliding
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary delineation, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (VEMA)
Federal Emergency Management Agency (FEMA)
Date: 5/28/2021
TOPSFIELD, MA


IPSWICH
BOXFORD
HAMILTON
MIDDLETON
WENHAM
DANVERS
0 0.25 0.5 Miles
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
TOPSFIELD , MA
Map 5:
Hurricanes / Tornadoes
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
Tornadoes
Tornado
Storm Tracks
Tropical Depression
Tropical Storm
Category 1 Hurricane
Category 2 Hurricane
Category 3 Hurricane
Beverly-Salem Water Supply
Hurricane Surge Inundation Area
Water Bodies
100 Year Wind Speeds
Miles Per Hour
90 MPH
100 MPH
110 MPH
120 MPH
130 MPH
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analysis.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Date: 3/28/2021


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
TOPSFIELD, MA
Map 6: Average Snowfall
Sites
Critical Infrastructure Sites *
* See data is in separate table
Average Annual Snowfall
36.1 to 48.0 inches
48.1 to 72.0 inches
Water Bodies
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
IPSWICH
BOXFORD
HAMILTON
MIDDLETON
WENHAM
DANVERS
0 0.25 0.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
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60 Temple Place, Boston, MA 02111 (617) 451 2770
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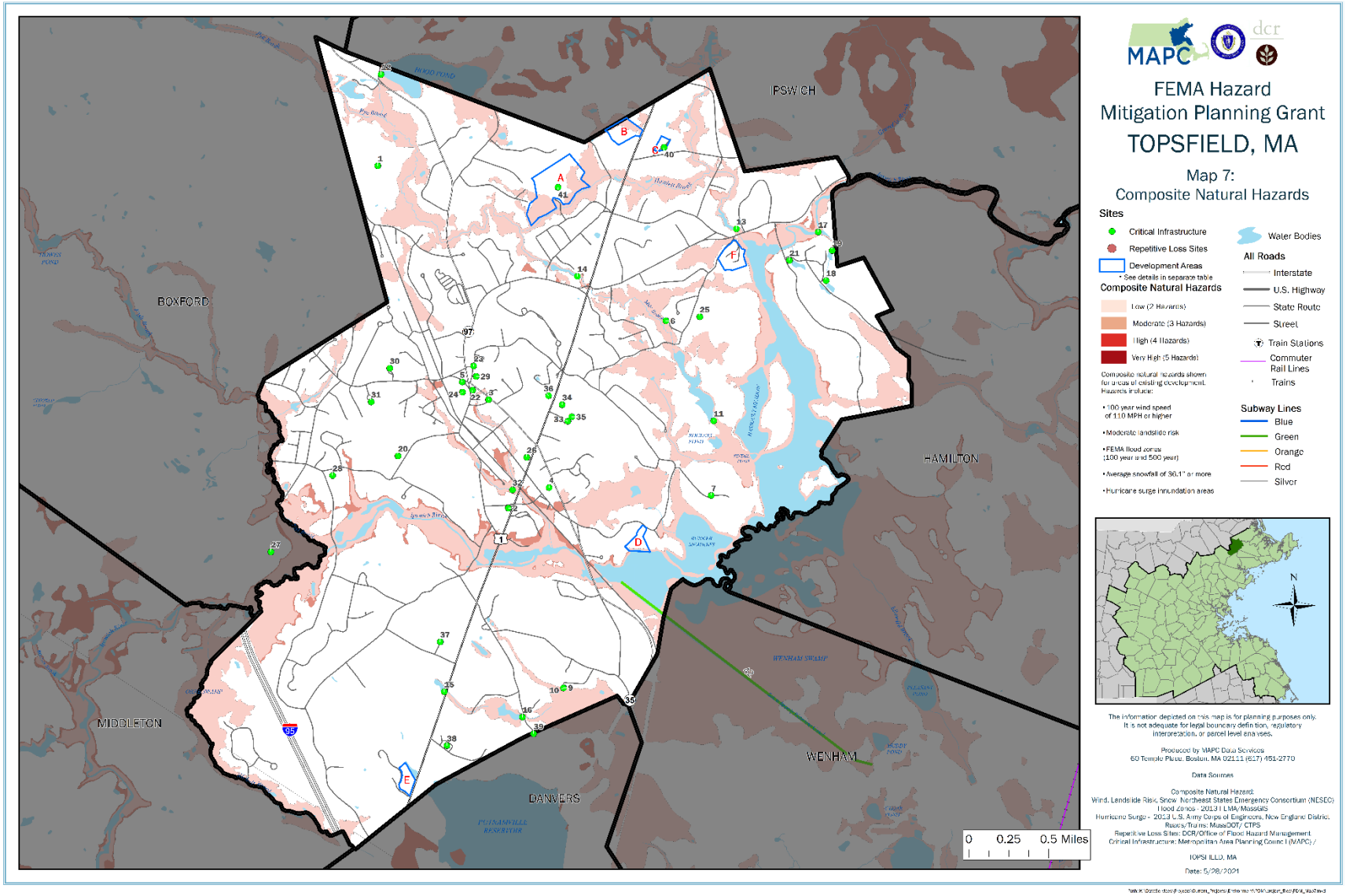
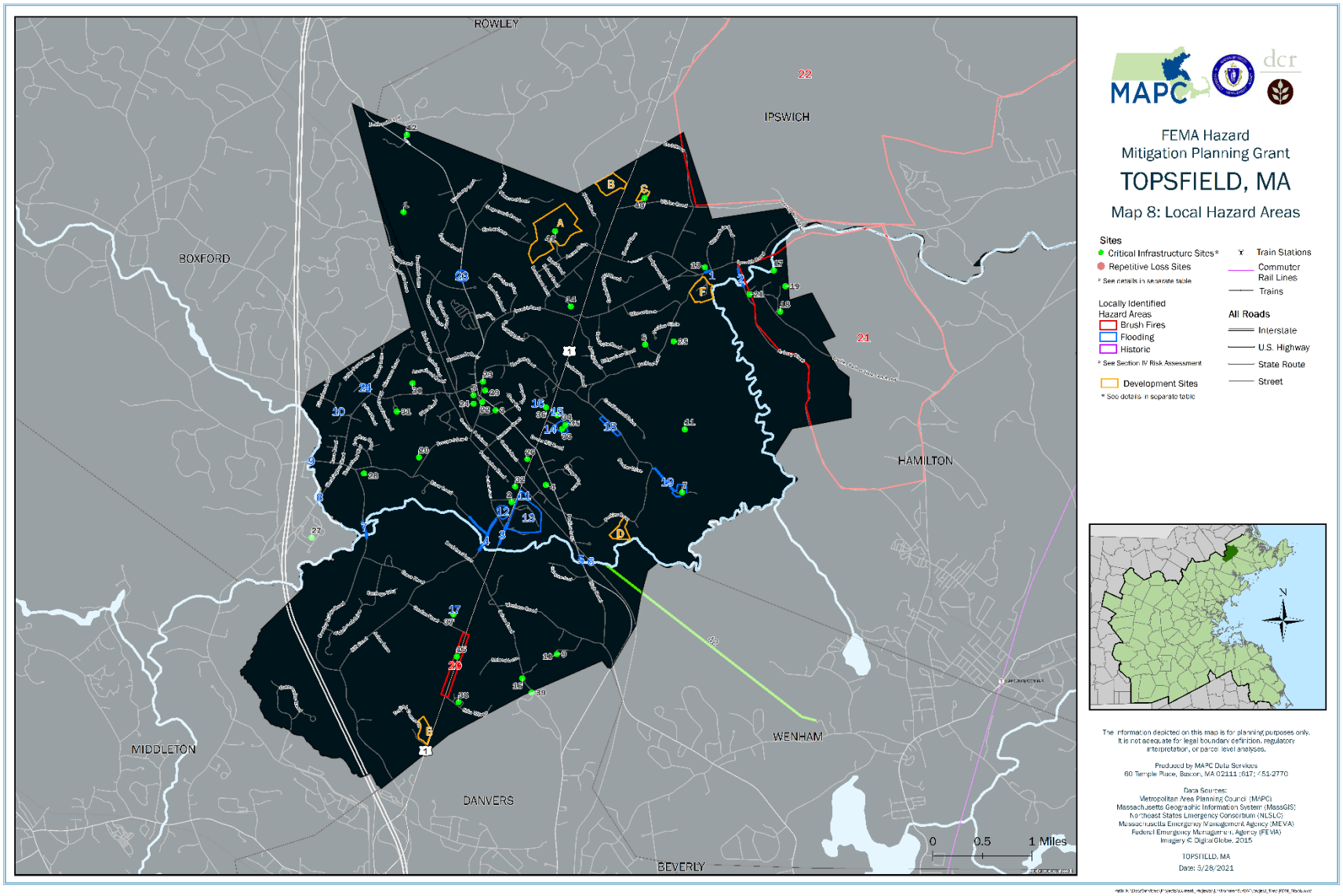
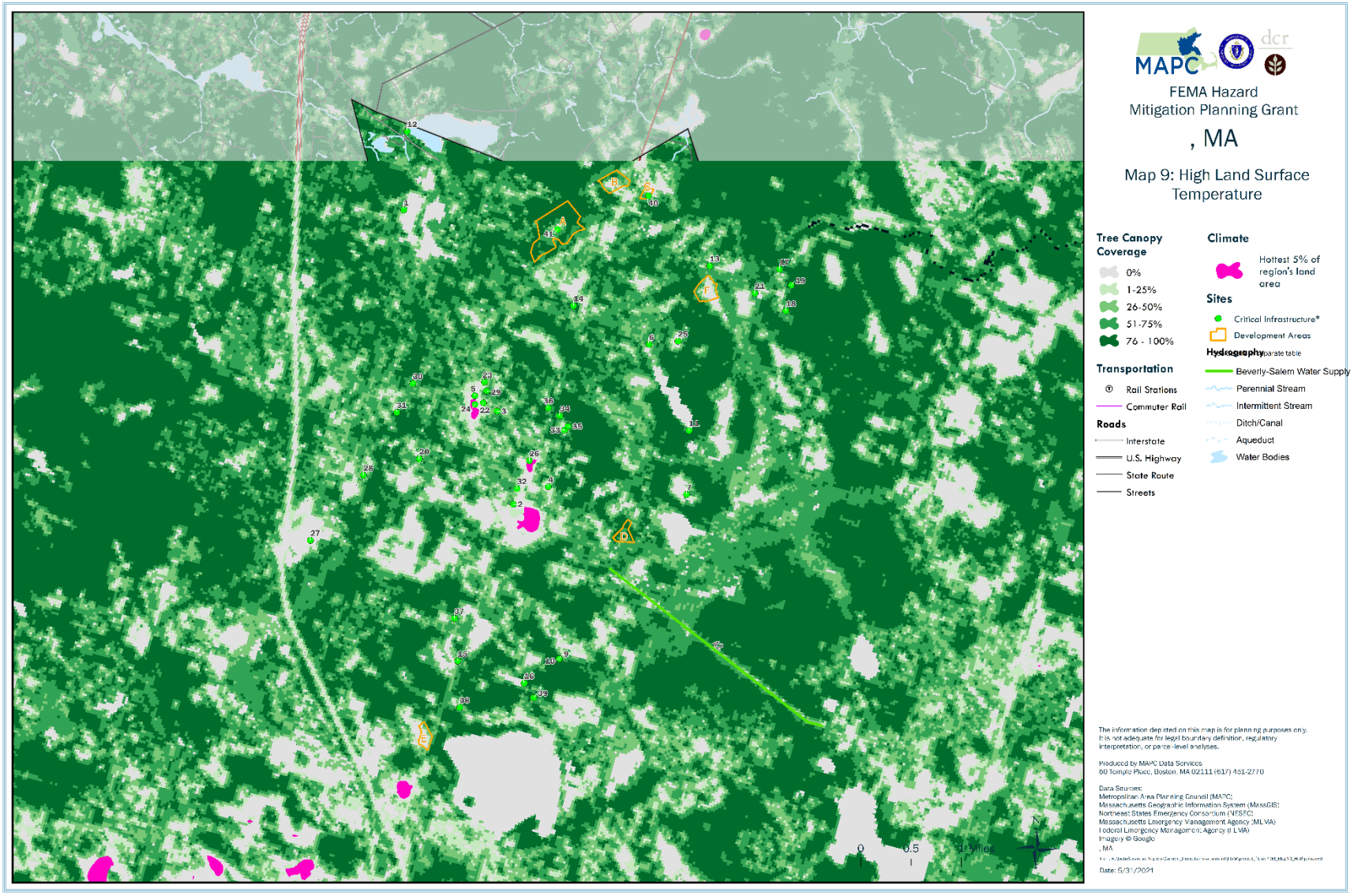
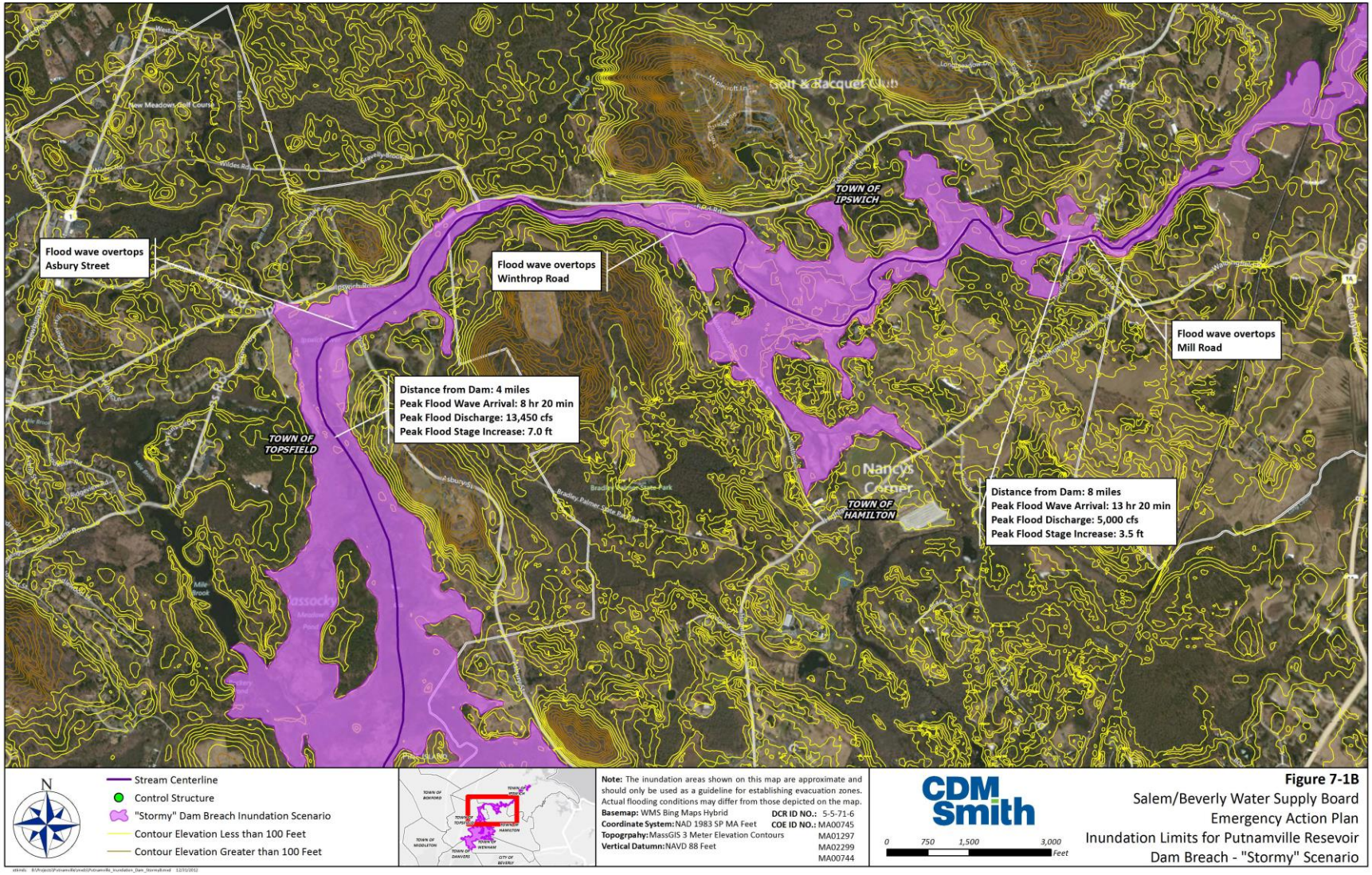
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
TOPSFIELD, MA
Date: 5/28/2021


IPSWICH
BOXFORD
HAMILTON
MIDDLETON
WENHAM
DANVERS
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
TOPSFIELD, MA
Map 7:
Composite Natural Hazards
Sites
Critical Infrastructure
Repetitive Loss Sites
Development Areas
• See details in separate table
Composite Natural Hazards
Low (2 Hazards)
Moderate (3 Hazards)
High (4 Hazards)
Very High (5 Hazards)
Composite natural hazards shown for areas of existing development. Hazards include:
• 100 year wind speed of 110 MPH or higher
• Moderate landslide risk
• FEMA flood zones (100 year and 500 year)
• Average snowfall of 30.1" or more
• Hurricane surge inundation areas
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Street
Train Stations
Commuter Rail Lines
Trains
Subway Lines
Blue
Green
Orange
Red
Silver
N
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources
Composite Natural Hazard:
Wind, Landslide Risk, Snow: Northeast States Emergency Consortium (NESEC)
Flood Zones - 2013 | LMA/ MassGIS
Hurricane Surge - 2013 U.S. Army Corps of Engineers, New England District.
Rivers/Trains: MassDOT/ CTPS
Repetitive Loss Sites: DCR/Office of Flood Hazard Management
Critical Infrastructure: Metropolitan Area Planning Council (MAPC)
TOPSFIELD, MA
Date: 5/28/2021

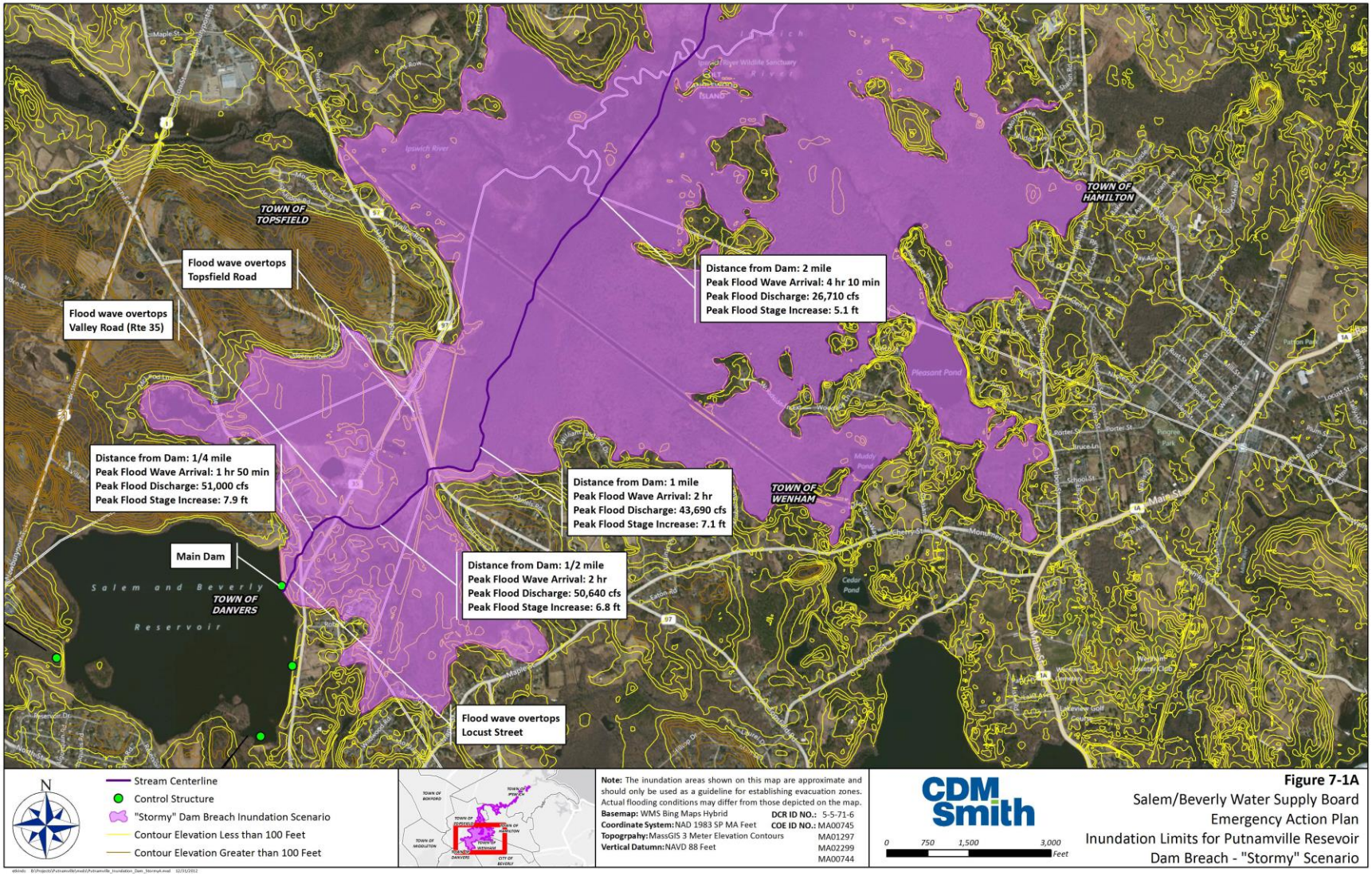

ROWLEY
IPSWICH
BOXFORD
HAMILTON
MIDDLETON
DANVERS
WENHAM
BEVERLY
0
0.5
1 Miles
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
TOPSFIELD, MA
Map 8: Local Hazard Areas
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Locally Identified
Hazard Areas
Brush Fires
Flooding
Historic
* See Section IV Risk Assessment
Development Sites
* See details in separate table
Train Stations
Commuter
Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
N
The information depicted on this map is for planning purposes only.
It is not adequate for legal boundary definition, regulatory
interpretation, or parcel level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © DigitalGlobe, 2015
TOPSFIELD, MA
Date: 5/28/2021


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
, MA
Map 9: High Land Surface Temperature
Tree Canopy Coverage
0%
1-25%
26-50%
51-75%
76 - 100%
Transportation
Rail Stations
Commuter Rail
Roads
Interstate
U.S. Highway
State Route
Streets
Climate
Hottest 5% of region's land area
Sites
Critical Infrastructure*
Development Areas
Hydrography
Beverly-Salem Water Supply
Perennial Stream
Intermittent Stream
Ditch/Canal
Aqueduct
Water Bodies
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
, MA
Date: 5/31/2021
0
0.5
1 Miles
N

Putnamville Main Dam Inundation Map, Stormy Weather, North Section



Putnamville Main Dam Inundation Map, Stormy Weather, South Section



APPENDIX B: TEAM MEETING AGENDAS

Topsfield MVP/Hazard Mitigation Plan
Topsfield Local Team Meeting #1

Wednesday, July 15, 2020
9:00 AM

Zoom Meeting
https://zoom.us/j/92376506029

Meeting ID: 923 7650 6029

One tap mobile
+16468769923,,92376506029# US (New York)

Dial by your location
+1 646 876 9923 US (New York)

AGENDA

1. Welcome and Introductions
2. Overview of the MVP and HMP Projects
   - Municipal Vulnerability Preparedness (MVP) Program (see handout)
   - Overview of the FEMA Hazard Mitigation Plan
   - Project tasks and schedule (see handout)
3. Getting Started: Local Data Collection
   - Critical Facilities Inventory and Map
   - Identify Local Hazard Areas of Concern (flood, fire, etc)
   - New and Planned Development sites
   - See handout & link to GoogleMyMaps: https://www.google.com/maps/d/viewer?mid=1XQLil12wUuJl9Dev42jMBpCrbRDTlDv4&ll=42.640144311795176%2C-70.95555581323131&z=15
4. Public Meetings and MVP Workshop
   - Identify local stakeholders to invite (see handout)
   - Invitation Letter, town outreach
   - Community Survey?

Topsfield MVP/Hazard Mitigation Plan

Topsfield Core Team Meeting

Wednesday, November 4, 2020

9:30 AM

Zoom Meeting
https://zoom.us/j/95084425605

Meeting ID: 950 8442 5605

One tap mobile
+13017158592,,95084425605#
+13126266799,,95084425605#

Dial by your location
+1 301 715 8592
+1 646 876 9923

AGENDA

1. **Welcome and Introductions**

2. **Overview of the MVP and Stakeholder Outreach**

   - Overview of the Municipal Vulnerability Preparedness (MVP) Program
   - Developing list of stakeholders for the MVP Workshop (see attachment)
   - Considering alternatives to an in-person event

3. **Hazard Mitigation Next Steps: Review Existing Mitigation**

   - Identify existing mitigation measures (see attached checklist)
   - Establishing Hazard Mitigation goals

4. **Next Steps: Follow up on data collected and mapped**

   - Draft Map and Tables of Critical Facilities, Hazard Areas, Developments
   - *Still needed: brief descriptions of local flooding sites (follow up)*

5. **Next Team Meeting – early January**

   - Develop Hazard Mitigation recommendations
   - Finalize MVP Stakeholders, outreach & workshop logistics

Topsfield MVP/Hazard Mitigation Plan
Topsfield Core Team Meeting #3

Friday, February 26, 2021
9:30 AM

Zoom Meeting

https://zoom.us/j/93007144870

Meeting ID: 930 0714 4870

One tap mobile:
+16468769923,,93007144870# US (New York)

Dial by your location:
+1 646 876 9923 US (New York)

AGENDA

1. **Welcome and Introductions**

2. **Preparing for the MVP Workshop (see attachments)**

   - Review of agenda and process for a "virtual" workshop
   - Matrices to summarize workshop findings & recommended actions
   - Setting a date for the workshop
   - Developing list of stakeholder contacts to invite to the workshop
   - Draft invitation letter

3. **Review Next Steps for Hazard Mitigation Plan**

   - Before the MVP workshop: develop draft mitigation actions
   - After the MVP workshop: review MVP actions and finalize mitigation recommendations for the HMP
   - Complete draft Hazard Mitigation Plan
   - Hold final public meeting with MVP listening session
   - Submit HMP to MEMA/FEMA for review and approval

Topsfield MVP/Hazard Mitigation Plan
Topsfield Core Team Meeting #4

Thursday, April 8, 2021
9:30 AM

Zoom Meeting

https://zoom.us/j/93295434891

Meeting ID: 932 9543 4891

One tap mobile
+13017158592,,93295434891# US (Washington DC)

Dial by your location
+1 301 715 8592 US (Washington DC)
+1 312 626 6799 US (Chicago)

AGENDA

1. **Welcome and Introductions**

2. **Preparing for the MVP Workshop on April 14**

   - Pre-workshop survey
   - Review workshop agenda for the day
   - Breakout-group' process—facilitated working sessions
   - Matrices to summarize findings & actions
   - Top priority actions from each group posted on Jam Board
   - Review RSVP's and assign breakout groups

3. **Review Next Steps for MVP and Hazard Mitigation Plan**

   - Core Team final meeting to review MVP actions and develop mitigation recommendations for the HMP
   - MAPC to Complete MVP report and Draft Hazard Mitigation Plan
   - Hold final public meeting on the HMP and MVP listening session
   - Submit MVP report to EEA and submit HMP to MEMA/FEMA
   - After FEMA approval, Town adoption of the plan by Board of Selectmen

Topsfield MVP/Hazard Mitigation Plan
Topsfield Core Team Meeting #5 (Final)

Thursday, May 20, 2021
9:30 AM

Join Zoom Meeting

https://zoom.us/j/94741621107

Meeting ID: 947 4162 1107

One tap mobile
+13017158592,,94741621107#
+13126266799,,94741621107#

Dial by your location
+1 301 715 8592
+1 312 626 6799

AGENDA

1. **Welcome and Introductions**

2. **Mitigation Recommendations for the Hazard Mitigation Plan**
   - Review Worksheet with suggested mitigation actions (attached)
   - Review summary of MVP Actions (attached)
   - Finalize list of recommended mitigation measures
   - Add time frame, estimated cost, local agency, funding

3. **Prepare for final Public Meeting & MVP Listening Session**
   - Chose date, late June
   - Decide on hosting the meeting
   - Outreach to stakeholders-MVP invitees and any others?

APPENDIX C: PUBLIC MEETINGS

Topsfield Hazard Mitigation Plan and Municipal Vulnerability Preparedness Public Meeting

Natural hazards and climate change can have serious impacts on Topsfield's residents and businesses



The Town of Topsfield is preparing a FEMA Hazard Mitigation Plan as well as a Municipal Vulnerability Preparedness (MVP) project to reduce the town's vulnerability to natural hazards such as flooding, hurricanes, and blizzards, and increase resilience to the impacts of climate change. Please join the Town for a public presentation about Hazard Mitigation Plan and MVP project at a virtual meeting of the Select Board:

Topic: Select Board Meeting
Time: Oct 19, 2020 07:00 PM Eastern Time (US and Canada)

Join Zoom Meeting
https://us02web.zoom.us/j/85464321346?pwd=SG1Qa0lHTHltNVdzK3RDVk5lMXViUT09

Meeting ID: 854 6432 1346
Passcode: 619153
Phone# 1 929 205 6099

For more information, contact Chief Jen Collins-Brown at jcollinsbrown@topsfield-ma.gov

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

CALENDAR LISTING / MEDIA ADVISORY

TOPSFIELD'S HAZARD MITIGATION PLAN TO BE DISSUSSED AT OCTOBER 19 PUBLIC MEETING ONLINE VIA ZOOM

What: On October 19, 2020 at 7:00 PM the Topsfield Select Board will host an online public meeting via Zoom to discuss the town's Hazard Mitigation Plan.

The Town of Topsfield is preparing a FEMA Hazard Mitigation Plan as well as a Municipal Vulnerability Preparedness (MVP) project to reduce the town's vulnerability to natural hazards such as flooding, hurricanes, and blizzards, and increase resilience to the impacts of climate change. Please join the meeting for a public presentation about Hazard Mitigation Plan and MVP project at a virtual meeting of the Select Board.

Who: Topsfield residents, business owners, civic organizations and institutions are invited to participate the public meeting and provide their questions and comments as part of this on-going effort to plan for a resilient future for the Town of Topsfield.

When: Tuesday, October 19, 2020, 7:00 PM

Where: Online meeting via Zoom at:

https://us02web.zoom.us/j/85464321346?pwd=SG1Qa0lHTHltNVdzK3RDVk5IMXViUT09

Meeting ID: 854 6432 1346
Passcode: 619153
Phone# 1 929 205 6099

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

##



Topsfield Municipal Vulnerability Preparedness and Hazard Mitigation Planning Project

Jen Collins-Brown
Fire Chief/ Emergency Management Director

Martin Pillsbury
MAPC Environmental Planning Director

October 19, 2020

;

Topsfield Hazard Mitigation and Municipal Vulnerability Preparedness Public Listening Session

Natural hazards and climate change can have serious impacts on Topsfield's residents and businesses



The Town of Topfield has conducted a **Community Resilience Building** workshop to increase its resilience to climate change and has also prepared a draft **FEMA Hazard Mitigation Plan** to reduce the Town's vulnerability to natural hazards such as flooding, hurricanes, and blizzards. Please join the Town for a presentation and public listening session about this important project. Your input is important to the Town, and your questions and comments are welcome.

All neighboring towns to Topsfield are invited to participate

Public Listening Session, virtual meeting via Zoom
Thursday, June 24, 2021 at 1:00 PM

To receive the Zoom meeting link
Please send an email to topsfieldresilience@mapc.org

For more information, contact Chief Jen Collins-Brown at jcollinsbrown@topsfield-ma.gov

MAPC

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

CALENDAR LISTING / MEDIA ADVISORY

TOPSFIELD'S HAZARD MITIGATION AND COMMUNITY RESILIENCE PROJECTS TO BE PRESENTED AT JUNE 24 PUBLIC MEETING ONLINE VIA ZOOM

What: On June 24 at 1:00 PM the town of Topsfield will host an online public meeting via Zoom to discuss the town's Hazard Mitigation Plan and its Municipal Vulnerability Preparedness project..

The Town of Topsfield has prepared a FEMA Hazard Mitigation Plan as well as a Municipal Vulnerability Preparedness (MVP) project to reduce the town's vulnerability to natural hazards such as flooding, hurricanes, and blizzards, and increase resilience to the impacts of climate change. Please join the meeting for a public presentation about Hazard Mitigation Plan and MVP project at a virtual meeting via Zoom.

Who: Topsfield residents, business owners, civic organizations and institutions are invited to participate the public meeting and provide their questions and comments as part of this effort to plan for a resilient future for the Town of Topsfield.

When: Thursday, June 24, 2020, 1:00 PM

Where: Online meeting via Zoom. To receive the Zoom log on link, please send a request to topsfieldresilience@mapc.orf

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

##

Notice of Public Meeting on the Topsfield Hazard Mitigation Plan, June 24, 2020, at 1:00 PM via Zoom

TO: Town Clerks in Boxford, Danvers, Hamilton, Ipswich, Middleton, and Wenham

PUBLIC MEETING NOTICE
TOWN OF TOPSFIELD
HAZARD MITIGATION PLAN AND MVP LISTENING SESSION

The Town of Topsfield has prepared its draft FEMA *Hazard Mitigation Plan 2021 Update* to reduce the town's vulnerability to natural hazards such as flooding, hurricanes, and winter storms. The Town has also completed a Municipal Vulnerability Preparedness (MVP) project to increase resilience to the impacts of climate change.

As part of the planning process, **all neighboring communities to Topsfield are being notified of a public meeting** on the draft Hazard Mitigation Plan and Listening Session on the MVP project to be hosted by the Town of Topsfield as follows:

Wednesday, June 24, 2021 at 1:00 PM
Town of Topsfield Public Meeting and Listening Session
Remote meeting via Zoom: *Please send an email to topsfieldresilience@mapc.org to request the Zoom meeting link*

A flyer announcing the meeting details is attached which may be posted or circulated to relevant parties. If you have any questions about this, please feel free to contact me.

Best regards,

Martin Pillsbury
Director of Environmental Planning
Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111
mpillsbury@mapc.org

=

Town of Topsfield MASSACHUSETTS

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Hazard Mitigation & Municipal Vulnerability Preparedness Public Listening Session 6/24/21 at 1:00 PM via ZOOM

POSTED ON: JUNE 16, 2021 - 10:28AM

The Town of Topsfield welcomes the community to a presentation and public listening session on the Town's Hazard Mitigation Plan on June 24, 2021 at 1:00 pm via ZOOM. Your input, comments and questions are welcome.

Zoom information:

https://zoom.us/j/92139049046

Meeting ID: 921 3904 9046

Passcode: 117826

Phone # for audio call-in:

312 626 6799

646 876 9923

Contact Us
Town Hall Hours
978-887-1500

Topsfield Town Offices
8 West Common Street, Topsfield MA 01983
Staff Login

Website Disclaimer
Government Websites by CivicPlus ®
Photo Credits

APPENDIX D: PLAN ADOPTION AND APPROVAL

TOWN OF TOPSFIELD

SELECT BOARD

8 West Common Street, Topsfield, Massachusetts 01983
Telephone 978-887-1500; Fax 978-887-1502

November 22, 2021

CERTIFICATE OF ADOPTION

SELECT BOARD

TOWN OF TOPSFIELD, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF TOPSFIELD HAZARD MITIGATION PLAN

WHEREAS, the Town of Topsfield established a committee to prepare the *Town of Topsfield Hazard Mitigation Plan*; and

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

WHEREAS, duly noticed public meetings were held by the Town of Topsfield October 19, 2020, and June 24, 2021, and

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

NOW, THEREFORE the Town of Topsfield adopts the *Town of Topsfield Hazard Mitigation Plan*, in accordance with M.G.L. 40 Sec. 4 and the Charter and Bylaws of the Town of Topsfield.

ADOPTED AND SIGNED this Date: November 22, 2021

Signature(s)

U.S. Department of Homeland Security
FEMA Region I
99 High Street, Sixth Floor
Boston, MA 02110-2132

FEMA

November 30, 2021

Dawn Brantley, Acting Director
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, Massachusetts 01702-5399

Dear Acting Director Brantley:

The U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) Region I Mitigation Division has approved the Town of Topsfield Hazard Mitigation Plan effective **November 29, 2021** through **November 28, 2026** 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 Brigitte Ndikum-Nyada at (617) 378-7951 or brigitte.ndikum-nyada@fema.dhs.gov.

Sincerely,

Paul F. Ford
Acting Regional Administrator
DHS, FEMA Region I

PFF: bnn

cc: Jeffrey Zukowski, Hazard Mitigation Planner, MEMA
Marybeth Groff, CFM, Hazard Mitigation & Climate Adaptation Coordinator
Beth Dubrawski, Hazard Mitigation Contract Specialist, MEMA

APPENDIX E: SUMMARY OF CRB WORKSHOP

HIGHEST PRIORITY ACTIONS IDENTIFIED BY THE
TOPSFIELD COMMUNITY RESILIENCE BUILDING (CRB) WORKSHOP
APRIL 14, 2021

See the full set of resilience and mitigation actions, along with strengths and vulnerabilities identified by Topsfield CRB Workshop in the MVP Final Report that accompanies this plan in a separate volume.

HIGHEST PRIORITY ACTIONS FROM THE WORKSHOP	VOTES
1. **Address impacts of intense winds on powerlines**, including tree maintenance (dead and diseased) and pole replacement and maintenance. Prepare the tree canopy for increased pest or other new hazards. Look into tree inventory, emphasize native specifics.	**11**
2. **Tackle Ipswich River flooding issues** Work with state and federal officials to find a **watershed wide solution to Ipswich River water withdrawal issues**	**10**
3. .**Road elevations and culverts need to be addresses as a system.** Identified areas include Rt. 1, Salem Rd., Rowley Bridge Rd., East St., Pond St. Wildes Rd. Need to find solutions to flooding caused by beavers.	**9**

4. **Storm Water Drainage/Infrastructure**: some places don't have stormwater drainage systems. A town-wide drainage model would be beneficial. Look at the design and make sure that it keeps in mind for the new reality of increased rainfall. Conservation Commission and Planning Board should also look into the design.	**8**
5.	
5. **Do a housing inventory study and a master plan** to create zoning that allows people to age in town in appropriate manageable housing. This could also help address issues of isolation.	**8**
6. **Consider sewage treatment**. Septic systems are increasingly subject to flooding and high groundwater levels.	**5**
7. **Address flooding on Bridge Road , Rowley Bridge Road, Ipswich and River Road, Washington Street**. Look into Improving drainage, and Nature-based solutions. Bridge replacement might be needed.	**4**
8. **Develop another water source** for the town, outside of the Ipswich River watershed	**4**
9. **Inspect water towers** and identify what repairs are needed and how to fund those repairs	**4**

10. **Expand existing program and database that identifies vulnerable citizen**s and how best to provide services in case of emergencies.	**4**
11. **Target land purchases for flood storage** and other ecosystem services	**4**
12. **Address drainage concerns along the rail trail** to prevent septic issues and harm of flooding in the area. Abutting residential properties experience septic system flooding.	**3**
13. **A communication Plan** is needed for emergency communication; redesigning the town website	**3**
14. **Conduct an assessment of the trees** across the town, particularly along major roadways, and develop a plan to identify weak trees and replace them. This is a program to be implemented by both the Town and National Grid.	**3**
15. **Address the needs of Low-income seniors** in town, and those who come into town for work, who can be impacted first and worst when there is a climate emergency. education campaign. Establish a stakeholder group/focus group with people connected to these Environmental Justice communities, and blogs for these specific groups.	**2**

16. Since the town does not have any full-service shelters, **locations should be identified, and plans developed to establish such shelters.**	**2**
17. **Conduct an assessment of the generators** in town facilities and identify which ones need to be replaced.	**0**