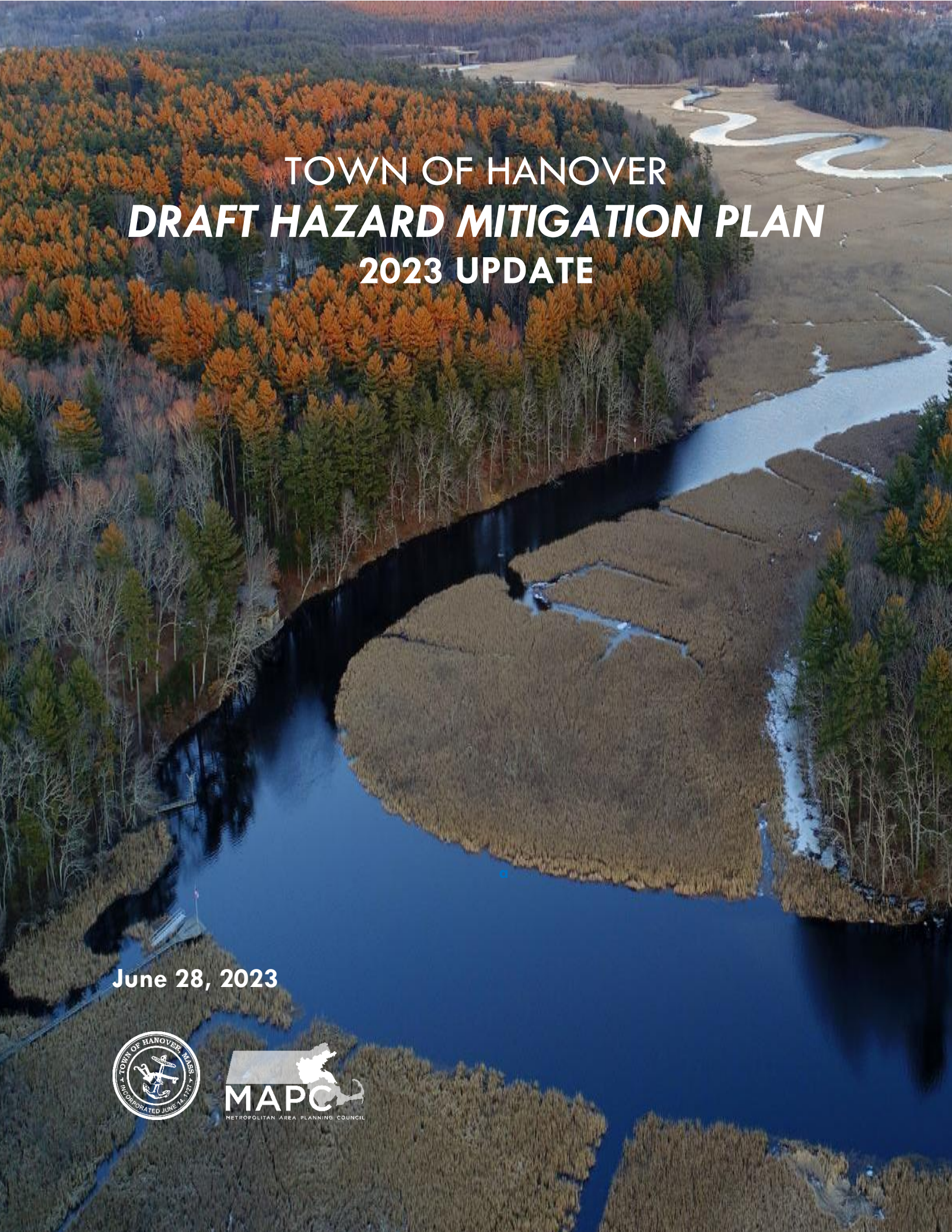


TOWN OF HANOVER
DRAFT HAZARD MITIGATION PLAN
2023 UPDATE

June 28, 2023

MAPC
METROPOLITAN AREA PLANNING COUNCIL

ACKNOWLEDGEMENTS AND CREDITS

This plan was prepared for the Town of Hanover by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation (PDM) Grant Program.

MAPC Officers

President, Adam Chapdelaine, Town of Arlington
Vice President, Jennifer Constable, Town of Rockland
Secretary, Imaikalani Aiu, Town of Weston
Treasurer, Sam Seidel, Gubernatorial
Executive Director, Marc Draisen, MAPC

Credits

Project Manager:	Martin Pillsbury
Mapping/Data Services:	Rachel Bowers

Massachusetts Emergency Management Agency

Acting Director:	Dawna Brantley

Department of Conservation and Recreation

Commissioner:	Brian Arrigo

Executive Office of Energy and Environmental Affairs

MVP Regional Coordinator	Carolyn Mecklenburg

Hanover Local Hazard Mitigation/MVP Core Team

Jason Cavallaro	Fire Chief / Emergency Management
Ann Lee	Assistant Town Manager
Dan Berry	Hanover YMCA
Ed Callahan	Prep Property Group
Victor Diniak	Public Works Dept.-Director
Fred Freeman	Hanover Fire Dept/EMA
Timothy Kane	Police Chief
Kurt Kelley	Deputy Superintendent, Dept. of Public Works
Sandra MacFarlane	Conservation Agent
Neal Merritt	Water Superintendent, Dept. of Public Works
Colleen Smith	Hanover Schools
Christine Stickney	Town Planner
Samantha Woods	North-South Rivers Watershed Association

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

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. The Town of Hanover's first plan was approved by FEMA in 2016 and this 2023 plan is the Town's first update.

PLANNING PROCESS

The -planning process for the Hanover Hazard Mitigation Plan was led by the Hanover Local Hazard Mitigation and MVP Core Team (HMP/MVP Core Team), comprised of staff from a number of Town departments as well as community stakeholders. The HMP/MVP Core Team provided local knowledge of where the impacts of natural hazards most affect the town, goals for addressing these impacts, and hazard mitigation measures that would benefit the town. The HMP/MVP Core Team met three times, on October 12 2022, January 18, 2023, and May 10, 2023.

The HMP/MVP Core Team oversaw this Hazard Mitigation Plan update in conjunction with Hanover's Municipal Vulnerability Preparedness (MVP) project, funded by an MVP Planning grant from the Massachusetts Executive Office of Energy and Environmental Affairs. The project featured a Community Resilience Building workshop focusing on the Town's strengths and vulnerabilities in light of climate change and addresses many of the same natural hazards that the Hazard Mitigation Plan focuses on. The priority action recommendations put forward by the MVP project provided useful input into this Hazard Mitigation Plan. A report on the MVP project was also prepared and is available as an accompanying document to this plan.

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. Two advertised public meetings were held, the first on December 5, 2022 hosted by the Hanover Planning Board, and the second was held on June 14, 2023 in Town Hall, in conjunction with a public listening session for the related MVP project described above.

The draft plan was posted on the town's website for public review and comment following the second public meeting, and a dedicated email address was created for comments to be submitted by the public. The meetings included a description of the hazard mitigation planning process, an overview of the plan and the second meeting highlighted the draft plan's proposed mitigation actions as well as the MVP recommendations. There was an opportunity for public questions and comments at both meetings, as well as directions on how the public could access the draft plan on the town website and make comments after the second meeting. Neighboring communities and community stakeholders were notified

and invited to attend the meeting by email, social media, website postings, and outreach to local press and radio.

RISK ASSESSMENT

The hazard mitigation plan assesses the potential impacts to the Town from multiple natural hazards, including flooding, high winds, winter storms, brush fires, extreme heat, drought, and geologic hazards. Flooding, driven by hurricanes, nor'easters, and other storms, clearly presents the most common hazard to the Town. These are described in Section 4, Risk Assessment and shown on the map series in Appendix A.

The Hanover Hazard Mitigation/MVP Core Team identified 69 Critical Facilities in the town. These are compiled in an inventory in Table 39, identifying which facilities are located within the mapped hazard zones. The locations of the Critical Facilities are shown on the hazard map series found in Appendix A.

A HAZUS-MH analysis provided estimates of damage from Hurricanes of c100-year and 500-year magnitude ($24.2 million to $98.9 million) as well as earthquakes of magnitudes 5 and 7 ($367 million to $2.7 billion). Flood damage estimates range from $13.8 million to $20.2 million.

The Hanover Local Hazard Mitigation Committee identified four areas where flooding has been a consistent concern. These areas total 231 acres or 2.3% of the Town's land area.

HAZARD MITIGATION GOALS

The Hanover HMP/MVP Core Team identified the following hazard mitigation goals for the Town. For this 2023 plan update the HMP/MVP Core Team added Goal 10, addressing climate change.

a

1. Prevent and reduce the loss of life, injury 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.

    - Ensure that the Planning Department considers hazard mitigation in its review and permitting of new development.
    - Review zoning regulations to ensure that the bylaw incorporates all reasonable hazard mitigation provisions.
    - Ensure that all relevant municipal departments have the resources to continue to enforce codes and regulations related to hazard mitigation.

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

- Begin to assess the vulnerability of municipal buildings and infrastructure to damage from an earthquake.
- Maintain existing mitigation infrastructure in good condition.

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. Educate the public about natural hazards and mitigation measures that can be undertaken by property-owners.

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

10. Consider the impacts of climate change and incorporate climate sustainability and resilience into the Town's planning and policies.

HAZARD MITIGATION STRATEGY

The Hanover HMP/MVP Core Team identified a number of mitigation measures that would serve to reduce the town's vulnerability to natural hazard events. These mitigation measures build on what the town began in its first Hazard Mitigation Plan (2016) as well as recommended actions from the related MVP project. This 2023 plan update also addresses climate change impacts for the first time, consistent with the approach that Massachusetts has taken in its 2018 State Hazard Mitigation and Climate Action Plan.

Overall, the hazard mitigation strategy recognizes that mitigating hazards for Hanover 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 impact the Town's vulnerability now and in the future, and local officials will need to work together across municipal lines and with state and federal agencies in order to understand and address these changes. This plan update's hazard mitigation strategy will be incorporated into the Town's other related plans and policies.

PLAN REVIEW & UPDATE PROCESS

The process for developing Hanover's Hazard Mitigation Plan 2023 Update is summarized in Table 1.

Table 1 - Plan Review and Update

Plan Section	Reviews and Updates
3 – Public Participation	The Hanover HMP/MVP Core Team placed an emphasis on public participation for the development of the Hazard Mitigation Plan 2023 Update and MVP project. Outreach strategies included the use of social media, e-mail, website postings, flyers, and media advisories. il notifications, website postings, and outreach to local press and radio. During plan development, the draft plan was presented to the Hanover Planning Board on December 5, 2022 and to the general public at a Community Forum on the HMP and MVP project on June 14, 2023. The draft plan was also available on the Town's website for public review and comment.
4 – Risk Assessment	MAPC gathered the most recently available hazard and land use data and met with Town staff to identify changes to local hazard areas and development trends. Town staff reviewed critical infrastructure with MAPC staff in order to create an updated list and GIS map of the sites. MAPC also used the most recently available version of HAZUS to assess the impacts of flooding, hurricanes, and earthquakes.
5 - Goals	The Hazard Mitigation Goals were revised to include climate change and endorsed by the Hanover HMP/MVP Core Team.
6 – Existing Mitigation Measures	Working with the Hanover HMP/MVP Core Team, MAPC updated the list of existing mitigation measures that reflected current mitigation activities in the Town.
7 & 8 – Hazard Mitigation Strategy	Mitigation measures recommended in the 2016 plan were reviewed and assessed as to whether they were completed, in-progress, or deferred. The Hanover HMP/MVP Core Team determined whether to carry forward measures into the 2016 Plan that had not yet been implemented, modify them, or delete them. The 2023 updated plan's hazard mitigation strategy reflects both measures carried forward from the 2016 plan and new measures not previously considered. The Hanover HMP/MVP Core Team prioritized all of the recommended mitigation measures based on current conditions and how they fit with the needs and capacity of the Town to implement them.
9 – Plan Adoption & Maintenance	This section of the plan was updated with a process for plan implementation review and a five-year update process that will assist the Town in incorporating hazard mitigation issues into other Town planning and regulatory review processes and better prepare the Town for the next 5-year plan update.

Since approval of the 2016 plan by FEMA the Town has made progress with several hazard mitigation measures, including completion of a winter weather awareness

program, and achieving StormReady designation and completing an update to the Open Space and Recreation Plan.

Five mitigation measures were partially completed, including an education program on wetlands compliance, a hydraulic analysis of the Indian Head River Watershed, a stormwater committee, a dumping bylaw, and recommendations on the Forge Pond Dam. The Hazard Mitigation/MVP Core Team recommended retaining these mitigation measures in the 2023 updated plan and revising several of them to reflect current circumstances and town priorities.

In addition, the Town is completing a Municipal Vulnerability Preparedness planning process in conjunction with this 2023 Hazard Mitigation Plan Update. Upon completion of the MVP project the Town will be eligible for designation as MVP Community by the Executive Office of Energy and Environmental Affairs. That will make the Town eligible for MVP Action Grants, which could help find several of the Town's mitigation measures. Several mitigation actions discussed at the MVP workshop have informed the hazard mitigation strategy of this 2023 plan update.

Moving forward into the next five-year plan implementation period there will be more opportunities to incorporate hazard mitigation into the Town's decision-making processes, plans, policies, and operations. The Town will document any actions taken within this iteration of the updated Hazard Mitigation Plan on challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Hanover HMP/MMP Core Team, as described in Section 9, 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 all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants adopt a local multi-hazard mitigation plan and update the plan in five-year intervals. This planning requirement does not affect disaster assistance funding. This is an update to the Town of Hanover's first Hazard Mitigation Plan, which was approved by FEMA in 2016.

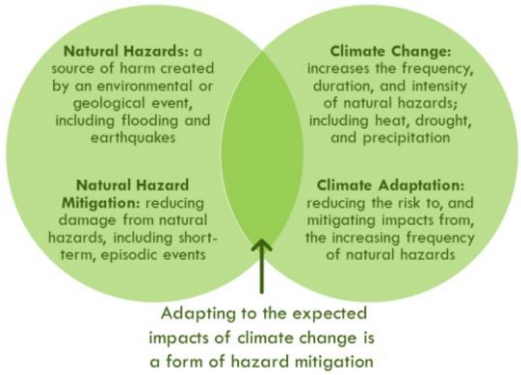
Federal hazard mitigation planning and grant programs are administered by the Federal Emergency Management Agency (FEMA) in collaboration with the states. These programs are administered in Massachusetts by the Massachusetts Emergency Management Agency (MEMA) in partnership with the Department of Conservation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

The Town of Hanover contracted with the Metropolitan Area Planning Council (MAPC), to assist the Town in updating its Hazard Mitigation Plan, as well as prepare its Municipal Vulnerability Preparedness project. Both the HMP and the MVP project were funded by an MVP Planning Grant from the Executive Office of Energy and Environmental Affairs. MAPC is the Regional Planning Agency (RPA) serving the 101 communities in the greater Boston area, and provided technical support, research, GIS mapping, and facilitation for this joint HMP/MVP project, in coordination with the Hanover HMP/MMP Core Team.

WHAT IS A HAZARD MITIGATION PLAN?

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 permanently reduces or alleviates loss of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, projects, and other activities. FEMA's 2022 Local Mitigation Planning Policy Guide recognizes that adapting to the expected impacts of climate change is a form of hazard mitigation. Therefore, this plan incorporates consideration of future risks due to projections for the increased frequency and severity of extreme weather fueled by a warming planet. The relationship between natural hazards mitigation and climate adaptation is illustrated in Figure 1.

Figure 1: Natural Hazards and Climate Change Overlap



PREVIOUS FEDERAL/STATE DISASTERS

Since 1991, there have been 18 natural hazard events that triggered federal disaster declarations that included Plymouth County, which includes the Town of Hanover. These are listed in Table 2 below. The majority of these events involved flooding, while others were due to hurricanes or nor'easters, and severe winter weather.

Table 2: Presidentially Declared Disasters 1991-2023

Disaster Name	Date of Event	Declared Areas
Hurricane Bob	August 1991	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Severe Coastal Storm (No Name Storm)	October 1991	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Winter Coastal Storm	December 1992	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk
Blizzard	March 1993	Statewide
Blizzard	January 1996	Statewide
Severe Storms, Flood	October 1996	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
Heavy Rain, Flood	June 1998	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Severe Storms, Flood	March 2001	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Snowstorm	February 2003	Statewide
Snowstorm	December 2003	Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, Worcester
Snowstorm	January 2005	Statewide
Hurricane Katrina	August 2005	Statewide
Severe Storms, Flooding	October 2005	Statewide
Severe Storms, Flooding	May 2006	Statewide
Severe Storm, Inland, Coastal Flooding	April 2007	Statewide
Severe Storms, Flooding	December 2008	Statewide

Disaster Name	Date of Event	Declared Areas
Severe Storms, Flooding	March/April 2010	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
Tropical Storm Irene	August 2011	Barnstable, Berkshire, Bristol, Dukes, Franklin, Hampshire, Norfolk, Plymouth
Hurricane Sandy	October/November 2012	Barnstable, Bristol, Dukes, Nantucket, Plymouth, Suffolk
Severe Winter Storm, Snowstorm, Flooding	February, 2013	Statewide
Severe winter storm, snowstorm, and flooding	April 2015	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Severe winter storm and flooding	March 2018	Barnstable, Bristol, Essex, Nantucket, Norfolk, Plymouth

Source: database provided by MEMA

FEMA FUNDED MITIGATION PROJECTS

Over the last 20 years the Town of Hanover has not received funding from FEMA for any mitigation projects.

COMMUNITY PROFILE

The Town of Hanover is a pastoral/suburban community in Plymouth County which was first settled in 1649 and incorporated in 1727. The town's early economy was based on agriculture and lumbering. By the 18th century, the town had made itself a very self-sufficient community on a sturdy agricultural and industrial foundation, with a wealth of waterpower resources and a shipbuilding complex on the North River. The town was the site of the invention of the first tack-making machine, and making tacks and fireworks were among the industries of the later 19th century for Hanover. However, the most significant post-civil war movement was toward residential subdivision development as the main roads from Brockton and Boston were improved in the 20th century. Residents are proud of the Four Corners Section of Hanover, which retains its authentic period village character, and of their close-knit and friendly town.

Economic Elements

Hanover is located just seventeen miles north of Plymouth and twenty-three miles southeast of Boston, with many residents commuting into the city for work. State highway Routes 3, 53, 123 and 139 traverse the northeastern corner of the Town. Route 53 is Hanover's commercial development strip, home to the University Sports complex, and Hanover Crossing which is located near the junction of Route 3 and 53. The University Sports

Complex is the largest indoor sports complex in New England. The complex contains eight indoor basketball courts and a large indoor turf field for football, soccer, baseball, and lacrosse, as well as the Starland Sports and Fun Park. Hanover Crossing is situated on the parcel formerly occupied by the Hanover Mall and is in the midst of a substantial revitalization project that will result in an open-air retail and commercial complex. At the time of the publication of this document, this complex has transformed significantly with several retail stores opening including Market Basket, Sephora, and Old Navy. Additionally, Showcase Cinema has opened as well as several restaurants and a large indoor entertainment chain – Ryan's Amusements. Hanover is also home to the South Shore YMCA's Emilson branch, which includes Laura's Center for the Arts, the Early Learning Center, Camp Gordon Clark, and a variety of facilities including indoor and outdoor aquatic complexes, basketball courts, tennis courts, youth and adult fitness areas, a playground and more. Within the past decade Hanover's commercial strip has attracted national corporations such as Target, Wal-Mart, Dick's Sporting Goods, Five Guys, Wendy's, and Chick fil a.

Historic, Cultural, and Natural Resource Areas

The Town of Hanover is an historic New England community that was first settled in 1649 and incorporated as a Town in 1727. Before the official incorporation of the town, Hanover was a series of small villages that included Assinippi, Four Corners, Hanover Center, North Hanover, South Hanover, and West Hanover. The Town's colonial economy was centered around agriculture and timber. In the 18th Century, shipbuilding and iron forging flourished along the banks of the North River. The Town of Hanover has one listing on the National Register of Historic Places and ten on the Massachusetts State Register of Historic Places. The Hanover Center Historic District, which encompasses the Town Hall, the John Curtis Free Library, the First Congregational Church, the Stetson House, and the Hanover Cemetery, was listed on the National Register in 1996.

Hanover has numerous open space properties including a number of water resources like rivers, streams, brooks, ponds, and wetlands which provide both recreational opportunities for residents and a home for wildlife and plant species. Since 2006, Hanover has used CPA funding to purchase four open space properties, which amounts to an additional 374 acres of protected land in Hanover. Some of these properties were acquired in an effort to further the Hanover Greenway Project, which was initiated in 1999. The Hanover Greenway Project seeks to link numerous towns, state- and privately-owned properties throughout Hanover to create a long, continuous walking trail. There are seven officially designated scenic roads throughout the town as well.

The Town of Hanover plans to construct a shared-use pathway that extends the Hanover Branch Rail Trail across West Hanover. This project will connect Hanover with the successful shared-use pathway that travels through neighboring towns of Abington and Rockland. Trail users can experience a quintessential New England journey through the natural beauty of woods and wetlands, historic village centers, and suburban post-industrial town settings while enjoying the natural and cultural wealth of Massachusetts and spending time

outdoors. The Hanover Branch Rail Trail is an iconic multi-community project that provides direct pedestrian connections between our historic village centers, commerce centers, school campuses, and local recreation areas located along the rail line. This project also connects to the Hanover Open Space trail network, including The Hanover Greenway, The Colby Phillips Trails, and The Wildlands Trust Land Preserve. This project fills in a critical network gap in that the Town of Hanover is currently not connected to the Hanover Branch Rail Trail and this project will establish that connection.

This trail will provide handicap accessibility to our natural environment. Hanover has many trails and walking paths, but none allow handicapped residents to travel through the forested environment in our town. This project will benefit disabled and senior residents from local housing locations including Legion Senior Housing and The Cushing Residences by providing a smooth handicap-accessible multi-use pathway suitable for any level of mobility. Residents of all abilities and income levels will be able to enjoy this free recreational amenity in our community.

This extension project adds .81 miles of shared-use trail with a 10-foot-wide paved pathway and 3-foot minimum graded shoulders within a 20- to 24-foot-wide cleared area. This format will be a continuation of the Hanover Branch Rail Trail project in neighboring towns. Surface material will remain consistent with asphalt paving over a gravel base. The terrain is a flat railroad bed and access grades will be gradual to provide handicap accessibility. A parking area will be located in West Hanover Square for visitors to access the Rail Trail.

Demographic and Housing Characteristics

Hanover's demographic and housing characteristics are summarized in Table 3.

Table 3. Town of Hanover Characteristics

Population	
Total population	14,833
Residents under 5 years old	6.6%
Residents under 18 years old	26.2%
Residents 65 years old and over	12.1%
Race & Ethnicity	
White alone	92%
Black or African American	1%
American Indian and Alaska Native	0%
Asian alone	2%
Native Hawaiian and Pacific Islander	0%
Other Race alone	1%
Two or More Races	4%
Households	
Total Households	4,744
Housing units built before 1960	27.1%

Renter Occupied Housing Units	9.5%
Median Household Income	$149,048
Speak a Language other than English	4.3%
Limited English-Speaking Households	0.08%
Additional Characteristics	
Residents with a Disability	7.9%
Age 65 to 74 with a disability	6.56%
Age 75 and over with a disability	43.5%
Households with no vehicle	7.4%
Residents in Poverty	4.8%

Sources: 2020 Decennial Census and American Community Survey (ACS) 5-Year Estimates (US Census Bureau, 2021)

One census tract in town is classified as an "Environmental Justice" area according to the state's definition, based on income criteria. This is located in the southeast corner of town along the Route 53 corridor, as shown on Map 1a in Appendix A.

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

- Hanover has been proactive in addressing the impact of climate on natural hazards and is in the process of certification for Municipal Vulnerability Preparedness.

- Hanover has the benefits of significant forest and tree cover, over a third of the Town's area. However, power outages and damage from falling trees, as well as the potential for forest fire are important concerns.

- Water quantity and quality are important concerns for both maintaining drinking water supply and the health of the many brooks and wetlands within the town.

SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION

PLANNING PROCESS SUMMARY

MAPC employs a six-step planning process based on FEMA's hazard mitigation planning program 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 vital 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. The process supports participation by the public and stakeholders through:

- Meetings and collaborative work with the Hanover HMP/MVP Core Team, which includes stakeholders from the community (business, social service, education, and environmental) as well as participation by all relevant town departments.
- Two public meetings, shared on Local Access TV and advertised through email, webpage content, a flyer, press release to local media, and social media posts.
- Launching a public comment period at the second public meeting and posting the draft plan to the town's website to facilitate public review and comment.
- A dedicated email for public comments, HanoverMVP@mapc.org
- Outreach to seven neighboring communities (Foxborough, Franklin, Medfield, Medway, Millis, Walpole, and Wrentham), other Hanover town boards and commissions, the local chamber of commerce and businesses, environmental and public health representatives, utility companies, and other local or regional entities.

By working on hazard mitigation plans in several communities in the region, MAPC is often able to identify regional opportunities for collaboration and facilitate communication between communities. In plan updates, the six-step process described below and summarized in Figure 2 allows staff to bring the most recent hazard information into the plan, including new hazard occurrence data, changes to existing mitigation measures, and progress made on actions identified in previous plans.

Figure 2: 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 analyze and map the areas with the potential to experience natural hazards. The analysis incorporates the most recent plans, studies, reports, and technical information for the study area. The 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, which is collected. These maps can be found in Appendix A.

2. Assess the Risks & Potential Damages – Working with the local team, 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 using FEMA's HAZUS-MH tool. MAPC drew on the following resources to complete the plan:

    - Blue Hills Observatory
    - Town of Hanover Zoning Bylaw, Flood Plain Protection District
    - Town of Hanover Wetlands Bylaw
    - Town of Hanover Draft Open Space Plan Update, 2017-18
    - Town of Hanover Subdivision Regulations
    - Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), 2018
    - Massachusetts State Hazard Mitigation Plan 2013
    - Massachusetts Climate Change Assessment, 2022
    - FEMA, Disaster Declarations for States and Counties, 2023
    - FEMA, Flood Insurance Rate Maps for Plymouth County, MA, 2021
    - FEMA, HAZUS-MH, 2022
    - FEMA, Local Mitigation Planning Policy Guide, 2022
    - FEMA, Local Mitigation Plan Review Guide; October 1, 2011
    - FEMA, Flood Insurance Program statistics
    - Massachusetts Office of Dam Safety, Inventory of Dams, 2018
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
    - New England Seismic Network, Boston College Weston Observatory,
    - NOAA National Centers for Environmental Information
    - Northeast States Emergency Consortium
    - Tornado History Project
    - US Census, 2020, American Community Survey
    - USDA Forest Service, Wildfire Risk to Communities
    - USGS, National Water Information System,
    - U.S. Global Change Research Program, Fourth National Climate Assessment, 2018
    - USACE Ice Jam Database

3. Review Existing Mitigation – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as many 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 must be documented.

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

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 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 plan update is an important on-going activity. Section 9 includes more detailed information on plan implementation.

2016 PLAN IMPLEMENTATION & MAINTENANCE

The 2016 Town of Hanover Hazard Mitigation Plan contained a risk assessment of identified hazards for the Town and mitigation measures to address the risks and vulnerability from these hazards. Since approval of the 2016 plan by FEMA the Town has made progress with several hazard mitigation measures.

Two of the recommended mitigation measures from the 2016 plan have been completed, including conducting a winter weather awareness program and achieving StormReady designation from the National Weather Service, as well as completing an update to the Open Space and Recreation Plan.

Five mitigation measures were partially completed, including an education program on wetlands compliance, a hydraulic analysis of the Indian Head River Watershed, a stormwater committee, a dumping bylaw, and recommendations on the Forge Pond Dam. The Hazard Mitigation/MVP Core Team recommended retaining these mitigation measures in the 2023 updated plan and revising several of them to reflect current circumstances and town priorities. See Section 7 for more information on the status of mitigation measures from the 2016 Hazard Mitigation Plan.

In addition, the Town is completing a Municipal Vulnerability Preparedness planning process in conjunction with this 2023 Hazard Mitigation Plan Update. Upon completion of

the MVP project the Town will be eligible for designation as MVP Community by the Executive Office of Energy and Environmental Affairs. That will make the Town eligible for MVP Action Grants, which could help find several of the Town's mitigation measures. Several mitigation actions discussed at the MVP workshop have informed the hazard mitigation strategy of this 2023 plan update.

THE LOCAL HAZARD COMMUNITY PLANNING TEAM

The local hazard mitigation team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The local team was tasked with working with MAPC to update plan goals, providing local information on the hazards that impact the Town, updating existing mitigation measures, and helping to develop new mitigation measures for this plan update. Given this role, it is important that this team includes a diverse representation of knowledgeable municipal staff and community stakeholders.

Because this plan update was conducted in conjunction with Hanover's Municipal Vulnerability Preparedness (MVP) project, the town designated a joint Hazard Mitigation/MVP Core Team to coordinate both related projects. The Hanover HMP/MVP Core Team was composed of key staff from 8 Town departments as well as community stakeholders representing the business, social services, and environmental sectors. The team members and their affiliations are listed in Table 4. These were the individuals who provided MAPC with data and local knowledge of the various hazards, reviewed the status of mitigation measures, and developed the recommended mitigation strategy for this 2023 plan update.

Table 4 - Hanover Hazard Mitigation/MVP Core Team Members

Name	Representing
Jason Cavallaro	Fire Chief / Emergency Management
Ann Lee	Assistant Town Manager
Dan Berry	Hanover YMCA
Ed Callahan	Prep Property Group
Victor Diniak	Public Works Dept.-Director
Fred Freeman	Hanover Fire Dept/EMA
Timothy Kane	Police Chief
Kurt Kelley	Deputy Superintendent, Dept. of Public Works
Sandra MacFarlane	Conservation Agent
Neal Merritt	Water Superintendent, Dept. of Public Works
Colleen Smith	Hanover Schools
Christine Stickney	Town Planner
Samantha Woods	North-South Rivers Watershed Association

The Hanover HMP/MVP Core Team held a project kick-off meeting via Zoom on September 15, 2022 with MVP Regional Coordinator and MAPC's project manager Martin Pillsbury. Following that, three meetings of the full Core Team were held on October 12 2022, January 18, 2023, and May 10, 2023. These were in-person meetings at Hanover Town Hall. Attendees at meetings of the Hanover HMP/MVP Core Team are

shown in Table 5. The topics of the four meetings of the Hanover HMP/MVP Core Team are summarized below. The agendas for these meetings are included in Appendix C.

- **September 15, 2022:** The team discussed the project overview with the MVP Regional Coordinator, Carolyn Mecklenburg and MAPC project manager Martin Pillsbury, and scheduled the first full team meeting for October 12, 2022.

- **October 12, 2023** Working with MAPC's GIS Analyst Rachel Bowers, the Core Team provided local updates to the inventory and maps of local flood and fire hazard areas. critical facilities, and new developments. The team also made preparations for the first public meeting, scheduled for December 5, 2022 with the Hanover Planning Board.

- **January 18, 2023:** The Core Team updated the hazard mitigation goals and reviewed the current status of the Town's existing mitigation measures, noting any changes and suggested improvements. The team discussed preparations for the MVP workshop scheduled for April 10, 2023. The team also heard a presentation on the Indian Head River restoration project from Becky Malamut from the North and South Rivers Watershed Association.

- **May 10, 2023: The Core Team** reviewed the status of the recommended mitigation from the 2016 plan and determine which measures should be retained in the 2023 plan. The team also decided on adding several new mitigation measures to the 2023 plan update, some of which were discussed at the MVP Workshop on April 10, 2023. The team discussed preparations for the final public meeting and MVP Listening Session, scheduled for May 14, 2023 at Town Hall.

Table 5 – Attendance at Hanover HMP/MVP Core Team Meetings

Name	Representing
Project Kick-off Meeting September 15, 2022 (Remote by Zoom)	
Jason Cavallaro	Fire Chief / Emergency Management
Ann Lee	Assistant Town Manager
Victor Diniak	Public Works Dept.-Director
Timothy Kane	Police Chief
Kurt Kelley	Deputy Superintendent, Dept. of Public Works
Sandra MacFarlane	Conservation Agent
Neal Merritt	Water Superintendent, Dept. of Public Works
Christine Stickney	Town Planner
Carolyn Mecklenburg	MVP Regional Coordinator
Martin Pillsbury	MAPC Director of Environmental Planning
Adria Boynton	MAPC Senior Environmental Planner
Core Team Meeting #1 October 12, 2022 (Hanover Town Hall)	
Jason Cavallaro	Fire Chief / Emergency Management
Ann Lee	Assistant Town Manager
Dan Berry	Hanover YMCA
Ed Callahan	Prep Property Group
Victor Diniak	Public Works Dept.-Director

Fred Freeman	Hanover Fire Dept/EMA
Timothy Kane	Police Chief
Kurt Kelley	Deputy Superintendent, Dept. of Public Works
Sandra MacFarlane	Conservation Agent
Neal Merritt	Water Superintendent, Dept. of Public Works
Colleen Smith	Hanover Schools
Christine Stickney	Town Planner
Samantha Woods	North-South Rivers Watershed Association
Martin Pillsbury	MAPC Director of Environmental Planning
Rachel Bowers (via Zoom)	MAPC GIS Planner
Core Team Meeting #2 January 18, 2023 (Hanover Town Hall)	
Jason Cavallaro	Fire Chief / Emergency Management
Ann Lee	Assistant Town Manager
Dan Berry	Hanover YMCA
Ed Callahan	Prep Property Group
Victor Diniak	Public Works Dept.-Director
Fred Freeman	Hanover Fire Dept/EMA
Timothy Kane	Police Chief
Kurt Kelley	Deputy Superintendent, Dept. of Public Works
Colleen Smith	Hanover Schools
Martin Pillsbury	MAPC Director of Environmental Planning
Core Team Meeting #3 May 10, 2023 (Hanover Town Hall)	
Jason Cavallaro	Fire Chief / Emergency Management
Ann Lee	Assistant Town Manager
Dan Berry	Hanover YMCA
Ed Callahan	Prep Property Group
Fred Freeman	Hanover Fire Dept/EMA
Timothy Kane	Police Chief
Kurt Kelley	Deputy Superintendent, Dept. of Public Works
Sandra MacFarlane	Conservation Agent
Samantha Woods	North-South Rivers Watershed Association
Martin Pillsbury	MAPC Director of Environmental Planning

In addition, Core Team members and many other municipal and community stakeholders participated in Hanover's Community Resilience Building workshop on April 10, 2023, a full-day workshop hosted by Hanover YMCA under the Town's MVP grant project. The 25 participants at the workshop are listed in Table 6. More details on the CRB workshop are included in the MVP report that was prepared for the town accompanying this plan.

Table 6 – Attendance at Hanover's CRB Workshop, April 10, 2023

First Name	Last Name	Representing
Town - HMP/MVP Core Team		
Ann	Lee	Assistant Town Manager
Jason	Cavallaro	Fire Chief / Emergency Management
Christine	Stickney	Town Planner
Victor	Diniak	Public Works Dept.-Director
Sandra	MacFarlane	Conservation Agent

First Name	Last Name	Representing
Colleen	Smith	Hanover Schools
Joseph	Stack	Building Commissioner/Assistant Health Agent
Kurt	Kelley	Hanover DPW
Town Departments, Boards, Commissions		
Joe	Colangelo	Town Manager
Steve	Ryerson	Hanover Communications
MaryAnn	Brugnoli	Planning Board
Diane	Sawin	Board of Health
Rick	Mattes	Hanover Emergency Management
Pete	Delprete	Building Dept.
Will	Barrett	Health Dept
Doreen	Zeller	Hanover Visiting Nurse, Nurse Administrator
James	Hayden	Hanover Emergency Management
Community, Business, Non-Profits		
Erin	Richardson	Hanover Chamber of Commerce
Ed	Callahan	Prep Property Group
Dan	Berry	Hanover YMCA
Samantha	Woods	North-South Rivers Watershed Association
Ryan	Earle	Utilities, Electric - Eversource
Joe	Carroll	National Grid
Carolyn	Mecklenburg	MVP Regional Coordinator
MAPC Facilitators		
Abigail	Bliss	MAPC Economic Development Planner II
Brad	Downy	MAPC Grants Management Specialist
Kat	Kobylt	MAPC Environmental Planner II
Martin	Pillsbury	MAPC Environment Dept. Director

Managing Development and Infrastructure

Hanover's HMP/MVP Core Team includes local officials responsible for planning and regulating growth and development in the Town. The Hanover Planning Board, Building Department, and Conservation Commission are responsible for regulating new development under local Zoning and General Bylaws and the Massachusetts Building Code. The Public Works Department manages critical infrastructure, including roadways, stormwater management, and public drinking water supply. The Board of Health regulates wastewater disposal under the state Sanitary Code, Title 5. MAPC, the State-designated Regional Planning Agency for Hanover, coordinates with all state and regional agencies that regulate development and infrastructure in the region, including the MassDOT, the MBTA transit system, the Department of Conservation and Recreation, and the Massachusetts Water Resources Authority.

PUBLIC OUTREACH AND STAKEHOLDER INVOLVEMENT

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 historical 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 resilience and hazard mitigation, the Town hosted two public meetings, one during the planning process and the other when a draft plan was available, as described below.

The public first had an opportunity to provide input to the Hanover MVP and Hazard Mitigation Planning process at a meeting hosted by the Planning Board, on December 5, 2022 held in Hanover Town Hall. At a second public meeting, the draft plan update was presented at a "Hazard-Ready Hanover" Community Forum held on June 14, 2023 in Hanover Town Hall, in conjunction with the MVP Public Listening Session. The first meeting was publicized as part of regular meetings of the Planning Board according to the Massachusetts Public Meeting Law. The Community Forum was publicized through direct outreach to community stakeholders, posts on the Town's website and social media accounts, notification of the local print press as well as a regional radio station, and networking with local NGO's. The draft Hanover Hazard Mitigation Plan 2023 Update was posted on the Town's website for the second public meeting, and public comments were solicited after the meeting, with a dedicated email address available to for submittal of questions or comments on the plan HanoverMVP@mapc.org). See public meeting notices and notes on the June 14 Public Listening Session in Appendix C.

The Hanover HMP/MVP Core Team reached out to the local stakeholders listed below that might have an interest in the Hazard Mitigation Plan update, including neighboring communities, agencies, businesses, nonprofits, and other interested parties. Notice was sent to the following Town boards, committees, departments; regional and state organizations; as well as neighboring municipalities inviting them to participate in the public meetings, to review the draft HMP Update, and submit comments to the Town. Comments received are shown in Appendix C

- Hanover Chamber of Commerce
- Prep Property Group
- Hanover YMCA
- North-South Rivers Watershed Association
- Utilities-Eversource
- Utilities-National Grid
- Hanover Visiting Nurse, Nurse Administrator
- Hanover Emergency Management
- Hanover Dept. of Public Works
- Hanover Water Department
- Hanover Communications
- Hanover Planning Board
- Hanover Board of Health
- Hanover Emergency Management
- Hanover Building Dept.
- Hanover Health Dept
- Fire Chief/Emergency Management
- Town Planner
- Conservation Agent
- Police Chief
- Hanover Schools
- Building Commissioner
- Town of Foxborough
- Town of Franklin
- Town of Medfield
- Town of Medway
- Town of Millis
- Town of Walpole
- Town of Wrentham

PLANNING TIMELINE

The major milestones in the planning process for the preparation of this plan update are summarized in Table 7.

Table 7: Planning Timeline for the 2023 HMP Update

September 15, 2022	Kickoff Meeting of the Hanover Hazard Mitigation/MVP Core Team
October 12, 2022	Hanover Hazard Mitigation/MVP Core Team
December 5, 2022	First Public Meeting, hosted by the Hanover Planning Board
January 18, 2023	Hanover Hazard Mitigation/MVP Core Team
April 10, 2023	Community Resilience Building Workshop, Hanover YMCA
June 14, 2023	Second Public Meeting, Community Forum & MVP Listening Session
TBD	Draft Plan submitted to MEMA
TBD	Approvable Pending Adoption notice issued by FEMA
TBD	Final Plan Adopted by the Town
TBD	Final Plan Approved by FEMA

Continuing Public Participation and Plan Implementation

Following the adoption of this plan, the planning team will continue to provide residents, businesses, and other stakeholders the opportunity to learn about the hazard mitigation planning process and to contribute information that will update the town's understanding of local hazards. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with town and state open meeting laws. The process for plan monitoring, evaluation and implementation is described in Section 9 of this plan. The major milestones for post-plan approval, with target dates for each, are summarized in Table 8.

Table 8: Implementation Timeline for the 2023 HMP Update

2025	Conduct Mid-Term Plan Survey on Progress
2026	Seek FEMA grant to prepare next plan update
2027	Begin process to update the plan
2028	Submit Draft 2028 Plan Update to MEMA and FEMA
2028	FEMA approval of 2028 Plan Update

SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Hanover 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 determine Hanover's risk assessment, MAPC gathered the most recently available hazard and land use data and met with the Hanover HMP/MVP Core Team to identify changes in local hazard areas and development trends since the 2016 plan. The team also provided updates to critical infrastructure in order to create an up-to-date inventory and GIS map. MAPC also used the most recent version of FEMA's HAZUS-MH program to assess the potential impacts of hurricanes, earthquakes, and floods under different scenariios.

INTEGRATING CLIMATE CHANGE INTO THE PLAN

With the adoption of the Hazard Mitigation and Climate Adaptation Plan 2018 (SHMCAP), Massachusetts became the first state to integrate climate projections in a state hazard mitigation plan. Following the state model, the projected impacts of our warming climate on natural hazards are integrated throughout the risk assessment. Key impacts include rising temperatures, which in turn affect precipitation patterns, sea level, and extreme weather.

Analysis of these impacts included in this plan aligned closely with the data and assessment presented in Massachusetts' 2018 State Hazard Mitigation and Climate Adaptation Plan (2018 SHMCAP) and the Massachusetts' 2022 Climate Change Assessment.

> *"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

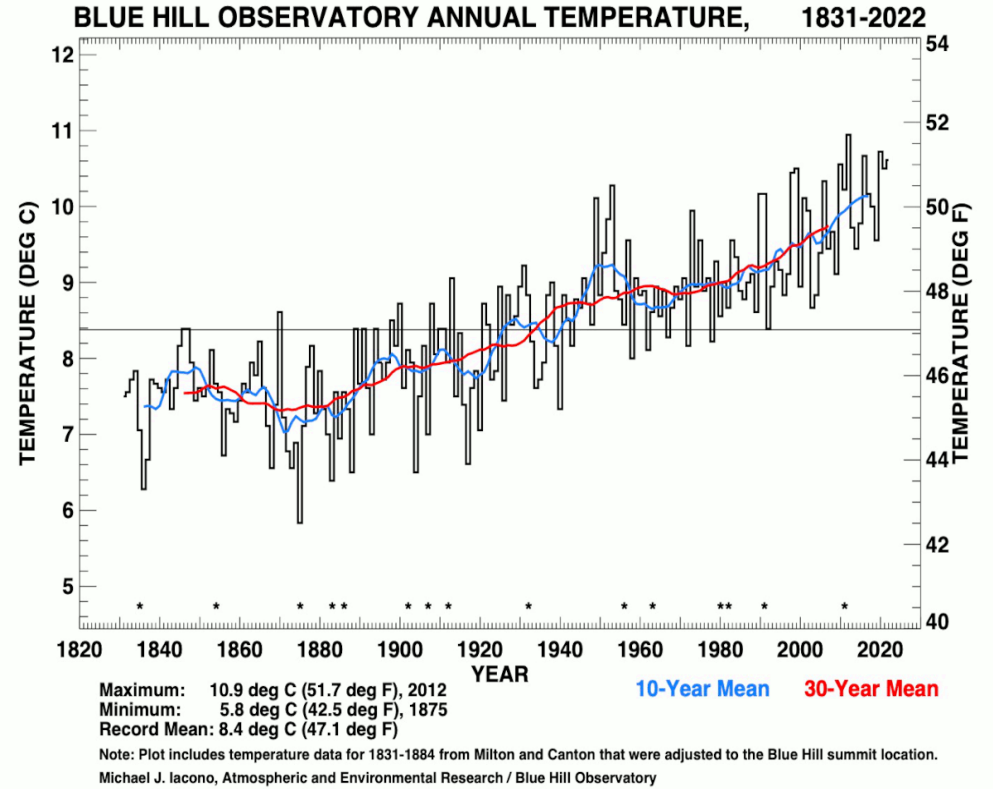
Climate change observations come from a variety of data sources that have measured and recorded changes in recent decades and centuries. Climate change projections, however, predict future climate impacts and, by their nature, cannot be observed or

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, which 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. See Figure 3 for more information.

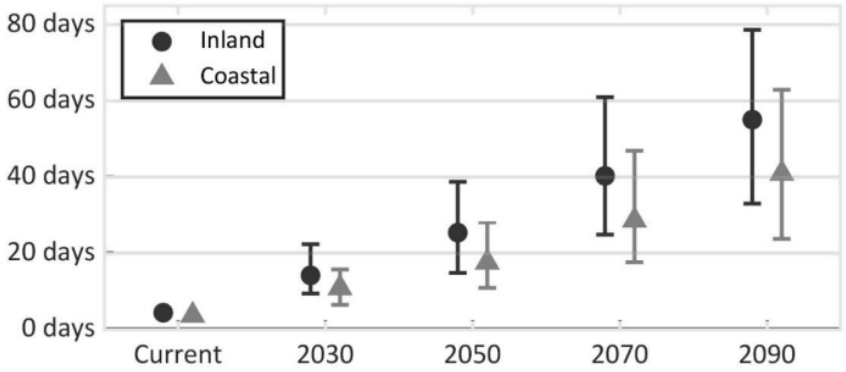
Figure 3: Observed Increase in Temperature



Source: Blue Hills Observatory

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. As shown in Figure 4, by 2030, the summer mean temperature could increase by 3.6°F from the historical period (1950-2013). By 2070, there could be 58 fewer days below freezing, which could lead to an increase in ticks. By mid-century, the State anticipates about 25 more days per year where the temperature exceeds 90°F for inland areas, and about 19 more days above 90°F for coastal areas.

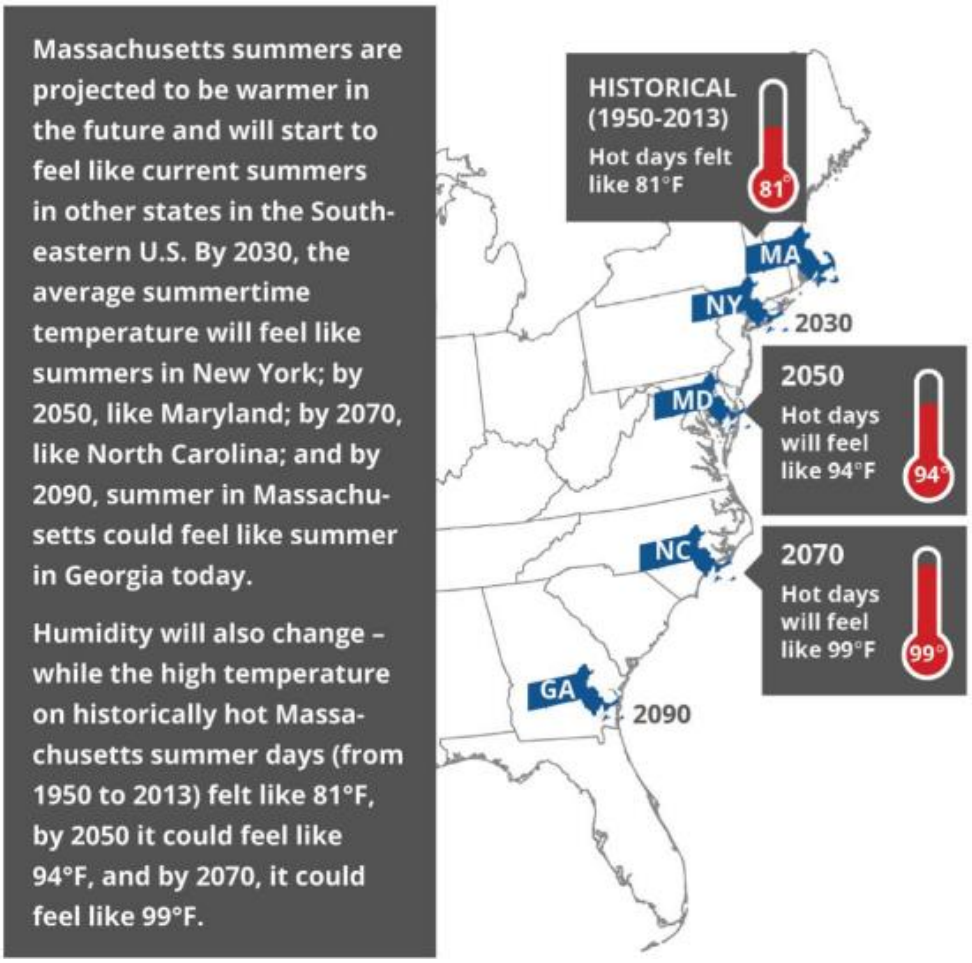
Figure 4: Change in the Annual Number of Days Over 90°F Compared to Today



Sources: 2022 MA Climate Change Assessment and Stochastic Weather Generator

These changes could result in Massachusetts summers feeling like a more southern state, as described in the infographic in Figure 5 from the MA 2022 Climate Change Assessment.

Figure 5: Change in Average Summertime Temperatures for Massachusetts

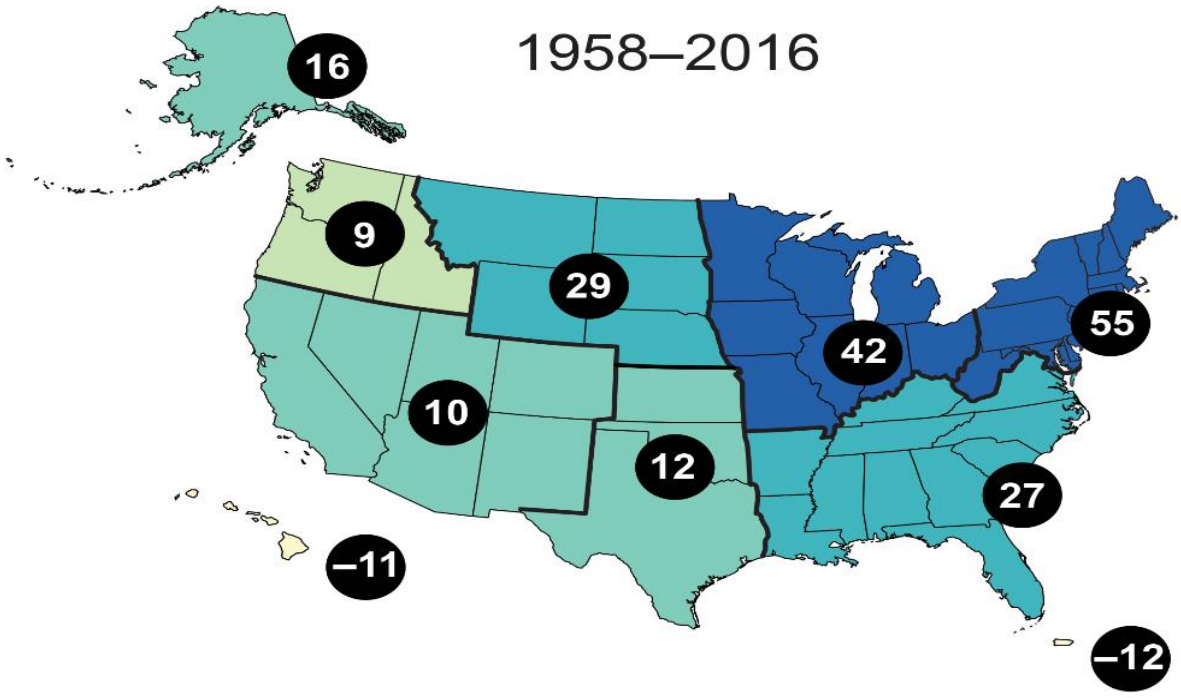


Source: 2022 MA Climate Change Assessment

PRECIPITATION PATTERNS

Annual precipitation in Massachusetts has increased by approximately 10% in the fifty-year period from 1960 to 2010 (MA EEA, 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 (US Global Change Research Program, 2018). Changes in precipitation are fueled by warming temperatures which increase evaporation and, therefore, the amount of water vapor in the air. See Figure 6 for more information.

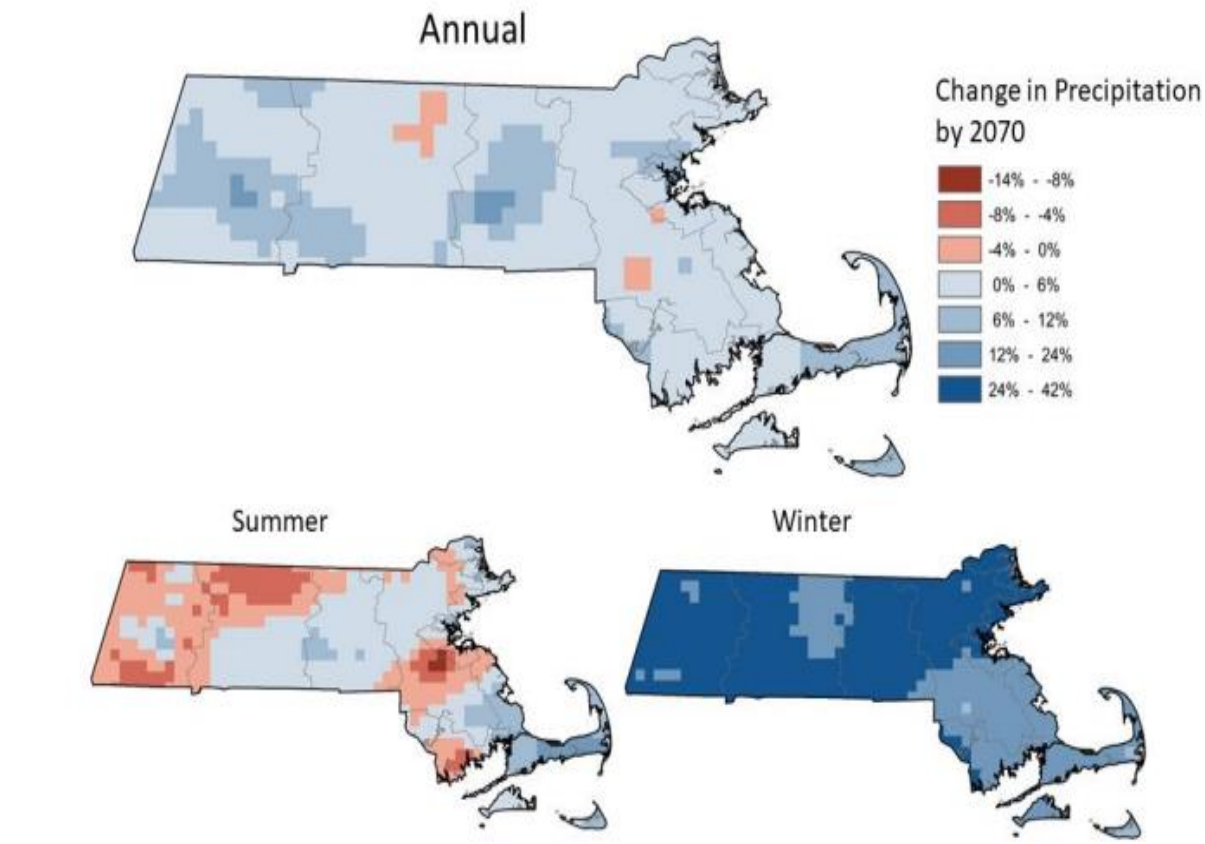
Figure 6: Observed Change in Total Annual Precipitation in the Heaviest 1% Events



Source: Fourth National Climate Assessment, 2018
Numbers circled in black indicate % change.

Massachusetts' 2022 Climate Change Assessment anticipates that most parts of the State will see a future increase in annual total precipitation of less than 8% per year (Figure 7). Most of these increases are anticipated during the winter months. Additionally, the historic 10% annual chance daily rainfall event (2.8-4.0" of rain) could occur four times more frequently by 2090.

Figure 7: Change in Annual and Seasonal Precipitation in 2070 Compared to Today



Source: 2022 MA Climate Change Assessment. Current climate is the 1986-2005 era, the projection for 2070 is for a 20-year era centered on 2070. Maps show LOCA downscaled GCM projections at the 50th percentile across 20 LOCA GCMs that overlap with the GCMs used in the Stochastic Weather Generator.

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, as a result of earlier snow melt, and higher temperatures that will reduce soil moisture. Massachusetts' 2022 Climate Change Assessment anticipates that these changes will vary by region. The North and South Shores region where Hanover is located may experience slightly more consecutive dry days, and significantly more days without rain per year, by 2090 (Commonwealth of Massachusetts, 2022). See Table 9 for more information.

Table 9: Consecutive dry day events (number of multiple-dry-day events per year)

Panel A: Consecutive dry day events (number of multiple-dry-day events per year)

Region	Baseline	2030	2050	2070	2090
Berkshires & Hilltowns	29	29	30	30	31
Greater Connecticut River Valley	31	31	32	32	33
Central	32	32	32	33	33
Eastern Inland	32	32	32	33	33
Boston Harbor	31	31	32	32	33
North & South Shores	31	31	32	32	33
Cape, Islands, & South Coast	31	31	32	32	33
Statewide	**31**	**31**	**31**	**32**	**33**
Statewide Percent Change	**0%**	**1%**	**2%**	**4%**	**6%**

Source: Stochastic Weather Generator

Panel B: Annual number of days without rain (days per year)

Region	Baseline	2030	2050	2070	2090
Berkshires & Hilltowns	159	161	165	167	170
Greater Connecticut River Valley	171	172	175	178	181
Central	180	182	185	188	192
Eastern Inland	186	181	185	188	193
Boston Harbor	192	185	192	194	198
North & South Shores	184	182	187	190	195
Cape, Islands, & South Coast	186	182	187	191	194
Statewide	**176**	**175**	**179**	**182**	**187**
Statewide Percent Change	**0%**	**-1%**	**2%**	**3%**	**6%**

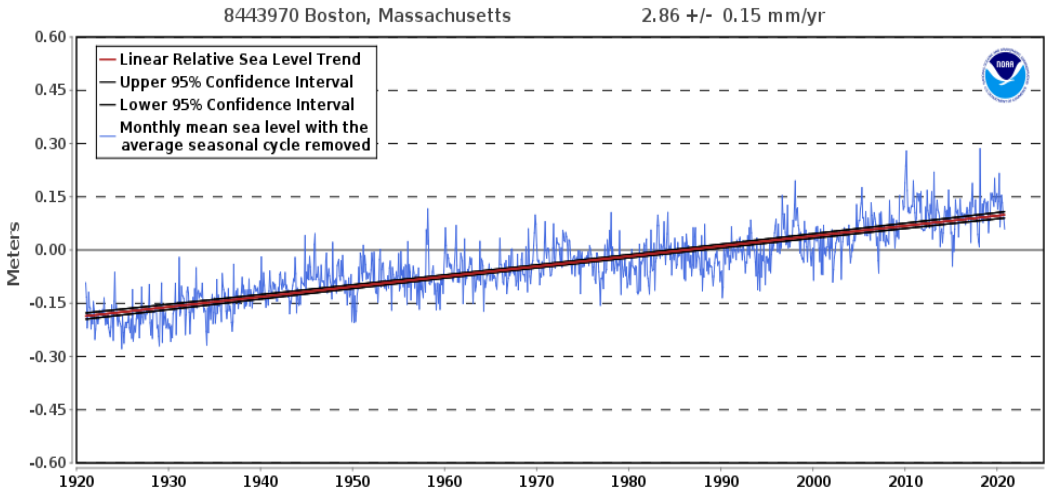
Source: 2022 MA Climate Change Assessment. The Town of Hanover is located in the North & South Shores Region, outlined by the blue box above.

SEA LEVEL RISE

While Hanover is not a coastal community, it is about five miles inland from the coast, and its neighboring towns are on the coast. information on sea level rise is discussed here as the regional economy of the South Shore region may be impacted by sea level rise in the future. Warming temperatures contribute to sea level rise in three 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.

NOAA's records from the Boston Tide Station show nearly one foot of sea level rise over the past century. See Figure 8 for more information.

Figure 8: Observed Increase in Sea Level Rise



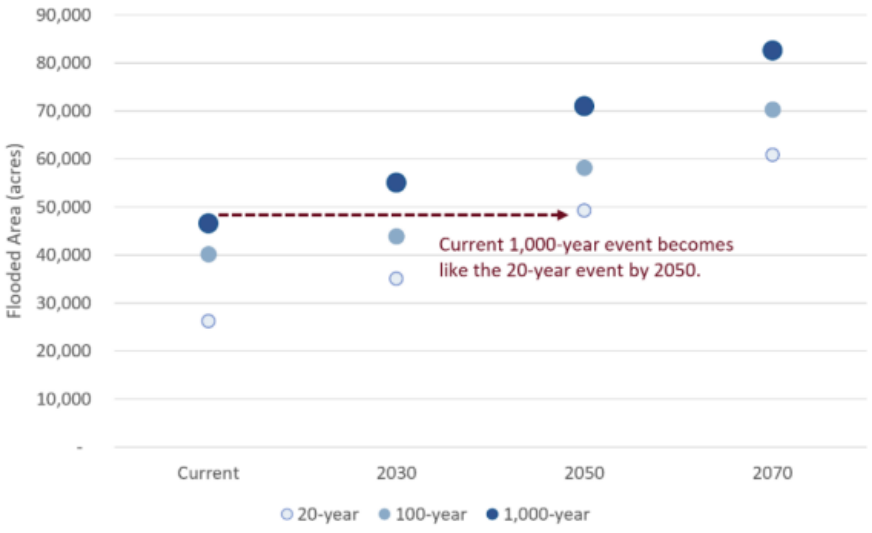
Source: NOAA

The sea level rise information in Massachusetts' 2022 Climate Change Assessment considers sea-level changes, land-level changes, and other regional facts that can impact the rate of change. The report includes the following approximate sea level rise projections for the southern part of the state: 23 inches by 2050 and 45 inches by 2070.

The 2022 Climate Change Assessment also quantified the developed land area flooded for events including: the 20-year (5% annual probability), 100-year (1% probability), and 1000-year (0.1% probability) events.

This approach found that the area flooded by the current 1000-year event is comparable to the area of a 20-year event by 2050. Even more areas could be impacted by the annual probability event by 2070. See Figure 9 for more information.

Figure 9: Total Flooded Area of the Commonwealth for Selected Events



Source: 2022 MA Climate Change Assessment

This local plan organizes consideration of natural hazards based on their relationship to projected climate changes. Table 10, which is from the SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts.

Table 10: Climate Change & 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, public health impacts from mold and worsened indoor air quality, vector-borne diseases from stagnant water, increased potential for loss of life, episodic drought, changes in snow-rain ratios, changes in extent and duration of snow cover, degradation of stream channels and wetland
	Drought	Rising Temperatures, Extreme Weather	
	Landslide	Rising Temperatures, Extreme Weather	
 **Sea Level Rise**	Coastal Flooding	Extreme Weather	Increase in tidal and coastal floods, storm surge, coastal erosion, marsh migration, inundation of coastal and marine ecosystems, loss of wetlands
	Coastal Erosion	Extreme Precipitation	
	Tsunami	Rising Temperatures	
 **Rising Temperatures**	Average/Extreme Temperatures	N/A	Shifting in seasons (longer summer, early spring, and earlier timing of spring peak flow), increased length of growing season, increase of invasive species, increase in vector-borne illnesses (West Nile, Zika, EEE), ecosystem stress, energy brownouts from higher demands, more intense heat waves, public health impacts from heat exposure and poor outdoor air quality, increased potential for loss of life, 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		
	Tornadoes		
	Other Severe Weather (Strong Wind & Thunderstorms)		

OVERVIEW OF HAZARDS AND IMPACTS

The 2018 SHMCAP and the 2013 Massachusetts State Hazard Mitigation Plan are two key planning documents that examine natural hazards that have the potential to impact the Commonwealth. The 2013 State HMP set the stage by defining considerations such as frequency and severity and summarizing the frequency and severity of hazards of greatest concern. The 2018 SHMCAP used similar definitions for hazard considerations and expanded on this research by including additional climate projections. Because the 2013 State HMP includes definitions that were not specified in the 2018 SHMCAP, both resources are referred to in this report.

Frequency: The frequency designations used for Hanover were based on the 2018 State Hazard Mitigation and Climate Action plan supplemented with NOAA's county-level storm event data, local information from the Hazard Mitigation Team, and HAZUS results, as well as the 2013 State HMP definitions, which define frequency categories as:

- **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%-2% per year).
- **Medium:** Events that occur from once in five years, to once in 50 years (2%-20% per year).
- **High:** Events that occur more frequently than once in five years (Greater than 20% per year)

Severity: The 2018 SHMCAP defines severity as, "the extent or magnitude of a hazard, as measured against an established indicator (e.g., Richter Scale, Saffir-Simpson Hurricane Scale, or Regional Snowfall Index)." The severity designations used for Hanover were based on NOAA's county-level storm event data, local information from the Hazard Mitigation Team, HAZUS result, and the 2013 State HMP definitions, which define severity categories as:

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

The Table 11 summarizes the frequency and severity of hazard risks for Massachusetts and Hanover, based on available data, including:

- **State-level data** including the 2022 Climate Change Assessment, 2018 SHMCAP, and 2013 State HMP)
- **County-level data** from NOAA's National Climatic Data Center and Storm Events Database for Plymouth County (where Hanover is located)
- **Local-level information** including input from the Local Team, the hazard mapping included in Appendix A, and the HAZUS results in Tables 40-42.

Table 11: Hazards Risk Summary

Natural Hazard	Frequency		Severity	
	MA	Hanover	MA	Hanover
Inland Flooding	High	High	Serious to Catastrophic	Serious
Drought	Medium	Medium	Minor to Serious	Minor to Serious
Landslide	High	Very Low	Minor to Extensive	Minor
Coastal Flooding	High	Vey Low	Serious to Extensive	Very Low
Tsunami	Very Low	N/A	Extensive to Catastrophic	N/A
Extreme Temperatures	High	High	Minor to Serious	Minor
Wildfires/Brushfire	High	High	Minor to Extensive	Minor to Serious
Invasive Species	High	High	Minor	Minor
Hurricanes/Tropical Storms	Medium	Medium	Serious to Catastrophic	Minor to Serious
Severe Winter Storm / Nor'easter	High	High	Minor to Extensive	Serious
Tornadoes	High	Very Low	Serious to Extensive	Serious
Other Severe Weather (Strong Wind & Thunderstorms)	High	High	Minor to Extensive	Minor
Earthquakes	Very Low	Very Low	Serious to Catastrophic	Serious to Catastrophic

Sources: Frequency information for MA comes from the 2018 SHMCAP. Severity information for MA comes from the 2013 State HMP. Frequency and severity information for Hanover come from NOAA's county-level data, local information from the Hazard Mitigation Team, and HAZUSs results.

Not all hazards included in the 2018 SHMCAP apply to the Town of Hanover. Given Hanover's inland location five miles from the coast, the Town is not directly impacted by coastal flooding (although riverine flooding from North River in the southeast corner of

town is tidal and could be influenced by future seal level scenarios, as noted below) Ice jams are also not a hazard in Hanover. The US Army Corps Ice Jam Database shows no record of ice jams in Hanover, and the Town did not identify ice jams as an issue of concern. [a]

CLIMATE TRENDS: CHANGES IN PRECIPITATION

FLOODING HAZARDS

Overview of Flooding and Watershed Resources

Flooding is generally caused by severe rainstorms, thunderstorms, hurricanes, and nor'easters. Large rainstorms can occur year-round. Hurricanes are most common in the summer and early fall. Nor'easters are most common in winter. Spring snowmelt may exacerbate flooding during storm events. Large rainstorms can occur year-round. Climate change has the potential to exacerbate these issues over time due to increasing extreme rainfall events. Increase in average annual rainfall may also lead to more incidents of basement flooding caused by high seasonal groundwater levels.

Flooding is one of the most prevalent natural hazards in Hanover. Hanover is subject to two kinds of flooding. The primary type of flooding is *inland/riverine flooding* where the rate of precipitation and/or amount of stormwater runoff overwhelms the capacity of streams to convey the excess volume, elevating water levels in floodplain areas. Flooding can also be related to stormwater runoff, often exacerbated by impervious surfaces, which contributes to peak storm flows that can overwhelm the capacity of structural drainage systems and stormwater infrastructure. Older and undersized stormwater infrastructure can be most subject to these impacts. Although Hanover is not a coastal community, it is bordered on the southeast by the North River which can be affected by tidal storm surges.

Flood hazards across the town's watersheds are described in the Hanover Open Space and Recreation Plan. The section on flood hazards provides the following overview:

> Because of Hanover's extensive river and tributary system, many flood hazard areas are spread throughout the town. All of the streams and brooks which are part of the Drinkwater River system have areas of potential flood hazard. On the west side of Hanover, the Shingle Mill Brook, Cushing Brook, Ben Mann Brook, and the Torrey Brook present limited flood hazard as well as larger open wetland or swamp areas. Flooding from the Longwater Brook and French Stream is more confined to areas directly adjacent to the banks of the waterways. The Drinkwater River is also fed by Pine Island Swamp, Peg Swamp, Hell Swamp, and Wampum Swamp, as well as an unnamed wetland north of Route 139 between Plain Street and Grove Street and an area behind Cedar School, all of which are marked as areas of 100-year flood hazard. The last area of flood hazard associated with the Drinkwater River system is a section of Beach Hill swamp on the western boundary of Town.

Flood hazards associated with Third Herring Brook and the Indian Head River drainage areas are more limited than the Drinkwater River system. Molly Brook and Silver Brook drain into the Third Herring Brook with few areas of expansive flood hazard. The most notable exception is Old Pond Meadows along Third Herring Brook; however, the majority of this wetland is in the bordering town of Norwell. Iron Mine Brook, part of the Indian Head River Drainage area, has several wetland and swamp areas which present 100-year flood hazard. These wetland areas are located to the west of Route 53 between Hanover Street and Silver Street and surrounding the former cranberry bogs downstream. Other flood areas along the Indian Head River are limited, aside from a few small unnamed streams which could potentially flood areas where water drains into the Indian Head River. The last area marked on the FIRM and Floodway maps, below the Curtis Crossing Dam forming the headwaters of the North River, shows a wetland area subject to flooding in the southeast corner of Hanover.

Additionally, the section of the open space and recreation plan that discusses environmental challenges addresses chronic flooding. The plan notes that Hanover drains to a river network in the western portion of town which then drains toward the North River. This results in two different types of flooding. The first type is major river flooding along the Drinkwater River and Forge Pond which occurs about every 25 years. The other is localized flooding where drainage networks empty into smaller rivers and streams and ditches.

Previous Occurrences and Extent of Flooding

There have been a number of major floods that have affected the Metro Boston region over the last fifty years. Significant historic flood events have included those listed below (Commonwealth of Massachusetts, 2018) and (NOAA, 2022).

- The Blizzard of 1978
- January 1979
- April 1987
- October 1991
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- February 2013
- January 2018
- March 2018
- June 2020

The best available data on previous occurrences of flooding is available through NOAA's National Centers for Environmental Information Storm Events Database. Plymouth County, which includes the Town of Hanover, experienced 32 flood events from March 2010 to December 2022. No deaths or injuries were reported and the total reported property damage in the county was $24.295 million. See Table 12 for more information.

Table 12: Plymouth County Flood Events, 2010 through 2022

Date	Deaths	Injuries	Property Damage
3/14/2010	0	0	16,150,000
3/29/2010	0	0	8,070,000
4/1/2010	0	0	0
7/13/2011	0	0	5,000
8/10/2012	0	0	30,000
5/11/2013	0	0	0
5/11/2013	0	0	0
6/7/2013	0	0	0
9/3/2013	0	0	0
3/30/2014	0	0	0
10/22/2014	0	0	0
11/17/2014	0	0	0
05/31/2015	0	0	0
07/28/2015	0	0	15,000
09/10/2015	0	0	0
10/29/2015	0	0	0
05/30/2016	0	0	0
04/01/2017	0	0	5,000
04/06/2017	0	0	5,000
6/24/2017	0	0	1,000
10/25/2017	0	0	0
10/29/2017	0	0	0
1/12/2018	0	0	0
11/3/2018	0	0	1,000
4/15/2019	0	0	0
7/12/2019	0	0	0
7/22/2019	0	0	0
9/2/2019	0	0	2,000
7/12/21	0	0	
09/012/21	0	0	2,000
11/12/21	0	0	5,000
08/05/22	0	0	4,000
TOTAL	**0**	**0**	**24,295,000**

Source: NOAA, National Environmental Information Center

Severe Precipitation

The most severe recent flooding occurred during the major storms of March 2010, when a total of 17.7 inches of rainfall was recorded by the Blue Hills Observatory from three storms over 19 days from March 13 to 31. accumulation was officially recorded by the National Weather Service (NWS). The weather pattern that caused these floods consisted of early springtime prevailing westerly winds that moved three successive storms, combined with tropical moisture from the Gulf of Mexico, across New England. Torrential

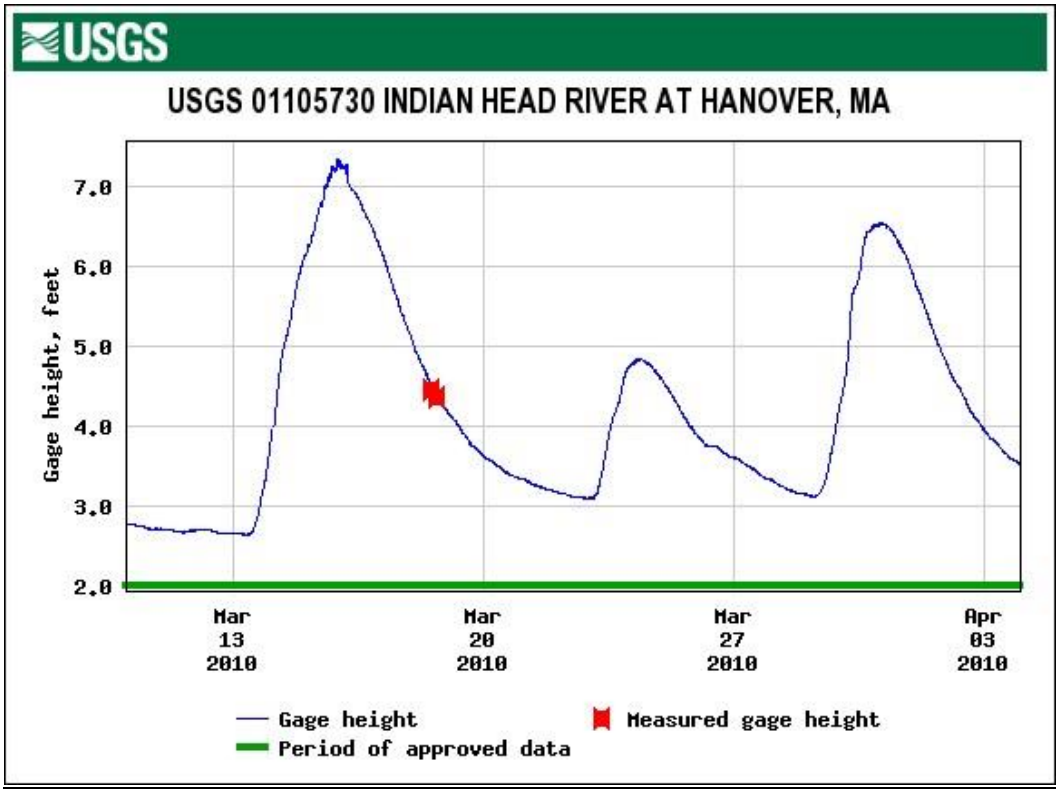
rainfall caused March 2010 to be the wettest month on record. The March 2010 rainstorms fit the profile of a type of severe precipitation event expected to increase in frequency as the climate warms. That is, significant precipitation, falling in late winter as rain rather than snow, on frozen ground, and while vegetation is still dormant.

In Hanover, King Street was closed for 2-3 days at the bridge at Forge Pond until the waters receded. The only damage was a small sinkhole in the road that was subsequently repaired. All of the houses on King Street and the roads off of King Street south of the bridge were impacted.

There was also significant puddling on Industrial Way as a result of this flooding. The fire department set up a mobile command post to ensure that the roads remained open. Many homes experienced basement flooding. The river overflowed its banks and reached the edge of neighboring properties on Pine Island Road and Brook Circle.

One indication of the extent of flooding is the gage height at the nearest streamflow gauging station. The United States Geological Survey (USGS) maintains a streamflow gauging station on the Indian Head River in Hanover. Figure 10 shows the peaks at that station for the three storms that occurred from March 13- 31, 2010. Gage height exceeded 7.0 feet after the first storm on March 16, and rose again to 6.5 feet after the third storm on March 31. Normal gage height in March is about 3 feet.

Figure 10: USGS Gage at Indian Head River, March 2010 Storms



Source: US Geologic Survey, National Water Information System

Damages from flooding from 2010 to 2022 in Plymouth County totaled $24.29 million. It is notable that $24.22 million of that, or 99.7% of all damages reported for the period 2010 through 2022, was due to the March 2010 storms. Those storms were a federally declared disaster, making federal disaster assistance available to residents who did not carry flood insurance. In Hanover there were 3 Flood Insurance claims and 212 Disaster Assistance claims totaling $ 578,425. The general location of the 2010 flood insurance and disaster claims is shown on Map 3B in Appendix A. Of the total 215 claims in Hanover, only four claims, or 1.9% of the total claims, were located with the FEMA Special Flood Hazard Areas (1% annual chance of flooding). Over 98% of the claims were outside of the Special Flood Hazard Area. This is a pattern that is reflected across all 101 communities in the MAPC region, where only 9% of a total 19,395 claims were within the Special Flood Hazard Area.

The HAZUS analysis estimates damages in Hanover from a 100-year flood at $13.8 million and $20.2 million from a 500-year flood (see Table 42).

Flooding Location, Impacts and Vulnerabilities

Information on flood hazard areas was taken from two sources. The first was the National Flood Insurance Rate Maps for Plymouth County. The FIRM flood zones are shown on Map 3 in Appendix A and are defined below. The Flood Insurance Rate Maps used are the current approved maps from FEMA dated July 7,2021a which are the current regulatory maps in force.

Flood Insurance Rate Map Zone Definitions

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

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

Zones X500 (0.2% annual chance) **-** Zone X500 is the flood insurance rate zone that correspond to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone.

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.

Locally Identified Areas of Flooding

The second source of flooding information was the Hanover HMP/MVP Core Team. The Locally Identified Areas of Flooding below were identified by Town staff as areas where flooding is known to occur. All of these areas do not necessarily coincide with the flood zones from the FIRM maps. Some may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers of the sites listed below correspond to the sites mapped on Map 8," Locally Identified Hazard Areas" in Appendix A.

The following areas were identified by the Town in the previous 2016 plan:

1. **Pleasant and Circuit Streets** – These two streets can go underwater. During storm events, the water flows rapidly and backs up at the culvert. Some of the homes in Brooks Circle are impacted, as are businesses. The homes in this area are on slabs so there is no basement flooding. The area does have groundwater issues. This area was heavily impacted during the storm of March 2010. The flooding here is also due to the overflow of the river. The brook has grown in with vegetation, reducing its flow capacity. Flooding has resulted in a few failed septic systems. Although the culvert is undersized, the DPW does not believe that enlarging the culvert is needed.

2. **King Street Bridge** – The King Street Bridge is a bottleneck. Flooding here is related to the brook. This area is impacted by water draining from Rockland. There is a dam right after the bridge. Forge Pond rises quickly, and the roadway can flood with 12-14 inches of water. Businesses on Industrial Way are impacted. The town has considered widening the channel, but this would just push the problem further downstream. Forge Pond Dam needs to have work done and the town has completed a Phase I assessment.

3. **CVS Plaza** – The CVS and the stores behind it are impacted. The other businesses are at a lower elevation than the CVS. The issue is caused by street drainage when there is an intense storm (i.e., 4 inches of rain in an hour). However, this area is on a state highway and therefore it is unlikely to change. There is a day care center in the strip mall which floods.

4. **King Street** - King Street is subject to flooding which can cause access problems for residents. Depending on the severity of the storm, the road can be closed for 2-3 days. This has occurred approximately 4 times in the last 20 years.

For this 2023 updated plan, the Town added the following additional areas of local flood hazard:

5. **Intersection with Rockland St and private Shows access Road**--Manmade drainage from Shaw's is going downhill and is coming out at overflow at that intersection. Drainage that goes underneath that intersection dumps out south of Rockland St. The existing drainage can't handle runoff from development completed over the last 50 years. Access Rd. under Shaw's is a downhill slope and Rt. 139 is also a downhill slope. It's a low point.

6. **Bridge at low end of Washington St. over the North River**—The bridge floods out, it's a low point. Catch basin is likely blocked during major storms, causing access issues. The bridge itself isn't the issue; basins north of the bridge on the shoreline side are the issue. River Road is a chokepoint, there is a 20–25-foot sharp drop from the road down to river.

7. **Candlewood Brook--** Small culverts run through there. There's a series of drainage ditches that drain that neighborhood. The whole neighborhood needs to be look at. Most drainage ditches drain the road and push water down towards Pine Tree Dr. Candlewood neighborhood was built in the 1960's. What they did then for drainage is very different than what we do now.

8. **Ponderosa Drive** -Neighborhood in the northwest corner of Town, near the Rockland line. The drainage system dumps out into a swamp on the north side of Ponderosa Drive. A couple streams flow from the swamp, and there's a drainage system. About every 10 years, the Town has to deal with flooding problems. It was probably never designed right.

9. **Drainage issue near post office,** --In a major rainstorm, 2-3", the catchment clogs on the road along the west side of the post office parking lot. It's all manmade drainage. It drains into Shaw's parking area.

Repetitive Loss Structures

As defined by the National Flood Insurance Program (NFIP), a repetitive loss property is any property which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978. For more information on repetitive losses see http://www.fema.gov/business/nfip/replps.shtm. There are no repetitive loss structures in the Town of Hanover.

Based on the record of previous occurrences flooding events in Hanover are a High frequency event. This hazard may occur more frequently than once in five years, or a greater than 20% chance per year.

Flooding and Climate Change

Data from the 2022 MA Climate Change Assessment related to changes in precipitation patterns is included in an earlier section of this chapter. Those projections suggest that future rain events will be increasingly intense and lengthy, which could lead to increased inland and stormwater flooding.

Precipitation frequency estimates, which are used to derive stormwater design standards, were published in 1961 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. Communities should consider future rainfall rates when designing infrastructure.

For example, communities could consider using NOAA Atlas 14 rainfall rates with an additional allowance to account for projected rainfall during the life of projects permitted today when sizing stormwater infrastructure. DEP takes a similar approach to describe current (not future) rainfall rates, called "NOAA14+". Mystic River Watershed Association (MyRWA) communities propose "NOAA14++", which they say reflects 2070 projections. The NOAA 14+ number is calculated by multiplying the NOAA 14 precipitation frequency estimate upper confidence interval by 0.9 (i.e., current but extreme precipitation events reflect 90% of upper confidence intervals). The NOAA 14++ number is the upper confidence interval. A comparison of these numbers is summarized in Table 13 (NOAA, 2023).

Table 13: Rainfall rates for the 10-year 24-hour storm

NOAA 14	NOAA 14+	NOAA 14++
5.27 inches	5.90 **inches**	6.56 **inches**

DAM HAZARDS

Dam failure can occur as a result of structural failure, independent of a hazard event, or as the result of a hazard event such as flooding associated with storms or an earthquake. In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the area in the path of the dam's floodwaters. Dam failure in general is very infrequent but, in some cases, can have the potential for severe impacts. That said, Hanover has not experienced dam failure or the impacts from a dam failure.

The increasing intensity of precipitation is the primary climate concern related to dams, as they were designed based on historic weather patterns. The 2018 SHMCAP indicates that changing precipitation patterns may increase the likelihood of overflow events.

According to data provided by the Massachusetts Department of Conservation and Recreation (DCR), there are 4 dams located in Hanover. These are summarized in Table 14. The Town of Hanover owns three of the Dams: Forge Pond Dam, Hackett Pond Dam, and Tack Factory Dam. One other dam, Curtiss Crossing Dam, is owned by the neighboring Town of Pembroke.

Table 14: DCR Inventory of Dams in Hanover

DAM NAME	RIVER	IMPPOUNDMENT	OWNER	HAZARD
Curtis Crossing Dam	Indian Head R.	Indian Head R	Town of Pembroke	Low
Forge Pond Dam	Drinkwater R.	Forge Pond	Town of Hanover	Low
Hackett Pond Dam	Longwater Bk.	Hackett Pond	Town of Hanover	Significant
Factory Pond Dam	Indian Head R.	Tack Factory Pond	Town of Hanover	N/A

Source: MA DCR, Office of Dam Safety, 2018

DCR classifies dams according to their potential hazard. It's important to note that this is based on the potential damage that could be caused by a breach of the dam due to its location and downstream areas that could be impacted, not on the condition of the dam or its likelihood of failing. The DCR defines hazard potential levels as follows:

> ***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) or cause interruption of use or service of relatively important facilities.
>
> ***Low*:** Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

None of the dams in Hanover are High Hazard dams. The Hackett Pond Dam is considered a Significant Hazard Dam and Tack Factory Dam is not rated.

Dams in Hanover are described below (numbers refer to location on map in Appendix A):

Curtis Crossing Dam - Curtis Crossing is an earth embankment and concrete/stone masonry structure that impounds the Indian Head River and Indian Head Reservoir (see Figures 11 and 12). The structure is classified as an intermediate dam with a low hazard potential. In 2017 a Phase I Inspection and Evaluation Report was prepared for the Curtiss Crossing Dam, but there is no Emergency Action Plan because the dam is classified as having a low hazard potential.

A reconnaissance level plan was completed in 2022 for dam removal. A grant from the Natural Resources Damages Trust was provided to North and South Rivers Watershed Association to work with Pembroke and Hanover to look at whether they want to remove the dam. There was an initial feasibility study for this dam and a small upstream dam, Cross Street Dam. The Town has developed plans and specifications for dam repairs, and a financial commitment was made by the Town of Pembroke.

The Forge Pond Dam – The Forge Pond Dam is slated for repairs. The Town completed a Phase 1 Assessment of the Dam before the previous 2016 Hazard Mitigation Plan, which found issues such as trees growing out of the earthen dam, which weakens the structure. The Town has authorized its engineers to begin the process for repairs but work on the dam has not yet begun.

Hackett's Pond Dam – This dam was rehabilitated using town funds. Since the previous HMP the Town prepared an Emergency Action Plan for this dam in 2019, which was updated in May 2023 (see below).

Factory Pond Dam – In 2013 the Department of Conservation and Recreation ordered the town to repair or remove this dam due to significant structural defects including cracks in the concrete spillway walls, erosion, seepage, and vegetation. Since then, the dam has

been repaired. Since the previous HMP the Town prepared an Emergency Action Plan for this dam in 2019, which was updated in May 2023 (see below).

Figure 11: Curtiss Crossing Dam, Crest from right abutment

Source: Curtiss Crossing Dam Phase I Inspection Evaluation Report

Figure 12: Curtiss Crossing Dam, primary spillway weir (right)

Source: Curtiss Crossing Dam Phase I Inspection Evaluation Report

Dam Emergency Action Plans

The Town of Hanover has completed Emergency Action Plans (EAP) for the Factory Pond Dam and Hackett's Pond Dam. A summary of key findings of the Emergency Action Plans for these dams follows.

Factory Pond Dam EAP

A computer model was utilized to develop the inundation mapping included in this document. Two analyses were modeled, a breach at normal pond level and a breach at maximum pond level (pond level at top of embankments). At normal pond level the pond is reported to impound approximately 200 acre-feet of water and at maximum pond level the impoundment is about 360 acre-feet. A full dam breach was modeled for each scenario.

The inundation area consists of the Indian Head River, North River, and adjacent low-lying areas. The Indian Head River flows from Factory Pond Dam approximately 3.67 miles to its confluence with the North River and the North River then flows another 9.6 miles to the Atlantic Ocean. The North River is tidal with an extensive salt marsh estuary so flooding of the North River from failure of Factory Pond Dam is not a concern as the inundation mapping shows the extents of the flooding to mostly be contained within the channel of the river.

The inundation mapping (Figure 13) indicates that there are some low-lying developed properties along the Indian Head River that may be flooded by a failure of Factory Pond Dam. The majority of the inundation area adjacent to the Indian Head River is comprised of undeveloped wetlands. There are three bridges that carry public roads across the Indian Head River downstream of Factory Pond Dam and another five along the North River. The three public roads with bridges along the Indian Head River that may be impacted are:

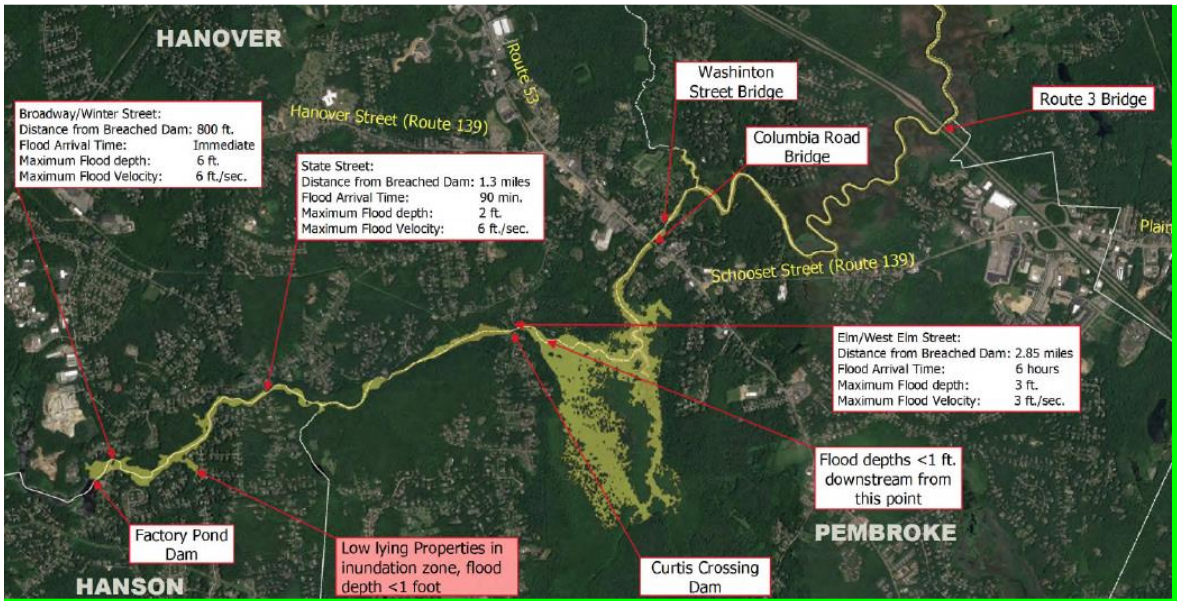
- **Broadway/Winter Street on the Hanover/Hanson Town Line:** flood waters would be expected to arrive at this location almost immediately after the breach at depths of 3 to 6 feet and velocities of up to 10 feet per second.

- **State Street on the Hanover/Hanson Town Line**: flood waters would be expected to arrive at this location within 60 to 90 minutes of the breach at depths of 2 to 3 feet and velocities of up to 6 feet per second.

- **Elm Street/Elm Street on the Hanover/Pembroke Town Line**: flood waters would be expected to arrive at this location within 3-6 hours of the breach at depths of 3 to 6 feet and velocities of up to 6 feet per second.

The inundation mapping also shows that a portion of Adams Circle in Hanson could be flooded during a breach of Factory Pond Dam. Flood waters would be expected to arrive at Adams Circle within 3 hours of the breach at depths of up to a foot and velocities of up to 1 foot per second.

Figure 13: Map of Potential Inundation Areas for Factory Pond at Full Pool



Source: Hackett's Pond Dam EAP

Hackett's Pond Dam EAP

A computer model was utilized to develop the inundation mapping for Hackett's Pond Dam (Figure 14). The information in this section related to roadways and properties at risk is for a worst-case scenario with the dam breaching at maximum pond level. The inundation area consists of Longwater Brook, Drinkwater River and adjacent low-lying areas. Longwater Brook flows from Hackett's Pond Dam approximately 0.9 miles to its confluence with the Drinkwater River, which then flows another 0.3 miles to its intersection with Cedar Street, the southernmost extent of the inundated area. There are two public roads within the inundated area, Cedar Street and Bates Way. The inundation area adjacent to the Longwater Brook and Drinkwater River is comprised of undeveloped wetlands. All nearby structures are elevated well above the wetlands and are not at risk of flooding. The impact of the flood waters on the public roads is as follows:

- Bates Way: flood waters would be expected to arrive at this location within 15 minutes after the breach at depths of up to 3 feet and velocities of up to 10 feet per second.

- Cedar Street: flood waters would be expected to arrive at this location within 2-3 hours after the breach at depths of up to 3 feet and velocities of up to 1 foot per second. Bates Way and Cedar Street may need to be closed during an emergency situation at Hackett's Pond Dam.

Probability of dam hazard occurrence

The probability of future dam failure events is classified in the Massachusetts State Hazard Mitigation Plan 2013 as very low frequency, or an event that occurs less frequently than once in 100 years (less than 1% per year).

Figure 14: Map of Potential Inundation Areas for Forge Pond at Full Pool

Source: Hackett's Pond Dam EAP

SEA LEVEL RISE

COASTAL FLOODING

Coastal flooding is most often associated with severe coastal storms that, through the combination of winds and tides, drive tidal waters to higher levels than normally experienced, leading to the inundation of low-lying land areas and the overtopping of sea walls. In low-lying areas coastal flooding can also be associated with routine tidal flooding or higher astronomic tides. Fueled by the warming climate, coastal flooding will become more frequent and severe due to the combination of sea level rise and more frequent and intense storms.

Hanover is about five miles inland, not located directly on the coast. However, the North River is tidal for the portion along southeastern section of the town. Future projected sea level rise and storm surge scenarios could have impacts that extend up the North River, which may be exacerbated by heavy rains (see Map 10 in Appendix A).

The best available local data about previous coastal flooding occurrences is for Plymouth County through the National Climatic Data Center. Eastern Plymouth County, which includes the Town of Hanover, experienced 40 coastal flood events from 2010 through 2019 (see Table 15). No deaths and two injuries were reported and the total reported property damage in the county was $15.03 million dollars. Nearly two-thirds of the property damage occurred during the winter of 2013.

Table 15: Eastern Plymouth County Coastal Floods, 2009-2019

DATE	DEATHS	INJURIES	PROPERTY DAMAGE
10/18/2009	0	0	0
1/2/2010	0	0	0
2/25/2010	0	0	0
3/4/2010	0	0	0
3/15/2010	0	0	0
10/6/2010	0	0	0
11/8/2010	0	0	1.000
12/27/2010	0	0	2.200.000
10/30/2011	0	0	10,000
11/23/2011	0	0	0
6/3/2012	0	1	35,000
6/4/2012	0	0	0
6/4/2012	0	0	40,000
10/29/2012	0	0	645,000
10/29/2012	0	0	322,000
12/27/2012	0	0	0
12/27/2012	0	0	0
2/9/2013	0	0	9,200,000

3/7/2013	0	0	500,000
12/15/2013	0	0	0
1/2/2014	0	0	0
1/2/2014	0	0	0
1/3/2014	0	0	0
3/26/2014	0	0	0
10/22/2014	0	0	75,000
10/23/2014	0	0	0
11/2/2014	0	0	0
1/27/2015	0	1	1,500,000
2/15/2015	0	0	0
10/2/2015	0	0	0
1/23/2016	0	0	0
1/24/2016	0	0	3,000
2/8/2016	0	0	0
1/4/2018	0	0	500,000
1/30/2018	0	0	0
3/2/2018	0	0	0
3/8/2018	0	0	0
10/27/2018	0	0	0
11/25/2018	0	0	0
1/20/2019	0	0	0
	0	**2**	**15.03M**

Source: NOAA, National Environmental Information Center

DROUGHT HAZARDS

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.

In Massachusetts, droughts are caused by the prevalence of dry northern continental air and a decrease in coastal- and tropical-cyclone activity. During the 1960's, a cool drought occurred because dry air from the north caused lower temperatures in the spring and summer of 1962-65. The northerly winds drove frontal systems to sea along the Southeast Coast and prevented the Northeastern States from receiving moisture (U.S. Geological Survey). This is considered the drought of record in Massachusetts.

Average annual precipitation in Massachusetts is 44 inches per year, with approximately 3-to-4-inch average amounts for each month of the year. Regional monthly precipitation ranges from zero to 17 inches. Statewide annual precipitation ranges from 30 to 61 inches. Thus, in the driest calendar year (1965), the statewide precipitation total of 30 inches was 68 percent of average.

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 DCR precipitation index divides the state into seven regions: Western, Central, Connecticut River Valley, Northeast, Southeast, Cape Cod, and Islands. Hanover is located in the Southeast Region. In Hanover drought is a potential town-wide hazard.

The Massachusetts Drought Management Plan was revised in 2019 to change the state's classification of droughts by establishing four levels to characterize drought severity beyond normal conditions:

- Level 0-Normal Conditions (no drought)
- Level 1-Mild Drought (formerly Advisory)
- Level 2-Significant Drought (formerly Watch)
- Level 3-Critical Drought (formerly Warning)
- Level 4-Emergency Drought (formerly Emergency)

As shown in Table 16, another measure of drought is the U.S. Drought Monitor, which characterizes droughts as abnormally dry, moderate, severe, extreme, and exceptional. Extreme drought is characterized by likely crop and pasture losses, water shortages, and water restrictions. The Massachusetts drought levels are shown in comparison to the U.S. Drought Monitor levels in Table 16. The two sets of drought indices are similar, but Massachusetts combines the USDM's level D2 and D3 into one category, Critical Droughts.

Table 16: US Drought Monitor Compared to MA Statewide Drought Levels

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

These levels are based on the conditions of natural resources and provide information on the current status of water resources. As dry conditions can have a range of different impacts, a number of drought indices are available to assess these 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 seven indices:

1. The Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. Crop Moisture Index: (CMI) reflects soil moisture conditions for agriculture.
3. Keetch Byram Drought Index (KBDI) is designed for fire potential assessment.
4. The Precipitation Index is a comparison of measured precipitation amounts to historic normal precipitation.
5. The Groundwater Level Index is based on the number of consecutive month's groundwater levels are below normal (lowest 25% of period of record).
6. The Stream flow Index is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record).
7. The Reservoir Index is based on the water levels of small, medium, and large index reservoirs across the state, relative to normal conditions for each month.

Table 17 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.

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

Table 17: 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: Massachusetts Drought Management Plan, 2019

The drought levels provide a framework from which to take actions to assess, communicate, and respond to drought conditions. Drought levels are used to coordinate both state agency and local response to drought situations. Water restrictions might be appropriate at the significant drought stage, depending on the capacity of each

individual water supply system. A critical drought level indicates a severe situation and the possibility that a drought emergency may be necessary. A drought emergency is one in which mandatory water restrictions or use of emergency supplies is necessary.

Previous Occurrences

Because drought tends to be a regional natural hazard, the best available date on previous drought occurrences is state-wide data, summarized in this section.

The Executive Office of Energy and Environment's Drought Management Task Force also provides information on historic drought status for Massachusetts. That information is summarized in Table 18.

Table18: Drought Status History, 2001-2022

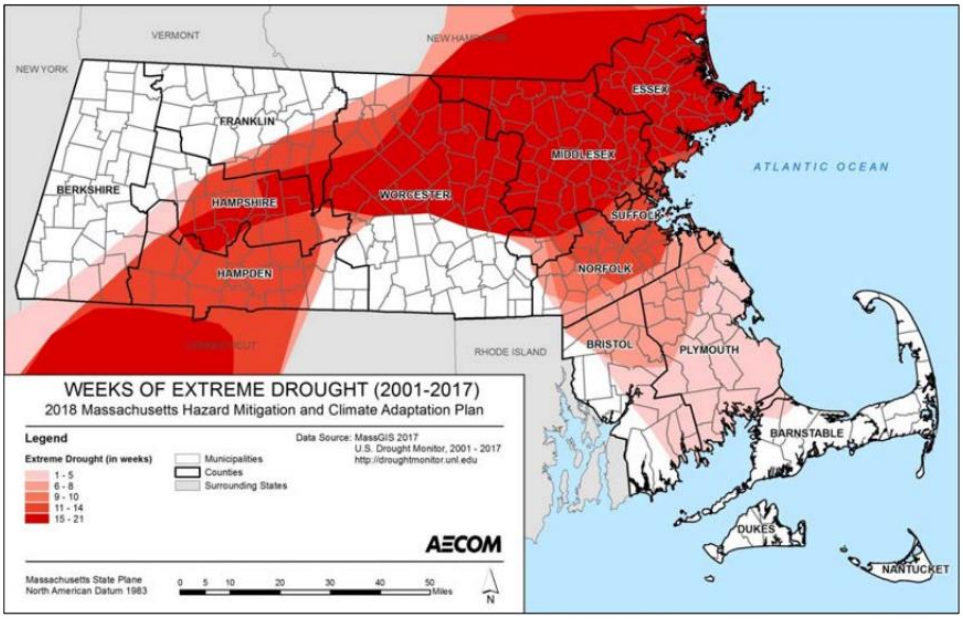
Mild Drought/Advisory	2001, 2002, 2007, 2014, 2016, 2017, 2020, 2021, 2022
Significant Drought/Watch	2002, 2016, 2017, 2020, 2021, 2022
Critical Drought/Warning	2016, 2017, 2020, 2022
Emergency Drought/Emergency	None

Source: Massachusetts Drought Management Task Force, 2023

A summary of Massachusetts long term historic drought events from 1879 to 2019 is shown in Table 19 below. This table was prepared for the 2019 Massachusetts Drought Management Plan, so it does not include the more recent droughts of 2020 (Level 3) and 2021(Level 2).

As shown in Figure 15, Hanover experienced between 6 and 8 weeks of extreme drought between 2001 and 2017.

Figure 15: Weeks of Extreme Drought (2001-2017)



Source: SHMCAP 2018

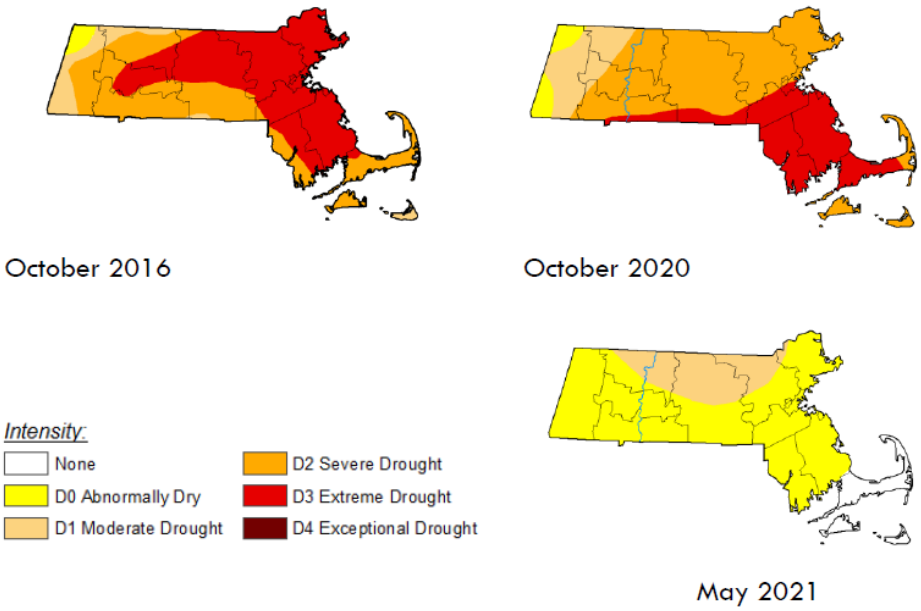
Table 19 - Chronology of major droughts in Massachusetts since 1879

Date	Area affected	Recurrence interval (years)	Remarks	Reference
1879-83	–	–	Kinnison 1931 referenced these periods as two of three worst droughts on record in 1931, the third being the then current drought of 1929-1932.	Kinnison 1931
1908-12	–	–		
1929-32	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.	USGS 1989
1939-44	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.	USGS 1989
1957-59	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.	USGS 1989
1961-69	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.	USGS 1989
1980-83	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.	USGS 1989
1985-88	Housatonic River Basin	25	Duration and severity as yet unknown. Streamflow showed mixed trends elsewhere.	USGS 1989
1995	–	–	Based on statewide average precipitation	DMP 2013
1998-1999	–	–	Based on statewide average precipitation	DMP 2013
Dec 2001 - Jan 2003	Statewide	–	Level 2 drought (out of 4 levels) was reached statewide for several months	DCR 2017
Oct 2007 - Mar 2008	Statewide except West and Cape & Islands regions	-	Level 1 drought (out of 4 levels)	DCR 2017
Aug 2010 - Nov 2010	Connecticut River Valley, Central and Northeast regions	–	Level 1 drought (out of 4 levels)	DCR 2017
Oct 2014 - Nov 2014	Southeast and Cape & Islands regions	–	Level 1 drought (out of 4 levels)	DCR 2017
Jul 2016 - Apr 2017	Statewide	–	Level 3 drought (out of 4 levels)	DCR 2017

Source: Massachusetts Drought Management Plan, 2019

In just the last seven 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 16). This was followed by another drought four years later in 2020, which was the most severe in Southeastern Massachusetts. 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 16: Recent Massachusetts Drought Events (2016-2021)



Source: US Drought Monitor, 2016-2021

Potential Drought Vulnerability

The most significant potential impact of drought on any community is on the public water supply. The town of Hanover depends on wells that withdraw from local aquifers for its water supply, and prolonged drought could lower water tables and reduce the amount of water available from pumping wells. This in turn can also reduce flow in local streams, ponds, and wetlands, impacting fisheries and other aquatic ecosystems.

Should there be a prolonged, severe drought, the most widespread consequence would likely be curtailment or elimination of non-essential outdoor water use, such as watering lawns, and landscaped areas. Potential financial damages could include the loss of landscaped properties such as parks and playing fields. Similar losses could be incurred by private property owners with landscaped areas that rely on irrigation.

However, there are other potential impacts of drought beyond limits on public water supply. Droughts stress vegetation, and a severe or prolonged drought can significantly increase the risk of brushfires and forest fires, which in some cases could threaten nearby structures or infrastructure. Under these circumstances, if there is also reduced water supply capacity, that could hinder the ability to respond to and control fires.

An extremely severe drought could have economic impacts if essential water uses for businesses, industry, and residences had to be greatly restricted. However, there is no precedent for a drought of this severity in Massachusetts.

Probability of Future Occurrence

The SHMCAP, using data collected since 1850, calculates that statewide there is a 1% chance of being in a drought emergency in any given month. For drought warning and

watch levels, the chance is 2% and 8% respectively in any given month. See Table 20 for more information.

Table 20: Frequency of Massachusetts Drought Levels

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

Source: 2018 SHMCAP

Droughts And Climate Change

Droughts are projected to increase in frequency and intensity in the summer and fall as weather patterns change. Factors contributing to this include increasing evaporation as a result of warmer weather, earlier snow melt, and more extreme weather patterns. Information from the 2022 Massachusetts Climate Change Assessment related to drought is included in the "Climate Change Observations and Projections" section of this report. Additionally, the 2022 Assessment highlights the following drought-related impacts:

- Freshwater ecosystem degradation due to drought and other impacts
- Increased contaminant concentrations in freshwater during drought conditions
- Loss of tree cover due to drought and other impacts.

LANDSLIDE HAZARDS

According to the USGS, "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; earthquakes create stresses that make weak slopes fail; and excess weight from accumulation of rain or snow, and stockpiling of rock or ore, from waste piles, or from man-made structures.

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. The lack of vegetation and root structure that stabilizes soil can destabilize hilly terrain.

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 soil underlain by till or bedrock.

There is no universally accepted measure of landslide extent, but it has been represented as a measure of destructiveness. Table 21 summarizes the estimated intensity for a range of landslides. For a given landslide volume, fast moving rock falls have the highest intensity while slow moving landslides have the lowest intensity.

Table 21 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

The SHMCAP utilized data from the MA Department of Transportation from 1986 to 2006 to estimate that, on average, roughly one to three known landslides have occurred each year in the state. 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.

The entire Town of Hanover is classified as having a low risk for landslides (Map 4, Appendix A). Although potentially a town-wide hazard, there are no documented previous occurrences of landslides in Hanover. Should a landslide occur in the future in Hanover, the type and degree of impacts would be highly localized. The town's vulnerabilities could include damage to structures, damage to transportation and other infrastructure, and localized road closures. Because the impacts would be so localized, there are no existing estimates for potential financial damages from landslides in Hanover; damages could vary widely depending on what if any development or infrastructure was affected. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Hanover.
Based on past occurrences, landslides are of Low frequency, events that can occur once in 50 to 100 years (a 1% to 2% chance of occurring per year).

Climate Change and Landslides

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.

CLIMATE TRENDS: RISING TEMPERATURES

EXTREME TEMPERATURE HAZARDS

AVERAGE AND EXTREME TEMPERATURES

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

Hanover has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those which are far outside of the normal seasonal ranges for Massachusetts. The average temperatures for Massachusetts are winter (Dec-Feb) Average = 31.8°F and summer (Jun-Aug) Average = 71°F. Extreme temperatures are a town-wide hazard.

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 NWS. These advisories are issued when the heat index (Figure 17) is forecast to exceed 100-degree Fahrenheit (F) for 2 or more hours; an excessive heat advisory is issued if forecast predicts the temperature to rise above105 degree F.

Figure 17: 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 data on past occurrences of extreme heat events is from NOAA's National Centers for Environmental Information (NCEI) for Plymouth County, which includes Hanover. The NCEI records indicate that in the last decade, there have been two excessive heat events recorded, with one reported death, no injuries, and no property damage (see Table 22).

Table 22: Plymouth County Extreme Heat Occurrences 2010-2022

Date	Deaths	Injuries	Damage
7/6/2010	0	0	0
7/5/2013	1	0	0
TOTAL	**1**	**0**	**0**

Source: NOAA, National Centers for Environmental Information

Extreme heat poses a potentially greater risk to the elderly, children, and people with certain medical conditions. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. 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 Hanover, approximately 15% of the population is over age 65. People who live in older housing stock and in housing without air conditioning have increased vulnerability to heat-related illnesses. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage.

Due to what is termed the "heat island effect," Areas with less shade and darker 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 Hanover 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. Hanover has significant tree cover (33%) and there is only one relatively significant 'hot spot" area located in a commercial area at the junction of Route 3 and Route 53"

Hot summer days can worsen air pollution. With increased extreme heat, urban areas are likely to experience more days that fail to meet air quality standards. People with pre-existing respiratory conditions such as asthma are most vulnerable to this impact.

Extreme Heat and Climate Change

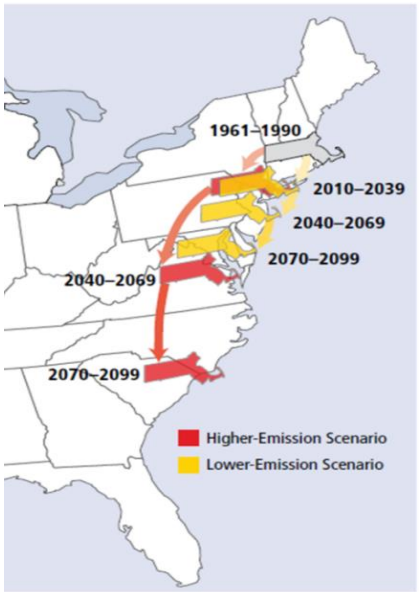
As the global climate continues to warm, extreme cold events are predicted to decrease in the future, while extreme heat days, as well as average temperatures are projected to increase. The projected increase in extreme heat and heat waves is the source of one of the key health concerns related to climate change. The 2022 MA Climate Change Assessment includes projections of climate-driven future increases in average temperature and in the number of extreme heat days. The assessment also highlights the following climate impacts related to temperatures:

- Warmer temperatures and more frequent heat waves are connected to impaired human health, increased droughts, reduced agriculture yields, species range shifts, and damaged infrastructure.
- By 2030, the summer mean temperature could increase by 3.6°F from the historical period (1950-2013), worsening stress on electric transmission and utility distribution infrastructure.
- By 2070, there could be 58 fewer days below freezing, increasing the chance of ticks overwintering and reducing winter recreation opportunities.
- Increase in vector borne diseases and bacterial infections, including West Nile Virus and Lyme disease due to more favorable conditions for ticks and mosquitoes.
- Damage to electric transmission and utility distribution infrastructure is associated with heat stress.
- Damage to rails and loss of rail/ transit service, including flooding and track buckling during high heat events.
- Reduced ability to work, particularly for outdoor workers during extreme heat, as well as commute delays due to damaged infrastructure.
- Freshwater ecosystem degradation due to warming waters.
- Forest health degradation from warming temperatures and increasing pest occurrence.

The 2018 SHMCAP identifies ecosystems that are expected to be particularly vulnerable to warming temperatures. These include cold-water fisheries, vernal pools, spruce-fir forests, northern hardwood forests (Maple, Beach, Birch), Hemlock forests, and urban forests (due to heat island impacts). Other Impacts on natural resources include a longer growing season and northern migration of plants and animals, including invasive species.

Over time our climate will become more similar to areas well to the south of New England (Figure 18).

Figure 18: Temperature Scenarios

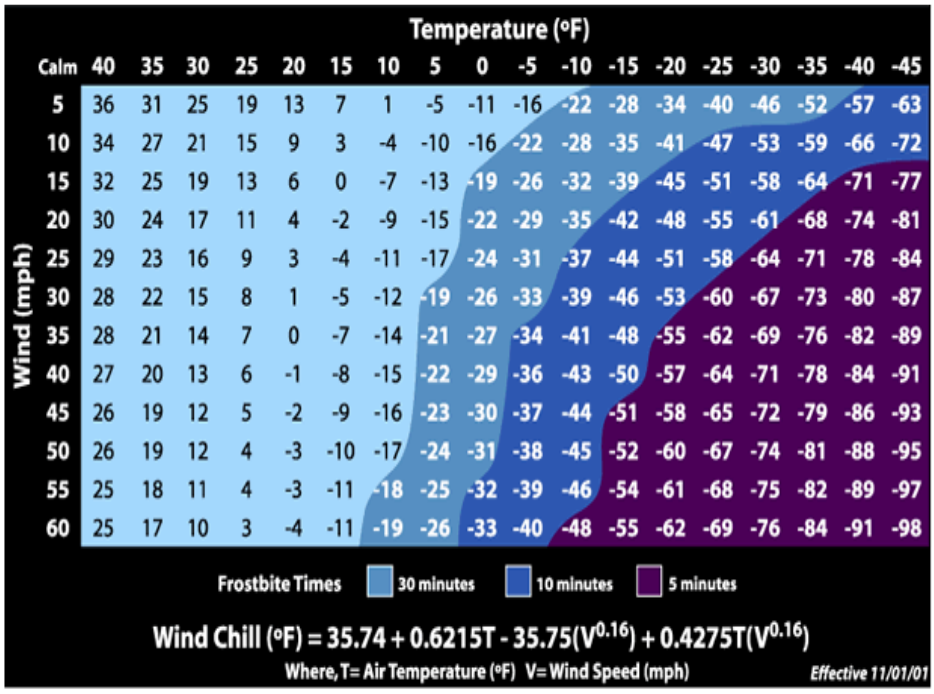


Source: Union of Concerned Scientists

EXTREME COLD

Extreme cold is relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. The severity of extreme cold temperatures is typically measured using the Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed. The index is provided in Figure 19. A Wind Chill warning is issued when the Wind Chill Index is forecast to fall below -25 degrees F for at least 3 hours.

Figure 19: Wind Chill Temperature Index and Frostbite Risk



Source: National Weather Service

The best available data on past occurrences of extreme cold events are from NOAA's National Centers for Environmental Information (NCEI) for Plymouth County, which includes Hanover. There were three extreme cold events recorded by NCEI in the past ten years, which caused no deaths, no injuries, or property damage (Table 23).

Table 23: Plymouth County Extreme Cold and Wind Chill Occurrences

Date	Deaths	Injuries	Damages
2/15/2015	0	0	0
2/16/2015	0	0	0
2/14/2016	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 or who are stranded or who live in homes that are poorly insulated or without heat. The greatest vulnerability to the town would be a power outage during a winter storm, which could temporarily leave many residents without heat. In Hanover, 12.1% of residents are 65 years old and over, and 4.8% are living in poverty (US Census Bureau, 2021).

Extreme temperatures are a community-wide hazard in Hanover. Extreme temperature events are projected to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan. Both extreme cold and hot weather events occur between once in five years to once in 50 years, or a 2 percent to 20 percent chance of occurring each year.

WILDFIRE HAZARDS

A wildfire is a non-structure fire occurring in a forested, shrub, or grassland area. In the Boston Metro region these fires rarely grow to the size of a wildfire as seen more typically in the western U.S. As their name implies, these fires typically burn no more than the underbrush of a forested area. There are three different classes of wildfires:

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

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.

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.

The National Wildfire Coordinating Group (NWCG) classifies the severity of wildfires based on their acreage as follows:

- Class A - one-fourth acre or less.
- Class B - more than one-fourth acre, but less than 10 acres.
- Class C - 10 acres or more, but less than 100 acres.
- Class D - 100 acres or more, but less than 300 acres.
- Class E - 300 acres or more, but less than 1,000 acres.
- Class F - 1,000 acres or more, but less than 5,000 acres.
- Class G - 5,000 acres or more (NWCG, 2023).

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. Fires can present a hazard where there is the potential to spread into developed or inhabited areas, particularly

residential areas where sufficient fuel materials might exist to allow the fire to spread into homes. Protecting structures from fire poses special problems and can stretch firefighting resources to the limit. The most common cause of wildfires is the careless disposal of smoking materials and untended campfires.

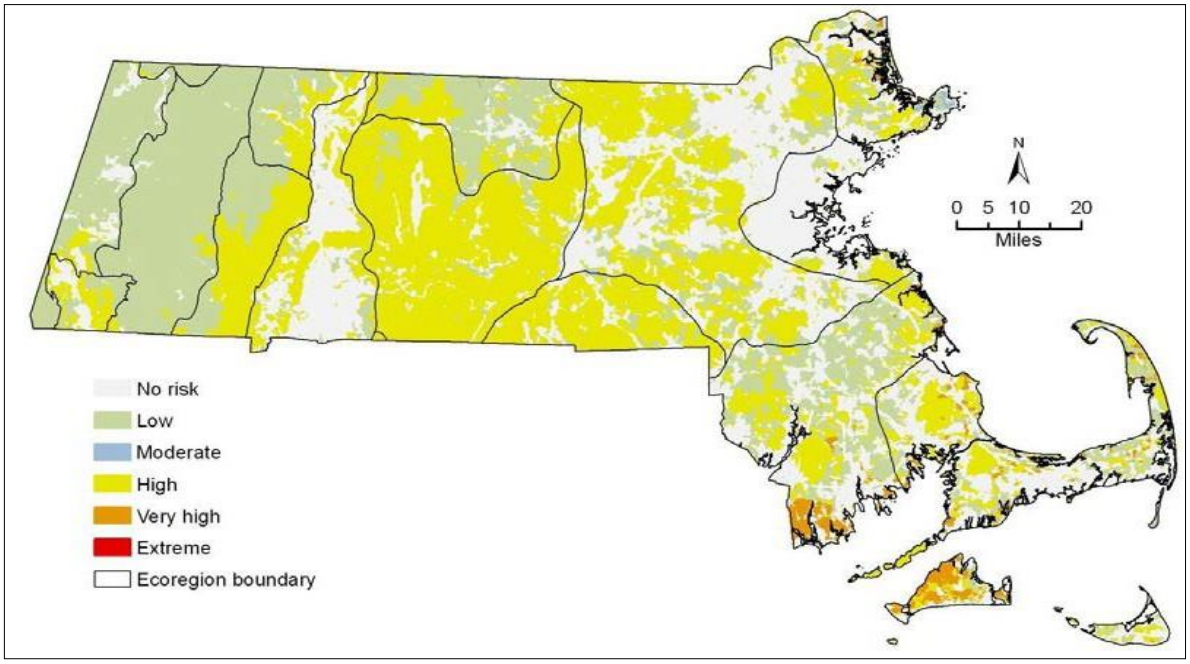
If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If the wildfire destroys the ground cover, then erosion becomes one of several potential problems.

Potential Wildfire Hazard Areas

The 2018 SHMCAP includes a map that depicts statewide fire risk incorporating three risk components: fuel, wildland-urban interface, and topography (Figure 20). The wildland-urban interface reflects communities where housing and vegetation intermingle, and fire can spread from structures to vegetated areas. Hanover is in the high-risk zone.

Because the entire town of Hanover is classified as urban/wildlands interface, any wooded area presents the possibility of a rapidly developing fire. **Wild**fires 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 to spread to homes. About a third of the town is forested, and the Fire Chief identified 13 areas that that are potential wildfire areas. These are delineated on Map 8 in Appendix A. The Fire Chief has also identified larger tracts of wooded land in Rockland where fires could start and spread into Hanover. Protecting structures from fire poses special problems and can stretch firefighting resources to the limit. The town relies heavily on mutual aid to fight these fires.

Figure 20: Wildfire Risk Areas in Massachusetts



Source: 2018 SHMCAP

The town's potential vulnerabilities to wildfires include damage to nearby structures and other improvements as well as impacts on natural resources such as wildlife habitat. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Should a wildfire occur in Hanover or in other nearby communities, the resulting smoke could have negative impacts on air quality. This could have public health impacts, particularly for sensitive populations including children, the elderly, those with respiratory conditions such as asthma. The Massachusetts Department of Public Health Bureau of Environmental Health states that Hanover has a lower pediatric asthma prevalence in K-8 students, and a lower rate of asthma emergency department visits, than the state average (MA Dept of Public Health, 2022). However, given the low extent of wildfires in the town and the immediate response times to reported fires in Hanover, the likelihood of injuries and casualties is minimal.

Based on past occurrences brushfires are of high frequency, events that occur more frequently than once in five years (Greater than 20% per year).

Wildfire and Climate Change

As the climate warms, drought and warmer temperatures may increase the risk of wildfire as vegetation dries out and becomes more flammable. Increasing drought and increasing damage to trees from pests can also lead to greater fire risk. The 2022 Assessment cites anticipated forest health degradation from increasing wildfire frequency (Commonwealth of Massachusetts, 2022).

CLIMATE TRENDS: EXTREME WEATHER

Extreme weather includes wind-related hazards (such as hurricanes, tropical storms, tornadoes, and thunderstorms) as well as winter weather (such as Nor'easters, blizzards, and ice conditions. Following is a description of the types of natural hazards associated with extreme weather events.

WIND HAZARDS

Wind-related hazards include hurricanes, tropical storms, and tornadoes as well as high winds during Nor'easters and thunderstorms. As with many communities, falling trees that result in downed power lines and power outages are an issue in Hanover. Information on wind related hazards can be found on Map 5 in Appendix A, which indicates that the 100-year wind speed in Hanover is 110 miles per hour.

HURRICANES AND TROPICAL STORMS

A hurricane is a violent wind and rainstorm with wind speeds of 74-200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as the storm hits the land. Given its location approximately 5 miles from the

coast, the town's entire area is vulnerable to hurricanes. Hurricanes occur between June and November. A tropical storm has similar characteristics, but wind speeds are between 34 and 73 miles per hour.

Since 1900, Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. Given its location near the coast, the Town of Hanover's entire area is vulnerable to hurricanes, which occur between June and November. As shown in Map 5 in Appendix A, there have been three storm tracks through Hanover. Category 2 Hurricane Bob tracked through Hanover in 1991, and tropical storms tracked through the town in 1916 and 1923. However, Hanover experiences the impacts of hurricanes and tropical storms regardless of whether the storm track passes directly through the town, and numerous hurricanes have affected the communities of eastern Massachusetts (see Table 24).

Table 24: Hurricane Records for Massachusetts, 1938 - 2012

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. The following gives an overview of the wind speeds, surges, and range of damage caused by different hurricane categories:

Scale No. (Category)	Winds(mph) Storm	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

Hanover is vulnerable to both the wind and rainfall that come with hurricanes. High winds can damage structures, bring down tree limbs and power lines, leading to blackouts and

disruption of the transportation system and obstructions to emergency access. Rainfall associated with hurricanes can cause flooding in the town's rivers and streams, as well as localized drainage related flooding. Potential hurricane damages to Hanover have been estimated using HAZUS-MH. The vulnerability analysis estimates $23.4 million in damages for a 100-year hurricane in Hanover, and $98.9 for a 500-year hurricane. Other impacts, such as debris generation and sheltering needs are also detailed in the analysis (see Table 40).

Based on records of previous occurrences, hurricanes in Hanover 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.

Hurricanes and Climate Change

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.

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 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 Hanover is through NOAA's National Centers for Environmental Information (NCEI). For the years 2010 to 2022, NCEI records show 45 thunderstorm wind events in Plymouth County (Table 25). These storms resulted in an estimate of 461,800 million in property damage. There were two injuries and no death reported.

Table 15: Plymouth County Thunderstorm Events, 2010 through 2022

DATE	DEATHS	INJURIES	PROPERTY DAMAGE
4/22/2010	0	0	25,000
6/20/2010	0	2	50,000
6/27/2010	0	0	500
8/5/2010	0	0	5,000
7/13/2011	0	0	15,000
7/18/2011	0	0	45,000
7/23/2011	0	0	60,000
6/23/2012	0	0	15,000
7/1/2012	0	0	10,000
7/18/2012	0	0	10,000
8/10/2012	0	0	15,000

10/30/2012	0	0	25,000
6/17/2013	0	0	3,000
7/20/2013	0	0	5,000
8/4/2015	0	0	5,000
2/25/2016	0	0	10,000
7/17/2016	0	0	5,000
7/18/2016	0	0	3,000
7/22/2016	0	0	5,000
7/23/2016	0	0	5,000
9/11/2016	0	0	1,000
6/13/2017	0	0	1,000
7/6/2018	0	0	1,000
7/17/2018	0	0	10,000
4/15/2019	0	0	4,000
6/29/2019	0	0	0
7/17/2019	0	0	1,500
7/31/2019	0	0	0
8/8/2019	0	0	300
8/19/2019	0	0	300
6/6/2020	50	0	0
6/28/2020	50	0	0
7/23/2020	50	0	0
8/22/2020	50	0	0
10/7/2020	56	0	0
6/22/2021	50	0	0
6/30/2021	50	0	0
7/7/2021	50	0	0
7/23/2021	50	0	0
7/27/2021	52	0	0
11/13/2021	50	0	0
7/14/2022	50	0	0
8/9/2022	50	0	0
8/26/2022	50	0	0
TOTAL	**0**	**2**	**461,800**

Source: NOAA National Centers for Environmental Information

Severe thunderstorms are a town-wide hazard for Hanover. The town's vulnerability to severe thunderstorms is like 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 Hanover 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. However, neither the 2018 SHMCAP, nor the 2022 Massachusetts Climate Change Assessment, specifically address whether climate will affect the intensity or frequency of thunderstorms.

TORNADOES

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.

Tornados can form from individual cells within severe thunderstorm squall lines. They can form from an isolated "supercell" thunderstorm. They can be spawned by tropical cyclones or even their remnants that are passing through. Tornados are most common in the summer, June through August, and most form in the afternoon or evening.

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 01, 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 26 below.

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touchdown somewhere in the Northeast region every year. Although there have been no recorded tornadoes within the limits of the Town of Hanover, since 1958, there have been nine tornados in Plymouth County recorded by the NOAA National Environmental Information Center (Table 27). There was one F2 tornado, two F2, and the rest were rated F0. The 1958 tornado caused one fatality and one injury, and a second injury was caused by the 1989 tornado.

The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC). Recent tornado events in Massachusetts resulted in significant damage 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 damage and 13 homes and businesses were rendered uninhabitable. And on August 22, 2016, an F1 tornado passed through part 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.

Table 26: Enhanced Fujita Scale

a

Scale	Wind speed		Relative frequency	Potential damage	
	mph	km/h			
EF0	65–85	105–137	53.5%	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.	
EF1	86–110	138–178	31.6%	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.	
EF2	111–135	179–218	10.7%	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.	
EF3	136–165	219–266	3.4%	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.	
EF4	166–200	267–322	0.7%	Extreme damage to near-total destruction. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.	
EF5	>200	>322	<0.1%	Massive Damage. Strong frame houses leveled off foundations and swept away; steel-reinforced concrete structures critically damaged; high-rise buildings have severe structural deformation. Incredible phenomena will occur.	

Source: SHMCAP 2018

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."

Table 27: Tornado Records for Plymouth County

Date	Fujita Scale	Fatalities	Injuries	Property Damage $
9/7/1958	F0	1	1	2,500
7/4/1964	F1	0	0	250,000
6/9/1965	F0	0	0	30
11/18/1967	F2	0	0	250
9/16/1986	F1	0	0	250,000
7/10/1989	F1	0	1	25,000
7/10/1989	F0	0	0	25,000
8/20/1997	F0	0	0	-
7/24/2012	EF0	0	0	3,000
TOTAL		**1**	**2**	**$ 555,780**

Source: The Tornado History Project

Buildings constructed prior to current building codes may be more vulnerable to damage 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. At this time, the Massachusetts State Building Code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence.

Although tornadoes are a potential town-wide hazard in Hanover, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Hanover would greatly depend on the track of the tornado. Generally, the town center area and the commercial corridor along Route 53 in the eastern portion of the town are more densely developed and would likely be subject to more damage in the event of a tornado.

Based on the record of previous occurrences since 1950, tornado events in Hanover are a low frequency event as there is no record of tornado activity in Hanover. 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. Massachusetts' 2022 Climate Change Assessment does not include information related to tornadoes.

HAIL

Hail events are frequently associated with thunderstorms and other storms. 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 as shown in Table 28.

Table 28: 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

Source: NOAA

Potential damages from larger-size hail could include damage to vehicles, windows, and other structures. The best available data on previous hail events are recorded for Plymouth County through NOAA's National Centers for Environmental Information (NCEI) Storm Events Database. There were 9 hail events recorded from December 2012 through December 2022, as shown in Table 29. There was no property damage, injuries, or deaths reported for any of these hail events.

Table 29: Plymouth County Hail Events, 2010-2022

Date	Magnitude (Hail diameter)	Deaths	Injuries	Property Damage ($)
5/26/2010	0.75	0	0	0
6/1/2011	1	0	0	0
9/15/2011	0.75	0	0	0
7/24/2012	1.75	0	0	0
8/7/2014	1	0	0	0
7/17/2016	0.88	0	0	0
6/13/2017	0.75	0	0	0
6/22/2019	0.75	0	0	0
6/30/2019	1	0	0	0
TOTAL		**0**	**0**	**0**

Source: NOAA, National Centers for Environmental Information

Hail events are a potential town-wide hazard in Hanover. Based on the record of previous occurrences in Plymouth County, hail events are a Medium frequency event. This hazard may occur from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

WINTER HAZARDS

SEVERE WINTER STORM/NOR'EASTER

A northeast storm, known as a nor'easter, is typically a large counterclockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 20 to 40 mph with gusts of up to 60 mph. These storms are accompanied by heavy rain or snow, depending on temperatures. Nor'easters may also sit stationary for several days, affecting multiple tide cycles and extended heavy precipitation.

Previous occurrences of nor'easters include the storm events included in Table 30. 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 snowfall amounts.

Table 30: Nor'easter Events for Massachusetts, 1978 - 2021

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

Hanover is vulnerable to both the wind and precipitation that accompanies nor'easters. High winds can cause damage to structures, fallen trees, and downed power lines leading to power outages. Intense rainfall can overwhelm drainage systems causing localized

flooding of rivers and streams as well as urban stormwater ponding and localized flooding. Fallen tree limbs as well as heavy snow accumulation and intense rainfall can impede local transportation corridors, and block access for emergency vehicles.

Although not a coastal community subject to wave action (e.g., there are no V Zones), the North River in the southeast part of town is a tidal river that can be affected by coastal flooding where wind and tide leads to flooding along tidal waterways.

The entire Town of Hanover could be at risk from the wind, rain, or snow impacts from a Nor'easter, depending on the track and radius of the storm.

Based on the record of previous occurrences, Nor'easters in Hanover are high frequency events. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

BLIZZARDS & HEAVY SNOW

Winter weather impacts 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 (NOAA, 2009). Blizzards and winter storms are often associated with a nor'easter event (see nor'easters section 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 conditions 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 Regional Snowfall Index (RSI) characterizes and ranks the severity of northeast snowstorms. RSI has five categories: Extreme, Crippling, Major, Significant, and Notable. RSI scores are a function of the area affected by the storm, the amount of snow, and the number of people living in the path of the storm. The largest RSI values result from storms producing heavy snowfall over large areas that include major metropolitan centers. The RSI categories are shown in Tale 31.

The best available data on previous occurrences and impacts of heavy snow events in Hanover is available for Plymouth County from the National Centers for Environmental Information (NCEI) records. From 2010 to 2022, Plymouth County experienced 27 days with heavy snowfall events, resulting in no injuries, deaths, and property damage of $143,500 (Table 32).

Table 31: Regional Snowfall Index

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

Source: 2018 SHMCAP

Table 32: Heavy Snow Events in Plymouth County, 2010 to 2022

Date	Deaths	Injuries	Property Damage ($)
1/18/2010	0	0	0
2/16/2010	0	0	15,000
12/20/2010	0	0	0
1/26/2011	0	0	0
1/21/2012	0	0	0
2/8/2013	0	0	0
3/7/2013	0	0	0
1/2/2014	0	0	0
1/21/2014	0	0	0
2/5/2014	0	0	0
2/15/2014	0	0	5,000
1/26/2015	0	0	0
2/2/2015	0	0	0
2/8/2015	0	0	0
2/14/2015	0	0	0
3/5/2015	0	0	0
1/23/2016	0	0	0
2/5/2016	0	0	100,000
2/8/2016	0	0	1000
4/4/2016	0	0	0
12/19/2019	0	0	0
12/16/2020	0	0	0
2/7/2021	0	0	0
1/7/2022	0	0	0
1/28/2022	0	0	0
2/13/2022	0	0	0
2/25/2022	0	0	0
TOTAL	**0**	**0**	**$143,500**

Source: NOAA, National Climatic Data Center

Another indication of previous severe winter events is the list of Presidentially declared disasters for blizzards snowstorms. There have been 14 since 1978, as shown in Table 33. The “Blizzard of 1978” resulted in over three feet of snowfall and multiple day closures of

roadways, businesses, and schools. The record snowfall of January 2015 resulted from a series of storms over that month.

Table 33: Winter-Related Federal Disaster Declarations, 1978-2022

Disaster Name	Date of Event
Coastal Storms, Flood, Ice & Snow	February 1978
Winter Coastal Storm	December 1992
Blizzard	March 1993
Blizzard	January 1996
Snowstorm	March 2001
Snowstorm	February 2003
Snowstorm	December 2003
Snowstorm	January 2005
Severe Winter Storm, Snowstorm	January 2011
Severe Winter Storm, Snowstorm, Flooding	February 2013
Severe winter storm, snowstorm, flooding	January 2015
Severe winter storm and Snowstorm	March 2018
Severe winter storm and flooding	March 2018
Severe winter storm and snowstorm	January 2022

Sources: OpenFEMA Dataset: Disaster Declarations and FEMA Declared Disasters

Winter storms are a community-wide hazard in Hanover. Map 6 in Appendix A illustrates the average annual average snowfall in Hanover, which is between 48 to 72 inches.

The majority of blizzards in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response. The impacts of winter storms are often related to the weight of snow and ice, which can cause roof collapses and also causes tree limbs to fall. This in turn can cause property damage and potential injuries. Power outages may also result from fallen trees and utility lines.

The winter of 2015 began with Winter Storm Juno on January 26-27 followed by three more major storms over a six-week period. The result was that on March 15, 2015 the recorded snowfall in Boston stood at 108.6 inches, the snowiest winter on record. The impacts of winter storms in Hanover are most significant on the transportation system. The Town must ensure that major roads remain passable, and some storms may trigger local parking bans or local and statewide travel bans on major highways.

A number of public safety issues can arise during snowstorms. Impassible streets are a challenge for emergency vehicles and affect residents and employers. 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.

The impacts were felt in Hanover. Town staff had to assist with snow removal on the roofs of the High School and the Cedar School. The National Guard was called in to help shovel out hydrants and many private businesses and homeowners had to deal with snow removal on their roofs, roof collapses and ice dams. Falling snow and snow removal activities also resulted in damage to gas meters.
d
Blizzards are considered high frequency events based on past occurrences. This hazard occurs more than once in five years, with a greater than 20 percent chance of occurring each year.

ICE STORMS

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

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

The best available data on previous ice storm events are recorded at the county level through NOAA's National Centers for Environmental Information (NCEI) Storm Events Database. However, there are no recorded ice storms for Plymouth County between 1950 and 2022 (the earliest records kept by NCEI). As a town near the coast in Southeastern Massachusetts, Hanover experiences somewhat milder winters than the central and western parts of the state, and conditions are less favorable for ice storms. By contrast, neighboring Middlesex County, which extends farther inland west and north of Boston, experienced three ice storms from 1998 to 2008, which caused a total of $3,155,000 in damages (Table 34).

a

Table 34: Middlesex County Ice Storm Events, 1998 –2008

BEGIN_DATE	EVENT_TYPE	DEATHS	INJURIES	DAMAGE ($)
1/9/1998	Ice Storm	0	0	5,000
11/16/2002	Ice Storm	0	0	50,000
12/11/2008	Ice Storm	1	0	3,000,000
TOTAL		0	0	**3,155,000**

Source: NOAA, National Centers for Environmental Information.

Ice storms are a potential town-wide hazard in Hanover. The town's potential vulnerability to ice storms is principally related to ice accumulation on roadways, tree limbs and power lines. The greatest 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 trees can cause falling branches, which can in turn cause property damage and potential injuries, as well as obstructions to transportation corridors and access by emergency vehicles. In Hanover, the area most vulnerable to this would be the heavily travelled Route 53 corridor in the eastern part of town.

Fallen tree limbs and the weight of ice on utility lines can cause localized power outages. The impacts of winter storms may also include roof collapses and property damage as well as injuries related to the weight of snow and ice.

Ice storms are considered to be medium-frequency events based on past occurrences. This hazard occurs from once in 5 years to once in 50 years, with a 2% to 20% chance of occurring each year.

Winter Weather and Climate Change

As with hurricanes, warmer ocean water and air will provide more fuel for winter storms. According to the 2018 SHMCAP it appears that Atlantic coast nor'easters are increasing in frequency and intensity. Further, the SHMCAP notes that research suggests that warmer weather in the Artic is producing changes to atmospheric circulation patterns that favor the development of winter storms in the Eastern United States. There is also some indication that as winters warm, temperatures may be more likely to produce icing conditions. Massachusetts' 2022 Climate Change Assessment predicts more mild winters, increased precipitation in the winter months, and multiple freeze-thaw cycles every winter due to warming temperatures (Commonwealth of Massachusetts, 2022)

NON-CLIMATE-INFLUENCED HAZARDS

EARTHQUAKES

Earthquakes are the sole natural hazard for which there is no established correlation with climate impacts. Damage in an earthquake stems from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location. An earthquake in New England affects a much wider area than a similar earthquake in California due to New England's solid bedrock geology (NESEC). Earthquakes can also trigger landslides.

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 Table35.

Table 35: Richter Scale and Effects

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

Source: Nevada Seismological Library (NSL), 2005

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2016, 408 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes in the distant past, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Anne. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940. A 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historic records of some of the more significant earthquakes in the region are shown in Table 36.

Table 36: Historic Earthquakes in Massachusetts or Surrounding Area

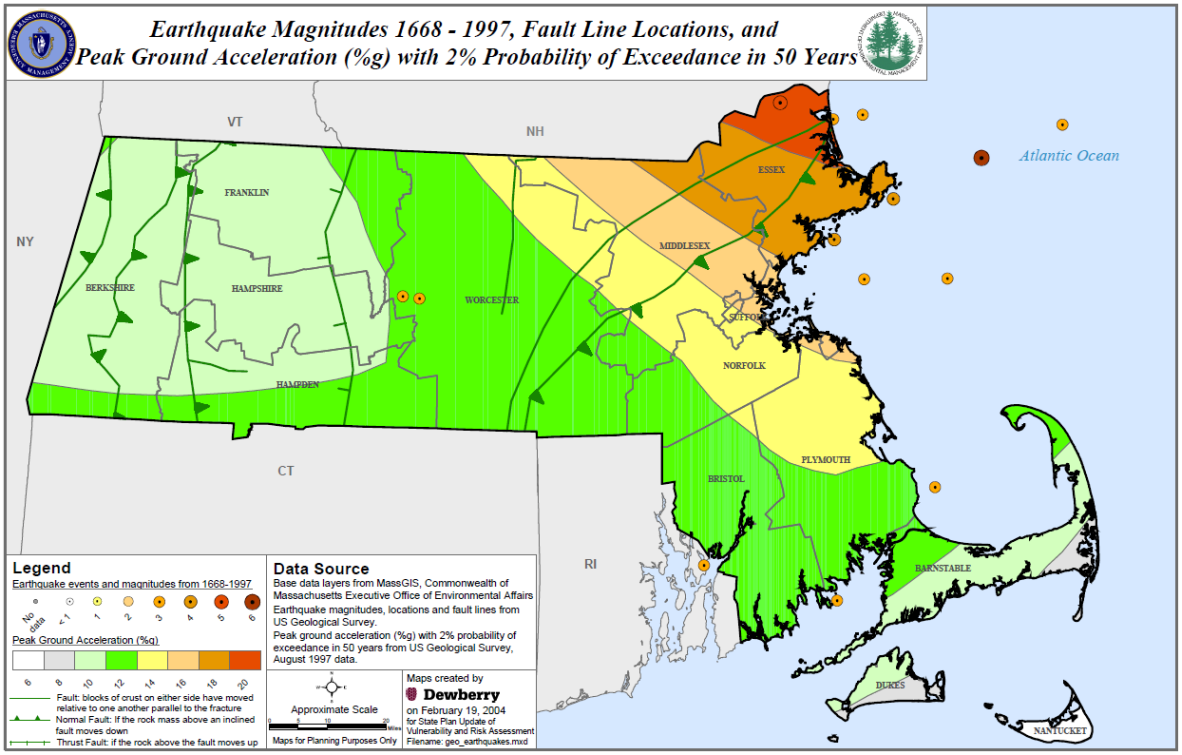
Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA – Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA – Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA

Location	Date	Magnitude
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, as shown in Figure 21. Hanover is in the middle part of the range for Massachusetts, at 12-14g, making it a moderate area of earthquake risk relative to the state, although Massachusetts 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 Hanover.

Figure 21: Massachusetts Earthquake Probability Map



Source: 2018 SHMCAP

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 are a potential town-wide hazard in Hanover. The Town has a mix of older and newer buildings, some of which have been built to higher seismic standards due to **more recent** changes in the **Massachusetts state** building code, but many older buildings could be vulnerable in the event of a severe earthquake. Potential earthquake damages to Hanover have been estimated using HAZUS-MH. Total damages are estimated at

$367,010,000 for a 5.0 magnitude earthquake and $2,664,950,000 for a 7.0 magnitude event. Other potential impacts of earthquakes such as sheltering and debris generation, are detailed in Table 41.

There are several ways the probability of future occurrences has been estimated. 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. According to the SHMCAP there is a 10-15% chance of a magnitude 5 earthquake in a given ten-year 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,

LAND USE AND DEVELOPMENT

EXISTING LAND USE

The most recent land use statistics available for Massachusetts communities are from aerial imagery completed in 2016. Some change has certainly occurred in Hanover since then, but this data provides the most detailed town-wide description of land use available. Table 37 shows the acreage and percentage of land in 22 categories. If all residential categories are aggregated, residential uses make up 33.24% of the area of the Town. The highest percentage use is forested land which comprises 34.77 %., followed by forested wetlands at 16.65 %. These two categories of forested land together comprise half of the town's area, at 51.43% of all land.

Table 37 - Hanover Land Use

Land Use Type	Acres	Percent
Cropland	52.23	0.52
Pasture	72.53	0.73
Forest	3,477.35	34.77
Non-forested wetlands	334.35	3.34
Open land	32.80	0.33
Participatory recreation	103.30	1.03
Multi-family residential	142.53	1.43
Medium density residential (¼ - ½ acre)	35.21	0.35
Low density residential (> ½ acre)	3,042.98	30.43
Very low density residential	103.36	1.03
Commercial	387.17	3.87
Industrial	165.73	1.66
Urban open	21.10	0.21
Transportation	44.32	0.44
Water	112.70	1.13
Cranberry bog	3.49	0.03
Powerlines	36.76	0.37
Urban public	122.36	1.22
Cemetery	32.31	0.32
Forested wetlands	1,665.27	16.65
Brushland	13.01	0.13
Total	***10,000.86***	***100%***

Source: MassGIS Land Use Database

For more information on how the land use statistics were developed and the definitions of the categories, please go to https://www.mass.gov/info-details/massgis-data-2016-land-coverland-use..

New Developments Since the Previous Plan

Hanover's predominant developed land use consists of housing, primarily low and moderate density. As a result of the town's zoning, the majority of the commercial land use is situated along the Route 53 corridor, which runs from north to south on the east side of town. Hanover's industrial land uses are located in the southwest corner of town, which contains the Fireworks District, where munitions were developed from 1907 to 1970.

Hanover has recently seen the redevelopment of older commercial properties, spurring new construction along the Route 53 corridor. Catering to the baby boomer population, Hanover has seen the development of three privately owned age-restricted housing communities for persons 55 years and older. Age-restricted developments are owner occupied and maintained through condo associations offering a communal atmosphere. The Hanover Affordable Housing Trust works diligently to develop affordable housing units within the community for a range of lifestyles and incomes.

Since the 2016 plan the following developments have been completed:

A. Stable Ridge Estates – This single-family residential development was permitted for 14 lots on 15 acres.

B. Webster Village – This 40B housing development consists of 76 rental units.

C. Merchants Row- This is a commercial redevelopment that includes a retail component and restaurants.

D. The Kennedy Building - This is a "friendly" 40B which consists of the redevelopment of the Kennedy Building on the grounds of the Cardinal Cushing complex. It consists of 37 affordable rental units.

E Building 19 – The 20-acre retail site was redeveloped for a tractor supply business.

F. 1810 Washington Street – The town has approved a new retail center consisting of 15,000 square feet. Four buildings will be razed to facilitate redevelopment of the site.

H. Benjamin Brooks Estates – A 6-lot subdivision on 9.2+ acres of land

J. Sconset Landing – A residential development with 130 units of 1,2- and 3-bedroom market rate condominiums with some townhouses. This was developed under the Town's Planned Unit Development zoning.

Potential Future Developments

New developments not yet completed, in permitting, or in the planning phase include the following:

G. Oakland Estates - This is land behind the Cardinal Cushing complex which is not being actively used as part of the school complex, a new development is a 9-lot subdivision single family homes.

I. Hanover Crossing – This is a redevelopment of the Hanover Mall into a mixed-use lifestyle center.

K. 1070 Washington Street – 9,000 sq. ft. commercial building for contractors' space and ancillary uses

L. Village Park – This is likely to be a single use retail development.

In order to characterize any change in the town's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with the hazard maps. The analysis is summarized in Table 38.

The analysis shows that portions of 6 sites are partially located within a FEMA A or AE flood hazard area, ranging between 0.26 and 22.19 percent of site area, typically a portion of the lot that is not built on. A very small portion 3%) of one site is in an area that could be impacted by a future sea level rise scenario of 10 feet. Also, portions of two sites are with a "hot spot" area, typically related to large parking lots or other paved areas.

Table 38 – New Development Sites in Hazard Areas

Map ID	Name	Area (acres)	Flood Zones	Sea Level Rise 10 ft	Hot Spot Areas
A	Stable Ridge Estates	16.2			
B	Webster Village	29.6	9.29% in A: 1% Annual Chance		
C	Merchant's Row	4.4			
D	Kennedy Building	3.2			
E	Building 19	30.7			16.6% in hot spot
F	1810 Washington St	6.4			
G	Cushing Land	194.8	10.23% in A: 1% Annual Chance	3.1% in 10 ft. SLR	
H	Benjamin Brook Estates	3.8	0.26% in A: 1% Annual Chance		
I	Hanover Crossing	119.0	8.67% in A: 1% Annual Chance		42.42% in hot spot
J	Sconset Landing	58.2	22.19% in AE: 1% Annual Chance		
K	1070 Washington St	0.9			
L	Village Park	1.5	13.25% in AE: 1% Annual Chance		

Source: MAPC Data Services GIS Analysis

CRITICAL INFRASTRUCTURE IN HAZARD AREAS

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, public works facilities, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.).

The purpose of mapping the natural hazards and critical infrastructure is to present an overview of hazards in the community, how they relate to critical infrastructure, and to better understand which facilities may be vulnerable to particular natural hazards.

There are 68 critical facilities identified and mapped in Hanover. These are listed in Table 39 and are shown on the maps in Appendix A. All critical facilities are in the same hazard category for landslides, snowfall, and wind speeds: the "low incidence" category for landslides, the average annual snowfall category of 36-48 inches, and the 100-year wind speed category of 110 mph. No critical facilities are in brush fire hazard areas. None are located in brushfire hazard areas.

There are 19 critical facilities located in a FEMA Flood Zone A or AE; 13 of which are bridges and dams, which by definition are located within flood zones as they cross streams and rivers. Water supply wells are also typically located in low-lying areas near to water bodies as favorable places to tap an aquifer. Three of Hanover's nine wells are located in a FEMA Zone A, as is the associated water treatment plant. The only other two critical facilities located in a flood hazard area are a parking garage and a cell tower. There are five facilities that would be impacted by a future scenario of 10 feet of sea level rise, including one bridge, one dam, and three water supply facilities.

Three facilities are located in "hot spot" areas subject to high surface temperatures. All of these are school sites with significant parking lot areas which are responsible for elevated surface temperatures. Overall, the vast majority of Hanover's critical infrastructure sites are well situated in areas not subject to severe hazards.

Explanation of Columns in Table 39

Column 1: ID #: The first column in Table 8 is an ID number which appears on the maps that are part of this plan. See Appendix B.

Column 2: Name: The second column is the name of the site. If no name appears in this column, this information was not provided to MAPC by the community.

Column 3: Type: The third column indicates what type of site it is.

Column 4: Landslide Risk: The fourth column indicates the degree of landslide risk for that site. This information came from Northeast States Emergency Consortium (NESEC). 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.

Column 5: FEMA Flood Zone: The fifth 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:

> **Zones A1-30 and AE**: Special Flood Hazard Areas that are subject to inundation by the base flood determined using detailed hydraulic analysis. Base Flood Elevations are shown within these zones.
>
> **Zone A** (Also known as Unnumbered A Zones): Special Flood Hazard Areas where, because detailed hydraulic analyses have not been performed, no Base Flood Elevations or depths are shown.
>
> **Zone AO**: Special Flood Hazard Areas that are subject to inundation by types of shallow flooding where average depths are between 1 and 3 feet. These are normally areas prone to shallow sheet flow flooding on sloping terrain.
>
> **Zone VE**, V1-30: Special Flood Hazard Areas along coasts that are subject to inundation by the base flood with additional hazards due to waves with heights of 3 feet or greater. Base Flood Elevations derived from detailed hydraulic analysis are shown within these zones.
>
> **Zone B and X** (shaded): Zones where the land elevation as been determined to be above the Base Flood Elevation, but below the 500-year flood elevation. These zones are not Special Flood Hazard Areas.
>
> **Zones C and X** (unshaded): Zones where the land elevation has been determined to be above both the Base Flood Elevation and the 500-year flood elevation. These zones are not Special Flood Hazard Areas.

Column 6: Locally Identified Flood Area: The locally identified areas of flooding were identified by town staff as areas where flooding occurs. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, "Hazard Areas".

Column 7: *Average Annual Snowfall*: Data on snowfall provided by the Northeast States Emergency Consortium (NESEC).

Column 8: Hot Spot Area Sites in the hottest 10% surface temperature based on MAPC's analysis of infrared satellite images.

a
Column 9: 10-Feet Sea Level Rise: Based on the Massachusetts Coastal Flood Risk Model (MC-FRM) prepared by Woods Hole Group for the Commonwealth of Massachusetts.

a

Table 39: Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	Landslide Risk	Within FEMA Flood Zone	Within Local Flood Area	Average Annual Snow Fall	Within Hot Spot Area	10 Feet Sea Level Rise
1	Bridge - Elm Street/Pembroke Line	Bridge	Low	AE Zone	King Street Bridge	36 – 48”	No	No
2	Bridge - Columbia Road at Pembroke Line (state owned)	Bridge	Low	No	No	a	No	Yes
3	Bridge - Washington Street at Pembroke Line	Bridge	Low	No	No	36 – 48”	No	No
4	Bridge - Broadway at Norwell Line	Bridge	Low	A Zone	No	36 – 48”	No	Yes
5	Bridge - East Street at Norwell Line	Bridge	Low	A Zone	No	36 – 48”	No	No
6	Bridge - Mill Street at Norwell Line	Bridge	Low	A Zone	No	36 – 48”	No	No
7	Bridge - Washington Street over Route 3 (state owned)	Bridge	Low	No	No	36 – 48”	No	No
8	Bridge - Pleasant St (W. Hanover)	Bridge	Low	A Zone	Pleasant & Circuit	36 – 48”	No	No
9	Bridge - Circuit Street	Bridge	Low	AE Zone	No	36 – 48”	No	No
10	Bridge - King Street (Forge Pond)	Bridge	Low	AE Zone	King Street Bridge	36 – 48”	No	No
11	Dam - Forge Pond	Dam	Low	AE Zone	King Street Bridge	36 – 48”	No	No
12	Dam - Factory Pond Dam	Dam	Low	AE Zone	No	36 – 48”	No	No
13	Bridge - Broadway at Hanson Line	Bridge	Low	AE Zone	No	36 – 48”	No	No
14	Dam - Curtis Crossing Dam	Dam	Low	AE Zone	No	36 – 48”	No	Yes
15	Dam - Hackett's Pond Dam	Dam	Low	A Zone	No	36 – 48”	No	No
16	Pond Street Water Treatment Plant	Water Supply	Low	No	No	36 – 48”	No	No
17	Cemetery Garage	Municipal	Low	No	No	36 – 48”	No	No
18	Water Distribution Garage	Water Supply	Low	No	No	36 – 48”	No	No
19	DPW Highway Garage	Public Works	Low	No	No	36 – 48”	No	No
20	DPW Office	Public Works	Low	No	No	36 – 48”	No	No
21	Broadway Water Treatment Plant	Water Supply	Low	No	No	36 – 48”	No	No
22	Beal Water Treatment Plant	Water Supply	Low	X Zone	No	36 – 48”	No	Yes
23	Beal Well #1	Water Supply	Low	No	No	36 – 48”	No	Yes
24	Beal Well #2	Water Supply	Low	No	No	36 – 48”	No	Yes

ID	NAME	TYPE	Landslide Risk	Within FEMA Flood Zone	Within Local Flood Area	Average Annual Snow Fall	Within Hot Spot Area	10 Feet Sea Level Rise
25	Broadway #2 Well	Water Supply	Low	No	No	36 – 48”	No	No
26	Broadway #1 Well	Water Supply	Low	No	No	36 – 48”	No	No
27	Hanover St Well #1	Water Supply	Low	No	No	36 – 48”	No	No
28	Hanover St Well #2	Water Supply	Low	No	No	36 – 48”	No	No
29	Pond Street Well #1	Water Supply	Low	A Zone	No	36 – 48”	No	No
30	Pond Street Well #2	Water Supply	Low	A Zone	No	36 – 48”	No	No
31	Pond Street Well #3	Water Supply	Low	A Zone	No	36 – 48”	No	No
32	Pond Street Lime Building	Water Supply	Low	No	No	36 – 48”	No	No
33	Pond Street Garage	Water Supply	Low	A Zone	No	36 – 48”	No	No
34	Standpipe - Union Street Old	Water Supply	Low	No	No	36 – 48”	No	No
35	Standpipe - Union Street New	Water Supply	Low	No	No	36 – 48”	No	No
36	Standpipe - Walnut Hill	Water Supply	Low	No	No	36 – 48”	No	No
37	Facility Maintenance Building	Public Works	Low	No	No	36 – 48”	No	No
38	Cedar School	School	Low	No	No	36 – 48”	No	No
39	Hanover High School	School	Low	No	No	36 – 48”	No	No
40	Hanover Middle School	School	Low	No	No	36 – 48”	Yes	No
41	Center Elementary School	School	Low	No	No	36 – 48”	Yes	No
42	Sylvester School	School	Low	No	No	36 – 48”	No	No
43	Salmond School	School	Low	No	No	36 – 48”	No	No
45	Fire Station #3	Fire Dept.	Low	No	Pleasant &Circuit	36 – 48”	No	No
46	Fire Headquarters	Fire Dept.	Low	No	No	36 – 48”	No	No
47	Town Hall	Municipal	Low	No	No	36 – 48”	No	No
48	John Curtis Free Library	Municipal	Low	No	No	36 – 48”	No	No
49	Hanover Police Headquarters	Police Dept.	Low	No	No	36 – 48”	No	No
50	Hanover Transfer Station	Waste Mgt.	Low	No	No	36 – 48”	No	No
52	Fire Station #1	Fire Dept.	Low	No	No	36 – 48”	No	No
53	South Shore Technical School	School	Low	No	No	36 – 48”	Yes	No
54	Power Substation - Water Street	Utility	Low	No	No	36 – 48”	No	No
55	Power Substation - Phillips Street	Utility	Low	No	No	36 – 48”	No	No
56	Cell Tower- Mayflower Drive	Communications	Low	AE Zone	No	36 – 48”	No	No
57	Cell Tower - Police Station	Communications	Low	No	CVS Plaza	36 – 48”	No	No

ID	NAME	TYPE	Landslide Risk	Within FEMA Flood Zone	Within Local Flood Area	Average Annual Snow Fall	Within Hot Spot Area	10 Feet Sea Level Rise
58	Cell Tower - Planet Subaru	Communications	Low	No	No	36 – 48”	No	No
59	Cell Tower - Assinippi	Communications	Low	No	No	36 – 48”	No	No
60	Cushing Residence	Housing	Low	No	No	36 – 48”	No	No
61	Roberts Animal Hospital	Veterinary	Low	No	No	36 – 48”	No	No
62	Legion Elderly Housing	Housing	Low	No	No	36 – 48”	No	No
63	St. Mary's Church	Church	Low	No	No	36 – 48”	No	No
64	Congregational Church	Church	Low	No	No	36 – 48”	No	No
65	St Andrews Church	Church	Low	No	No	36 – 48”	No	No
66	Bridge - Route 139 (state owned)	Bridge	Low	AE Zone	Pleasant & Circuit	36 – 48”	No	No
67	Council on Aging	Elder Services	Low	No	No	36 – 48”	No	No
68	Cell Tower	Communications	Low	No	No	36 – 48”	No	No
69	Benchmark Assisted Living Facility	Assisted Living	Low	No	No	36 – 48”	No	No
70	Barstow Village	Elderly Housing	Low	No	No	36 – 48”	No	No
71	South Shore Tech Admin. Offices	Admin. Offices	Low	No	No	36 – 48	No	No

VULNERABILITY ASSESSMENT

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

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 https://www.fema.gov/hazus/

> "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 City of Marlborough, 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 40 - Estimated Damages from Hurricanes

	100 Year	500 Year
Building Characteristics		
Estimated total number of buildings	4,981	
Estimated total building replacement value (2006 $)	2,508,000,000	
Building Damages		
# of buildings sustaining NO damage	4.582	3,419
# of buildings sustaining minor damage	366	1,234
# of buildings sustaining moderate damage	32	281
# of buildings sustaining severe damage	1	29
# of buildings destroyed	0	17
Population Needs		
# of households displaced	1	
# of people seeking public shelter	0	
Debris		
Building debris generated (tons)	1,065	4,791
Tree debris generated (tons)	6,562	15,582
Total debris generated (tons)	7,628	20,333
# of truckloads to clear building debris	43	192
Value of Damages		
Total property damage (buildings and content)	$23,441,910	$91,836,400
Losses due to business interruption	$817,270	$7,151,100
Total losses	$24,259,170	$98,987,500

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 magnitude 7.0. However, there was a technical problem with HAZUS running the 7.0 scenario. Historically, major earthquakes are rare in New England, though a magnitude 5 event occurred in 1963.

Table 41 - Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	4,981	
Estimated total building replacement value	2,508,000,000	
Building Damages		
# of buildings sustaining NO damage	2,444	6
# of buildings sustaining slight damage	1,463	107
# of buildings sustaining moderate damage	796	670
# of buildings sustaining extensive damage	222	1,380
# of buildings completely damaged	58	2,617
Population Needs		
# of households displaced	92	2,470
# of people seeking public shelter	53	1,424
Debris		
Building debris generated (tons)	66,000	494,000
# of truckloads to clear debris (@ 25 tons/truck)	2,640	19,760
Value of Damages (Millions of dollars)		
Property damage	$310,140,900	$2,357,289,100
Losses due to business interruption	$58,871,000	$307,657,500
Total Losses	$367,010,000	$2,664,950,000

ESTIMATED DAMAGES FROM FLOODING

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

Table 42: Estimated Damages from Flooding

	100-Year Flood	500-Year Flood
Building Characteristics		
Estimated total number of buildings	4,981	
Estimated total building replacement value	2,508,000,000	
Building Damages		
# of buildings sustaining limited damage	7	15
# of buildings sustaining moderate damage	0	0
# of buildings sustaining extensive damage	0	0
# of buildings substantially damaged	0	0
# Total building with damages	7	15
Population Needs		
# of households displaced	55	72
# of people seeking public shelter	0	1
Value of Damages		
Building Losses	$8,780,000	$12,070,000
Losses due to business interruption	$5,030,000	$8,160,000
Total of All Losses	$13,810,000	$20,230,000

CLIMATE CHANGE RISK ASSESSMENT SUMMARY

Table 43: Summary of Hazard Risks for Society, Built Environmetn, and Natural Resources

CLIMATE CHANGE	NATURAL HAZARD	KEY CONCERNS SOCIETY	KEY CONCERNS BUILT ENVIRONMENT	KEY CONCERNS NATURAL RESOURCES
Changes in Precipitation 	Inland Flooding	Elderly residents and environmental justice populations; property damage, on businesses	Roadway closures, damage to buildings; impacts on infrastructure	Pollutants, erosion, scouring, damage to habitat
	Drought	Increases costs for irrigation, drinking water supply	Impacts on landscaped areas, parks, playing fields, etc.	Impacts on streams, wetlands, vegetation
	Landslide	Private property damage	Damage to buildings &infrastructure	Erosion, sedimentation
Sea Level Rise 	Coastal Flooding	Property damage, impacts on businesses	Roadway closures, damage to buildings; impacts on infrastructure	Damage to coastal habitat
Rising Temperatures 	Average and Extreme Temperatures	Elderly populations if no access to cooling or financial resources to buy an AC		Increasing invasives, stress on aquatic and terrestrial habitats
	Wildfires	Air Quality - Smoke	Damage to buildings	Damage to resources
	Invasive species	Potential health impacts of pests	Impaired use of park and open space	Loss of biodiversity
Extreme Weather 	Hurricanes / Tropical Storms	Power outages: property damage, impacts to businesses	Street closures, house flooding, emergency access, wind damage to buildings, power outages	Tree damage
	Severe Winter Storms	Power outages, elderly, or isolated residents	Damage to public buildings with snow loads, power outages, operations, road blockages.	Tree damage
	Tornadoes	Property damage, impacts on businesses	Damage to buildings and infrastructure	Tree damage
	Thunderstorms/ Microbursts)	Power outages, property damage	Power loss, road closures (same as above)	Tree damage
Non-Climate Hazard	Earthquake	Property damage, impacts on businesses	Damage to buildings and Infrastructure	Landslides

SECTION 5: HAZARD MITIGATION GOALS

The Hanover Hazard Mitigation/MVP Core Team reviewed and discussed the goals from the 2016 Hazard Mitigation Plan for the Town of Hanover. The Team endorsed the nine goals and added one new goal, #10, addressing climate changes. All of the goals are considered critical for the town, and they are not listed in order of importance.

1. Prevent and reduce the loss of life, injury 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.

    - Ensure that the Planning Department considers hazard mitigation in its review and permitting of new development.
    - Review zoning regulations to ensure that the bylaw incorporates all reasonable hazard mitigation provisions.
    - Ensure that all relevant municipal departments have the resources to continue to enforce codes and regulations related to hazard mitigation.

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

    - Begin to assess the vulnerability of municipal buildings and infrastructure to damage from an earthquake.
    - Maintain existing mitigation infrastructure in good condition.

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. Educate the public about natural hazards and mitigation measures that can be undertaken by property-owners.

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

10. Consider the impacts of climate change and incorporate climate sustainability and resilience into the City's planning and policies.

SECTION 6: EXISTING MITIGATION MEASURES

The central component of a hazard mitigation plan is the strategy for reducing the community's vulnerabilities to natural hazard events. Responding to the analysis of risk, vulnerabilities, potential impacts, and anticipated future development, the process for developing this strategy is one of setting goals, understanding what actions the community is already taking that contribute to mitigating the effects of natural hazards and assessing where more action is needed to complement or modify existing measures. The following sections include descriptions of existing mitigation measures and descriptions of proposed new mitigation measures.

The existing protections in the Town of Hanover are a combination of zoning, land use, and environmental regulations, infrastructure maintenance and drainage infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage clogging problems, while large scale capacity problems may require pipe replacement or invert elevation modifications. These more expensive projects are subject to the capital budget process and lack of funding is one of the biggest obstacles to the completion of some of these. The Town's existing mitigation measures are listed by hazard type here and are summarized in Table 44 below.

Mitigation Measures Relating to Multiple Hazards

There are several mitigation measures that impact more than one hazard. These include the Comprehensive Emergency Management Plan (CEMP), the Massachusetts State Building Code and participation in a local Emergency Planning Committee.

Comprehensive Emergency Management Plan (CEMP) – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response, and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures, and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to all of the hazards discussed in this plan. The Town of Hanover is working to establish startup certification of the CEMP.

Emergency Equipment – The Hanover Emergency Management Agency has received Federal and State grants and was able to purchase portable radio equipment, shelter supplies and office supplies to support the HEMA and LEPC.

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

The Hanover Local Emergency Planning Committee– the LEPC applied for and received full certification from the Commonwealth of Massachusetts State Emergency Response Commission. The LEPC has representation from twelve categories including Elected Local Officials, Law Enforcement, Emergency Management, Fire Service, Emergency Medical Services, Local Environmental, Hospital, Transportation, Media, Community Groups,

Facilities using Extremely Hazardous Substances and Public Works. Certified LEPCs are eligible to receive grant funding to help support emergency management operations.

Existing Flood Related Hazards

CEMP – The Hanover Comprehensive Emergency Management Plan contains a section on flooding. It lists seven generic mitigation measures:

- Identify areas in the community that are flood prone and define methods to minimize the risk. Review National Flood Insurance Maps.
- Disseminate emergency public information and instructions concerning flood preparedness and safety.
- Community leaders should ensure that their community is enrolled in the National Flood Insurance Program.
- Strict adherence should be paid to land use and building codes (e.g., Wetlands Protection Act) and new construction should not be built in flood-prone areas.
- Ensure that flood control works are in good operating condition at all times.
- Natural water storage areas should be preserved.
- Maintain plans for managing all flood emergency response activities including addressing potentially hazardous dams.

Town Storm Drain System- Street sweeping is done annually and is contracted out. Catch basin cleaning is also done annually. The town has identified areas that it checks in advance of a storm to ensure that the inlet screens are free of debris. Catch basin cleaning is contracted out. There are approximately 2,500 catch basins. As sand is not used on Hanover's roads, the Town has not had a problem with clogged catch basins or stream sedimentation. Catch basins are cleaned annually.

***Participation in the National* Flood Insurance Program (NFIP)** –Hanover participates in the NFIP with 17 policies in force as of May 2023. DCR provides information on flood insurance policies for Massachusetts communities. The following information was provided for the Town of Hanover as of May 2023:

Flood insurance policies in force	17
Coverage amount of flood insurance policies	$5,780.000
Total losses (all losses submitted regardless of the status)	14
Closed losses (Losses that have been paid)	14
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	4
Total payments (Total amount paid on losses)	$69,319.39

Zoning bylaw– The zoning bylaw for the Town of Hanover contains a number of provisions that mitigate flooding problems.

The Town has amended the Bylaw to incorporate new Flood Insurance Rate Maps issued by FEMA in 2021. One of the key revisions includes: "The Floodplain District includes all special flood hazard areas within the Town of Hanover designated as Zone A, AE, AH, AO, A99, V, or VE on the Plymouth County Flood Insurance Rate Map (FIRM) dated July 6,

2021 issued by the Federal Emergency Management Agency (FEMA) for the administration of the National Flood Insurance Program. The map panels of the Plymouth County FIRM that are wholly or partially within the Town of Hanover are panel numbers 25023C0094K, 25023C111K, 25023C113K, 25023C114K, 25023C118K, 25023C182K, 25023C201K, 25032C202K, 25032C206K, 25032C184K, 25032C203K Dated 7/6/2021. The exact boundaries of the district shall be defined by the 1%-chance base flood elevations shown on the FIRM and further defined by the Plymouth County Flood Insurance Study (FIS) report dated July 6, 2021. The FIRM and FIS report are incorporated herein by reference and are on file with the Town Clerk, Planning Board, Building Official, Conservation Commission and [other].

The relevant section of the zoning bylaw is Section 6.700. These provisions include:

- Section 6.710: The Floodplain District includes all special flood hazard areas designated as Zone A, AE, and AH on the Flood Insurance Rate Map.
- Section 6.720: All development must be in compliance with Chapter 131, Section 40; sections of the State Building Code which address floodplain issues, DEP Wetlands Protection Regulations, Inland Wetlands Restrictions and Title V.
- Section 6.740: Prohibits encroachments in the floodway as designated on the Flood Insurance Rate Map unless such encroachments shall not result in any increase in flood levels during the occurrence of the one-hundred-year flood.
- Section 6.750: Within Zone A the applicant shall obtain base flood elevation data and must prove that the building can meet elevation or flood-proofing requirements. Within Zone AH, there must be adequate drainage paths to guide floodwaters away from structures. In Zone A and AE if there is no regulatory floodway designated, the best available floodway data shall be used to prohibit encroachments that would result in increased flood levels.

Subdivision regulations – The Town updated the Subdivision Rules and Regulations in 2021. Key provisions include requirements that plans show the floodplain line and elevation of the floodplain on portions of a lot within the floodplain. The Base Flood Elevation must be shown for portions of lots/parcels with the Flood Plain District. The use of proposed Low Impact Development (LID) designs is encouraged where applicable. Definitive Plans must identify zoning districts with an existing and proposed density and dimensional table and all wetlands and floodplain designations. Drainage requirements specify that detention and retention basins located with local and state wetland jurisdiction be constructed in accordance with the latest Hanover Conservation Commission "Detention Basin Regulations and Standards" found in the Wetlands Protection Bylaw. Low Impact Development drainage system design in accordance with the MA Stormwater Standards are encouraged.

Section II C states that all proposed developments in the flood plain district shall be reviewed to determine whether they will be safe from flooding, including utilities. Subdivision plans must also show base flood elevations.

Section IV E addresses lot drainage and states that lots must be graded in such a way that the development of a lot will not cause detrimental drainage on another lot.

Section V E contains specific requirements for drainage structures.

Wetlands Bylaw - The Hanover Wetlands Protection Bylaw utilizes the Home Rule authority of the town to protect the resource areas under the Wetlands Protection Act Massachusetts General Laws (M.G.L.) Ch.131 §40) to a greater degree, to protect additional resource areas recognized by the Town as significant, to protect all resource areas for their additional values beyond those recognized in the Act, and to impose in local regulations and permits additional standards and procedures stricter than those of the Act.

Open Space and Recreation Plan – The town's 2009 Open Space and Recreation Plan was updated for 2017-2018 by MAPC. The plan identifies and prioritizes protection of key land parcels, many of which support flood mitigation by preserving open and vegetated land the reduces and often infiltrates stormwater runoff.

Existing Dam Failure Mitigation Measures

CEMP – The Hanover Comprehensive Emergency Management Plan contains a section on dam safety. It lists eight generic mitigation measures.

- Develop and conduct public education programs concerning dam hazards.
- Maintain up-to-date plans to deal with dam overspill or failure.
- Emergency Management and other local government agencies should familiarize themselves with technical data and other information pertinent to the dams which impact their jurisdiction. This should include determining the probable extent and seriousness of the effect to downstream areas.
- Dams should be inspected periodically and monitored regularly.
- Repairs should be attended to promptly.
- As much as is possible burdens on faulty dams should be lessened through stream re-channeling.
- Identify dam owners.
- Determine minimum notification time for downstream areas.

Dam Emergency Action Plans -- The Town completed Emergency Action Plans for the Factory Pond Dam and Hackett's Pond Dam in 2019, which were updated in May 2023. See the Dam Hazards in Section 3 Risk Assessment for details.

Phase 1 Inspection and Evaluation Report: Dam Assessment- The town completed a Phase I Inspection and Evaluation Report for the Curtiss Crossing Dam in 2017.

Curtiss Crossing Dam - A reconnaissance level plan was completed in 2022 for the removal. A grant from the Natural Resources Damages Trust was provided to North and South Rivers Watershed Association to work with Pembroke and Hanover to look at whether they want to remove the dam. The Town has developed plans and specifications for dam repairs, and a financial commitment was made by the Town of Pembroke.

The Forge Pond Dam –The Town has authorized its engineers to begin the process for repairs but work on the dam has not yet begun.

Existing Wind Hazard Mitigation Measures

CEMP – The Hanover Comprehensive Emergency Management Plan contains a section on hurricanes. It lists four generic mitigation measures:

- Develop and disseminate emergency public information and instructions concerning hurricane preparedness and safety.
- Community leaders should ensure that Hanover is enrolled in the National Flood Insurance Program.
- Develop and enforce local building codes to enhance structural resistance to high winds and flooding. Build new construction in areas that are not vulnerable to direct hurricane effects.
- Maintain plans for managing all hurricane emergency response activities.

The Hanover CEMP outlines three generic mitigation measures for tornados.

- Develop and disseminate emergency public information and instructions concerning tornado safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters.
- Strict adherence should be paid to building code regulations for all new construction.
- Maintain plans for managing tornado response activities. Refer to the non-institutionalized, special needs and transportation resources listed in the Resource Manual.

Tree-trimming program – The town has a tree trimming program. The town does not have the equipment to grind stumps. Light brush is chipped with town owned equipment. The Town also outsources the grinding of a town-wide brush pile, typically twice a year. The Town lacks ready access to a bucket truck for tree trimming and removal of dangling limbs. Trimming is done through outsourced services as well as cooperative relationships with electric utilities.

Massachusetts State Building Code - The Town has adopted the Massachusetts State Building Code. The Massachusetts State Building Code contains detailed regulations regarding wind loads. The code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence.

Existing Winter Storm Hazard Mitigation Measures

CEMP – The Hanover CEMP outlines three generic mitigation measures for winter storms.

- Develop and disseminate emergency public information concerning winter storms, especially material which instructs individuals and families how to stock their homes, prepare their vehicles, and take care of themselves during a severe winter storm.
- Local governments should assume that winter will occur annually and budget fiscal resources with snow management in mind.
- Maintain plan for managing all winter storm emergency response activities.

Snow disposal – The Town undertakes regular plowing and snow/ice removal. Sodium chloride and liquid magnesium chloride are the two chemicals used for road treatment. The DPW works to clear roads and town owned parking lots to ensure the safe flow of traffic and emergency access for the Fire and Police Departments. Snow removal has not been a problem for the town, although extreme winters such as the winter of 2015 have required extraordinary measures to provide adequate access.

Existing Geologic Hazard Mitigation Measures

CEMP – The Hanover CEMP outlines five mitigation measures for earthquakes.

- Community leaders in cooperation with Emergency Management Personnel should obtain local geological information and identify and assess structures and land areas that are especially vulnerable to earthquake impact and define methods to minimize the risk.
- Strict adherence should be paid to land use and earthquake resistant building codes for all new construction.
- Periodic evaluation, repair, and/or improvements should be made to older public structures.
- Emergency earthquake public information and instructions should be developed and disseminated.
- Earthquake drills should be held in schools, businesses, special care facilities, and other public gathering places.

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

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

Existing Brush Fire Mitigation Measures

Subdivision/Development Review – The Fire Department participates in the review of new subdivisions and development/redevelopment projects to ensure that proper fire safety provisions are incorporated.

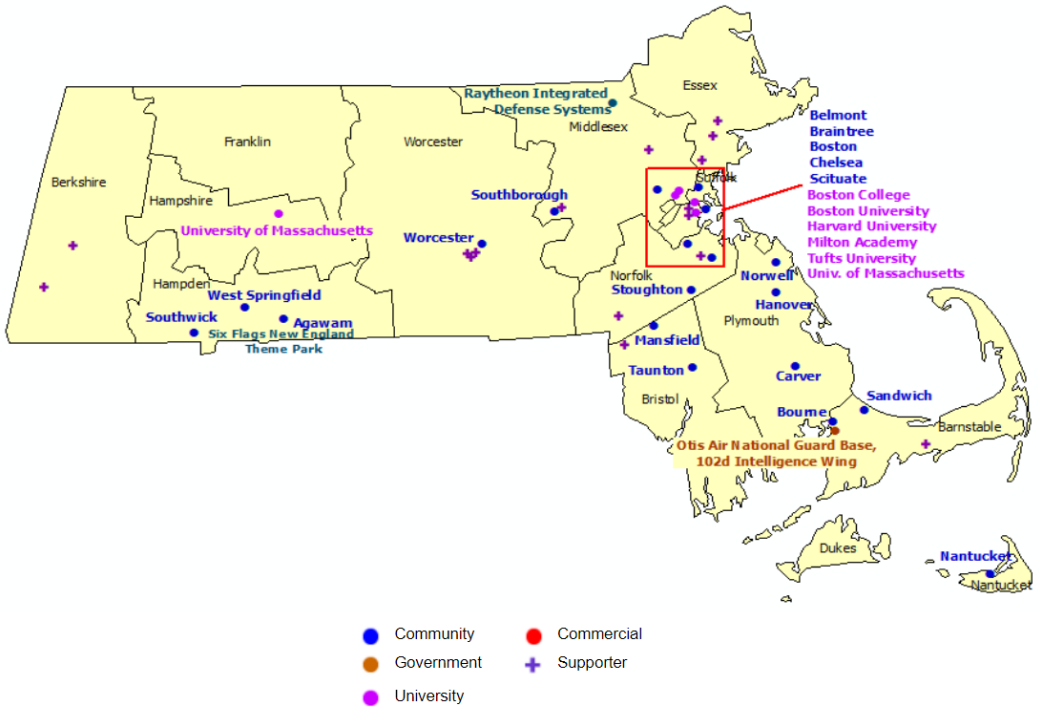
Brush fire equipment - The Hanover Fire Department has two vehicles capable of responding to brush fires. Forest Fire 1 is a 1997 Ford Pick Up Truck and Forest Fire 2 is a 2007 Ford Pick Up Truck. Both vehicles spend the majority of their time outside with the inability of the Department to properly house them. The Hanover Fire Department lacks a smaller Utility Terrain Vehicle (UTV).

Outdoor burning permits - Outdoor burning is regulated by the Department of Environmental Protection, which allows outdoor burning of brush, cane, forestry debris, etc. during an annual period usually from January 15th through May 1st under the supervision and control of the Fire Department. Permits are issued during the annual period each year between the hours of 9:30 a.m. and 2:00 p.m. The phone number to obtain a permit is: 781-826-7850. The Hanover Fire Department web page has extensive information about outdoor burning permits, regulations, and best practices at: https://www.hanover-ma.gov/fire-department/faq/what-about-outdoor-burning

New Mitigation Measures Since 2016

StormReady Community - Hanover was designated as a StormReady Community by the National Weather Service. Hanover is one of only 21 communities in Massachusetts to achieve StormReady designation by the NWS, and along with Norwell, one of only two communities on the South Shore (see Figure 22).

Figure 22: StormReady Communities in Massachusetts



Source: National Weather Service

Radio System Upgrades - The Town upgraded its radio system for public safety. An antenna/receiver was located near Hanover Crossing. Additional public safety radio system infrastructure upgrades are anticipated as part of the recent migration to a regional dispatch center.

Local Capacity for Implementation

The Town of Hanover has recognized several existing mitigation measures that require implementation or improvements and has the capacity within its local boards and departments to address these. The Planning Board enforces the Floodplain District and updates it as needed, as well as other Zoning provisions and Subdivision Regulations and Site Plan Review pertaining to new development. The Public Works Department maintains and upgrades the town's stormwater management system and conducts regular street sweeping, catch basin cleaning and snow removal operations. The Conservation Commission enforces the local Wetlands Bylaw along with the state Wetlands Protection Act. The Fire Department regulates outdoor burning and provides public education on fire safety. The Building Department enforces the State Building Code for new development and reconstruction projects.

Table 44: Hanover Existing Mitigation Measures

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
MULTIPLE HAZARDS				
Comprehensive Emergency Management Plan (CEMP)	Address preparedness, mitigation, response, and recovery from natural and man-made emergencies.	Emphasis is on emergency response	None	August 2022 the town added Addenda to CEMP for DPW, EAP for Factory Pond Dam, Hazardous Materials Emergencies, Training, Shelter Support, Emergency Lights, Radio System for Schools
Massachusetts State Building Code	Contains detailed building regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads.	Effective for new construction and reconstruction	None	None
Emergency Equipment	The Hanover Emergency Management Agency received three Federal and State grants and was able to purchase portable radio equipment, shelter supplies and office supplies to support the HEMA and LEPC	Effective	None	None
Local Emergency Planning Committee (LEPC)	Representation from Elected Local Officials, Law Enforcement, Emergency Management, Fire, Public Works, Emergency Medical Services, Environmental, Hospital, Transportation, Media, Community Groups. Certified by the State Emergency Response Commission	A forum for cooperation on natural and manmade disasters	The Town is working to receive Full Certification Status for its LEPC	None

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
FLOOD RELATED HAZARDS				
Participation in the National Flood Insurance Program (NFIP)	Hanover participates in the NFIP with 17 policies with $5,780.000 insurance in force. There have been 14 losses paid, totaling $69,319 since 1978. There are no Repetitive Loss Properties in Hanover.	Effective	Encourage all eligible homeowners to obtain insurance	None
Public Works Operations/Maintenance	Street sweeping and Catch Basin cleaning are done annually and contracted out. There are ~2500 catch basins. The town checks identified areas in advance of storms to ensure that inlet screens are free of debris. Sand is not used on streets. There are approximately 10-15 water main breaks annually. The town has a program to ensure that valves and gates are operational.	Effective	Continue with regular catch basin and street sweeping programs.	
Open Space and Recreation Plan 2008-2012		Effective	Plan has expired and needs to be updated	A 2017-18 update to the Open Space and Recreation Plan was prepared for the town by MAPC.

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
Flood Plain District	The Floodplain District includes all special flood hazard areas designated as Zone A, AE, and AH on the Flood Insurance Rate Map. Development must comply with Building Code, Wetlands Regulations, and Title V. Restricts encroachment on Floodway, requires BFE in Zone A and drainage paths in Zone AH • Section 6.720: Development must comply with Ch. 131, Sec. 40; of the State Building Code which address floodplain issues, Wetlands Protection Regulations, Inland Wetlands Restrictions and Title V. • Section 6.740: Prohibits encroachments in the floodway unless they do not result in any increase in flood levels during the 100-year flood. • Section 6.750: Development within Zone A must include base flood elevation data and must prove that the building can meet elevation or flood-proofing requirements.	Effective	Continue to enforce	The Town has revised the Bylaw to incorporate new Flood Insurance Rate Maps issued by FEMA in 2021 as well as the Massachusetts Model Flood Plain Zoning Bylaw. See the section above for more information.

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
	In Zone A and AE, if there is no regulatory floodway designated, the best available floodway data must be used to prohibit encroachments that would result in increased flood levels.			
Wetland Bylaw	The Hanover Wetlands Protection Bylaw utilizes the Home Rule authority of the town to protect the resource areas under the Wetlands Protection Act Massachusetts General Laws (M.G.L.) Ch.131 §40) to a greater degree, to protect additional resource areas recognized by the Town as significant, to protect all resource areas for their additional values beyond those recognized in the Act, and to impose in local regulations and permits additional standards and procedures stricter than those of the Act.	Effective	None	None
Subdivision Rules and Regulations	Section II C requires all proposed developments in the flood plain district be reviewed to determine whether they will be safe from flooding, including utilities. Subdivision plans must show base flood elevations.	Effective	None	The Town updated the Subdivision Rules and Regulations in 2021. Key provisions include requirements that plans show the floodplain line and elevation of the floodplain on portions of a

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
	Section IV E addresses lot drainage and states that lots must be graded so that development will not cause detrimental drainage on another lot. Section V E contains specific requirements for drainage structures.			lot within the floodplain. The Base Flood Elevation must be shown for portions of lots within the Flood Plain District. The use of Low Impact Development (LID) designs is encouraged. See the section above for more information.
Flood related building restrictions.	Appendix C references the Regulations and Standards Governing the Design and Construction of Detention Basins. The post-development runoff rate shall not exceed the pre-development runoff rate. Runoff volume after development shall not cause receiving waters to experience higher flood levels.	Effective	Continue to enforce	Revisions to the Flood Plain District adopted in 2021 deleted Appendix C of that bylaw and replaced it with the Detention Pond standards in Subsection VII F of Wetlands Regulations under the Hanover Wetlands Protection Bylaw.
DAM RELATED HAZARDS				
Phase 1 Assessment for the Forge Pond Dam.	The town completed a Phase I assessment of the Forge Pond Dam in order to determine what actions would be necessary to rehabilitate the dam.	Effective. Will be used to determine actions for dam rehabilitation	Continue with process to address the needs of the Forge Pond Dam and Curtiss Crossing Dam.	The Town prepared Emergency Action Plans for Factory Pond and Hackett's Pond Dams and a Phase 1 Inspection Report for the Curtiss Crossing Dam. See the section above for more information

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
DCR Dam Safety Regulations		Effective	None.	None
The Hanover Comprehensive Emergency Management Plan contains a section on dam safety which includes eight recommended mitigation measures.	• Public education programs concerning dam hazards. • Maintain plans to deal with threat and occurrence of dam over-spill or failure. • Emergency Management and other local agencies should familiarize themselves with the probable extent and seriousness of the impact to downstream areas. • Dams should be inspected periodically and monitored regularly. • Repairs should be attended to promptly. • As much as possible burdens on faulty dams should be lessened through stream re-channeling. • Identify dam owners. • Determine minimum notification time for downstream areas.	Effective	None	None

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
WIND RELATED HAZARDS				
CEMP-The Comprehensive Emergency Management Plan contains a section on hurricanes which includes four recommended measures.	• Disseminate emergency public information and instructions concerning hurricane and tornado preparedness and safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters. • Ensure that Hanover is enrolled in the National Flood Insurance Program. • Develop and enforce local building codes to enhance structural resistance to high winds and flooding. Build new construction in areas that are not vulnerable to direct hurricane effects. • Maintain plans for managing hurricane and tornado response activities. Refer to the non-institutionalized, special needs and transportation resources listed in the Resource Manual	Effective.	None.	None

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
The Massachusetts State Building Code	Contains regulations regarding wind loads.	Effective for most situations except severe storms.	None.	None
Tree trimming program	Tree trimming is done through outsourced services as well as cooperative relationships with electric utilities. The Town lacks ready access to a bucket truck for tree trimming and removal of dangling limbs. The Town also outsources the grinding of a town-wide brush pile, typically twice a year. Light brush is chipped with town owned equipment.	Satisfactory.	The town lacks ready access to a bucket truck for tree trimming and equipment to grind stumps and branches.	The Utility Company has increased efforts to trim trees to prevent power outages in storms.
WINTER RELATED HAZARDS				
Snow Removal	The Town conducts regular plowing and snow/ice removal. The DPW works to clear roads and town parking lots to ensure the safe flow of traffic and emergency access for the Fire and Police Departments.	Effective under normal winter conditions.	None.	None

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
Road treatment for de-icing	Sodium chloride and liquid magnesium chloride are used for road treatment. Sand is not used.	Effective.	None.	None
BRUSHFIRE HAZARDS				
Outdoor Permits	Outdoor burning is regulated by the Dept. of Environmental Protection, which allows outdoor burning of brush, forestry debris, etc. during an annual period usually from January 15th through May 1st under the supervision and control of the Fire Dept.	Effective.	None.	None
Brushfire equipment	The town has two forest fire trucks based as the Fire Department Headquarters	Effective.	Town lacks small vehicle for accessing hiking/walking trails	None
Subdivision/Development Review	The Fire Department participates in the review of new subdivisions and development/redevelopment projects to ensure that proper fire safety provisions are incorporated.	Effective.	None.	None
Public Education on Fire Safety	The Hanover Fire Department web page has extensive information about outdoor burning permits, regulations, and best practices.	Effective.	None.	None

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
GEOLOGIC HAZARDS				
CEMP-The Comprehensive Emergency Management Plan outlines five recommended mitigation measures for earthquakes	• Obtain local geological information and identify and assess structures that are especially vulnerable to earthquake impact and define methods to minimize the risk. • Strict adherence to earthquake resistant building codes for all new construction. • Periodic evaluation, repair, and/or improvements should be made to older public structures. • Emergency earthquake public information should be disseminated. • Earthquake drills should be held in schools, businesses, special care facilities, and other public gathering places.	Effective.	Evaluate vulnerability of public buildings.	None
The Massachusetts State Building Code	The State Building Code contains a section on designing for earthquake loads. Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to a table	Effective.	None.	None

Mitigation Measure	Description	Effectiveness	Improvements Needed	Changes since 2016 Plan
NEW MITIGATION SINCE 2016				
StormReady Community	Hanover was designated as a StormReady Community by the National Weather Service	Effective	Continue participation in the program	The town achieved Storm-Ready designation.
Radio System Upgrades	The Town upgraded its radio system for public safety. An antenna/receiver was located near Hanover Crossing	Effective	Infrastructure improvements planned as part of migration to ROCCC	None

SECTION 7: MITIGATION MEASURES FROM THE 2016 PLAN

IMPLEMENTATION PROGRESS OF THE PREVIOUS PLAN

The Hanover Hazard Mitigation/MVP Core Team reviewed the recommended mitigation measures identified in the Town's 2016 Hazard Mitigation Plan and determined whether each measure had been completed, partially completed, or not completed. Table 45 summarizes the current status of mitigation measures from the 2016 plan.

Of those measures that had not been completed, the local team evaluated if they should be carried over and retained in this 2023 updated plan, or whether they should be deleted from this plan. The decision on whether to delete or retain a particular measure was based on the Team's assessment of the continued relevance or effectiveness of the measure. For those mitigation measures carried forward to this updated plan, the local team also considered if any revisions to the original mitigation measure are needed due to changed circumstances, and whether the priority assigned in the previous plan should be retained or revised for this plan update.

Table 45 also summarizes the recommendations of the Hazard Mitigation/MVP Core Team for any changes in priority. The last two columns indicate if mitigation measures are being carried over into this 2023 plan update, and if so, if there are any revisions or changes in priority.

Two of the recommended mitigation measures from the 2016 plan have been completed, including conducting a winter weather awareness program and achieving StormReady designation from the National Weather Service, as well as completing an update to the Open Space and Recreation Plan.

Five mitigation measures were partially completed, including an education program on wetlands compliance, a hydraulic analysis of the Indian Head River Watershed, a stormwater committee, a dumping bylaw, and recommendations on the Forge Pond Dam. The Hazard Mitigation/MVP Core Team recommended retaining these mitigation measures in the 2023 updated plan and revising several of them to reflect current circumstances and town priorities.

Likewise, all mitigation measures that have not yet been completed will be carried over into the 2023 updated plan, with revisions in some cases as shown in the table.

Most of the carried over measures will retain the same priority they had in the 2016 plan. Two mitigation recommendations will have revised priorities for 2023, including assessing options to retrofit public buildings will change from Medium to Low, and map and maintain fire roads will change from Medium to High.

Table 45: Status of Hanover Mitigation Measures from the 2016 Plan

Mitigation Recommendations from the 2016 Plan	2023 Status 1. Completed 2. Partially Completed 3. Not Completed	For 2023 Plan 1. Retain 2. Revise 3. Delete	Priority Change 2016 >2023 Plan
Flood Hazards			
A) Education program to improve compliance with wetlands regulations	**PARTIALLY COMPLETED** Conservation Commission Bylaws revised 2023, flyers explain permitting, used in newsletter	**RETAIN & REVISE** Continue process to updated regulations under the bylaw	Medium>Same
C) Perform a hydraulic analysis of the Indian Head River Watershed	**PARTIALLY COMPLETED** A hydrology/hydraulic study was done for removal of State St. Dam, did not go further upstream to Forge Pond. Grant funded, with liaison committee for Hanover, Hanson, and Pembroke. Concerns that Forge Pond and Factory Pond dams can't carry the100-year flood flow.	**RETAIN & REVISE** complete analysis for the remaining part of the watershed, including Forge Pond and Factory Pond	High>Same
D) Create a stormwater advisory committee	**PARTIALLY COMPLETED** DPW has adopted Stormwater Policies. The Stormwater Bylaw needs to be updated, need to coordinate with Planning Board and Conservation Commission has adopted Standard Conditions for new development	**RETAIN & REVISE** Update the Stormwater Bylaw, coordination with DPW, Planning, Conservation	Medium>Same
E) Update the Open Space and Recreation Plan	**COMPLETED** A plan updated was competed by MAPC in 2017	**RETAIN** OSRP's should be updated every 7 years. Prepare next update for 2024.	Medium>Same
F) Enact a dumping bylaw	**PARTIALLY COMPLETED** A bylaw on dumping within the Transfer Station adopted in 2022	**RETAIN & REVISE** Bylaw Committee to Evaluate components of dumping restrictions spread across various bylaws and ensure comprehensive regulations are in place, including addressing dumping on Conservation Land	Low>Same

Mitigation Recommendations from the 2016 Plan	2023 Status 1. Completed 2. Partially Completed 3. Not Completed	For 2023 Plan 1. Retain 2. Revise 3. Delete	Priority Change 2016 >2023 Plan
Dam Hazards			
B) Implement recommendations of the Forge Pond Dam Phase 1 Assessment	**PARTIALLY COMPLETED** The Town completed a Phase 1 Assessment of the dam before the previous 2016 Hazard Mitigation Plan, which found issues such as trees growing out of the earthen dam. The Town has authorized its engineers to begin the process for repairs but work on the dam has not yet begun.	**RETAIN & REVISE** Continue with process to address the needs of the Forge Pond Dam	High>Same
WINTER HAZARDS			
G) Assess options to retrofit public buildings	**NOT COMPLETED**	**RETAIN & REVISE.** Coordinate with roof analysis for solar panels. Revise priority	Medium>Low
H) Conduct winter weather risk awareness activities	**COMPLETED** Hanover was designated an NWS StormReady Community and received a grant	**DELETE** (Completed)	Medium>Same
WIND HAZARDS			
I) Educate homeowners on the benefits of wind retrofits.	**NOT COMPLETED**	**RETAIN**	Low>Same
GEOLOGIC HAZARDS			
J) Implement seismic upgrades to the communications center	**NOT COMPLETED**	**RETAIN** Coordinate with Public Facilities	Low>Same
WILDFIRE HAZARDS			
K) Acquire a small brush truck	**NOT COMPLETED**	**RETAIN**	Medium>Same
L) Install dry hydrants	**NOT COMPLETED**	**RETAIN**	Medium>Same
M) Map and maintain fire roads	**NOT COMPLETED**	**RETAIN** Revise priority	Medium>High

SECTION 8: HAZARD MITIGATION STRATEGY

WHAT IS HAZARD MITIGATION?

Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, education programs, infrastructure projects and other activities. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HGMP), the Building Resilient Infrastructure and Communities (BRIC) grant, 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/grants/mitigation/building-resilient-infrastructure-communities
- https://www.fema.gov/flood-mitigation-assistance-grant-program

According to FEMA Local Multi-Hazard Mitigation Planning Guidance, identified 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.

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

REGIONAL PARTNERS

Regional hazard mitigation issues vary with the nature of the community and are different in densely developed urban communities than in more suburban or rural communities. In many communities, mitigating natural hazards, particularly flooding, is more than a local issue. New development in an adjoining community can increase runoff in the neighboring community and yet the neighboring community cannot review new development proposals. The presence of state roads such as Route 3, Route 53, and Route 139, with their attendant drainage structures means that the host community does not have as much control over mitigation measures that may be necessary. Agencies such as MASS DOT, the Dept. of Conservation and Recreation (DCR) and the Mass. Water Resources Authority (MWRA) should be considered the town's regional partners in hazard mitigation. The planning, construction, operation, and maintenance of regional infrastructure can be integral to the hazard mitigation efforts of communities. These state and regional agencies often operate under the same constraints that communities do, including budgetary and staffing constraints and numerous competing priorities. In the sections that follow, the plan includes recommendations for activities where cooperation with these other agencies may be necessary. Implementation of these recommendations will require that all parties work together to develop solutions.

INTER-COMMUNITY CONSIDERATIONS

One of the major inter-community considerations involves the recommended mitigation strategy of preparing a hydraulic study of the Indian Head River watershed. This would involve multiple communities as well as non-profits like the North and South Rivers Watershed Association and the North River Commission.

IMPROVING LOCAL CAPABILITIES

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 limit future risks. Taking into consideration the town's Floodplain Zoning District enforced for new development, the Wetlands Bylaw enforced by the Conservation Commission, the Comprehensive Plan, the town determined that existing Home Rule land use measures could be strengthened by undertaking the following measures: updating the Open Space Plan, establishing a Stormwater Committee, adopt a dumping bylaw. The town's focus on infrastructure includes implementing the Forge Pond Dam Phase 1 Assessment, seismic upgrades to the communications center, and evaluating the retrofitting of public buildings for snow loads.

RECOMMENDED MITIGATION MEASURES FOR 2023 HMP UPDATE

Hanover's 2023 mitigation strategy, which was developed by the Hazard Mitigation/MVP Core Team, includes the following recommended mitigation measures to address multiple natural hazards in the town.

FLOOD HAZARDS

A) Develop regulations under the wetlands protection bylaw – The bylaw was revised 2023, and flyers were prepared explain permitting, and were published in a newsletter. The town should continue education efforts on wetlands enforcement and focus on education about wetland regulations under the bylaw.

B) Implement the recommendations of the Forge Pond Dam Phase I assessment – The town should implement the recommendations of the Phase I assessment. The next step will be a more in-depth assessment and development of design plans and specifications to do the work. The work suggested by the Phase I assessment would preserve the integrity of the existing structure and make it less likely to breach.

C) Perform a hydraulic analysis of the remaining portion of the Indian Head River. – Since the 2016 plan the town partially completed this recommendation. A hydrology/hydraulic study was done for removal of State Street Dam, but the extent of the study did not go further upstream to Forge Pond. Through grant funding, a 3-town liaison committee was established for Hanover, Hanson, and Pembroke. The local team notes the concern that the Forge Pond and Factory Pond dams, can't carry the100-year flood flow. For the next five-year planning period, the Town should complete the hydrologic analysis for the remaining part of the Indian Head watershed, extending upstream to include Forge Pond and Factory Pond.

D) Update the stormwater bylaw – Coordinate with the Planning Dept. Public Works, and the Conservation Commission to adopt an updated stormwater bylaw. Consider incorporating provisions to address more intense rainfall and future climate change impacts to make new development more resilient.

F) ***Create a dumping bylaw –*** The Town should consider passing and enforcing a bylaw that regulates dumping in streams and ditches.

WINTER HAZARDS

G) ***Assess options to retrofit public buildings*** to withstand snow loads and prevent roof collapse. This should include an analysis of school roofs to determine if any of them are particularly vulnerable.

H) G) Provide additional staff resources to expand the Town's capacity for managing winter snow and ice hazards for trees to address power outages.

WIND HAZARDS

I) ***Educate homeowners on the benefits of wind retrofits*** - This might include structural improvements such as shutters and hurricane clips. The Town's Building Department would be a logical place for this activity to occur.

J) Provide additional staff resources to expand the Town's capacity for managing wind hazards for trees to address power outages.

GEOLOGIC HAZARDS

K) ***Implement seismic upgrades to the communications center*** – The Public Safety building should be reviewed to determine if changes are needed in order to be brought up to seismic standards. This review would help determine and address the potential for a collapse of the communications system that would impact the Town's ability to respond to emergencies after an earthquake.

L) ***Public building assessment:*** Assess the potential vulnerability of public buildings to earthquakes; and evaluate options for retrofits to make them more resilient, if any

BRUSH FIRE HAZARDS

M) ***Acquire a small brush truck*** - The Fire Department has indicated that they lack a small vehicle for accessing hiking/walking trails that could provide access into areas that are prone to brush fires. An additional piece of equipment such as a 4X4 Gator truck would add to the town's ability to fight these types of fires.

N) ***Installation of Dry Hydrants*** – Though there are many ponds and streams located throughout the Town, the Fire Department does not have easy access for their apparatus to draft water. The installation of dry hydrants at strategic locations will enhance the Department's ability to obtain water for firefighting purposes.

O) ***Map and maintain fire roads***– Many of the trails that provided access to wooded areas have been blocked by development. Many of these trails need to have downed branches and trees removed to allow easy passage of brush trucks. Other trails are overgrown and in need of clearing. The Fire Department has indicated that an accurate mapping of usable trails is needed.

EXTREME HEAT HAZARDS

P) Adopt Site Design Guidelines to increase tree plantings for new development and redevelopment to increase tree plantings near buildings, increase the percentage of trees used in parking areas, and along public ways.

Q) Promote Green Building and Cool Roof designs: Mitigate urban heat by implementing designs for green buildings and cool roofs. Implement new State Net Zero Energy pending the 10th Edition of the state Building Code.

DROUGHT HAZARDS

R) Promote drought tolerant landscaping and site design measures: Adopt site development guidelines promoting drought-tolerant plantings and landscape design by using permeable pavement to reduce runoff and increase groundwater recharge. Resources and guidance are available to Hanover residents through the Greenscapes Program of the North and South Rivers Watershed Association.

S) Water Bank: Evaluate the benefits of adopting a Water Bank to fund the implementation of water efficiency improvements as new developments add more water demand to the system. Other nearby communities have adopted this measure, including Weymouth, Hingham/Hull, and Scituate.

T) Diversify water supply: Evaluate the benefits of diversifying the Town's water supply and considering alternative water sources

U*) *Protect aquifer conservation zones, upgrade, and expand stormwater infrastructure, invest in robust treatment technologies

MULITI-HAZARDS

V*) *Provide enhanced emergency communications for vulnerable populations to promote access to cooling resources and other emergency services

W*) *Increase visibility of CERT Team and recruit people of younger generations; double the number of volunteers

X*) *Increase building resilience such as reliable backup power in critical facilities: High School, Council on Aging, YMCA/Early Learning Center, Starland

Input to Plan Recommendations from the Community Resilience Building Workshop

Twelve top-priority actions were identified and prioritized by the Community Resilience Building workshop on April 10, 2023. Most of these actions (9 of 12) were incorporated into this Hazard Mitigation Plan's mitigation strategy. These are listed in Table 46 with references to their related HMP mitigation recommendations. The priority CRB actions are distributed across all categories: societal, infrastructure, and environment.

Table 46: Priority Actions from the CRB Workshop and HMP Recommendations

CRB#	TABLE	CATEGORY	MITIGATION ACTION	HMP Strategy
CRB 1	Red, Blue, &Green	Societal	Invest in improved communications for emergencies, including vulnerable populations. Use multiple formats, all media: print, TV, sign boards, AM radio tower; leverage existing networks	Multi-Hazards #V
CRB 2	Green	Societal	Increase visibility of CERT Team and recruit people of younger generations; double the number of volunteers	Multi-Hazards #W
CRB 3	Blue	Societal	Address staff shortages/lack of manpower	Winter Hazards #H Wind Hazards #J
CRB 4	Red	Infrastructure/ Social	Provide treatment and education on PFAS in water supply in relation to public health	
CRB 5	Green	Infrastructure	Increase building resilience such as reliable backup power in critical facilities: High School, Council on Aging, YMCA/Early Learning Center, Starland	Multi-Hazards #X
CRB 6	Red	Infrastructure	Sustainable funding sources for infrastructure; includes additional & situational staffing for emergencies	
CRB 7	Blue	Infrastructure	Improving power substations	
MVP 8	Blue	Infrastructure	Address the Impacts of wind/severe weather on critical infrastructure	Winter Hazards #F Wind Hazards #I
CRB 9	Red	Infrastructure	Coordinated approach to balancing water supply and growth across Town departments	Drought Hazards #S
MVP 10	Red	Infrastructure	Diversify the Town's water supply; seek alternative sources	Drought Hazards #T
CRB 11	Green	Environment	Protect aquifer conservation zones, upgrade, and expand stormwater infrastructure, invest in robust treatment technologies	Drought Hazards #U
CRB 12	Green	Environment	Work with National Grid to trim trees aggressively near power lines; bury lines during construction projects; educate homeowners about privately owned trees	Winter Hazards #H Wind Hazards #J

PROCESS FOR SETTING PRIORITIES FOR MITIGATION MEASURES

A key step in developing the mitigation strategy is to assign a level of priority to each mitigation measure so as to guide the Town's limited resources towards actions with the greatest potential benefit. At this stage in the process, the Hanover HMP/MVP Core Team has limited access to detailed data of the costs and benefits of the measures, so prioritization is based on the team member's knowledge of the existing and potential hazard impacts and an approximate idea of the costs associated with each measure.

Prioritization occurred through discussion at a meeting of the local team and through subsequent review by team members and public comment. Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events and the extent of the area impacted and the relation of a mitigation measure to the Town's goals.

Through the discussion, the local team took into consideration factors such as the number of homes and businesses affected, whether or not road closures occurred and what impact closures had on delivery of emergency services and the local economy, anticipated project costs, whether the Town currently has the technical and administrative capability to carry out the mitigation measures, whether any environmental constraints existed, and whether the Town would be able to justify the costs relative to the anticipated benefits.

The table below demonstrates the prioritization. For each mitigation measure, the geographic extent of the benefiting area is identified, as is an estimate of the overall benefit and cost of the measures. The benefits and costs were evaluated in terms of:

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event
Estimated Costs	
High	Estimated costs greater than $200,000
Medium	Estimated costs between $100,000 to $200,000
Low	Estimated costs less than $100,000 and/or staff time
Mitigation 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

Priorities for all mitigation measures are shown in Table 47, and the mitigation descriptions, priorities, lead agency, estimated cost, timeframe, and potential funding sources for each mitigation action are shown in Table 48 below.

Table 47: Hanover Mitigation Measure Prioritization

Mitigation Measure	Geographic Area	Benefit	Estimated Cost	Priority
Flood Hazard Mitigation Measures				
A) The town should continue education efforts on wetlands enforcement and focus on education about wetland regulations under the bylaw.	Townwide	Medium	Low	Medium
B) Implement recommendations of the Forge Pond Dam Phase 1 Assessment	Forge Pond Dam watershed	High	High	High
C) Complete the hydrologic analysis for the remaining part of the Indian Head watershed, extending upstream to include Forge Pond and Factory Pond	Indian Head River watershed	High	Medium	High
D) Update the stormwater bylaw	Town-wide	Medium	Low	Medium
F) Enact a dumping bylaw	Town-wide	Medium	Low	Low
Winter Storm Hazard Mitigation Measures				
G) Assess options to retrofit public buildings for snow loads on roofs.	Building specific	Medium	Medium	Medium
H) Provide additional staff resources to expand the Town's capacity for managing winter snow and ice hazards for trees to address power outages.	Town-wide	Medium	Medium	Medium

Table 47: Hanover Mitigation Measure Prioritization

Mitigation Measure	Geographic Area	Benefit	Estimated Cost	Priority
Wind Hazard Mitigation Measures				
I) Educate homeowners on the benefits of wind retrofits.	Town-wide	Low	Low	Low
J) Provide additional staff resources to expand the Town's capacity for managing wind hazards for trees to address power outages.	Town-wide	Medium	Medium	Medium
Geologic Hazards Mitigation Measures				
K) Implement seismic upgrades to the communications center	Site specific	Medium	High	Low
L) Assess the potential vulnerability of public buildings to earthquakes; and evaluate options for retrofits to make them more resilient, if any	Public Buildings	Low	Medium	Low
Fire Hazard				
M) Acquire a small brush truck	Town-wide	Medium	Medium	Medium
N) Install dry hydrants	Town-wide	Medium	Medium	Medium
O) Map and maintain fire roads	Town-wide	High	Low	High
Extreme Heat Hazards				
P) Adopt Site Design Guidelines to increase shade tree plantings for new development	Town-wide	Medium	Low	Medium

Table 47: Hanover Mitigation Measure Prioritization

Mitigation Measure	Geographic Area	Benefit	Estimated Cost	Priority
Q) Promote Green Building and Cool Roof designs to mitigate urban heat	Town-wide	Low	Low	Low
Drought Mitigation Measures				
R) Promote drought tolerant landscaping and site design measures	Town-wide	Medium	Medium	High
S) Evaluate the benefits of adopting a Water Bank	Town-wide	High	Medium	High
T) Evaluate the benefits of diversifying the Town's water supply and considering alternative water sources	Town-wide	Medium	Medium	Medium
U) Protect aquifer conservation zones, upgrade, and expand stormwater infrastructure, invest in robust treatment technologies	Water Supply resource areas	High	Low	High
Multi-Hazard Mitigation Measures				
V) Provide enhanced emergency communications for vulnerable populations to promote access to cooling resources and other emergency services	Town-wide	High	Medium	High
W) Increase visibility of CERT Team and recruit people of younger generations; double the number of volunteers	Town-wide	Medium	Low	Medium
X) Increase building resilience such as reliable backup power in critical facilities: High School,	Municipal Buildings	High	High	High

Table 47: Hanover Mitigation Measure Prioritization

Mitigation Measure	Geographic Area	Benefit	Estimated Cost	Priority
Council on Aging, YMCA/Early Learning Center, Starland				

RECOMMENDED MITIGATION TABLE

INTRODUCTION TO MITIGATION MEASURES TABLE (Table 48)

Mitigation Recommendation – The name and brief description of the mitigation measure.

Priority – As described above, the designation of high, medium, or low priority was done considering potential benefits and estimated project costs.

Lead Implementation– based on a general knowledge of what each municipal department is responsible for. Most mitigation measures may require coordination of multiple departments, and assigning staff is the sole responsibility of the governing body of each community. Coordination with state agencies should also be considered.

Estimated Cost – The Local Hazard Mitigation Team assigned a cost category as follows:

Low:	<$100,000 and/or staff time
Medium:	$$100,000 to $200,000
High:	>$200,000

Time Frame – The timeframe was based on a combination of the priority for that measure, the complexity of the measure and whether the measure is conceptual, in design, or already designed and awaiting funding. The timing for all mitigation measures has also been kept within the typical five-year HMP framework. The identification of a likely timeframe is not meant to constrain a community from taking advantage of funding opportunities as they arise. In some cases, target dates are listed. In other cases, the estimated time ranges are used.

Potential Funding Sources – This column attempts to identify the most likely potential sources of funding for each recommended mitigation 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. Identification of a potential funding source in this table does not guarantee that a project will be eligible for or selected for funding. The best way to determine eligibility for a particular funding source is to review the project with a staff person at the funding agency.

Abbreviations used in the Table below include:

- BRIC: Building Resilient Infrastructure and Communities (FEMA)
- DEP: Department of Environmental Protection
- MassDOT: Massachusetts Department of Transportation
- MET: Massachusetts Environmental Trust
- MVP: Municipal Vulnerability Preparedness (MA Energy and Environmental Affairs)
- TAP: Technical Assistance Program (MAPC)

Table 48: Recommended Hanover Mitigation Strategy

Mitigation Recommendations	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe	Potential Funding Sources
FLOOD HAZARDS					
A) The town should continue education efforts on wetlands enforcement and focus on education about wetland regulations under the bylaw.	Medium	Conservation Commission	Low	2023-2025	Town General Fund
B) Implement recommendations of the Forge Pond Dam Phase 1 Assessment	High	DPW	High	2023-2026	Town General Fund/BRIC
C) The Town should complete the hydrologic analysis for the remaining part of the Indian Head watershed, extending upstream to include Forge Pond and Factory Pond	High	Planning/DPW	Medium	2024-2025	Town General Fund BRIC/HMGP/ACOE
D) Update the stormwater bylaw	Medium	Planning	Low	2024	Town General Fund/TAP
F) Enact a dumping bylaw: Bylaw Committee to Evaluate components of dumping restrictions spread across various bylaws and ensure comprehensive regulations are in place, including addressing dumping on Conservation Land	Low	Planning and Conservation	Low	2025	Staff time

Mitigation Recommendations	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe	Potential Funding Sources
WINTER HAZARDS					
G) Assess the potential vulnerability of public buildings to snow loads; evaluate options for retrofits to make them more resilient, if any. Coordinate with roof analysis for solar panels	Medium	Public Facilities.	Low	2025-2026	Town General Fund
H) Provide additional staff resources to expand the Town's capacity for managing winter snow and ice hazards for trees to address power outages.	Medium	DPW	Medium	2024-2028	Town Genera Fund
WIND HAZARDS					
I) Educate homeowners on the benefits of wind retrofits.	Low	Building Dept.	Low	2024-2028	Town General Fund
J) Provide additional staff resources to expand the Town's capacity for managing wind hazards for trees to address power outages.	Medium	Building Dept.	Medium	2024-2028	Town General Fund

Mitigation Recommendations	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe	Potential Funding Sources
GEOLOGIC HAZARDS					
K) Implement seismic upgrades to the communications center	Low	Public Facilities/ Emergency Mgt.	Medium	2026-2028	Town General Fund/BRIC
L) Assess the potential vulnerability of public buildings to earthquakes; and evaluate options for retrofits to make them more resilient, if any	Low	Public Facilities	Low	2026-2028	Town General Fund
WILDFIRE HAZARDS					
M) Acquire a small brush truck	Medium	Fire Dept.	Medium	2025-2026	Town General Fund/USDA
N) Install dry hydrants	Medium	Fire Dept.	Medium	2025-2028	Town General Fund/USDA
O) Map and maintain fire roads	High	Fire Dept.	Medium	2024-2026	USDA/Town General Fund

Mitigation Recommendations	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe	Potential Funding Sources
EXTREME HEAT HAZARDS					
P) Adopt Site Design Guidelines to increase shade tree plantings for new development	Medium	Planning/ Conservation	Low/Staff Time	2024-2025	Staff Time
Q) Promote Green Building and Cool Roof designs to mitigate urban heat	Low	Planning/ Building	Low/Staff Time	2024-2025	Staff Time
DROUGHT HAZARDS					
R) Promote drought tolerant landscaping and site design measures	Medium	Planning/ Conservation	Low/Staff Time	2024-2025	Staff Time
S) Evaluate the benefits of adopting a Water Bank	High	DPW	Low/Staff Time	2024-2025	Town General Fund/DEP
T) Evaluate the benefits of diversifying the Town's water supply and considering alternative water sources	Medium	DPW	High	2024-2028	Town General Fund/DEP
U) Protect aquifer conservation zones, upgrade, and expand stormwater infrastructure, invest in robust treatment technologies	High	Planning, Conservation, DPW	Low/Staff Time	2024-2025	Town General Fund

Mitigation Recommendations	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe	Potential Funding Sources
MULTI-HAZARDS					
V) Provide enhanced emergency communications for vulnerable populations to promote access to cooling resources and other emergency services	High	Emergency Management, Town Communications, Council on Aging	Low/Staff Time	2024-2026	Town General Fund / MVP
W) Increase visibility of CERT Team and recruit people of younger generations; double the number of volunteers	Medium	Emergency Management	Low/Staff Time	2024-2026	Town General Fund
X) Increase building resilience such as reliable backup power in critical facilities: High School, Council on Aging, YMCA/Early Learning Center, Starland	High	Public Facilities, Emergency Management	High	2025-2028	Town General Fund/BRIC/HMGP

SECTION 9: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION AND APPROVAL

The Hanover Hazard Mitigation Plan 2023 Update was adopted by the Board of Selectmen on *[ADD DATE]*. See Appendix D for documentation. The plan was approved by FEMA on [*ADD DATE*] for a five-year period that will expire on [*ADD DATE*].

PLAN MAINTENANCE

MAPC worked with the Hanover Hazard Mitigation/MVP Core Team to prepare this plan. This group will continue to meet to coordinate the implementation and maintenance of this plan, with the Emergency Management Director/Fire Chief designated as the team coordinator. Additional members could be added to the local team from businesses, non-profits, and institutions. The Town will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the Hazard Mitigation/MVP Core Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation/MVO Core Team will be publicly noticed in accordance with town and state open meeting laws.

IMPLEMENTATION AND EVALUATION SCHEDULE

Mid-Term Survey on Progress – The coordinator of the Hazard Mitigation Team will prepare and distribute a survey in year three of the plan. The survey will be distributed to all the local team members and other interested local stakeholders. The survey will poll the members on progress and accomplishments for implementation, any new hazards or problem areas that have been identified, and any changes or revisions to the plan that may be needed.

Evaluation criteria--In reviewing progress on implementing the plan, the local team will consider factors that may be barriers or constraints to implementation of the mitigation strategies, including capital costs, operating costs, staff capacity, training, or expertise, legal and regulatory barriers, public support or opposition (such as NIMBY objections), and planning and coordination among multiple municipal departments.

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

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

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

Prepare and Adopt an Updated Local Hazard Mitigation Plan – Once the resources have been secured to update the plan, the Hazard Mitigation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However, the Hazard Mitigation Implementation Team decides to update the plan, the Town will need to review the current FEMA hazard mitigation plan guidelines at that time for any changes in requirements for hazard mitigation plans since the previous plan. Once the next plan update is prepared, the Town

will submit it to MEMA and FEMA for review and_approval and adopt the plan update in order to obtain formal FEMA approval of the plan.

INTEGRATION OF THE PLANS WITH OTHER PLANNING INITIATIVES

Upon approval of the Hanover Hazard Mitigation Plan 2023 Update by FEMA, the Hanover Hazard Mitigation/MVP Core Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire/Emergency Management
- Police
- Public Works
- Planning
- Conservation
- Water
- Facilities

Other groups that will be coordinated include Chambers of Commerce, 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 Open Space and Recreation Plan, Comprehensive Emergency Management Plan, Master Plan, and Capital Plan.

SECTION 10: LIST OF REFERENCES

Blue Hills Observatory
Hanover Comprehensive Emergency Management Plan
Hanover Open Space and Recreation Plan, 2017-18
Hanover Subdivision
Hanover Wetlands Bylaw
Hanover Zoning Bylaws as adopted, amended, and approved.
FEMA, Disaster Declarations for States and Countie
FEMA, Flood Insurance Rate Maps for Plymouth County, Hanover, MA
FEMA, Flood Insurance Program statistics
FEMA, Hazard Mitigation Plan Review Guide, September 2011
FEMA, Hazards US Multi-Hazards
FEMA, Local Mitigation Planning Policy Guide, 2022
FEMA, Mitigation Ideas- A Resource for Reducing Risk to Natural Hazards, 2013
MacConnell Land Use Statistics, Commonwealth of Massachusetts, 2005
Massachusetts Climate Change Assessment, 2022
Massachusetts Department of Community Development, Community Profiles
Massachusetts State Drought Management Plan 2019
Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018
MA Emergency Management Agency, State *Hazard Mitigation Plan*, 2013
Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams
MA Geographic Information System, *McConnell Land Use Statistics*
Metropolitan Area Planning Council, Geographic Information Systems Lab
Metropolitan Area Planning Council. *MassBuilds* development database
National Weather Service
Nevada Seismological Library (NSL) 2005
New England Seismic Network, Weston Observatory
NOAA, National Centers for Environmental Information, data for Plymouth County, MA
Northeast Climate Adaptation Science Center
Northeast States Emergency Consortium (NESEC)
Tornado History Project
USACE, Ice Jam Database
USDA Forest Service, Wildfire Risk to Communities
U.S. Census, 2020 and American Community Survey, 2021
U.S. Geologic Survey, Landslides 101
U.S. Geologic Survey, National Water Information System
US Global Change Research Program, *Fourth National Climate Assessment,* 2018

APPDENDIX A: HAZARD MAP SERIES

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

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

Map 1.	Population Density
Map 1b.	Environmental Justice
Map 2.	Land Use
Map 3.	Flood Zones
Map 3b.	Flood Claims from March 2010 Disaster Declaration
Map 4.	Earthquakes and Landslides
Map 5.	Hurricanes and Tornadoes
Map 6.	Average Snowfall
Map 7.	Composite Natural Hazards
Map 8.	Local Hazard Areas
Map 9	Land Surface Temperature
Map 10	Coastal Flooding
Map 11	Wildfires

Map 1: Population Density – This map uses the US Census block data for 2020 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 1b: Environmental Justice – This map shows Environmental Justice (EJ) populations using 2020 data. EJ designations from the State include English isolation, income, and minority residents.

Map 2: Land Use – This map shows land cover and land use from MassGIS' 2016 Land Cover/Land Use dataset.

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones for Plymouth 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.

Map3b: Flood Claims – This map shows flood insurance and disaster claim records from March 2010. The March 29, 2010 federal disaster declaration associated with severe rainfall and flooding triggered the launch of the Federal Emergency Management Agency's (FEMA's) Individual Assistance Program through which residential property owners, businesses, and institutions without flood insurance were eligible to apply for relief to pay for storm-related expenditures and repairs. In the MAPC region, 18,400 claims were approved for $30 million dollars in disaster assistance.

Map 4: Earthquakes and Landslides (Regional) – This map depicts landslide risk and recorded earthquake epicenters in the community and surrounding region. 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.

APPDENDIX A: HAZARD MAP SERIES

5: Hurricanes and Tornadoes (Regional) – This map shows the spatial characteristics of several different meteorological properties and past events in the community and surrounding region. 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 and areas that could be inundated by storm surge during a hurricane, if any.

Map 6: Average Snowfall (Regional) - This map shows the average snowfall in the community and the surrounding region.

Map 7: Composite Natural Hazards (Regional) - This map shows four categories of composite natural hazards. 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 hazards present. High hazard areas have three hazards present and severe hazard areas have four hazards present.

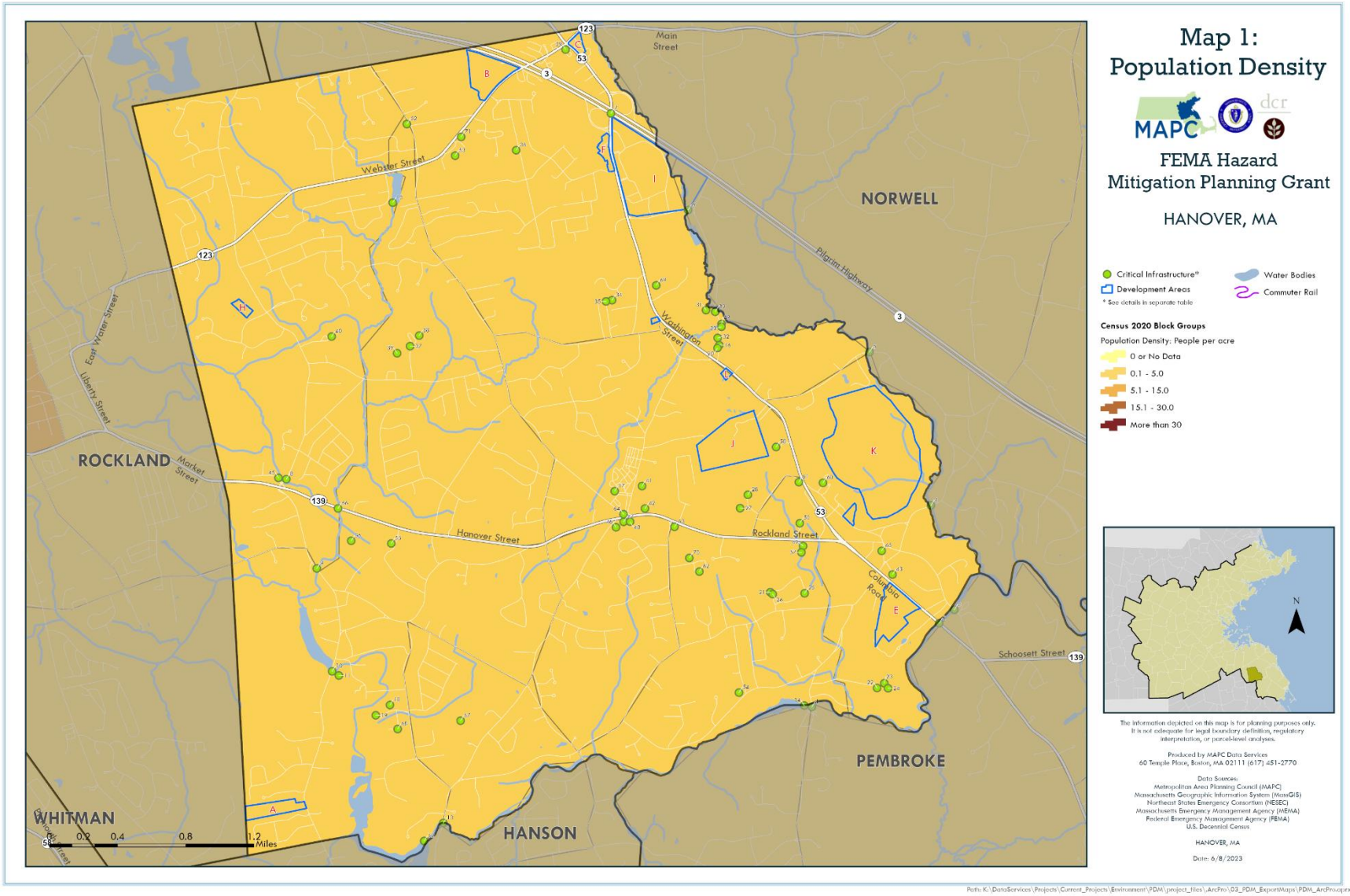
Map 8: Local Hazard Areas – For each community, locally identified hazard areas are overlaid on an aerial photograph. The critical infrastructure sites and planned development areas are also shown. The source of the aerial photograph is Mass GIS.

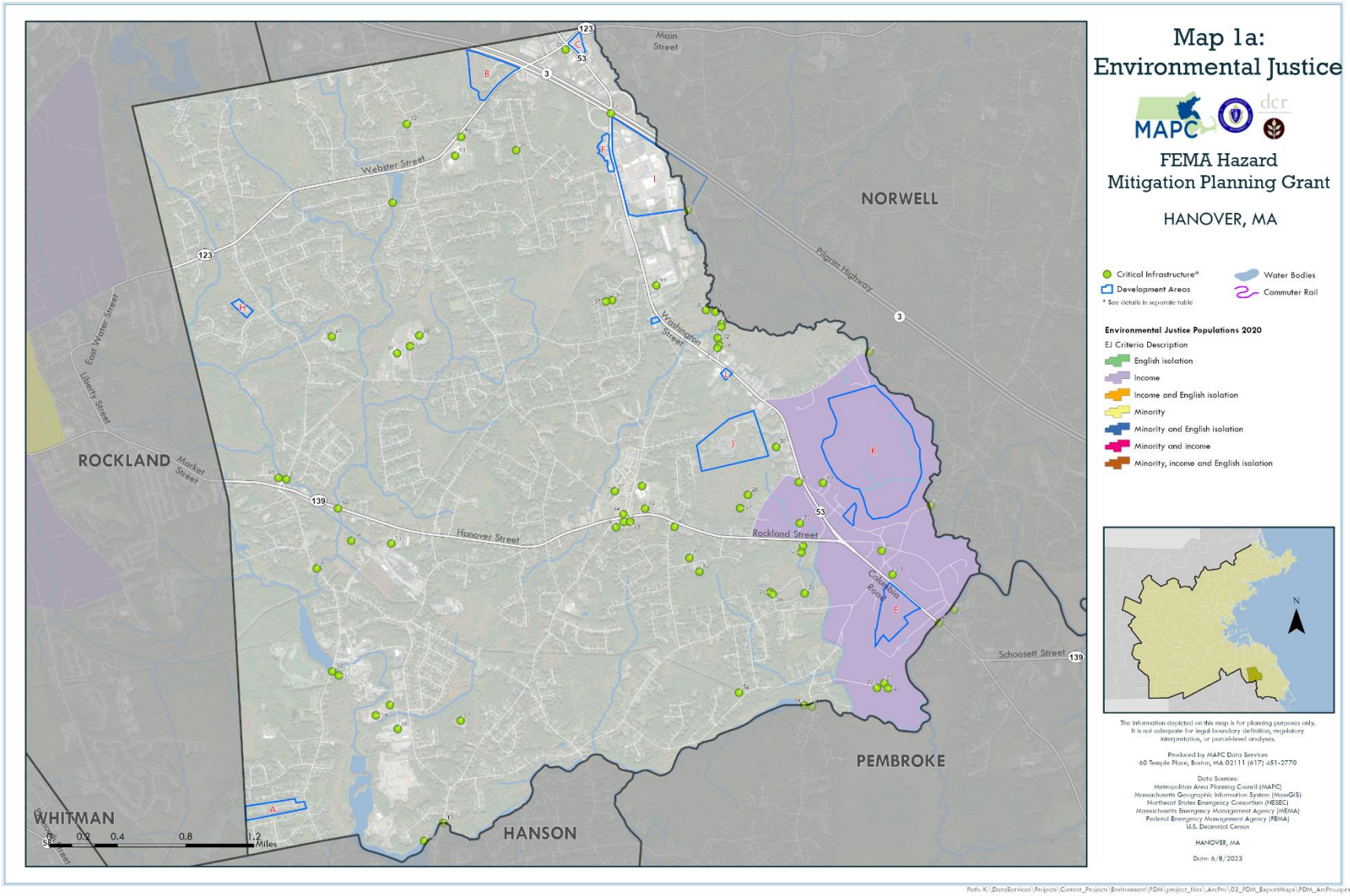
Map 9: Extreme Heat – MAPC's Statewide Land Surface Temperature (LST) Index was created by combining estimates of surface temperature from days in 2018, 2019, and 2020 where the daily air temperature maximum exceeded 70 degrees Fahrenheit. The Statewide LST Index "Hot Spots" data depicts the 5% highest LST index areas in each Regional Planning Agency (RPA) region. The data was generated by identifying pixels whose LST index values are equal to or greater than 95% of LST index values in the region, and then delineating cohesive regions where pixels meet this criterion as polygons. Map 9 represents the "Hot Spots" relative to the MAPC region, mapped on top of the National Land Cover Database's 2016 30-m tree canopy data.

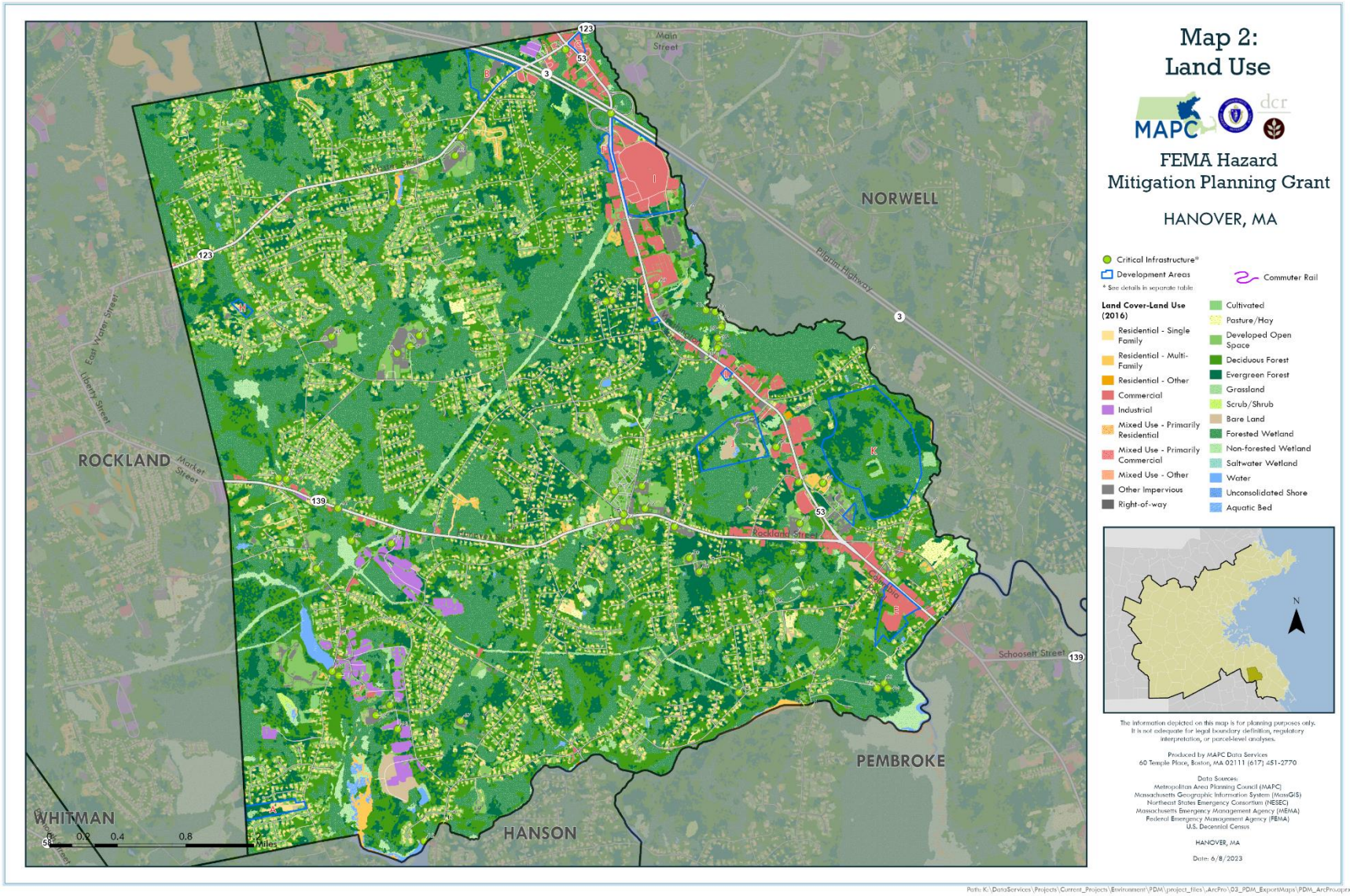
Map 10: Sea Level Rise – This map presents the projections for several future sea level rise scenarios developed for the Massachusetts Coastal Flood Risk Model (MC-FRM) by the Wood Hole Group. The analysis was contracted by the Commonwealth of Massachusetts.

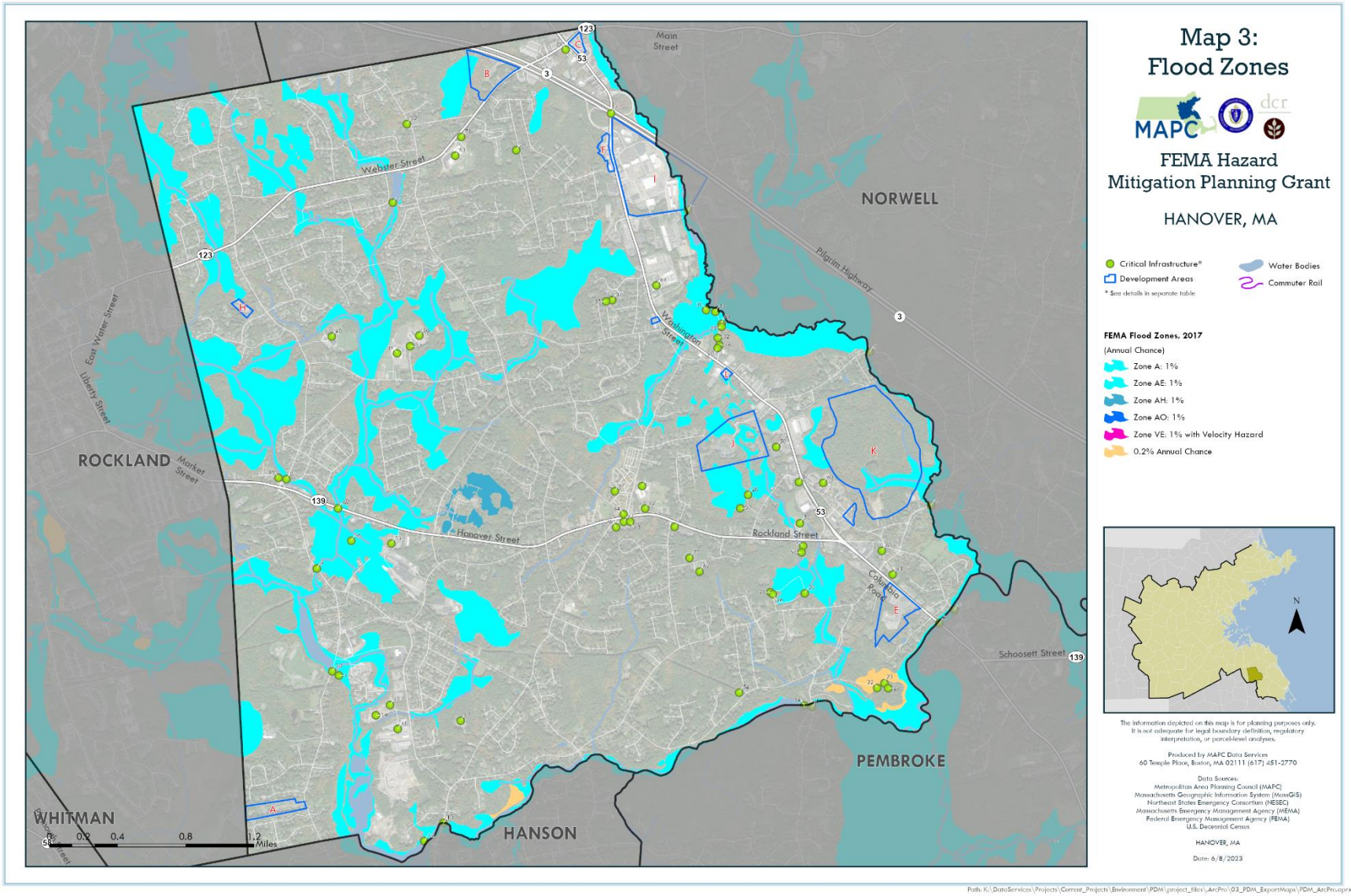
Map 11: Wildfires – This map shows wildfire risk to the community using USDA data. Wildfire risk is classified as very low, low, moderate, high, and very high.

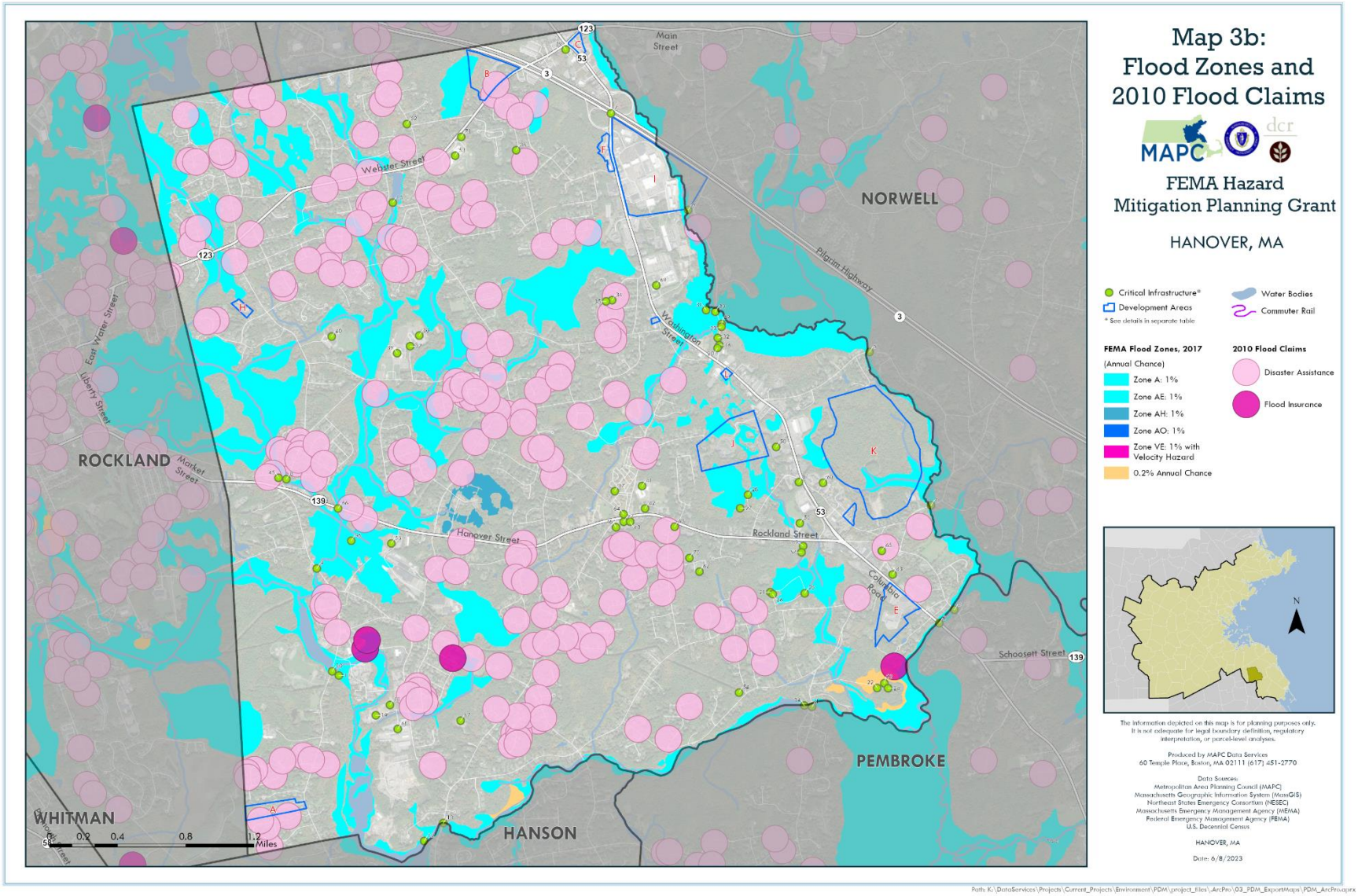
The map set described above is included on the subsequent pages.

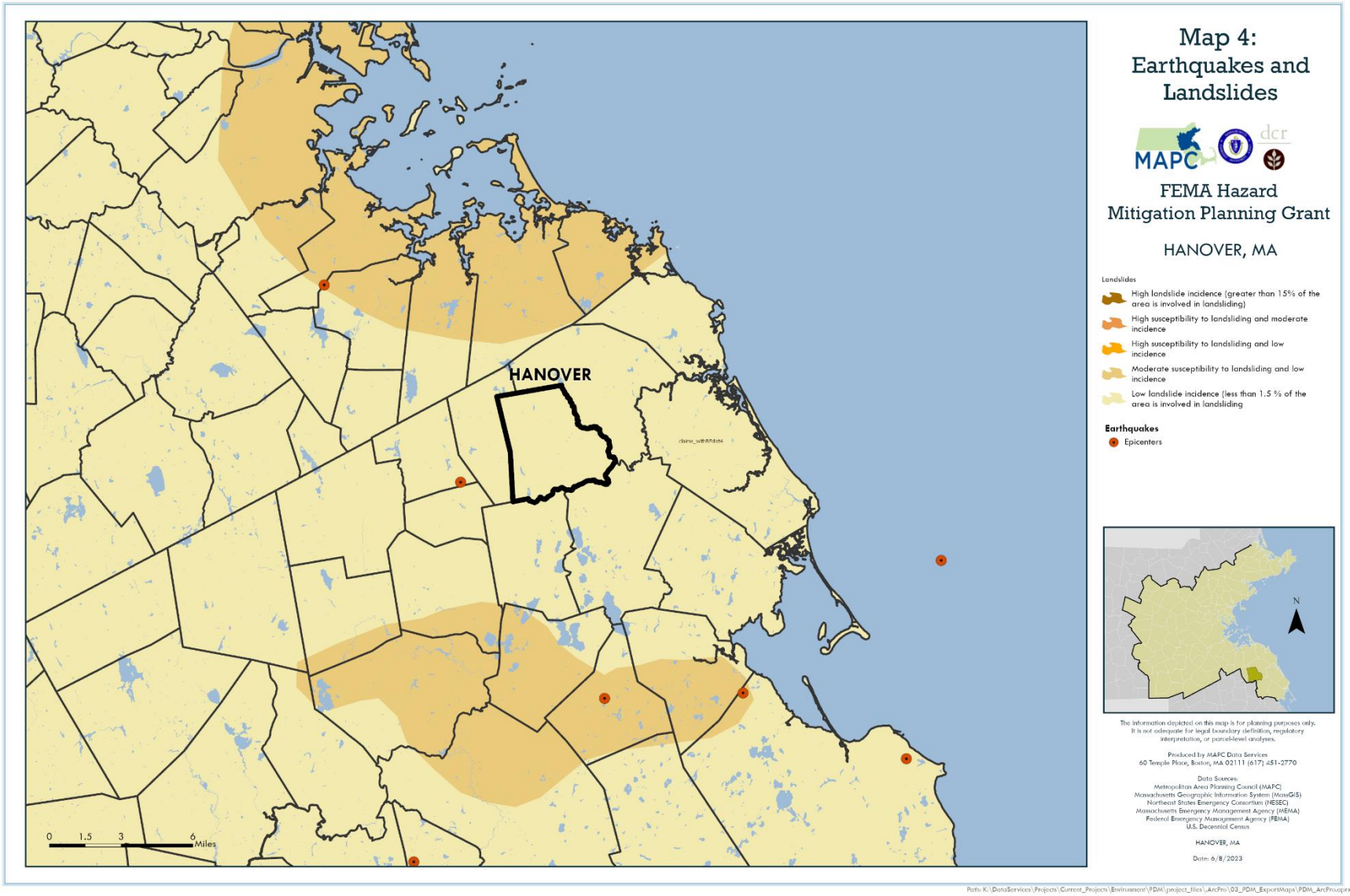

Map 1:
Population Density
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Census 2020 Block Groups
Population Density: People per acre
0 or No Data
0.1 - 5.0
5.1 - 15.0
15.1 - 30.0
More than 30
NORWELL
ROCKLAND
WHITMAN
HANSON
PEMBROKE
Main Street
Webster Street
Pilgrim Highway
East Water Street
Liberty Street
Market Street
Washington Street
Hanover Street
Rockland Street
Columbia Road
Schoosett Street
123
3
53
139
A
B
C
D
E
F
I
J
K
0 0.2 0.4 0.8 1.2 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.
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)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023

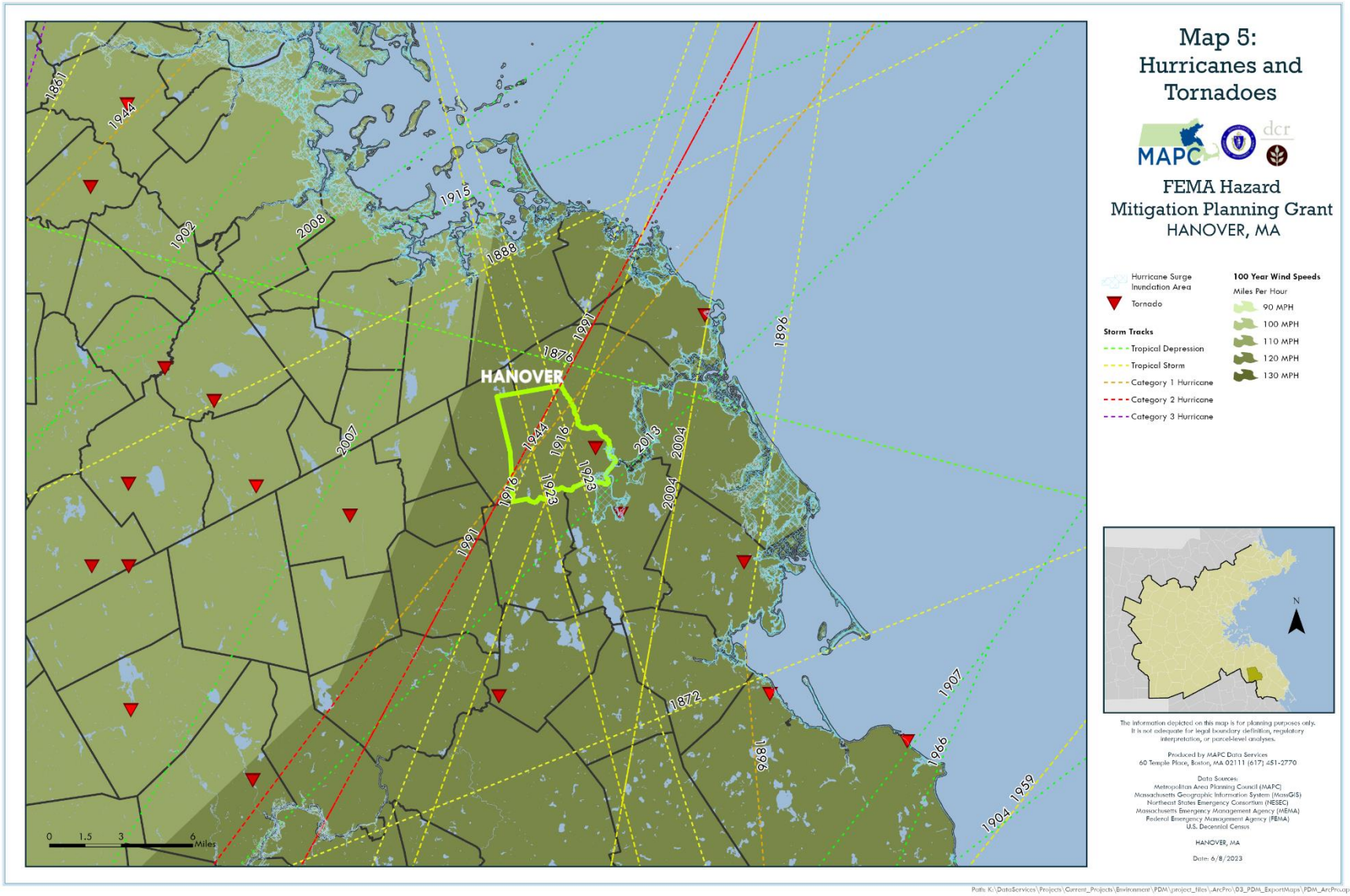

Map 1a:
Environmental Justice
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Environmental Justice Populations 2020
EJ Criteria Description
English isolation
Income
Income and English isolation
Minority
Minority and English isolation
Minority and income
Minority, income and English isolation
NORWELL
ROCKLAND
WHITMAN
HANSON
PEMBROKE
Main Street
Webster Street
Pilgrim Highway
Washington Street
East Water Street
Liberty Street
Market Street
Hanover Street
Rockland Street
Columbia Road
Schoosett Street
0 0.2 0.4 0.8 1.2 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 (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023

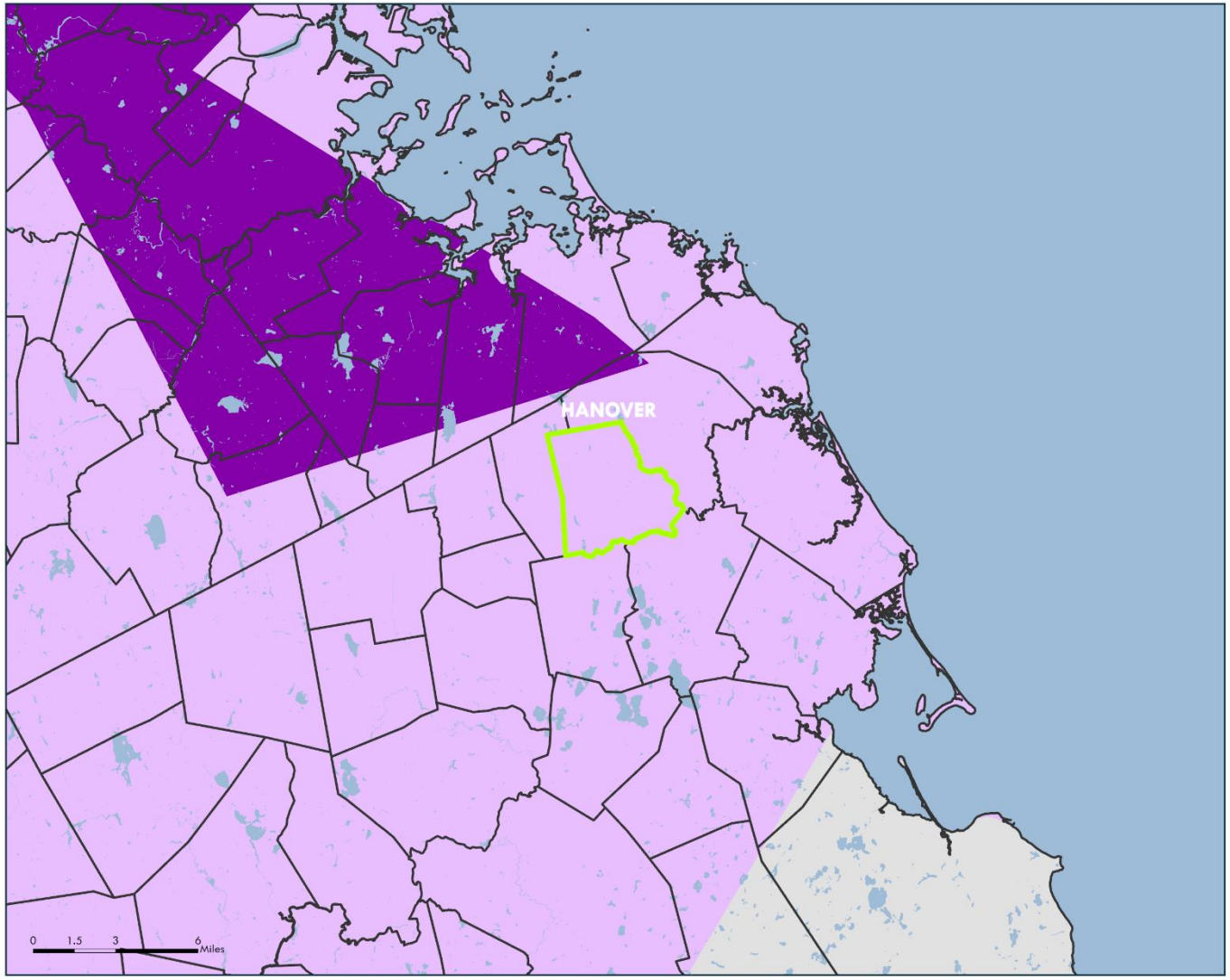

Map 2:
Land Use
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Commuter Rail
Land Cover-Land Use (2016)
Residential - Single Family
Residential - Multi-Family
Residential - Other
Commercial
Industrial
Mixed Use - Primarily Residential
Mixed Use - Primarily Commercial
Mixed Use - Other
Other Impervious
Right-of-way
Cultivated
Pasture/Hay
Developed Open Space
Deciduous Forest
Evergreen Forest
Grassland
Scrub/Shrub
Bare Land
Forested Wetland
Non-forested Wetland
Saltwater Wetland
Water
Unconsolidated Shore
Aquatic Bed
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)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023
NORWELL
ROCKLAND
HANSON
PEMBROKE
WHITMAN
Main Street
Pilgrim Highway
Market Street
Rockland Street
Schooner Street
0 0.2 0.4 0.8 Miles


Map 3:
Flood Zones
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
FEMA 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
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)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023
NORWELL
ROCKLAND
HANSON
PEMBROKE
WHITMAN
Main Street
Webster Street
Pilgrim Highway
Washington Street
East Water Street
Liberty Street
Market Street
Hanover Street
Rockland Street
Columbia Road
Schoosett Street
0 0.2 0.4 0.8 1.2 Miles


Map 3b:
Flood Zones and
2010 Flood Claims
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
FEMA 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
2010 Flood Claims
Disaster Assistance
Flood Insurance
NORWELL
ROCKLAND
HANSON
PEMBROKE
WHITMAN
Main Street
Webster Street
Pilgrim Highway
Washington Street
East Water Street
Liberty Street
Market Street
Hanover Street
Rockland Street
Columbia Road
Schoosett Street
0 0.2 0.4 0.8 1.2 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 (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023


HANOVER
0 1.5 3 6 Miles
Map 4:
Earthquakes and
Landslides
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
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
Earthquakes
Epicenters
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)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023


Map 5:
Hurricanes and Tornadoes
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
HANOVER, MA
Hurricane Surge Inundation Area
Tornado
Storm Tracks
Tropical Depression
Tropical Storm
Category 1 Hurricane
Category 2 Hurricane
Category 3 Hurricane
100 Year Wind Speeds
Miles Per Hour
90 MPH
100 MPH
110 MPH
120 MPH
130 MPH
HANOVER
1861
1944
1902
2008
1915
1888
1991
1876
1896
2007
1944
1916
2013
2004
1916
1938
1938
2004
1991
1872
1907
1966
1959
1904
1988
0 1.5 3 6 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.
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)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023
Path: K:\DataServices\Projects\Current_Projects\Environment\PDM\project_files\ArcPro\03_PDM_ExportMaps\PDM_ArcPro.aprx



Map 6: Average Snowfall

FEMA Hazard Mitigation Planning Grant

HANOVER, MA

Average Annual Snowfall

Inches

G 36.1 - 48.0

H 48.1 - 72.0

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.

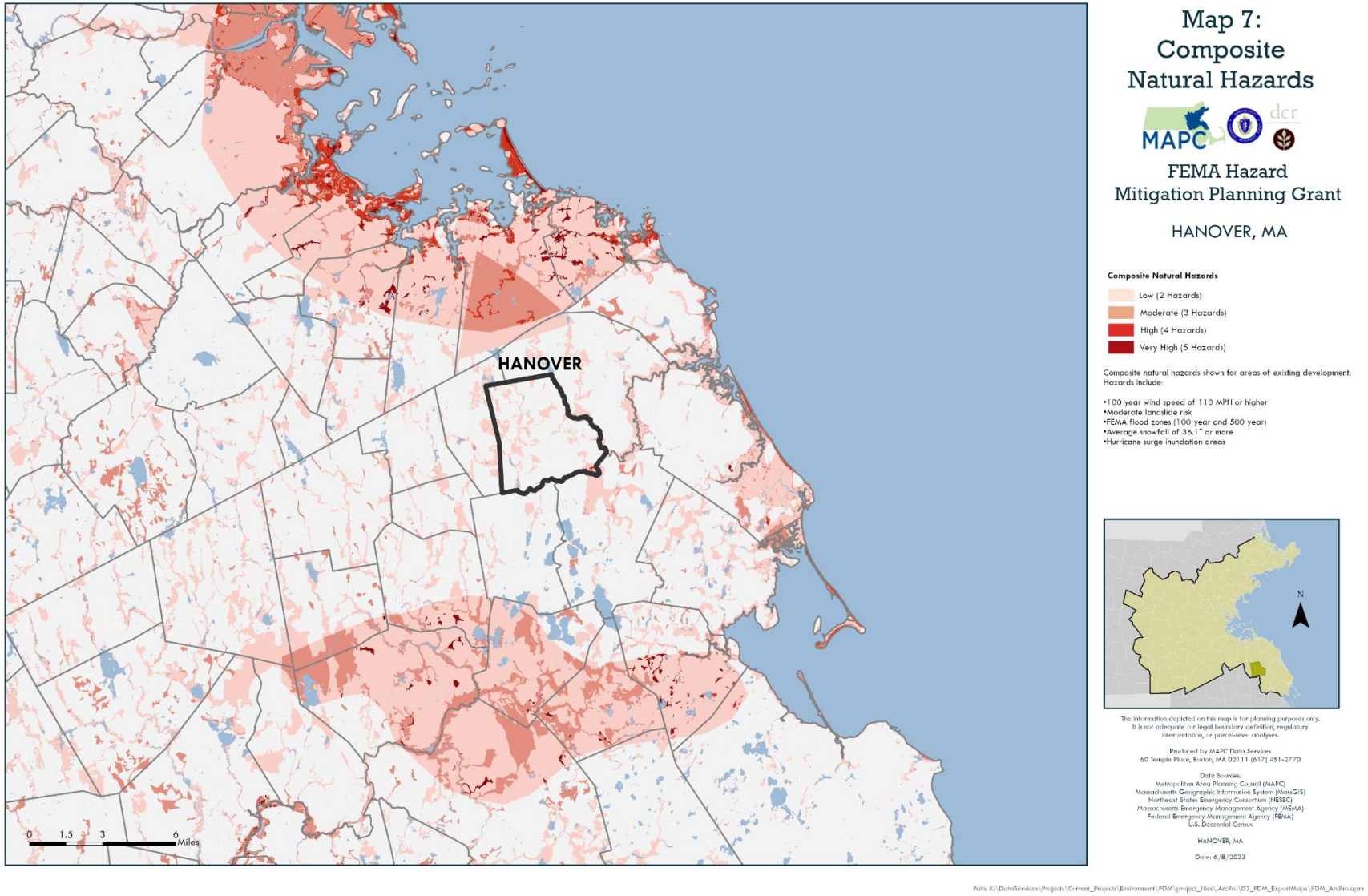
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770

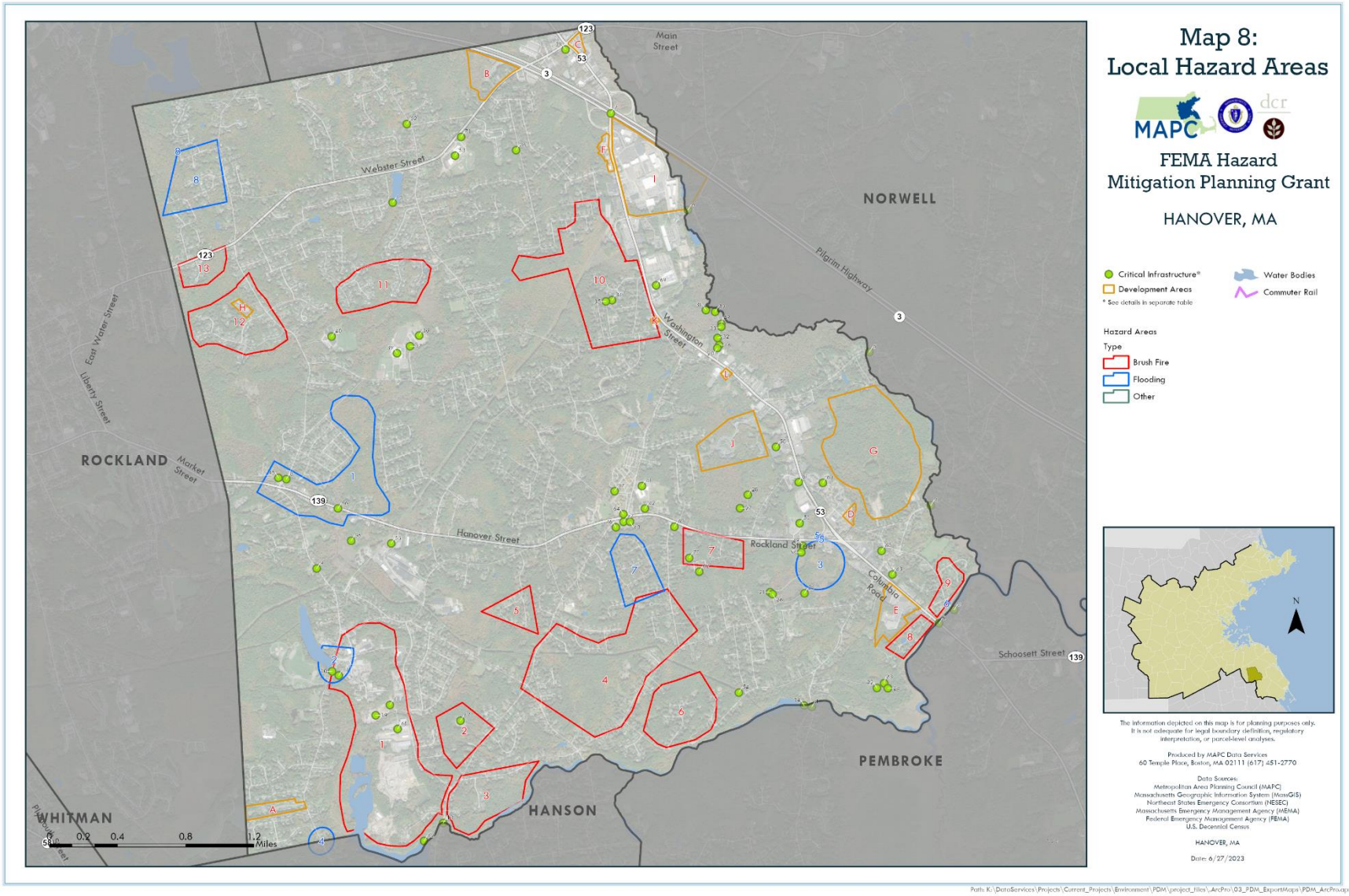
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census

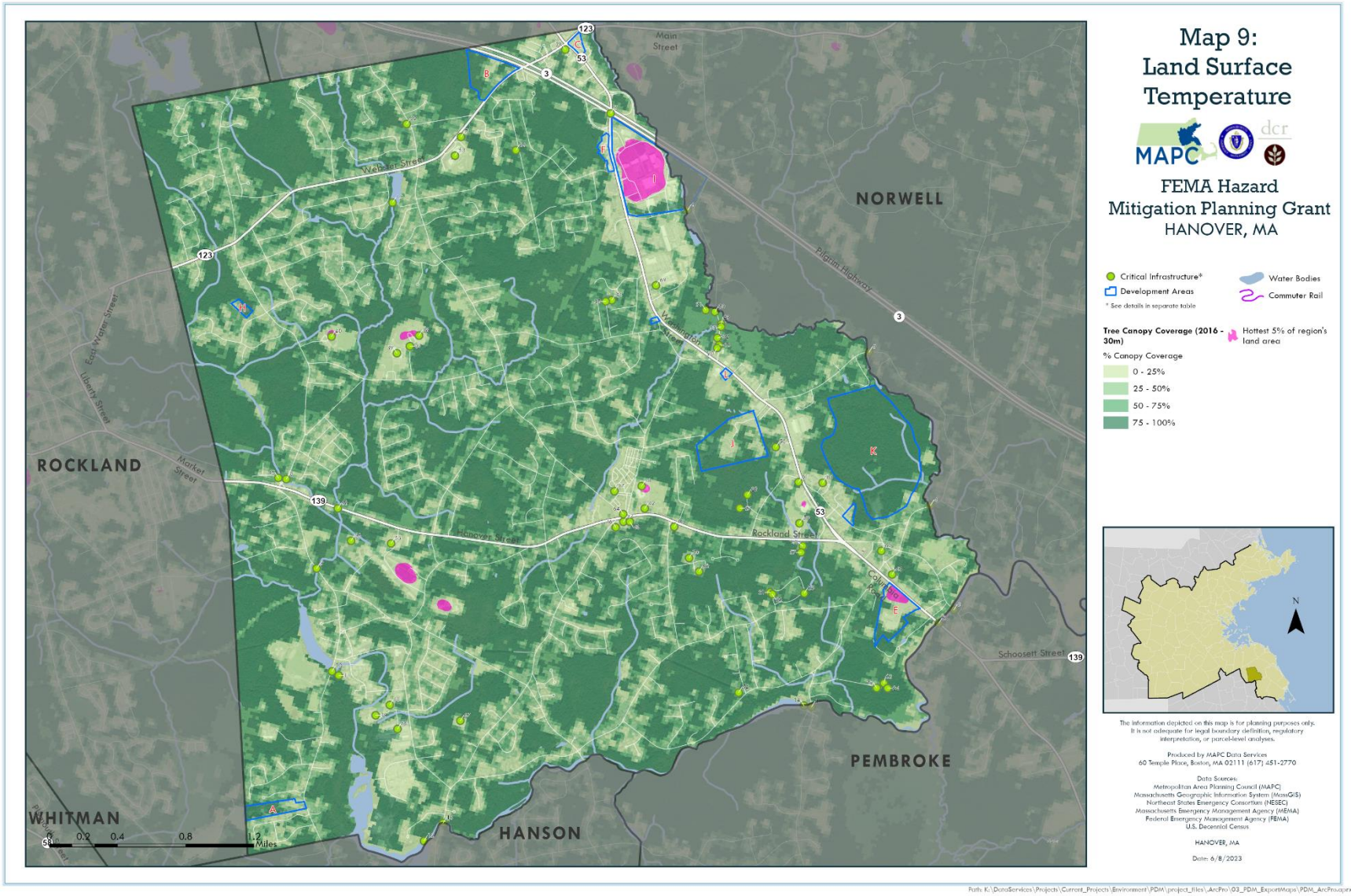
HANOVER, MA

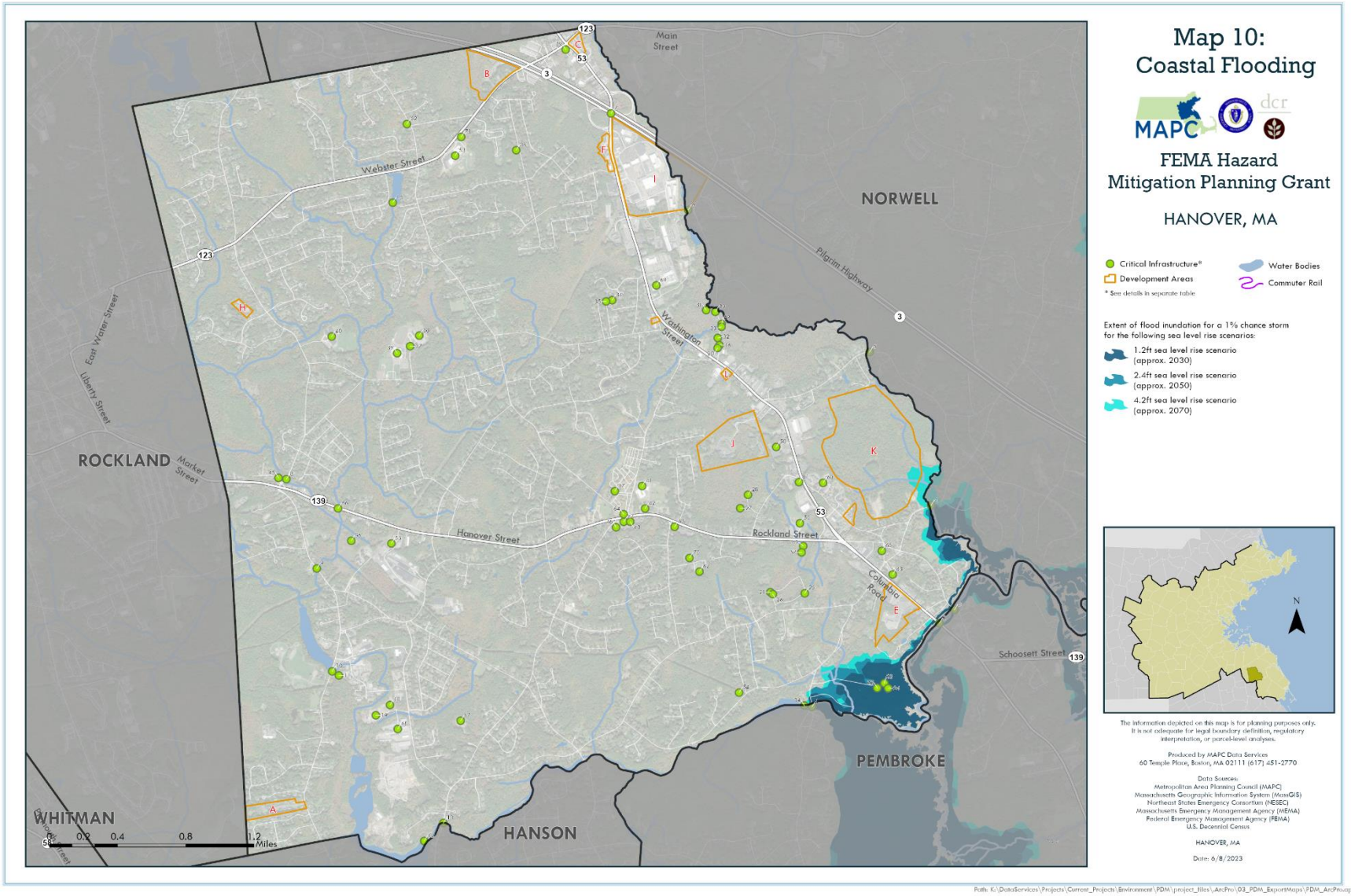
Date: 6/8/2023

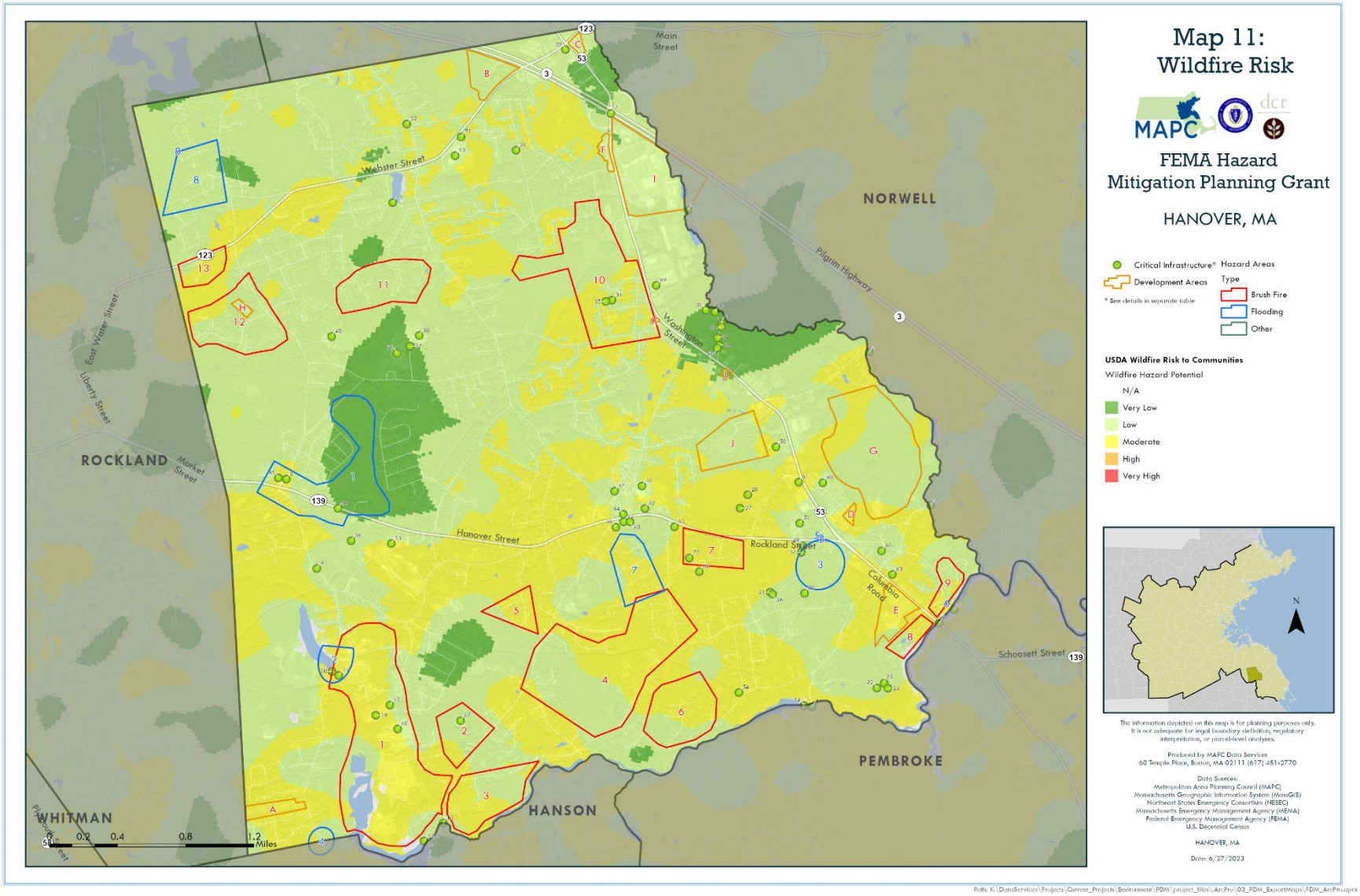
Path: K:\DataServices\Projects\Current_Projects\Environment\PDM\project_files\ArcPro\03_PDM_ExportMaps\PDM_ArcPro.aprx


HANOVER
0 1.5 3 6 Miles
Map 7:
Composite
Natural Hazards
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
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 36.1" or more
•Hurricane surge inundation areas
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)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023
Path: K:\DataServices\Projects\Current_Projects\Environment\PDM\project_files\ArcPro\03_PDM_ExportMaps\PDM_ArcPro.aprx


Map 8:
Local Hazard Areas
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Hazard Areas
Type
Brush Fire
Flooding
Other
NORWELL
ROCKLAND
HANSON
PEMBROKE
WHITMAN
Webster Street
Pilgrim Highway
Washington Street
East Water Street
Liberty Street
Market Street
Hanover Street
Rockland Street
Columbia Road
Schoosett Street
Main Street
0 0.2 0.4 0.8 1.2 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.
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)
U.S. Decennial Census
HANOVER, MA
Date: 6/27/2023


Map 9:
Land Surface Temperature
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Tree Canopy Coverage (2016 - 30m)
Hottest 5% of region's land area
% Canopy Coverage
0 - 25%
25 - 50%
50 - 75%
75 - 100%
NORWELL
ROCKLAND
PEMBROKE
HANSON
WHITMAN
Main Street
Webster Street
Pilgrim Highway
East Water Street
Liberty Street
Market Street
Hanover Street
Washington Street
Rockland Street
Schoosett Street
0 0.2 0.4 0.8 1.2 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 (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023


Map 10:
Coastal Flooding
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Commuter Rail
Extent of flood inundation for a 1% chance storm
for the following sea level rise scenarios:
1.2ft sea level rise scenario
(approx. 2030)
2.4ft sea level rise scenario
(approx. 2050)
4.2ft sea level rise scenario
(approx. 2070)
NORWELL
ROCKLAND
WHITMAN
HANSON
PEMBROKE
Main Street
Webster Street
Pilgrim Highway
Washington Street
East Water Street
Liberty Street
Market Street
Hanover Street
Rockland Street
Columbia Road
Schoosett Street
0 0.2 0.4 0.8 1.2 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.
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)
U.S. Decennial Census
HANOVER, MA
Date: 6/8/2023


Map 11:
Wildfire Risk
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HANOVER, MA
Critical Infrastructure*
Development Areas
* See details in separate table
Hazard Areas
Type
Brush Fire
Flooding
Other
USDA Wildfire Risk to Communities
Wildfire Hazard Potential
N/A
Very Low
Low
Moderate
High
Very High
NORWELL
ROCKLAND
HANSON
PEMBROKE
WHITMAN
Webster Street
Pilgrim Highway
Washington Street
East Water Street
Liberty Street
Market Street
Hanover Street
Rockland Street
Columbia Road
Schoosett Street
Main Street
0 0.2 0.4 0.8 1.2 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.
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)
U.S. Decennial Census
HANOVER, MA
Date: 6/27/2023

APPDENDIX B: HAZARD MITIGATION TEAM

Hanover MVP and Hazard Mitigation Plan Update

Core Team Meeting #1

Wednesday, October 12, 2022
10:00 – 11:30 AM

AGENDA

---

1. Welcome and Introductions
2. Overview of the HMP Project
   - Overview of the FEMA Hazard Mitigation Plans
3. Overview of the MVP Project
   - Community Resilience Building Workshop
   - Stakeholder outreach and invitations
4. Project Tasks and Schedule (attached)
5. Getting Started: Local Data Updates from the 2016 Plan
   - *We will update the following 3 types of local data from the 2016 plan (see attached worksheets for updating each of the 3 data types):*
     - Worksheet#1: Hazard Areas of Concern (Flooding/Wildfire)
     - Worksheet#2: Critical Facilities
     - Worksheet#3: New Development sites
6. Next steps: Begin Preparing for Public Meetings and Outreach
   - Two Public Meetings for the Hazard Mitigation plan
   - CRB Workshop and Public Listening Session
   - Identify local stakeholders to invite (review MVP Workshop invitees)

APPDENDIX B: HAZARD MITIGATION TEAM

Hanover MVP and Hazard Mitigation Plan Update
Summary of the Planning Process

---

1) Hanover Core Team Meeting #1: Overview/Data & Map Update — Oct. 2022

- Review project tasks and timeline
- Update: Local Hazard Areas and Map
- Update: Critical Facilities: Inventory and Map
- Update: Development Sites and Map
- Preparing for CRB Workshop; identify stakeholders to invite

2) Hanover Core Team Meeting #2: Update of Existing Mitigation — Dec. 2022

- Update: Hazard Mitigation Goals for the Plan
- Update: Existing Mitigation Measures

3) Hanover Public Meeting #1: Plan Overview/Public Input — Dec. 2022

4) Hanover Core Team Meeting #3: Review Mitigation Status — Feb. 2022

- Review status of Recommended Mitigation Strategies from the Previous Plan
- Discuss possible changes to mitigation strategies and need for new strategies

5) MVP Public Listening Session — Mar 2023

6) Hanover Core Team Meeting #4: Develop Mitigation Strategy — April 2023

- Develop Recommended Mitigation Measures and Prioritize
- Designate Implementing agencies, Timeframes, Estimated Costs, Funding Sources
- Prepare for 2nd Public Meeting and outreach to stakeholders

6) Hanover Public Meeting #2: Presentation of Draft HMP — June 2023

7) Draft HMP: submitted to MEMA & FEMA — June 2023

APPDENDIX B: HAZARD MITIGATION TEAM

Municipal Vulnerability Preparedness Project Overview

In September 2016, Governor Charlie Baker signed **Executive Order 569**, instructing state government to provide assistance to cities and towns to complete climate change vulnerability assessments and resiliency planning.

The **Municipal Vulnerability Preparedness** grant program (MVP) provides support for cities and towns in Massachusetts to begin the process of planning for resiliency. The program is administered by the Executive Office of Energy and Environment (EEA). The state awards communities with funding to complete vulnerability assessments and develop and prioritize actions the community can take to enhance their resiliency to climate impacts. The MVP program helps communities to:

- Understand extreme weather and natural and climate related hazards
- Identify the community's strengths and vulnerabilities
- Develop and prioritize actions for the community
- Identify opportunities to take action to reduce risk and build resilience

MVP certified service providers are trained in workshops developed by EEA to provide technical assistance to communities in conducting their MVP projects using *the Community Resilience Building Framework*. MAPC, as an MVP Certified service provider, is assisting the towns of Bellingham and Franklin in conducting their joint MVP project.

Communities who 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.

About Workshop Methodology- *Community Resilience Building*

The need for municipalities, businesses, community-based organizations, institutions, and academia to build community resilience and adapt to extreme weather and hazards is now strikingly evident. Ongoing events continuously reinforce this urgency and compel leading communities to proactively plan and act. As a response to this, the Community Resilience Building Workshop process was created.

Over the last decade the *Community Resilience Building Workshop* has been utilized by over one hundred communities across 6 states. Community Resilience Building provides a user-friendly "anywhere at any scale" approach for developing community resilience action plans for municipalities, businesses, organizations, academia, and institutions. Community Resilience Building employs a unique community-driven process, rich with local information, experience, and dialogue, where participants identify top hazards, current challenges, strengths, and priority actions to improve their community's resilience to natural and climate-related hazards today, and in the future.

About MVP-https://www.mass.gov/service-details/mvp-program-information

About CRB: www.CommunityResilienceBuilding.org

APPDENDIX B: HAZARD MITIGATION TEAM

Examples of MVP Workshop Invitees

Elected Officials (or equivalents):
Town Selectman – (other appointed boards/commissions)
State Representatives and Senators
U.S. Representatives and Senators (or legislative aides)

Business Leadership
Chamber of Commerce
Downtown Business Association
Major Employers (CEOs/Managers/Community Liaisons)

State and Federal Government
Agency or Division Heads/Community Outreach Coordinators
(DCR, DOT, EPA, MWRA, USACE, etc)

Municipal Departments/Boards/Commissions
Building Department
Community/Economic Development Department
Conservation Commission
Council on Aging/Senior Services
Emergency Management
Engineering Department
Finance Department
Fire Department
Health Department
Historic Commission
Housing Authority
Parks and Recreation Department
Planning Department
Police Department
Public Facilities Department
School Department
Small & Minority Business Resource Office

Key Community Stakeholders:
Churches and Faith-based Organizations
Colleges, Community Colleges, Private Schools
Community Foundations (Local & Regional)
Cultural Institutions (Museums, Historic Sites)
Engineering and Design Consulting Firms
Environmental NGOs, Land Trusts
Food Pantries, Service Organizations
Hospitals/Health Care Providers
Neighborhood Associations
Nursing/Assisted Living/Hospice Providers
Real Estate Agencies
Sustainability Groups/Committees
Utilities (Gas, Electric)
Water & Wastewater Utilities
Watershed Associations

APPDENDIX B: HAZARD MITIGATION TEAM

WORKSHEET #1 – HANOVER HAZARD AREAS FROM 2016 PLAN FOR 2022 UPDATE

Please note any updates, revisions, additional sites, or deletions for 2022

FLOODING POTENTIAL HAZARD AREAS	UPDATES, REVISIONS, NEW SITES, OR DELETIONS?
1. Pleasant and Circuit Streets – These two streets can go under water. During storm events, the water flows rapidly and backs up at the culvert. Some of the homes on Brooks Circle are impacted, as are businesses. The homes in this area are on slabs so there is no basement flooding. The area does have groundwater issues. This area was heavily impacted during the storm of March 2010. The flooding here is also due to the overflow of the river. Flooding has resulted in a few failed septic systems. Although the culvert is undersized, the DPW does not believe that enlarging the culvert is needed.	1.
2. King Street Bridge – The King Street Bridge is a bottleneck. Flooding here is related to the brook. This area is impacted by water draining from Rockland. There is a dam right after the bridge. Forge Pond rises quickly and the roadway can flood with 12-14 inches of water. Businesses on Industrial Way are impacted. The town has considered widening the channel but this would just push the problem further downstream. Forge Pond Dam needs to have work done and the town has completed a Phase I assessment.	2.
3. CVS Plaza – The CVS and the stores behind it are impacted. The other businesses are at a lower elevation than the CVS. The issue is caused by street drainage when there is an intense storm (i.e. 4 inches of rain in an hour). However, this area is on a state highway and therefore it is unlikely to change. There is a day care center in the strip mall which floods.	3.
4. King Street - King Street is subject to flooding which can cause access problems for residences. Depending on the severity of the storm, the road can be closed for 2-3 days. This has occurred approximately 4 times in the last 20 years.	4.

APPDENDIX B: HAZARD MITIGATION TEAM

TABLE 2: HANOVER CRITICAL FACILITIES FROM 2016 PLAN FOR 2022 UPDATE

- *These are the 66 Critical Facilities listed and mapped in the 2016 Plan*
- *Under "2022 Status Update," please note sites that should be revised or deleted, if any.*
- *If there are any additional sites, please add them to the bottom of the list. They also need to be mapped; MAPC's GIS will assist.*

MAP ID#	FACILITY NAME	2022 STATUS UPDATE Delete or Revise sites // Add new sites on p.4 below
1	Bridge - Elm Street at Pembroke Line	
2	Bridge - Columbia Road at Pembroke Line	
3	Bridge - Washington Street at Pembroke Line	
4	Bridge - Broadway at Norwell Line	
5	Bridge - East Street at Norwell Line	
6	Bridge - Mill Street at Norwell Line	
7	Bridge - Washington Street over Route 3	
8	Bridge - Pleasant Street (West Hanover)	
9	Bridge - Circuit Street	
10	Bridge - King Street (Forge Pond)	
11	Dam - Forge Pond	
12	Dam - Factory Pond Dam	
13	Bridge - Broadway at Hanson Line	
14	Dam - Curtis Crossing Dam	
15	Dam - Hackett's Pond Dam	
16	Pond Street Water Treatment Plant	
17	Cemetery Garage	
18	Water Distribution Garage	
19	DPW Highway Garage	
20	DPW Office	

Page 1 of 4

APPDENDIX B: HAZARD MITIGATION TEAM

A

WORKSHEET #3 – HANOVER NEW DEVELOPMENTS FROM 2016 PLAN FOR 2022 UPDATE
Update of 2016 New Development Sites: Please note any changes, additions, or deletions for 2022

PART 1: NEW DEVELOPMENT SITES FROM THE 2016 PLAN	PART 1: 2022 STATUS: Completed, Revised, Deleted?
A. Stable Ridge Estates – This development has been permitted for 14 lots on 15 acres. Work on the roads will likely start in the fall of 2014.	A.
B. Woodland Village – This 40B housing development has been in litigation for four years. If developed, it will likely consist of 200 rental units.	B.
C. Village Park – This project was originally permitted for mixed-use and the original permit is still in place. However, it is unlikely to be developed under that permit and will most likely be a single use development such as a big box retail store. The site is 70-85 acres.	C.
D. Village Commons/The Village at Seven Springs – This is a Planned Unit Development that will have 130 one, two and three bedroom market rate units. The project has been approved by the Planning Board, Zoning Board of Appeals and the Conservation Commission. Construction is projected to begin in the summer of 2015.	D.
E. Webster Village – This is a 40B housing development consisting of 76 rental units. This project is expected to break ground during the 2015 construction season.	E.
F. Merchants Row- This is a retail redevelopment opportunity which will likely include a retail component and restaurants.	F.
G. Assisted Living – An assisted living facility has been permitted at the Hanover Mall.	G.

PAGE 1 OF 4

APPDENDIX B: HAZARD MITIGATION TEAM

Hanover MVP and Hazard Mitigation Plan Update
Core Team Meeting #2

Wednesday, January 18, 2023
10:00 – 11:30 AM

Hanover Town Hall

AGENDA

---

1. Welcome and Introductions

2. Hazard Mitigation Next Steps: Mitigation Measures and Goals

- Update existing mitigation measures (checklist attached)
- Review and update Hazard Mitigation goals (draft list attached)
- Indian Head R Restoration, Becky Malamut, Coordinator

3. Preparing for the MVP Workshop and Stakeholder Outreach

- Choose date and consider location or alternative to an in-person event
- Identifying stakeholders to invite to the MVP Workshop (list attached)
- Draft invitation letter (attached)
- Review of agenda and process for in person or virtual workshop
- Matrices to summarize workshop findings & recommended actions

APPDENDIX B: HAZARD MITIGATION TEAM

HANOVER HAZARD MITIGATION GOALS (2016 PLAN)

The Hanover Local Multiple Hazard Community Planning Team met on May 13, 2015. At that meeting, the team reviewed and discussed draft goals for the plan. This resulted in the team endorsing the following nine goals.

1. Prevent and reduce the loss of life, injury 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.

    - Ensure that the Planning Department considers hazard mitigation in its review and permitting of new development.
    - Review zoning regulations to ensure that the bylaw incorporates all reasonable hazard mitigation provisions.
    - Ensure that all relevant municipal departments have the resources to continue to enforce codes and regulations related to hazard mitigation.

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

    - Begin to assess the vulnerability of municipal buildings and infrastructure to damage from an earthquake.
    - Maintain existing mitigation infrastructure in good condition.

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. Educate the public about natural hazards and mitigation measures that can be undertaken by property-owners.

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

POTENTIAL ADDITIONAL GOAL FOR THE 2023 PLAN UPDATE:

10. Consider the impacts of climate change and incorporate climate sustainability and resiliency into the Town's planning and policies.

APPDENDIX B: HAZARD MITIGATION TEAM

Hanover Hazard Mitigation Plan and Municipal Vulnerability Preparedness
Core Team Meeting #3

Wednesday, May 10, 2023
10:00 – 11:30 AM

AGENDA

1. **Brief recap of the MVP Workshop**

2. **Update the Status of Mitigation Actions from the 2016 Plan**

   - ***Actions Completed:*** Identify mitigation actions from 2016 that have been *completed.*
   - ***Actions Not Completed:*** Review 2016 mitigation actions that have *not been completed*:
     - **Retain:** Identify 2016 actions that should be **retained in the 2023 plan**
     - **Revise:** Identify any 2016 actions should be **revised for the 2023 plan**
     - **Delete:** Decide if any 2016 measures should be **deleted for the 2023 plan**

   Note: A worksheet summarizing mitigation actions is attached

3. **Recommended Mitigation Actions for the 2023 Plan Update**

   - ***New Actions:*** Consider new/additional mitigation actions (e.g., MVP priority actions).
   - ***Priority, cost, etc***: For all actions, update priority, cost, lead agency, funding source.

4. **Public Listening Session/Final Public Meeting**

   - **MAPC will present an overview of the MVP Workshop results and the Draft Hazard Mitigation Plan 2023 Update**
     - *Participants invited to comment in the meeting or after via email*
     - *The Draft Plan will be posted online for review and comment*
   - **MAPC will prepare meeting notice and a media advisory**
     - *Town to post on its website, post to Social Media, CCTV, other publicity?*

   Meeting to be scheduled for Wednesday, June 14, evening meeting in Town Hall.
   Core Team members are welcome but do not need to attend.

APPDENDIX B: HAZARD MITIGATION TEAM

Hanover Mitigation Strategies

Mitigation Recommendations from the 2016 Plan, Updated for the 2023 plan

1. Please review the recommendations from the 2016 plan and note their current 2023 status in the yellow column.
2. Then note which recommendations should be continued into the 2023 plan in the green column, with revisions if any.
3. For the recommendations to be continued in the 2023 plan, please update the descriptions in the blue columns
4. Finally, consider adding new recommendations for hazards with no mitigation listed. See pages 5 & 6 for examples & ideas.

DRAFT Mitigation Strategies for the Malden 2022 Hazard Mitigation Plan							
Mitigation Recommendations from the 2016 Plan	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe	Potential Funding Sources	2023 Status 1. Completed 2. Partially Completed 3. Not Completed	2023 Plan 1. Keep? 2. Revise? 3. Delete?
FLOOD HAZARDS							
A) Education program to improve compliance with wetlands regulations	Medium	Conservation Commission	Low	2016-2021	Town General Fund		
B) Implement recommendations of the Forge Pond Dam Phase 1 Assessment	High	DPW	High	2016-2018	HMGP/PDM and Town General Fund		
C) Perform a hydraulic analysis of the Indian Head River Watershed	High	Planning/DPW	Medium	2016-2018	ACOE/Town General Fund/HMGP/PDM		

HANOVER MITIGATION STRATEGY PAGE 1 OF 8

APPDENDIX C: PUBLIC MEETINGS

Hanover Hazard Mitigation Plan
Public Meeting

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



The Town of Hanover is preparing an updated Hazard Mitigation Plan to reduce its vulnerability to natural hazards such as flooding, hurricanes, and winter storms. Please join the Town for a presentation about the plan at a public meeting hosted by the Hanover Hazard Mitigation Team and the Metropolitan Area Planning Council at a meeting of the Planning Board on December 5 at 7:00 PM. Questions and suggestions for the plan are welcome at the meeting, and may also be sent by email to HanoverMVP@mapc.org .

Virtual and In-Person Meeting

Monday, December 5, 2022, 7:00 pm

Hanover Town Hall
550 Hanover Street, Hanover MA
Second Floor Meeting Room

- **Meeting address:** https://hanover-ma-gov.zoom.us/j/86585597553?pwd=Z0ptd1kvUTNkUDdVMDlkemoxUGIDZz09
- **Telephone:** Dial one of the following phone numbers: 929-205-6099; 312-626-6799; 301-715- 8592; 346-248-7799; 669-900-6833; 253-215-8782
- If you are a dial-in participant and would like to ask a question, please press *9 to enter the question queue.
- If you are a dial-in participant and would like to mute/unmute, please press *6.
- **Meeting ID:** 865 8559 7553
- **Passcode:** 02339

APPDENDIX C: PUBLIC MEETINGS

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

CALENDAR LISTING / MEDIA ADVISORY

HANOVER'S HAZARD MITIGATION PLAN AND MVP PROJECT TO BE DISCUSSED AT DECEMBER 5 PUBLIC MEETING

Who: Hanover residents, business owners, institutions, and non-profit organizations, and others interested in preventing and reducing damage from natural hazards.

What: At a public meeting on Monday, December 5 at 7:00 PM, a presentation on the Hanover Hazard Mitigation Plan 2022 Update will be given at the Hanover Planning Board meeting. The presentation will be given by the Metropolitan Area Planning Council, which is assisting the town's Hazard Mitigation Team in the preparation of the plan. The presentation will also cover the town's Municipal Vulnerability Preparedness (MVP) project, which is being prepared in conjunction with the Hazard Mitigation Plan to address the impacts of climate change on the Town. There will be an opportunity for questions and discussion following the presentation.

The Town of Hanover is preparing the updated 2022 Hazard Mitigation Plan to document natural hazards that affect the Town, such as floods, hurricanes, and severe winter storms. The companion MVP project will address the current and future impacts of climate change on the town. The combined projects will recommend actions the Town can take to reduce its vulnerability to these hazards.

When: **Monday, December 5, 2022, 7:00 PM**

Where: **Virtual and in-person meeting:**

Hanover Town Hall
550 Hanover Street, Hanover MA
Second Floor Meeting Room

Online meeting address:

- https://hanover-ma-gov.zoom.us/j/86585597553?pwd=Z0ptd1kvUTNkUDdVMDlkemoxUGIDZz09
- **Telephone:** Dial one of the following phone numbers: 929-205-6099; 312-626-6799; 301-715- 8592; 346-248-7799; 669-900-6833; 253-215-8782
- If you are a dial-in participant and would like to ask a question, please press *9 to enter the question queue.
- If you are a dial-in participant and would like to mute/unmute, please press *6.
- **Meeting ID:** 865 8559 7553
- **Passcode:** 02339

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.

##

APPDENDIX C: PUBLIC MEETINGS

About | Departments | Boards and Committees | Meetings | Residents | Business | COVID-19 | Contact Us | Where Do I Go For...

Town of HANOVER Massachusetts

Search

Home

Town of Hanover Hazard Mitigation Plan Public Meeting, December 5, 2022

POSTED ON: NOVEMBER 14, 2022 - 4:23PM

The Town of Hanover received grant funding to complete a Municipal Vulnerability Preparedness Plan as well as update our Hazard Mitigation Plan. The effort to update the Town's Hazard Mitigation Plan is aimed at reducing its vulnerability to natural hazards such as flooding, hurricanes, and winter storms.

Residents and community members are invited to a presentation about the plan at a public meeting hosted by the Hanover Planning Board, Hanover Hazard Mitigation Team, and Metropolitan Area Planning Council on December 5, 2022, at 7:00 pm.

Questions and suggestions for the plan are welcome at the meeting and may also be sent by email to HanoverMVP@mapc.org.

Meeting Information

In-Person

- Hanover Town Hall, 550 Hanover Street, Hanover, MA 02339
- Second Floor Hearing Room

Remote Meeting Access

- **Meeting address:** https://hanover-ma-gov.zoom.us/j/86585597553?pwd=Z0ptd1kvUTNkUDdVMDlkemoxUGJDZz09
- Telephone: Dial one of the following phone numbers: 929-205-6099; 312-626-6799; 301-715- 8592; 346-248-7799; 669-900-6833; 253-215-8782
- If you are a dial-in participant and would like to ask a question, please press *9 to enter the question queue.
- If you are a dial-in participant and would like to mute/unmute, please press *6 to toggle.
- **Meeting ID:** 865 8559 7553
- **Passcode:** 02339

Attachment	Size
hanover_hazard_mitigation_meeting_12-5-22.pdf	298.64 KB

APPDENDIX C: PUBLIC MEETINGS

About | Departments | Boards and Committees | Meetings | Residents | Business | COVID-19 | Contact Us | Where Do I Go For...

Town of HANOVER Massachusetts

Search

Home

Town of Hanover Hazard Mitigation Plan Public Meeting Reminder, December 5, 2022

POSTED ON: NOVEMBER 29, 2022 - 11:27AM

The Town of Hanover received grant funding to complete a Municipal Vulnerability Preparedness Plan as well as update our Hazard Mitigation Plan. The effort to update the Town's Hazard Mitigation Plan is aimed at reducing its vulnerability to natural hazards such as flooding, hurricanes, and winter storms.

Residents and community members are invited to a presentation about the plan at a public meeting hosted by the Hanover Planning Board, Hanover Hazard Mitigation Team, and Metropolitan Area Planning Council on December 5, 2022, at 7:00 pm.

Questions and suggestions for the plan are welcome at the meeting and may also be sent by email to HanoverMVP@mapc.org.

Meeting Information

In-Person

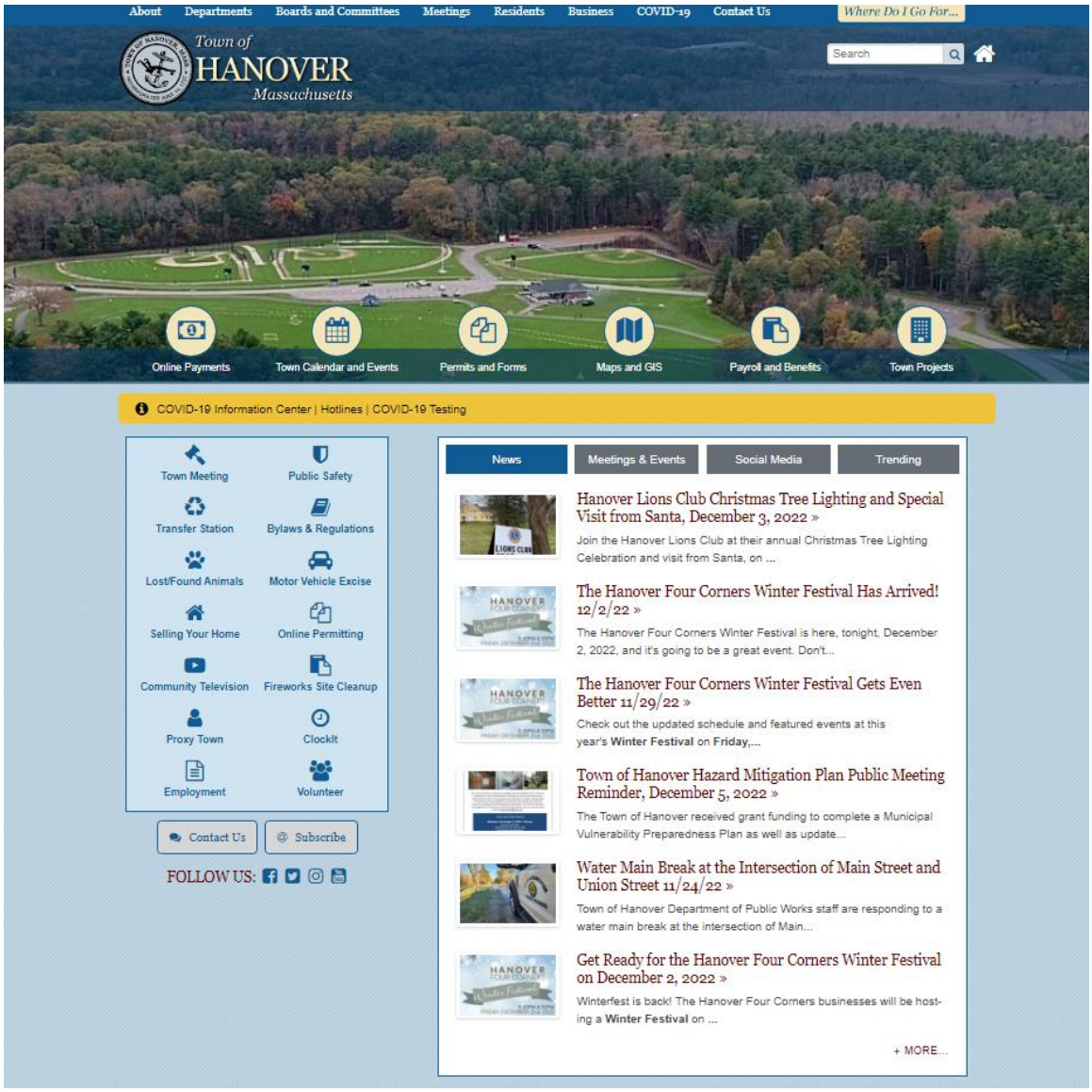
- Hanover Town Hall, 550 Hanover Street, Hanover, MA 02339
- Second Floor Hearing Room

Remote Meeting Access

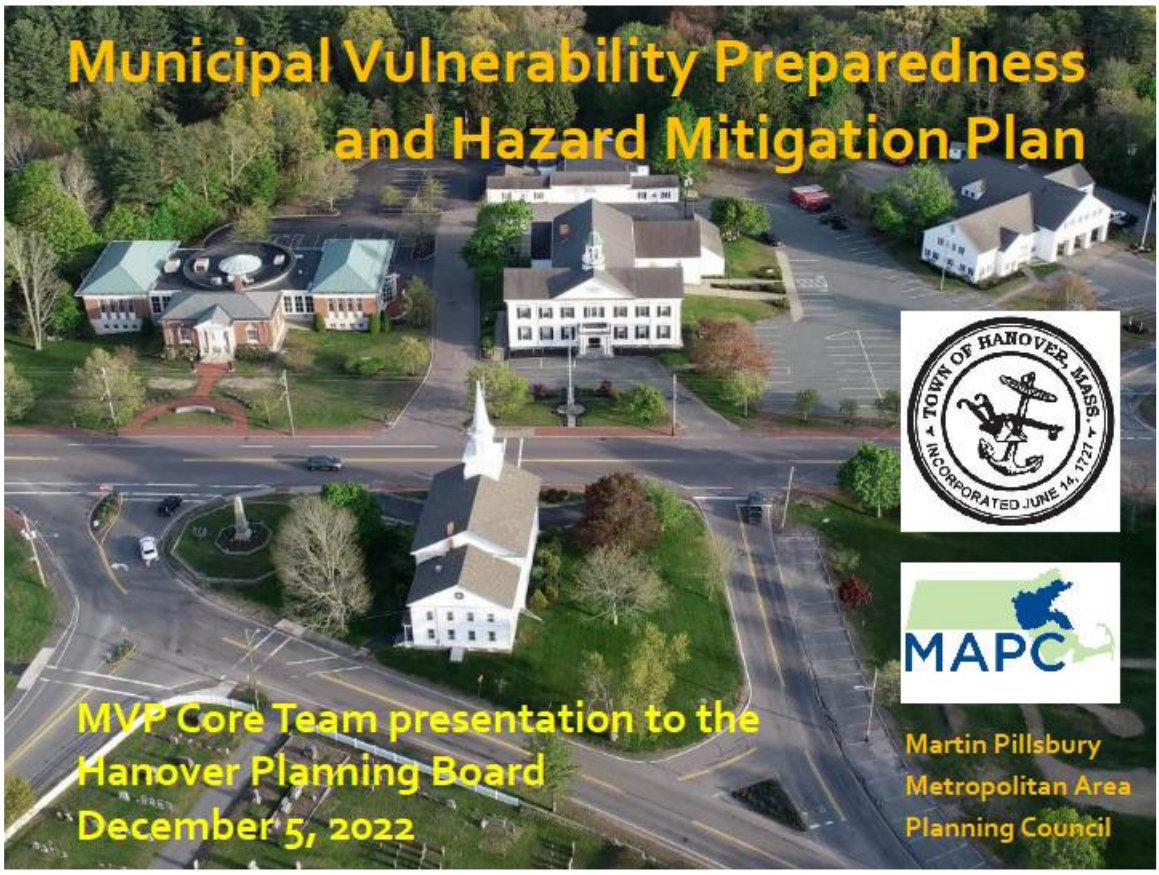
- **Meeting address:** https://hanover-ma-gov.zoom.us/j/86585597553?pwd=Z0ptd1kvUTNkUDdVMDlkemoxUGJDZz09
- Telephone: Dial one of the following phone numbers: 929-205-6099; 312-626-6799; 301-715- 8592; 346-248-7799; 669-900-6833; 253-215-8782
- If you are a dial-in participant and would like to ask a question, please press *9 to enter the question queue.
- If you are a dial-in participant and would like to mute/unmute, please press *6 to toggle.
- **Meeting ID:** 865 8559 7553
- **Passcode:** 02339

Attachment	Size
hanover_hazard_mitigation_meeting_12-5-22.pdf	298.64 KB

APPDENDIX C: PUBLIC MEETINGS



APPDENDIX C: PUBLIC MEETINGS



APPDENDIX C: PUBLIC MEETINGS

APPDENDIX C: PUBLIC MEETINGS

Social Media Card

APPDENDIX C: PUBLIC MEETINGS

MEDIA ADVISORY TO WATD, 99.5 AM RADIO, MARSHFIELD, MA

From: Pillsbury, Martin
Sent: Friday, June 2, 2023 11:38 AM
To: mreed@959watd.com
Cc: Linehan, Amanda <ALinehan@mapc.org>
Subject: "Hazard-Ready Hanover" Community Forum, June 14 at 7 PM

Good morning,

The Town of Hanover has a Community Forum, "Hazard-Ready Hanover," coming up on Wednesday, June 14 at 7:00 PM in Town Hall. The forum will present the draft Natural Hazards Mitigation Plan, which helps the Town prepare for hazards like flooding, extreme storms, winter hazards, and drought. The forum will also present the highlights of a day-long workshop held on April 10 as part of the town's "Municipal Vulnerability Preparedness" project funded by a state grant.

The presentation will be made by the Metropolitan Area Planning Council (MAPC), which assisted the Town in preparing the plan and the MVP Workshop (MAPC is the Regional Planning Agency for greater Boston, which includes communities on the South Shore from Quincy to Duxbury).

Attached are a meeting flyer (PDF file) and a social media card (JPG file). Any questions from the public can be directed to the project email, HanoverMVP@mapc.org

If you have any questions for me, my contact information is:

Martin Pillsbury
Director of Environmental Planning
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111
617-939-3896 (cell)
mpillsbury@mapc.org

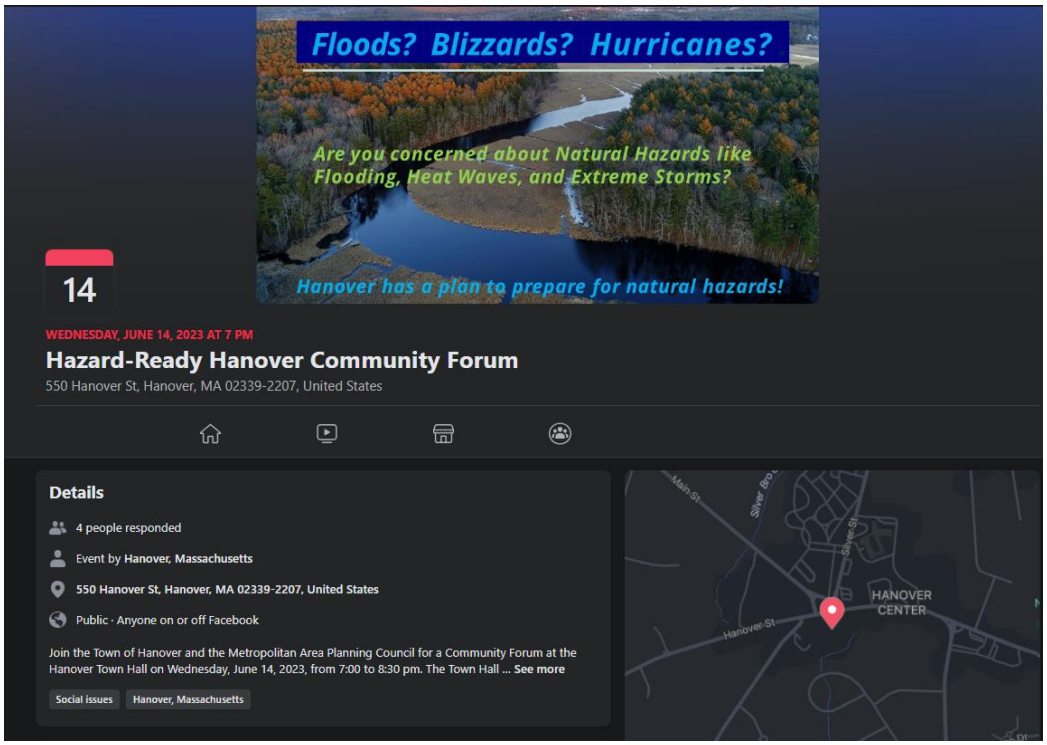
Best regards,
Martin Pillsbury

APPDENDIX C: PUBLIC MEETINGS

APPDENDIX C: PUBLIC MEETINGS

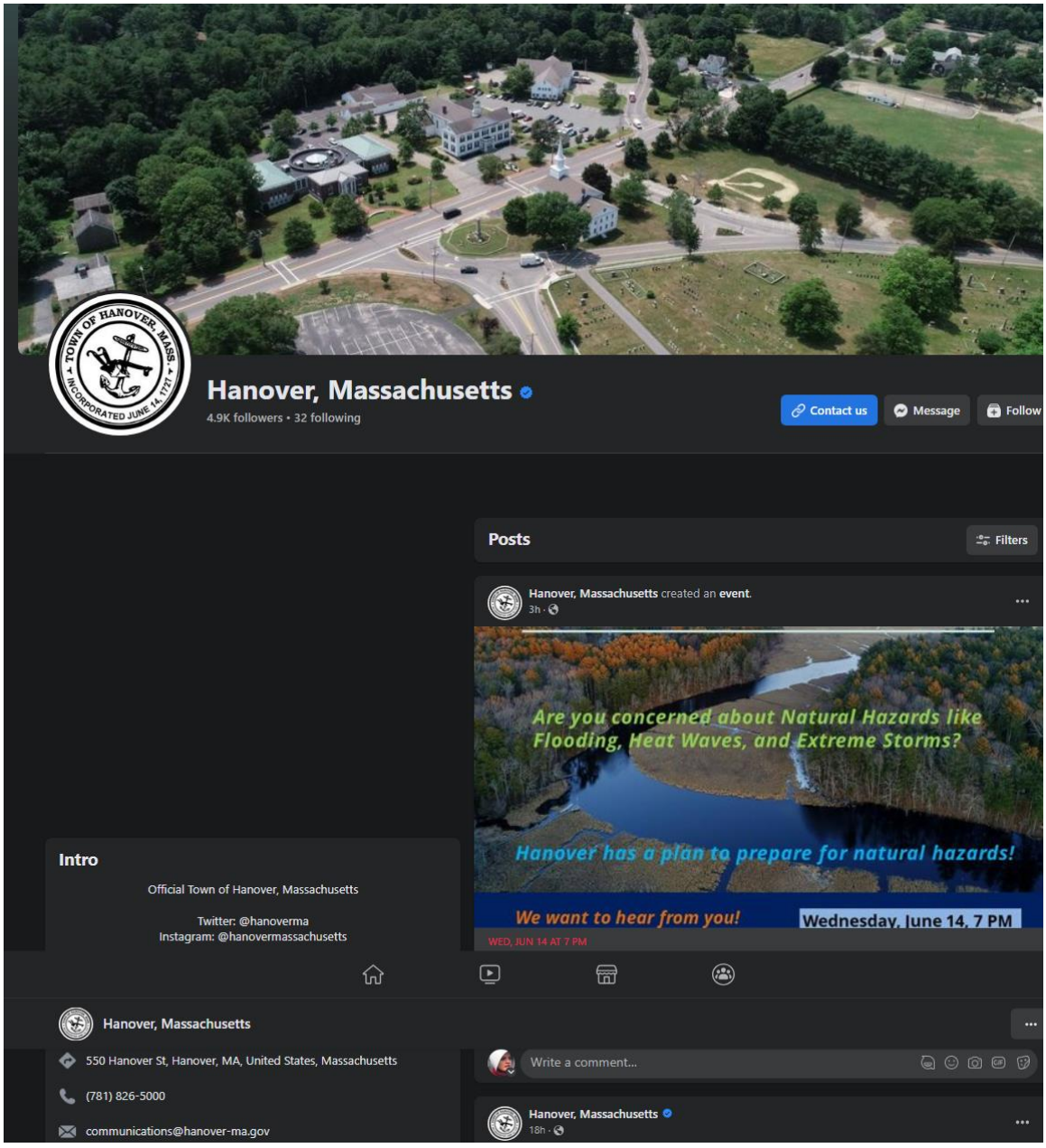
Town of Hanover Website Post

Town of Hanover Facebook Post



APPDENDIX C: PUBLIC MEETINGS

Town of Hanover Facebook Post

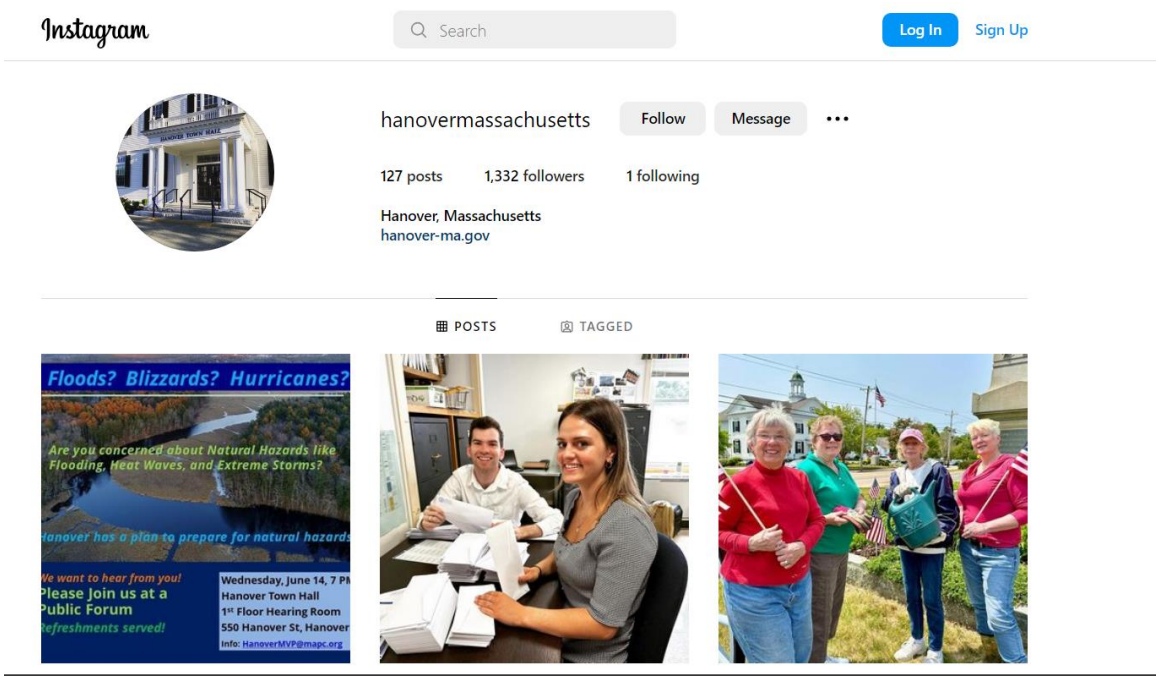


APPDENDIX C: PUBLIC MEETINGS

Town of Hanover Twitter Post

APPDENDIX C: PUBLIC MEETINGS

Town of Hanover Instagram Post



APPDENDIX C: PUBLIC MEETINGS

MVP PUBLIC LISTENING SESSION AND HMP DRAFT PLAN PRESENTSTION

Wednesday, June 14, 2023, 7:00 PM
Hanover Town Hall

Attendees

Timothy Kane	Hanover Fire Department
Victor Diniak	Department of Public Works
Christine Stickney	Town Planner'
Ann Lee	Assistant Town Manager, CDMI Director
Jason Cavallaro	Hanover Fire Dept/Emergency Management Director
David Ladd	Hanover Citizen
Becky Malamut	North and South Rivers Watershed Association
Doreen Zeller	Hanover VNI
Martin Pillsbury	Metropolitan Area Planning Council

Questions and Discussion

David Ladd discussed approaches to emergency management and described the difference between tactics and logistics. He emphasized the need to focus on logistics when considering how the town can respond to hazardous events in the immediate aftermath as well as addressing ongoing longer-term needs. A few examples include logistical issues during emergency events such as:

- Health Care – lack of access to medications,
- Keeping roads open to allow for emergency access
- Supplying fuel
- Emergency generation at critical facilities such as the town's fuel pump

Mr. Ladd also addressed emergency communication, discussing various modes (UHF/VHF and Simplex/Multiplex), deployable antennas, and internet connectivity (hard line only vs. backup to Wi-Fi / Satellite).

APPDENDIX C: PUBLIC MEETINGS

NOTICE OF PUBLIC MEETING
TO HANOVER'S NEIGHBORING COMMUNITIES

TO: Town Clerks in Hanson, Norwell, Rockland, and Pembroke

RE: Notification of Public Meeting on the Draft *Hanover Hazard Mitigation Plan*

The Town of Hanover has prepared a draft 2023 update of the *Hanover Hazard Mitigation Plan*, which is intended to reduce the town's vulnerability to natural hazard events such as flooding, drought, hurricanes, and winter storms. The plan identifies a range of recommended local hazard mitigation measures, including infrastructure improvements, regulatory measures, and educational and outreach efforts related to natural hazards.

As part of the planning process, Hanover's neighboring communities are being notified of a public meeting on the draft plan. The meeting will be held as follows:

The Meeting will be held in-person at a Community Forum in Hanover Town Hall:

Hazard-Ready Hanover!
Community Forum
Wednesday, June 14, 2023, 7:00-8:30 PM
Hanover Town Hall, 500 Hanover Street
1st Floor Hearing Room
Refreshments will be served!

A flyer announcing the meeting with the above information is also attached. Questions and comments on the draft plan may be submitted at the meeting or in writing after the meeting by email to HanoverMVP@mapc.org by June24, 2023.

APPDENCIX D: PLAN ADOPTION CERTIFICATE

<TOWN LETTERHEAD>

CERTIFICATE OF ADOPTION

SELECT BOARD

TOWN OF HANOVER, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF HANOVER HAZARD MITIGATION PLAN 2023 UPDATE

WHEREAS, the Town of Hanover established a Hazard Mitigation/MVP Core Team, coordinated by the Emergency Management Director and the Assistant Town Administrator, to prepare the *Town of Hanover Hazard Mitigation Plan 2023 Update*; and

WHEREAS, the Town of Hanover *Hazard Mitigation Plan 2023 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Hanover, and

WHEREAS, duly-noticed public meetings were held by the PLANNING BOARD ON DECEMBER 5, 2022, and at a Community Forum in Town Hall on June 14, 2023, and

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

NOW, THEREFORE BE IT RESOLVED that the Hanover Select Board adopts the Town of Hanover *Hazard Mitigation Plan 2023 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Hanover.

ADOPTED AND SIGNED this Date. _____

Name(s)

Title(s)

Signature(s)

ATTEST