Tighe&Bond
Engineers | Environmental Specialists

Westford Multi-Hazard Mitigation Plan



SUBMITTED TO

Town of Westford

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Section 1
Introduction

The purpose of hazard mitigation is to reduce loss from current and future natural hazards. Storms and other natural disasters such as floods, earthquakes, and hurricanes can cause loss of life, damage to buildings and infrastructure, and negatively affect a community's economic, social, and environmental well-being. The Town of Westford has developed this Hazard Mitigation Plan (HMP) as a means to permanently reduce or alleviate the losses of life, injuries, and damage to property resulting from natural hazards through adopting long-term strategies. These long-term strategies address not only municipal infrastructure but also societal, economic, and environmental assets of Westford through planning, policy changes, programs, projects, educational outreach, and other activities. The desired outcome of implementing the HMP will be creating a more resilient community that is better prepared prior to a natural disaster and can recover more quickly after one occurs.

1.1 Overview of Planning Requirements

1.1.1 Planning Requirements under the Federal Disaster Mitigation Act

The Federal Disaster Mitigation Act, adopted in 2000, requires that after November 1, 2004, all municipalities that wish to continue to be eligible to receive Federal Emergency Management Agency (FEMA) funding for hazard mitigation grants must adopt a local Hazard Mitigation Plan (HMP) and update the plan every five years. This planning requirement does not affect federally authorized disaster assistance funding and is exempt from this requirement.

A1 b

The Town of Westford received grant funding from EEA under the Municipal Vulnerability and Preparedness (MVP) Program to complete the five-year update of this HMP.

The single jurisdiction local HMP for Westford produced under this grant is designed to meet the requirements of the Disaster Mitigation Act, following guidance provided in FEMA's Local Mitigation Planning Handbook (March 2013)[1] and FEMA's Local Mitigation Plan Review Guide (October 1, 2011)[2]. Where text in the Hazard Mitigation Plan meets an element identified in the Review Guide, it is called out in a blue box in the margins.

FEMA developed a "Local Mitigation Review Guide" to help Federal, State and Local official assess Local Hazard Mitigation Plans and make sure they will meet the requirements of the Stafford Act and Title 44 Code of Federal Regulations (CFR) 201.6. The most recent version of this guide (October 1, 2011) was used in preparing this five-year HMP Update. Where text in the Hazard Mitigation Plan meets an element identified in the Review Guide, it is called out in a blue box in the margins.

1.1.2 Municipal Vulnerability Preparedness (MVP) Program

The MVP grant program allows municipalities in the Commonwealth to begin the process of preparing for climate change resiliency. The MVP planning process engages the local

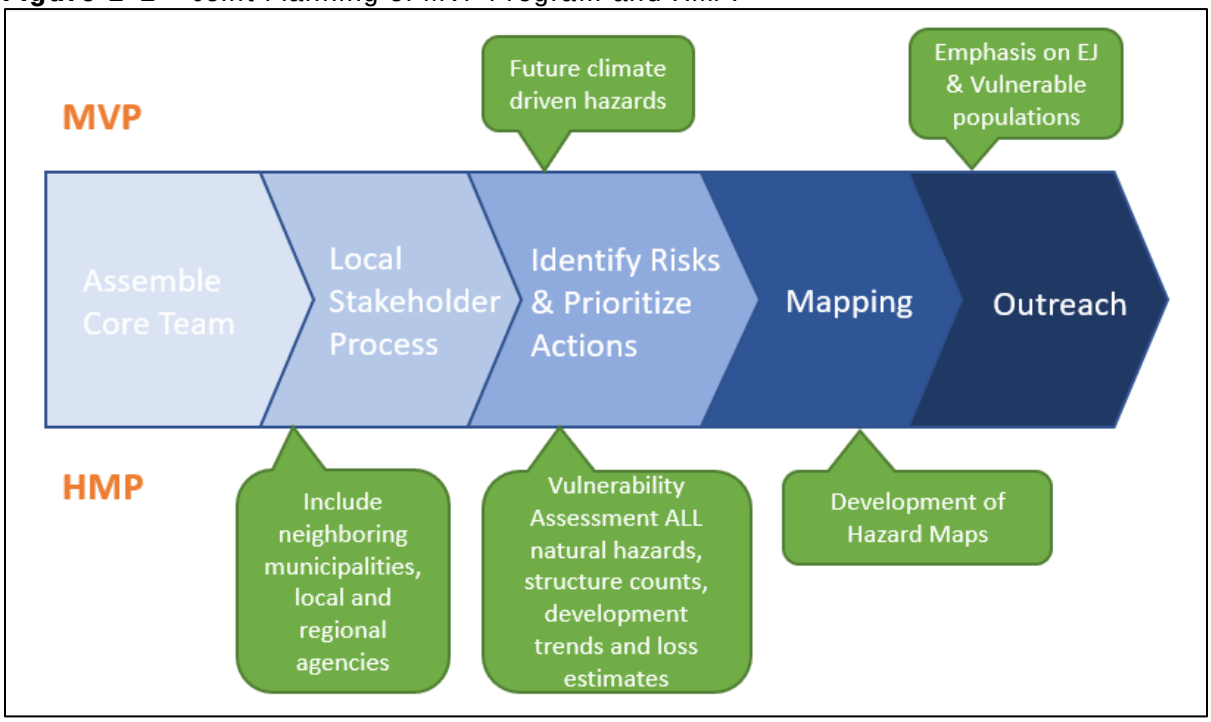
[1] FEMA (2013), "Local Mitigation Planning Handbook", https://www.fema.gov/media-library/assets/documents/31598.

[2] FEMA (2011), "Local Mitigation Plan Review Guide", https://www.fema.gov/media-library/assets/documents/23194.

community as they participate in identifying, community strengths and vulnerabilities and prioritize actions to improve resiliency to natural hazard risk including impacts of climate change. Communities who complete the MVP program become certified as an MVP community and are eligible for MVP Action grant funding and other opportunities.

The MVP effort supplements the HMP process by providing a statewide and major basin specific climate change data to use in the natural hazard risk assessment and a consistent methodology for public engagement through the Community Resilience Building (CRB) workshops. Figure 1-1 below demonstrates the overlap between the MVP and HMP development.

Figure 1-1 – Joint Planning of MVP Program and HMP.



Source: MA Executive Office of Energy and Environmental Affairs

1.2 Community Profile[3]

1.2.1 Westford's Demographics

D1

The most recent data available from the Bureau of the Census estimates that Westford's population is approximately 22,854, for a population density of approximately 747 people per square mile. **Table 1-1** shows how Westford's population has grown.

[3] Information from this section was taken from Westford's Comprehensive Master Plan, dated April 2009 and Westford Open Space and Recreation Plan, dated 2018

TABLE 1-1
Westford Population Growth

	Total Land Area	Decennial Census Population				Percent Change
		1980	1990	2000	2010	
Westford	30.6	13,434	16,392	20,754	21,951	4.11%

Table 1-2 below shows population projections for the Town of Westford. The table below was developed through projections from MassDOT, MPOs, and NMCOG.

TABLE 1-2
Westford Population Projections

2010 Actual	2020 Estimate	2030 Estimate	2040 Estimate	% Change 2010-2040
21,951	22,464	23,039	25,105	14.4%

Population Age

Westford is following the same population age pattern found throughout the nation, as people born during the "Baby Boom" era (1946-1964) progress towards retirement. From 1990-2000, children under 18 accounted for 45% of Westford's total population growth and 31.8% of the total population in 2000. However, between 2000 and 2010, the under-18 population declined by 1.38%. In contrast the over-55 population is growing rapidly. This trend can be seen in the change in Westford's median population age from 36.9 years in 2000 to 42.5 years in 2010.

Race, Ethnicity, Language and Culture

Westford's population is predominately white. The Town has experienced foreign-born population growth, though not to the extent found in some surrounding communities.

Environmental Justice Populations

A community is recognized as an Environmental Justice (EJ) community if a census block has an annual median household income equal to or less than 65% of the statewide median, 25% or more of the residents identify as minority, or 25% or more of the households have no one over the age of 14 that speaks English only or very well. The 2010 Decennial Census classified the census block group in the northeast corner of the Town (bound by Route 40 and Dunstable Road) as an EJ population based on the high percentage of minorities.

1.2.2 Westford's Economy

Overall, Westford's economy has recovered from the Great Recession caused by the 2007 housing bubble burst and subprime mortgage crisis. During the economic downturn the percentage of unemployed Westford residents rose to a high of 8.1%; however, Westford fared slightly better than many parts of the Commonwealth. By the end of 2016, Westford's annual unemployment rate had fallen to 3% compared to the statewide average of 3.7%.

The number of establishments in Westford increased from 642 in 2006 to 728 in 2016, for a 13.4% increase. During this period, Westford had a 0.9% increase in establishments in the good-producing domain and a 16% increase in the service-providing domain. Among good-producing industries there was a 9.6% increase in construction establishments and a 16.7% decrease in manufacturing establishments. Although there was a net loss in manufacturing establishments, the losses were in durable goods manufacturing while nondurable goods manufacturing establishments increased, such as computer and electronic product manufacturing, which increased by 28.6%. In the same period, there was a 16% increase in the service-providing domain, accounted for by losses in establishments in information and trade, transportation and utilities, and gains in establishments in financial activities, professional and business services, education and health services, leisure and hospitality, and other services.

Total employment in Westford increased 7.9% between 2006 and 2016, which was slightly below the statewide rate. The greatest percentage gains in employment were in goods production such as computer and electronic product manufacturing which added over 1,000 jobs which were accompanied by a 90.6% increase in wage growth with average weekly wage increasing from $1,450 to $2,764. Across all industries in Westford, average weekly wages increased 13.7% from $1,485 in 20036 to $1,688 in 2016. Although Westford had a smaller increase in wage growth than that of the State, which has a 28.7% increase during the same period, Westford's average weekly wage was more than 30% higher than the State average in 2006.

The increase in employment opportunities within Westford coupled with future multifamily housing developments in their proximity afforded residents the ability to commute via alternative modes such as biking or walking.

1.2.3 Westford's Natural Environment

Natural resources and open space are linked so closely with Westford's identity and sense of place that they have served as consistent themes in local planning efforts for at least three decades. When residents speak of Westford's open space, they mention a wide range of images: working landscapes, forests, the town common, vistas, trails, and water. Westford depends on all of these resources for their ecological and scenic value. As Westford evolves, preserving its remaining open space will be important to its quality of life, the diversity and health of its natural resources, and its fiscal condition.

Geology

Westford's bedrock consists of several igneous and metamorphic units trending southwest to north east. These rocks formed in the early to middle Paleozoic Era (490 to 354 million years ago), when the continent experienced tremendous mountain building along its margins. The bedrock visible in Westford today was once emplaced at depth within the crust but has now become exposed by uplift and erosion. The town's granitic rock formations were produced by intrusions of molten material. Metamorphic units formed when pre-existing rocks were squeezed during plate collisions. One rock type in Westford, the Chelmsford Granite, is noteworthy because it underlies much of the northern third of town and has been actively quarried since the early 1800s.

Soils

Soil is a dynamic resource that affects hydrology, supports plant life, controls biogeochemical cycles, determines plant and animal habitat and supports human habitation. There are thirty-four mapped soil units in Westford. The principal soil series include Hinckley, Freetown Muck, Paxton, and Charlton-Hollis-Rock Outcrop Complex. Other common units in Westford include Windsor, Canton, Woodbridge, Swansea, Montauk, and Udorthents (disturbed soil parent materials). Sediment deposits covered by surface water total about 3.5 percent of Westford's land area, and quarry and gravel pits, about 1.5 percent.

A total of 1,221 acres in Westford (about six per-cent of the town's total land area) consists of Prime Farmland soils, which are especially well suited for agriculture. Most of the soils classified as prime farmland are located in the uplands in the central and southern parts of town. More than 3,000 acres in Westford are classified as farmland of unique importance and 4,400 acres are classified as farmland of state importance – that is, soils known to be valuable for specific types of crop production or otherwise designated for agriculture by state law, but not conforming to the definition of prime farmland.

Together, Westford's prime farmland and farmland of unique or state importance constitute forty-three percent of the town's total area. Westford has a long history of farming, most notably apple growing, but much farmland has been converted to developed land. In fact, between 1985 and 1999, Westford experienced the second greatest loss of agricultural land of any town in Massachusetts (478 acres of farmland converted to development). While almost fifty percent of Westford's soils are considered optimal for farming, the reality of land use in town is much different today than in the past.

Watersheds

Westford falls within two major drainage basins or watersheds: the Merrimack basin and the Sudbury-Assabet-Concord (SuAsCo) basin. The Merrimack River basin covers about 279 square miles within 28 cities and towns in northeast Massachusetts, and an additional 4,700 square miles in New Hampshire. It is the fourth largest major drainage basin in New England. The Sudbury-Assabet-Concord River basin is located entirely within Massachusetts and includes all or part of thirty-six cities and towns in a 398 sq. mi. area. The boundary between them bisects the town approximately east to west, north of I-495. These major basins include a series of connected sub-basins. The sub-basins do not have given geographic names by USGS or the Massachusetts Water Resources Commission, but they correspond with certain significant hydrologic features. Seven sub-basins drain most of Westford's surface area: the Snake Meadow Brook/Keyes Brook sub-basin; the Nabnasset Lake sub-basin; the Stony Brook subbasin; the Forge Pond subbasin; the Nashoba Brook sub-basin; the Tadmuck Swamp sub-basin; and the Heart Pond sub-basin. There are also four sub-basins that lie largely outside of Westford: Bridge Meadow Brook (Tyngsborough); Deep Brook (Chelmsford); Beaver Brook (Littleton); and a very small piece of the Massapog Pond sub-basin (Groton, Tyngsborough).

Surface Water

Like most of New England, Westford consists of shallow glacial till and stratified drift over bedrock and as a result, the town has only a few small productive ground-water aquifers. These aquifers are intimately related to the surface water above them, making protection of surface water vitally important to Westford.

By virtue of the size of its drainage sub-basin, Stony Brook is Westford's principal watercourse. Stony Brook's headwaters begin at Wolf Swamp in Boxborough and terminate about 22 miles east at its confluence with the Merrimack River in Chelmsford. The stream is known as Beaver Brook from Wolf Swamp to Forge Pond in Westford, where it becomes Stony Brook and remains so until its terminus at the Merrimack River. From Forge Village to the Chelmsford town line, Stony Brook collects surface water from about eight square miles or almost one-quarter of the town's area. Nashoba Brook and its tributaries Vine Brook, Nonset Brook and Butter Brook collect water from the southern third of Westford and travel south toward the Concord River.

Westford has many beautiful lakes and ponds. At 203 acres, Forge Pond is Westford's largest pond, though part of it lies within Littleton. Similarly, Nabnasset Lake serves as the center of its natural and built environment within Nabnasset Village. Many other ponds characterize Westford, particularly in the Merrimack basin north of Stony Brook, including Keyes Pond, Long Sought for Pond, Flushing Pond, Greystone Pond, Grassy Pond, and Burge's Pond. In the Concord basin are Heart Pond (mostly in Chelmsford) and many smaller ponds and adjoining wetlands. Eight lakes and ponds in Westford are classified as Great Ponds under M.G.L. c. 91, the Public Waterfront Act, including Burge's Pond, Flushing Pond, Forge Pond, Grassy Pond, Heart Pond, Keyes Pond, Long Sought for Pond, and Nabnasset Lake. Public access to Westford's great ponds is available at the Town Beach on Forge Pond, Edwards Beach on Nabnasset Lake, and from canoe access ramps at Keyes Pond, Long Sought for Pond, Beaver Brook, and Stony Brook on River Street.

Westford's lakes and ponds provide some of its most pristine open spaces and natural vistas, and the town has taken steps to protect several of them. Grassy Pond, Kennedy Pond and Burge's Pond are located within parcels managed by the Westford Conservation Commission while Greystone Pond is bordered by conservation land. However, other waterbodies such as Long Sought for Pond and Lake Nabnasset are surrounded by private property. Many of the town's former quarries have developed small ponds and they are recognized not only for their scenic quality but also for their ecological value as vernal pools, providing valuable habitat to vernal pool species. These resources are also unprotected from potential adverse development.

Groundwater

Westford has a high-yield aquifer suitable for drinking water in the stratified drift beneath Stony Brook and its surroundings. The town adopted a Water Resource Protection Overlay District (WRPOD) in order to protect the sensitive drinking water supply areas. Within the overlay districts, Westford prohibits certain land uses and allows others only by special permit.

Wetlands

Westford has several large and significant wetland areas distributed throughout town, particularly around Stony Brook and Nashoba Brook. The town has enacted a local Wetlands Protection Bylaw and regulations to supplement the Massachusetts Wetlands Protection Act, M.G.L. c.131, s. 40. The local bylaw establishes additional interests beyond those set by the state law, including water pollution prevention, recreation, and aquaculture values. The bylaw also regulates activities within 100 feet of the wetland resource areas defined in the state law (buffer zones) as well as activities affecting smaller wetlands, including vernal pools, which are not subject to the Wetlands Protection Act.

Flood Hazard Areas

Westford has a Flood Plain Overlay District (FOD) that restricts uses on land within mapped flood plains The purpose of the FOD is to protect public health and safety, and to preserve natural flood control characteristics and flood storage capacity of the floodplain, and to protect the groundwater recharge areas within the floodplain. The boundaries of the FOD are shown on the Federal Emergency Management Agency's Flood Insurance Rate Map, dated June 4, 2010 for the Merrimack Basin and July 7, 2014 for the SuAsCo Basin. No construction or earth-moving activities are permitted in the FOD without a special permit from the Planning Board. Additionally, FEMA flood boundaries reflect flood conditions at a certain point in time. Due to the anticipated increased rainfall and intensity of storms associated with climate change in the northeast portion of the United States, flood boundaries in the northeast are predicted to migrate upgradient over time.

Vegetation

Westford occupies a transitional place in the mosaic of forest types that characterize New England, i.e., a blend between northern (hardwood-hemlock-white pine) and southern (hardwood-oak-hickory) New England forests. This diverse mixture of hardwoods and conifers gives the land a quilted appearance from a distance, and also provides a wide range of habitats for wildlife. Westford is home to several state champion trees, the largest trees of their species in the state, including the largest catalpa (Catalpa speciosa) on private property on Concord Road and the largest shagbark hickory (Carya ovata) on Trust land on Hildreth Street.

According to the Massachusetts Natural Heritage & Endangered Species Program (NHESP), Westford is known to have seven plant species classified as state endangered, threatened, or species of special concern.

Fisheries & Wildlife

The NHESP reports that Westford is home to six species listed as endangered, threatened, or of special concern in Massachusetts, and for which estimated habitats have been mapped.

Resources of Regional Significance

The Stony Brook and Nashoba Brook sub-basins and their greater watershed areas are particularly significant to downstream environments and towns. Water that enters these basins in Westford flows into the larger watersheds that include the towns of Chelmsford, Carlisle, Acton and Littleton. Local decisions in Westford, such as zoning and development siting, can have an impact on downstream communities by affecting surface water and ground-water quality and quantity. Non-point source pollution, excessive water withdrawals, and alteration of local hydrology (e.g. flow restrictions, impervious surfaces) can compromise the health of an ecosystem and public welfare both in the sub-basin and far downstream in neighboring communities.

Several areas of Westford are designated endangered species habitat, which makes them significant to the existence of the species across the state.

Open Space

Westford has a variety of open spaces including: agricultural land, forested land, water resources, public parkland, trails, granite quarries, private sports facilities, public conservation land, semi-public land, Agricultural Preservation Restriction (APR) lands, conservation lands, and some private lands.

1.2.4 Westford's Infrastructure

Transportation[4]

Westford is served by regional highways, with direct access from Interstate Highway I-495 and U.S. Route 3. Interstate 495 bisects Westford. According to MassDOT, I-495 has approximately four road miles and more than 26 lane miles within Westford's boundaries. Westford has one I-495 interchange, Exit 83 (old Exit 32), providing access to Boston Road/ Route 110. Route 3, which generally runs in a north/south direction, also provides access into Westford. Although approximately one mile of Route 3 lies within Westford, the Route 40 interchange is located just outside the town line in Chelmsford, and Route 40 serves not only as an important gateway into Westford but also as a connection to the regional highway network and towns west of Westford such as Groton.

State Route 110 is a state-owned and maintained minor arterial road south of I-495. It runs primarily in a southwesterly to northeasterly direction parallel to I-495. Land uses along the Route 110 corridor are primarily commercial and industrial, including some major retail developments, office parks and Kimball's Farm. Route 40 has predominantly residential uses along its frontage, except near major intersections such as Oak Hill Road and Keyes Road, where there is a mix of residential and commercial uses. Route 27 is residential in character and provides access to multiple subdivisions.

Westford is also connected to surrounding towns and cities such as Chelmsford, Lowell, Tyngsborough, Dunstable, Groton, Littleton and Acton through arterials and collector roads.

Westford lies within the Lowell Regional Transit Authority's (LRTA) service area, which also provides transit service to Acton, Billerica, Chelmsford, Dracut, Dunstable, Groton, Lowell, Maynard, Pepperell, Tewksbury, Townsend, and Tyngsborough.

Commuter rail service to North Station in Boston is available to Westford residents via the Fitchburg Line, which is accessible from the Littleton/I-495, South Acton and West Concord commuter stations. Additionally, commuter rail service is available on the Lowell Line from the Lowell Gallagher Terminal or North Billerica Station to North Station in downtown Boston.

Westford also has an extensive town-wide trail network. On a regional scale, Westford is part of the Bruce Freeman Rail Trail project, which runs along the southern end of the town's boundaries. The trail will connect communities from Lowell to Framingham once finally completed.

[4] The following was excerpted from the Town of Westford Master Plan

Drinking Water

The Town of Westford is served by a municipally owned and operated water department that provides drinking water to approximately 75% of the Town's population and serves residential, municipal, commercial, and industrial customers. The Westford Water Department (PWS ID 3330000) is entrusted with providing a safe, high-quality, adequate water supply and uninterrupted service at a reasonable pressure and reasonable cost, to protect public health, meet fire protection needs, and address Federal and State regulatory requirements. The Westford Water Department water system operates and maintains two 3.0 MGD greensand water treatment plants, nine active wells with associated pumping stations, five water storage tanks that contain approximately 5.2 MG of finished water storage, two water booster pumping stations, approximately 133 miles of water mains, approximately 1,200 fire hydrants, around 5,365 service connections[5], and one operations and maintenance facility.

Wastewater

The Town of Westford does not have a centralized wastewater collection and treatment system, and therefore buildings are served by decentralized collection, treatment, and disposal systems or by on-site treatment and/or wastewater disposal systems (e.g, septic systems or tight tanks). Twelve municipal parcels discharge to one of the four Town-owned wastewater treatment facilities (WWTF) (Abbot WWTF, Blanchard WWTF, Academy WWTF, and Stony Brook WWTF). These facilities vary in treatment type and handle larger volumes of wastewater. Of these parcels, six properties connect to the Abbot WWTF (Fletcher Library, Town Hall, Roudenbush Community Center, Roudenbush Child Care, Main Street Fire and Police Station, and Abbot School & Millennium School), two properties connect to the Blanchard WWTF (Blanchard School and Norman Day School), two properties connect to the Academy WWTF (Crisafulli and Robinson School and Westford Academy), and two properties connect to the Stony Brook WWTF (Stony Brook Middle School and Stony Brook Housing). As part of the wastewater pre-treatment, each facility has a large capacity tank that settles large solids and is routinely pumped.

Stormwater

Stormwater infrastructure includes all components of the MS4 (e.g., catch basins, drainage manholes, stormwater outfalls, drainage pipes, open channel conveyances, etc.), interconnections with other MS4s (e.g., abutting communities or MassDOT), culverts, dams, and Town-owned or operated structural Best Management Practices (BMPs) such as detention basins, retention basins, swales, etc.

Stormwater infrastructure serves several important functions which can be broadly organized into two groups: drainage and water quality. The original goal of stormwater infrastructure was to remove water from roadways and other impervious surfaces to prevent icing and flooding. The systems were originally designed to collect runoff and quickly discharge it to the nearest water course. Now that the role of stormwater as a transport mechanism for non-point source pollution is better understood, the scope of

[5] Number of service connections per 2016 ASR, GIS map shows around 5,150 mapped services

stormwater infrastructure design has expanded to include water quality as well as quantity.

Westford is responsible for operating and maintaining the extensive town-owned drainage system, which includes 60 miles of drainage piping, approximately 6,300 drainage structures (including catch basins, manholes, and outfalls), 150 miles of public roadways, almost 185 culverts, three municipally-owned and operated dams, numerous structural best management practices, and natural drainage conveyances.

1.3 Federal/State Disaster Declarations

Westford has experienced 20 natural hazard incidents that triggered federal or state disaster declarations since 1991, listed in **Table 1-3**. Most events involved severe storms and flooding.

TABLE 1-3
Federal/State Disaster Declarations in Middlesex County (1991- 2018)

Disaster Name (Date of Event)	Type of Federal Assistance Provided	Declared Areas in Massachusetts
Hurricane Bob (August 1991)	FEMA Public Assistance Project Grants Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk Statewide Hazard Mitigation
No-Name Storm (October 1991)	FEMA Public Assistance Project Grants FEMA Individual Household Program Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk Statewide Hazard Mitigation
Nor'easter-Winter Coastal Storm (December 1992)	FEMA Public Assistance Project Grants FEMA Individual Household Program	Counties of Barnstable, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
March Blizzard (March 1993)	FEMA Public Assistance Project Grants	Statewide
January Blizzard (January 1996)	FEMA Public Assistance Project Grants	Statewide
October Flood (October 1996)	FEMA Public Assistance Project Grants FEMA Individual Household Program Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Plymouth, Norfolk, Suffolk Statewide Hazard Mitigation
June Flood (June 1998)	FEMA Individual Household Program Hazard Mitigation Grant Program Community Development Block Grant- HUD	Counties of Bristol, Essex, Middlesex, Plymouth, Norfolk, Suffolk, Worcester Statewide Hazard Mitigation

March Flood (March 2001)	FEMA Individual Household Program Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Plymouth, Norfolk, Suffolk, Worcester Statewide Hazard Mitigation
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	Statewide
May Rainstorm/Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide Hazard Mitigation
April Nor'easter (April 15-27, 2007)	Hazard Mitigation Grant Program	Statewide Hazard Mitigation
Flooding (March 2010)	FEMA Public Assistance FEMA Individual and Household Programs SBA Loans Project Grants/Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Plymouth, Norfolk, Suffolk, Worcester Statewide Hazard Mitigation
Nor'easter (January 11-12, 2011)	FEMA Public Assistance Grants Hazard Mitigation Grant Program	Counties of Berkshire, Essex, Hampshire, Middlesex, Norfolk and Suffolk Statewide Hazard Mitigation
Tropical Storm Irene (August 27-28, 2011)	FEMA Public Assistance Grants Hazard Mitigation Grant Program	Counties of Franklin and Berkshire Statewide Hazard Mitigation
"Snowtober" October 29-30, 2011	FEMA Public Assistance Grants Hazard Mitigation Grant Program	Counties of Berkshire, Franklin, Hampshire, Hampden, Worcester and Middlesex Statewide Hazard Mitigation
Hurricane Sandy October 27- Nov 8, 2012	FEMA Public Assistance Grants Hazard Mitigation Grant Program	Counties of Bristol, Plymouth, Barnstable, Dukes and Nantucket Statewide Hazard Mitigation
Winter Storm Nemo February 8-10, 2013	FEMA Public Assistance Grants Hazard Mitigation Grant Program	Statewide
Winter Storm Juno January 26-29, 2015	FEMA Public Assistance Grants Hazard Mitigation Grant Program	Counties of Worcester, Middlesex, Essex, Suffolk, Norfolk, Bristol, Plymouth, Barnstable, Dukes and Nantucket Statewide Hazard Mitigation

Winter Storm Riley March 2-3, 2018	FEMA Public Assistance Grants Hazard Mitigation Grant Program	Counties of, Essex, Norfolk, Bristol, Plymouth, Barnstable, and Nantucket. Statewide Hazard Mitigation
Winter Storm Skylar March 14-15, 2018	FEMA Public Assistance Grants Hazard Mitigation Grant Program	Counties of Worcester, Middlesex, Essex, Suffolk, and Norfolk, Statewide Hazard Mitigation

1.4 Available Documents

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See **Appendix A** for a list of all reports, plans, studies, and technical information that was used in the development of the MVP/HMP 5-year Update. Information that was used to develop key findings is cited directly in the document.

Section 2
MVP/HMP Planning Process

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To develop this combination MVP/HMP report, the Town of Westford followed the planning process framework consistent with FEMA's hazard mitigation planning guidance and EEA's Community Resilience Building framework, while focusing on local needs and priorities, and maintaining a regional perspective on natural hazard events. The combined process included the following main steps:

1. **Identifying and Mapping the Hazards** – The Town used data from federal, state, and locally developed data to identify hazards that impact Westford. A profile of each hazard was developed including previous occurrences, magnitude and severity of the hazard, and probability for future occurrences. Maps were created to show areas affected by the identified natural hazards and were used as the basis for developing the risk assessment. The Natural Hazards Risk Assessment is included in Section 3.
2. **Assessing the Critical Community Assets and Potential Damages** – Critical community assets including municipal facilities, infrastructure, vulnerable populations, economic, and natural resources were located and compared with hazard data to identify those that may be vulnerable to hazards. Westford developed estimates of the potential impacts of certain hazard events on the community including flooding, flooding impacts due to future climate change, earthquakes, and hurricane winds. Further discussion is included in the Asset Inventory in Section 4 and the Vulnerability Assessment in Section 5.
3. **Reviewing Existing Mitigation** – Westford has implemented many mitigation strategies. All current municipal mitigation measures were documented and discussed as part of the Capabilities Assessment in Section 6.
4. **Developing Mitigation Strategies** – The Town worked with a designated planning group, local stakeholders, and their consultants to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessment, and exiting mitigation measures to determine where additional work is needed to reduce potential future damages from hazard events. The Mitigation Strategy discussed in Section 7 includes goals and objectives, mitigation actions, and an implementation strategy.
5. **Implementing and Updating the Plan** – Implementation is the final and most important part of any planning process. Hazard Mitigation Plans must also be updated on a 5-year basis making preparation for the next Plan update an important on-going activity. A schedule for implementation, Plan Evaluation and Maintenance is included in Section 8.
6. **Plan Approval and Adoption** – Once a final draft of the HMP update is complete it is sent to MEMA for the state level review and pending the completion of any revisions, it is sent to FEMA for approval. Once FEMA approves the Plan, FEMA issues a conditional approval pending adoption of the Plan by the Town of Westford. The Plan Approval Process is included in Section 9.

The steps included public participation as an important component of the process, providing critical information about the local occurrence of hazards, a discussion on regional issues, and to build support for hazard mitigation activities.

Public participation was accomplished through the Community Resilience Building (CRB) Process. Westford held four online webinars and two online public meetings open to the general public to present and discuss aspects of the Hazard Mitigation Plan 5-year Update.

2.1 The Planning Team

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The **MVP/HMP Core Team**, listed in **Table 2-1**, was assembled at the start of the MVP/HMP 5-year update project to solicit input from multiple staff in the Town of Westford. The advisory group met to kick-off the HMP planning process. The meeting was led by Rob Anderson, Community Development, and the Town's consultant, Tighe & Bond. Presentations served to outline the MVP/HMP project, to discuss new HMP goals, and to provide guidance for town staff on project responsibilities.

TABLE 2-1
MVP/HMP Core Team

Name	Title & Department
Carol Gumbart	Conservation Resource Planner
Henry Fontaine	Building Commissioner
Jeffrey Morrissette	Director of Land Use Management
Jeffrey Stephens	Health Director
Jeremy Downs	Assistant Town Engineer
Joe Targ	Fire Chief / Co-Emergency Management Director
Matthew Salem	Assistant Planner
Paul Fox	Director of Facilities
Paul Starratt	Town Engineer
Rebecca Cheney	Town Planner
Richard Barrett	Highway Department Superintendent
Stephen Cronin	Director of Public Works

2.2 Outreach Strategy

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The Town of Westford completed public outreach through the MVP and HMP update, and other recent climate resiliency efforts under master planning. Outreach efforts included core team and advisory group meetings, public meetings, and multi-media outreach including articles and press releases.

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Table 2-2 summarizes the meetings and public forums conducted throughout the MVP/HMP process.

TABLE 2-2

Meetings and Public Forums

Meeting Date	Topic	Audience	Purpose
September 11, 2019	MVP/HMP Kickoff Core Team Kickoff	Core Team	Identify Process and workshop planning, hazard risk and goals update
February 24, 2020	Core Team Check-In	Core Team	Review goals, community assets, mitigation actions updates, and workshop coordination
May 7, 2020	Core Team Check In	Core Team	Discuss alternative public engagement, review draft deliverables and next steps
May 14, 2020	CRB Workshop #1	Core Team & Public	Outline community assets and vulnerabilities and mitigation actions for Society
May 18, 2020	HMP Public Hearing	Public & Neighboring Communities	Present HMP Planning Process and review results of risk and vulnerability assessment
May 21, 2020	CRB Workshop #2	Core Team & Public	Outline community assets and vulnerabilities and mitigation actions for Infrastructure
June 4, 2020	CRB Workshop #3	Core Team & Public	Outline community assets and vulnerabilities and mitigation actions for Natural Environment
June 18, 2020	Listening Session	Public	Review final plan
June 25, 2020	Core Team Check In	Core Team	Review Summary of Findings Report
March 23, 2021	Draft HMP Approve for MEMA review	Public	Select Board vote to send the Draft HMP to MEMA for review

2.2.1 Community Resilience Building Workshops

Stakeholders were invited to participate in three Community Resilience Building (CRB) workshops held online on May 14, May 21, and June 4 of 2020. Due to the COVID-19 crisis, the MVP/HMP process was altered to accommodate social distancing and stay-at-home advisories. Three 1.5-hour workshops were held to meet the requirements of the MVP/HMP process. The CRB workshop methodology is an "anywhere at any scale" format that draws on stakeholder's wealth of information and experiences to foster dialogue about the strengths and vulnerabilities within the Town. Webinar participants interacted using an online multi-modal approach to gather input, synthesize ideas across, and ultimately develop a set of priority resilience and adaptation actions. This input from participants was incorporated into the priority hazards and actions for the Hazard Mitigation Plan.

The Workshop's central objectives were to:

- Plan for more frequent and intense weather events;
- Improve pre-event planning, response and recovery, and long-term actions;
- Aid Westford in maintaining functions, protecting its residents and businesses, and be prepared for future storm events and a changing climate;

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

Public meeting materials are included in **Appendix B**. All webinar materials including the MVP Town website, pre- and post- surveys, presentations, attendee lists, and notes are included in **Appendix C**.

2.2.2 MVP/HMP Listening Session

A listening session to present the draft report and review the high priority actions identified through the CRB workshops was held on virtually on June 18, 2020. Town Staff from Planning and Community Development led the workshop with support from Tighe & Bond. Eight community members were in attendance. Tighe & Bond provided a presentation that briefly overviewed the MVP process, including findings. A copy of this presentation is included in **Appendix C**.

2.2.3 Select Board Meeting to Approve the Draft HMP

A Select Board Meeting to approve the draft HMP was held on March 23, 2021 at 7:00 p.m.

Section 3
Natural Hazard Risks

3.1 Identification of Natural Hazards

3.1.1 Hazards from State HMP

The 2018 Massachusetts State Hazard Mitigation and Climate Action Plan (SHMCAP)[6] provides an in-depth overview of natural hazards in Massachusetts. The SHMCAP identifies 15 natural hazards that have an impact or have a history of impacting communities in the Commonwealth of Massachusetts. These hazards are as follows:

Hydrologic & Geologic Flood Related Hazards-

- Inland Flooding- including Riverine Flooding, Urban Drainage Flooding, Ground Failure, Ice Jams, and Dam Overtopping
- Drought
- Landslides
- Coastal Flooding
- Coastal Erosion
- Tsunami

Atmospheric Hazards

- Extreme Temperatures
- Wildfires
- Invasive Species

Extreme Weather

- Hurricane and Tropical Storms
- Nor'easters
- Severe Winter Weather (includes snow, blizzards and ice storms)
- Tornadoes
- Other Severe Weather (includes high winds, thunderstorms,)

Non-Climate Related Hazards

- Earthquake

[6] MEMA (2018), "Massachusetts State Hazard Mitigation and Climate Adaptation Plan": https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf.

3.1.2 Selection of Hazards that Affect Town of Westford

As suggested under FEMA planning guidance, the Planning Team reviewed the full range of natural hazards identified in the 2018 SHMCAP and identified natural hazards that have impacted Westford in the past or could impact Westford in the future. The hazards selection for Westford was made using local expertise from the Planning Team, information from the 2015 Hazard Mitigation Plan for the Northern Middlesex Region[7], the 2018 SHMCAP and other sources. Climate change impacts are integrated into the natural hazard elements where appropriate, consistent with the strategy used in the 2018 SHMCAP. Westford falls within both the Merrimack and SuAsCo sub-basins. The Merrimack sub-basin was utilized for integrating data from the 2018 SHMCAP as it includes the majority of the land area in Westford.

The Planning Team reviewed each natural hazard and analyzed the history of occurrence in Town, hazard probability, hazard frequency, geographic extent, and severity of impact. Each of these categories were ranked based on the Hazard Profile Definitions, displayed in **Table 3-1**.

TABLE 3-1
Hazard Profile Definitions [8]

Points	Rank	Description
Hazard Probability (Possible occurrence in the future)		
1	Unlikely	Less than a 1% probability over the next 100 years
2	Possible	1-10% probability in the next year or at least one chance in the next 100 years
3	Likely	10-100% probability in the next year or at least one chance in the next 10 years
4	Highly Likely	Near 100% probability in the next year
Hazard Frequency		
0	Very Low	Events that occur less frequently than once in 1,000 years (less than 0.1% per year)
1	Low	Events that occur from once in 100 years to once in 1,000 years (0.1% - 1% per year).
2	Medium	Events that occur from once in 10 years to once in 100 years (1% - 10% per year).
3	High	Events that occur more frequently than once in 10 years (greater than 10% per year).
Geographical Extent (Area Impacted by a Given Natural Hazard)		
1	Small	Less than 10% of the Town affected
2	Medium	10-50% of the Town affected
3	Large	More than 50% of the Town affected
Severity of Impact from Hazard		

[7] Hazard Mitigation Plan for the Northern Middlesex Region, 2015 Update; Northern Middlesex Council of Governments

[8] 2018 MA State Hazard Mitigation and Climate Adaption Plan (SHMCAP)

1	Minor	Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e. one or two communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.
2	Serious	Scattered major property damage (more than 10% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services briefly interrupted up to 1 day; some minor injuries.
3	Extensive	Consistent major property damage (more than 25%); major damage public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and possible fatalities.
4	Catastrophic	Property and public infrastructure destroyed (more than 50%); essential services stopped for 30 days or more, multiple injuries and fatalities.

The Planning Team analyzed each type of hazard in respect to the Town of Westford, as shown in **Table 3-2** below. The final Hazard Risk Ranking is the total of all categories for each type of hazard.

B1

Table 3-2
Relevant Natural Hazards for the Town of Westford

Type of Hazard	History of Occurrence (Y/N)	Hazard Probability	Hazard Frequency	Geographic Extent	Severity of Impact	**Hazard Risk Ranking**
Hydrological Hazards						
Inland Flooding	Yes	2	3	1	1	**7**
Coastal Flooding	No	0	0	0	0	N/A
Drought	Yes	3	2	3	2	**10**
Atmospheric Hazards						
Extreme Temperatures	Yes	4	3	3	2	**12**
Hurricanes/Tropical Storms	Yes	3	3	3	3	**12**
Nor'easter	Yes	4	3	3	3	**13**
Other Severe Weather - High Winds and Thunderstorms	Yes	4	3	3	2	**12**
Severe Winter Storm Snow, Ice and Blizzards	Yes	4	3	3	2	**12**
Tornados	No	1	0	1	3	**5**
Tsunami	No	0	0	0	0	N/A
Geological Hazards						

Coastal Erosion	No	0	0	0	0	N/A
Earthquake	Yes	2	1	3	4	**10**
Landslide	No	1	1	1	2	**5**
Other Hazards						
Wildfires	Yes	3	2	2	4	**11**
Invasive Species	Yes	4	3	3	1	**11**
Blue Green Algae	Yes	4	3	2	1	**10**

Westford has elected to include 12 of the 15 hazards from the SHMCAP, with the addition of blue green algae as the basis for evaluating hazards for the Westford Hazard Mitigation Plan (HMP) 5-year update. Coastal natural hazards including coastal flooding and coastal erosion and tsunamis are not applicable for this inland community.

The Types of Hazard were then assigned a ranking between 1 and 5 depending on its overall Hazard Risk Ranking. **Figure 3-3** below demonstrates the correlation between the Hazard Risk Ranking and the Priority Hazards for the Town of Westford.

FIGURE 3-3
Priority Hazard Ranking

Hazard Risk Ranking	Westford Priority Hazards Ranking	Description
13 - 12	#1	High Priority
11 - 10	#2	
8 - 8	#3	
7 - 6	#4	
5 – or lower	#5	Lowest Priority

Based on the ranking scale provided in Table 3-1, the highest ranked natural hazards for Westford include:

- Severe Winter Storms / Nor'easter
- Severe Winter Storms/ Snow, Ice and Blizzards
- Other Severe Weather- Hurricanes, High Winds, Thunderstorms and Microbursts

The lowest ranked natural hazards for Westford include:

- Tornadoes
- Landslides

3.1.3 Impacts from Climate Change

Changes in precipitation, temperature, sea level rise, and storm surge due to climate change are summarized in this section. Climate change projections for Westford were reviewed using data from the Northeast Climate Adaptation Science Center (NE CASC) at

the University of Massachusetts Amherst developed for inclusion in the 2018 SHMCAP[9]. The data used in downscaled projections for Massachusetts are based on simulations from the latest generation of climate models included in the Coupled Model Intercomparison Project Phase 5, which form the basis of projections summarized in the Intergovernmental Panel on Climate Change Fifth Assessment Report (2013). To ensure consistency with the SHMCAP, Westford has adopted data developed for the Merrimack River Watershed region from the State-wide climate change projections (2017, NE CASC and EEA)[10]. Climate change for each natural hazard risk is discussed within the hazards profiles below.

A categorization of traditional natural hazards, within the context of climate change, was included to demonstrate the connections between traditional natural hazard analysis and climate change projections. This categorization also aligns with the four climate change categories included on the Commonwealth's resilient MA Climate Change Clearinghouse website (http://www.resilientma.org/). Those categories are illustrated as follows.



Changes in Precipitation: Changes in the amount, frequency, and timing of precipitation—including both rainfall and snowfall—are occurring across the globe as temperatures rise and other climate patterns shift in response.



Sea Level Rise: Climate change will drive rising sea levels, and rising seas will have wide-ranging impacts on communities, natural resources, and infrastructure along the Commonwealth's 1,519 tidal shoreline miles.



Rising Temperatures: Average global temperatures have risen steadily in the last 50 years, and scientists warn that the trend will continue unless greenhouse gas emissions are significantly reduced. The 9 warmest years on record all occurred in the last 20 years (2017, 2016, 2015, 2014, 2013, 2010, 2009, 2005, and 1998), according to the U.S. National Oceanographic and Atmospheric Administration (NOAA).



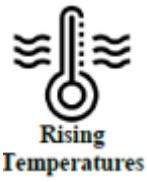
Extreme Weather: Climate change is expected to increase extreme weather events across the globe, as well as right here in Massachusetts. There is strong evidence that storms—from heavy downpours and blizzards to tropical cyclones and hurricanes—are becoming more intense and damaging and can lead to devastating impacts for residents across the state.

[9] Resilient MA Climate Change Clearinghouse for the Commonwealth: http://resilientma.org/datagrapher/

[10] EEA (2017). "Statewide and Major Basins Climate Projections Final, 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan Natural Hazards Risk Assessment

Table 3-4 from the 2018 SHMCAP shows the climate change and natural hazard taxonomy for the State of Massachusetts.

TABLE 3-4
Climate Change and Natural Hazard Taxonomy

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

3.2 Hazard Profiles

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Hazard profiles are provided in Sections below for each of the natural hazards that could impact Westford in the future or have impacted the Town in the past. Each hazard profile includes a definition and description of the hazard, previous occurrence and extent, local areas of impact, and probability for future occurrence. A discussion of previous occurrences includes historic data. Evaluation of the extent or severity of the hazard includes the measuring scale for a specific hazard. Locally identified areas of impact include maps showing the areas identified by the hazard whenever possible. The probability of future occurrences is based on best available science and historic events using the hazard probability scale provided in **Table 3-2**.

For each natural hazard, the major vulnerability issues for four key sectors are summarized. The key sectors or categories of community assets include:

- **Societal** - Vulnerable populations and cultural assets
- **Infrastructural** - Built environment including municipal and critical structures
- **Environmental** – Natural environmental resources
- **Economic** – Commercial and industrial industries

Resources used to develop the natural hazard profiles are referenced as footnotes throughout the chapter.

3.2.1 Hydrological Hazards

Floods are the most common type of hydrologic hazard in Westford. Flood hazard includes inland flooding as the direct result of heavy rains, Nor'easters, and dam failure. Coastal flooding does not impact this inland community. At the other end of the spectrum, drought impacts are included as a hydrologic hazard for Westford, primarily based on the negative impacts to water supplies and agriculture.

3.2.1.1 Inland Flooding

Nationally, inland flooding causes more damage annually than any other severe weather event[11]. Flooding typically occurs where the rate of precipitation from a severe storm like a Nor'easter or tropical storm causes a large amount of rain in a short period of time, overwhelming the capacity of natural or constructed drainage systems causing overflows. Inland flooding along rivers and streams is known as **riverine flooding.** Flooding can also result from **ice jams.** Ice jams forming from the breakup of the ice cover at ice-out may build up to a thickness great enough to raise the water level and cause flooding upstream of the obstruction.

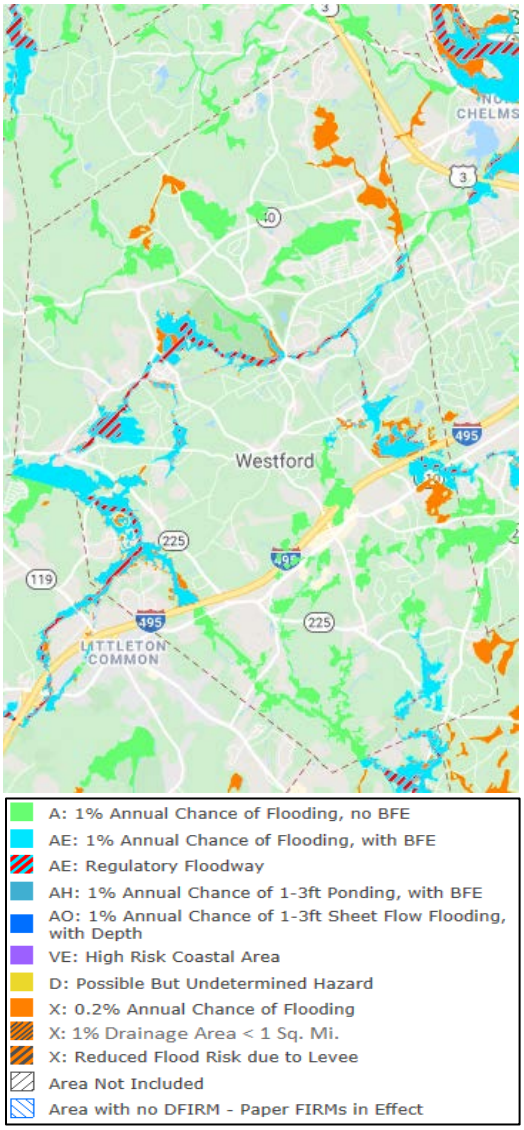
Flooding due to **poor drainage** occurs in flat areas where runoff or rain collects and cannot drain. Poor drainage after flood events is usually associated with poorly infiltrating soils and undersized stormwater conveyance, including channelized streambeds and culverts that do not have adequate capacity to handle runoff from larger storm events.

[11] U.S. Climate Resilience Toolkit, 2017

Developed, impervious areas can contribute to inland flooding. Increases in precipitation and extreme storm events will result in increased inland flooding.

FEMA Flood Hazard Areas

Areas at risk of flooding are mapped by FEMA as part of the National Flood Insurance Program (NFIP) established in 1968 to reduce the nation's flood losses via local floodplain management practices. A floodplain is defined by the NFIP as any land area susceptible to being inundated by floodwaters from any source[12]. FEMA's flood maps, the Flood Insurance Rate Maps (FIRM) delineate flood zones that are defined according to varying risk of, or potential for, flooding due to the land area's characteristics (proximity to a waterbody, topography/slope) and current waterbody conditions (water levels, historic storm experience).



The frequency and severity of flooding are measured based on the probability that a certain river discharge (flow) will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different flooding levels. For example, the 100-year flood has a 1-percent chance of being equaled or exceeded in any given year. The 100-year flood, or 1% chance annual flood is **not** inherently a flood that will occur once every 100 years.

The 100-year flood is used by the NFIP to guide floodplain management and determine the need for flood insurance. The term "500-year flood" or 0.2% annual chance flood, is the flood that has a 0.2-percent chance of being equaled or exceeded each year. The 100- and 500- year regulated floodplains and areas subject flooding within Westford, shown below in **Figure 3.1** as defined by the NFIP FIRM with an effective date of June 4, 2010. (Note: Portions of Westford within SuAsCo watershed have an effective date of July 7, 2014)

Figure 3.1: Westford's FEMA Flood Hazard Zones

Previous Occurrence and Extend of Inland Flooding in Westford-

Flooding in Massachusetts is often the direct result of frequent weather events, such as coastal storms, nor'easters, tropical storms, hurricanes, heavy rains, and snowmelt.

[12] https://www.fema.gov/national-flood-insurance-program/definitions

Rainfall events are the most consistently influential drivers of riverine flooding in the Commonwealth. The state receives approximately 48 inches of rain per year on average, with average monthly rainfall between 3 and 4 inches in all regions of the state. However, heavy rainfall events occur regularly. As a result, riverine flooding affects most of the communities in the Commonwealth, including Westford. **Figure 3-2** shown below, Westford has had 14 FEMA flood declared disasters between 1954-2017:

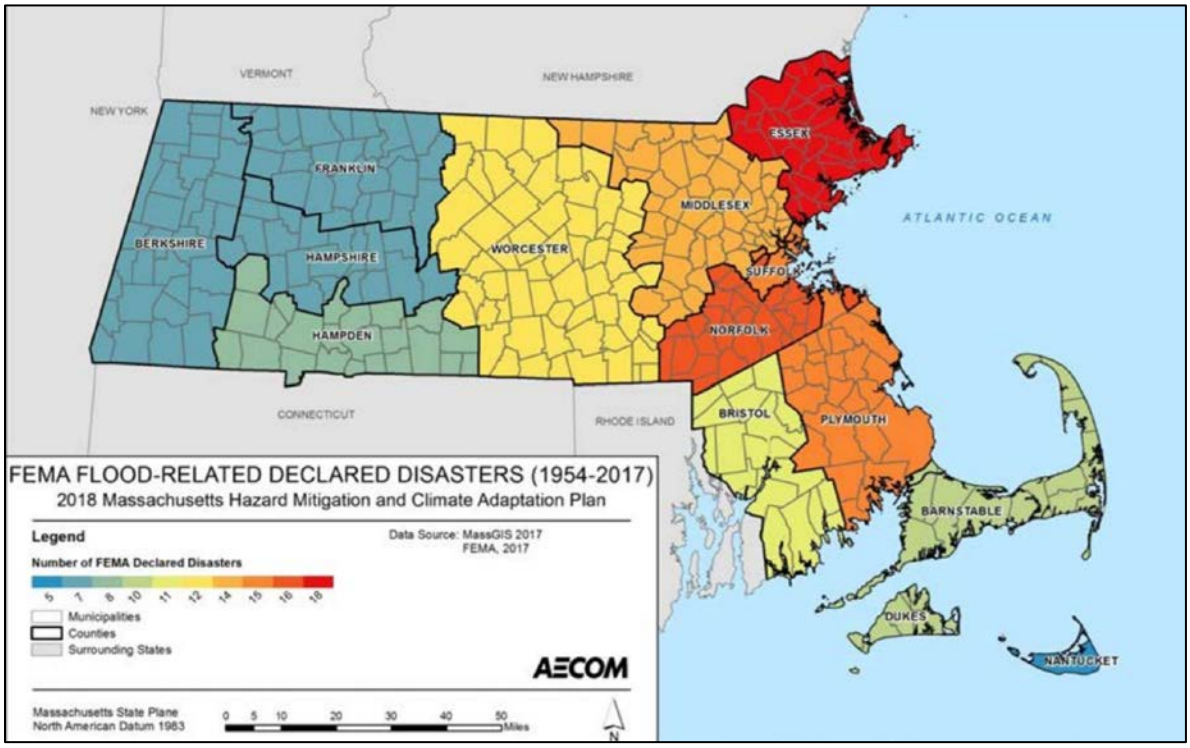


Figure 3-1 – FEMA Flood-Related Declared Disasters (1954-2017)

Locally Identified Areas of Impact

The majority of floodplain affected land in Westford is found along Snake Meadow Brook, Keyes Brook, Stony Brook, Nabnasset Lake, Forge Pond, Tadmuck Swamp and Heart Pond and associated tributaries. Flooding typically occurs in the spring, as a result of melting snow and ice, and in the late summer due to storms.

Historically, roadways and areas that have experienced chronic flooding include:

- Bridge Street at Stony Brook Crossing and at Blacksmith Pond;
- Gould Road;
- Wing Road near Keyes Road;
- Tenney Road;
- Route 40 near Keyes Road;
- Concord Road at Vine Brook; and
- Route 110 in the vicinity of Tadmuck Swamp.

Repetitive Loss Structures

B4 a

The frequency and locations of flood hazard events in Westford can be estimated based on the reported loss occurrences for repetitive loss properties and from local knowledge of flood hazard areas.

As defined by the Community Rating System (CRS) of the NFIP, a repetitive loss property[13] 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. A severe repetitive loss property is any NFIP-insured property that has met at least one of the following paid flood loss criteria since 1978, regardless of ownership:

- Four or more separate claim payments of more than $5,000 each (including building and contents payments); or
- Two or more separate claim payments (building payments only) where the total of the payments exceeds the current value of the property.

Westford has 71 policies in force and no repetitive loss properties as of July 10, 2019. A total of 10 claims have been paid between the years of 1974 and 2019 for a total of $76,520[14]. The claims were all for properties located in the 500-year flood or other zones.

Inland Flooding with Climate Change

Precipitation and temperature changes due to climate change are key factors that will impact inland flooding in the future. These changes have the potential to modify the current floodplain, impacting areas of Westford that have not flooded in the past. According to the Northeast Climate Impacts Assessment report of 2007, annual precipitation levels are expected to increase across New England by as much as fourteen percent (14%) by the end of this century, with an estimated thirty percent (30%) increase in precipitation during winter months. Changes in precipitation and extreme weather can trigger the following:

- **Changes in precipitation result in more intense and frequent downpours:** More intense downpours often lead to inland flooding as soils become saturated and stop absorbing more water, river flows rise, and urban stormwater systems become overwhelmed. Flooding may occur as a result of heavy rainfall, snowmelt, or coastal flooding associated with high wind and storm surge.
- **Extreme weather may produce more frequent severe storms:** Climate change is expected to result in an increased frequency of severe storm events. This would directly increase the frequency of flooding events and could increase the chance that subsequent precipitation will cause flooding if water stages are still elevated.
- **Changes in precipitation may trigger episodic droughts:** Vegetated ground cover has been shown to significantly reduce runoff. If drought causes vegetation to die off. this flood-mitigating capacity is diminished.

The climate projections suggest that the frequency of high-intensity or extreme rainfall events will trend upward. As shown in **Figure 3-3**, the amount of precipitation released

[13] For more information on repetitive losses see http://www.fema.gov/business/nfip/replps.shtm

[14] FEMA Community Information System Westford Report 07.10.2019

by storms in the northeast has increased by 71% from the baseline level (recorded 1901-1960) and present-day levels (measured 2001-2012)[15].

Overall, it is anticipated that the severity of flood-inducing weather events and storms will increase, with events that produce sufficient precipitation to present a risk of flooding likely increasing. A single intense downpour can cause flooding and widespread damage to property and critical infrastructure.

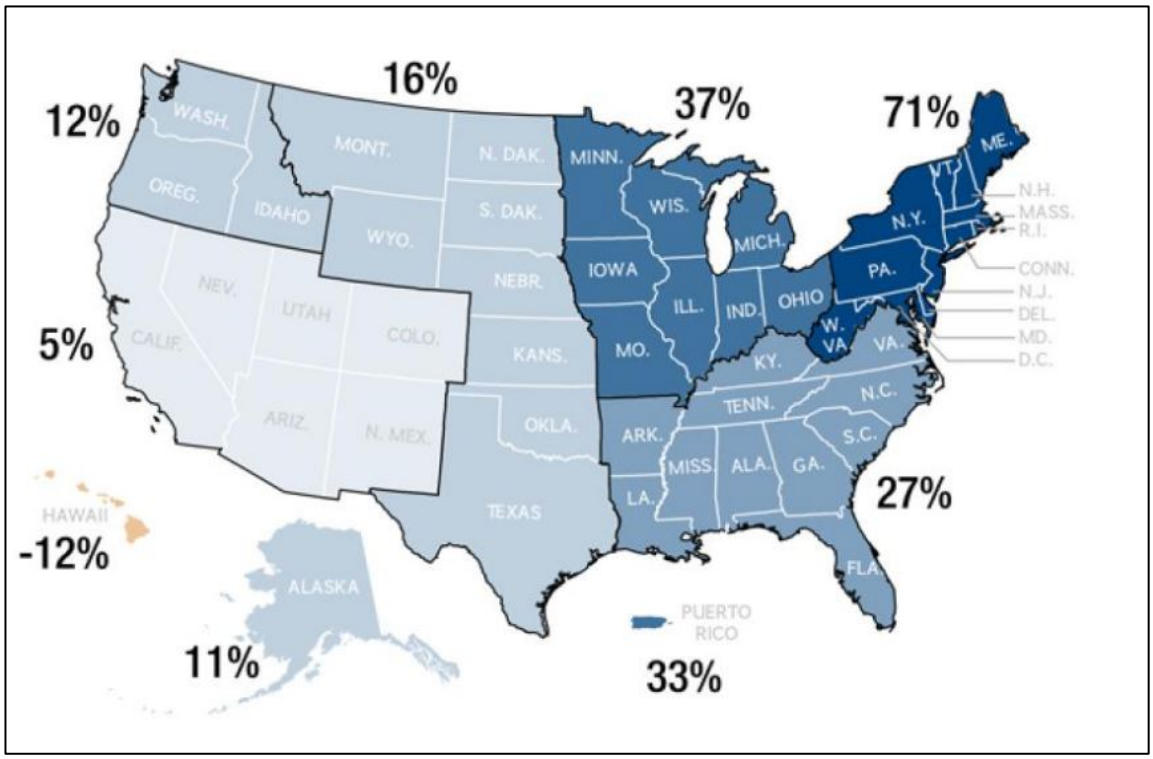


Figure 3-2 Nation-wide Comparison of Increase in Precipitation (source: NCA, 2014)

The number of days each year with extreme precipitation over one inch are variable for the Merrimack Basin, fluctuating between loss and gain of days (**Table 3-5**). Seasonally winter season is expected to see the highest projected increase of 0-1 days by mid-century and 0-2 days by the end of century.

[15] 2018 MA SHMCAP

Table 3-3

Projected Annual Frequency of Future Extreme Precipitation Events in the Merrimack Basin[16]

Merrimack Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	6.72	+0.19 to +1.61	+0.38 to +2.58	+1.05 to +2.52	+0.95 to +3.51
	Winter	1.58	-0.09 to +0.69	+0.12 to +1.03	+0.19 to +1.33	+0.27 to +1.59
	Spring	1.52	-0.11 to +0.64	-0.05 to +0.92	+0.01 to +1.10	+0.10 to +1.21
	Summer	1.42	-0.12 to +0.46	-0.15 to +0.69	-0.09 to +0.61	-0.14 to +0.52
	Fall	2.19	-0.26 to +0.58	-0.05 to +0.74	-0.15 to +0.78	-0.23 to +0.72
Days with Precipitation Over 2"	Annual	0.76	+0.01 to +0.42	+0.00 to +0.50	+0.11 to +0.61	+0.11 to +0.70
	Winter	0.09	-0.04 to +0.08	-0.02 to +0.08	-0.01 to +0.13	+0.00 to +0.17
	Spring	0.12	-0.05 to +0.15	-0.03 to +0.16	-0.07 to +0.21	+0.00 to +0.23
	Summer	0.18	-0.06 to +0.16	-0.02 to +0.16	-0.03 to +0.14	-0.01 to +0.17
	Fall	0.36	-0.06 to +0.31	-0.08 to +0.22	-0.04 to +0.23	-0.08 to +0.29
Days with Precipitation Over 4"	Annual	0.07	-0.01 to +0.10	-0.02 to +0.10	-0.02 to +0.09	-0.02 to +0.16
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.01
	Spring	0.00	-0.01 to +0.02	+0.00 to +0.03	-0.01 to +0.03	-0.01 to +0.04
	Summer	0.02	-0.01 to +0.03	-0.01 to +0.04	-0.01 to +0.02	-0.01 to +0.05
	Fall	0.04	-0.03 to +0.11	-0.02 to +0.06	-0.03 to +0.07	-0.05 to +0.09

Probability of Future Occurrence

The potential effects of climate change significantly impact inland flooding due to the increased frequency of severe storm events including nor'easters and hurricanes. Global climate change models suggest that Middlesex County may experience additional inland flooding as precipitation increases by 2100[17]. The Planning Team has determined that it is **LIKELY** that flooding will impact the Town of Westford in the future. The Town has implemented both structural and non-structural measures to withstand floods from heavy rain, and dam/culvert failure. The Town is enforcing the State Code in flood prone areas (100-year floodplain as shown on the FIRM).

In spite of these best efforts, a storm with sufficient magnitude could result in damages far greater than any the community has known, impacting the economy, natural resources, cultural and historic assets, and buildings and structures. Therefore, it is in the best interest of the Town and residents to understand how climate change may influence flooding and begin proactive planning to adapt or mitigate these impacts.

Extreme Precipitation Impact on Engineering Design

Estimating changes in the expected intensity of future rainfall events is constantly evolving, with technological advancements, increases in available precipitation records, and climate change models. Utilizing rainfall values that reflect the changing climate are

[16] NECSC, 2017

[17] 2018 MA SHMCAP

important in engineering design. Accounting for extreme precipitation is necessary to design adequate capacity in drainage system and provide sufficient structural elevation to avoid flooding.

There is a variety of opinions on the definition of "extreme precipitation", and which precipitation metric to compare over time. Rainfall can be compared using statistical thresholds (e.g. 95th percentile), absolute thresholds (e.g. greater than 1 inch) and return intervals (e.g. 100-year storm), all of which can be applied over a range of time scales from minutes to years.[18]

The "design storm" approach is a practical way to compare extreme precipitation amounts that is consistent with values used for engineering design. Rainfall amounts are compared over time periods based on storms of a similar size and duration called recurrence intervals or "return period", typically ranging from a 2-year to 100-year storm event. For example, a 2-year storm event has a 1 in 2 chance of occurring in a given year or a 50% probability. A 100-year storm event has a 1 in 100 chance of occurrence in a given year, or a 1% probability. A "design storm" is based on the historical precipitation records for a particular return interval and duration of the storm event such as a 2-year, 24-hour storm.

To assist the Town in planning for climate change, methods to calculate future design storm events for a variety of recurrence intervals were reviewed. Available data included a review of data from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14[19], Northeast Regional Climate Center (NRCC) [20] data and the 2017 NE CASC state-wide precipitation climate change data[21].

The National Oceanic and Atmospheric Administration (NOAA) Atlas 14 has been used for a number of years as an improved source of extreme precipitation. The Atlas was completed in 2016 and is the most current rainfall intensity dataset in Massachusetts. The NRCC or Cornell data is a second commonly used source for extreme precipitation. **Table 3-6** shows the 24-hour rainfall depths for Middlesex County, Massachusetts using both NOAA Atlas 14 and NRCC data choosing the higher value for each recurrence interval shown.

TABLE 3-6
Westford, MA 24-hour Rainfall Depth Estimates

Recurrence Interval Storm Event	NOAA / NRCC 24-hour Rainfall Depth (inch)
2 year	3.17
10 year	4.89
25 year	5.97
50 year	6.79
100 year	8.08

[18] MEMA (2018),"SHMCAP"

[19] NOAA Precipitation Frequency Data Server (PFDS), "NOAA Atlas 14 Point Precipitation Frequency Estimates: MA": https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ma

[20] Northeast Regional Climate Center Northeast Regional Climate Center (http://precip.eas.cornell.edu/data.php?1603838395678)

[21] NE CASC, "Massachusetts Climate Change Projections": https://necsc.umass.edu/projects/massachusetts-climate-change-projections

Implications for Inland Flooding with Climate Change

Rainfall is expected to increase in spring and winter months particularly in Massachusetts, with increasing consecutive dry days in summer and fall. More total rainfall can have an impact on the frequency of minor but disruptive flooding events, especially in areas where storm water infrastructure has not been adequately sized to accommodate higher levels.

More intense downpours often lead to inland flooding as soils become saturated and stop absorbing more water, river flows rise, and the capacity of storm water systems is exceeded. Flooding may occur as a result of heavy rainfall, snowmelt, ice or dam failure, but precipitation is the strongest driver of flooding in Massachusetts. Winter flooding is also common in the state, particularly when the ground is frozen. Westford experienced 14 flood-related disaster declarations from 1954-2017 with many of these falling in winter, or early spring.

Westford's current FEMA Flood Insurance Maps provide an important baseline for gaging the extent of future flood condition; however, it is important to note that FEMA defined floodplain areas are based on historic and existing conditions; but do not include future or projected climate conditions. This floodplain will expand in the future as extreme precipitation impacts inland flood levels.

Flooding Impacts on Westford's Four Key Sectors

Major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how flooding will impact them as shown in **Table 3-7** below.

TABLE 3-7
Inland Flooding Exposure and Vulnerability by Key Sector[22]

Sector	Vulnerability
Infrastructural	Flooding can wash out sections of roadways and bridges as well as cause extensive damage to public utilities and disruptions to delivery services.
Economic	Economic losses due to a flooding include, but are not limited to, damages to buildings (and their contents) and infrastructure, agricultural loses, business interruption (including loss of wages), impacts on tourism, and tax base.
Societal	Populations that are particularly vulnerable to this hazard include the economically disadvantaged, who may face greater difficulty in evacuating, and individuals with medical needs who may not have been able to receive required medical care either during evacuation or if isolated by flooded infrastructure.
Environmental	Severe floods cause a wide range of environmental impacts. Animals can lose their habitats if habitat elements are swept away or destroyed. Riverbank and soil erosion transform existing habitats and deposit sediment to downstream areas. If high levels of nutrients are present in the soil, this can lead to eutrophication in downstream ecosystems.

Dam Failure

A dam is an artificial barrier that has the ability to impound water for the purpose of storage or control of water. Dam failure is a catastrophic type of failure characterized by a sudden, rapid, and uncontrolled release of impounded water. Dam failure can occur as a result of structural failure, independent of a hazard event, or as the result of the impacts 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 infrequent but has the potential for severe impacts. An issue for dams in Massachusetts is that many were built in the 19th century without the benefits of modern engineering or construction oversight.

The Massachusetts DCR has three hazard classifications for dams:

- **High Hazard**: Dams located where failure or mis-operation will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).
- **Significant Hazard**: 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.

[22] 2018 MA SHMCAP

- **Low Hazard**: Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

In general, DCR requires that dams that are rated as low hazard be inspected every ten years while dams that are rated as significant hazards must be inspected every five years. High hazard dams must be inspected every two years. Owners of dams are responsible for having their dam inspected. MGL Chapter 253 and 302 CMR 10.00 requires that dam owners prepare, maintain and update Emergency Action Plans for all High Hazard Potential dams and certain Significant Hazard Potential dams.

Non-jurisdictional dams are not regulated by the Office of Dam Safety or under their jurisdiction. Typically, these dams are under 6 feet in height and/or under 15 acre-feet in storage and do not have an assigned 'Hazard Code'. Dams owned and regulated by the Federal Government are also typically non- jurisdictional but DO have an assigned Hazard Code.

Culvert Failure

A culvert is defined as a structural opening under a roadway that allows water to pass from one side of a roadway to the other. A culvert can impound water similar to a dam under certain flood conditions, and if conditions are extreme, culverts can fail, causing road and property damage. A culvert can fail under the following conditions:

- clogged with debris and sediment, invasive species and other vegetation
- buildup of flood water or on the upstream side of the culvert exceeding the capacity of the culvert
- loss of structural integrity
- culvert and road are washed out during a heavy rain or from snowmelt
- soil around the culvert erodes, and without support, the culvert will buckle or sag and the culvert will collapse

Previous Occurrence and Extent

Historically, dam failure has had a low occurrence in Middlesex County. However, many of the dams within the county are more than 100 years old, and some are even older, meaning the possibility of dam failure is not inconceivable. There have been several culverts that have been washed out due to flooding in the past.

Locally Identified Areas of Impact

There are 8 dams in Westford. Most are owned by the Town of Westford, however, Millbrook Brookside Station Dam and Forge Pond Dam are privately owned and operated. **Table 3-8** below displays the name of the day and hazard level.

TABLE 3-8
Dams Located in Westford, MA

Dam Name	Hazard Level
Winning Pond Dam	Significant
Millbrook Dam	Significant
Talbot Mills Dam	Significant

Winning Pond Dam	Significant
Millbrook Dam	Significant
Talbot Mills Dam	Significant
Flushing Pond Dam	Non-Jurisdictional
Long Sought for Pond Dam	Non-Jurisdictional

Probability of Future Occurrence

Climate change is likely to increase the severity of extreme precipitation events, increasing the probability that dams and culverts will exceed their capacity. The Planning Team determined that based on past history of culvert failure events it is **LIKELY** that this natural hazard risk will impact the planning area in the future.

Dam/Culvert Failure Impacts on Westford's Key Sectors

Major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how dam and culvert failure will impact them as shown in **Table 3-9** below.

TABLE 3-9
Dam and Culvert Failure Exposure and Vulnerability by Key Sector[23]

Sector	Vulnerability
Infrastructural	Flood waters from dam and culvert failure may potentially cut off evacuation routes, limit emergency access, and create isolation issues. Utilities such as overhead power lines, cable and phone lines in the inundation zone are also vulnerable.
Environmental	Following a dam failure, the impounded reservoir would experience a reduction water levels, displacing aquatic organisms and exposing the benthic community to air. Downstream, habitat impacts would likely include direct mortality of flora and fauna, toppling of trees and removal of soil and inhibition of plant respiration in areas that remain flooded for long periods of time.
Economic	In addition to buildings and infrastructure in the inundation area, any habitat or agricultural operations in the area would also be exposed to this hazard, which could cause extensive economic damage if crops were ruined.
Societal	Given the relatively short warning time associated with dam failure, culvert or tide gate failure, any population that is exposed inundation and cannot rapidly evacuate would be considered vulnerable. This population includes households without vehicles, the elderly and young children who may be unable to get themselves out of the inundation area.

3.2.1.2 Drought

Background

[23] 2018 MA SHMCAP

Drought is a period characterized by long durations of below normal precipitation.[24] Drought conditions typically last a season or more and result in water shortages, causing adverse impacts on vegetation, animals, and people. A drought may also increase the probability of a wildfire occurring.

Drought characteristics vary significantly from one region to another, since it is relative to the normal precipitation in that area. Drought is a temporary aberration, and is different from aridity, which is a permanent feature of climate in areas where low precipitation is normal, such as in a desert.

Previous Occurrence and Extent of Drought in Westford

The entire planning area can be affected by drought, impacting local water resources often requiring voluntary or required water-use restrictions. In Massachusetts, drought is defined by a combined look at several indices, as defined by the Massachusetts Drought Management Plan (EEA and MEMA, 2019)[25]. The indices are

1. Precipitation
2. Streamflow
3. Groundwater
4. Lakes and impoundments
5. Fire danger (Keetch-Byram Drought Index,KBDI)
6. Evapotranspiration (crop-Moisture Index, CMI)

These indices are analyzed on a monthly basis to generate a hydrological conditions report and used to determine the onset, severity and end of droughts. Five levels of increasing drought severity are defined in the Plan – Normal, Mild Drought, Significant Drought, Critical Drought and Emergency. The drought levels are associated with state actions as outlined in the Plan. Recommendations of drought levels are made by the Drought Management Task Force (DMTF) to the Secretary of EEA who declares the drought level from each region of the state. Current drought status and indices data can be viewed through the Northeast Drought Early Warning System dashboard.[26]

While drought does involve multiple indices, historic multi-year droughts were identified by the USGS by analyzing annual and cumulative departures from long-term average streamflow at gauging stations across Massachusetts. Streamflow deficits were analyzed and recurrence intervals computed for selected droughts. The droughts of 1929-32, 1939-44, 1961-69, and 1980-83 stand out as particularly significant because of their severity and areal extent. The severest drought on record in the Northeastern United States was during 1961 through 1969. Water supplies and agriculture were affected because of the severity and long duration of the drought.[27]

[24] NOAA May 2008, Drought Public Fact Sheet (http://www.nws.noaa.gov/om/brochures/climate/DroughtPublic2.pdf)

[25] EEA and MEMA (2019), "Massachusetts Drought Management Plan," https://www.mass.gov/doc/massachusetts-drought-management-plan/download

[26] http://nedews.nrcc.cornell.edu

[27] U.S. Geological Survey Water-Supply Paper 2375 National Water Summary 1988-89--Floods and Droughts: Massachusetts Floods and Droughts

More recently drought periods include 10 months of drought in 2002 and 10 months of drought from June 2017 through March 2017[28]. **Figure 3-4** shows areas within the Commonwealth that are prone to Severe Drought[29] [30]. Westford is among the communities with 27 to 49 days severe drought.

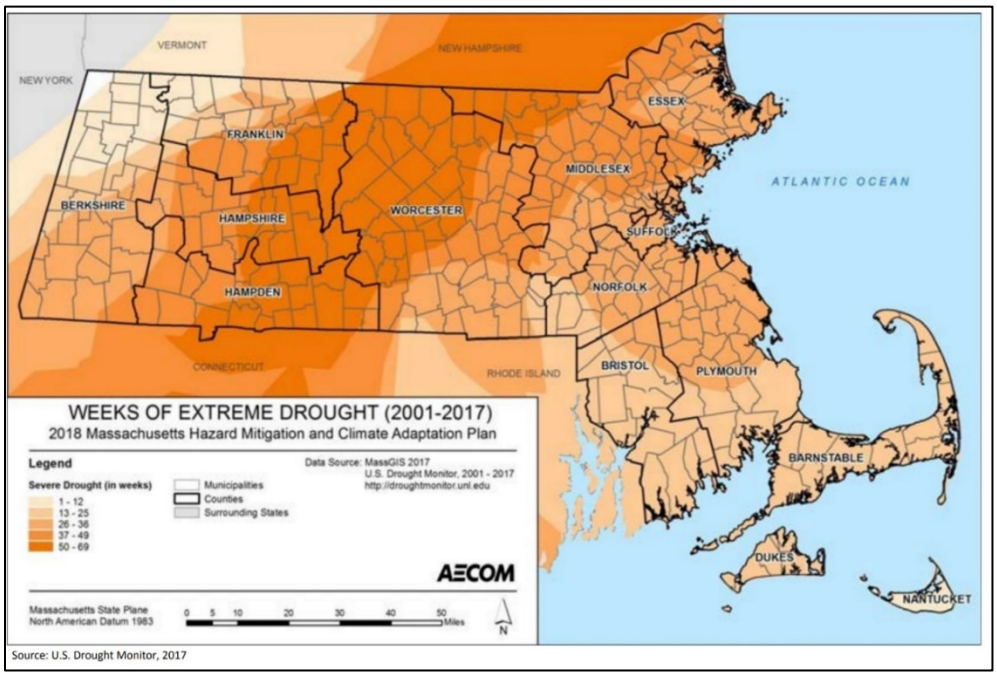


Figure 3-4 – Severe Drought across Massachusetts (2001-2017)

Figure 3-5[31] shows areas within the Commonwealth that are prone to Extreme Drought. Note that the entirety of Middlesex County has experienced the longest duration of extreme drought in the State.

[28] "Massachusetts Drought Management Plan," https://www.mass.gov/doc/massachusetts-drought-management-plan/download

[29] MEMA (2018), "SHMCAP"

[30] NOAA (2017), "U.S. Drought Monitor": https://droughtmonitor.unl.edu/

[31] 2018 MA SHMCAP

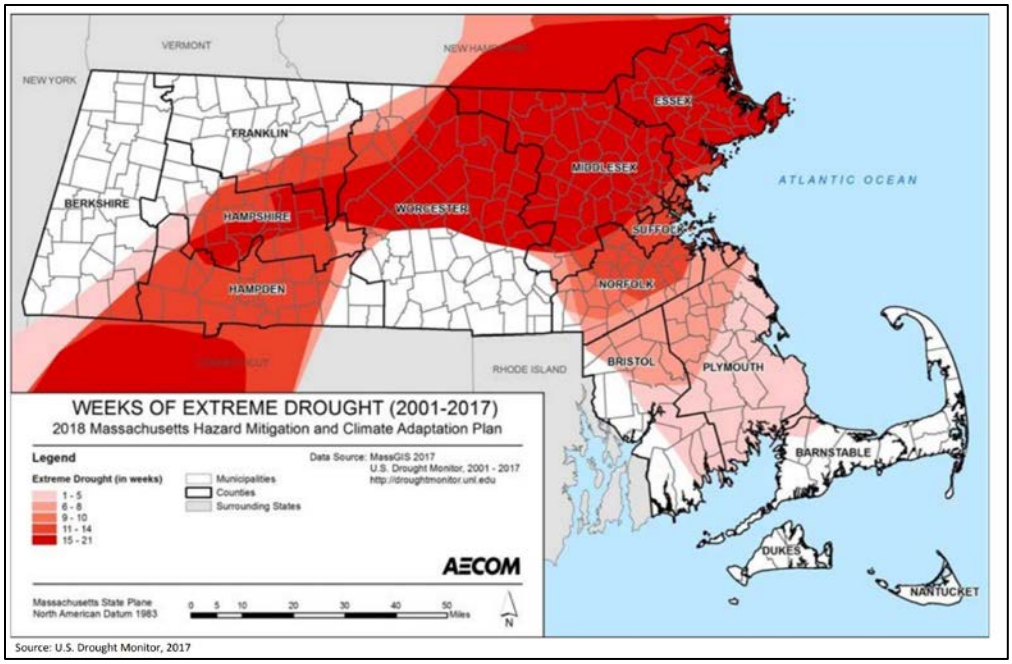


Figure 3-5 – Extreme Drought across Massachusetts (2001-2017)

Droughts will create challenges for local water supply by reducing surface water storage and the recharge of groundwater supplies, including private wells. More frequent droughts could also exacerbate the impacts of flood events by damaging vegetation that could otherwise help mitigate flooding impacts. Droughts may also weaken tree root systems, making them more susceptible to toppling during high wind events.

Locally Identified Areas of Impact

The entire planning area can be affected by drought, impacting local water resources often requiring voluntary or required restrictions on water use. Westford's water source is from groundwater supplied by the Stony Brook and Beaver Brook aquifers. The Massachusetts Office of the USGS provides local data to monitor streamflow and drought conditions across Massachusetts. The USGS maintains the statistics and streamflow information on their Water Watch website,[32] and the DCR Water Resource Commission issues monthly reports of hydrologic conditions.[33]

Probability of Future Occurrence

The 2013 Drought Management Plan[34] conducted an extensive review of precipitation indices since the beginning of data collection in 1850. The probability of each drought level, as identified in the Plan, is shown in **Table 3-10.**

TABLE 3-10
Frequency of Drought Events

[32] http://newengland.water.usgs.gov/drought/index.html
[33] https://www.mass.gov/drought-management
[34] EEA and MEMA (2013), "Massachusetts Drought Management Plan": https://drought.unl.edu/archive/plans/drought/state/MA_2013.pdf

Drought Level	Frequency Since 1850	Probability of Occurrence in a Given Month
Emergency Drought	5 occurrences	2% chance
Critical Drought (formerly Warning)	5 occurrences	2% chance
Significant Drought (formerly Watch)	46 occurrences	8% chance

Source: EEA and MEMA 2013

Drought with Climate Change

Although research suggests that the overall amount of precipitation is likely to increase under climate change, the length of time between rain events is also expected to increase. Prolonged dry periods increase the probability of drought conditions occurring.

Table 3-11 indicates how much these durations are likely to increase according to the "high" and "low" limits of the NE CASC data for the Merrimack basin. This data suggests that the average time between rain events is likely to remain fairly constant; however, individual drought events could still increase in frequency and severity.

TABLE 3-11[35]
Continuous Dry Days by Planning Year

Planning Year	2030	2050	2070	2100*
Projected Range of Consecutive Dry Days	16.8 – 18.6	17.0 – 19.0	16.5 – 19.8	17.0 – 20.1

*Because the study generated 5-year averages for future conditions, "2100" values from this study are derived from the period centered around 2095, the further year available. This practice is generally considered to provide a useful approximation for conditions this far in the future.

The occurrence of drought due to rising temperatures and changes in precipitation is outlined below.

- **Rising temperatures and changes in precipitation prolong drought:** The frequency and intensity of droughts are projected to increase during summer and fall in the Northeast as higher temperatures lead to greater evaporation and earlier winter and spring snowmelt. and precipitation patterns become more variable and extreme.
- **Rising temperatures and changes in precipitation reduce snowpack:** Due to climate change. the proportion of precipitation falling as snow and the extent of time snowpack remains are both expected to decrease. This reduces the period during which snowmelt can recharge groundwater supplies, bolster streamflow, and provide water for the growing period.

The Planning Team determined that based on past history of drought events and climate change data provided by the NE CASC, it is **LIKELY** that drought will impact the planning area in the future.

[35] NECSC, 2017

Drought Impacts on Westford's Key Sectors

Major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how drought will impact them as shown in **Table 3-12** below.

TABLE 3-12
Drought Exposure and Vulnerability by Key Sector[36]

Sector	Vulnerability
Infrastructural	Drought impacts on elements of the built environment are limited, except to the extent that drought conditions increase the risk of wildfires.
Environmental	Prolonged droughts can have severe impacts on ecosystems and natural resources, as most organisms require water throughout their life cycle. Forests managed for timber or other economic uses could experience reduced growth rates or mortality during periods of drought
Economic	The economic impacts of drought can be significant in the agriculture, recreation, forestry, and energy sectors. Crop failure can also result in an increase in food prices, placing economic stress on a broader portion of the economy.
Societal	Citizens with a private water supply, such as a well, are more vulnerable to drought than those who receive water through a public provider. Drought can also increase the concentration of airborne pollutants, presenting a health hazard for those with respiratory health conditions like asthma.

3.2.2 Atmospheric Hazards

Atmospheric Hazards covered in this section include extreme temperature, hurricanes and tropical storms, severe weather, severe winter storms and nor'easters, and tornadoes.

3.2.2.1 Extreme Temperature

Extreme temperatures are defined as temperatures that are far outside the normal ranges for the season in a specific area. Extreme cold events are characterized in a temperate zone by the air temperature dropping to approximately 0 ºF or below. Extreme heat is identified as the number of days with a maximum temperature greater than or equal to 90ºF and greater than or equal to 100ºF.

Extreme Cold

The extent (severity or magnitude) of extreme cold temperatures can be measured through the Wind Chill Temperature Index (**Figure 3-6**). Wind Chill Temperature is based on the rate of heat loss from exposed skin by the effects of wind and cold. As the wind increases, the body loses heat at a faster rate, causing the skin's temperature to drop.

[36] 2018 MA SHMCAP

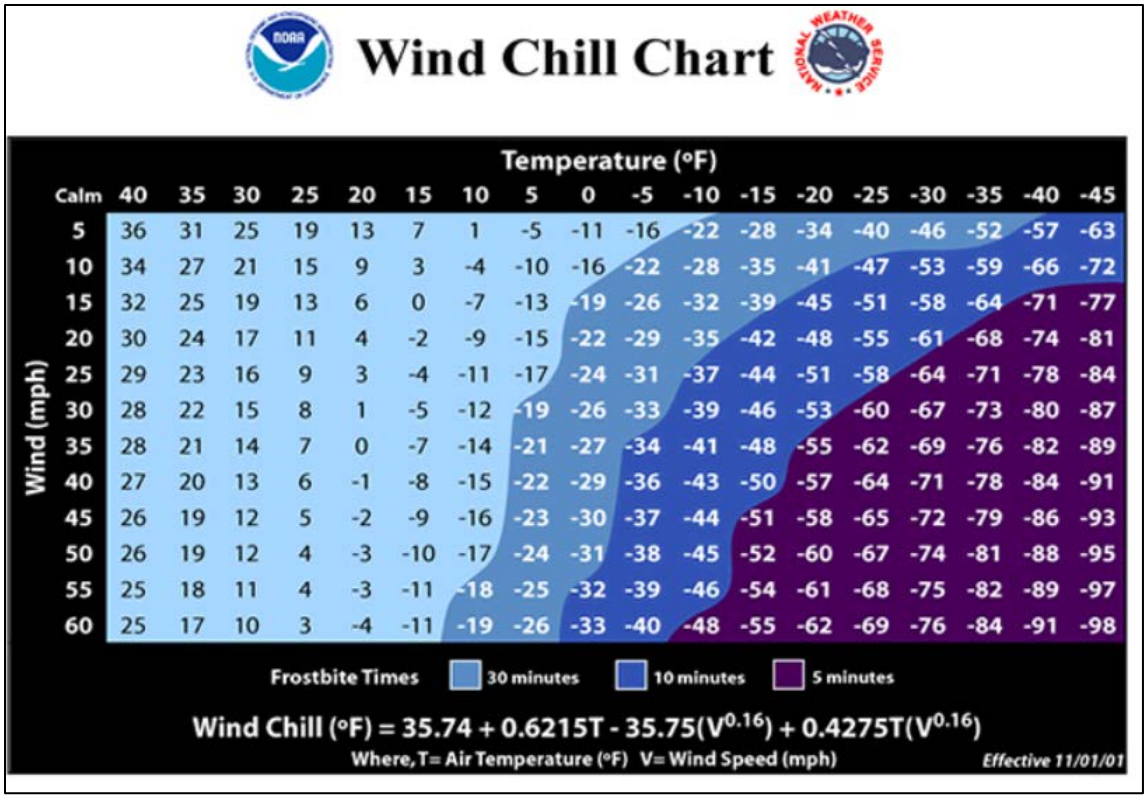


Figure 3-6 – NOAA Wind Chill Index [37]

When winter temperatures drop significantly below normal, staying warm and safe can become a challenge. Extremely cold temperatures often accompany a winter storm, which may also cause power failures, icy roads and freezing ice in rivers, streams and lakes.

Cold weather also can present hazards indoors. Many homes will be too cold, either due to a power failure or because the heating system is not adequate for the weather. Exposure to cold temperatures, whether indoors or outside, can cause other serious or life-threatening health problems. The use of space heaters and fireplaces to stay warm, and/or the use of generators and candles in power outages, increases the risks of residential fires and carbon monoxide poisoning.

Extreme Heat

The extent of extreme heat is documented by the National Weather Service (NWS) Heat Index. The NWS issues a Heat Advisory when the Heat Index is forecast to reach 100-104°F for 2 or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105+ °F for 2 or more hours. The Heat Index describes a temperature that the body feels and is based both on temperature and relative humidity (**Figure 3-7**). A heat wave is defined as 3 or more days of temperatures 90°F or above.

[37] NOAA Wind Chill Index: http://www.nws.noaa.gov/om/cold/wind_chill.shtml

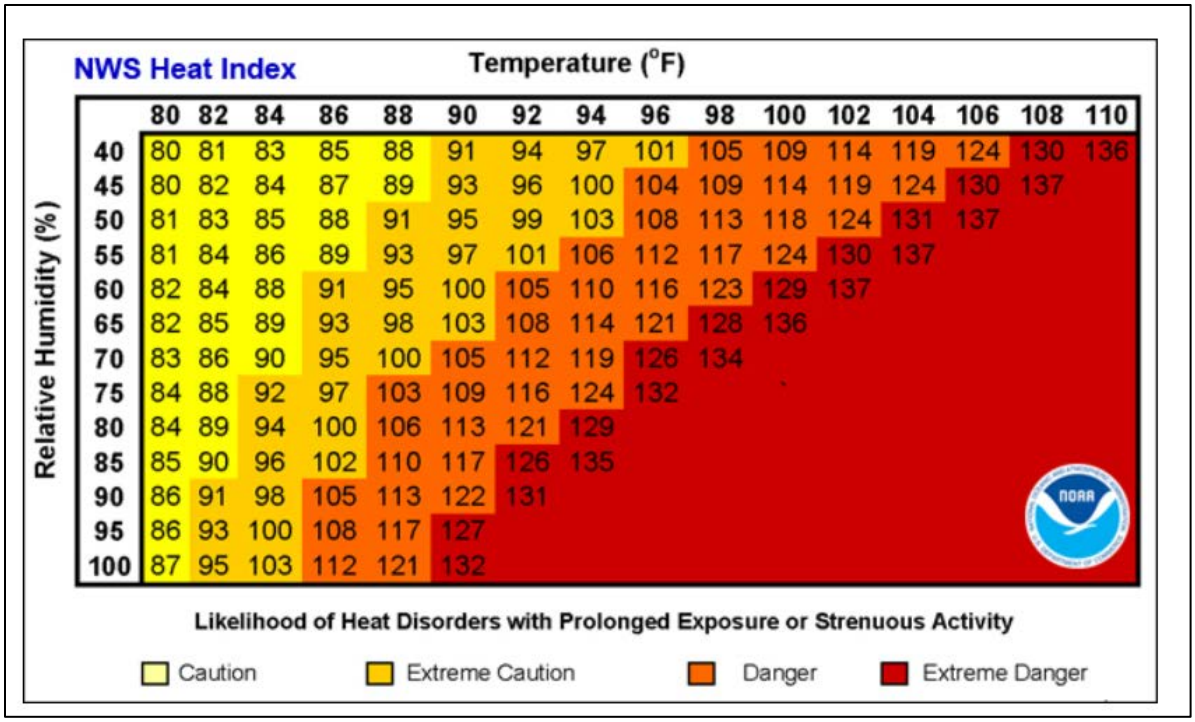


Figure 3-7 – NOAA Heat Index[38]

Extreme heat is currently the leading weather-related cause of death in the United States.[39] Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat syncope, heat exhaustion, heat stroke, and death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. Additionally, heat is expected to contribute to the exacerbation of chronic health conditions.[40] In particular, hyperthermia—elevated body temperature due to failed thermoregulation can be caused by heat stroke — is a contributing factor to cardiovascular, metabolic, and other causes of death.[41]

Those at particularly high risk of adverse health effects from extreme heat exposure are older adults, children, those living alone and/or with chronic illnesses, urban residents, minorities, lower income families, people with less education, and people without access to air conditioning. In addition, people with chronic mental disorders or pre-existing medical conditions (e.g., cardiovascular disease, obesity, diabetes, neurologic or psychiatric disease), and those participating in outdoor manual labor or sports in hot weather also are at increased risk for heat-related illness.[42] Extreme heat adversely

[38] NOAA Heat Index: http://www.nws.noaa.gov/om/heat/heat_index.shtml

[39] Luber, G., & McGeehin, M. (2008b). Climate change and extreme heat events. American Journal of Preventive Medicine, 35(5), 429–435. http://doi.org/10.1016/j.amepre.2008.08.021

[40] Kravchenko, J., Abernethy, A. P., Fawzy, M., & Lyerly, H. K. (2013). Minimization of heat wave morbidity and mortality. American Journal of Preventive Medicine, 44(3), 274–282. http://doi.org/10.1016/j.amepre.2012.11.015

[41] O'Neill, M. S., & Ebi, K. L. (2009). Temperature Extremes and Health: Impacts of Climate Variability and Change in the United States. Journal of Occupational and Environmental Medicine, 51(1), 13–25. http://doi.org/10.1097/JOM.0b013e318173et22

[42] Holstein, J., Canouï-Poitrine, F., Neumann, A., Lepage, E., & Spira, A. (2005). Were less disabled patients the most affected by 2003 heat wave in nursing homes in Paris, France? Journal of Public Health (Oxford, England), 27(4), 359–365.

impacts utility companies that may struggle meet the extra demand created by operation of air conditioners. Brown outs may result in secondary impacts to vulnerable populations.

Previous Occurrence and Extent of Extreme Temperatures

According to NOAA NCDC data, the entire area is vulnerable to extreme temperatures. For the past decade, Massachusetts has been reporting 2 to 4ºF warmer than the 20th Century Average.[43] **Figure 3-8** depicts the trend of maximum high summer temperatures and minimum low winter temperatures from 1895 to 2015.

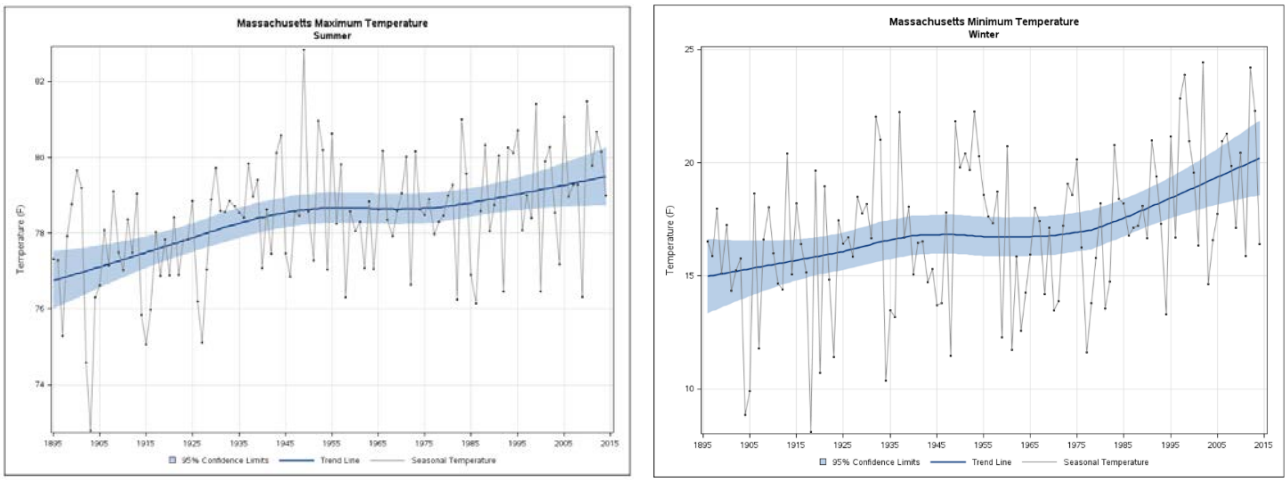


Figure 3.8: Maximum Summer and Minimum Winter Monthly Temperatures in MA (1895-2015)

According to the Northeast Regional Climate Center at Cornell University, 2012 was the warmest year in the US to date, and the third hottest summer. Extreme heat for Westford is most common in July, with an average high of 83 ºF. Extreme cold temperatures are most common in January, with an average low of 17ºF.

Locally Identified Areas of Impact

The entire planning area is at risk for impacts due to extreme temperatures.

Probability of Future Occurrence of Extreme Temperatures in Westford

The IPCC forecasts temperatures continuing to increase worldwide during the 21st century due to the GHG emission trajectory we are on. The latest scenarios from the 2015 United Nations Paris Climate Summit for average temperature changes across all RCP greenhouse gas emissions scenarios show a continuation of increased global temperatures. The average temperature in Massachusetts between 1961 and 1990 has been approximately 46.4 °F. By mid-century this is anticipated to increase by approximately 3.6 to 5.4°F. By the latter part of the 21st century average temperatures are expected to increase by 5.4 to 9°F.

Recent Massachusetts Statewide Climate Projections (NE CASC 2017) shown in **Table 3-13** estimate that Westford is expected to experience increased average temperatures

[43] https://www.ncdc.noaa.gov/temp-and-precip/state-temps/

throughout the 21st century. Maximum and minimum temperatures are also expected to increase throughout the end of the century. These increased temperature trends are expected for annual and seasonal projections.

TABLE 3-13

Seasonal and Annual Temperature Projections for Merrimack River Basin Region[44]

Merrimack Basin		Observed Baseline 1971-2000 (°F)	Projected Change in 2030s (°F)	Mid-Century Projected Change in 2050s (°F)	Projected Change in 2070s (°F)	End of Century Projected Change in 2090s (°F)
Average Temperature	Annual	48.09	+2.24 to +4.44	+2.96 to +6.39	+3.56 to +9.13	+3.90 to +10.94
	Winter	26.83	+2.45 to +5.27	+3.18 to +7.77	+3.99 to +9.50	+4.27 to +10.83
	Spring	46.06	+1.72 to +3.47	+2.55 to +5.37	+2.71 to +7.70	+3.29 to +9.43
	Summer	68.79	+2.08 to +4.33	+2.81 to +6.67	+3.23 to +9.92	+3.75 to +12.47
	Fall	50.3	+2.30 to +5.02	+3.25 to +6.70	+3.52 to +9.57	+4.02 to +11.78
Maximum Temperature	Annual	59.14	+2.14 to +4.20	+2.74 to +6.30	+3.26 to +9.12	+3.58 to +10.87
	Winter	36.74	+2.13 to +4.83	+2.78 to +7.26	+3.42 to +8.80	+3.78 to +9.97
	Spring	57.46	+1.60 to +3.40	+2.21 to +5.48	+2.63 to +7.90	+3.23 to +9.35
	Summer	80.47	+1.85 to +4.36	+2.66 to +6.70	+3.11 to +10.15	+3.62 to +12.75
	Fall	61.48	+2.43 to +4.89	+3.54 to +6.93	+3.43 to +9.85	+3.93 to +12.19
Minimum Temperature	Annual	37.04	+2.33 to +4.76	+3.21 to +6.54	+3.86 to +9.09	+4.23 to +11.02
	Winter	16.93	+2.73 to +5.76	+3.57 to +8.28	+4.62 to +10.21	+4.77 to +11.56
	Spring	34.65	+1.85 to +3.79	+2.73 to +5.70	+2.86 to +7.47	+3.35 to +9.25
	Summer	57.1	+2.19 to +4.47	+2.97 to +7.06	+3.35 to +9.68	+3.96 to +12.18
	Fall	39.13	+2.18 to +5.17	+3.54 to +6.62	+3.61 to +9.38	+4.11 to +11.59

Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase throughout the 21st century.

- Summer mid-century increase of 2.7 °F to 6.7 °F (3-8% increase); end of century increase of 3.6 °F to 12.8 °F (4-16% increase).
- Fall mid-century increase of 3.5 °F to 6.9 °F (6-11% increase); end of century increase of 3.9 °F to 12.2 °F (6-20% increase).

Seasonally, minimum winter and fall temperatures are expected to see increases throughout the 21st century.

- Winter mid-century increase of 3.6 °F to 8.3 °F (21-49% increase); end of century increase of 4.8 °F to 11.6 °F (28-68% increase).
- Fall mid-century of 3.5 °F to 6.6 °F (9-17% increase); end of century increase of 4.1°F to 11.6 °F (11-30% increase).

Based on historic data and local projections, the Planning Team determined that it is **HIGHLY LIKELY** that extreme temperatures will impact the planning area.

[44] NE CASC (2017), "Massachusetts Climate Change Projections": https://necsc.umass.edu/projects/massachusetts-climate-change-projections

Impacts on Westford's Key Sectors

Major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how extreme temperatures will impact them as shown in **Table 3-14** below.

TABLE 3-14
Extreme Temperature Exposure and Vulnerability by Key Sector[45]

Sector	Vulnerability
Infrastructural	Extreme heat events can sometimes cause short periods of utility failure due to increased usage from air conditioners and other appliances. Heavy snowfall and ice storms, associated with extreme cold temperature events, can also cause power interruption. Backup power is recommended for critical facilities and infrastructure.
Economic	Extreme temperature events can have significant economic impacts, including loss of business function and damage/loss of inventory. The agricultural industry is the industry most at risk in terms of economic impact and damage due to extreme temperature and drought events.
Societal	Populations that are most at risk to extreme cold and heat events include individuals aged over 65, infants and young children, individuals who are physically ill, low-income individuals who cannot afford proper heating and cooling, and those whose jobs involve exposure to extreme temperature events.
Environmental	Because the species that exist in a given area are designed to survive within a specific temperature range, extreme temperatures events can place significant stress both on individual species and ecosystems. Warming temperatures across the globe force species poleward, or upward in elevation, while species that cannot relocate fast enough face local extinction.

3.2.2.2 Severe Weather Wind Related Hazards

Severe weather wind related hazards include hurricanes, tropical storms, and tornadoes as well as high winds during severe rainstorms and thunderstorms. The typical wind speed in Westford range from 3-10 miles per hours over the course of the year, with peak gusts over 50 mph.[46] The prevailing wind direction is west, and the highest wind speeds occur January through March. **Figure 3-9** shows the average monthly wind speed for the contiguous US for March based on wind conditions in the lower troposphere.[47] The Northeast United States, including Middlesex County, have some of the highest average wind speeds in the contiguous US.

[45] 2018 MA SHMCAP
[46] NOAA Climatic Wind Data for the United States 1930-1996- Data for Boston
[47] https://www.ncdc.noaa.gov/societal-impacts/wind/w-mean/201603

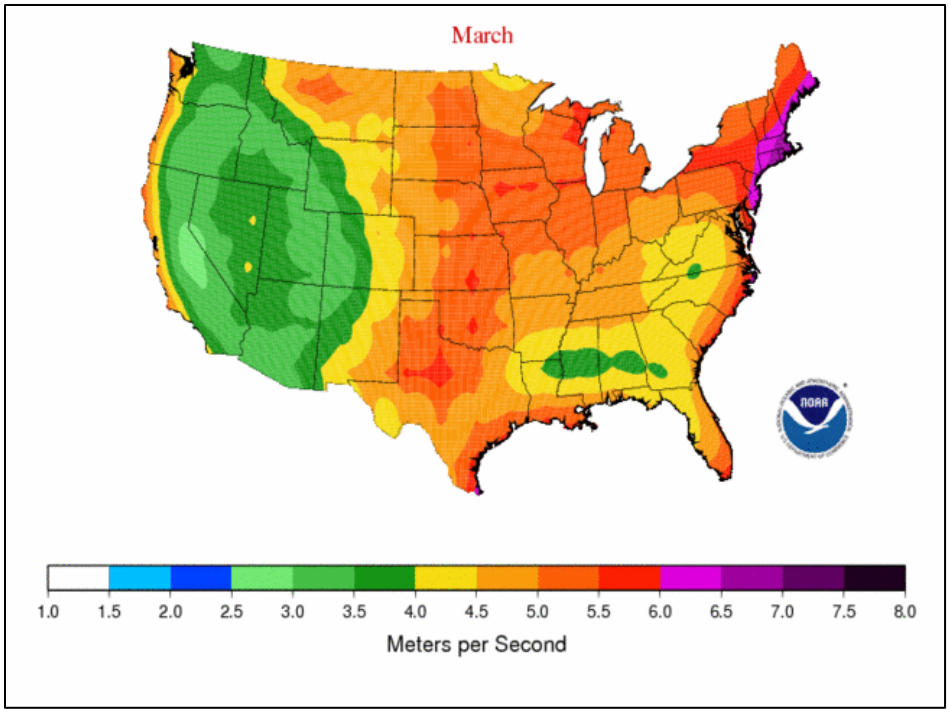


Figure 3-10 – March Average Wind Speeds in the Lower Troposphere (1971-2000)

High winds can occur as an isolated event or accompany other weather events such as:

- Before and after frontal systems
- Hurricanes and tropical storms
- Severe thunder and lightning storms
- Tornadoes
- Nor'easters

National wind zone designations were developed by FEMA based on 40 years of tornado history and 100 years of hurricane history. As shown in **Figure 3-10**, Middlesex County lies within Zone II with maximum winds of 160 mph. Westford is also within the Hurricane-Susceptible Region along with the entire East Coast and Gulf of Mexico.[48]

[48] FEMA Taking Shelter from the Storm: Building a Safe Room Inside Your House. https://www.fema.gov/pdf/library/ism2_s1.pdf

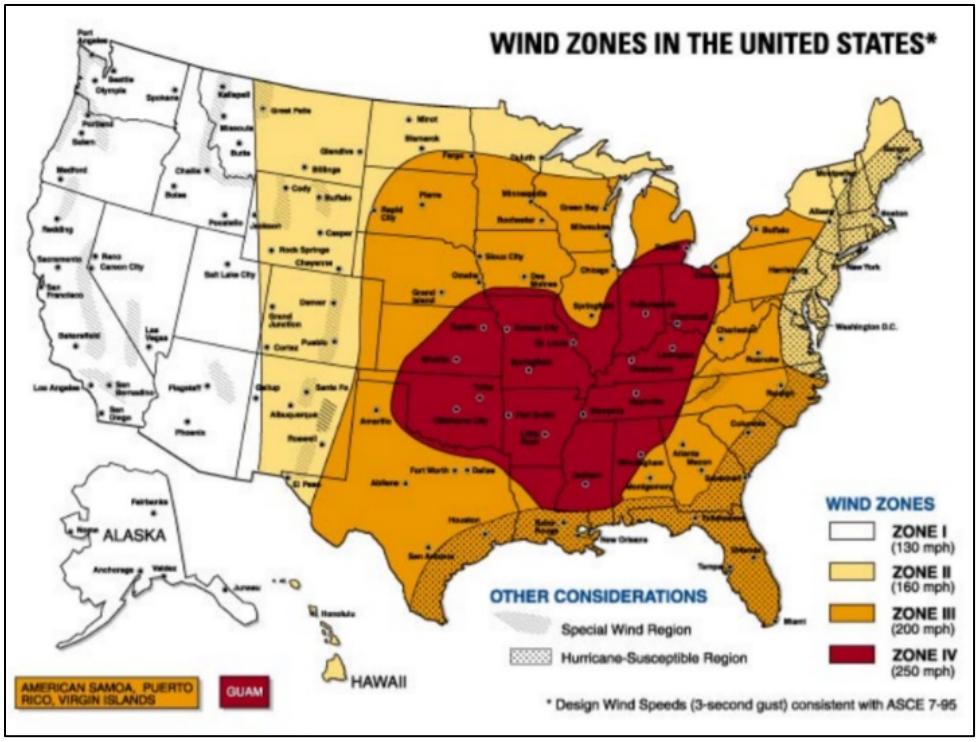


Figure 3-11 – Wind Zones in the United States

Table 3-15 includes the high wind warning categories issued by the NWS for both non-tropical and tropical events. Winds measuring under 30 mph are not considered to be hazardous under most conditions.[49]

TABLE 3-15
NWS High Wind Warning

Type of Warning	Wind Speeds
Non-tropical event over land:	
Wind Advisory	Sustained winds of 31-39 mph for at least 1 hour, or any gust 46 to 57 mph
High Wind Warning	Sustained winds 40+ mph or any gust 58+ mph
Non-tropical event over water:	
Small Craft Advisory	Sustained winds 25-33 knots
Gale Warning	Sustained winds 24-47 knots
Storm Warning	Sustained winds 48 to 63 knots
Hurricane Force Winds	Sustained winds 64+ knots
Tropical storm events (inland or coastal):	
Tropical Storm Warning	Sustained winds 39 to 73 mph
Hurricane warning	Sustained winds of 74+ mph

[49] 2018 MA SHMCAP

Effects from high winds can include downed trees and/or power lines, damage to structures, etc. This is especially true after periods of heavy snow, rain or prolonged drought due to the weakening of tree branches and roots. High winds can cause scattered power outages and are a hazard for the boating, shipping, and aviation industry sectors. More specific discussion on severe weather high wind events impacting Westford as follows.

3.2.2.3 Severe Winter Storm / Nor'easter

Winter Storms

Hazards associated with Heavy Snow, Nor'easters, Blizzards, and Ice Storms can be similar in many ways and therefore have been categorized under Winter Storms although each of these hazard events is separately distinguished under Probability of Future of Events.

Nor'easters

Nor'easters are a ferocious type of northeastern coastal storm that typically occur in the winter months. The storm's name refers to the continuous strong northeasterly winds blowing in a large counter-clockwise circulation pattern around a low-pressure center, resulting in heavy snow and rain, gale force winds, rough seas, and coastal flooding that often cause shoreline erosion. The radius of these storms can extend up to 1,000 miles.[50] Impacts along the coast are typically worse than inland locations due to the additional moisture picked up from the ocean. Nor'easters may be especially damaging because they can sit stationary for several days, affecting multiple tidal cycles and producing extended periods of heavy precipitation, resulting in increased flooding, shoreline erosion, and damage to coastal infrastructure.

There is no widely used scale to classify Nor'easters, but a combination of scales including the Beaufort Scale for wind speed, Regional Snowfall Index for snowfall, and precipitation associated with a historic recurrence interval (i.e. 100-year rainfall) can be combined to evaluate the magnitude of the storm. For Westford, precipitation amounts of 7.93 inches are associated with a 100-year storm event (1% chance of occurring in any one year). Winter and spring flooding from Nor'easters may be exacerbated due to snow melt and frozen ground conditions. The severity of a nor'easter also depends on the time of occurrence relative to the lunar tide cycles (spring or neap tides) and during what tide stage the maximum storm surge occurs at (high tide or low tide). Depending on the metric used to measure the storm, assigned severity may also take into account the storm's societal and economic impacts.

The level of damage in a hurricane is often more severe than a Nor'easter, but historically Massachusetts has suffered more damage from Nor'easters because of the greater frequency of these coastal storms (1 to 2 per year). As another comparison, the duration of high surge and winds in a hurricane is 6 to 12 hours while a Nor'easter can last from 12 hours to 3 days.

Nor'easters are not typically named the way that hurricanes are by the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS), though locally coined names have been used. For example, Winter Storm Juno and Winter Storm

[50] 2018 MA SHMCAP

Nemo were named by the Weather Channel in 2014 and 2015.[51] The unofficial storm naming is controversial with meteorologists because winter storms can reform more than once, making naming hard and redundant. Naming a storm may bring more attention to the event and help people with advance emergency preparations.

Previous Occurrence and Extent

There have been 12 winter storms related federally declared disasters during the time frame of 1996 through 2020 (**Table 3-16**) which include nor'easters.

TABLE 3-16

FEMA Nor'easter and Winter Storm Related Disaster Declarations (1996-2020) impacting Westford[52]

Disaster #	Dates	Unofficial Storm Name	Impact
DR-4379	March 13-13, 2018	Winter Storm Reilly	Severe winter storm, snowstorm, flooding- Nor'easter
DR-4214	January 26-29,2015	Winter Storm Juno	Severe winter storm, snowstorm, flooding- Nor'easter
DR-4110	February 8-10, 2013	Winter Storm Nemo	Severe winter storm, snowstorm and flooding
DR-4051/ EM-3343	October 29-30, 2011	Snowtober	Severe Storm
DR-1959	January 11-12, 2011		Severe winter storm and record snowstorm
DR-1895	March 12, 2010		Severe weather, record breaking rain and flooding
DR-1813/ EM3296	December 11, 2008	December Ice Storm	Severe winter and ice storm
DR-1614	October 7-16, 2005	Nor'easter	Severe Storms and Flooding
EM-3191	December 3, 2003	December Blizzard	Severe winter storm, snowstorm
EM-3175	Feb 17, 2003	February Blizzard	Severe winter storm, snowstorm
EM-3165	March 5-7, 2001	February Blizzard	Severe winter storm, snowstorm
DR-1090	January, 1996	January Blizzard	Severe winter storm, snowstorm

Locally Identified Areas of Impact

The entire planning area is at risk for impacts due to Nor'easters. Westford's overall vulnerability for Nor'easters is similar to severe winter weather and flooding.

[51] https://en.wikipedia.org/wiki/Winter_storm_naming_in_the_United_States

[52] Fema.gov/disasters

Probability of Future Occurrence

Nor'easters may occur at any time of the year, however, they are most common from September to April. Based on the historical record of the top winter storm events from 1953 to 2015, Nor'easters have an average frequency of 1 or 2 per year. Nor'easters are likely to become more intense in the future due to potential effects of climate change including increased snowfall, sea level rise, storm surge and a concentration of storm events in the coldest winter months. Nor'easters along the coast coinciding with astronomical high tides will result in increased flooding and more significant structural damages as sea level continue to rise.

Increased sea surface temperature in the Atlantic Ocean will cause air moving north over this ocean to hold more moisture. As a result, when these fronts meet cold air systems moving from the north, an even greater amount of rain and snow than normal can be anticipated to fall on Massachusetts. Although no one storm can be linked directly to climate change, the severity of rain and snow events has increased dramatically in recent years.

Based on the historic record of Nor'easters impacting Westford and the future predictions for increased severity and intensity of Nor'easters, the Planning Team determined that is **HIGHLY LIKELY** that a Nor'easter will impact the planning area in the future.

Impacts on Westford's Key Sectors

As previous outlined, major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how Nor'easters will impact them as shown in **Table 3-17** below.

TABLE 3-17
Nor'easter Exposure and Vulnerability by Key Sector[53]

Sector	Vulnerability
Infrastructural	Flooding can also wash out sections of roadways and bridges, as well as cause extensive damage to public utilities and disruptions to the delivery of services. Wind can take down power lines, disrupting power service and damage buildings.
Economic	Nor'easter events, similar to hurricanes and severe winter storms, can greatly impact the economy, including loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, wage loss, road repair, and rental loss due to the repair/replacement of buildings.
Societal	Of the population exposed, the most vulnerable include the Economically disadvantaged and population over the age of 65. Economically disadvantaged populations are more likely to evaluate the economic impact of evacuating, and individuals over 65 are more likely to face physical challenges in evacuating or to require medical care while evacuated.
Environmental	The environmental impacts of nor'easters are similar to those of hurricanes and severe winter storms. They often involve flood and wind damage, can cause direct mortality to individuals, and transform habitats.

Severe Winter Storms: Snow and Blizzard

Severe Winter Weather includes snowstorms, blizzards, and ice storms. A winter storm occurs when there is significant precipitation during periods of low temperatures. Winter storms are a combination of hazards because they often involve wind, ice, and heavy snow fall.

Winter storms can occur from early autumn to late spring and include any of the following events:[54]

- Blizzards
- Blowing Snow
- Snow Squalls
- Snow Showers
- Snow Flurries
- Ice pellets and sleet
- Icing
- Coastal flooding
- Ice jams and flow
- Snow melt

Impacts from winter weather – in addition to non-passable streets and sidewalks – include downed power lines causing loss of electric power service, catch basins being buried and sometimes clogged, water service pipes bursting and shut-off valves being buried (more common when cold and windy), fire hydrants being buried by snow, older water mains bursting, and dangerous icicles forming on buildings. Snow can also block building ventilation, increasing the risk of indoor carbon monoxide poisoning and place a heavy load on roofs.

[53] 2018 MA SHMCAP
[54] http://www.nws.noaa.gov/om/winter/index.shtml

Previous Occurrence and Extent of Snow and Blizzards on Westford

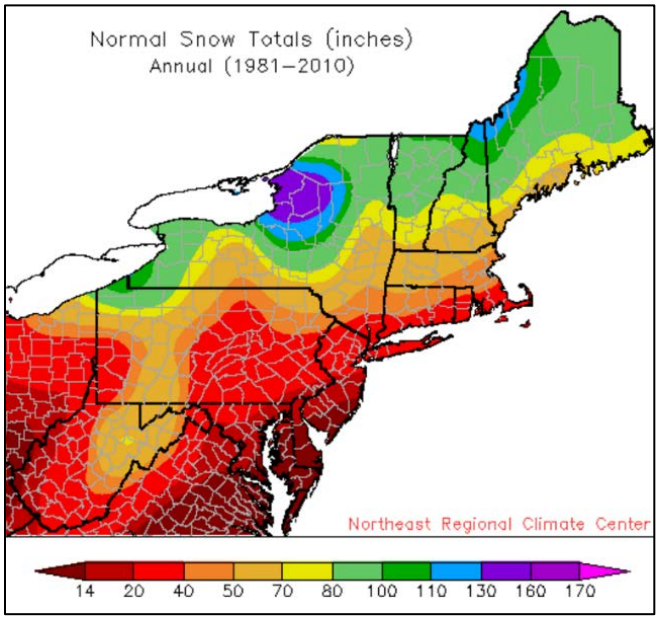


Figure 3-12: Annual Snow Totals

Snow and other forms of winter precipitation occur frequently in Westford, with a normal 30-year average between 50-70 inches per year as shown in **Figure 3-11**. [55]

The one day records snowfall of 29.0 inches was recorded for Middlesex County at the Natick Weather Station on April 1, 1997. This winter storm is known as the "April Fool's Day Storm" and dropped a record amount of snow in Middlesex County and throughout the State of Massachusetts and left thousands without power. More recently the February 9, 2013 snowstorm resulted in a snow emergency declaration (FEMA DR-4110). Westford recorded 24 inches.

Although there is significant interannual variability in the frequency and severity of winter storms, this hazard should be expected to occur every winter. [56]

Locally Identified Areas of Impact

The entire planning area is at risk for severe winter weather. During these events, the areas along the higher elevation may experience higher snow accumulations and higher winds than other areas of.

Westford's overall vulnerability to winter weather is primarily related to restrictions to travel on roadways, inaccessible or icy sidewalks, temporary road closures, school closures, and potential restrictions on emergency vehicle access. Other vulnerabilities include power outages due to fallen trees and utility lines, and damage to structures due to heavy snow loads.

Probability of Future Occurrence

Based on the record of previous occurrences, winter storm events in Westford are high frequency events as defined by the 2018 SHMCAP. This hazard may occur more frequently than once in five years (greater than 20% per year). Climate change impacts are predicted to increase the severity of winter storms because changing circulation patterns and warming ocean water allowing additional moisture to fuel the storm to greater intensity.

Based on the past record, the Planning Team concludes that it is **HIGHLY LIKELY** that severe winter weather will impact Westford in the future.

[55] http://www.nrcc.cornell.edu/regional/climatenorms/climatenorms.html
[56] 2018 MA SHMCAP

Impacts of Westford's Key Sectors

As previous outlined, major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how Severe Winter Storms will impact them as shown in **Table 3-18** below.

TABLE 3-18
Severe Winter Storm Exposure and Vulnerability by Key Sector[57]

Sector	Vulnerability
Infrastructural	All elements of the built environment in Westford are exposed to the severe winter weather hazard.
Economic	Potential impacts from winter storms include loss of utilities, interruption of transportation corridors, loss of business function and loss of income during business closures. The cost of snow and ice removal and repair of roads from the freeze/thaw process can also strain local financial resources.
Societal	Populations over 65 are considered most susceptible due to their increased risk of injury and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice or related to power failures. Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply).
Environmental	Winter storms are a natural part of the Massachusetts climate, and native ecosystems and species are well-adapted to these events. However, more extreme winter storms can result in direct mortality, habitat modification, and flooding when snow and ice melt, especially in areas with high road salt applications.

3.2.2.4 Tornadoes, High Winds and Thunderstorms

A tornado is a violently rotating column of air extending from a cumuliform cloud, such as a thunderstorm, to the ground. Tornadoes are not always visible as funnel clouds because they may appear nearly transparent until they pick up dust and debris. The average tornado moves from southwest to northeast, but they can move in any direction and can suddenly change direction. The average speed of a tornado is 30 mph, but they can be stationary or move as fast as 70 mph. The strongest tornadoes have rotating winds of more than 200 mph.[58] **Table 3-19** shows the Enhanced Fujita Tornado Damage Scale developed by T. Theodore Fujita.[59]

[57] 2018 MA SHMCAP

[58] Thunderstorms, Tornadoes, Lightning: Nature's Past Violent Storms, A Preparedness Guide, US Department of Commerce, NOAA, and the National Weather Service

[59] http://www.spc.noaa.gov/efscale/

Table 3-19
Enhanced Fujita Scale Levels and Description of Damage

EF-Scale Number	Intensity Phrase	3-Second Gust (MPH)	Type of Damage Done
EF0	Gale	65-85	Some damage to chimneys; breaks branches off trees; shallow rooted trees pushed over; sign boards damaged
EF1	Moderate	86-110	Peels surfaces off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
EF2	Significant	111-135	Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.

Previous Occurrence and Extent of Tornadoes in Westford

On average, six tornadoes per year touch down somewhere in New England. Those at risk include people in automobiles, anyone not in a secure structure, and those residing in mobile homes. Since 1951, there have been 121 tornadoes in Massachusetts, which resulted in 105 fatalities and 1,559 injuries. Within Middlesex County there have been a total of 17 historical tornado events, which killed 1 and injured 6[60].

Probability of Future Occurrence

The Disaster Center[61] evaluated tornado statistics from 1950-1995 by state. When compared with other states across the country, Massachusetts ranked 35th in frequency, 16th in the number of tornado-related deaths, 21st in the number of injuries, and 12th for the cost of tornado-related damages. In terms of tornado frequency per square mile, Massachusetts ranked 14th in overall frequency, and first in terms of fatalities, injuries, and cost per area. The Tornado density for Northern Middlesex county is 32-48 per 20 square miles. Based on the past record, the Planning Team concludes that it is **LIKELY** that tornadoes will impact Westford in the future.

Impact on Westford's Key Sectors

As previous outlined, major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how Tornadoes will impact them as shown in **Table 3-20** below.

[60] https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=25%2CMASSACHUSETTS

[61] http://www.disastercenter.com/mass/mass.htm

TABLE 3-20
Tornado Exposure and Vulnerability by Key Sector[62]

Sector	Vulnerability
Infrastructural	All elements of the built environment in Westford are exposed to tornadoes.
Economic	Tornado events are typically localized; however, in those areas, economic impacts can be significant. Types of impacts may include loss of business function, water supply system damage, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Recovery and clean-up can also be costly.
Societal	Vulnerable populations include all those who may have difficulty evacuating, including car-free households, individuals over 65, and households with young children. Individuals with limited internet or phone access may not be aware of impending tornado warnings. The potential insufficiency of older or less stable housing to offer adequate shelter from tornados is also a concern.
Environmental	Direct impacts may occur to flora and fauna small enough to be transported by the tornado. Even if the winds are not sufficient to transport trees and other large plants, they may still uproot them. Material transported by tornados can also cause environmental havoc in surrounding areas, particularly of contaminating materials are introduced into the atmosphere or local water supplies.

3.2.2.5 Hurricanes/Tropical Storms

A tropical cyclone is a rotating, organized system of clouds and thunderstorms that originate over tropical or subtropical water. The 4 types of tropical cyclones are classified as follows:

- **Tropical Depression:** A tropical cyclone with maximum sustained winds of 38 mph (33 knots) or less.
- **Tropical Storm:** A tropical cyclone with maximum sustained winds of 39 to 73 mph (34 to 63 knots).
- **Hurricane:** A tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher.
- **Major Hurricane:** A tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.

Hurricanes are characterized by high winds and extratropical moisture resulting in torrential rainfall, especially if the storm is slow moving. The rotational nature of hurricanes often results in winds changing direction as the storm passes, altering wave generation and surge setup. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as storms hit the land. In the Atlantic Basin,

[62] 2018 MA SHMCAP

the hurricane season runs from June 1 to November 30 with peak activity occurring in early to mid-September.[63]

Hurricanes are classified by the Saffir-Simson Scale, which categorizes intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. **Table 3-21** shows the wind speeds, surges, and range of damage caused by different hurricane categories.

TABLE 3-21
Saffir/Simson Scale to Measure Hurricane Intensity

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

Previous Occurrence and Extent

The National Oceanic and Atmospheric Administration (NOAA) has been keeping records of hurricanes since 1858. Within the last 25 years, hurricanes and tropical storms that have impacted Massachusetts include Hurricane Gloria (1985), Irene (Category 2, 2011), Earl (Category 4, 2010), and Bob (Category 2, 1991); and Tropical Storms Sandy (2012), Bill (2009), Hanna (2008), and Beryl (2006).[64]

While historic records include 28 tropical storms and hurricanes for New England, only 3 events have resulted in FEMA hurricane-related disasters for Middlesex County as listed in **Table 3-22**.

TABLE 3-22
FEMA Hurricane-Related Declared Disasters Impacting Middlesex County[65]

FEMA Disaster #	Name	Date	Category
DR-751	Hurricane Gloria	9/27/1985	Category 2
DR-914	Hurricane Bob	8/19/1991	Category 2
DR-4028	Tropical Storm Irene	9/3/2011	Category 2

Locally Identified Areas of Impact

Based on past history, the Planning Team determined the entire planning area is at risk for impacts due to hurricanes and tropical storms.

Probability of Future Occurrence

[63] National Hurricane Center Educational Resources
[64] 2018 MA SMCAP
[65] https://www.fema.gov/disasters

According to the 2018 MA SHMCAP and NOAA Hurricane Research Division, the Commonwealth has a 6 to 30 percent chance of a tropical storm or hurricane affecting the area each year. The probability increases moving from the northwest corner of the state to the southeast, with the highest probability along the coast, specifically Cape Cod and the Islands. New England averages about one hurricane per decade, but there is some evidence that more and stronger hurricanes occur when Atlantic Sea-Surface-Temperatures are warm. While the science of global warming and hurricanes is evolving, present research calls for slightly stronger and wetter storms, but changes in frequency are unknown. Based on the past regional and local history of tropical cyclones, the Planning Team determined that it is **POSSIBLE** that a hurricane or tropical storm will impact the area in the future**.**

Impacts on Westford's Key Sectors

As previous outlined, major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how hurricanes will impact them as shown in **Table 3-23** below outlines this.

TABLE 3-23
Hurricane Exposure and Vulnerability by Key Sector[66]

Sector	Vulnerability
Infrastructural	Hurricane flooding can also wash out sections of roadways and bridges, as well as cause extensive damage to public utilities and disruptions to the delivery of services. Hurricane wind can down trees and powerlines and damage buildings.
Environmental	As the storm is occurring, flooding, or wind – or water-borne detritus can cause mortality to animals if it strikes them or transports them to a non-suitable habitat. In the longer term, environmental impacts can occur as a result of riverbed scour, fallen trees, or contamination of ecosystems by transported pollutants.
Economic	Hurricanes and severe winter storms, can greatly impact the economy, including loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, wage loss, road repair, and rental loss due to the repair/replacement of buildings.
Societal	Of the population exposed, the most vulnerable include the Economically disadvantaged and population over the age of 65. Economically disadvantaged populations are more likely to evaluate the economic impact of evacuating, and individuals over 65 are more likely to face physical challenges in evacuating or to require medical care while evacuated.

Thunderstorms

A thunderstorm is a storm with lightning and thunder produced by a cumulonimbus cloud, usually producing gusty winds, heavy rain, and sometimes hail. The NWS classifies a thunderstorm as 'severe' when it produces damaging wind gusts in excess of 58 mph (50 knots), hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

[66] 2018 MA SHMCAP

Three basic ingredients are required for a thunderstorm to form:[67]

- moisture to form clouds and rain
- rising unstable warm air that can rise rapidly
- lift- caused by cold or warm fronts, sea breezes, mountains, or the sun's heat

While less severe than other types of storms, a thunderstorm can lead to localized damage and represents a hazard risk for all communities in Massachusetts. An average thunderstorm is 15 miles across and lasts 30 minutes; severe thunderstorms can be much larger and longer. Southern New England typically experiences 10 to 15 days per year with severe thunderstorms (**Figure 3-12**).

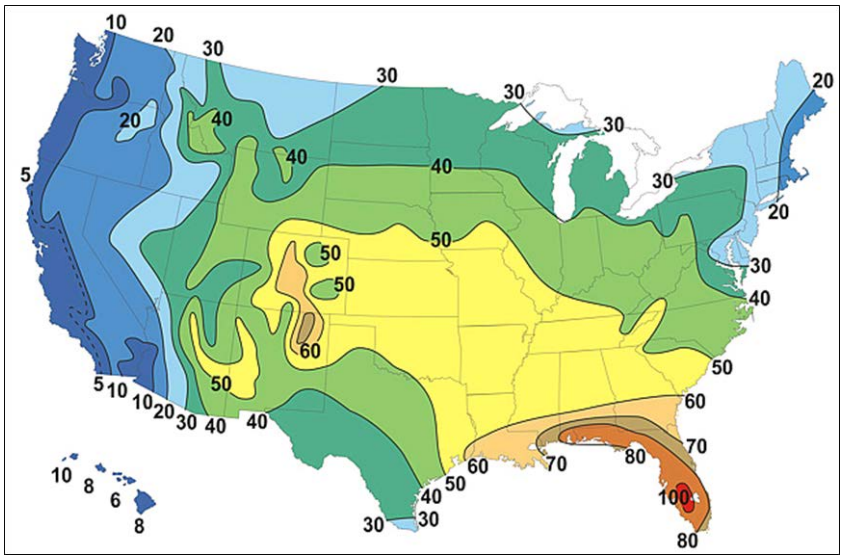


Figure 3-13 – Annual Average Number of Thunderstorm Days in the U.S. (*Source: NOAA NWS*)

Thunderstorms have masses of air, an updraft (rising air), and a downdraft (sinking air). A strong downdraft, also known as a downburst, can cause tremendous wind damage similar to a tornado. Damage from hail and lightning are secondary impacts to thunderstorms. Hail can cause damage to vehicles and crops especially when the hail stones are large in diameter.

Previous Occurrence and Extent of Thunderstorms in Westford

There have been several damaging thunderstorms in Massachusetts. In June of 1998, a very slow moving and complex storm system moved through southeast New England. The combination of its slow movement and presence of tropical moisture across the region produced rainfall of 6 to 12 inches over much of eastern Massachusetts. This led to widespread urban, small stream, and river flooding. As a result, the counties of Suffolk, Essex, Middlesex, Norfolk and Bristol received a Presidential Disaster Declaration for the Individual Household Program (Individual Assistance) on June 23, 1998. Each community in the Northern Middlesex region is at equal risk of being impacted by a severe thunderstorm and it is not possible to predict where damage from such a storm might

[67] Thunderstorms, Tornadoes, Lightning: Nature's Past Violent Storms, A Preparedness Guide, US Department of Commerce, NOAA, and the National Weather Service

occur. On May 22, 2006 a severe thunderstorm toppled trees in several Middlesex County towns and left 5,000 residents without power. Wind gusts reached 45 mph.[68]

According to the NOAA National Climatic Data Center (NCDC)[69], Middlesex County experienced the following events between January 1, 1950 and January 1, 2020:

- 17 days with reported Tornado (EF1-F3 magnitude, 1 death and 6 injuries, $4.9M property damage)
- 49 days with reported Lightning (1 death, 30 injuries, $2.9M property damage)
- 79 days with reported Hail (0-2.25-inch diameter, $75.3K property damage)
- 114 days of reported High/Strong Wind (up to 50 knots, 3 injuries, $764.7K property damage)
- 177 days of reported Thunderstorm Wind (up to 80 knots, 24 injuries, $3.9M property damage

Probability of Future Occurrence

Based on the past regional and local history of severe weather wind events, the Planning Team determined that it is **HIGHLY LIKELY** that a weather event due to wind, including lightning, hail, strong winds, and thunderstorms will impact the area in the future**.** The planning team thinks that it is **LIKELY** that a weather event due to tornadoes will impact the area in the future.

3.2.3 Geologic Hazards

3.2.3.1 Earthquake

An earthquake is the movement or trembling of the ground produced by a sudden displacement of rock in the Earth's crust. The theory of plate tectonics is commonly used to explain much of the earthquake activity in the world. The plates over the Earth are in constant slow motion and this movement can cause earthquakes, most frequently at the boundary of the plates.[70]

In general, magnitude measures the size of an earthquake, while intensity measures the effects, which vary according to how far you are from the earthquake and the soils you are on.[4] Two scales are frequently used to measure earthquakes: Richter Scale measures the amount of energy released by an earthquake, or its magnitude. The Richter Scale ranges from 3.5 to 8.0, where 3.4 may be felt but doesn't cause damage, to an 8 which includes Great Earthquakes, and serious damage over extremely large areas. The Modified Mercalli Intensity Scale measures the intensity or impact of an earthquake on people and the built environment, and the Scale ranges from a Level 1, where the earthquake is not felt except by very few under especially favorable circumstances to a 10, with total

[68] https://www.ncdc.noaa.gov/

[69] https://www.ncdc.noaa.gov/

[70] Earthquake Causes and Characteristics, FEMA Emergency Management Institute Training Guide, https://training.fema.gov/emiweb/is/is8a/is8a-unit3.pdf

damage: where all works of construction are damaged or destroyed, lines of sight and level are distorted, and objects are thrown into the air.[4]

Earthquake hazards have multiple impacts beyond the obvious building collapse. Buildings may suffer structural damage that may or may not be readily apparent. Earthquakes can cause major damage to roadways, making emergency response difficult. Water lines and gas lines can break, causing flooding and fires. Another potential vulnerability is equipment within structures. For example, a hospital may be structurally engineered to withstand an earthquake, but if the equipment inside the building is not properly secured, the operations at the hospital could be severely impacted during an earthquake. Earthquakes can also trigger landslides.

Previous Occurrence and Extent

According to the State Hazard Mitigation Plan, New England experiences an average of 5 earthquakes per year. Between 1627 and 2008, 366 earthquakes were recorded in Massachusetts. Most earthquakes in the northeast region tend to be small in magnitude and cause little damage; however, between 1924 and 2012 there have been 104 earthquakes measured at a magnitude of 4.5 or greater on the Richter Scale. Due to the geologic composition and rock structure in the Northeast, seismic shaking for many of these larger earthquakes were felt throughout all of New England. Most of the earthquakes originated from the La Malbaie fault in Quebec or from the Cape Ann fault located off the coast of Rockport. The list below includes earthquakes that affected eastern Massachusetts:

- August 8, 1847: No data available on the extent of hazard.
- November 27, 1852: No data available on the extent of hazard.
- December 10, 1854: No data available on the extent of hazard.
- September 21, 1876: No data available on the extent of hazard.
- May 21, 1880: No data available on the extent of hazard.
- January 21, 1903: No data available on the extent of hazard.
- April 24, 1903: No data available on the extent of hazard.
- October 15, 1907: No data available on the extent of hazard.
- January 7, 1952: Earthquake occurred off of Cape Ann and the reported felt area extended from Providence, RI to Kennebunk, ME.
- April 24, 1925: No data available on the extent of hazard.
- January 28, 1940: No data available on the extent of hazard.
- October 16, 1963: Intensity VI, caused plaster to fall in a house, crack walls, dishes and windows.
- October 30, 1963: No data available on the extent of hazard.
- October 24, 1965: Slight damage to homes on Nantucket, house timbers creaked, doors, windows and dishes rattled.
- December 30, 2012: Magnitude 1.2 earthquake about 7 miles south of Gardner, MA. No extent data available.

- April 2012: A swarm of 12 or more earthquakes occurred off of the New England coast about 250 miles east of Boston. The largest of these earthquakes measured a magnitude of 4.4 on the Richter Scale. This swarm of earthquakes was of particular concern because of the major earthquake on the continental shelf further north in 1929 that produced a deadly and damaging tsunami in Nova Scotia.

There have been no declared earthquake disasters for Massachusetts. There have been no recorded earthquake epicenters within Westford and there have been no historical recorded effects on the Town associated with earthquake impacts originating from outside of Westford. FEMA has published maps with seismic design categories (SDCs) for building design and construction professionals. Most of New England is classified as SDC "B," as areas that could experience shaking of moderate intensity.[71]

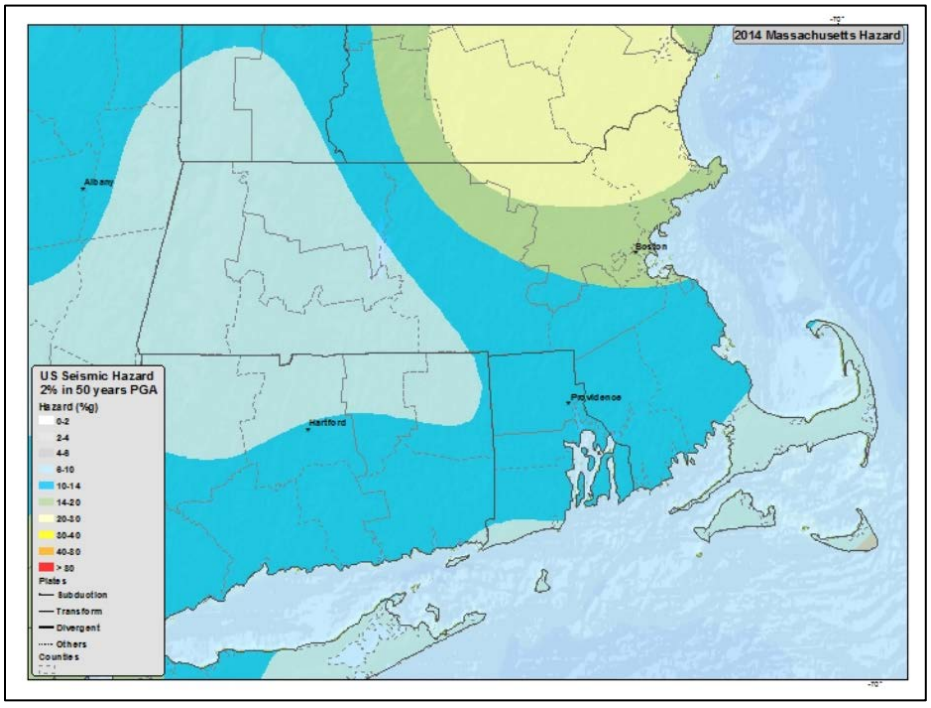
Locally Identified Areas of Impact

Based on mapping by FEMA, the entire planning area is at risk from impacts due to earthquakes**.**

Probability of Future Occurrence

Earthquakes cannot be predicted and may occur at any time of the day and any time of the year. However, for the purpose of this Plan, the USGS 2014 Seismic Hazard Map was used to review the probability of future occurrence as shown in **Figure 3-13**.[72]

The data is derived from seismic hazard curves and depict probabilistic ground motions with a 2 percent probability of exceedance in 50 years. For Westford, moderate peak gravity acceleration from 14 to 20 percent is predicted.



[71] https://www.fema.gov/earthquake-hazard-maps
[72] https://earthquake.usgs.gov/hazards/hazmaps/conterminous/index.php#2016

Figure 3-14 – Seismic Hazard Map of New England

Westford is similar to many communities in Massachusetts and may not be prepared for earthquakes. Although new construction under the most recent building codes will be built to seismic standards, much of the development in the Town predates the most recent building code. The Planning Team determined that it is **POSSIBLE** that an earthquake will impact Westford in the future and therefore are including it in the Multi-Hazard Mitigation Plan.

Impact on Westford's Key Sectors

As previous outlined, major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how Earthquakes will impact them as shown in **Table 3-24** below outlines this.

TABLE 3-24
Earthquake Exposure and Vulnerability by Key Sector[73]

Sector	Vulnerability
Infrastructural	In addition to direct impacts, earthquakes also present a risk associated with hazardous materials releases, which have the potential to impact a production or storage facility during transportation, or a result of pipeline damage. These events could cause widespread interruption of services, as well as air and water contamination.
Economic	Earthquake losses can include structural and non-structural damage to buildings (which could include damage to architectural components like ceilings and lights, or power systems), loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings.
Societal	Socially vulnerable populations are the most likely groups to be affected by this hazard based on a number of factors, including their physical and financial ability to react or respond during a hazard, the location and construction quality of their housing, and the ability to be self-sustaining after an incident due to limited ability to stockpile supplies.
Environmental	If strong shaking occurs in a forest, trees may fall – resulting not only in environmental impacts but also potential impact to any industries relying on that forest. If shaking occurs in a mountainous environment, cliffs may crumble, and caves may collapse. Disrupting the physical foundation of the ecosystem can cause species displacement and modify the species balance in that ecosystem and leave the area more vulnerable to the spread of invasive species.

3.2.3.2 Landslide

Landslides encompass a wide variety of ground movements under the effect of gravity including rock falls, slope failures, and shallow debris flows. In the Commonwealth of Massachusetts, landslides are primarily caused by slope saturation by water, which increases the weight on the slope, as well as the pore pressure.[74] Increasing the pore pressure will decrease the cohesiveness of the soil, making the land more vulnerable to

[73] 2018 MA SHMCAP
[74] 2018 MA SHMCAP

outside pressures (i.e. gravity). In Massachusetts, landslides are often caused by construction-related failures, undercut slopes, and water saturation.

- Construction-related failures are caused by construction activities that weaken the slope by increasing the steepness of the bank and decreasing supporting material along the bank.
- Undercut slopes occur when streams, tides, or other water movement cut into the toe of the slope, eventually undermining.
- Slope saturation on a slope occurs after high precipitation events and drastic water level changes that augments the weight on the slope and diminishes the slope's cohesiveness.

Landslide incidence is the number of landslides that have occurred in a given geographic area. High incidence means greater than 15 percent of a given area has been involved in land sliding, medium incidence means 1.5 to 15 percent of an area has been involved, and low incidence means that less than 1.5 percent of an area has been involved. Westford has a low incidence of landslides.

Previous Occurrence and Extent

Landslides tend to coincide with other natural disasters such as earthquakes and floods that exacerbate relief and reconstruction efforts. As a result, landslide frequency is related to the frequency of other hazards. There have been zero federally declared landslide disasters from 1954 to 2012.[75] According to the 2018 State Hazard Mitigation Plan, there are roughly 1 to 3 landslides events each year. There is no specific data on events in Westford. Town officials did not identify any problems with areas of geologic instability such as sinkholes or subsidence, or any past occurrences with landslides, sinkholes or subsidence.

Locally Identified Areas of Impact

The entire planning area is identified as low risk for landslides.

Probability of Future Occurrence

Due to the low incidences of historic landslides, the Planning Team determined that it is **UNLIKELY** that landslides will impact Westford in the future. Potential effects of climate change could increase the likelihood of landslides due to slope saturation with more frequent and intense storms, and reduced vegetation cover due to the increased frequency of drought events or increased urbanization.

Impact on Westford's Key Sectors

As previous outlined, major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how Landslides will impact them as shown in **Table 3-25** below outlines this.

[75] 2018 MA SHMCAP

TABLE 3-25
Landslide Exposure and Vulnerability by Key Sector[76]

Sector	Vulnerability
Infrastructural	Landslides can cause damage to elements of the built environment and can interfere with travel if large enough to block or damage roads.
Environmental	Landslides can affect many facets of the environment, including the landscape itself, water quality, and habitat health. Transported soil may harm aquatic habitats, and mass movement of sediment may result in stripping of forests and other vegetated systems.
Economic	Direct costs include the actual damage sustained by buildings, property, and infrastructure. Indirect costs from a large landslide event could include clean-up costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity.
Societal	Populations who rely on potentially impacted roads for vital transportation needs are considered to be particularly vulnerable to this hazard.

3.2.3.3 Tsunami

Based on the Massachusetts State Hazard Mitigation and Climate Adaption Plan of 2018, Tsunamis do not post a significant threat to Massachusetts, or more specifically Northern Middlesex County. Therefore, Tsunamis will not be discussed in this report.

3.2.4 Other Hazards

Other hazards discussed in this section include wildfires and invasive species.

3.2.4.1 Wildfires

Fire needs the right combination of heat source, fuel, and oxygen in order to ignite and thrive. Availability of fuel, weather conditions, and terrain all dictate how a fire will behave. Fires are classified as disasters when they affect people or developed areas. Fires can start from a variety of natural or anthropogenic causes. Urban fires occur in developed landscapes, where a fire has the potential to spread from one structure to another.

A wildfire is any non-structural fire that occurs in the vegetative wildlands. The 3 major classes of wildfires are surface, ground, and crown fires. A surface fire creeps slowly on the forest floor, while killing or damaging trees. Often occurring during droughts, ground fires burn organic ground cover below the forest floor. Rapidly spreading due to wind, crown fires quickly jump along the treetops.

Major urban and wildfires often result from other hazards, such as storms, earthquakes, gas leaks, transportation accidents, hazardous material spills, criminal activity, or terrorism. In contrast, small structural fires occur frequently from mundane events.

Previous Occurrence and Extent

The wildfire season in Massachusetts typically begins in late March and usually culminates in early June, following the driest live fuel moisture periods of the year. Historically, April

[76] 2018 MA SHMCAP

has the highest wildfire danger.[77] Westford's forested areas are a blend of northern (hardwood-hemlock-white pine) and southern (hardwood-oak-hickory) New England forests. Data from the Massachusetts Office of Fire Services reported that there have been 171 brush fires/wildfires in Westford from 2002 to 2010.

Locally Identified Areas of Impact

The Northeast Wildfire Risk Assessment Geospatial Work Group determined the wildfire risk based off of fuels, wildland-urban interface and topography, as shown in **Figure 3.14.**[78] Based on this mapping, the planning area could be at risk for wildfires.

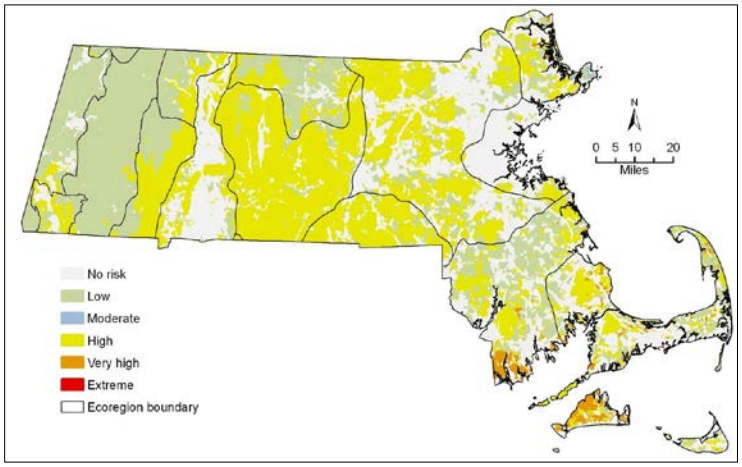


Figure 3-15 – Wildfire Risk in Massachusetts

Probability of Future Occurrence

It is difficult to predict the likelihood of wildfires given the complexity of predicting the factors leading to fires. Fires will continue to present a risk, and that risk is likely to increase with potential drought impacts of climate change. Periods of hot, dry weather and more frequent lighting strikes may increase wildfires. Research has found that the frequency of lightning strikes could increase by approximately 12 percent for every degree Celsius of warming. The Planning Team determined that it is **POSSIBLE** that a wildfire will impact the planning area based on the large amount of forested land in Westford and past history of fires.

Impact on Westford's Key Sectors

As previous outlined, major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how Wildfires will impact them. **Table 3-26** below outlines this.

[77] 2018 MA SHMCAP
[78] 2018 MA SHMCAP

TABLE 3-26
Wildfire Exposure and Vulnerability by Key Sector[79]

Sector	Vulnerability
Infrastructural	Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. They can also damage infrastructure elements such as power and communication lines.
Economic	Wildfire events can have major economic impacts on a community, both from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. Additionally, wildfires can require thousands of taxpayer dollars in fire response efforts.
Societal	All residents whose homes are located in wildfire hazard areas are vulnerable to this hazard. Smoke and air pollution from the wildfires can also be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases.
Environmental	Fire serves important ecological purposes; however, it can also cause environmental impacts. In addition to direct mortality, wildfires and the ash they generate can distort the flow of nutrients through an ecosystem, reducing the biodiversity that can be supported.

3.2.4.2 Invasive Species

The Massachusetts Invasive Plant Advisory Group (MIPAG) defines invasive plants as "non-native species that have spread into native or minimally managed plant systems in Massachusetts, causing economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems."[80] These species have biological traits that provide them with competitive advantages over native species, particularly because in a new habitat they are not restricted by the biological controls of their native habitat. As a result, these invasive species can monopolize natural communities, displacing many native species and causing widespread economic and environmental damage.

The Massachusetts Invasive Plant Advisory Group (MIPAG) recognized 69 species as "Invasive," "Likely Invasive," or "Potentially Invasive." In order to be considered “invasive,” a plant species must meet the following criteria[81]:

- Be nonindigenous to Massachusetts.
- Have the biologic potential for rapid and widespread dispersion and establishment in minimally managed habitats.
- Have the biologic potential for dispersing over spatial gaps away from site of introduction.
- Have the biologic potential for existing in high numbers away from intensively managed artificial habitats.

[79] 2018 MA SHMCAP
[80] https://www.massnrc.org/mipag/
[81] https://massnrc.org/mipag/docs/MIPAG_FINDINGS_FINAL_042005.pdf#page=6

- Be naturalized in Massachusetts (persists without cultivation in Massachusetts).
- Be widespread in Massachusetts, or at least common in a region or habitat type(s) in the state.
- Have many occurrences of numerous individuals in Massachusetts that have high numbers of individuals forming dense stands in minimally managed habitats.
- Be able to out-compete other species in the same natural plant community.
- Have the potential for rapid growth, high seed or propagule production and dissemination, and establishment in natural plant communities.

The damage rendered by invasive species is significant. The 2018 State Hazard Mitigation Plan sites an estimate that about 3 million acres within the United States (an area twice the size of Delaware) are lost each year to invasive plants. The massive scope of this hazard means that the entire Commonwealth experiences impacts from these species. Furthermore, the ability of invasive species to travel far distances (either via natural mechanisms or accidental human interference) allows these species to propagate rapidly over a large geographic area.[82]

Regulations on Invasive Species

Massachusetts has a variety of laws and regulations in place that attempt to mitigate the impacts of these species. The Department of Agricultural Resources (DAR) has added the plant species described to a list of noxious weeds regulated with prohibitions on importation, propagation, purchase and sale in the Commonwealth. Additionally, the Massachusetts Wetlands Protection Act (310 CMR 10.00) includes language requiring all activities covered by the Act to account for, and take steps to prevent, the introduction or propagation of invasive species.

In 2000, Massachusetts passed an Aquatic Invasive Species Management Plan, making the Commonwealth eligible for federal funds to support and implement the plan through the federal Aquatic Nuisance Prevention and Control Act. The Commonwealth also has several resources pertaining to terrestrial invasive species, such as the Massachusetts Introduced Pest Outreach Project, although a strategic management plan has not yet been prepared for these species. More specific regulations are discussed below.

330 CMR 6.0(d) requires any seed mix containing restricted noxious weeds to specify the name and number per pound on the seed label. 339 CMR 9.0 restricts the transport of currant or gooseberry species in an attempt to prevent the spread of white pine blister rust.

There are also a number of state laws pertaining to invasive species. Chapters 128, 130, and 132 of Part I of the General Laws of the state include language addressing water chestnuts, green crabs, the Asian longhorn beetle and a number of other species. These laws also include language allowing orchards and gardens to be surveyed for invasive species, and for quarantines to be put into effect, at any time.

[82] 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan

Locally Identified Areas of Impact-Flora

The 35 plant species listed on the MIPAG website as "Invasive" (last updated April 2016) are listed in **Table 3-27**.

TABLE 3-27
Invasive Species (Flora) in Massachusetts

Acer platanoides	Norway maple
Acer pseudoplatanus	Sycamore maple
Aegopodium podagraria	Bishop's goutweed, bishop's weed; goutweed
Ailanthus altissima	Tree of heaven
Alliaria petiolata	Garlic mustard
Berberis thunbergii	Japanese barberry
Cabomba caroliniana	Carolina fanwort; fanwort
Celastrus orbiculatus	Oriental bittersweet; Asian or Asiatic bittersweet
Cynanchum louiseae	Black swallow-wort; Louise's swallow-wort
Elaeagnus umbellata	Autumn olive
Euonymus alatus	Winged euonymus, burning bush
Euphorbia esula	Leafy spurge; wolf's milk
Frangula alnus	European buckthorn, glossy buckthorn
Glaucium flavum	Sea or horned poppy, yellow hornpoppy
Hesperis matronalis	Dame's rocket
Iris pseudacorus	Yellow iris
Lepidium latifolium	Broad-leaved pepperweed, tall pepperweed
Lonicera japonica	Japanese honeysuckle
Lonicera morrowii	Morrow's honeysuckle
Lonicera x bella [morrowii x tatarica]	Bell's honeysuckle
Lysimachia nummularia	Creeping jenny, moneywort
Lythrum salicaria	Purple loosestrife
Myriophyllum heterophyllum	Variable water-milfoil; two-leaved water-milfoil
Myriophyllum spicatum	Eurasian/European water-milfoil; spike water- milfoil
Phalaris arundinacea	Reed canary-grass
Phragmites australis	Common reed
Polygonum cuspidatum/Fallopia japonica	Japanese knotweed; Japanese or Mexican bamboo
Polygonum perfoliatum	Mile-a-minute vine or weed; Asiatic tearthumb
Potamogeton crispus	Crisped pondweed, curly pondweed
Ranunculus ficaria	Lesser celandine; fig buttercup
Rhamnus cathartica	Common buckthorn

Robinia pseudoacacia	Black locust
Rosa multiflora	Multiflora rose
Salix atrocinerea/Salix cinerea	Rusty Willow/Large Gray Willow complex
Trapa natans	Water chestnut

Massachusetts has also implemented biological control programs aimed at controlling the invasive species purple loosestrife (*Lythrum salicaria*), mile-a-minute vine (*Persicaria perfoliata*), hemlock woolly adelgid (*Adelges tsugae*), and winter moth (*Operophtera brumata*).

Locally Identified Areas of Impact-Fauna

According to the 2018 State Hazard Mitigation Plan, there are a number of animals that have disrupted natural systems and inflicted economic damage on the Commonwealth, as described in **Table 3-28**. Because of the rapidly evolving nature of the invasive species hazard, this list is subject to modification.

TABLE 3-28
Invasive Species (Fauna) in Massachusetts

Lymantria dispar	Gypsy moth (insect)
Ophiostoma ulmi, Ophiostoma himal-ulmi, Ophiostoma novo-ulmi	Dutch elm disease (fungus)
Adelges tsugae	Hemlock woolly adelgid (insect)
Cryphonectria parasitica	Chestnut blight (fungus)
Anoplophora glabripennis	Asian long-horned beetle
Cronartium ribicola	White pine blister rust (fungus)
Carcinus maenus	European green crab (crab)
Hemigrapsis sanguineus	Asian shore crab
Membranipora mambranacea	Lace Bryozoan
Codium fragile ssp. fragile	Codium
Didemnum vexillum	Tunicate
Palaemon elegans	European Shrimp
Dreissena polymorpha	Zebra mussel

Probability of Future Occurrence

Because the presence of invasive species is ongoing, rather than a series of discrete events, it is difficult to quantify the frequency of these occurrences. However, increased rates of global trade and travel have created many new pathways for the dispersion of exotic species. A warming climate may place stress on colder-weather species, while allowing non-native species accustomed to warmer climates to spread northwards. Elevated atmospheric CO2 concentrations could reduce the ability of ecosystems to recover after a major disturbance, such as flood or fire. As a result, invasive species, which are often able to establish more rapidly following a disturbance, could have an increased probability of successful establishment or expansion. The Planning Team determined that it is **LIKELY** that invasive species will continue to impact the planning area in the future.

Impacts on Westford's Key Sectors

As previous outlined, major vulnerability issues for each of the four major sectors (Infrastructural, Economic, Societal, and Environmental) were assessed to determine how Invasive Species will impact them as shown in **Table 3-29** below.

TABLE 3-29
Invasive Species Exposure and Vulnerability by Key Sector[83]

Sector	Vulnerability
Infrastructural	As described above, water bodies such as reservoirs could be exposed to the zebra mussel if it is introduced.
Economic	Invasive species are widely considered to be one of the most costly natural hazards in the United States, as invasive control efforts can be quite extensive and these species can damage crops, recreational amenities, and public goods such as water quality.
Societal	Individuals who are particularly vulnerable to the economic impacts of this hazard would include all groups who depend on existing ecosystems for their economic success.
Environmental	Invasive species present a significant threat to the environment and natural resources present in Westford. Research has found that competition or predation by alien species is the second most significant threat to biodiversity, only surpassed by direct habitat destruction or degradation.

[83] 2018 MA SHMCAP

Section 4
Community Asset Inventory

Section 4 provides an inventory of the community assets that are important to the Town of Westford. The Section is broken up into three parts: a discussion of current and future land use trends, a description of the community assets categories used in the Town's MVP/HMP and the results of the Westford's Community Assets Inventory organized by FEMA's community asset categories. Identifying the community assets allows the Town to investigate how they will be impacted by the different natural hazards.

4.1 Inventory Overview

FEMA defines a community asset as anything that is important to the character and function of a community. Community assets can be split up into four different categories: People, Economy, Built Environment, and Natural Environment. The People category includes populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations), densely populated areas, and societal assets such as cultural and historical resources. Economy is included because economic drivers are a major part of disaster recovery. Community assets in the Economy category can include major employers, commercial centers, and locations providing food, medical supplies and building materials. The Built Environment is the largest category and includes existing structures, infrastructure (transportation and utilities) and critical facilities important for disaster response and evacuation (e.g., police, fire stations and medical facilities). The Natural Environment category is meant to capture any natural resources important to the community's character, economy (tourism, recreation, and the protection of clean air and water), and ecosystem services (e.g., wetlands providing flood storage, coastal areas providing erosion control as a first line of defense from coastal storms).

Table 4-1 summarizes the community asset categories included in FEMA guidelines, relevant critical sectors within each category, and the general characteristics that describe why these assets are important to include in a hazard mitigation plan.

TABLE 4-1

Community Asset Categories

FEMA Community Asset Categories	Critical Sectors	Characteristics of Community Assets
Societal Assets	Schools, Vulnerable Populations, Cultural and Historical Facilities	Areas of greater population density, or population with unique vulnerabilities or less able to respond and recover during a disaster.
Infrastructural Assets	Critical Municipal Facilities, Water, Wastewater, Energy, Stormwater, Transportation	Critical facilities necessary for a community's response to and recovery from emergencies, infrastructure critical for public health and safety, economic viability, or for critical facilities to operate.
Economic Assets	Seaport, Business District, Food and Medical Supplies, Building Supplies	Major employers, primary economic sectors and commercial centers where loss or inoperability would have severe

		impact on the community and ability to recover from a disaster.
Environmental Assets	Natural Resources	Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc.

Each Community Asset group was further subdivided into subtypes (e.g. churches, schools, pharmacies) to provide a more comprehensive picture of resources.

Maps in this section show the location of all selected community assets. The tables in this section list the assets. **Section 5 Vulnerability Risk Assessment** provides a discussion on natural hazards that may impact the community assets and their vulnerability.

4.1.1 Built Environment

Table 4-2 displays the notable infrastructure found in the Town of Westford.

Table 4-2
Town of Westford Community Assets - Infrastructure

Category	Name
Bridge	I 495 NB - Bridge (NBI)
Bridge	I 495 SB - Bridge (NBI)
Bridge	I 495 - Short Span Bridge
Bridge	I 495 NB - Bridge (NBI)
Bridge	I 495 SB - Bridge (NBI)
Bridge	HWY BEAVER BK RD - Bridge (NBI)
Bridge	I 495 NB - Bridge (NBI)
Bridge	I 495 SB - Bridge (NBI)
Bridge	ST225 PLEASANT ST - Short Span Bridge
Bridge	ST225 PLEASANT ST - Bridge (NBI)
Bridge	I 495 - Short Span Bridge
Bridge	HWY TOWN FARM RD - Bridge (NBI)
Bridge	HWY MILOT RD - Culvert
Bridge	HWY GRANITEVILLE - Bridge (NBI)
Bridge	HWY BRIDGE ST - Bridge (NBI)
Bridge	HWY BROADWAY ST - Bridge (NBI)
Bridge	HWY RIVER ST - Bridge (NBI)
Bridge	HWY DEPOT RD - Bridge (NBI)
Bridge	HWY STONY BRK RD - Bridge (NBI)
Bridge	HWY BROOKSIDE RD - Bridge (NBI)
Bridge	ST 40 GROTON RD - Short Span Bridge
Bridge	HWY RUSSELLS WAY - Bridge (NBI)

Category	Name
Bridge	HWY RUSSELLS WAY - Bridge (NBI)
Bridge	ST 3 SB - Bridge (NBI)
Bridge	ST 3 NB - Bridge (NBI)
Communication Utilities	Water Tank
Communication Utilities	Milestone Hill
Communication Utilities	Nextel
Communication Utilities	Antennas/Private
Communication Utilities	Cellular One
Communication Utilities	MIT/Haystack Obs
Communication Utilities	Antennas
Communication Utilities	Nashoba Sky
Culverts	Townwide
Dams	Murray Printing Company Dam
Dams	Stony Brook Dam At Graniteville
Dams	Westford Depot Dam
Dams	Commodore Foods Company Dam
Dams	Nabnasset Lake Dam
Dams	Flushing Pond Dam
Dams	Long Sought for Pond Dam
Dams	Fletcher Pond Dam
Funeral Homes	JA Healy Sons Funeral Home
Gas Station	Cumberland Farms Gas
Gas Station	Gulf
Gas Station	Mobil
Gas Station	United
Gas Station	Getty (BP)
Gas Station	Shell
Gas Station	Citgo
Gas Station	Getty (BP)
Helicopter Landing Zone	Nashoba Tech HS - Rear
Helicopter Landing Zone	Papillion Park - Parking lot
Helicopter Landing Zone	Hamilton Field
Helicopter Landing Zone	Blanchard School - Open Area
Helicopter Landing Zone	Abbott School - Open Area
Helicopter Landing Zone	Westford Highway Garage
Helicopter Landing Zone	Westford Academy - Open Field
Helicopter Landing Zone	Forge Village - Ball Field
Helicopter Landing Zone	Stony Brook School - Open area
Helicopter Landing Zone	Jack Walsh Field
Helicopter Landing Zone	Robins Road - Cul de Sac - 100'x100'

Category	Name
Medical Facilities	Westford Internal Medicine, PC
Medical Facilities	CVS MinuteClinic
Medical Facilities	Circle Health Westford
Medical Facilities	Westford Counseling Center
Medical Facilities	Greater Lowell Pediatrics of Westford
Medical Facilities	Floating Hospital Pediatric Specialty Center
Medical Facilities	China Acupuncture Health Center
Municipal Facilities	Town Hall
Municipal Facilities	IT Department (Forge Village Fire Station)
Municipal Facilities	Parkerville Schoolhouse
Municipal Facilities	Recreation Dept Storage (Graniteville Fire Station)
Municipal Facilities	Recreation Department
Municipal Facilities	School Maintenance Garage (Old Highway Garage)
Post Offices	United States Postal Service - Rt 110/225
Post Offices	United States Postal Service - Forge Village
Post Offices	United States Postal Service - Nabnasset
Power Utilities	Electric Substation
Power Utilities	Electric Substation
Power Utilities	Electric Substation
Power Utilities	Power Transmission Line
Power Utilities	Power Line
Power Utilities	Power Line
Power Utilities	Natural Gas Pipeline
Private Water Facility	Hitchin Post Greens
Private Water Facility	Graniteville Woods Development
Private Water Facility	Honeysuckle Road Booster Station
Public Safety	Rogers Fire Station
Public Safety	Police Central Station & Public Safety Communications
Public Safety	Fire Department
Public Safety	Nabnasset Fire Station
Public Works Facilities	Highway Garage
PWS Facility	Nutting Road Water Treatment Plan
PWS Facility	Perchlorate Treatment Facility (inactive)
PWS Facility	Highway Garage Booster Station
PWS Facility	Howard Road Pumping Station
PWS Facility	Forge Village Water Treatment Plant
PWS Facility	Booster Station No. 3 (Forge Village)
PWS Facility	Cote Pumping Station
PWS Facility	Stepinski Pumping Station
PWS Facility	Boston Road Booster Station

Category	Name
PWS Facility	Fletcher Pumping Station
PWS Facility	Country Road 2 Pumping Station
PWS Facility	Twin Peaks Tank
PWS Facility	Depot Road Pumping Station
PWS Facility	Forge Village 1 Pumping Station
PWS Facility	Forge Village 2 Pumping Station
PWS Facility	Francis Hill Tank
PWS Facility	Prospect Hill Tank
PWS Facility	Hildreth Hills Booster Station
PWS Facility	Hildreth Hills Tank
PWS Facility	Nutting Road Pumping Station
PWS Facility	Town Farm Road Tank
PWS Well	Howard Road Wellfield
PWS Well	Fletcher Well
PWS Well	Country Rd. 2 Well
PWS Well	Forge Village No 1. Wellfield
PWS Well	Forge Village No. 2 Well
PWS Well	Stepinski Well
PWS Well	Cote Well
PWS Well	Depot Road Well
PWS Well	Nutting Rd Satellite Wells
Transportation	IBM Littleton Extension Bus Route
Transportation	LRTA Route 15 Bus Route
Transportation	Railroad

4.1.2 People

Table 4-3 displays the societal assets in the Town of Westford.

Table 4-3
Town of Westford Community Assets – Society

Category	Name	Address
Adult Day Care	Millennium Home Adult Day Care	5 Lyberty Way
Affordable Housing	Hawk Ridge	Kestrel Lane
Affordable Housing	Stone Ridge	Stone Ridge Road
Affordable Housing	Brookside Mill	12 Brookside Road
Affordable Housing	Alder Point	354 Groton Road
Affordable Housing	Line Road	14 Line Road
Affordable Housing	Princeton Westford Apartment Homes	16 Littleton Road
Affordable Housing	Tadmuck Meadows	1 Bandon Circle
Affordable Housing	65 Tadmuck Road	65 Tadmuck Road
Affordable Housing	Tadmuck Housing	65 Tadmuck Road
Affordable Housing	Orion Way (1)	14 Orion Way
Affordable Housing	Keyes Corner	100 Nutting Road
Affordable Housing	Rosegate	99 Main Street
Affordable Housing	Residences at Stony Brook	3, 5 and 6 Farmer Way
Affordable Housing	Southgate	5 Southgate Road
Affordable Housing	Cottages in the Woods	Joes Way
Affordable Housing	Juniper Hill Road	Juniper Hill Road
Affordable Housing	Elderberry Estates	1 Silo Path
Affordable Housing	77 Graniteville Road	77 Graniteville Road
Affordable Housing	7 Cross Street	7 Cross Street
Affordable Housing	School Lane	2 School Lane
Affordable Housing	7 Church Street	7 Church Street
Affordable Housing	CHOICE Housing	173 Carlisle Road
Affordable Housing	Graniteville Woods	2 Indian Ridge Terrace
Affordable Housing	Haystack	10 Groton Road
Affordable Housing	Stoneview	6 Stoneview Drive
Affordable Housing	Hanover Westford Hills	2 Robbins Road
Affordable Housing	Hanover Westford Valley	312 Littleton Road
Affordable Housing	Beaver Brook Village	2 Conservation Lane
Affordable Housing	Concord Place	135 Concord Road
Affordable Housing	Woodlands at Laurel Hills	2 Conservation Lane
Affordable Housing	Sugar Maple Lane	Powers Road
Art and Culture	Parish Center for the Arts	10 Lincoln Street
Cemetery	Hillside Cemetery	Nutting Road
Cemetery	Fairview Cemetery	Main Street

Category	Name	Address
Cemetery	Picking-Wright Cemetery	Groton Road
Cemetery	St. Catherine's Cemetery	Pine Ridge Road
Cemetery	Pine Grove Cemetery	68 Forge Village Road
Cemetery	Russian Brotherhood Cemetery	Patten Road
Cemetery	Westlawn Cemetery	Concord Road
Cemetery	Keyes Cemetery	Jonas Road
Child Care	Westford Children's Learning Center	508 Groton Road
Child Care	Roudenbush Children's Center	65 Main Street
Child Care	Tracy's Tiny Tots Daycare	37 North Street
Child Care	Right at Home Daycare	33 River Street
Child Care	Westford Preschool at St. Mark's	75 Cold Spring Road
Child Care	Westford KinderCare	26 Carlisle Road
Child Care	The Kid's League of Westford	10 Church Street
Child Care	Next Generation Children's Centers	9 Powers Road
Child Care	The Goddard School of Westford	162 Concord Road
Child Care	Acorn Child Care Center	439 Littleton Road
Community Centers	Cameron Senior Center	20 Pleasant Street
Community Centers	Roudenbush Community Center	65 Main Street
Elderly Care	Senior Helpers of Westford	66 Tadmuck Road
Elderly Care	Bridges by EPOCH at Westford	108 Littleton Road
Elderly Care	Samaritan Home Care	234 Littleton Road
Elderly Care	Westford House	3 Park Drive
Elderly Housing	Tadmuck Road Senior Housing	65 Tadmuck Road
Elderly Housing	Village at Mystery Spring	67 Tadmuck Road
Elderly Housing	Graniteville Senior Housing	7 Cross Street
Food Pantries	Westford Food Pantry	20 Pleasant Street
Libraries	J.V. Fletcher Library	50 Main Street
Museum	Westford Museum	2 Boston Road
Place of Worship	Chabad of Nashoba Valley	26 Tadmuck Road
Place of Worship	Grace Community Church	130 Littleton Road
Place of Worship	First Parish Church United	48 Main Street
Place of Worship	St. Mark's Episcopal Church	75 Cold Spring Road
Place of Worship	Cornerstone Congregational Church	32 Graniteville Road
Place of Worship	United Methodist Church	10 Church Street
Place of Worship	St. Catherine of Alexandria	107 N. Main Street
Place of Worship	Wat Buddhabhavana	25 Milot Road
School	Rita Edwards Miller School	1 Mitchell Way
School	Nabnasset School	99 Plain Road
School	Abbot and Millennium Elementary School	25 Depot Street

Category	Name	Address
School	Stony Brook School	9 Farmers Way
School	Nashoba Valley Technical High School	100 Littleton Road
School	Blanchard Middle School	14 West Street
School	Norman E. Day School	75 East Prescott Street
School	Westford Academy School	30 Patten Road
School	Robinson and Crisafulli Elementary School	13 Robinson Road
School	Col. John Robinson School	60 Concord Road
Special Needs Schools	Westford Integrated Preschool	23 Depot Street
Vulnerable Population	Village at Mystery Spring	67 Tadmuck Road
Environmental Justice Area	Minority Population	North-east corner of Town

4.1.3 Economy

Table 4-4 displays economic assets in the Town of Westford.

Table 4-4
Town of Westford Community Assets – Economy

Category	Company Name	Address
Hardware Stores	Westford ACE Hardware	527 Groton Road
Hardware Stores	MacKay ACE Hardware & Rentals	224 Littleton Road
Major Employers (100+)	Juniper Networks	10 Technology Drive
Major Employers (100+)	Nashoba Valley Technical High School	100 Littleton Road
Major Employers (100+)	Sanborn Head & Assoc. Inc.	1 Technology Park Drive
Major Employers (100+)	Whole Foods Market	160 Littleton Road
Major Employers (100+)	Cynosure	5 Carlisle Road
Major Employers (100+)	Sentry Insurance	3 Carlisle Road
Major Employers (100+)	Market Basket	6A Cornerstone Square
Major Employers (100+)	Mack Technologies	27 Carlisle Road
Major Employers (100+)	Marshalls	11 Cornerstone Square
Major Employers (100+)	Materion Precision Optics	2 Lyberty Way
Major Employers (100+)	Westford Regency Inn	219 Littleton Road
Major Employers (100+)	Keller Williams Realty	3 Lan Drive
Major Employers (100+)	Pediatria	238 Littleton Road
Major Employers (100+)	Westford House	3 Park Drive
Major Employers (100+)	Westford Academy School	30 Patten Road
Major Employers (100+)	Dee Bus Services Inc.	30 Town Farm Road
Major Employers (100+)	Netscout Systems Inc.	310 Littleton Road
Major Employers (100+)	Nashoba Valley Ski Area	79 Powers Road
Major Employers (100+)	Kimball Farm	400 Littleton Road

Category	Company Name	Address
Oil Delivery Services	J.A. Healy & Sons Oil Company	5 2nd Street
Pharmacies	Walgreens Pharmacy	145 Littleton Road
Pharmacies	CVS Pharmacy	174 Littleton Road
Specialty Grocer	British Delights	63 Powers Road
Supermarkets	Whole Foods Market	160 Littleton Road
Supermarkets	Market Basket	6A Cornerstone Square
Towing Services	Joe's Auto & Towing LLC	496 Groton Road
Towing Services	Whitney Service	107 Main Street
Towing Services	Bob's Auto Services	290 Littleton Road
Tree Removal Services	Scott's Tree & Landscape, Inc.	8 Elliot Road

4.1.4 Natural Environment

Table 4-5 displays the natural environmental assets in the Town of Westford. There are an additional 250 open space parcels in Westford that were not included in this table.

Table 4-5
Town of Westford Community Assets – Environmental

Category	Name	Address
Ball Fields	Jack Walsh Field	Carlisle Road
Beach	Edwards Beach	Williams Avenue
Beach	Forge Pond Town Beach	Pleasant Street
Camp	East Boston Camps at Stony Brook Conservation Land	Depot Street
Conservation Land	Stony Brook Conservation Land - Recreation Commission Parcel 1	Nutting Road
Field	Graniteville Ballfield/American Legion Field	15 River Street
Field	Greystone Playing Fields (Lot Q)	Russell's Way
Orchard	Hill Orchard Farm Stand	Hunt Road
Orchard	Hill Orchard West 1	Chamberlin Road
Orchard	Hill Orchard West 2	Chamberlin Road
Park	Captain Stephen Hamilton Ballfield	Plain Road
Park	VFW Softball Field	52 W Prescott Street
Undeveloped Land	Minot's Corner Parcel	Littleton Road
Undeveloped Land	Old Landfill/New Meadow	Cold Spring Road
Waterbody	Stony Brook	MA84B-03 and 04
Waterbody	Tadmuck Brook	MA84B-07
Waterbody	Beaver Brook	MA84B-02
Waterbody	Deep Brook	MA84A-21
Waterbody	Nabnasset Lake	MA84044
Waterbody	Forge Pond	MA84015
Waterbody	Reed Brook (Coldwater Fishery Resource)	MA84B-08

Category	Name	Address
Waterbody	Heart Pond	MA82059
Waterbody	Nashoba Brook	MA82B-14
Waterbody	Burges Pond	
Waterbody	Graniteville Pond	
Waterbody	Kennedys Pond	
Waterbody	Blue Brook	
Waterbody	Boutwell Brook	
Waterbody	Butter Brook	
Waterbody	Coldspring Brook	
Waterbody	Flushing Pond	
Waterbody	Gilson Brook	
Waterbody	Greystone Pond	
Waterbody	Keyes Pond	
Waterbody	Long Sought For Pond	
Waterbody	Nonset Brook	
Waterbody	Pond Brook	
Waterbody	Snake Meadow Brook	
Waterbody	Tadmuck Swamp	
Waterbody	Vine Brook	
Waterbody	Wetlands	Town-wide

4.2 Land Use and Development Trends

4.2.1 Overview of Historical Development Pattern

D1

Westford is a fairly large town compared with other communities in the region and throughout the state. Its territorial extent of 31.3 sq. mi. includes 30.6 sq. mi. of land, making Westford the 79th largest town in the state and second largest in the Northern Middlesex area. Westford's water resources and its direct access to major transportation routes have influenced its land use pattern in noteworthy ways, both historically and since the town adopted its first zoning bylaw in 1955.

Westford's land use pattern is that of an evolving suburb. The town has well-preserved urban villages that stand out on any land use map, but the extensive suburban housing development that has occurred here in the past thirty years forms one of the dominant impressions of Westford today. Its affluence, prestigious reputation and zoning requirements have attracted a residential development pattern composed of spacious single-family homes, mainly on large lots. Despite its efforts to encourage alternatives to conventional plans, Westford, like all towns in Massachusetts, is vulnerable to constraints imposed by zoning and subdivision laws that have not been updated in more than three decades. It also is vulnerable to Chapter 40B, the state's affordable housing law. Against the backdrop of weak land use statutes, limitations on home rule and local tensions about growth and change, Westford has been able to rally support for protecting open space and the results can be seen in many parts of town. Although it has all of the land use challenges found in other suburbs, Westford remains a beautiful community.

Table 4-6 shows the degree to which Westford's land use pattern has changed since 1971, including data from the state through 1999 and from the town's GIS department through 2007.

TABLE 4-6
Land Use Change in Westford, 1971-2007[84]

	Acres in Use				Percent Change			% town 2007
Land Use	1971	1985	1999	2007	1971-1991	1985-1999	1999-2007	
Commercial	71	138	181	217	94%	31%	20.3%	1.1%
Industrial	478	573	997	992	20%	74%	-0.5%	4.9%
Residential	2,505	3,643	6,216	6,563	45%	71%	5.6%	32.7%
Other	17,014	15,714	12,674	12,295	-8%	-19%	-3.0%	61.3%
Summary								
Developed	3,052	4,354	8,114	8,114	43%	71%	8.8%	40.4%
Undeveloped	1,7014	15,714	11,953	11,953	-8%	-20%	-5.2%	59.6%
Total	20,067	20,067	20,067	20,067	NA	NA	NA	NA

From 1971-1999, nearly 2,900 acres of forest and more than 1,000 acres of agricultural land changed to another use, mainly housing. Well over half of all residential land use changes occurred between 1985 and 1999, a period that included two cycles of intense housing growth: one prior to the recession and the other after 1994. Some small-lot housing development occurred in Westford in the form of townhouses and single-family homes in cluster developments, but most the conspicuous land use change has involved the conversion of agricultural land to large-lot single-family homes. Considering all residential use types, more than 4,100 acres were converted to housing between 1971 and 2007.

Residential land use change is not the only indicator of Westford's late-twentieth century transformation from a semi-rural town to a suburb. In the same era, land used for commercial purposes increased by 154 percent and for industrial purposes, nearly 110 percent, excluding land devoted to power easements, transmission lines and so forth, while traditional economic activities such as farming, and quarrying declined. As the town gained households, it also experienced growth in demand for schools, playing fields and public services. Westford experienced these changes in the form of an increase in recreation land and institutional or urban open space. In addition to building two new schools and renovating or expanding three existing schools between 1971 and 1999, Westford also constructed a new fire station and two pumping stations for new water supplies. The Nashoba Valley Vocational-Technical School was built in this period, too. Viewed in their entirety, the areas devoted to residential, commercial and industrial uses in 1999 represented a 28-year increase of about 3,800 acres.

[84] For 1971, 1985, and 1999 data, UMass-Amherst, McConnell Land Use Maps, MassGIS for 2007, Westford GIS, aerial photogrammetry analysis. Data supplied courtesy of NMCOG.

4.2.2 Current Land Use

Nowhere in Westford is the difference between land coverage and parcel-based land use statistics more obvious than the town's inventory of residentially developed land. As of Fiscal Year (FY) 2007, residential uses occupy about 7,400 acres of land in parcels. This has less to do with the amount of new growth in Westford than with the characteristics of Westford's residential land use pattern. For example, the town has several single-family residences on large parcels that may have some additional development potential. It also has a number of condominium or townhouse developments on large parcels that have no additional development potential due to deed restrictions placed on the open space.

The total amount of land used for commercial and industrial purposes today is also much greater than the land coverage statistics would suggest. However, planners and assessors do not always use the same terminology to describe land uses. For example, businesses and industries own more land than the number of acres physically occupied by buildings, access drives and parking lots. Some of the land supports drainage areas, and local zoning regulations (including Westford's) often require nonresidential uses to reserve a percentage of their land as open space. In addition, many companies hold land for future expansion. These variables mean that sometimes a parcel classified by an assessor as "industrial" would be reclassified in a land coverage analysis as partially industrial and partially forested. Moreover, in Westford and many communities, the commercial base includes large outdoor recreation facilities. While Westford's golf course constitutes a commercial use for appraisal purposes, a planner would classify it as recreational land.

4.2.3 Potential Future Development

Smart Growth

Westford has expressed interest in a "smart growth" plan, yet the Town faces obstacles to implementing a smart growth plan even through the town is ideally posed to succeed with smart growth initiatives. Some of the obstacles extend beyond the Town's control, yet others plainly fall into the realm of local policy, for example:

- Westford does not have direct access to public transportation, but the town could make sidewalks a higher priority and work toward making Westford a place that encourages people to walk.
- Westford could do far more to promote mixed-use development by updating its use regulations and reducing regulatory barriers. Ironically, the only residential use that Westford allows by right in a commercial district is the detached single-family home – and only in the B District, which is largely built out and composed of many nonconforming lots.
- Current zoning regulations force new commercial buildings to be set back at a considerable distance from the street. They also encourage inefficient land use by writing down the development potential of business-zoned property. This inefficiency is caused by a combination of factors: very low building coverage ratios, a sub-urban height standard of three stories for buildings in all of the business districts, and excessive parking requirements, especially for retail uses. Westford does not allow enough development on commercial lots to make underground parking feasible. As a result, the combined factors of low coverage ratios, building height limitations, large open space requirements and a large amount of land required for off-street parking mean that in many cases, a permitted use would need more land than the minimum lot area required in a commercial zoning district.

- Westford allows a limited mix of residential uses by special permit. It also requires developers to provide affordable units without any guarantee of additional density or other types of offsets that would help to reduce a developer's risk and the total cost of development. Moreover, multi-family housing is not a permitted use in any zoning district and even when it is allowed by special permit, Westford limits multi-family units to a maximum of five per building, except in the Mill Conversion Overlay District (MCOD). The town also places significant limitations on the size of housing units other than single-family homes. Whether unwitting or intentional, Westford has adopted a housing policy framework that privileges single-family homes and makes it very difficult to create lower-cost multi-unit dwellings for families in a Flexible Development or MCOD.
- Westford's present zoning policies contemplate a blueprint for buildout that would divide almost ninety percent of the town's land into one-acre (40,000 sq. ft.) lots. While the OSRD and Flexible Development bylaws encourage smaller lots and open space preservation, they are not designed to alter Westford's overall build-out potential or to induce a fundamental rearrangement of future growth. At best, tools like Westford's OSRD and Flexible Development regulations encourage projects that are more attractive and environmentally sensitive than conventional subdivisions. These outcomes are important, but they do not reduce pressure on outlying land or guide development toward designated growth areas.
- Many features of Westford's zoning work to separate land uses instead of mixing them. For example, the town requires a 100' "no-disturb" buffer area between Flexible Developments or SRMD projects and adjacent residential areas, landscaped buffers along the front and sides of developments in the Commercial Highway District, and generous buffers separating uses with-in most of the business and industrial districts. There do not appear to be any requirements for pedestrian connectivity between commercial areas and nearby neighborhoods. Most zoning districts require exceptionally deep front yard setbacks, too.
- Westford's villages, Route 110, and eastern Route 40 could support a growth management strategy such as transfer of development rights (TDR), but the zoning bylaw does not offer any TDR mechanisms. Moreover, the bylaw all but "freezes" the villages at historic densities by requiring a minimum lot area of 20,000 sq. ft. and minimum lot frontage of 100 feet. A greater challenge to instituting TDR in Westford is the absence of sewer service, yet some communities in Massachusetts have developed small, district-oriented wastewater treatment facilities in an effort to accommodate some compact building forms and infill uses in established areas.
- Zoning in Westford sometimes makes it difficult for developers to anticipate how much they will be able to build on a given site or what it will cost to obtain permits and approvals from the Town. For example, the MCOD bylaw gives the Planning Board authority to set the maximum number of units in MCP projects, based on a loosely defined Development Impact Statement. Moreover, the regulations for Major Retail/Commercial Project (MRP) and Major Commercial Project (MCP) developments call for a fiscal impact analysis and impacts mitigation without any clear standards for determining what sort of mitigation the Town may require.
- People often forget that one of the central tenets of smart growth is fairness and predictability in permitting. Under Westford's present zoning, neither developers nor abutters can readily foresee what the town will require as a condition of approval for MRP, MCP, Planned Commercial Development (PCD) or Public Improvement District (PID) projects. Many of the regulations are vague, and so

many uses in Westford require a special permit that the permitting process itself exposes applicants to an extended, potentially costly path for obtaining development approvals in addition to a heightened risk of appeal.

Zoning and Business Development

Westford would like to see fewer "franchise" businesses along Route 110 and attract more locally owned or unique stores, restaurants and services. To some extent, the absence of a "Westford identity" on Route 110 stems from the corridor's proximity to the I-495/Boston Road interchange. The resulting volume of highway traffic makes land on Route 110 attractive to commercial developers because they know they can lure regional and national chains that pay high rents. Today, Route 110 in the vicinity of Boston Road is lined with chain retail establishments separated from the road by large parking lots. Many Westford residents probably shop on Route 110 even though the business district does not offer what they say they would like in their town.

While the location of Route 110 has a great deal to do with the composition of businesses located there, Westford's zoning regulations do not make it easy for small companies to locate in the Commercial Highway District. However, zoning changes alone are unlikely to influence the mix of businesses because Route 110 has evolved into a retail strip.

Section 5
Multi-Hazard Vulnerability Assessment

5.1 Overview

B3 b

The purpose of the vulnerability assessment is to estimate the extent or magnitude of potential damages from natural hazards of varying types and intensities. Section 5 ties together the hazards identified in Section 3 and the community assets identified in Section 4 to estimate the potential losses that Westford could experience during a natural hazard event. There are four assessments included in **Section 5** of the this HMP Update:

1. **HAZUS-Multi Hazards (MH) Assessment:** HAZUS is a standardized hazard assessment methodology created by FEMA. This vulnerability assessment includes estimation of damages for hurricanes and earthquakes using HAZUS-MH software and is described in **Section 5.2**.
2. **Exposure Assessment of Parcels and Building Flood Risk**: This assessment was completed using GIS analysis for existing flooding using assessor's data, and current FEMA FIRMs. This assessment is described in **Section 5.3.1**.
3. **Vulnerability Assessment for Future Development:** This assessment was completed for areas slated for future development, identifying natural hazard risk from hurricanes, earthquakes, and flooding, and is further described in **Section 5.3.2.**
4. **Vulnerability of Community Assets**: This assessment was completed to determine whether critical facilities and other identified community assets could be exposed to flooding, surge, sea level rise and coastal erosion. The assessment looks at existing flood conditions based on approved FEMA FIRMS with 2017 and 2018 map revisions and future flood conditions due to climate change based on data from the Massachusetts Climate Change Warehouse. This assessment is described in **Section 5.4**.

5.1.1 HAZUS-MH for Hurricanes and Earthquakes

Methodology

HAZUS-MH (multiple-hazards) is a computer program developed by FEMA to estimate losses due to a variety of natural hazards. For the purposes of this Plan, HAZUS-MH was used to estimate losses due to hurricane winds and earthquakes.

The following overview of HAZUS-MH is taken from the FEMA website:

HAZUS is a nationally applicable standardized methodology that estimates potential losses from earthquakes, hurricane winds, and floods. FEMA developed HAZUS under contract with the National Institute of Building Sciences (NIBS).

HAZUS uses state-of-the-art 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 earthquakes, hurricane winds, and floods on populations.

Estimating losses is essential to decision-making at all levels of government, providing a basis for developing mitigation plans and policies, emergency preparedness and response, and recovery planning. [85]

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 in this Plan 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 community, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is subject to a great deal of uncertainty.

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

Results - Hurricanes

For the purposes of this Plan, a Category 2 and a Category 4 storm were chosen to illustrate damages. The reason is to present more of a "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 5-1** below presents estimated damages from hurricanes.

TABLE 5-1
Hurricane Damage Estimates

	Category 2 (Carol peak gust 100mph)	**Category 4 (Donna peak gust 152mph)**
Building Characteristics		
Estimated total number of buildings	8,238	8,238
Estimated total building replacement value (Year 2002 $) (Millions of Dollars)	4,401	**4,401**
Building Damages		
# of buildings sustaining minor damage	46	**66**
# of buildings sustaining moderate damage	1	**2**
# of buildings sustaining severe damage	0	**0**
# of buildings destroyed	0	**0**
Population Needs		

[85] For more information on the HAZUS-MH software, go to https://www.fema.gov/hazus.

# of households displaced	0	**0**
# of people seeking short-term public shelter	0	**0**
Debris		
Building debris generated (tons)	172	**241**
Tree debris generated (tons)	2,826	**3,473**
Value of Damages (Thousands of dollars)		
Total economic losses from property damage	**$11,937**	**$14,277**

*No Category 4 or 5 hurricanes have been recorded in New England. However, a Category 4 hurricane was included to help the community understand the impacts of a hurricane beyond what has historically occurred in New England.

Results – Earthquakes

The HAZUS earthquake module allows users to define a number of different types of earthquakes and to input a number of different parameters. The module is more useful where there is a great deal of data available on earthquakes. In New England, defining the parameters of a potential earthquake is much more difficult because there is little historical data. The earthquake module does offer the user the opportunity to select a number of historical earthquakes that occurred in Massachusetts. For the purposes of this Plan, two earthquakes were selected: an earthquake with a 5.1 magnitude and 10 fault depth and a 5.8 with 10 fault depth. **Table 5-2** below presents estimated damages from earthquakes.

TABLE 5-2

Earthquake Damages Estimates

	Magnitude 5.1	**Magnitude 5.8**
Building Characteristics		
Estimated total number of buildings	8,238	**8,238**
Estimated total building replacement value (Year 2002 $)(Millions of dollars)	4,401	**4,401**
Building Damages		
# of buildings with no damage	99	**719**
# of buildings sustaining slight damage	3,955	**1,567**
# of buildings sustaining moderate damage	2,493	**2,602**
# of buildings sustaining extensive damage	1,332	**2,440**
# of buildings completely damaged	359	**910**
Population Needs		
# of households displaced	133	**580**
# of people seeking short-term public shelter	68	**298**

Debris		
Debris generated (tons)	93	**326**
Value of Damages (Millions of dollars)		
Total property economic loss	**$602.1**	**$1,782.4**

5.2 Exposure Assessment of Parcel and Building Flood Risk

An exposure assessment was used to estimate losses due to flooding. An exposure assessment is a geospatial evaluation where geographic areas and hazards are mapped together to show the physical relationship to one another. The geospatial relationship can also be used to quantify the number and value of parcels and structures within the hazard area to estimate losses. For flooding, a GIS-based exposure analysis was used to identify potential losses of developed properties that fall within Westford's 100-year and 500-year flood zones, as defined in Section 3.2.1.

The analysis for current conditions was based on Westford's 2017 Assessor's data and the FEMA approved flood insurance rate maps (FIRMs) (dates). Future flooding with climate change was evaluated using the extent of the 500-year flood zone.

5.2.1 Existing Flood Vulnerability Assessment Methodology

The vulnerability assessment will identify locations that are at risk from flooding inundation based on current and historic flooding extent as defined by the FEMA 100-year flood plain and predicted future flooding extent using the 500-year flood. The following assumptions were used in the methodology:

Risk of Current Flooding- FEMA Analysis for Developed Parcels, and Community Assets

Current risk of flooding is evaluated based on the most recent approved FEMA flood zones (dated 7/7/2014).

- Developed properties and Community Assets currently within the FEMA mapped A, and AE zones were identified, including areas with defined base flood elevations or inundation depth.
- Determination of risk was based on whether a mapped building is within the zone, not based on whether the parcel boundary alone is within the zone.
- The total building value for A/AE zone parcels is included in **Table 5.3**. Individual properties and land use classifications were not identified for privacy.
- Community Asset located within FEMA flood zones were also identified.

Risk of Future Flooding- FEMA Analysis for Developed Parcels

- Developed properties currently within the FEMA mapped X500 zones will be identified following the same selection criteria as described above for A/AE zone analysis. The total building value for X500 zones is included in **Table 5.4**.

Results

Out of a total of 7,003 developed parcels in Westford, about 12% (867) are located in the FEMA 100-year floodplain. Based on the building value of the developed property, estimated potential losses for inland flood areas are tabulated in **Table 5-3**.

Table 5-3
Flooding Vulnerability in Westford Current Development- Building Values

FEMA 100-year Flood Zone	Number of Developed Parcels within the Zone	Building Value
Total	867	$296,948,300

A total of 526 of Westford's developed parcels are located within inland or riverine 500-year flood hazard areas. Out of a total of 7,003 developed parcels in Westford about 8% (526) are located in the FEMA 500-year flood plain. Based on the building value of the developed property, estimated potential losses for inland areas are tabulated in **Table 5.4**.

Table 5-4
Future Flooding Vulnerability in Westford Current Development-Building Values

FEMA 500-year Flood Zone	Number of Developed Parcels within the Zone	Building Value
Total	526	$181,369,900

The total value of properties located within flood zones is $478,318,200.

5.3 Community Assets

5.3.1 Community Assets within Flooding Zones

A total of 18 community assets were located within the 100-year flood zone.

TABLE 5-5
Community Assets within the 100-year Floodplain

Name	Address
Line Road	14 Line Road
Senior Helpers of Westford	66 Tadmuck Road
CHOICE Housing	173 Carlisle Road
Mack Technologies	27 Carlisle Road
Materion Precision Optics	2 Lyberty Way
MacKay ACE Hardware & Rentals	224 Littleton Road
Westford Regency Inn	219 Littleton Road
Nashoba Valley Ski Area	79 Powers Road
Kimball Farm	400 Littleton Road
Brookside Mill	12 Brookside Road
Flushing Pond Dam	42.62325152, -71.44160436
Long Sought for Pond Dam	42.625003, -71.458275

Alder Point	354 Groton Road
Stone Ridge Condos	Stone Ridge Road
Depot Road Well	0 Depot Road
Haystack	10 Groton Road
Keyes Corner	100 Nutting Road
Electric Substation	24 Town Farm Road

A total of 15 community assets were located within the 500-year flood zone:

TABLE 5-6
Community Assets within the 500-year Floodplain

Name	Address
Tadmuck Meadows	1 Bandon Circle
Princeton Westford Apartment Homes	16 Littleton Road
HWY BROOKSIDE RD - Bridge (NBI)	42.609664, -71.410784
HWY GRANITEVILLE - Bridge (NBI)	42.592173, -71.45981783
Commodore Foods Company Dam	42.60961049, -71.41100633
Westford ACE Hardware	527 Groton Road
Westford Children's Learning Center	508 Groton Road
Fletcher Pond Dam	42.63288357, -71.42519448
Wat Buddhabhavana	25 Milot Road
Dee Bus Services Inc.	30 Town Farm Road
Norman E. Day School	75 East Prescott Street
Right at Home Daycare	33 River Street
Fairview Cemetery	Main Street
Murray Printing Company Dam	42.58006, -71.487663
United States Postal Service - Forge Village	5 W. Prescott Street

5.3.2 Future Development in Hazard Areas

D1

The Town of Westford has identified parcels where development has been proposed, is underway, or is expected to occur in the future. **Table 5-5** shows the relationship of these parcels to 3 of the mapped hazards. This information is provided so that planners can ensure that development proposals meet all floodplain zoning and that careful attention is paid to drainage issues.

TABLE 5-7
Natural Hazard Risk in Areas Slated for Future Development within 10 Years

Area of Future Development	Flood Zone (Y/N)
Spalding Hill Estates, 29 lots off of St. Augustine Drive	No
Wendell Place, 23 lots off of Nutting Road	No
Colonel Rolls Drive, 8-lots off of Hartford Road	No
0 & 37 Carlisle Road, 8 lots	No

Section 6
Capabilities Assessment

C6 b.

The Town of Westford updated the documentation of the community's current capabilities, which consist of existing authorities, policies, programs, and resources, that reduce hazard impacts or could be used to mitigate and adapt to the identified vulnerabilities. A copy of the completed FEMA Capability Assessment Worksheet in included in Appendix D. This section presents an overview of that evaluation and documentation of needed improvements and recommended actions.

6.1 Planning and Regulatory

C1 a

Planning and regulatory capabilities are the plans, policies, codes, and bylaws that prevent and reduce the impacts of hazards.

6.1.1 Existing Planning Mechanisms

The Planning Team updated information regarding existing planning mechanisms to mitigate natural hazards in the Town of Westford**. Table 6-1** summarized the local plans that include hazard mitigation elements.

Table 6-1

C6 d

Summary of Current Planning Efforts related to Hazard Mitigation

Date of Plan	Status	Plan Name	Department Responsible for Update
2020	In Progress	Comprehensive Emergency Management Plan (CEMP)	Emergency Management
2019	Completed	Forestry Management Plan (East Boston Camps)	Conservation Commission
2019	Completed	Stormwater Management Master Plan	Department of Public Works (formally the Engineering Department)
2018	Completed	Water System Master Plan	Department of Public Works (formally the Water Department)
2009	Completed	Comprehensive Master Plan	Land Use Management Department
2007	Completed	Watershed Action Plan	Department of Public Works (formally the Engineering and Water Departments)

6.1.2 Existing Regulatory and Programmatic Mechanisms

C1 a

The Planning Team updated information regarding existing regulatory and programmatic mechanisms to mitigate natural hazards in the Town of Westford**.** The local codes, regulations and programs that include hazard mitigation elements are summarized below.

Comprehensive Emergency Management Plan (CEMP): The CEMP addresses mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. The plans contain important information regarding flooding, hurricanes, tornadoes, dam failures, earthquakes, and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to all of the hazards discussed in this plan. This plan is maintained on an ongoing basis.

Stormwater Management Master Plan: This plan is a requirement of the 2016 EPA Small MS4 General Permit and was finalized in 2019. The plan identifies drainage and water quality needs and prioritizes capital projects to address these needs as well as identifies best management practices to ensure compliance with the general permit.

Water System Master Plan: This plan is the comprehensive plan of the Water Department which ensures the department fulfills its mission to provide safe, high quality, adequate water supply and uninterrupted service at a reasonable pressure and reasonable cost, to protect public health, meet fire protection needs, and address Federal and State regulatory requirements. This plan includes an evaluation of the existing water system and facilities, an estimate of the future water supply requirements and demand, an analysis of the adequacy of the existing water supply to meet demand, an update to the water distribution system GIS map, an update to the water system model, and a Capital Improvement Plan that projects facility and distribution system improvement needs and budgets.

Comprehensive Master Plan: Completed in 2009, the Westford's Comprehensive Master Plan is the community's planning guide. Of particular relevance to this plan are the sections that identify issues, opportunities and goals related to natural resources and open space, land use, and transportation infrastructure.

Watershed Action Plan: The Watershed Action Plan (WAP) was prepared by the Town of Westford in order to better protect the Town's water resources and environmental assets in the Stony Brook and Nashoba Brook watersheds. The preparation of this report was funded through a grant from the Executive Office of Energy and Environmental Affairs (EOEEA) under the Fiscal Year 2007 Smart Growth Technical Assistance grant program. The intent of the WAP is to better understand the water and other related important resources within the Town, compile and evaluate the existing data related to these resources, identify areas and topics where additional data collection and research are necessary, and guide future planning and prioritization efforts.

6.2 Administrative and Technical

A2

The Town has multiple staff members that assist with planning, development, and implementation of hazard mitigation. **Table 6-2** provides a summary of the positions and the roles are further described below.

The Planning Department and Planning Board participate in site plan review to make sure buildings are constructed to meet all applicable codes, regulations and Town bylaws to

minimize the risk of natural hazards from development. The Westford Planning Board is the primary town agency responsible for regulating development in town. They have the authority to regulate development through project review and approval decisions. The Town's Flood Plain Overlay District regulations are enforced through the Zoning Bylaw. The Planning Department is leading the HMP update and resiliency planning.

The Zoning Board of Appeals also regulates development in town through review of special permits, variances, and comprehensive permits, including to ensure risks of natural hazards are minimized. The Conservation Department and Conservation Commission review proposed projects within 100 feet of wetland resource areas and within 200 feet of perennial streams and rivers. During the review process, the Commission takes care to ensure proper construction practices and ongoing maintenance, and avoid detriment to the environment or abutting properties, including having orders of conditions to that effect.

Additionally, NMCOG is the State-designated regional planning authority for Westford and works with all agencies that regulate development in its region, including State agencies like DCR and MassDOT.

The Department of Land Use Management is comprised of the Building, Zoning, Planning and Conservation departments. Together these departments provide a public safety function by enforcing appropriate codes and regulations to ensure that buildings are safe for inhabitation. They also ensure that development is designed to protect natural resources and mitigate hazard risk.

The Department of Public Works as of June 2020 (Engineering, GIS, Highway and Water Departments) is responsible for cleaning catch basins, maintaining, repairing and replacing culverts, and repairing weather related or natural hazard damage to roads and bridges. The Water Department/The Engineering Department reviews development proposals under site plan review and subdivision processes focusing on stormwater management and roadway adequacy. The DPW has separately addressed specific hazard mitigation initiatives included in the Water System Master Plan and the Stormwater Master Plan.

The Health Department addresses public health issues related to water quality, vector borne disease, extreme temperature.

Emergency Management Department, Police Department and Fire Department all support Hazard Mitigation Plan with an emphasis on community preparedness and emergency response.

Director of Facilities is responsible for maintenance of all public buildings including schools (some used as emergency shelters), three fire stations, police headquarters, Town Hall, DPW buildings, parks and recreation buildings, and others. The Facilities Director is responsible for maintain all public buildings to ensure a healthy and safe work environment, be emergency ready and operating as efficiently as possible.

The Council on Aging provides outreach and communication to the town's seniors during extreme weather events and natural disasters.

Table 6-2
Hazard Mitigation Staffing

Staff	Hazard Mitigation Role
Building Department	Enforces Mass Building Code, Westford Municipal Code and maintains all critical building facilities
Town Engineer	Maintains the infrastructure to protect the Town from flooding, implements mitigation projects, maintains and updates the HMP plan with the Town Planner
Floodplain Administrator	Reviews projects for NIFP compliance and manages the Community Rating System Program
Emergency Management Director	Implements the Comprehensive Emergency Management Plan and provides education on community preparedness. The Emergency Management Director coordinates with both the Westford Fire and Police Departments to align Hazard Mitigation strategies with the Departments ongoing programs and policies.
Town Planner	Maintains and updates HMP plan with the Town Engineer, incorporates HMP goals into other Town plans, lead on resiliency planning efforts

6.3 Financial

Westford has multiple funding mechanisms in place or planned to help fund mitigation projects. These include:

- Capital Improvement Funding
- Community Preservation Act Funds
- Stormwater Fee

6.4 Education and Outreach

Westford has implemented the follow education and outreach methods to help the citizens of Westford understand how to protect and prepare themselves and their community from the top natural hazards:

- Maintain Town Emergency Management Website with Natural Hazard Preparedness information
- Keep Citizens informed in the event of an emergency through Rave/Smart911 alerts
- Building Department Website provides links to FEMA Flood Map Center, and MEMA

6.5 Existing Mitigation Measures

Westford has implemented the following mitigation measures to the Town and the community from top natural hazards.

C2 a

Participation in the National Flood Insurance Program (NFIP)

The Town of Westford complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at https://www.fema.gov/policy-claim-statistics-flood-insurance. Out of a total of 7,003 developed properties in Westford, 71 flood insurance policies are in force for sites located within the 100- and 500-year flood zone. The total insured value is $18,773,100 and there have been 10 paid losses as of 07/31/2019.

Flood Hazard Mitigation Measures

Westford has instituted regulations to protect floodplains from new development through a Flood Plain Zone Overlay District (FOD). No construction or earthmoving activities are permitted in the FOD without a special permit from the Planning Board. The applicant must demonstrate that a proposed project conforms to the State Building Code and provide an engineer's certification that it will not increase flood levels.

- Participation in the National Flood Insurance Program
- Acquisition of land for open space
- Drainage System Mapping
- Street sweeping
- Catch basin cleaning
- Roadway treatments
- Culvert maintenance and replacement
- Snow disposal
- Geographic Information System
- Communication Equipment
- Emergency Power Generators

Westford Regulations Addressing Flooding

TABLE 6-3
Westford Regulations Addressing Flooding

Regulatory Category	Applicable Section	Hazard Mitigation Benefit
Zoning Bylaw	7.1 - Open Space Residential Development (OSRD)	OSRD protects natural drainage and aquifer recharge by reducing required lot sizes and requiring a proportion of open space in a proposed development.
	7.2 – Flexible Development	Flexible development provides density bonuses for affordable housing while also protecting open space and creating more dense development.
	8.1 – Water Resource Protection Overlay District (WRPOD)	The WRPOD preserves and protects existing and potential sources of drinking water in through Planning Board review of projects proposed within WRPOD Zones II and III.
	8.2 – Floodplain Overlay District	The FOD ensures that all proposed activities and development within all special flood plain areas comply with MGL Chapter 131 Section 40.
	9.4 – Site Plan Review	Westford requires site plan review of any construction, expansion or alteration of nonresidential or multifamily structures, and the construction or expansion of a parking lot.
General Bylaws	Chapter 82- Discharges to the Municipal Storm Drain System	The Board of Health is empowered to regulate the storage and discharge of hazardous materials.
	Chapter 90 – Earth Removal	With recommendation from the Conservation Commission and the Planning Board, the Select Board may issue an Earth Removal permit for removal of more than 1,000 cubic feet of earth material.
	Chapter 61 – Hazardous Materials Storage	The Health Department may issue residential and nonresidential Hazardous Materials Storage permits.
	Chapter 169 – Water	The Water Bylaw gives the town enforcement powers during states of water conservation or water emergency.
	Chapter 171 - Wetlands	Except as permitted by the Conservation Commission, the bylaw prohibits the removal, fill, dredging or alteration, or building within one hundred feet of any

		wetland, stream or pond, or within one hundred feet of the 100 year flood zone.
	Chapter 147 – Stormwater Management	A stormwater management permit issued by the Planning Board is required for any development that will disturb greater than one acre in area and for all subdivisions.
Subdivision Rules and Regulations	Section 218	Subdivision Rules and Regulations contain provisions that serve to reduce impacts of flooding and erosion. Through its design and layout standards, the regulations contribute to the town's efforts to reduce the risks created by additional development

Wind Hazard Mitigation Measures:

- State Building Code
- Tree trimming - National Grid has conducted extensive tree trimming and clearing around its electrical wires to protect them from trees and limbs falling due to wind damage

Extreme Heat:

- Cooling Centers - The Department of Public Health in collaboration with the Council on Aging provides cooling centers open to elderly residents during extreme heat events.

Fire Hazard Mitigation Measures:

- Burn Permit
- Site Plan Review/Definitive Subdivision Plan Review - The Fire Department reviews all subdivision and development plans and makes recommendations to the Planning Board about emergency vehicle access and method of water provision in case of a fire emergency.

Geologic Hazard Mitigation Measures:

- State Building Code

Invasive Species removal

- Parks & Recreation Maintenance Plans

Multi-hazard mitigation measures

- State Building Code
- Comprehensive Emergency Management Plan

Section 7
Mitigation Strategies and Targeted Adaptation Strategies

C3 a b

D3 a

7.1 Mitigation Goals and Objectives

The Core Team and Advisory Committee reviewed and updated the mitigation goals present in the 2015 Hazard Mitigation Plan for the Northern Middlesex Region. This Hazard Mitigation Plan Update includes specific plan goals, objectives and addresses additional community assets including the environment, economy and cultural facilities.

7.1.1 2020 Town of Westford Hazard Mitigation Goals

In updating this Plan, the Core Team and the Advisory Committee reviewed the hazard identification and analysis, the vulnerability assessment, and the existing protection matrix and measures. The goals in the 2015 Plan were reviewed.

- Increase coordination between the Federal, State, regional and local levels of government;
- Discourage future development in hazard prone areas, such as flood plains;
- Protect and preserve irreplaceable cultural and historic resources located in hazard prone areas;
- Ensure that critical infrastructure is protected from natural hazards;
- Develop programs and measures that protect residences and other structures from natural hazards;
- Protect electric power delivery infrastructure from natural hazards;
- Encourage alternative drinking water supplies in the event of contamination or disruption from a natural hazard;
- Increase awareness and support for natural hazard mitigation among municipality, private organizations, businesses, and area residents through outreach and education;
- Implement a broad range of mitigation measures that protect the Town's vulnerable population and infrastructure;
- Protect critical public facilities and services from damage due to natural hazards;
- Develop a mitigation strategy that considers area businesses and protects the economic vitality of the Town;
- Update and maintain the Plan as resources permit;
- Organize information concerning hazard mitigation funding opportunities;
- Increase community's capability for responding to a natural hazard event by promoting the adequate provision of emergency service capabilities; and
- Implement adaptation strategies and modify local emergency plans to protect critical infrastructure and property from the impacts of climate change.

The 2015 goals were revised to make sure that broad goals and department specific objectives are included. The 2020 goals are shown below:

1: Public Health and Safety

Recommended Goal: Protect the health and safety of the public.

- Promote cost-effective hazard mitigation actions that protect and promote public health and safety from all hazards with an emphasis on reducing damage to repetitive and severe repetitive loss properties.
- Encourage people to be prepared before, during and after a hazard event.
- Ensure that services related to public health (e.g., sanitation, water, debris removal, hospitals and emergency services) can function during and after a hazard.
- Ensure that evacuation can happen in an organized and efficient manner.
- Minimize secondary impacts from hazards, such as the release of pollutants. (e.g., fuel spills into waterbodies).
- Promote public communications.

2: Protection of Existing Infrastructure

Recommended Goal: Protect existing properties and structures.

- Provide resources for residents and businesses to make their buildings and properties more disaster resistant.
- Educate the public on measures they can take to protect their property from natural hazards.
- Maintain existing drainage and seawall infrastructure to protect residential and business areas from flooding.
- Ensure that critical facilities and infrastructure are protected from hazards.
- Upgrade existing structures to mitigate repetitive or severe repetitive loss properties.
- Ensure that future development / redevelopment does not make existing properties more vulnerable to hazards.

3: Protection of Natural Resources

Recommended Goal: Increase resilience by protecting and enhancing natural resources.

- Protect natural areas (including open space, wetlands, green spaces) to ensure that they buffer impacts to developed areas during a natural disaster.
- Protect tree canopy.
- Manage stormwater with Low Impact Development techniques (provide capital resources to encourage investment in LID upgrades).

4: Emergency Response to Hazards

Recommended Goal: Ensure that essential services can function during and after a hazard event.

- Ensure that critical infrastructure is protected from natural hazards.
- Ensure that key service emergency personnel and employees can get into and around the Town to provide services.

- Promote effective and consistent interdepartmental communication.

5: Planning for Future Development

Recommended Goal: Minimize hazard risks for future development

- Encourage future development in areas that are not prone to natural hazards.
- Engage developers in discussions regarding the Hazard Mitigation Plan and known hazards in Westford.
- Enforce existing zoning and building regulations and make updates to address known hazards and risks.
- Ensure that future development meets federal, state, and local standards for preventing and reducing the impacts of natural hazards including impacts due to climate change on natural and historic resources.

6: Regional Cooperation

Recommended Goal: Work regionally to mitigate impacts from natural hazards and to respond and recover from hazard events.

- Continue to participate in regional efforts.
- Cooperate with other agencies, communities, and private entities.

7: Hazard Awareness

Recommended Goal: Maintain Hazard Awareness

- Track and compile hazard related data.
- Understand the potential implications of climate change on the frequency and extent of natural hazard events and incorporate that knowledge into hazard mitigation efforts.
- Maintain publicly available information on natural hazard risks in the Town.
- Integrate hazard mitigation into other Town initiatives and plans.
- Encourage the business community and local agencies representing vulnerable populations to work with the Town to participate in development of the hazard mitigation plan.
- Plan outreach events educating the broader community on hazard risks and community vulnerability, and the benefits of hazard mitigation.

8: Hazard Mitigation Resources

Recommended Goal: Determine priorities for directing resources for hazard mitigation and response.

- Maintain adequate staff resources.
- Prioritize mitigation projects.
- Pursue various funding sources.
- Encourage private property owners to implement measures to protect their own properties.

7.2 Mitigation Actions

C4 abc

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.

The following categorizes mitigation actions that will serve to minimize risks or reduce losses from natural hazards. The actions have been organized into the following categories, as recommended in the FEMA Local Multi-Hazard Mitigation Planning Guide (7/1/08) and the Multi-Jurisdictional Mitigation Planning Guide, (August 2006) FEMA's Local Multi-Hazard Mitigation Planning Guidance:

- Prevention: Prevention actions are intended to address future development and guide development away from natural hazards. Many of the hazards that impact the region can be reduced by addressing them upfront through code enforcement and regulatory measures. Prevention activities include planning, zoning, building ordinances, subdivision regulations, and requirements to bury utilities;
- Property Protection: Property protection actions address individual buildings and reduce risk through modification. Activities include acquisition, building relocation, building elevation, retrofitting, barriers, flood-proofing, utility relocation or flood-proofing, and insurance;
- Public Education and Awareness: Public educations and awareness actions will inform and remind the public about natural hazards and actions that can be taken to avoid potential damage and injury resulting from a hazard. Activities include providing informational mailings or workshops, community outreach, real estate disclosure of hazards, environmental education, and technical assistance provided on disaster management issues;
- Natural Resource Protection**:** Natural resource protection reduces the intensity of hazard effects and improves the quality of the environment. Activities include preservation or restoration of natural systems, open space preservation, state and local floodplain and wetland regulations, stormwater management, watershed protection measures and best management practices, and soil erosion and sediment control;
- Structural Projects: Structural projects are actions that control the hazard and directly protect people and property. Such activities include construction and maintenance of berms, dams, floodwalls, channel improvements, drainage improvements, and detention/retention basins; and
- Emergency Services Protection: Emergency services protection actions are aimed at protecting emergency services before, during and immediately after an occurrence. Activities include hazard recognition, emergency warning systems, emergency response training, evacuation planning, protection of critical facilities, protection of public facilities, and health and safety maintenance.

These actions will be coordinated with other regional and community priorities, as well as with mitigation goals of state and federal agencies. Such coordination will improve access to technical assistance; provide broader support for implementation; and reduce duplication of effort. The actions have been further categorized by timeframe into on-going, immediate, short-term projects and long-term measures.

Funding to implement hazard mitigation projects may come from a variety of federal, state, and local sources. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HGMP), the Building Resilience Infrastructure and Communities program (BRIC), and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

- HMGP: https://www.fema.gov/grants/mitigation/hazard-mitigation
- BRIC: https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities
- FMA: https://www.fema.gov/grants/mitigation/floods

Other potential funding sources include the Municipal Vulnerability and Preparedness Action Grant Program through the Massachusetts Executive Office of Energy and Environmental Affairs, Massachusetts State Revolving Funds, U.S. Army Corps of Engineers, and the Small Business Administration.

7.2.1 Progress on Prior Actions

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Since completion of the 2015 Regional HMP, the Town of Westford has made significant progress in implementing additional measures to mitigate natural hazards. The Planning Team reviewed the 2015 Mitigation Actions to determine what progress had been made towards implementation. The town has taken steps to implement findings from the 2015 HMP into the Open Space & Recreation Plan update; Stormwater Management Master Plan (SWMMP, 2019); Oak Hill, Moore Road, and Plain Road Transportation and Stormwater Improvement Project (scheduled for 2021-2022); Stony Brook Flow Restoration Project (June 2018); and various Transportation Improvement Projects (TIP) including Littleton Road (Route 110) Roadway Reconstruction Project (Minot's Corner Intersection), Route 40 (Groton Road) & Dunstable Road Intersection Improvement Project, and several bridge replacements.

Table 7-1 provides an update on the mitigation actions described in the 2015 Regional HMP, including the description, responsible department, implementation status, and comments to describe the status. All other actions were pulled into this plan update.

Table 7-1
Review of 2015 Mitigation Actions

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Hazard to Mitigate	Description	Responsible Department	Status Completed / Existing Capability / In Progress / Deferred / Deleted	Explanation of Status as of 2020
All Hazards	Implement Master Plan recommendations advocating public education on hazard mitigation and refinement of regulatory measures.	Planning Board, Conservation Commission and Emergency Managers	Deferred	No progress.

Hazard to Mitigate	Description	Responsible Department	Status Completed/ Existing Capability/ In Progress/ Deferred/ Deleted	Explanation of Status as of 2020
Flooding	Provide training to 3 Town staff and board members relative to stormwater regulations.	Engineering Department, Highway Department, Planning Board and Conservation Commission	Ongoing	Informal training completed; bylaw being updated. Board needs formal training.
All Hazards	Participate in updates to the regional hazard mitigation plan and assist in developing the local annex.	Town Engineering Department, Emergency Managers, Planning staff and NMCOG	Delete	Each community is preparing their own HMP.
All Hazards	Update Building Department policies and practices to include further consideration of natural hazards, such as wind, snow and seismic loads.	Building Department	Delete	Building Department in process of updating numerous plans and policies.
Flooding	Complete town wide Stormwater Master Planning	Engineering Department and Stormwater Master Plan Committee. Town has hired a consultant to prepare the Plan	Complete	Stormwater Management Master Plan (SWMMP) completed in February 2019
Flooding	Complete town wide Stormwater Master Planning Adopt stormwater regulations to implement stormwater by law.	Planning Board and Conservation Commission. The town has retained a consultant to update its stormwater regulations.	Complete	Town has adopted stormwater regulations as of November 2012.
Flooding	Conduct hydrological/drainage studies at problem locations throughout Town.	Engineering/ Public Works Department	In progress	Locations with known problem areas preliminarily evaluated as part of SWMMP. Further work to address findings and complete follow up studies is ongoing and funded by Stormwater Utility.

Hazard to Mitigate	Description	Responsible Department	Status Completed/ Existing Capability/ In Progress/ Deferred/ Deleted	Explanation of Status as of 2020
Flooding	Conduct outreach campaign to encourage residents to purchase flood insurance.	Emergency Management and Building Departments	Delete	Westford has not completed any specific targeted outreach. FEMA, as part of updating FIRMs, will be reaching out to homeowners.
All Hazards	Conduct an ongoing hazard mitigation community Outreach program for residents, through the schools and at town events. *Include discussion of climate change in outreach materials.*	Emergency Management, School Department, Conservation Commission, Board of Health	Ongoing/ *Modified*	Various Departments Complete outreach and discussions have occurred at Strategic Planning retreat, but message is not explicitly called "hazard mitigation". *Modify this action to specifically include climate change.*
All Hazards	Utilize internet-based technology to better distribute information concerning natural hazards.	Town Emergency managers, IT staff and local cable media	Ongoing/ *Modified*	Town does social media, message on AM radio, emergency alert notification system. *Westford CAT capabilities are under scrutiny, therefore cable TV may need to be removed.*
Flooding, hurricane	Flood-proof electric transmission lines and substations in flood-prone areas of Town.	National Grid at the request of the Town Emergency managers and Select Board		Work to be completed by National Grid using utility funds. Effort to be coordinated by the Emergency Managers using local general funds.

Hazard to Mitigate	Description	Responsible Department	Status Completed/ Existing Capability/ In Progress/ Deferred/ Deleted	Explanation of Status as of 2020
Earthquakes, flooding	Regularly inspect and maintain all Town-owned dams	Engineering Department and DCR. The town has completed improvements to its dams since the 2006 Plan was adopted.	Ongoing	Consultant completes required inspections of Town-owned dams and provides reports to Engineering.
Wildfire	Participate in DCR's Fire Wise program to reduce wildfire risk.	Fire Department	Ongoing/ Deferred	Did a few years ago, not currently participating
Flooding, hurricane	Replace undersized culverts and drainage structures at problem locations, as described in earlier sections of this Plan	Highway/ Engineering Department, and MassDOT. Drainage problems have been addressed at numerous locations since the completion of the 2006 Plan	Initial study in progress, program will be ongoing.	Town has been addressing culverts as needed. A town-wide culvert asset management program is currently underway. The initial inventory is anticipated to be complete in FY20, and annual improvements and maintenance will be completed following the initial program.
All Hazards	Interconnect traffic signals and equip with advance vehicle detection (Opticom)	Highway Department, MassDOT	Completed	Town has Opticom at many areas. Town was required to pay for first one and MassDOT automatically installs now.
All Hazards	Incorporate disaster mitigation into the Open Space and Recreation Plan update process	Conservation Commission-the town's Open Space Plan currently addresses hazard mitigation	Deferred	OSRP update submitted in spring 2018, it was returned for additional edit, so it is not yet certified. Potential to add more about disaster mitigation to this plan.

Hazard to Mitigate	Description	Responsible Department	Status Completed/ Existing Capability/ In Progress/ Deferred/ Deleted	Explanation of Status as of 2020
All Hazards	Study the possibility of establishing a mutual aid agreement with neighboring communities to administer NFIP following a major storm event	Town Emergency Managers, building inspector and Select Board	Deleted	Currently there are mutual aid agreements but not related to NFIP administration.
Extreme Temperatures	Increase public awareness of the dangers of extreme temperatures and outline locations were vulnerable populations (elderly and those with health issues) can have access to air conditioning or shelter from the cold	Town Emergency Manager	Ongoing	Town communicates to public in various ways, including a sign board in plaza, and social media. The library and senior center are used for cooling shelters. In addition, the senior center has a call down list.
Flooding	Revise subdivision regulations, erosion control regulations, and Board of Health regulations to improve floodplain management as needed	Town Planning Board, Conservation Commission and Board of Health	Ongoing/ Deferred	Subdivision regulations slated to be revised this year
Severe Winter Storms, snowstorms, blizzards, ice storms	Distribute educational information to residents and businesses on protecting life and property from severe winter storm events	Emergency Manager	Ongoing	Town communicates to public in various ways, including a sign board in plaza, and social media. The library and senior center are used for cooling shelters. In addition, the senior center has a call down list.
Tornado	Ensure that administrators of schools, businesses, medical facilities, and municipal buildings have a shelter plan in the event of a tornado warning	Emergency Manager and public safety	Deferred	No progress. Town school safety task force may be able to evaluate this for schools
Drought, Wildfire	Provide information to homeowners on how to protect their property from brush fire or wildfire during times of drought	Fire Department	Deferred	No specific messaging has been distributed.

Hazard to Mitigate	Description	Responsible Department	Status Completed/ Existing Capability/ In Progress/ Deferred/ Deleted	Explanation of Status as of 2020
Severe Winter Storms, snowstorms, blizzards, ice storms	Inspect public buildings to evaluate the capacity to withstand snow loads and prevent roof collapse. Develop plans to clear roofs of excessive snow accumulations to prevent collapse.	Building inspector and Emergency Manager	Ongoing	Water Department had partial collapse at treatment plant due to recent winter blizzard. School Department Administration building had serious concerns about collapse due to recent blizzard. Town has not made progress but will evaluate if MIIA can assist.
Severe Winter Storms, snowstorms, blizzards, ice storms	Identify locations for snow storage farms for utilization in severe winters with heavy snowfall	Highway Department	Ongoing	Forge Village ballfields on West Prescot Street are identified as a snow dump. If used, in the Spring, Town inspects the area and removes trash and debris. Town would like to evaluate additional locations throughout community.
Hurricane, tornado, blizzard	Evaluate public buildings and critical facilities for the potential to withstand high winds	Building inspector and emergency manager	Ongoing	Town has not made progress but will evaluate if MIIA can assist.
Wildfire	Assess bridges and roadways to ascertain their capability to support fire apparatus and develop alternative routing plans where deficiencies are noted	Fire Department and Highway Department	Competed/ Delete	This has been completed. Only Stony Brook Road remains deficient.
Earthquake	Develop an inventory of public buildings that do not currently meet seismic standards	Building inspector and emergency manager	Ongoing	Town has not made progress but will evaluate if MIIA can assist.

7.2.2 Current Mitigation Action and Adaptation Strategy

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The Planning Team developed a revised Mitigation Action Plan for the 2020 HMP Update. The revised plan includes 14 projects carried over from the 2015 Plan, 6 of which were revised, and 13 new projects identified by the Planning Team and the Community Resilience Building Workshops. The completed list of 27 projects were reviewed and refined by members of Town staff who would lead in implementing the action.

The goal of the Plan is to reduce Westford's vulnerability to hazards, and by selecting and implementing the most costs effective mitigation actions the Town will be on the road toward implementing that goal. The Planning Team completed a Risk and Benefit Assessment to prioritize the most cost-effective mitigation actions, as described in **Section 7.2.3**.

7.2.3 Benefit Cost Review Methodology

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The cost benefit review is the first step in completing a prioritization of mitigation projects. FEMA does not dictate how the cost benefit review is completed; however, it is a required element for the plan. For the Westford HMP, the prioritization of projects was based on a benefit cost review using the FEMA STAPLEE method. STAPLEE is a cost/benefit analysis tool that includes considerations for **S**ocial, **T**echnical, **A**dministrative, **P**olitical, **L**egal, **E**nvironmental and **E**conomic issues.

In its simplest application, the STAPLEE method consists of a table where actions (and mitigation options) are shown along the vertical axis and the STAPLEE categories along the horizontal axis (see inset below). Each action is analyzed per the categories in STAPLEE and a mark is placed in each category that the action affects in a positive way. The action with the most marks achieves a higher priority.

For Westford's HMP, the basic STAPLEE basic method was modified to allow for a more detailed evaluation accounting for both **benefits** and **costs** and reflects the types of mitigation actions being considered for the Town. For many of the criterion values, a range of scores were assigned. **Table 7-2** includes the values that were considered for each STAPLEE criteria and potential scores. A final score for each mitigation action was tabulated as the sum of the cost score and the benefit score.

Table 7-2

STAPLEE Benefit Cost Review: Criteria, Considered Values and Rating Scores

	COSTS		BENEFITS	
	Cost Values	**Cost Rating Scores**	**Benefit Values**	**Benefit Rating Scores**
Social	Adversely Affects Segment of the Population or Community Values	-3=yes -2=maybe -1=no	Benefits a Large Segment of the Population	3=large 2=med 1=small
Technical	Years to Implement Project	-1 =1 year -2= 2-3 years -3= 4 or more	Easy to Implement with Local Resources	3= yes
Administrative	Operations and Maintenance $$ Required	-3=high -2=med -1=low or none	Sufficient Staffing Available	3=yes 2=maybe 1=no

Political	Public Opposition	-3=high -2=med -1=low	Local Champion-Politically Acceptable	3= yes
Legal	Action Potentially Subject to Legal Challenge	-3 Subject to legal challenge	Existing Local Authority to Implement	3= state or local authority
Economic	Approximate Cost	$=$50,000-$100,000 $$= $100,001-$500,000 $$$ = $500,001-$1,000,000 $$$$= >$1,000,001	Funding Available	3= yes
Environmental	Adverse Environmental Impacts	-3=high -2=med -1=low	Other Community Goals Achieved	3=yes

Once a total cost benefit rating score was calculated for each mitigation action, all of the mitigation actions were ranked as high, medium and low priority for implementation by hazard category based on the range of scores for each hazard.

7.2.4 2020 Mitigation Action Plan

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This Migration Action Plan is an update of the 2015 Action Plan. The matrices note whether each particular action was included in the 2015 Regional HMP. Many of the actions contained in the 2015 Regional HMP remain in the updated plan and are still a priority for Westford. The actions delineated in this Plan will be implemented as resources are made available. Table 7-3 below is the 2020 Mitigation Action Plan.

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Table 7-3
2020 Mitigation Action Plan

Hazard		Mitigation Action	Funding Source	Lead Town Entity	Approximate Cost	Timeframe*	Consistency with Mitigation Goals	Benefit Cost Review Rating	Priority Ranking
All Hazards	1	For bridges, assessment of MassDOT inspections and initiation of maintenance and repair/replacement program.	MassDOT Small Bridge Grant	DPW	$$	Ongoing	Protection of Existing Infrastructure	10	High
All Hazards	2	Develop a Natural Resource Overlay District in Zoning code to mitigate impacts on the environment, economy, society, and Town infrastructure from development on undisturbed sites. (e.g., Change code to require developers to plant larger and more trees with species requirements, and to maintain their health for longer than currently required.)	MVP Action Grant	Planning Board, Historic Commission, Director of Land Use Management	$	Mid	Protection of Natural Resources	5	Low
All Hazards	3	The Town's information technology department is a critical service for all municipal staff and the public and relocating these services to a facility that is safe and has redundancy is critical for Town operations.		IT, Emergency Management	$$$$	Near	Emergency Response to Hazards	0	Low
All Hazards	4	Educate residents about the AM radio station (1630 AM) that can be activated during emergencies. Send out via Town emails/and website		IT, Emergency Management	$	Near	Hazard Awareness	7	Medium
All Hazards	5	Enhance existing education program to include hazard mitigation, coupled with overall sustainability, conservation, and environmental stewardship, in public schools *and town events.*	DPH and MassDEP Grants	Emergency Management, School Department, Conservation Commission, Board of Health	$	Near	Hazard Awareness	11	High
All Hazards	6	Proactively maintain roadways and replace / upgrade drainage as needed to manage water quality and water quantity	MVP Action Grant, 319 Grant, Ch. 90	Public Works - Highway and Engineering	$$$	Ongoing	Protection of Existing Infrastructure	6	Medium
All Hazards	7	Fine tune communication plan related to social media and homeowner/subdivision networks to be strategic for natural hazards. *Utilize internet-based technology to better distribute information concerning natural hazards.*		Town Emergency managers, IT staff and local cable media	$	Long	Hazard Awareness	9	High
All Hazards	8	Extend Town's water distribution system to neighborhoods on private wells with poor water quality to improve public health and reduce susceptibility to climate change impacts	SRF, Betterments	Public Works - Water, Board of Health	$$$$	Ongoing	Public Health and Safety	3	Low

Table 7-3
2020 Mitigation Action Plan

C4 abc

Hazard		Mitigation Action	Funding Source	Lead Town Entity	Approximate Cost	Timeframe*	Consistency with Mitigation Goals	Benefit Cost Review Rating	Priority Ranking
Earthquakes	9	Develop an inventory of public buildings that do not currently meet seismic standards	FEMA	Public Works - Highway and Engineering	$	Mid	Protection of Existing Infrastructure	5	Low
Extreme Temperatures	10	Amend subdivision rules and regulations to address heat island effects and increase resiliency by adjusting planting requirements (e.g., native plants, less grass, etc.). Also, subdivision rules/regulations.	MVP Action Grant	Building inspector and emergency manager	$	Mid	Protection of Natural Hazards	8	High
Extreme Temperatures	11	Increase public awareness of the dangers of extreme temperatures and outline locations were vulnerable populations (elderly and those with health issues) can have access to air conditioning or shelter from the cold.	Greater Lowell Health Alliance Funding/Grants	Town Emergency Manager	$	Ongoing	Hazard Awareness	9	High
Flooding	12	Continue to require inspections of dams *(both public and private) and educate private dam owners on inspection and maintenance.* Review specific remedial repairs and improvements for dams as outlined in Phase II Reports.		Public Works - Engineering and DCR.	$	Ongoing	Protection of Existing Infrastructure	7	Medium
Flooding	13	Provide training to Town staff and board members relative to stormwater regulations *(fee, overall program, etc).*	Stormwater Enterprise Fund	Public Works, Planning Board and Conservation Commission	$	Ongoing	Hazard Awareness	10	High
Flooding	14	To protect watersheds, waterbodies, and aquifers, continue to undertake stormwater management master plan recommendations (including but not limited to conducting hydrological/drainage studies, designing and constructing non-structural and structural improvements related to drainage including culverts)	319 Grant, Stormwater Enterprise Fund, MVP Action Grant	Planning Board, Engineering Department	$$$	Ongoing	Protection of Natural Resources	5	Low
Flooding	15	Retrofit Stony Brook Dam to allow for low flow releases.	DEP SWMI	Engineering Department	$$$	Mid	Protection of Existing Infrastructure	7	Medium
Flooding	16	For conservation land with known erosion issues (e.g. Forge Pond, Burges Pond, Kennedy Pond), use a combination of education and restoration to redirect water flow (e.g., plantings, structural controls).	MVP Action Grant	Conservation Commission, Planning Board	$	Mid	Protection of Natural Resources	8	High

Table 7-3
2020 Mitigation Action Plan

C4 abc

Hazard		Mitigation Action	Funding Source	Lead Town Entity	Approximate Cost	Timeframe*	Consistency with Mitigation Goals	Benefit Cost Review Rating	Priority Ranking
Flooding	17	Revise subdivision regulations, erosion control regulations, and Board of Health regulations to improve floodplain management.	MVP Action Grant	Director of Land Use Management, Town Planner, Conservation Agent and Board of Health	$	Near	Protection of Natural Resources	6	Medium
Hurricane, tornado, blizzard	18	Protect and invest in keeping Westford populated with trees. Allocate more resources towards the Tree Warden role. Develop an inventory of trees and a tree planting/ vegetation program (that considers power line locations).	MVP Action Grant, DCR Urban Forestry Grants	Conservation Commission, Planning Board, Tree Warden	$$	Long	Protection of Natural Resources	3	Low
Hurricane, tornado, blizzard	19	Evaluate public buildings and critical facilities for the potential to withstand high winds	FEMA	Building Inspector, Emergency Manager	$	Mid	Protection of Existing Infrastructure	5	Low
Invasive Species	20	Educate municipal staff, elected and appointed officials, and the public about invasive species, using native species, and best lawn maintenance practices including timing mowing to protect pollinators and nesting for certain species	DPH and MassDEP Grants	Conservation Commission	$	Near	Hazard Awareness	11	High
Invasive Species	21	Map invasive species	MVP Action Grant	Conservation Commission, Director of Land Use Management	$$	Mid	Protection of Natural Resources	6	Medium
Severe Winter Storms, snowstorms	22	Provide information to caregivers of special needs, the elderly, and other vulnerable populations about what to do, and how to access resources during natural hazards. Provide that information in multiple languages.	Safe Elder Grant	Board of Health	$	Mid	Public Health and Safety	8	High
Severe winter storms, snowstorms, blizzards, ice storms	23	Distribute educational information to residents and businesses on protecting life and property from severe winter storm events		Emergency Manager	$	Mid	Public Health and Safety	6	Medium
Severe winter storms, snowstorms, blizzards, ice storms	24	Inspect public buildings to evaluate the capacity to withstand snow loads and prevent roof collapse. Develop plans to clear roofs of excessive snow accumulations to prevent collapse.	FEMA	Building inspector and emergency manager	$	Mid	Protection of Existing Infrastructure	5	Low

Table 7-3
2020 Mitigation Action Plan

C4 abc

Hazard		Mitigation Action	Funding Source	Lead Town Entity	Approximate Cost	Timeframe*	Consistency with Mitigation Goals	Benefit Cost Review Rating	Priority Ranking
Severe winter storms, snowstorms, blizzard, ice storms	25	Identify locations for snow storage farms for utilization in severe winters with heavy snowfall	FEMA, BRIC	Public Works - Highway	$	Mid	Emergency Response to Hazards	9	High
Severe winter storms, Extreme Temperatures	26	For elderly care and nursing home facilities, keep inventory of facilities updated, enhance communication on planning, provide assistance with planning to understand what services they use related to emergency response		Council on Aging, Board of Health, Emergency Management	$	Mid	Public Health and Safety	4	Low
Severe Weather	27	Evaluate Highway Department Building lightning suppression system	FEMA, BRIC	Public Works	$$	Mid	Protection of Existing Infrastructure	5	Low

* Near = 1 to 2 yrs; Mid = 3 to 4 yrs; Long = 5 or greater

7.2.4.1 Timeline for Implementation

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Table 7-3 includes ten projects ranked with a high priority, seven with a medium priority and ten with a lower priority for all hazard categories. Although all projects are important to the Town, the high priority projects are summarized below relative to recommended timing of the individual mitigation actions. The Town has identified its Capital Improvement Planning, Stormwater Management Plan, Master Plan, and Open Space and Recreation Plan, and Comprehensive Emergency Management Plan as mechanisms to integrate mitigation actions over the next five years.

Three high priority mitigation actions are ongoing including:

- Increase public awareness of the dangers of extreme temperatures and outline locations were vulnerable populations (elderly and those with health issues) can have access to air conditioning or shelter from the cold.
- Provide training to Town staff and board members relative to stormwater regulations (fee, overall program, etc.).
- For bridges, assessment of MassDOT inspections and initiation of maintenance and repair/replacement program.

Two high priority mitigation actions are identified for year one and year two including:

- Enhance existing education program to include hazard mitigation, coupled with overall sustainability, conservation, and environmental stewardship, in public schools and town events.
- Educate municipal staff, elected and appointed officials, and the public about invasive species, using native species, and best lawn maintenance practices including timing mowing to protect pollinators and nesting for certain species.

Four high priority projects identified to begin in 3 to 4 years include:

- Amend subdivision rules and regulations to address heat island effects and increase resiliency by adjusting planting requirements (e.g., native plants, less grass, etc.).
- For conservation land with known erosion issues (e.g. Forge Pond, Burges Pond, Kennedy Pond), use a combination of education and restoration to redirect water flow (e.g., plantings, structural controls).
- Provide information to caregivers of special needs, the elderly, and other vulnerable populations about what to do, and how to access resources during natural hazards. Provide that information in multiple languages.
- Identify locations for snow storage farms for utilization in severe winters with heavy snowfall.

One high priority project is identified to begin in five years or more years include:

- Fine tune communication plan related to social media and homeowner/subdivision networks to be strategic for natural hazards. Utilize internet-based technology to better distribute information concerning natural hazards.

7.2.4.2 Continued Compliance with NFIP

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The National Flood Insurance Program (NFIP), established by Congress in 1968, provides flood insurance to property owners in participating communities. This program is a direct agreement between the federal government and the local community that flood insurance will be made available to residents in exchange for community compliance with minimum floodplain management requirements. Since homeowners' insurance does not cover flooding, a community's participation in the NFIP is vital to protecting property in the floodplain, as well as ensuring that federally backed mortgages and loans can be used to finance property within the floodplain.

Pursuant to the Flood Disaster Protection Act of 1973, any federal financial assistance related to new construction or substantial improvements (greater than 50% of a structure's market value) of existing structures located in the 100-year floodplain is contingent on the purchase of flood insurance. Such federal assistance includes not only direct aid from agencies, but also from federally insured institutions. Thus, in order for property owners to be eligible for purchasing flood insurance, their respective community must be participating in the NFIP and in compliance with the NFIP.

Communities participating in the NFIP must:

- Adopt the Flood Insurance Rate Maps as an overlay regulatory district;
- Require that all new construction or substantial improvement to existing structures in the flood hazard area will be elevated; and
- Require design techniques to minimize flood damage for structures being built in high hazard areas, such as floodways or velocity zones.

The NFIP standards are contained in the Massachusetts State Building Code (Section 3107), which is implemented at the local level by municipal building inspectors. In Massachusetts, 344 out of 351, or 98%, of Massachusetts municipalities participate in the NFIP.

The Town continues to enforce required elements of the NFIP so that they may continue to participate in the program including:

- Issuing or denying floodplain development/ building permits.
- Inspecting all development to assure compliance with the local floodplain zoning by-law.
- Maintaining records of floodplain development.
- Assisting in the preparation and revision of floodplain maps.
- Helping residents obtain information on flood hazards, floodplain map data, flood insurance and proper construction measures.

The Town periodically reviews the zoning bylaw for consistency and uses the most recent FIRM data to determine base flood elevation or the best available scientific data for determinations of base flood elevation if no FIRM data is available to achieve a reasonable measure of flood protection.

Section 8
Plan Evaluation and Maintenance

8.1 Who is Involved?

Each department identified in the Westford Hazard Mitigation Plan is responsible for implementing specific mitigation actions detailed in the Mitigation Actions section of the plan (**Section 7**). Every proposed action listed in the Future Mitigation Action section is assigned to a specific "lead" department as a way to assign responsibility and accountability and increase the likelihood of subsequent implementation. Annual review will enable specific actions to be modified, if needed, rather than wait until the 5-year update, allowing mitigation projects to evolve in a more timely manner as circumstances dictate.

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Westford's Town Planner will be responsible for ensuring that the Plan is monitored, evaluated, and updated throughout the next five years.

8.2 How will the Plan be Maintained?

The following activities describe how the plan will be maintained and updated over the next five years:

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Plan Monitoring

Members of the Planning Team will communicate annually to report on the implementation status of each Mitigation Action identified in **Section 7**, noting accomplishments, challenges, and recommended modifications to identified actions. The Planning Team will also describe and document any new hazard data that can be incorporated in the Hazard Profile section of the Plan, noting any new hazard location, extent, and impact.

At least once per year, the Planning Team will update the implementation status of Mitigation Actions and an evaluation of the appropriateness of the actions, noting any changes warranted.

Plan Evaluation

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The Planning Team will communicate annually to evaluate the purpose and goals of the Hazard Mitigation Plan to ensure the Plan continues to serve its purpose. The annual review will include the following activities:

- Submit survey to all members of the implementation group and other interested local stakeholders. The survey will poll the members on any changes or revisions to the plan that may be needed, progress and accomplishments for implementation, and any new hazards or problem areas that have been identified.
- Review survey results and make recommendations if any changes to the plan are needed.
- Review the Mitigation Goals in the Hazard Mitigation Plan.
- Discuss recent activities to reduce loss of life and property such as grants received/applied for and any completed Mitigation Actions.

- Discuss ongoing or recent planning efforts that are consistent with the Mitigation Goals and Actions of the Hazard Mitigation Plan.

Plan Update

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This Hazard Mitigation Plan will be reviewed and updated every five years to ensure there is no lapse in Plan coverage. The Plan update process will be scheduled one to one and a half years before the Plan is set to expire.

8.3 When Will the Plan be Maintained?

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A start date and time periods were assigned to each Mitigation Action in **Section 7** to assess whether actions are being implemented in a timely fashion. Also, the Planning Team will communicate annually to discuss progress on Mitigation Actions.

Following a disaster declaration, this Hazard Mitigation Plan will be revised as necessary to reflect lessons learned or to address specific issues and circumstances arising from the event. It will be the responsibility of the Town Planner to coordinate with the Planning Team and ensure that appropriate stakeholders are invited to participate in the plan revision and update process following a declared disaster event.

8.4 Incorporation with Other Plans

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Upon approval of the Westford's Hazard Mitigation Plan by FEMA, the Planning Team will provide all interested parties and implementing departments with access to 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 shared with the following departments, commissions, and boards:

- Fire Department
- Emergency Management Agency
- Police
- Department of Public Works
- Planning Board
- Conservation Commission
- Parks & Recreation Department
- Technology Department
- Energy Committee
- Board of Health
- Building Department
- School Committee
- Housing Authority
- Historical Commission
- Zoning Board of Appeals
- Town Forest Committee
- Communications Advisory Committee
- Land Use Management

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.

Section 9
Plan Adoption

Once the draft of the Westford Hazard Plan is reviewed by the Planning Team, stakeholders, and the general public, the Plan is reviewed by MEMA and FEMA. If approved by MEMA and FEMA, the Westford Select Board can officially adopt the Plan. If and when the Plan is approved, it enters into the five year "maintenance" phase. This Section describes the timeline for plan adoption and includes documentation of the Plan adoption by the Select Board.

9.1 Timeline for Plan Adoption

The timeline for Plan Adoption is as follows:

March 23, 2021: After initial approval by the Westford Select Board at its March 23, 2021 meeting the Planning Team submitted the Westford Hazard Mitigation Plan to MEMA on April 5, 2021.

MEMA reviewed the Plan and returned it to the Town with required edits. The Westford Hazard Mitigation Plan was then submitted to FEMA for final review.

October 4, 2021: FEMA issued an Approved Pending Adoption status on October 4, 2021.

January 25, 2022: The Westford Select Board officially adopted the Hazard Mitigation Plan on January 25, 2022. during a regularly scheduled meeting.

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9.2 Plan Adoption

The Certificate of Adoption is provided in this section.

TOWN OF WESTFORD
SELECT BOARD

TOWN HALL
55 Main Street
WESTFORD, MA 01886
(978) 692-5501 FAX (978) 399-2557

TOWN OF WESTFORD CERTIFICATE OF ADOPTION

A RESOLUTION ADOPTING THE TOWN OF WESTFORD HAZARD MITIGATION PLAN

WHEREAS the Town of Westford established a Committee to prepare the *Hazard Mitigation Plan*; and

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

WHEREAS a duly noticed public meeting was held by the Select Board on January 25, 2022,

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

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

ADOPTED AND SIGNED ON January 25, 2022

TOWN OF WESTFORD
SELECT BOARD

Tighe&Bond
Engineers | Environmental Specialists

APPENDIX A

Reference List

Boston Research Advisory Group (June 2016) Climate Ready Boston Climate Change and Sea Level Rise Projections for Boston, Final, Report.

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Tighe&Bond
Engineers | Environmental Specialists

APPENDIX B

Town of Westford
PLANNING BOARD
Town Hall, 55 Main Street
Westford, Massachusetts 01886
(978) 692-5524 · Fax: (978) 399-2732

RECEIVED
MAY 14 2020
TOWN CLERK
WESTFORD

MEETING AGENDA
May 18, 2020
7:30 PM Meeting
Via webinar
Please see instructions for participation below

Open Forum

General Business

A. 2020 Hazard Mitigation Plan Update Presentation – Tighe & Bond
The Town of Westford is pleased to share a brief presentation on our community's commitment to creating local resiliency to weather events such as extreme precipitation and flooding, blizzards, drought, and other natural hazards coupled with climate change. Westford was awarded grant funding by the Executive Office of Energy and Environmental Affairs to complete a Community Resilience Building workshop process and prepare a Town-specific Hazard Mitigation Plan update. This presentation will explain the scope of the grant work, review natural hazards that impact Westford and the risk and vulnerability of our facilities, infrastructure, vulnerable populations, and natural resources, and provide an opportunity for your input and questions.

Public Hearing Items

1. PB 1923 DEF SUB SP OSRD SWM – 73 Nutting Road "Wendell Place"
Public hearing to consider the application of ***Kathleen Coyle and William Perry*** *for approval of a* ***Definitive Subdivision Plan*** *in accordance with* ***Section 218-11 of the Subdivision Rules and Regulations,*** *a* ***Special Permit*** *for an* ***Open Space Residential Development*** *in accordance with* ***Section 7.1 of the Zoning Bylaw,*** *and a* ***Stormwater Management Permit*** *in accordance with* ***Chapter 147 of the Town of Westford General Bylaws*** *and any other permit or relief as may be required under the Town of Westford Subdivision and/or Zoning Bylaws in order to create a twenty-three (23) lot subdivision (Wendell Place). The subject property includes five parcels and is located at* ***73 Nutting Road*** *and are identified as Assessor's Map 036 Parcels 0024, 0026, 0027, 0028, and 0029 and lies within the Residence A Zoning District.*

Continued from:
July 15, 2019
September 9, 2019
October 7, 2019 (No discussion)
October 21, 2019 (No discussion)
November 4, 2019 (No discussion)
November 18, 2019 (No discussion)
December 2, 2019 (No discussion)
December 16, 2019 (No discussion)
January 6, 2020 (No discussion)
February 3, 2020 (No discussion)
March 2, 2020 (No discussion)

March 16, 2020 (No discussion – meeting canceled)
May 4, 2020

2. **PB 2017 MOD DEF SUB – St. Augustine Drive**
*Public hearing to consider the application of **Connell Real Estate Trust** for a **Modification to a Definitive Subdivision Plan** in accordance with Section 218-11 of the Subdivision Rules and Regulations to modify a previously approved definitive subdivision to upgrade a portion of the St. Augustine roadway from a minor street to a secondary street to provide improved access to an adjoining subdivision, and to request additional waivers from the construction standards including slopes, tree planting and sidewalks (and any other waivers as may be required under the Town of Westford Subdivision Rules and Regulations). The subject property is identified as **St. Augustine Drive** and lies within the Residence A (RA) zoning district.*

Continued from: *April 6, 2020*
May 4, 2020

The Applicant has requested postponement without discussion to June 1, 2020

3. **PB 2014 PRE SP OSRD – 0, 19, 33 & 35 Hartford Road**
*Public hearing to consider the application of **KMR Real Estate, LLC** for a for a **Preliminary Subdivision Plan Review** in accordance with **Section 218-11 of the Subdivision Rules and Regulations, and** a **Special Permit** for an **Open Space Residential Development** in accordance with **Section 7.2 of the Westford Zoning Bylaw** in order to create a subdivision with up to nine (9) lots (and any other permit or relief as may be required under the Town of Westford Zoning or General Bylaws). The subject properties are located at 0, 19, 33 & 35 Hartford Road and identified as Assessor's Map 020 Parcel 0076 Lot 0000, Map 020 Parcel 0075 Lot 0001, Map 020 Parcel 0074 Lot 0007 and Map 020 Parcel 0074 Lot 0008 and located in the Residence A (RA) zoning district.*

Continued from: *March 16, 2020 (No discussion – meeting canceled)*
April 6, 2020
May 4, 2020 (No discussion)

General Business continued

B. **41 & 43 Lowell Road (DHD Adams Realty Trust) – Lots 2 and 3 on Plan Book 245 Plan 143**
Discuss proposal to sell and convert two lots subject to M.G.L. Chapter 61A to residential use and possible recommendation regarding the Town's right of first refusal to purchase

C. **BOA 2010 VAR – 0 & 37 Carlisle Road**
Non-binding discussion regarding an application to the Board of Appeals by SMurph, LLC for a Variance to allow more than one principal structure per lot (23 dwellings on 2 lots). The property is located at 0 & 37 Carlisle Road in the Residence A Zoning District

Correspondence, Reports and Updates

Instructions for participation:

Options available to access the Planning Board meeting remotely:

1. Register to watch the meeting through the GotoWebinar website at: https://attendee.gotowebinar.com/register/9171738887793286157 After registering, you will receive a confirmation email. There are basic instructions on how to use GoToWebinar available at: **https://www.youtube.com/watch?v=IQ3Xwwgbd8Y**

2. You may call in and listen on any phone (landline or cellphone) by dialing +1 (415) 655-0060 and using meeting code 209-554-447.

3. WCAT will record the meeting and it will be available within a few days of the meeting date. Please see their website for more details: **https://www.westfordcat.org/**

If you do not have access to one of these methods of participation, please submit written comments to Rebecca Cheney, Town Planner, rcheney@westfordma.gov by 3 pm on May 18, 2020.

If any member of the public wishing to attend this meeting seeks special accommodations in accordance with the Americans with Disabilities Act, please contact the Permitting Department at (978) 692-5524 or email etoothaker@westfordma.gov



WESTFORD HAZARD MITIGATION AND MUNICIPAL VULNERABILITY PREPAREDNESS PLANNING

Public Meeting

May 18, 2020 7:30 to 8 PM

Tighe&Bond

WELCOME



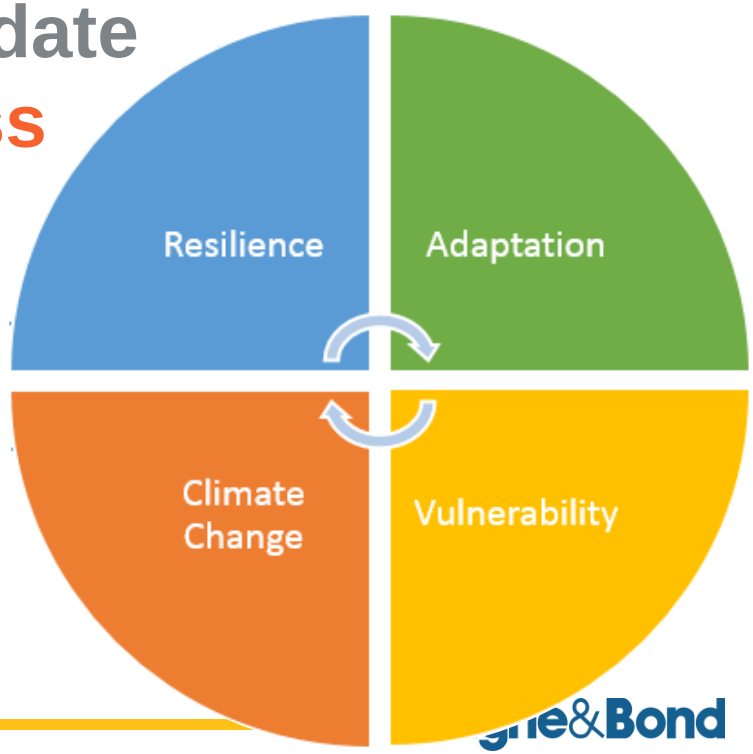
Westford awarded $36K grant for

- Municipal Vulnerability Preparedness (MVP) Community Resilience Building (CRB) Workshop Process; and
- Draft Hazard Mitigation Plan (HMP) Update

First step in unlocking additional funding opportunities for Westford from FEMA/MEMA and Commonwealth of Massachusetts

MVP/HMP GRANT AND CRB PROCESS

1. Establish Core Team
2. Complete Evaluation/Assessment
   - Natural Hazard Risks
   - Community Assets
   - Multi-Hazard Vulnerability Assessment
   - Capabilities Assessment
   - Mitigation Strategies
3. Draft Hazard Mitigation Plan Update
4. **Hold Public Meeting mid-process**
5. Hold MVP Workshops
6. Draft MVP Report
7. Hold Listening Session
8. Final MVP Report



PURPOSE OF PUBLIC MEETING

- **Required** to comply with Federal HMP guidance and contract with EEA
- **Introduce Hazard Mitigation and Municipal Vulnerability Planning** and **provide an update** on work completed to date
- Provide opportunity for **Q&A**

A brief thanks to Westford's MVP Core Team

CORE TEAM

- Carol Gumbart
- Henry Fontaine
- Jeffrey Stephens
- Jeremy Downs
- Joe Targ
- Paul Fox
- Paul Starratt
- Rae Dick
- Rebecca Cheney
- Richard Barrett
- Stephen Cronin
- Tim Whitcomb



BACKGROUND

EXECUTIVE ORDER 569 9.16.16

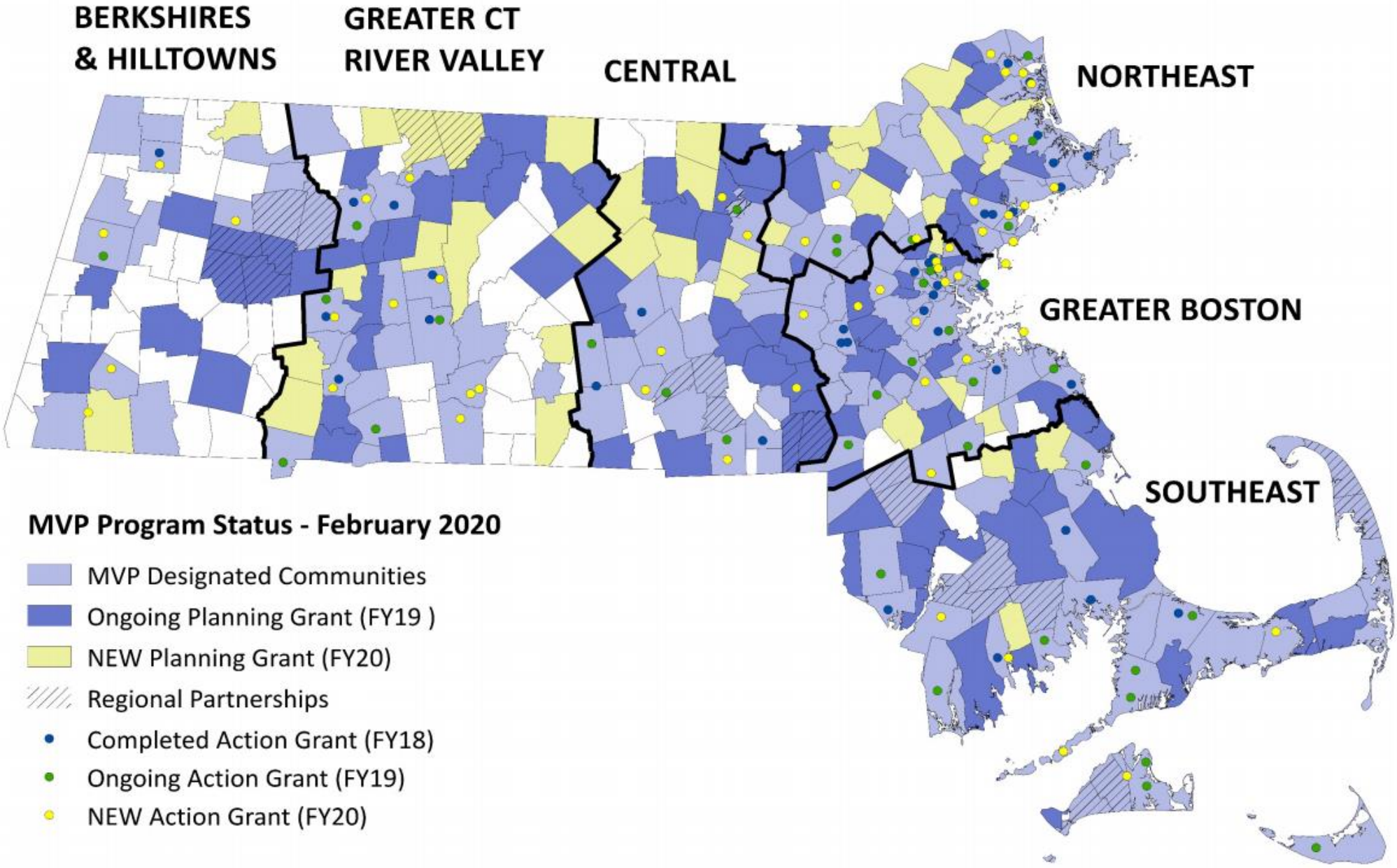


ENVIRONMENTAL BOND BILL 8.21.18



- $2.4 billion bond bill with focus on climate change resiliency
- Over $200 million authorized for climate change adaptation
- **Codifies EO 569, including the MVP Program**

BACKGROUND

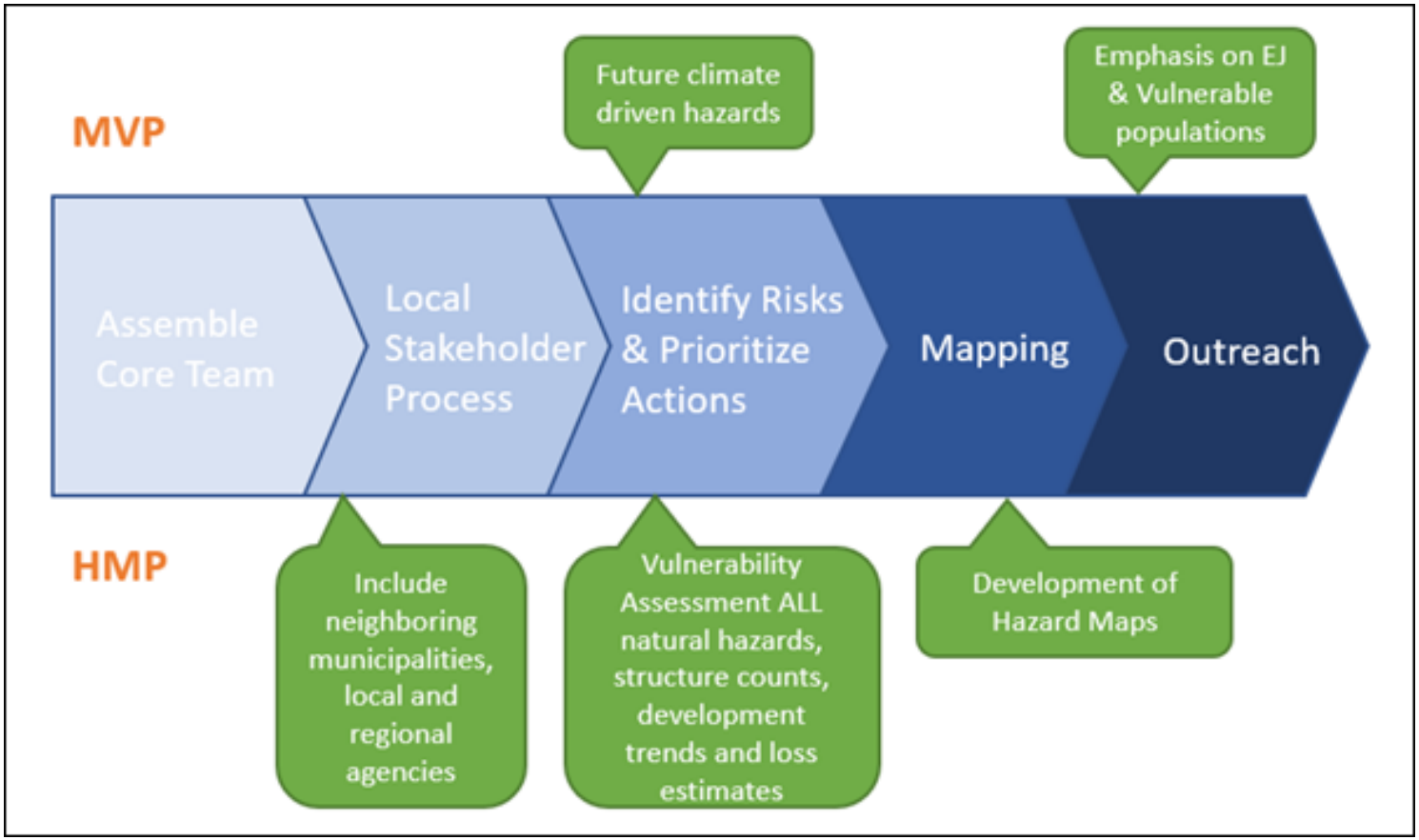

BERKSHIRES & HILLTOWNS
GREATER CT RIVER VALLEY
CENTRAL
NORTHEAST
GREATER BOSTON
SOUTHEAST
MVP Program Status - February 2020
MVP Designated Communities
Ongoing Planning Grant (FY19)
NEW Planning Grant (FY20)
Regional Partnerships
Completed Action Grant (FY18)
Ongoing Action Grant (FY19)
NEW Action Grant (FY20)

BACKGROUND ON HAZARD MITIGATION PLANNING

- **FEMA Requirements:**
  - Disaster Mitigation Act of 2000, 44 CRF Part 201.6
  - *FEMA Local Mitigation Plan Review Guidance, October 2011*
  - *FEMA Local Mitigation Planning Handbook, March 2013*
- **Westford included in Northern Middlesex Regional Hazard Mitigation Plan, approved August 2015.**
  http://www.nmcog.org/Websites/nmcog/images/Hazard_Mitigation_Plan_FEMA_approved_8_15.pdf
- **To maintain eligibility for FEMA/MEMA funding, must update plan every 5 years**
- **Commonwealth of Massachusetts State Hazard Mitigation & Climate Adaptation Plan 2018 must be considered in update**

HOW DO THE MVP AND HMP PROCESSES OVERLAP?

The MVP effort supplements the HMP process by providing a statewide and major watershed specific climate change data to use in the natural hazard risk assessment and a consistent methodology for public engagement through the Community Resilience Building (CRB) workshops.



WHY DO THIS PLANNING?

Help Westford Build Resilience and Preparedness:

- Build on the Town's existing emergency management capabilities
- Plan for more frequent and intense weather events that are linked to climate change
- Engage multiple stakeholders in the planning process
- Improve access to funding for mitigation and adaptation





COMMUNITY ASSET INVENTORY

Tighe&Bond

COMMUNITY ASSET CATEGORIES

FEMA defines a community asset as anything that is important to the character and function of a community.

FEMA Community Asset Categories	Critical Sectors	Characteristics of Community Assets
People	Schools, Vulnerable Populations, Cultural Facilities	Areas of greater population density, or population with unique vulnerabilities or less able to respond and recover during a disaster.
Built Environment	Critical Municipal Facilities, Water, Wastewater, Energy, Stormwater, Transportation, Cultural Resources	Critical facilities necessary for a community's response to and recovery from emergencies, infrastructure critical for public health and safety, economic viability, or needed for critical facilities to operate.
Economy	Marinas, Business and Industry	Major employers, primary economic sectors and commercial centers where loss or inoperability would have severe impact on the community and ability to recover from a disaster.
Natural Environment	Natural Resources	Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc.

PEOPLE – SOCIETAL ASSETS

- Child Care (e.g. Roudenbush Children's Center, Westford KinderCare, etc.)
- Places of worship
- Cemeteries
- Emergency shelters
- Westford Food Pantry
- Historical Places
- Nursing Homes/elderly housing/elderly care
- Cameron Senior Center and Roudenbush Community Center
- J.V. Fletcher Library
- Schools
- Village at Mystery Spring
- Westford Museum
- Parish Center for the Arts



WESTFORD
FOOD PANTRY

BUILT ENVIRONMENT – INFRASTRUCTURE ASSETS

- Fire and Police facilities
- Water treatment and distribution
- Culverts (town-wide) and bridges
- Dams (private and town-owned) and bridges
- Town Hall and other municipal buildings
- Medical facilities (e.g., CVS Minute Clinic, Westford Counseling Center)
- Power grid
- Public safety communications
- Schools/town shelters





ECONOMIC ASSETS

- Banks
- Funeral Homes (Main Street, Pleasant Street)
- Gas Stations
- Supermarkets (Whole Foods, Market Basket)
- Hardware Store (ACE Hardware)
- Kimball Farm
- Nashoba Valley Ski Area
- Oil Delivery (e.g. JA Healy & Sons)
- Pharmacies (CVS, Walgreens)
- Major employers (e.g., Juniper Networks, Netscout system, etc.)
- Tree removal services
- Veterinary hospitals





ENVIRONMENTAL ASSETS

- Conservation lands and open space
- Wetlands and Waterbodies throughout town (e.g., Stony Brook, Nabnasset Lake, Forge Pond, Beaver Brook, etc.)
- Habitat (including vernal pools)
- Trails (Nashua River Trail)
- Well contribution areas
- Parks, fields (e.g. VFW softball field)
- East Boston Camps
- Beaches (Edwards and Forge Pond)







NATURAL HAZARD RISK AND VULNERABILITY ASSESSMENT

Tighe&Bond

WHAT ARE NATURAL HAZARDS?


Inland Flooding


Tsunami


Severe Winter Storm

Blizzards
Snow
Ice Storms


Drought


Average/Extreme Temperatures


Tornadoes


Landslide


Wildfires


Other Severe Weather

Nor'easters
High Wind
Heavy Precipitation
Microbursts


Hurricanes/Tropical Storms


Invasive Species


Earthquake

HISTORICAL EVENTS

- October 1963 Earthquake
  - Magnitude 4.5 earthquake
- October 1970 Tornado
  - Killed one person and caused between $50,000 and $500,000 in damages
- Winter of 1995
  - Snowfall reached over 126 inches
- May 2007 Brush/Wildland Fire
  - Spread across several acres and to a home
- December 2008 Ice Storm
  - Brought down trees and power lines
- August 2011 Hurricane Irene
  - Widespread power outage
- October 2011 Halloween Storm
  - Power out for six days



- March 2018 Nor'easter
  - Westford received over 20 inches of snow from a winter nor'easter

NATURAL HAZARD RISK INDEX

Type of Natural Hazard	History of Occurrence in Westford	Hazard Probability	Hazard Frequency	Geographic Extent	Severity of Impact	Hazard Risk Ranking
Hydrological Hazards						
Inland Flooding	Yes	2	3	1	1	7
Drought	Yes	3	2	3	2	10
Atmospheric Hazards						
Extreme Temperatures	Yes	4	3	3	2	12
Hurricanes/ Tropical Storms	Yes	2	0	3	2	7
Nor'easters	Yes	4	3	3	3	13
Other Sever Weather – High Winds and Thunder storms	Yes	4	3	3	2	12
Severe Winter Storm – Snow, Ice, and Blizzard	Yes	4	3	3	2	12
Tornadoes	Yes	1	0	1	3	5
Microburst	Yes	4	3	1	3	11
Geologic Hazards						
Earthquake	Yes	2	1	3	4	10
Other Hazards						
Wildfires	Yes	3	2	2	4	11
Invasive Species (including algae)	Yes	4	3	3	1	11

WESTFORD'S TOP HAZARDS

- **Input on past, present, and future hazards based on public perception being provided via survey:**
  - https://www.surveymonkey.com/r/8BZDR87

- **Top hazard risk ranking by Core Team:**
  - Nor'easters
  - Severe Weather (e.g. thunderstorms, high wind) & Winter storms (e.g., ice and blizzards)
  - Extreme Temperature
  - Invasive Species



AMPLIFIED RISKS



CLIMATE CHANGE

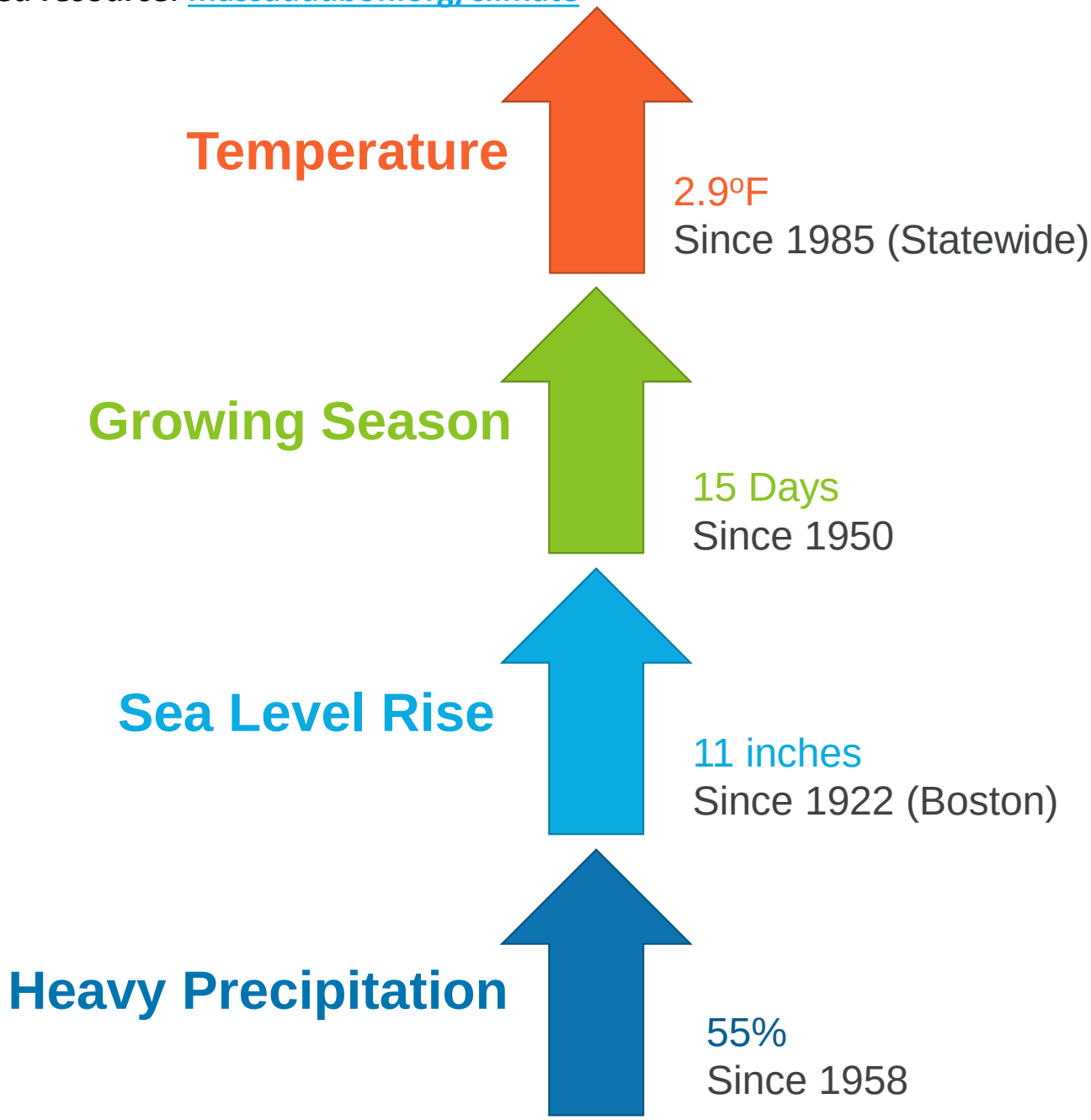
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CLIMATE CHANGE REFERENCES FOR MVP PROCESS

- **Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan, September 2018**
  - https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan
- **Massachusetts Climate Clearinghouse**
  - https://resilientma.org/
- **Statewide and Major Watershed (Basin) Climate Change Projections**
  - https://www.mass.gov/files/ma-statewide-and-majorbasins-climate-projections-final.pdf

MASSACHUSETTS OBSERVED CLIMATE CHANGES

Recommended resource: massaudubon.org/climate



MASSACHUSETTS CLIMATE PROJECTIONS

By end of century:

Changes in precipitation

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

Rising temperatures

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

Sea level rise

- 4-10.5 feet along the MA coast

Extreme weather

- Increase in frequency and magnitude



CHANGES IN PRECIPITATION

Nashua Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	45.9	+0.4 to +4.9	+1.2 to +6.3	+2.3 to +7.9	+1.3 to +8.4
	Winter	11.0	-0.3 to +1.9	+0.2 to +2.5	+0.4 to +3.3	+0.6 to +4.3
	Spring	11.8	-0.0 to +2.2	+0.1 to +2.0	+0.5 to +3.0	+0.1 to +2.9
	Summer	11.3	-0.3 to +1.5	-0.3 to +2.2	-0.6 to +2.2	-1.1 to +2.2
	Fall	11.8	-1.1 to +1.1	-1.2 to +1.8	-1.6 to +1.7	-1.4 to +1.5

IMPACTS OF CHANGING PRECIPITATION

- Episodic droughts
- Concerns over food production and drinking water supply
- Stress on ecosystems
- Flooding

EXTREME STORMS

Blizzards

- There have been more than 5 in Massachusetts since 2011

Nor'easters and Hurricanes

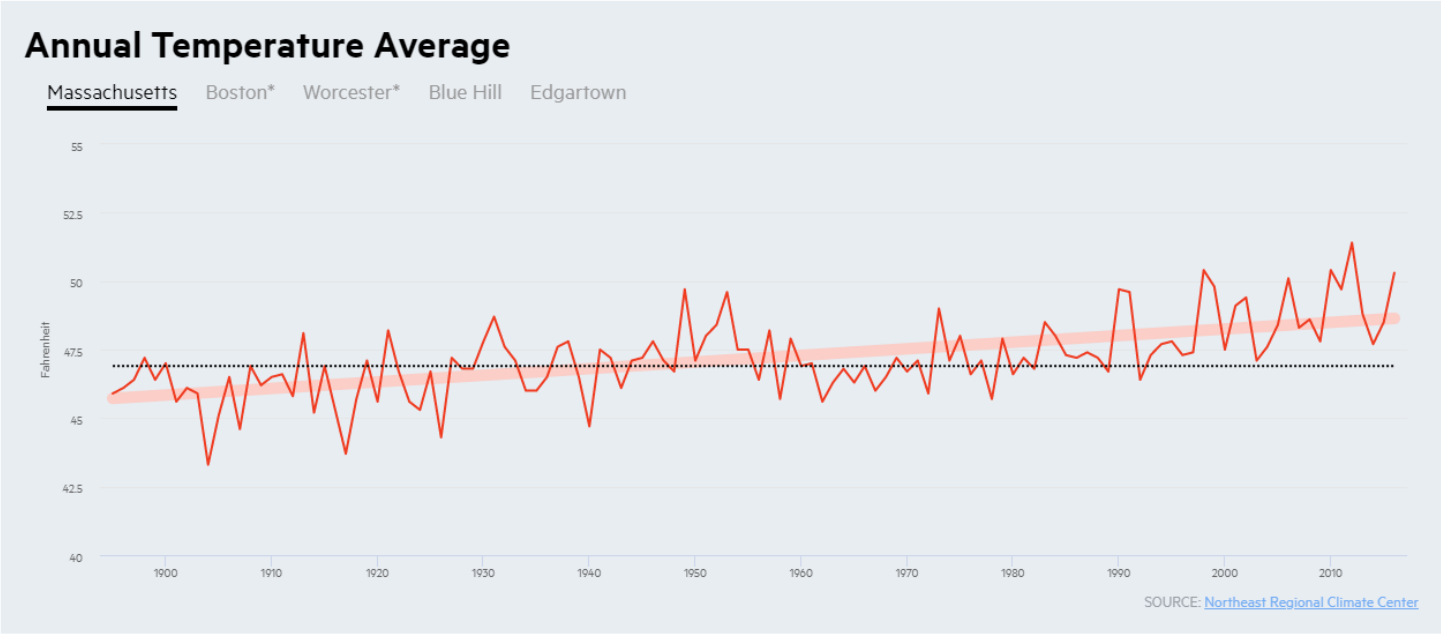
- Upward trend since the 1970s



IMPACTS OF EXTREME STORMS:

- **Public safety concerns, including increased injuries and mortality**
- **Economic damages and business disruption**
- **Property and infrastructure damage**
- **Natural resources**

RISING TEMPERATURE



IMPACTS OF RISING TEMPERATURE:

- Heat-related illnesses
- Vector borne-diseases
- Health of plants, animals, ecosystems
- Reduced crop production
- Larger energy demand
- Droughts and wildfires



MITIGATION STRATEGIES FOR VULNERABLE ASSETS

Tighe&Bond

TYPES OF MITIGATION ACTIONS

1. Prevention
2. Property Protection
3. Public Education and Awareness
4. Natural Resource Protection and Green Infrastructure
5. Structural Projects
6. Emergency Services Protection



MVP WORKSHOPS

In progress now

Tighe&Bond

THURSDAYS AT 10:30 AM

1. Workshop #1: 5/14/2020 on Societal Assets and People

2. Workshop #2: 5/21/2020 on Infrastructure

3. Workshop #3: 5/28/2020 on Economy

4. Workshop #4: 6/4/2020 on Environment and Natural Resources

Sign up on Town website or contact Rebecca Cheney
https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla

WORKSHOP OBJECTIVES

- Hear from stakeholders who can help evaluate our community's strengths and vulnerabilities of residents, infrastructure, and natural resources
- Understand connections between natural hazards and local planning/mitigation efforts
- Develop and prioritize resiliency actions for the municipality, organizations, businesses, neighborhoods, and community groups
- Identify opportunities to advance actions that reduce the impact of hazards and increase resiliency in the community





Community Resilience Building
WORKSHOP GUIDE



www.CommunityResilienceBuilding.org



resilient **MA**

Climate Change Clearinghouse for the Commonwealth

ResilientMA.org

Tighe&Bond

NEXT STEPS BEFORE JUNE 30, 2020

- Complete draft Hazard Mitigation Plan for Town staff and public review
- Hold listening session
- Selectmen vote to submit Hazard Mitigation Plan to FEMA
- Submit documents to EEA and FEMA



GRANT OPPORTUNITIES

HOW DOES THIS PROCESS BENEFIT WESTFORD?



MVP Community Designation = Eligibility for MVP Action Grants

Once approved, HMP = Eligibility for FEMA Hazard Mitigation Grants



OPEN DISCUSSION & QUESTIONS

Contact Information:



- **Rebecca Cheney, Town Planner**
  - Rcheney@westfordma.gov
  - (978) 399-2577
- **Janet Moonan, PE, Project Manager**
  - JSMoonan@tighebond.com
  - (781) 708-9826

Information on Town's website at:

- https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla

HMP/MVP Public Meeting
Town of Westford Planning Board Meeting

ATTENDEES: Darrin Wizst, Mike Bonenfant, Jeff Morrissette, Dylan O'Connor, Janet Moonan, Tighe & Bond, Kate Hollister, Gary Lavelle, Matt Salem, Rebecca Cheney

DATE: May 28, 2020

On May 28, 2020, the HMP/MVP Process was discussed at the Town of Westford's Planning Board Meeting. The meeting was held virtually due to COVID-19 restrictions. A recording of the meeting can be found at the link below.

Meeting Summary

Janet Moonan, PE, from Tighe & Bond gave a 20 minute presentation on the HMP/MVP Process and opened the floor to discussion afterwards. Presentation is included as an attachment.

Discussion items included:

- Where to locate the HMP/MVP packet that includes survey information, mapping, general information, etc.
    - Response: Information can be located on the Town's HMP/MVP website. Additionally, a copy of the presentation will be sent after the meeting.
- How increased rainfall, storms, etc. are being taken into consideration within the Town.
    - The State has already adjusted the amount of rainfall for storm categorizations and more changes are in the works.
    - Engineering Department considers these factors when planning and reviewing projects.
- Culverts, bridges, and other projects can be considered within this funding however, nature based solutions are preferred.
- Confirmation that cell towers are listed in the assets list.
- Topics not applicable under this grant will be covered in Emergency Management Planning documents.

Meeting Recording

https://www.westfordcat.org/watch-online/government/meetings-coverage/planning-board/episode/5-18-2020-webinar

Tighe&Bond
Engineers | Environmental Specialists

APPENDIX C

Tighe&Bond
Engineers | Environmental Specialists

COMMUNITY RESILENCE BUILDING WORKSHOPS- SUMMARY OF FINDINGS

TOWN OF WESTFORD
MUNICIPAL VULNERABILITY PREPAREDNESS (MVP) PROGRAM



Source: *https://www.westfordma.gov/*

SUBMITTED TO

Town of Westford

June 2020

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Section 1
Community Resilience Building Workshops

1.1 Overview

The Town of Westford, like other communities in the Commonwealth of Massachusetts, is already feeling the impacts of climate change. In particular, the Town has experienced severe weather related to extreme winter weather events, flooding, and severe wind. Westford has experienced 20 natural hazard incidents that triggered federal or state disaster declarations since 1991. Most events involved severe storms and flooding, most recently Winter Storm Skylar, Winter Storm Riley, Winter Storm Juno, and "Snowtober". In mid-May 2020, an extreme thunderstorm and microburst left many without power for over 24 hours. These extreme weather events will test Westford's ability to prepare for and respond to emergencies.



FIGURE 1: Images from May 2020 severe thunderstorm and windstorm

In 2017, the Commonwealth of Massachusetts inaugurated the Municipal Vulnerability Preparedness (MVP) program to assist municipalities in planning for and undertaking strategies to adapt to predicted changes in our warming climate. The Executive Office of Energy and Environmental Affairs (EEA) oversees and implements the MVP program. Funds are awarded to municipalities under two categories of work: planning grants and action grants.

To prepare for climate resiliency and begin to consider adaptation strategies, the Town was awarded a grant to complete the MVP planning process. This summary describes the planning process and findings suggested by the community for building a more resilient Westford.

1.1.1 How does the MVP Planning Process Augment Other Hazard Mitigation Planning?

The Federal Disaster Mitigation Act, adopted in 2000, requires that after November 1, 2004, all municipalities that wish to continue to be eligible to receive Federal Emergency Management Agency (FEMA) Hazard Mitigation Grant funding for hazard mitigation activities must adopt a local Hazard Mitigation Plan (HMP) and update the plan every 5-years. Note that this planning requirement does not affect federally authorized disaster assistance funding, which is exempt from the HMP requirement.

Currently, Westford is included in the "Hazard Mitigation Plan for the Northern Middlesex Region", which was approved by FEMA in August 2015. This plan covers Chelmsford, Dracut, Dunstable, Lowell, Pepperell, Tewksbury, Tyngsborough, and Westford and was prepared under the overall direction of the Northern Middlesex Council of Governments (NMCOG). This plan expires in August 2020. Westford's MVP grant awarded by EEA also provided funding to prepare a town-specific HMP plan update.

The MVP effort supplements the HMP process by providing a statewide and major basin-specific climate change data to use in the natural hazard risk assessment and a consistent methodology for public engagement through the Community Resilience Building (CRB) process. Figure 2 demonstrates the overlap between the MVP and HMP development.

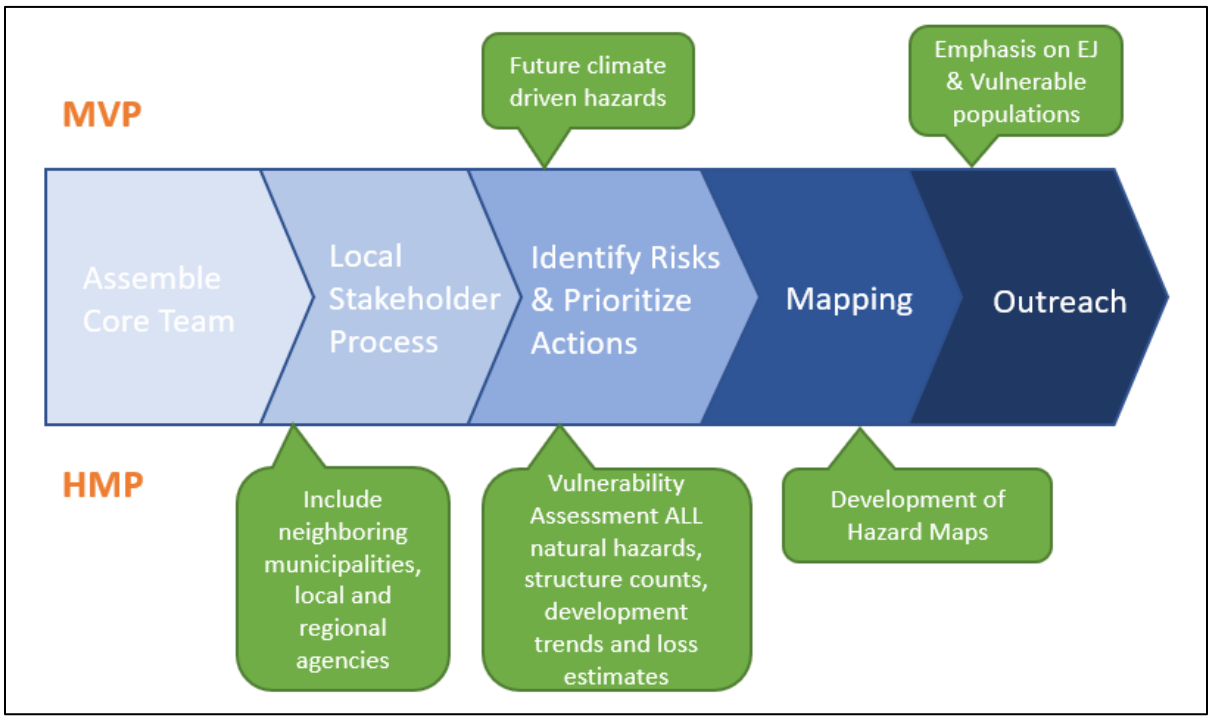


FIGURE 2: Overlap between MVP and HMP Development

1.1.2 Overview of the Community Resilience Building (CRB) Process

The CRB methodology is an "anywhere at any scale" format that draws on stakeholders' wealth of information and experiences to foster a collaborative dialogue about the strengths and vulnerabilities within a community, identify potential resiliency actions, and advance the education, planning, and ultimately implementation of priority actions. Figure 3 provides an overview of this process from the CRB Workshop Guide.

During the workshops, participants interact at both small and large group levels, using an iterative process to gather input, synthesize ideas across groups, and ultimately develop a set of priority resilience and adaptation actions. The workshop's central objectives are to:

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

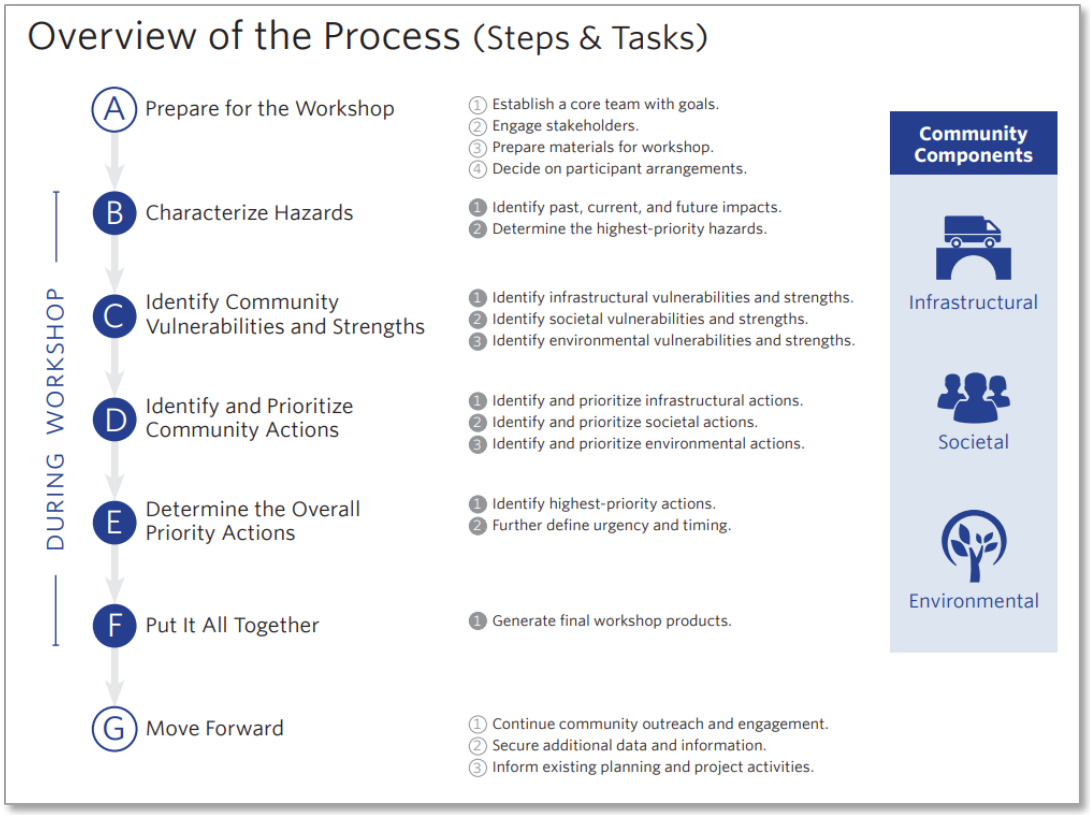


FIGURE 3: Overview of the CRB Process[1]

[1] https://www.communityresiliencebuilding.com/

1.2 Westford's CRB Planning Activities

Rebecca Cheney, Town Planner, served as the Local Project Manager undertaking the integrated MVP and HMP planning process. The Town partnered with Tighe & Bond, a state-certified MVP Provider, to complete the town-specific HMP update and CRB process including holding the CRB workshops.

To complete the first step in the CRB Process, Core Team members for the Town of Westford MVP were identified from multiple departments, boards, and commissions. The Core Team is listed Table 1.

The role of the Core Team was to

- Identify and engage community stakeholders to participate in the CRB workshops and the listening session;
- Review workshop materials and attend workshop session;
- Review the summary of findings report; and
- Attend the final listening session.

TABLE 1: Core Team Members

Name	Title/Department/Affiliation
Carol Gumbart	Conservation/Resource Planner
Henry Fontaine	Building Commissioner & Zoning Enforcement
Jeffrey Stephens	Health Department Director
Jeremy Downs	Assistant Town Engineer
Joe Targ	Co-Emergency Management Director
Matthew Salem	Conservation Commission Assistant Planner
Paul Fox	Director of Facilities
Paul Starratt	Town Engineer
Rae Dick	Director of Environmental Services
Rebecca Cheney	Town Planner
Richard Barrett	Highway Department Superintendent
Stephen Cronin	Water Department Superintendent
Tim Whitcomb	Co-Emergency Management Director

The following provides additional detail on the overcall CRB planning process undertaken by the Town of Westford to obtain MVP Community Designation.

1.2.1 Core Team Meetings

The MVP kickoff meeting, held on September 11, 2019, was coordinated to involve the Core Team at an early stage in the planning process. At this meeting, Tighe & Bond presented an overview of EEA's MVP Program and Goals, reviewed the scope, schedule, and budget, discussed public involvement and outreach, and reviewed the CRB process.

A Core Team Check-In Meeting took place on February 24, 2020. At this meeting, Tighe & Bond provided an update on the MVP process, reviewed hazard mitigation planning goals, discussed the draft community asset inventory, reviewed the 2015 hazard mitigation plan mitigation strategies, and coordinated workshop dates, times, and locations.

Due to COVID-19 and the need to accommodate social distancing and stay-at-home advisories that went into effect in mid-March, additional Core Team review was completed via email. A virtual Core Team Check-In Meeting was held on May 7, 2020. At this meeting, Tighe & Bond provided an MVP status update, reviewed the alternative public engagement approach needed due to COVID-19, and led an open discussion.

A final Core Team Check-In Meeting was held on June 25, 2020. At this meeting, the Core Team discussed the final MVP Summary of Findings Report, the draft Hazard Mitigation Plan, and mitigation actions to be included in both reports.

Materials documenting the various Core Team meetings are provided in Appendix A.

1.2.2 COVID-19 Alternate Public Engagement Strategy

Westford worked with their MVP Provider, Tighe & Bond, to develop a virtual engagement process for the CRB workshops and public listening session following the recommendations made by the EEA MVP staff.

1. **Provide an online space for MVP materials**: A municipal-specific MVP website was designed by Tighe & Bond to provide all necessary materials for completing the MVP process. Reference material including the Massachusetts State Hazard Mitigation and Climate Action Plan, ResilientMA.org, the MVP Workshop Guide, and the municipality's Hazard Mitigation Plan are available for public access on this website. Recorded CRB Workshop Webinars, survey results, and the draft and final MVP Summary of Findings Report are also posted on the website.

2. **Survey to identify strengths and vulnerabilities**: Tighe & Bond used Survey Monkey to create and distribute a survey to members of the Core Team and identified stakeholders. The survey questionnaire results were used to develop an initial list of strengths and vulnerabilities in the community. The survey was distributed via email and linked to the MVP website.

3. **Distribute recorded presentation on background information**: Tighe & Bond developed a pre-workshop video including information on climate change and the MVP process. The short video was posted on the MVP website for viewing or downloads. Stakeholders were encouraged to view the introductory video prior to attending the Virtual CRB Workshop Webinars.

4. **Distribute virtual CRB Workshop webinar materials**: Materials necessary to participate in the workshop were distributed via email, posted on the MVP website or sent by regular mail if requested.

5. **Hold Webinars to meet the CRB Workshop requirement**: Tighe & Bond planned to host four virtual CRB Workshop Webinars featuring each one of the Community Asset Categories: infrastructural, societal, natural environment, and the economy. Due to lack of interest, the economy webinar was cancelled. During

each workshop, attendees brainstormed mitigation actions for specific community assets, addressing top priority hazards. Recordings of these sessions are on YouTube.

   a. People and Society: https://youtu.be/L6-mdFBNamM
   b. Buildings and Infrastructure: https://youtu.be/EesZkK12LUE
   c. Natural Resources and the Environment: https://youtu.be/1PHFmmZytxA

6. **Prioritization Polling**: After the completion of the virtual CRB Workshop webinars, Tighe & Bond developed and distributed a Survey Monkey poll to the Core Team and stakeholders. This poll includes a list of mitigation actions developed during the webinar. Individuals were asked to rank mitigation actions. This developed a draft prioritization.

7. **Distribute Listening Session materials**: Tighe & Bond distributed listening session materials to Core Team members and stakeholders electronically or through mailings if requested. Information about the Listening Session and directions to participate were publicly posted.

8. **Hold Listening Session:** Tighe & Bond and the Town hosted a live, one-hour Listening Session to present the draft MVP Summary of Findings Report and allow time for a Question & Answer session for community input. The Final Draft MVP Summary of Findings Report was available on the MVP website for a public comment period. The session is also available on YouTube.

9. **Core Team Meeting**: Tighe & Bond hosted a final virtual Core Team meeting. The goal of the meeting was to review the results of the prioritization polling and discuss the Draft MVP Summary of Findings Report.

10. **MVP Website:** Tighe & Bond posted the recorded Listening Session and Final Draft MVP Summary of Findings Report on the MVP website.

A memorandum documenting the proposed alternative public engagement strategy is included in Appendix B.

1.2.3 Stakeholder Engagement and Pre-Workshop Survey

Community stakeholders included municipal staff not already a member of the Core Team, elected and appointed officials in Westford, municipal staff and representatives from abutting communities, environmental non-profits, representatives from the local Climate Action Committee, owners and managers of local businesses, and the citizens involved in local planning. The complete stakeholder list is provided in Appendix C.

Pre-workshop stakeholder engagement materials were developed including maps of community assets and hazard areas and an introductory video about the MVP program and community climate change impacts. A pre-workshop survey was created to get input from stakeholders regarding perception of natural hazard risk, future impacts due to climate change, and important community assets in each of the four sectors.

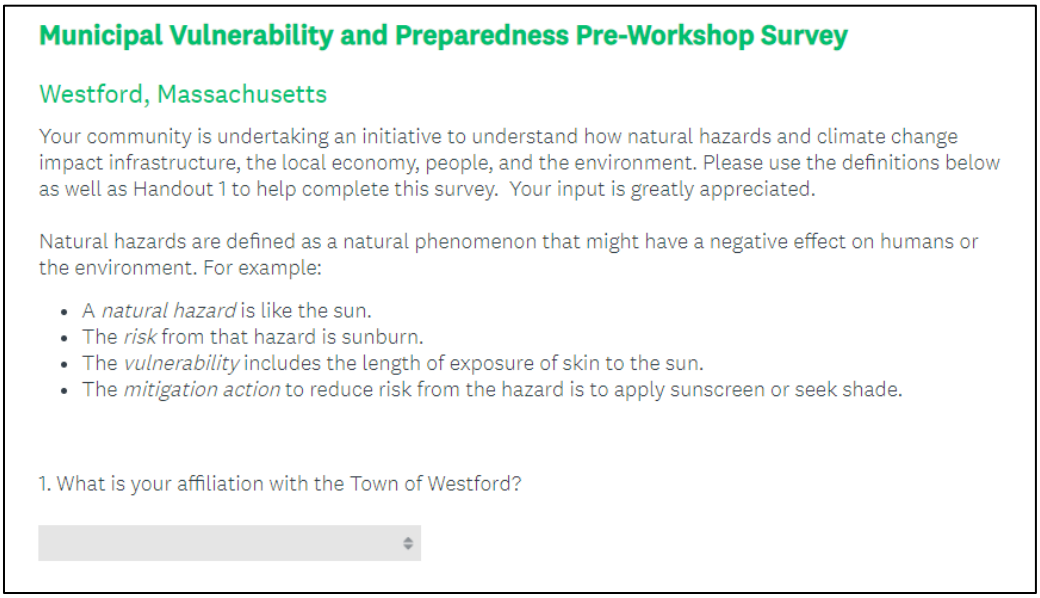


FIGURE 4: Pre-Workshop Survey via SurveyMonkey

Westford MVP lead, Rebecca Cheney, emailed invitations to 60 stakeholders to participate in the MVP CRB workshop process. The email included a link to the MVP website, instructions on how to take the survey, access pre-workshop materials and links to sign up for the four workshops.

1.2.4 Community Resilience Building Workshops

The four workshops focusing on society, infrastructure, economy and the environment were scheduled to be held over a four-week period from May 14 through June 4.

Each workshop followed a similar format with an introduction by Town Planner, Rebecca Cheney, an overview of the MVP planning process, discussion of top natural hazards impacting Westford including future climate change impacts, followed by a discussion of the featured community assets and survey results. The working sessions with stakeholders included an initial session to further discuss specific strengths and vulnerabilities of the community assets and a second session to develop mitigation strategies that addressed the top identified natural hazards.

The virtual workshops used the GoToMeeting platform, which enabled a production team to provide live video and audio, present slides and complete the CRB worksheets based on input from stakeholders. Participants in the workshop provided comment verbally and through the chat function.

As each workshop was completed, a recording of the workshop, documented chat and a draft of the CRB matrix was uploaded to the website. The website address is: https://www.westfordma.gov/1309/Municipal-Vulnerability-Preparedness-Pla. A copy of the final website is included in Appendix D.

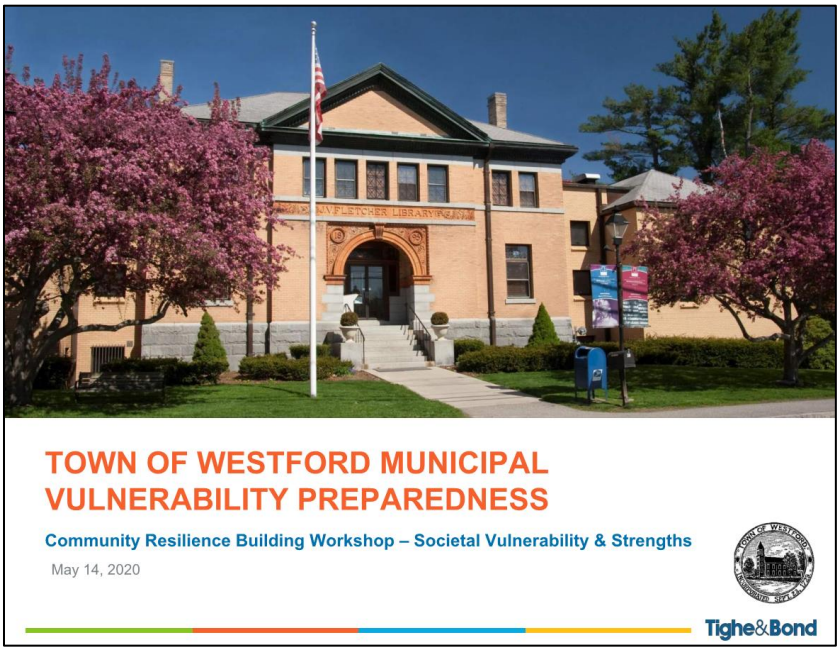


FIGURE 5: Presentation for Westford's Virtual CRB Workshop #1

Appendix D contains the MVP website page, the SurveyMonkey Pre-Webinar Survey, and supplemental workshop materials including PowerPoint Presentations. Natural Hazard Maps and a list of community assets by category are presented in Appendix E. The completed CRB matrix is included in Appendix H.

1.2.5 Listening Session

A listening session to present the final report and review the high priority actions identified through the CRB workshops was held on June 18, 2020, from 10:30 to 11:30 AM, via a GoToMeeting Event. This event was advertised by the Town Manager in her June 9, 2020, report to the Board of Selectmen. The Town Planner invited all stakeholders that had been identified by the Core Team and those that had participated in previous workshops.

Town Staff led the session with support from Tighe & Bond. Seven attendees participated. The group had a lively discussion about climate concerns, additional strengths and vulnerabilities in Westford, and mitigation actions. Highlights of that discussion include:

- The Cameron Senior Center is an excellent resource for the aging community in Westford.
- Ways to encourage use of alternative energy sources to petroleum.
- The impacts on the environment, economy, society, and Town infrastructure may be less significant from a project on a previously developed parcel than on an undeveloped parcel. There are ways to manage this with Zoning bylaw updates, such as a Natural Resource Overlay District, among others.
- Opportunities to educate residents and developers to use sustainable building methods, including LEED Certification, and less wasteful building methods and materials, and make this a requirement of municipal projects.
- Protection of the Town's public water supply is a high priority.

- Recognition that Native American ceremonial sites are a societal asset that should be included in the inventory.
- Reinforcement that the Town's information technology department is a critical service for all municipal staff and the public, and relocating these services to a facility that is safe and has redundancy is critical for Town operations.
- Education of municipal staff, elected and appointed officials, and the public about invasive species, using native species, and best lawn maintenance practices including timing mowing to protect pollinators and nesting for certain species, is important to preserving Westford's natural environment and overall character.
- Reinvigorating awareness of the AM radio station that can be activated during emergencies should be a priority. While the Town has a "reverse 911" system (i.e., CODE RED), which is used strategically and for serious emergencies, there is concern about cell phone service being limited during an extended power outage. The AM radio station could be used to transmit information critical to response and help with recovery to natural hazards.
- Education of students on hazard mitigation, overall sustainability, conservation, and environmental stewardship is a priority.
- Protection of and investment in maintaining Westford's tree cover is important. It might be worth considering allocating more resources towards the Tree Warden role and developing an inventory of trees and tree planting program (that considers power line locations). Ways to require new developments to plant larger and more trees, with specific species requirements and maintain their health for longer than currently required, should be considered. This would help with reduce impacts of heat island effects, and improve overall air quality and public health. On proposed development sites, make assessment of opportunities for tree retention and preservation of tree canopy requirement of permitting review.
- Wildlife corridors are an important natural asset in Westford and should be better mapped and protected, and education on these corridors would help municipal staff and residents make decisions about land use.
- Underground utilities could provide some relief from storm events that cause downed lines, but are very expensive and vulnerable to groundwater and flooding.
- Police in Westford are proactive about protecting vulnerable, including elderly, citizens in Westford.

The presentation for the listening session and a list of attendees is provided in Appendix G.

Section 2
Top Hazards and Vulnerable Areas

This section discusses Steps B and C of the CRB Process to characterize hazards and identify community vulnerabilities and strengths (a.k.a. community assets).

2.1 Natural Hazard Risk

2.1.1 State Identified Hazards

The 2018 Massachusetts Hazard Mitigation and Climate Adaptation Plan (SHMCAP)[2] provides an in-depth overview of natural hazards in Massachusetts. The State Plan identifies 14 natural hazards that have impacted or historically occurred in communities within the Commonwealth of Massachusetts. These hazards are as follows:

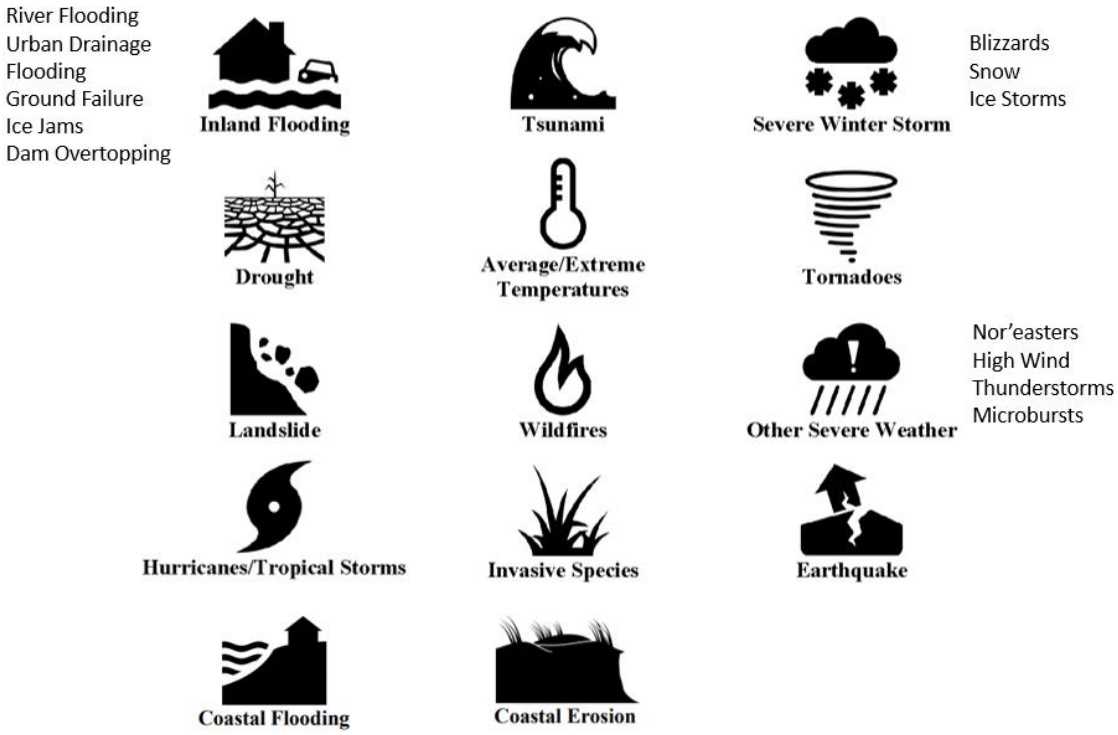


FIGURE 6: Hazards Identified in the SHMCAP

[2] https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf

2.1.2 Hazards that Apply to Westford

The SHMCAP includes coastal flooding, coastal erosion, and tsunamis, however, because Westford is not a coastal community, these hazards are not applicable and therefore are not further discussed or evaluated in this report.

The Core Team reviewed the remaining natural hazards identified in the SHMCAP and identified natural hazards that have impacted Westford in the past or could impact Westford in the future. The hazards selection for Westford was made using local expertise from the Planning Team, information from the 2015 Regional Hazard Mitigation Plan, the SHMCAP, and other sources. All of the natural hazards presented in the SHMCAP except those applicable to coastal communities were included in the ranking process.

The Core Team reviewed each natural hazard and analyzed the history of occurrence in Town, hazard probability, hazard frequency, geographic extent, and severity of impact. Each of these categories were ranked based off of the Hazard Profile Definitions, displayed in Table 2 and taken from the 2018 SHMCAP.

TABLE 2: Hazard Profile Definitions (2018 SHMCAP)

Points	Rank	Description
Hazard Probability (Possible occurrence in the future)		
1	Unlikely	Less than a 1% probability over the next 100 years
2	Possible	1-10% probability in the next year or at least one chance in the next 100 years
3	Likely	10-100% probability in the next year or at least one chance in the next 10 years
4	Highly Likely	Near 100% probability in the next year
Hazard Frequency		
0	Very Low	Events that occur less frequently than once in 1,000 years (less than 0.1% per year)
1	Low	Events that occur from once in 100 years to once in 1,000 years (0.1% - 1% per year).
2	Medium	Events that occur from once in 10 years to once in 100 years (1% - 10% per year).
3	High	Events that occur more frequently than once in 10 years (greater than 10% per year).
Geographical Extent (Area Impacted by a Given Natural Hazard)		
1	Small	Less than 10% of the Town affected
2	Medium	10-50% of the Town affected
3	Large	More than 50% of the Town affected
Severity of Impact from Hazard		
1	Minor	Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e. one or two communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.

Points	Rank	Description
2	Serious	Scattered major property damage (more than 10% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services briefly interrupted up to 1 day; some minor injuries.
3	Extensive	Consistent major property damage (more than 25%); major damage public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and possible fatalities.
4	Catastrophic	Property and public infrastructure destroyed (more than 50%); essential services stopped for 30 days or more, multiple injuries and fatalities.

Table 3 includes list of the hazards selected by Westford for inclusion in this Summary of Findings Report and the HMP update. The HMP Update includes profiles for each natural hazard and documents additional detail about the history of occurrence and potential future occurrence.

TABLE 3: Relevant Natural Hazards for the Town of Westford

Type of Natural Hazard	History of Occurrence in Westford	Hazard Probability	Hazard Frequency	Geographic Extent	Severity of Impact	Hazard Risk Ranking
Inland Flooding	Yes	2	3	1	1	**7**
Severe Winter-Storm/Nor'easter	Yes	4	3	3	2	**12**
Drought	Yes	3	2	3	2	**10**
Extreme Temperature	Yes	4	3	3	2	**12**
Tropical Storms/ Hurricanes	Yes	2	0	3	3	**12**
Severe Weather-Strong Wind and High Precipitation	Yes	4	3	3	2	**12**
Invasive Species	Yes	4	3	3	1	**11**
Microburst	Yes	4	3	1	3	**11**
Earthquake	Yes	2	1	3	4	**10**
Wildfires	Yes	3	2	2	4	**11**
Tornadoes	No	1	0	1	3	**5**
Landslide	No	1	1	1	2	**5**

2.1.3 Top Hazards for Westford from Risk Matrix

Based on the evaluation of natural hazard risk ranking coupled with the history of occurrence, the geographic extent of impact, economic impact, and consideration for climate change, the Core Team determined the highest ranked natural hazards for Westford consist of:

- Severe Winter Storm/Nor'easter
- Extreme Temperature
- Tropical Storms/Hurricanes
- Severe Weather- Strong Wind and High Precipitation (including Thunderstorms)

2.1.4 Top Hazards for Westford from Survey

The pre-workshop survey included polling to identify the top natural hazards currently impacting Westford, and hazards likely to impact Westford in the future with climate change. Figure 7 shows how frequently natural hazards have occurred in the past/present based on survey responses (e.g., just over 60% of respondents stated that blizzards have occurred once every 3 to 5 years, 100% of respondents said that thunderstorms happen once a year or more often, etc.)

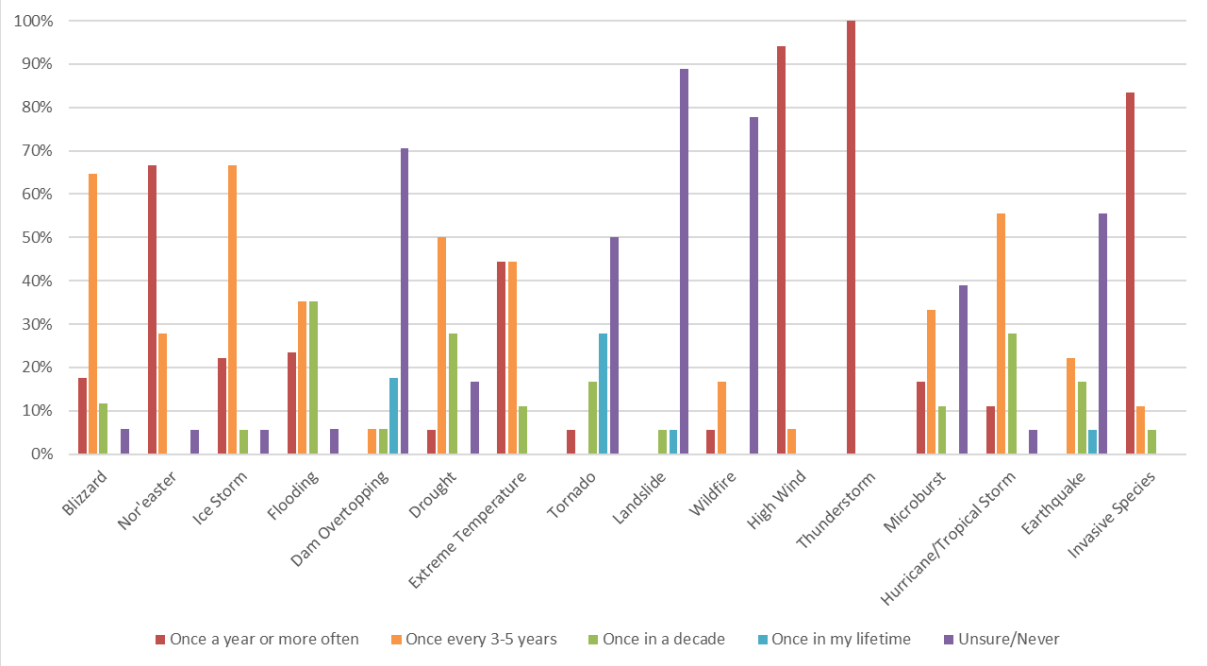


FIGURE 7: Survey Results Showing Perceived Frequency of Past and Present Natural Hazards in Westford

The survey agreed with the findings of the Core Team for natural hazards that are currently impacting Westford or have impacted the Town in the past, however future natural hazard concerns with climate change emphasized invasive species and specifically ice storms.

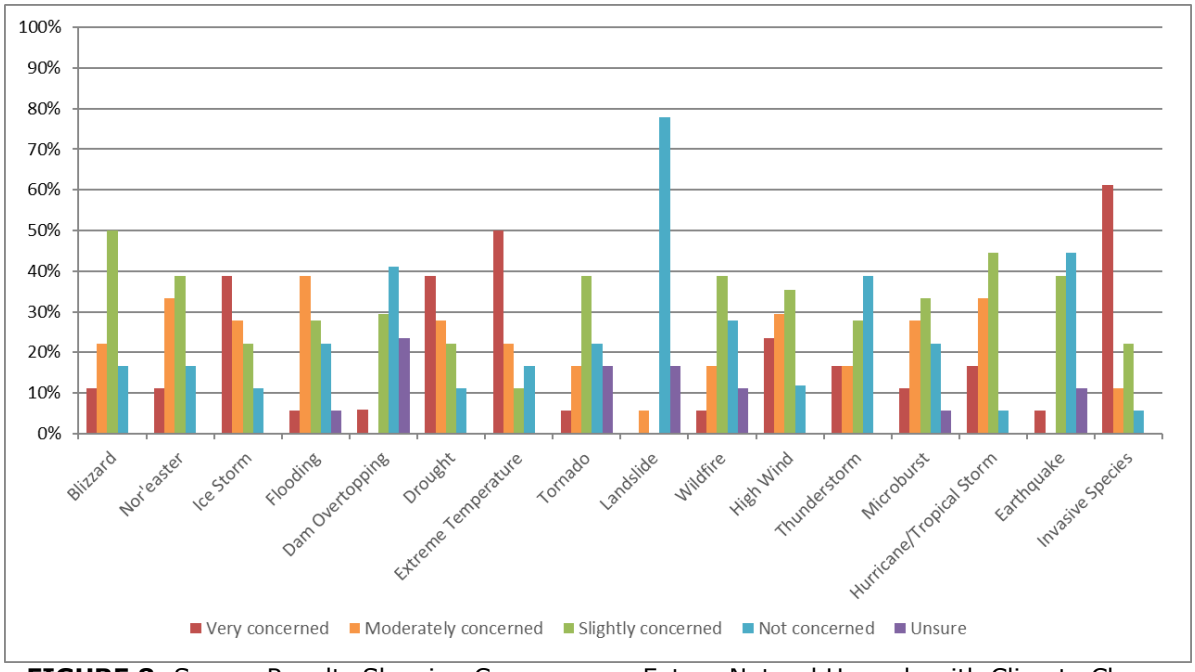


FIGURE 8: Survey Results Showing Concern over Future Natural Hazards with Climate Change

2.1.5 Top Natural Hazards for Westford

The CRB Workshop top natural hazards are based on combining the Core Team evaluation with the stakeholder survey results, resulting in a final list consisting of:

- Severe Weather/Strong Wind/Thunderstorms
- Invasive Species
- Severe Winter Storm/Nor'easter
- Extreme temperatures

2.2 Areas of Concern

During the CRB Workshops, participants outlined areas of concern under three categories of community assets, consistent with the CRB Workshop Guide: infrastructural, societal, environmental. In addition, for consistency with the HMP update, participants included areas of concern in Westford's economic assets. The completed CRB Risk Matrix in Appendix H provides additional information.

2.2.1 Infrastructural (Built Environment)

Critical facilities necessary for a community's response to and recovery from emergencies, infrastructure critical for public health and safety, economic viability, or for critical facilities to operate.

The workshop participants identified the following infrastructure with vulnerabilities or strengths within the community:

- Bridges
- Cell Towers & Antennas
- Highway Department
- Information Technology Center

- Communications Infrastructure
- Culverts
- Dams
- Drinking water wells, treatment, and distribution, including pumping stations
- Electric Grid
- Fire Department
- Gas infrastructure
- Gas stations
- Helicopter landing zones
- Interstates
- Police Central Station
- Railroad
- Roads
- Schools
- Secondary salt storage shed
- Town Hall
- Wastewater facilities



FIGURE 9: Stony Brook Bridge *(Westford Comprehensive Master Plan, 2009)*



FIGURE 10: Forge Village Water Treatment Plant



FIGURE 11: Central Fire Station (*Open House Brochure, photo by Michael Woessner*)

2.2.2 Societal (People/Vulnerable Populations)

The workshop participants identified the following societal sectors with vulnerabilities or strengths within the community:

1. **Buildings or facilities that support community needs**
    - Adult day centers
    - Bridges by EPOC
    - Churches
    - Day cares
    - Elderly housing
    - Senior center
    - Shelters
    - Westford Nursing home
2. **Vulnerable populations**
    - Elderly, particularly living alone
    - Disabled residents
    - Homebound residents
    - Low income residents
    - Veterans
    - Limited or non-English speaking groups
    - Essential workers
3. **Support services**
    - Caregivers
    - Medical Reserve Core
    - Communication network
    - Westford community garden
    - Westford food pantry



Figure 12: Westford's Community Center

2.2.3 Environmental (Natural Environment)

Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc.

The workshop participants identified the following environmental sectors with vulnerabilities or strengths within the community:

1. **Hydrologic Resources**
   - Aquifers
   - Floodplain
   - Waterbodies and wetlands (e.g. the many ponds, Stony Brook, etc.)
2. **Open Space and Conservation Lands**
   - All conservation lands, including Stony Brook Conservation Land
   - Connected open space
3. **Parks and Recreational Areas**
   - East Boston Camps
   - Forge Pond and Forge Beach
   - Nabnasset Lake
   - Trails
4. **Environmental Health**
   - Vernal pools
   - Tree cover
   - Invasive species
   - Healthy Lakes and Ponds Committee
   - Stream team
   - Stormwater Management Master Plan
5. **Environmental Education**
   - Conservation Commission
   - Healthy Westford Committee
   - Involvement by scouts to maintain trails
   - Open Space and Recreation Plan
   - Trail mapping
   - Water Department



FIGURE 13: Kayakers on Nabnasset Lake



FIGURE 14: Russell Bird Sanctuary

Section 3
Current Concerns and Challenges Presented by Hazards and Climate Change

3.1 Climate Change Concerns

The pre-workshop survey results indicate that Westford is very concerned about climate change impacts on natural hazard risk. As shown in Figure 15, over half of the survey respondents were very concerned with climate change, approximately one fourth were moderately concerned, and the remainder of the respondents had limited concern. Those that took the survey noted concerns that the community is already experiencing impacts of climate change, with concerns about energy demand, diminishing breathable air, reduced forest cover, and invasion of non-native species.

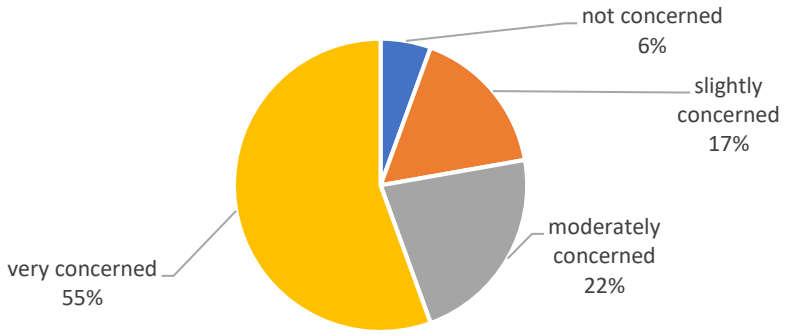


Figure 15: Climate Change Concerns from Survey Results

- Severe storms seem to be more frequent and have a significant impact on the Town.
- The community is feeling the impacts from extreme temperatures, including drought. Atmospheric hazards impact the public water supply and private wells.
- Tropical storms and hurricanes impact Westford, resulting in flooding and power outages.
- Invasive species are located throughout Town and harm local waterbody health and impact habitat for native species.
- Microbursts have occurred a number of times and had significant impacts to localized areas.
- While Westford is not a coastal community, a survey respondent noted that all municipalities will be in some way impact by climate change.

These hazards are anticipated to be amplified by climate change as discussed in Commonwealth's resilient MA Climate Change Clearinghouse website (http://www.resilientma.org/)



Changes in Precipitation: Changes in the amount, frequency, and timing of precipitation—including both rainfall and snowfall—are occurring across the globe as temperatures rise and other climate patterns shift in response.



Rising Temperatures: Average global temperatures have risen steadily in the last 50 years, and scientists warn that the trend will continue unless greenhouse gas emissions are significantly reduced. The 9 warmest years on record all occurred in the last 20 years (2017, 2016, 2015, 2014, 2013, 2010, 2009, 2005, and 1998), according to the U.S. National Oceanographic and Atmospheric Administration (NOAA).



Extreme Weather: Climate change is expected to increase extreme weather events across the globe, as well as right here in Massachusetts. There is strong evidence that storms—from heavy downpours and blizzards to tropical cyclones and hurricanes—are becoming more intense and damaging, and can lead to devastating impacts for residents across the state.

The following table reproduced from the SHMCAP shows how climate change interacts with natural hazards.

TABLE 4: Climate Change Interactions

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

3.2 Massachusetts Climate Change Projections

Researchers from the Northeast Climate Adaptation Science Center (NECASC) at University of Massachusetts Amherst prepared projections for changes in temperature, precipitation, and sea level rise for the entire state, as well as each major watershed in recognition that there are regional differences in weather. EEA is encouraging municipalities, industry, non-government organizations, state government and others to utilize this information as a standard, peer-reviewed set of climate change projections and is recommending these projections be included in MVP planning efforts.

The Town of Westford is located within the Sudbury-Assabet-Concord (SuAsCo) Basin and the Merrimack Basin. The southern part of the Town is within the SuAsCo Basin and the northern half is in the Merrimack Basin. The information specific to the SuAsCo Basin and the Merrimack Basin was excerpted from Massachusetts Climate Change Projections, dated March 2018[3] and is included in Appendix F.

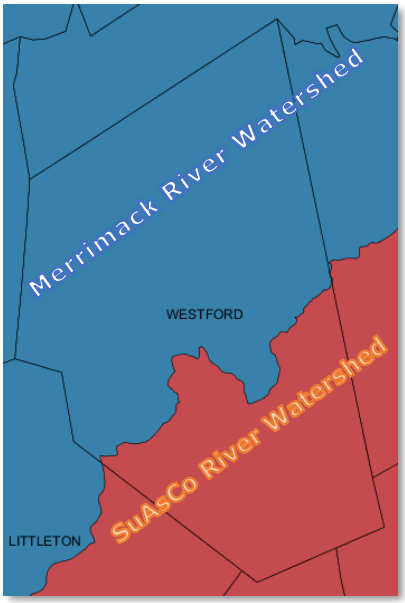


FIGURE 16: Major Watersheds in Westford

3.3 Specific Categories of Concerns and Challenges

Workshop attendees identified community assets that were either vulnerable to the impacts of climate change or strengths to the Town of Westford. The completed matrix is included in Appendix H.

The vast majority of the assets were seen as a strength to the community while a number had specific vulnerabilities noted. Some examples of vulnerabilities are included below.

Societal Vulnerabilities

- The elderly population, particularly those living alone, they may not be able to get out as often, may need assistance to get food or assistance with evacuation. However, this population has the experience of having survived many natural hazard disasters and being creative in up with solutions that are based on those experiences.
- Staffing at nursing homes and care facilities can be limited during natural hazards.
- The Cameron Senior Center is an excellent resource for the aging community in Westford.
- Bridges by EPOC is a 54-bed facility for Alzheimer's patients. While it has a generator, and is required to have individual emergency evacuation plan, this facility is vulnerable to natural hazards, especially those with an extended duration.

[3] https://www.mass.gov/files/ma-statewide-and-majorbasins-climate-projections-final.pdf

Infrastructural Vulnerabilities

- Cell phone communication system is vulnerable to natural hazards that may cause power outages or equipment damage.
- Concerns about impacts to the aquifer for the Town's drinking water supply due to development and redevelopment, and use of chemicals on lawns and for agriculture.
- Town has no authority over private dams, some of which could pose a risk to public safety if they are not inspected and maintained.
- Gas stations are primarily located in two key parts of Town.
- An unknown number of stormwater management and/or treatment structures.
- If certain bridges or culverts fail, they will impede emergency response passage to parts of Town.
- The electric grid is highly vulnerable to storm events.
- High pressure gas line crosses southern border with Carlisle. There may be aging gas infrastructure throughout Westford as well.
- Town record storage space is limited and some of it is located in basements that have concerns about water accrual. Record management is dictated by state requirements, but there may be an option to store more documents electronically.
- The Stony Brook railroad line is a heavily traveled freight route. If there was an accident or spill, Westford would by impacted. There is a emergency response plan the railroad follows.



FIGURE 17: Stony Brook Dam (Left: Upstream View, Right: Downstream View)

Environmental Vulnerabilities



FIGURE 18: Algal Bloom at Nabnasset Lake (*Westford Patch*)

- Invasive species are a huge issue in Westford's many waterbodies, wetlands, and open space areas, and impede growth of native species and hinder habitat and water quality.
- Conservation land has challenges with illegal dumping and off-leash pets.
- Beavers pose a risk to flow of wetlands and waterbodies, as well as roadways and culverts.
- Town has Forest Committee and a Forest Management Plan, however, funding is limited.
- Weak coordination between committees are boards in development effective polices for environmental protection or hazard mitigation.
- The town's zoning bylaw has limited provisions for environmental protection, and there are instances where variances are granted without strong supporting evidence for doing so.

3.4 Current Strengths and Assets

Westford officials and emergency response staff are actively engaged in preparing the community to respond to and adapt to current and future natural hazards. Collaboration, communication, and responsiveness of these staff is viewed as a strength in Westford. In addition, Westford has an active and engaged resident base that helps facilitate outreach and education and provide input on ongoing planning processes. Westford's public works staff are viewed as a strength in terms of their operation and management of the water and wastewater systems and assistance with emergency response. The Town also completes thoughtful planning exercises, such as currently updating its Master Plan, and has begun the process of preparing a Town-specific HMP update.

Numerous community assets were identified as a strength to mitigate impacts of climate. Some examples are included below:

Societal Strengths

- Westford has a special population registry used for communication and emergency response.
- Community garden can provide food during recovery from a natural hazard event, depending on time of year.
- Medical Reserve Core is made up of 520 volunteers that serves both medical and non-medical needs.
- Town emergency response staff help private care facilities exercise emergency response plans periodically.
- Native American ceremonial sites are located in Westford.

- Police in Westford are proactive about protecting vulnerable, including elderly, citizens in Westford.
- Churches provide individual families with resources for recovery to natural hazards.

Infrastructural Strengths

- Westford undertakes proactive planning for drinking water (e.g. water system master plan) and stormwater work (e.g. stormwater management master plan, culvert inventory and assessment, stormwater utility, etc.)
- Westford has numerous shelter options and warming/cooling center capabilities.
- Town has a second salt shed for winter deicing, which helps improve response during hazard events and maintain public safety and emergency response capabilities.
- Senior center has a backup generator.
- Certain bridges provide critical emergency access routes.
- Electric company provides a strong response to restoring power after storm events.
- Fire stations, especially new station, provide quality and timely emergency response to town.
- May town buildings have backup power.
- Westford has a quality public water supply system.
- There are a number of mapped helicopter landing zones in Westford. The one at the Highway Facility and the one at the cul-de-sac at Robins Road are maintained throughout the winter and therefore accessibility is preserved.



FIGURE 19: Westford Highway Garage

Environmental Strengths

- Water quality is tested at 14 locations for beaches and the stream team has historically measured water quality in stream at various locations throughout Westford.
- Town has extensive trails that are well mapped. Trails are well maintained by various groups including scouts.
- Certain areas of Town are now mowed at specific time that considers species nesting.

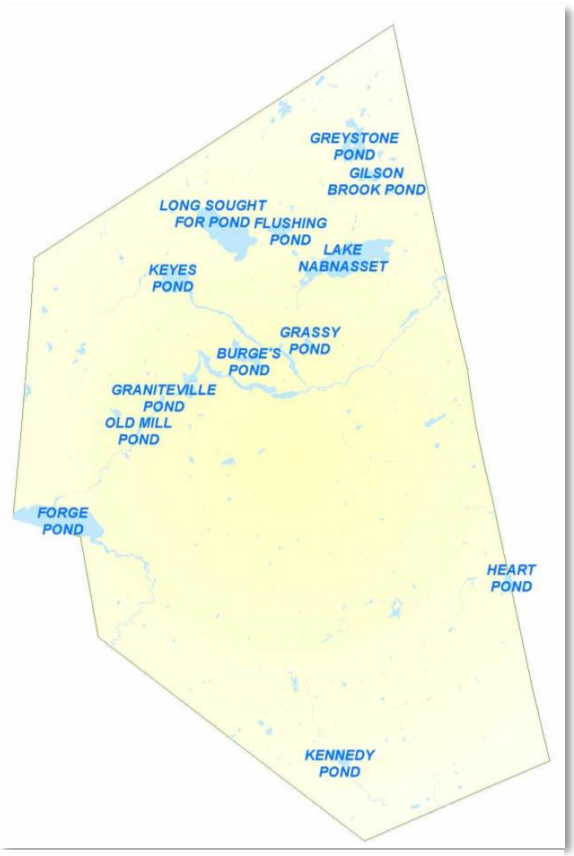


FIGURE 20: Westford's Lakes and Ponds

- Town's standard Order of Conditions from Conservation Commission requires clean fill to avoid invasive species and contamination.
- Conservation Commission also restricts storage of fuels and undesirable liquids in buffer zones.
- The Town's Open Space and Recreation Plan, which has been conditionally approved as of the data of this report, lays out preservation of open space, conservation plan, and commitment to recreation facilities.

3.5 Hazard Mitigation Measures

According the FEMA's Local Multi-Hazard Mitigation Planning Guidance, hazard mitigation measures can generally be sorted into six categories:

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

   Projects that were recommended for prevention include:

   - Amend zoning bylaws to address heat island effects and increase resiliency by adjusting planting and parking requirements (e.g., require native plants, limit monoculture, reduce impervious areas, etc.).
   - Update local code for historic properties that would apply if building was renovated or damaged to include natural hazard resiliency considerations.
   - For bridges, assessment of MassDOT inspections and initiation of maintenance and repair/replacement program.
   - Develop a strategic vegetation program that considers locations of power lines.
   - Continue to require inspections of dams (both public and private).
   - Create a "Ranger" position that will support management and maintenance of conservation lands, trails, and open space.
   - Map lands that are critical for climate resiliency.
   - Develop a Natural Resource Overlay District in Zoning code to mitigate impacts on the environment, economy, society, and Town infrastructure from development on undisturbed sites.
   - Consider code changes to require Town projects, residents and developers to use sustainable building methods, including LEED Certification, and less wasteful building methods and materials.
   - Change code to require developers to plant larger and more trees with species requirements, and to maintain their health for longer than currently required.
   - Amend wetland bylaw to provide more detail on climate resiliency and improve clarity regarding buffer zone protection.
   - Consider code changes to require consideration of watershed-based management when making development discussions.

2. **Property Protection**: Modification or removal of existing buildings or infrastructure to protect them from a hazard. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter resistant glass.

   Projects that were recommended for property protection include:

   - Evaluate Highway Department Building lightning suppression system.
   - The Town's information technology department is a critical service for all municipal staff and the public, and relocating these services to a facility that is safe and has redundancy is critical for Town operations.
   - Continue to comply with the Office of Dam Safety regulations and continue to monitor the condition of dams.

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

   Projects that were recommended for public education and awareness include:

   - Educate residents and developers to use sustainable building methods, including LEED Certification, and less wasteful building methods and materials.
   - Educate municipal staff, elected and appointed officials, and the public about invasive species, using native species, and best lawn maintenance practices including timing mowing to protect pollinators and nesting for certain species.
   - Educate municipal staff, elected and appointed officials, and the public about the connection between development, land use patterns and hazard mitigation. Promote education on connecting climate change with land use decisions.
   - Educate residents about the AM radio station (1630 AM) that can be activated during emergencies.
   - Enhance existing education program to include hazard mitigation, coupled with overall sustainability, conservation, and environmental stewardship, in public schools.
   - Provide information to caregivers of special needs, the elderly, and other vulnerable populations about what to do, and how to access resources during natural hazards. Provide that information in multiple languages.
   - Develop education materials on using non-phosphorous fertilizers that may create eutrophication and other nutrient impairments and impact the public water supply.
   - The Healthy Lakes and Ponds Collaborative and Healthy Westford Committee are two organizations that could be used to present educational materials on healthy lawns, water conservation, and watershed/water supply protection. Revisit using these groups to distribute education.
   - Educate private entities that rely on drinking water wells on routinely testing their drinking water.

- Provide signage/education on erosion on conservation land – such as restricting vehicular usage.
- Educate private dam owners on inspection and maintenance, along with responsibility they have of the dam on their property.

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

   Projects that were recommended for natural resource protection and green infrastructure include:

   - Protect and invest in keeping Westford populated with trees. Allocate more resources towards the Tree Warden role. Develop an inventory of trees and a tree planting program (that considers power line locations).
   - For higher density areas (e.g., villages), add trees and stormwater improvements.
   - Map invasive species.
   - To protect watersheds, waterbodies, and aquifers, continue to undertake stormwater management master plan recommendations including non-structural and structural improvements.
   - Use the Town Forest Committee and the Water Department to improve management of forested areas.
   - Implement a "Green Roof Project" through new construction or infrastructure rehabilitation. Buildings such as the library, apartments, and municipal centers could be candidates for green roof installation.
   - Assess and map wildlife corridors and stream corridors, then consider acquisition for flood storage, wildlife habitat, water quality protection, and climate resiliency.
   - Map lands that are most suitable for climate change resiliency through a partnership with Massachusetts Audubon and The Nature Conservancy.
   - Protect land for pollinators by implementing a Pollinator Project to acquire land and/or restrict mowing in known pollinator areas. Additionally, pollinator gardens could be installed.

5. **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.

   Projects that were recommended for structural actions include:

   - Initiate maintenance and repair program for culverts.
   - Proactively maintain roadways and replace / upgrade drainage as needed to manage water quality and water quantity.
   - Implement stormwater best management practices as feasible on both public and private projects.

- Retrofit Stony Brook Dam to allow for low flow releases.
- For conservation land with known erosion issues (e.g. Forge Pond, Burges Pond, Kennedy Pond), use a combination of education and restoration to redirect water flow (e.g., plantings, structural controls).
- Replace stormwater systems within roadways with known flooding concerns.
- Extend Town's water distribution system to neighborhoods on private wells with poor water quality to improve public health and reduce susceptibility to climate change impacts.
- The Highway Department facility was constructed with only one entrance. If the adjacent property became available, could purchase and add second access. It would be beneficial to increase fuel storage for redundancy for all Town vehicles. Currently only fueling station located at Highway Facility and some other vehicles uses. Fuel will not deliver to facility if there is snow on the ground or predicted for that day, and will not deliver fuel if there are thunderstorms.
- Review specific remedial repairs and improvements for dams as outlined in Phase II Reports.

6. **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.

   Projects that were recommended for emergency services protection include:

   - For elderly population, especially those living alone, providing transportation to support people getting to food pantry and other social services.
   - For elderly care and nursing home facilities, keep inventory of facilities updated, enhance communication on planning, provide assistance with planning. Consider methods to strengthen planning for these facilities and coordination with Town. In addition to communication, understand what services they use related to emergency response.
   - Fine tune communication plan related to social media and homeowner/subdivision networks to be strategic for natural hazards.
   - Enhance security for water facilities by installing security cameras, additional fencing, etc.
   - Develop an Emergency Equipment Storage, Inventory, and Maintenance Plan to keep emergency supplies accessible, in adequate supply, and usable (i.e., avoid expired supplies).
   - Obtain MassDOT emergency response plans for roadways through Westford (e.g., Interstate 495, Route 3, etc.)

3.6 Top Recommendations to Improve Resilience for the Town of Westford

All Mitigation Projects identified in the CRB workshops are a priority for the Town. The list prepared below is subject to change based on evolving conditions in the Town and will be updated annually as part of the annual reporting on the MVP program to EEA. Capacity of Town staff needs to be considered in implementation of all projects. Volunteers should be leveraged if at all feasible.

HIGHEST PRIORITY

- Continue to require inspections of dams (both public and private)
- Develop a Natural Resource Overlay District in Zoning code to mitigation impacts on the environment, economy, society, and Town infrastructure from development on a previously undeveloped parcel
- The Town's information technology department is a critical service for all municipal staff and the public, and relocating these services to a facility that is safe and has redundancy is critical for Town operations.
- Educate residents about the AM radio station that can be activated during emergencies.
- To protect watersheds, waterbodies, and aquifers, continue to undertake stormwater management master plan recommendations including non-structural and structural improvements.
- Obtain MassDOT emergency response plans for roadways through Westford (e.g., Interstate 495, Route 3, etc.)
- Initiate maintenance and repair program for culverts
- Proactively maintain roadways and replace / upgrade drainage as needed to manage water quality and water quantity
- Implement stormwater best management practices as feasible on both public and private projects
- Retrofit Stony Brook Dam to allow for low flow releases
- Replace stormwater systems within roadways with known flooding concerns
- Extend Town's water distribution system to neighborhoods on private wells with poor water quality to improve public health and reduce susceptibility to climate change impacts

MODERATE PRIORITY

- Amend zoning bylaws to address heat island effects and increase resiliency by adjusting planting requirements (e.g., native plants, less grass, etc.)
- For bridges, assessment of MassDOT inspections and initiation of maintenance and repair/replacement program
- Develop a strategic vegetation program that considers locations of power lines

- Consider code changes to require Town projects, residents and developers to use sustainable building methods, including LEED Certification, and less wasteful building methods and materials
- Change code to require development to plant larger and more trees, and maintain their health for longer than currently required
- Educate residents and developers to use sustainable building methods, including LEED Certification, and less wasteful building methods and materials.
- Educate municipal staff, elected and appointed officials, and the public about invasive species, using native species, and best lawn maintenance practices including timing mowing to protect pollinators and nesting for certain species.
- Provide information to caregivers of special needs, elderly, other vulnerable populations about what to do, resources during natural hazards. Provide that information in multiple languages.
- Educate private dam owners on inspection, maintenance.
- Protect and invest in keeping Westford populated with trees. Allocate more resources towards the Tree Warden role. Develop an inventory of trees and tree planting program (that considers power line locations).
- Improve mapping and protection of wildlife corridors in Westford.
- Undertake a tree inventory and management program.
- For higher density areas (e.g., villages), add trees and stormwater improvements.
- For elderly population, especially those living alone, providing transportation to support people getting to food pantry.
- For elderly care and nursing home facilities, keep inventory of facilities updated, enhance communication on planning, provide assistance with planning. Consider methods to strengthen planning for these facilities and coordination with Town. In addition to communication, understand what services they use related to emergency response.
- Fine tune communication plan related to social media and homeowner/subdivision networks to be strategic for natural hazards.
- For conservation land with known erosion issues (e.g. Forge Pond, Burges Pond, Kennedy Pond), use a combination of education and restoration to redirect water flow (e.g., plantings, structural controls)
- Review specific remedial repairs and improvements for dams as outlined in Phase II Reports

LOWER PRIORITY

- Update local code for historic properties that would apply if building was renovated or damaged to include natural hazard resiliency considerations
- Create a "Ranger" position that will support management and maintenance of conservation lands, trails, and open space
- Evaluate Highway Department Building lightening suppression system.

- Enhance existing education program to include hazard mitigation, coupled with overall sustainability, conservation, and environmental stewardship, in public schools.
- Map invasive species.
- Consider watershed-based management program
- The Highway Department facility was constructed with only one entrance. If the adjacent property became available, could purchase and add second access. It would be beneficial to increase fuel storage for redundancy for all Town vehicles. Currently only fueling station located at Highway Facility and some other vehicles uses. Fuel will not deliver to facility if there is snow on the ground or predicted for that day, and will not deliver fuel if there are thunderstorms

Section 4
Workshop Details

4.1 Workshop Participants

A list of those invited to participate in the workshops and who attended is included in Appendix C. Members of the core team that had a role are also documented.

4.1.1 Workshop #1 (Societal) Attendance

Workshop Date: May 14, 2020: 10:30 AM
Workshop Host: Rebecca Cheney, Town Planner
Workshop Facilitator: Gabrielle Belfit, CFM, MVP Certified Provider – Tighe & Bond
Workshop Presentation: Jennie Moonan, PE, MVP Certified Provider - Tighe & Bond

4.1.2 Workshop #2 (Infrastructural) Attendance

Workshop Date: May 21, 2020: 10:30 AM
Workshop Host: Rebecca Cheney, Town Planner
Workshop Facilitator: Gabrielle Belfit, CFM, MVP Certified Provider – Tighe & Bond
Workshop Presentation: Jennie Moonan, PE, MVP Certified Provider - Tighe & Bond

4.1.3 Workshop #3 (Environmental) Attendance

Workshop Date: June 4, 2020: 10:30 AM
Workshop Host: Rebecca Cheney, Town Planner
Workshop Facilitator: Gabrielle Belfit, CFM, MVP Certified Provider – Tighe & Bond
Workshop Presentation: Jennie Moonan, PE, MVP Certified Provider - Tighe & Bond

4.2 Acknowledgements

Funding for the CRB workshop was provided through a Massachusetts Executive Office of Energy and Environmental Affairs (EEA) Municipal Vulnerability and Preparedness Planning Grant during Fiscal Year 20.

Many thanks to Rebecca Cheney for serving as the lead for the MVP Planning Process. A special thanks to all MVP Core Team members and everyone who participated in the CRB workshops as presenters, facilitators, scribes and stakeholders.

4.3 Report Citation

Tighe & Bond (2020). *Community Resilience Building Workshop Summary of Findings*, Town of Westford, Massachusetts.

J:\W\W5005 Westford MA\015 MVP Planning Grant\8 - MVP Report\02 - Westford MVP Findings Report_DRAFT.docx

Tighe&Bond

APPENDIX A

Westford MVP / HMP Core Team Kickoff Meeting Agenda

TO: Attendees (See sign-in sheet)
LOCATION: Westford Town Hall – Conference Room
DATE: September 11, 2019
TIME: 10:00 to 11:30 AM

10:00 AM **Welcome & Introductions**

10:05 AM **Presentation**

Background
MVP / HMP Grant and Workshop Goals
MVP / HMP Grant and CRB Process
Overlap with Local Planning
Guidelines/Guidance
More about the workshops…
Deliverables
What does Westford get from this process?
Roles & Responsibilities
Schedule

10:30 AM **Discussion Item: Natural Hazard Risks**

Matrix to be presented

10:50 AM **Discussion Item: HMP Goals**

See handout

11:10 AM **Discussion Item: Open Input on Vulnerabilities and Mitigation Actions**

11:25 AM **Next Steps**

11:30 AM **Conclude**

Westford MVP / HMP Core Team Kickoff Meeting Summary

TO: Attendees (See sign-in sheet)

LOCATION: Westford Town Hall – Conference Room

DATE: September 11, 2019

TIME: 10:00 to 11:30 AM

10:10 AM **Welcome & Introductions**

10:15 AM **Presentation & Discussion – see copy attached**

Group discussion about the following topics

Background
MVP / HMP Grant and Workshop Goals
MVP / HMP Grant and CRB Process
Overlap with Local Planning
Guidelines/Guidance
More about the workshops…
Deliverables
What does Westford get from this process?
Roles & Responsibilities
Schedule

11:00 AM **Discussion Item: Natural Hazard Risks**

Matrix presented and draft attached

Added beavers, algal blooms, microbursts, tsunamis, and separated dams from culverts

Initial rating by MVP Core Team is likely to be modified after T&B completes natural hazard risk assessment research

11:25 AM **Next Steps & Action Items**

Set up DropBox
Send Rebecca information for Chris to complete asset inventory
Send Rebecca capabilities assessment information
Provide examples of MVP reports
Send group schedule
Obtain reports on dams from Jeremy

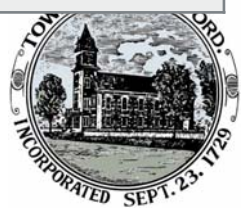
11:30 AM **Conclude**

Town of Westford
MVP / HMP Grant Core Team Workshop
September 11, 2019
Westford Town Hall Conference Room
10:00 am -11:30 am

Name	Signature
Carol Gumbart- Conservation/Resource Planner	
Gabrielle Belfit- Senior Environmental Scientist	
Henry Fontaine- Assistant Building Commissioner	
Jeffrey Morrissette- Director of Land Use Management	absent
Jeffrey Stephens- Health Director	
Jennie Moonan- Project Manager	
Jeremy Downs- Assistant Town Engineer	
Joe Targ- Fire Chief	
Matthew Hakala- Building Commissioner	
Matthew Salem- Assistant Planner	absent
Paul Fox- Director of Facilities	
Paul Starratt- Town Engineer	
Rebecca Cheney- Town Planner	
Richard Barrett- Highway Superintendent	absent
Stephen Cronin- Water Superintendent	
Tom Mahanna- Vice President	

SCHEDULE

Task	Date
1. Kickoff Meeting	September 2019
2. Characterize and Prioritize Hazards	September/October 2019
3. Community Asset Inventory	September/October 2019
4. Multi-Hazard Vulnerability Assessment	November 2019
5. Capabilities Assessment	October/November 2019
6. Development of Adaptation Strategies	January 2020
7. MVP workshops	April 2020
8. Draft and Final MVP Report	April - June 2020
9. Draft HMP Update Report	May 2020
10. Public Community Listening Session	May 2020
11. Ongoing Coordination	





HMP / MVP PLANNING GRANT

Core Team Kickoff Meeting

September 11, 2019

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INTRODUCTIONS

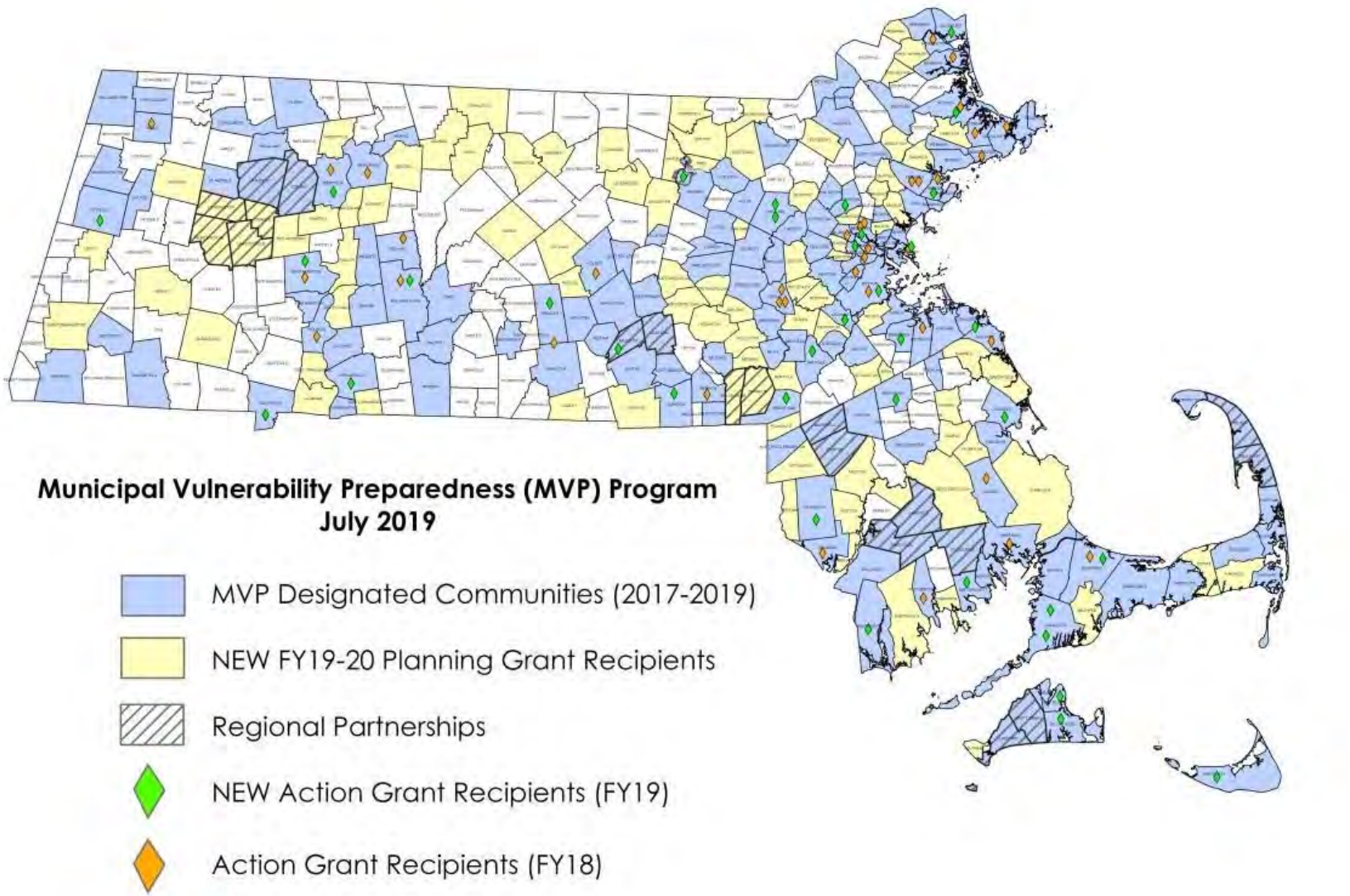


BACKGROUND

- Executive Order 569: An Integrated Climate Change Strategy for the Commonwealth
- Town awarded a planning grant through Commonwealth's Executive Office of Energy and Environment
- Grant is to complete **Municipal Vulnerability Preparedness (MVP)** Community Resilience Building (CRB) Workshop Process and prepare a **draft Hazard Mitigation Plan (HMP) Update**

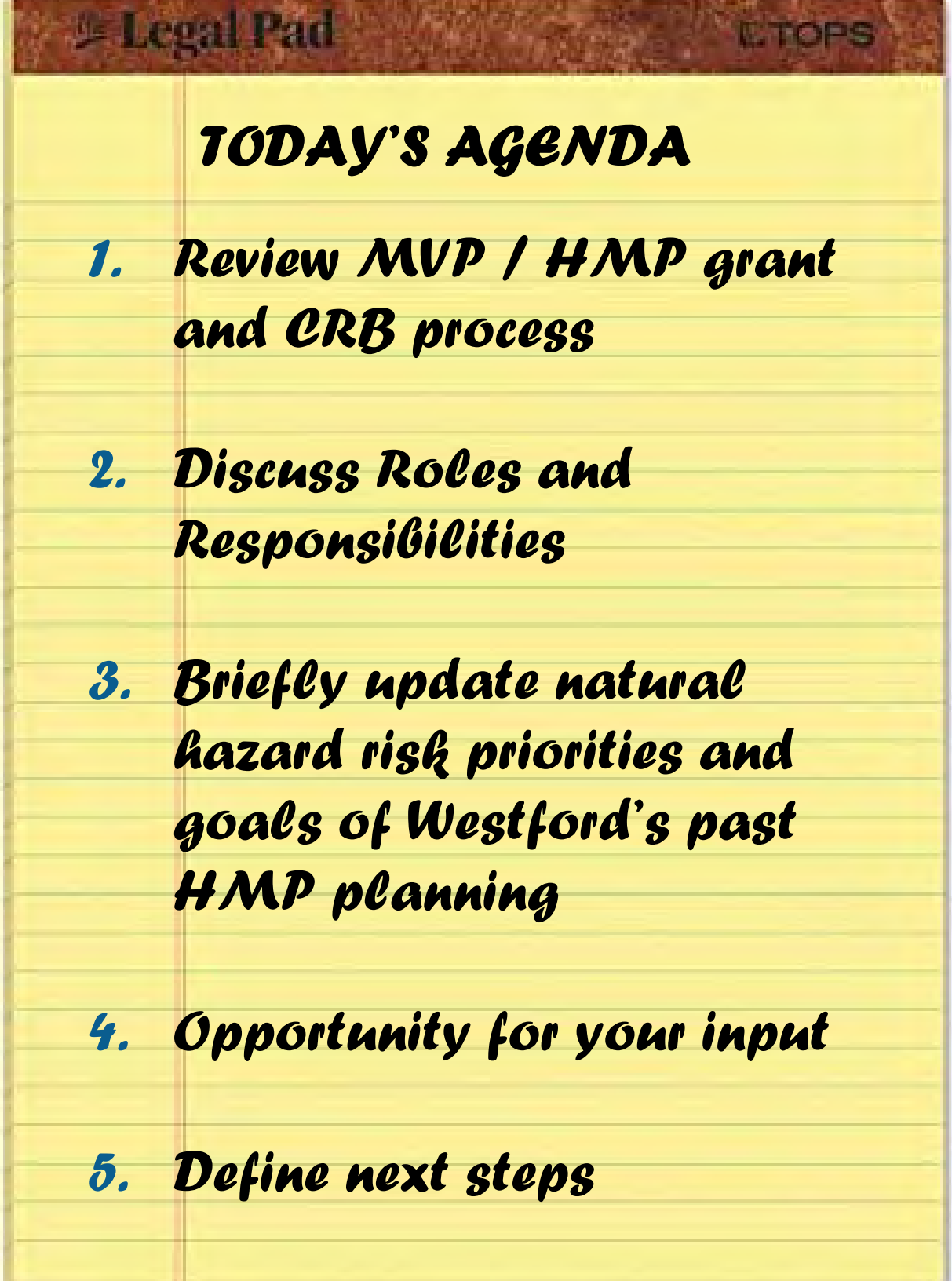
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BACKGROUND



TOWN OF WESTFORD
INCORPORATED SEPT. 23, 1729

Tighe&Bond


Legal Pad
TOPS
TODAY'S AGENDA
1. Review MVP / HMP grant and CRB process
2. Discuss Roles and Responsibilities
3. Briefly update natural hazard risk priorities and goals of Westford's past HMP planning
4. Opportunity for your input
5. Define next steps

MVP/HMP GRANT AND WORKSHOP PROCESS GOALS

Build Resilience and Preparedness:

- Understand community assets and vulnerabilities
- Plan for more frequent and intense weather events
- Improve pre-event planning, response & recovery, and identify long-term mitigation actions

A prepared and resilient Westford will be able to maintain functions, protect its residents, and be ready for future storm events and a changing climate



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MVP/HMP GRANT AND CRB PROCESS

1. Establish Core Team
2. Complete MVP/HMP Evaluation/Assessment
   - Natural Hazard Risks
   - Community Assets
   - Multi-Hazard Vulnerability Assessment
   - Capabilities Assessment
   - Mitigation Strategies
3. Hold two Workshops
4. Draft MVP Report
5. Hold Listening Session
6. Final MVP Report & Draft HMP Report

See handout: *Attachment A – Scope of Services: Integrating MVP and Hazard Mitigation Planning*

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THERE IS AN OVERLAP WITH LOCAL PLANNING

- Stormwater Management Master Plan / MS4
- Comprehensive Emergency Management Plan?
- Water System Master Plan
- Open Space and Recreation Plan

Copies available

Community Resilience Building

WORKSHOP GUIDE



www.**CommunityResilienceBuilding**.org

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Overview of the Process (Steps & Tasks)

DURING WORKSHOP

A Prepare for the Workshop
1. Establish a core team with goals.
2. Engage stakeholders.
3. Prepare materials for workshop.
4. Decide on participant arrangements.

B Characterize Hazards
1. Identify past, current, and future impacts.
2. Determine the highest-priority hazards.

C Identify Community Vulnerabilities and Strengths
1. Identify infrastructural vulnerabilities and strengths.
2. Identify societal vulnerabilities and strengths.
3. Identify environmental vulnerabilities and strengths.

D Identify and Prioritize Community Actions
1. Identify and prioritize infrastructural actions.
2. Identify and prioritize societal actions.
3. Identify and prioritize environmental actions.

E Determine the Overall Priority Actions
1. Identify highest-priority actions.
2. Further define urgency and timing.

F Put It All Together
1. Generate final workshop products.

G Move Forward
1. Continue community outreach and engagement.
2. Secure additional data and information.
3. Inform existing planning and project activities.

Community Components



Infrastructural



Societal



Environmental

MULTI-HAZARD MITIGATION PLAN GUIDANCE

- **Disaster Mitigation Act of 2000, 44 CRF Part 201.6**
- **Commonwealth of Massachusetts State Hazard Mitigation Plan 2013**
- ***FEMA Local Mitigation Plan Review Guidance, October 2011***
- ***FEMA Local Mitigation Planning Handbook, March 2013***

1. Document the Planning Process
2. Document Methodologies Used
3. Involve Larger Community
4. Address FEMA concerns from 2013

FEMA

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WHAT ARE THESE WORKSHOPS…?







DELIVERABLES

- **MVP Report**



- **Hazard Mitigation Plan**



y Resilience Building Risk Matrix — www.CommunityResilienceBuilding.org

Quincy's Top Priority Hazards

Assets	Location	Ownership (City, State, Federal, Private)	V or S	Inland Flooding	Coastal Flooding & Erosion	Nor'easter	Severe Winter Weather	Priority H - M - L	Time Short Long Ongoing
	Complete for New Assets Only								
ral									
portation Corridors	Citywide	City/State	V	Improve access during emergencies and severe weather events; Establish alternative routes and emergency alternative means of transportation; Increase culvert size at main corridors throughout City				H	O/S
				Improve Stormwater Management	Install Pump Stations				
et	East Squantum Street	City	V		Ongoing maintenance and repairs to seawall; Ongoing clearing of debris from road			M	L
	Sea Street	City	V	Backup Generator; MWRA Sewer Easement Access, develop hydraulic model, Sea Street Seawall Rehab and Enhancement for greater protection				H	S
	Terne Road	City	V		Analysis for Construction of Pump Station; Assessment of Tide gates			H	S
	Quincy Shore Drive	DCR	V/S	Storm Drain Maintenance	Salt Marsh restoration; Ongoing tide gate repair and maintenance; ongoing seawall repair and maintenance; Increase seawall height; Blacks Creek Tide Gate project; Sand Removal			H	O
				Alternative Route Planning; Ongoing maintenance and clearing of debris along road; Allocate funding to maintenance and improvements of Quincy Shore Drive; Conduct Analysis of Local Code and Feasibility study for elevating residential homes on Quincy Shore Drive; Mosquito spraying; control of invasive species; Sand Removal;					
ighborhood	Post Island Road	City/Private	V/S	Emergency Backup Generators; Georges Island Seawall Analysis; Pump Station Analysis; Construct new seawall; Evaluate living shoreline; Increase capacity of culverts on Sea Street; Perform dike assessment				H/M	O/S
	Neponset Ave	City	V		Salt Marsh Restoration; Saganore Creek Tide Gate; Division Street Pump Station Repairs			H	L
ry Pier	552 Victory Road	City	V/S		Breakwater			L	O
	Squantum Neighborhood	City/Private	V	Increase culvert size				H	O
cess	Citywide	State	S	Improve Stormwater management and Construction of Stormwater Pumping Stations				H	L
	Hancock Street	State	V/S	Maintain up to date SPCC Plan; Maintain fleet for use in case of emergencies				M	O
				Retrofit Bus Barn for flooding and elevate roads			Retrofit site to sustain severe winter weather		
vacuation Routes	Citywide	N/A	V	Provide emergency power to light evacuation routes				H	S
y Services	Citywide	N/A	V	Maintain Comprehensive Emergency Management Plan; Provide additional Public Education; Establish an Emergency Notification and Warning System to Resident's Cell Phones; Improve Stormwater Management				H	O
ment Office	1 Merrymount Pkway	City	S	Maintain Equipment in case of emergency; Generator upgrades; Maintenance of Vehicles/Fleet, Site Floodproofing				H	O/S
ngine 5	182 Copeland Street	City	S	Maintenance of Equipment; Adequate Staffing; Ongoing Public Education and Emergency Alert System				H	O

TOWN OF WESTFORD INCORPORATED SEPT. 23, 1729

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WHAT DOES WESTFORD GET FROM THIS PROCESS?



MVP Community Designation =
Eligibility for MVP Action Grants

Once approved, HMP =
Eligibility for FEMA/MEMA Grants



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WHY ARE YOU HERE?

See roles & responsibilities handout

- Kickoff Meeting
- Two interim meetings to review / provide input on work products
- Each attend at least 1 MVP Workshop
- Review draft reports & provide comments



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SCHEDULE

Task	Date
1. Kickoff Meeting	September 2019
2. Characterize and Prioritize Hazards	September/October 2019
3. Community Asset Inventory	September/October 2019
4. Multi-Hazard Vulnerability Assessment	November 2019
5. Capabilities Assessment	October/November 2019
6. Development of Adaptation Strategies	January 2020
7. MVP workshops	April 2020
8. Draft and Final MVP Report	April - June 2020
9. Draft HMP Update Report	May 2020
10. Public Community Listening Session	May 2020
11. Ongoing Coordination	



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DISCUSSION ITEM: NATURAL HAZARD RISKS

See Handout & Spreadsheet

DISCUSSION ITEM: UPDATE HMP GOALS

See Handout

DISCUSSION ITEM (IF TIME ALLOWS): VULNERABILITIES AND MITIGATION ACTIONS

Open discussion

YOUR CHANCE FOR INPUT TODAY ON LOGISTICS…

- **Plan for communication & workshops**
  - Key stakeholders
  - Public notification
  - Approach to staffing workshops (need a facilitator per table)

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NEXT STEPS

- Town GIS Coordinator to prepare Asset Inventory
- Proceed with Evaluation/Assessment
- Meeting later this Fall/early Winter to review draft deliverables
- Individual input, provided separately, welcome

OPEN DISCUSSION & QUESTIONS

Contact Information

- **Jennie Moonan, PE, Project Manager**
  - JSMoonan@tighebond.com
  - 781-708-9826



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Westford MVP / HMP Core Team Kickoff Meeting Agenda

TO: Attendees (See sign-in sheet)

LOCATION: Westford Town Hall – Conference Room

DATE: February 24, 2020

TIME: 1:00 – 3:00 PM

1:00 PM Welcome and Update

- Please sign in
- Update on project progress

1:10 PM Discussion on HMP Goals

- See handout, will present on screen

1:30 PM Discussion About Draft Asset Inventory

- See handout, will present details on screen

2:00 PM Mitigation Strategies – Update from 2015 HMP

- See handouts, will present live on screen

2:30 PM Meeting and Workshop Planning

- 4/6/2020 – Public Hearing
- Discussion on MVP Workshop
    - 4/9/2020 – Library Meeting Room (1:00 -5:00 PM)?
    - 4/28/2020 – Millennium School Conference Room B (5:00 – 9:00 PM)?
    - 4/30/2020 – Library Meeting Room (9:00 AM – 5:00 PM)?
- 5/12/2020 – Listening Session
- _____ - Board of Selectmen vote to approve to send to MEMA for review (prior to June 30, 2020)

2:50 PM Next Steps, Questions & Acton Items

- Town staff to provide edits to Asset Inventory by _____
- Tighe & Bond to provide Chapters 1 through 5 of draft HMP by _____

3:00 PM Adjourn

Town of Westford, MA
MVP/HMP Planning Grant
Sign-in Sheet

Date: Monday, February 24, 2020 **Time:** 1:00 – 3:00 PM

Location: Westford Town Hall, Conference Room

RE: MVP Planning Grant

Attendees:

Name	Title/Department	Signature
Carol Gumbart	Conservation/Resource Planner	
Henry Fontaine	Building Commissioner	
Jeffery Morrissette	Director of Land Use Management	
Jeffery Stephens	Health Director	
Jennie Moonan	Tighe & Bond	
Jeremy Downs	Assistant Town Engineer	
Joe Targ	Fire Chief	
Matthew Salem	Assistant Planner	
Paul Fox	Director of Facilities	
Paul Starratt	Town Engineer	
Rebecca Cheney	Town Planner	
Richard Barrett	Highway Superintendent	
Stephen Cronin	Water Superintendent	
Tom Mahanna	Tighe & Bond	
Tim Whitcomb	Public Safety Communications	

Westford MVP / HMP Core Team Check In Meeting Agenda

TO: Attendees

LOCATION: Webinar (see email for instructions)

DATE: May 7, 2020

TIME: 10:30 to 11:30 AM

10:30 AM **Brief Update on Grant Information from EEA**

Extensions available, Westford has elected to maintain June 30, 2020 deadline

Alternative public engagement guidance must be followed

Action Grant $ - some changes for FY21 and beyond

10:40 AM **HMP/MVP Project Status Update**

Completed:

- Natural Hazard Identification and Ranking
- Community Asset Inventory

In progress:

- Draft HMP Report sections
- Community Capabilities Assessment

Scheduled:

- Public Meeting: Monday May 18, 2020, Planning Board Meeting
- Workshops (see below)

10:50 AM **Review of Alternative Public Engagement Approach**

Pre-workshop survey & materials

Four separate workshops, Thursdays at 10:30 AM. Goal is 1 hour, allocating 1.5 hours to address EEA desired total of 8 hours of workshops.

Post-workshop survey

Ability for folks to receive hardcopies if desired

11:10 AM **Open Discussion and Questions**

11:30 AM **Conclude**



WESTFORD HAZARD MITIGATION AND MUNICIPAL VULNERABILITY PREPAREDNESS PLANNING

Public Meeting

April 18, 2020 7:30 to 8 PM

Tighe&Bond

WELCOME



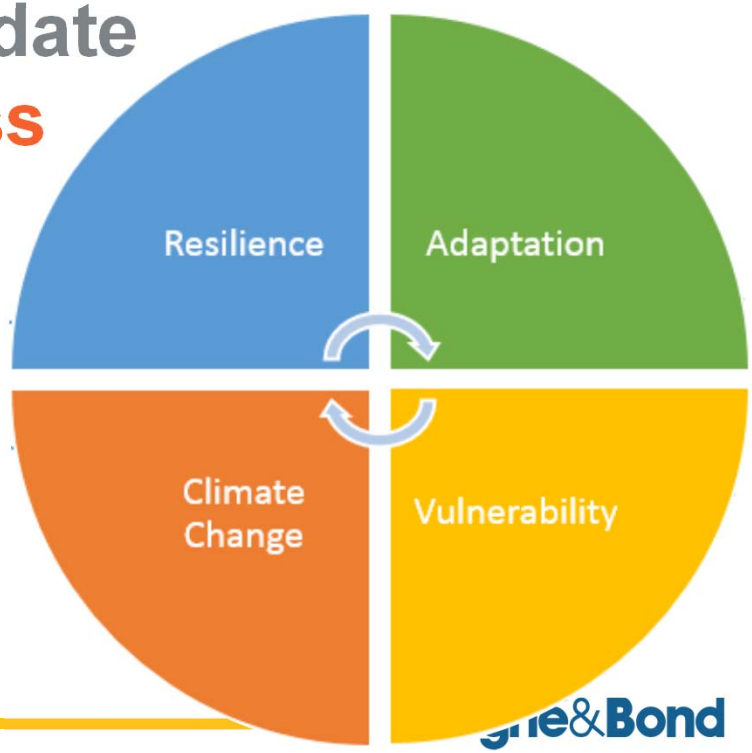
Westford awarded $36K grant for

- Municipal Vulnerability Preparedness (MVP) Community Resilience Building (CRB) Workshop Process; and
- Draft Hazard Mitigation Plan (HMP) Update

First step in unlocking additional funding opportunities for Westford from FEMA/MEMA and Commonwealth of Massachusetts

MVP/HMP GRANT AND CRB PROCESS

1. Establish Core Team
2. Complete Evaluation/Assessment
   - Natural Hazard Risks
   - Community Assets
   - Multi-Hazard Vulnerability Assessment
   - Capabilities Assessment
   - Mitigation Strategies
3. Draft Hazard Mitigation Plan Update
4. **Hold Public Meeting mid-process**
5. Hold MVP Workshops
6. Draft MVP Report
7. Hold Listening Session
8. Final MVP Report



PURPOSE OF PUBLIC MEETING

- **Required** to comply with Federal HMP guidance and contract with EEA
- **Introduce Hazard Mitigation and Municipal Vulnerability Planning** and **provide an update** on work completed to date
- Provide opportunity for **Q&A**

A brief thanks to Westford's MVP Core Team

CORE TEAM

- Carol Gumbart
- Henry Fontaine
- Jeffrey Stephens
- Jeremy Downs
- Joe Targ
- Paul Fox
- Paul Starratt
- Rae Dick
- Rebecca Cheney
- Richard Barrett
- Stephen Cronin
- Tim Whitcomb



BACKGROUND

EXECUTIVE ORDER 569 9.16.16

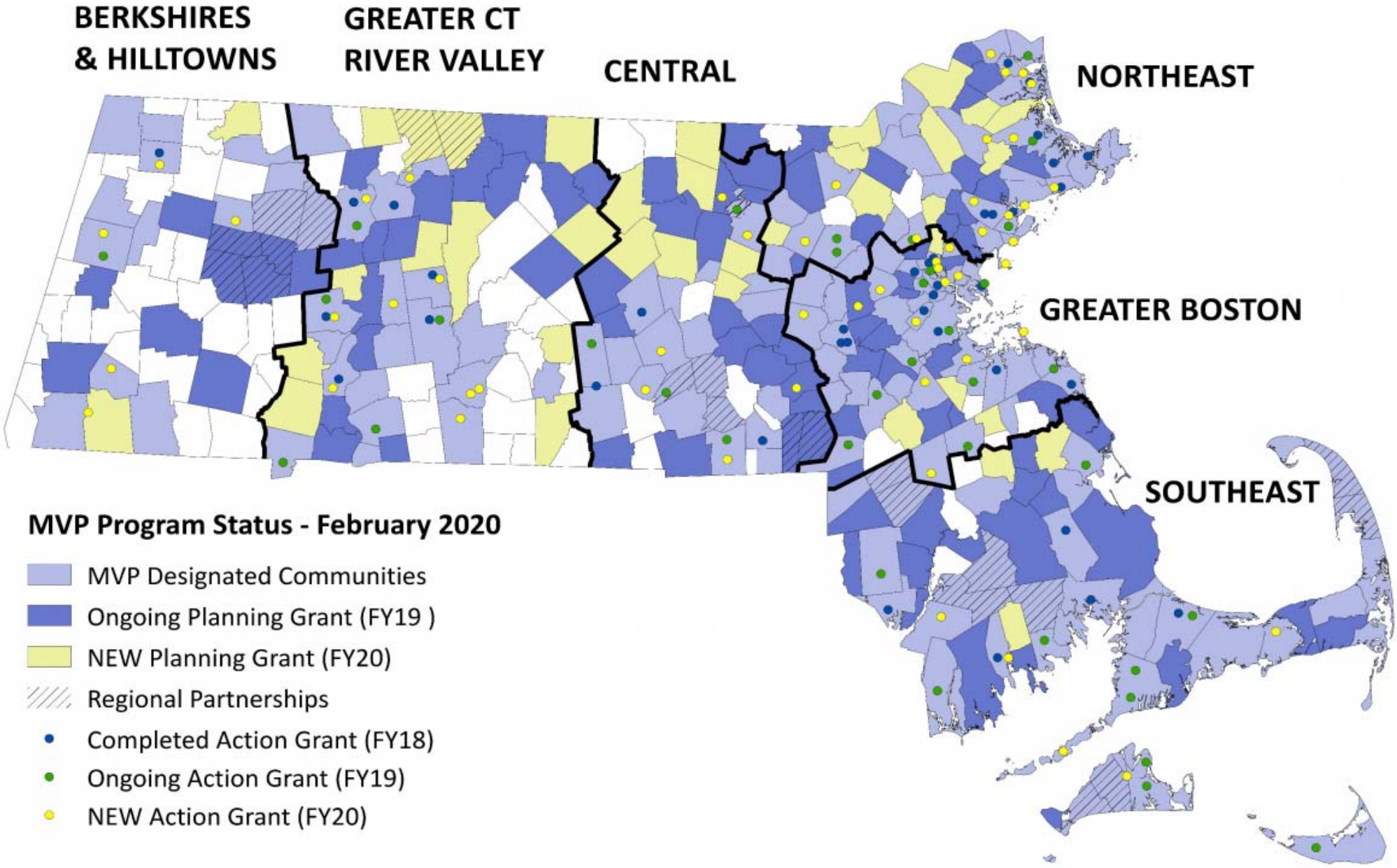


ENVIRONMENTAL BOND BILL 8.21.18



- $2.4 billion bond bill with focus on climate change resiliency
- Over $200 million authorized for climate change adaptation
- **Codifies EO 569, including the MVP Program**

BACKGROUND

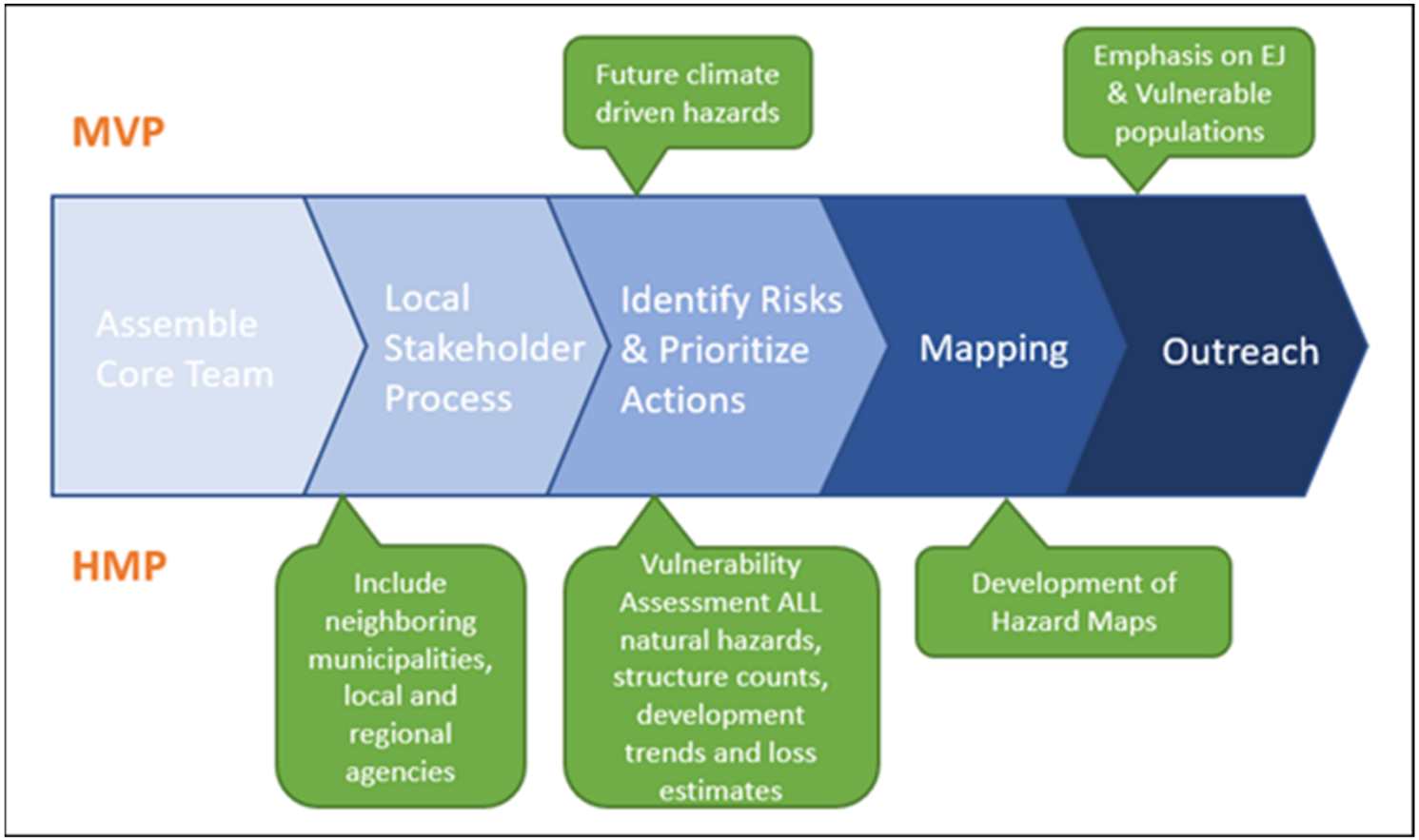

BERKSHIRES & HILLTOWNS
GREATER CT RIVER VALLEY
CENTRAL
NORTHEAST
GREATER BOSTON
SOUTHEAST
MVP Program Status - February 2020
MVP Designated Communities
Ongoing Planning Grant (FY19)
NEW Planning Grant (FY20)
Regional Partnerships
Completed Action Grant (FY18)
Ongoing Action Grant (FY19)
NEW Action Grant (FY20)

BACKGROUND ON HAZARD MITIGATION PLANNING

- **FEMA Requirements:**
  - Disaster Mitigation Act of 2000, 44 CRF Part 201.6
  - *FEMA Local Mitigation Plan Review Guidance, October 2011*
  - *FEMA Local Mitigation Planning Handbook, March 2013*
- **Westford included in Northern Middlesex Regional Hazard Mitigation Plan, approved August 2015.**
  http://www.nmcog.org/Websites/nmcog/images/Hazard_Mitigation_Plan_FEMA_approved_8_15.pdf
- **To maintain eligibility for FEMA/MEMA funding, must update plan every 5 years**
- **Commonwealth of Massachusetts State Hazard Mitigation & Climate Adaptation Plan 2018 must be considered in update**

HOW DO THE MVP AND HMP PROCESSES OVERLAP?

The MVP effort supplements the HMP process by providing a statewide and major watershed specific climate change data to use in the natural hazard risk assessment and a consistent methodology for public engagement through the Community Resilience Building (CRB) workshops.



WHY DO THIS PLANNING?

Help Westford Build Resilience and Preparedness:

- Build on the Town's existing emergency management capabilities
- Plan for more frequent and intense weather events that are linked to climate change
- Engage multiple stakeholders in the planning process
- Improve access to funding for mitigation and adaptation





COMMUNITY ASSET INVENTORY

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COMMUNITY ASSET CATEGORIES

FEMA defines a community asset as anything that is important to the character and function of a community.

FEMA Community Asset Categories	Critical Sectors	Characteristics of Community Assets
People	Schools, Vulnerable Populations, Cultural Facilities	Areas of greater population density, or population with unique vulnerabilities or less able to respond and recover during a disaster.
Built Environment	Critical Municipal Facilities, Water, Wastewater, Energy, Stormwater, Transportation, Cultural Resources	Critical facilities necessary for a community's response to and recovery from emergencies, infrastructure critical for public health and safety, economic viability, or needed for critical facilities to operate.
Economy	Marinas, Business and Industry	Major employers, primary economic sectors and commercial centers where loss or inoperability would have severe impact on the community and ability to recover from a disaster.
Natural Environment	Natural Resources	Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc.

PEOPLE – SOCIETAL ASSETS

- Child Care (e.g. Roudenbush Children's Center, Westford KinderCare, etc.)
- Places of worship
- Cemeteries
- Emergency shelters
- Westford Food Pantry
- Historical Places
- Nursing Homes/elderly housing/elderly care
- Cameron Senior Center and Roudenbush Community Center
- J.V. Fletcher Library
- Schools
- Village at Mystery Spring
- Westford Museum
- Parish Center for the Arts



WESTFORD
FOOD PANTRY

BUILT ENVIRONMENT – INFRASTRUCTURE ASSETS

- Fire and Police facilities
- Water treatment and distribution
- Culverts (town-wide) and bridges
- Dams (private and town-owned) and bridges
- Town Hall and other municipal buildings
- Medical facilities (e.g., CVS Minute Clinic, Westford Counseling Center)
- Power grid
- Public safety communications
- Schools/town shelters





ECONOMIC ASSETS

- Banks
- Funeral Homes (Main Street, Pleasant Street)
- Gas Stations
- Supermarkets (Whole Foods, Market Basket)
- Hardware Store (ACE Hardware)
- Kimball Farm
- Nashoba Valley Ski Area
- Oil Delivery (e.g. JA Healy & Sons)
- Pharmacies (CVS, Walgreens)
- Major employers (e.g., Juniper Networks, Netscout system, etc.)
- Tree removal services
- Veterinary hospitals





ENVIRONMENTAL ASSETS

- Conservation lands and open space
- Wetlands and Waterbodies throughout town (e.g., Stony Brook, Nabnasset Lake, Forge Pond, Beaver Brook, etc.)
- Habitat (including vernal pools)
- Trails (Nashua River Trail)
- Well contribution areas
- Parks, fields (e.g. VFW softball field)
- East Boston Camps
- Beaches (Edwards and Forge Pond)







NATURAL HAZARD RISK AND VULNERABILITY ASSESSMENT

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WHAT ARE NATURAL HAZARDS?


Inland Flooding


Tsunami


Severe Winter Storm

Blizzards
Snow
Ice Storms


Drought


Average/Extreme Temperatures


Tornadoes


Landslide


Wildfires


Other Severe Weather

Nor'easters
High Wind
Heavy Precipitation
Microbursts


Hurricanes/Tropical Storms


Invasive Species


Earthquake

HISTORICAL EVENTS

- October 1963 Earthquake
  - Magnitude 4.5 earthquake
- October 1970 Tornado
  - Killed one person and caused between $50,000 and $500,000 in damages
- Winter of 1995
  - Snowfall reached over 126 inches
- May 2007 Brush/Wildland Fire
  - Spread across several acres and to a home
- December 2008 Ice Storm
  - Brought down trees and power lines
- August 2011 Hurricane Irene
  - Widespread power outage
- October 2011 Halloween Storm
  - Power out for six days



- March 2018 Nor'easter
  - Westford received over 20 inches of snow from a winter nor'easter

NATURAL HAZARD RISK INDEX

Type of Natural Hazard	History of Occurrence in Westford	Hazard Probability	Hazard Frequency	Geographic Extent	Severity of Impact	Hazard Risk Ranking
Hydrological Hazards						
Inland Flooding	Yes	2	3	1	1	7
Drought	Yes	3	2	3	2	10
Atmospheric Hazards						
Extreme Temperatures	Yes	4	3	3	2	12
Hurricanes/ Tropical Storms	Yes	2	0	3	2	7
Nor'easters	Yes	4	3	3	3	13
Other Sever Weather – High Winds and Thunder storms	Yes	4	3	3	2	12
Severe Winter Storm – Snow, Ice, and Blizzard	Yes	4	3	3	2	12
Tornadoes	Yes	1	0	1	3	5
Microburst	Yes	4	3	1	3	11
Geologic Hazards						
Earthquake	Yes	2	1	3	4	10
Other Hazards						
Wildfires	Yes	3	2	2	4	11
Invasive Species (including algae)	Yes	4	3	3	1	11

WESTFORD'S TOP HAZARDS

- **Input on past, present, and future hazards based on public perception being provided via survey:**
  - https://www.surveymonkey.com/r/8BZDR87

- **Top hazard risk ranking by Core Team:**
  - Nor'easters
  - Severe Weather (e.g. thunderstorms, high wind) & Winter storms (e.g., ice and blizzards)
  - Extreme Temperature
  - Invasive Species



AMPLIFIED RISKS



CLIMATE CHANGE

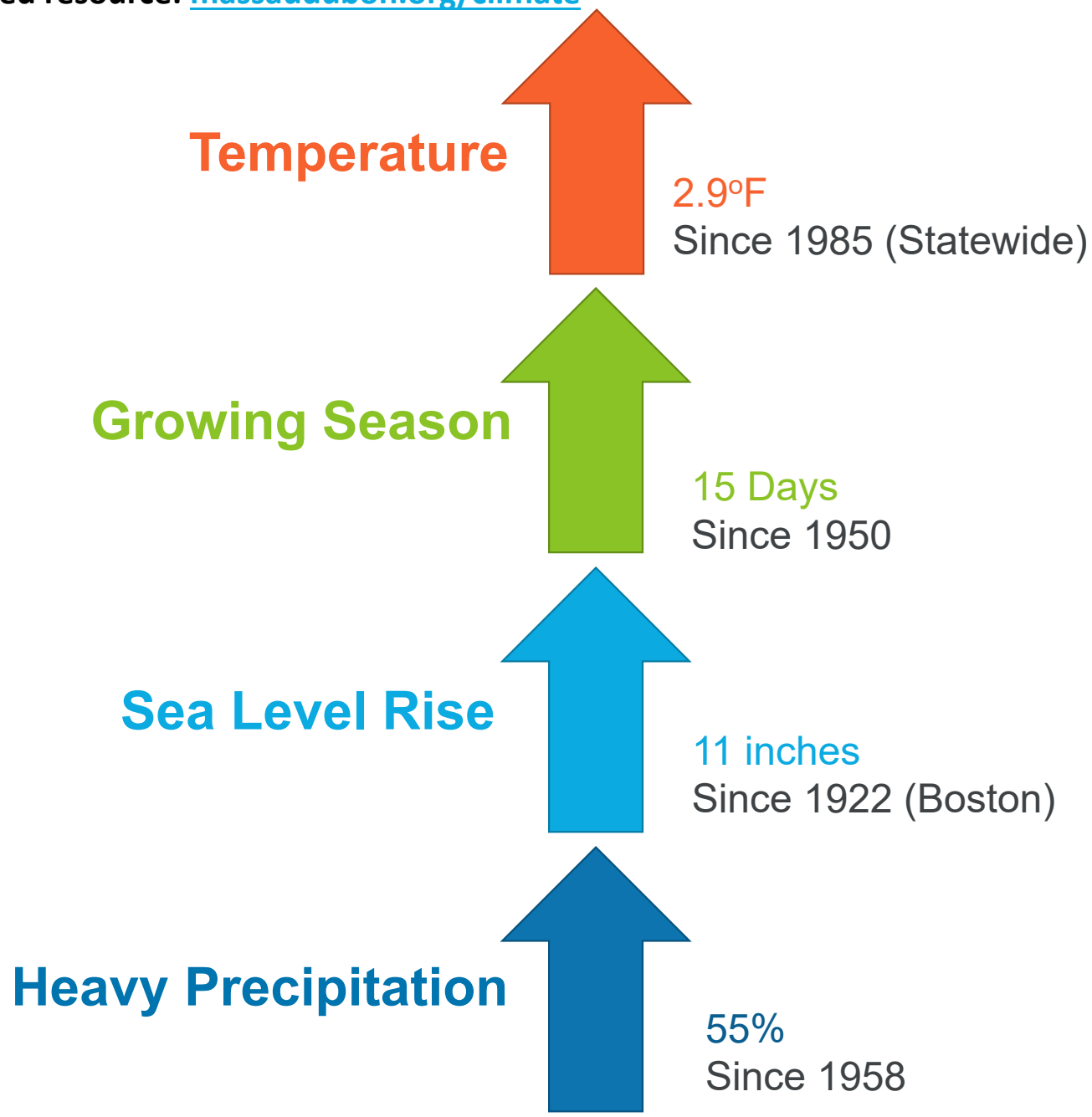
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CLIMATE CHANGE REFERENCES FOR MVP PROCESS

- **Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan, September 2018**
  - https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan
- **Massachusetts Climate Clearinghouse**
  - https://resilientma.org/
- **Statewide and Major Watershed (Basin) Climate Change Projections**
  - https://www.mass.gov/files/ma-statewide-and-majorbasins-climate-projections-final.pdf

MASSACHUSETTS OBSERVED CLIMATE CHANGES

Recommended resource: massaudubon.org/climate



MASSACHUSETTS CLIMATE PROJECTIONS

By end of century:

Changes in precipitation

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

Rising temperatures

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

Sea level rise

- 4-10.5 feet along the MA coast

Extreme weather

- Increase in frequency and magnitude



CHANGES IN PRECIPITATION

Nashua Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	45.9	+0.4 to +4.9	+1.2 to +6.3	+2.3 to +7.9	+1.3 to +8.4
	Winter	11.0	-0.3 to +1.9	+0.2 to +2.5	+0.4 to +3.3	+0.6 to +4.3
	Spring	11.8	-0.0 to +2.2	+0.1 to +2.0	+0.5 to +3.0	+0.1 to +2.9
	Summer	11.3	-0.3 to +1.5	-0.3 to +2.2	-0.6 to +2.2	-1.1 to +2.2
	Fall	11.8	-1.1 to +1.1	-1.2 to +1.8	-1.6 to +1.7	-1.4 to +1.5

IMPACTS OF CHANGING PRECIPITATION

- Episodic droughts
- Concerns over food production and drinking water supply
- Stress on ecosystems
- Flooding

EXTREME STORMS

Blizzards

- There have been more than 5 in Massachusetts since 2011

Nor'easters and Hurricanes

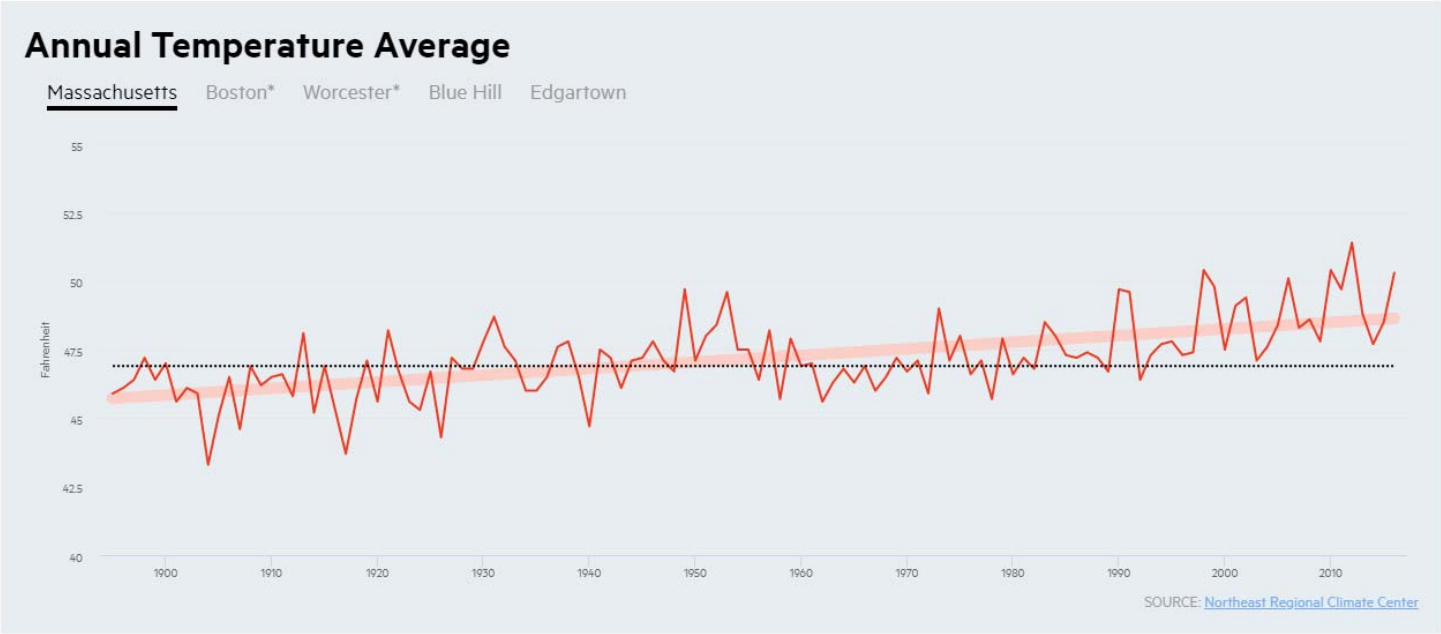
- Upward trend since the 1970s



IMPACTS OF EXTREME STORMS:

- **Public safety concerns, including increased injuries and mortality**
- **Economic damages and business disruption**
- **Property and infrastructure damage**
- **Natural resources**

RISING TEMPERATURE



IMPACTS OF RISING TEMPERATURE:

- Heat-related illnesses
- Vector borne-diseases
- Health of plants, animals, ecosystems
- Reduced crop production
- Larger energy demand
- Droughts and wildfires



MITIGATION STRATEGIES FOR VULNERABLE ASSETS

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TYPES OF MITIGATION ACTIONS

1. Prevention
2. Property Protection
3. Public Education and Awareness
4. Natural Resource Protection and Green Infrastructure
5. Structural Projects
6. Emergency Services Protection



MVP WORKSHOPS

In progress now

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THURSDAYS AT 10:30 AM

1. Workshop #1: 5/14/2020 on Societal Assets and People

2. Workshop #2: 5/21/2020 on Infrastructure

3. Workshop #3: 5/28/2020 on Economy

4. Workshop #4: 6/4/2020 on Environment and Natural Resources

Sign up on Town website or contact Rebecca Cheney
https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla

WORKSHOP OBJECTIVES

- Hear from stakeholders who can help evaluate our community's strengths and vulnerabilities of residents, infrastructure, and natural resources
- Understand connections between natural hazards and local planning/mitigation efforts
- Develop and prioritize resiliency actions for the municipality, organizations, businesses, neighborhoods, and community groups
- Identify opportunities to advance actions that reduce the impact of hazards and increase resiliency in the community





Community Resilience Building
WORKSHOP GUIDE



www.CommunityResilienceBuilding.org



resilient **MA**

Climate Change Clearinghouse for the Commonwealth

ResilientMA.org

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NEXT STEPS BEFORE JUNE 30, 2020

- Complete draft Hazard Mitigation Plan for Town staff and public review
- Hold listening session
- Selectmen vote to submit Hazard Mitigation Plan to FEMA
- Submit documents to EEA and FEMA



GRANT OPPORTUNITIES

Tighe&Bond

HOW DOES THIS PROCESS BENEFIT WESTFORD?



MVP Community Designation = Eligibility for MVP Action Grants

Once approved, HMP = Eligibility for FEMA Hazard Mitigation Grants



OPEN DISCUSSION & QUESTIONS

Contact Information:



- **Rebecca Cheney, Town Planner**
  - Rcheney@westfordma.gov
  - (978) 399-2577
- **Janet Moonan, PE, Project Manager**
  - JSMoonan@tighebond.com
  - (781) 708-9826

Information on Town's website at:

- https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla

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APPENDIX B

Town of Westford MVP Grant – Virtual Public Engagement During COVID-19

TO: Michelle Rowden, MVP Northeast Regional Coordinator, Executive Office of Energy and Environmental Affairs (EEA)

FROM: Janet S. Moonan, PE, Project Manager, Tighe & Bond

COPY: Rebecca Cheney, Town Planner, Westford

DATE: April 17, 2020

Westford is in receipt of EEA's April 7, 2020, email that contained recommendations for adjusting the public engagement strategies to accommodate social distancing and stay-at-home advisories due to the ongoing COVID-19 crisis, while still accomplishing the Fiscal Year Municipal Vulnerability Preparedness (MVP) grant program requirements.

We understand that a key component of the MVP program is public engagement; however, during this time, meeting the various requirements for public engagement within the MVP program will require a multi-modal approach. To meet the requirements of the program, it is necessary that Westford's community is informed and engaged. The virtual public engagement plan proposed below recognizes equitable engagement within the MVP process as a top priority. The engagement methods proposed below allow participation from key stakeholders as well as vulnerable populations.

The MVP Planning Grant process typically includes a minimum of three in-person, group meetings: Core Team Meeting, the Community Resilience Building (CRB) Workshop, and Public Listening Session. In addition, Westford was awarded funds to complete a Hazard Mitigation Plan (HMP) Update which requires a Public Meeting. Westford has completed two in-person Core Team meetings, and prepared for the workshops.

The sections below outline Westford's proposed strategy to virtually meet the goals of the MVP engagement process. **Westford is seeking confirmation from EEA as soon as possible that the proposed virtual engagement strategy meets the requirements of the MVP contract so we may proceed.**

Overview of Proposed Virtual MVP Engagement Process

To meet the requirements of the in-person meetings outlined above, Westford will work with their MVP Provider, Tighe & Bond, to complete the following virtual engagement process:

1. **Provide an online space for MVP materials**: A municipal-specific MVP website will be designed and hosted to provide all necessary materials for completing the MVP process. Reference material such as the Massachusetts State Hazard Mitigation and Climate Action Plan, ResilientMA.org, the MVP Workshop Guide, and the Regional Hazard Mitigation Plan that covers Westford will be available for public access on this website. Municipal-specific information such as maps and the workshop matrix will also be provided via the online website or through email. Recorded meetings and Virtual CRB Workshop Webinars and the draft and final MVP Summary of Findings Report will be posted to the website.

2. **Survey to identify strengths and vulnerabilities**: Tighe & Bond will use Survey Monkey to create and distribute a survey to members of the Core Team and identified stakeholders. The survey questionnaire results will be used to develop a master list of

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APPENDIX C

Westford MVP Stakeholder list - 2020

Name	Contact	Affiliation
Alemeida, Elizabeth	ealmeida@westfordma.gov	Select Board
Amiro, Tom	tomamiro@comcast.net	Climate Action Committee
Barrett, Chris	cbarrett@westfordma.gov	Pedestrian Safety and Capital Planning Committees
Bartl, Roland	planning@acton-ma.gov	Acton PLanner
Berenson, Margie	meberenson@comcast.net	Climate Action Committee
Berlinski, Mike	michaelberlinski@yahoo.com	Energy Committee
Brem, Jeff	jabrem@meisnerbrem.com	Meisner Brem Engineers, principal, green building advocate
Cataldo, Zac	zcataldo@westfordma.gov	Chair, Board of Health
Christopher, Alison	achristopher@westfordma.gov	COA social worker
Claro, Jennifer	jclaro@westfordma.gov	COA director
Clay, Tom	tclay@westfordma.gov	Select Board
Clery, Kerry	kclery@westfordk12.us	School Department
Cohen, Lynn	Lynnlcohen@gmail.com	Climate Action Committee
Coleman, Richard	Rjcoleman2020@gmail.com	Climate Action Committee
Collins, Christine	ccollins@westfordma.gov	Town Tax Collector
Cook, Nancy	Noakescook01886@yahoo.com	Affordable housing advocate
Dibello, Gerry	Gdbmail900@gmail.com	Climate Action Committee
Drake, Jonathan MD	Jonathan.Drake@lowellgeneral.org	Lowell General Doctor
Duane, Jim	jduane@westfordma.gov	Parks and Rec Dept director
Dumont, Ed	edumont@kimballfarm.com	Kimball Farm, Director of Operations
Field-Juma, Alison	afieldjuma@oars3rivers.org	Executive Director, OARS: For the Assabet, Sudbury, and Concord Rivers
Flaherty, Joe	jflaherty1955@gmail.com	Contractor, green building advocate
Gemma, Ron	rgemma@westfordconservationtrust.org	President, Westford Conservation Trust
Gozzo, Jim	jgozzo@mitre.org	ConsComm, Town Forest Committee
Greene, Kristina	kdfgreene@msn.com	Climate Action Committee
Hannaford, Jeff	nds@verizon.net	Designer, resident
Harde, Ellen	eharde@westfordma.gov	Recycling Committee,
Hazelton, Scott	shazelton@westfordma.gov	Select Board
Heideman, Eric	eheideman@westfordma.gov	Asst Town Manager
Hudson, Karen		Affordable Housing & Ped Safety Committees
Jeffries, Ann	annrjefferies@gmail.com	ConsComm
Kazeniac, Jim	jkazeniac@comcast.net	ZBA member

Kelly, Sean	skelly@westfordk12.us	School Committee member
Kosicki, Bern	kosicki@verizon.net	Climate Action Committee
Kost, mark	mkost@westfordma.gov	Select Board
Lauber, Diane	dianelauber@comcast.net	resident
Lewis, Marcus	marcus@marcuslewisenterprises.com	Owner, Marcus Lewis Day Camp
Lorrain, Chris	clorrain@landtechinc.com	LandTech Consultants
Lynch, Kathy	kathy.lynch@me.com	Healthy Westford Committee, state rep candidate
MacKay, Scott	sdmackay@aol.com	ZBA member, business owner (hardware)
Minska, Walter	westfordrotarypres@gmail.com	Westford Rotary Club
Morrison, Beth	bethoshaffer@hotmail.com	Climate Action Committee
Morse, Carol	carolgmorse@yahoo.com	Climate Action Committee
O'Connor, Dylan	Dylanoconnor71@gmail.com	Planning Board
O'Donnell, Rose	rose.odonnell@gmail.com	Friend of East Boston Camps
O'Lalor, Mark	molalor@westfordma.gov	Ag Committee
Peraner-Sweet, Andrea	asweet@westfordma.gov	Select Board
Perkins, Beth	beth@middlesexdesign.com	Climate Action Committee
Ross, Jodi	jross@westfordma.gov	Town Manager
Rowden, Michelle	Michelle.rowden@state.ma.us	EEA Coordinator, Northeast Region
Salerno, Eric	esalerno@tyngsboroughma.gov	Tyngsborough Planner
Salowsky, Steven	salowskyenterprise@gmail.com	Climate Action Committee
Sleger, Mark	msleger@verizon.net	Sleger Engineering, owner
Teller, Emily	eteller@earthlink.net	Climate Action Committee
Theriault, Barbara	barbrayt@aol.com	Climate Action Committee
Thomas, Susan	susanlavignethomas@gmail.com	Climate Action Committee
Tyndall, Lynn	lynntyndall@gmail.com	Healthy Westford Committee
Warren, Mark	mwarren@westfordma.gov	Water department
Waterman, Matt	mwaterman@landtechinc.com	LandTech Consultants Principal
Woods, Bev	bwoods@nmcog.org	NMCOG, director

Tighe&Bond

APPENDIX D

Municipal Vulnerability Preparedness Plan 2020

Public Listening Session to review draft report: June 18 - 10:30-11:30 AM. Click here to review the draft report

- Register to join the Listening Session through the GoToWebinar website at: https://attendee.gotowebinar.com/register/2356028425679663118 .
- After registering, you will receive a confirmation email.
- There are basic instructions on how to use GoToWebinar available at: **https://www.youtube.com/watch?v=lQ3Xwwgbd8Y**
- You may call in and listen on any phone (landline or cellphone) by dialing +1 (415) 655-0052 and using meeting code 307-796-139

Municipal Vulnerability and Preparedness Planning for the Town of Westford Public Engagement Information

The Town of Westford was recently awarded a $36,000 grant by the Executive Office of Energy and Environmental Affairs (EEA) Municipal Vulnerability and Preparedness (MVP) Planning Grant program to complete a public engagement and climate resilience planning process before June 30, 2020. Westford's Town Planner is taking the lead on the MVP program, with participation of a Core Team of Town Staff to plan for ways to better prepare and protect the Town from natural and climate-related hazards. Once the plan is completed and approved by EEA, the Town of Westford will be designated as an MVP Community, joining 287 communities across Massachusetts that have been designated since the MVP program began in 2017. This work also includes preparing a Town-specific Hazard Mitigation Plan (HMP) 5-year update to help Westford continue to be eligible to receive certain types of non-emergency disaster assistance, including funding for mitigation projects.

Why plan for climate resilience? Resilience is the ability of a community to address the needs of its built, social and natural environment to anticipate, cope with, and rebound stronger from events and trends related to climate change hazards. Planning for climate resilience allows Westford to build capacity to reduce the impacts from future climate events rather than just react to events as they occur.

How will the public engage? MVP is a Community Driven Process to understand climate vulnerabilities and identify priority actions. MVP provides structured opportunities for public engagement through review of community specific mapping and climate data, participation in unique Community Resilience Building Workshops, and developing priority action plans to improve their community's resilience with an emphasis on nature-based solutions. There will be a public meeting to review the HMP update, as well.

Due to COVID-19, previously planned public meetings and workshops will be held online.

The Town is utilizing a number of public engagement methods including:

- Posting online resources that will be used in the workshops
- Conducting pre- and post- workshop surveys
- Hosting virtual workshops focusing on climate resilience within the context of Westford's societal, built infrastructure, natural resources and economic community assets.
- Hosting a public meeting and a community listening session

Please watch the introductory video, take the survey, and sign up for a meeting to share your thoughts.

1. **Step 1:** Take the pre-workshop survey asap. Click here for HANDOUT 1 ***This should take 10 mins or less.***

2. **Step 2: Sign up for one or more of the workshops**. The 1 to 1.5 hour workshops will consist of four separate live webinars discussing climate risks and adaptation related to the following categories:

- **People and Society**: May 14 – 10:30-12:00 PM Workshop completed. Click here to watch video of the workshop
- **Buildings and Infrastructure**: May 21 – 10:30-12:00 PM Workshop completed. Click here to watch this video of the workshop
- **Economy:** May 28 – *This workshop has been **cancelled**. You may provide feedback on Westford's economy and climate resiliency by emailing Jennie Moonan at JSMoonan@tighebond.com*
- **Natural Resources and the Environment:** June 4 – 10:30-12:00 PM Click here to watch video of the workshop
- **Public Listening Session to review draft report:** June 18 - 10:30-11:30 AM. Click here to review the draft report
  - Register to join the Listening Session through the GoToWebinar website at: https://attendee.gotowebinar.com/register/2356028425679663118 .
  - After registering, you will receive a confirmation email.
  - There are basic instructions on how to use GoToWebinar available at: **https://www.youtube.com/watch?v=lQ3Xwwgbd8Y**
  - You may call in and listen on any phone (landline or cellphone) by dialing +1 (415) 655-0052 and using meeting code 307-796-139

You are encouraged to join all of the webinars, although, you may opt to only attend one.

Please contact Jennie Moonan at JSMoonan@tighebond.com with any questions or concerns about access. Thank you for your consideration and participation!

Planning Resources

- Westford's current Hazard Mitigation Plan, prepared in 2015: https://www.nmcog.org/s/Hazard_Mitigation_Plan_FEMA_approved_8_15.pdf
- Massachusetts' Climate Change Clearinghouse http://www.resilientma.org/
- State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan
- Westford's Emergency Management Department: https://westfordma.gov/440/Emergency-Management
- Westford's flood plain maps: https://westfordma.gov/170/Flood-Plain-Information

Frequently Asked Questions:

Q: How much time will it take to participate?
A: You should plan on spending up to 6 hours over a 6-week period, responding to surveys, previewing planning resources and participating in one or more workshops

Q: Do I have to commit to participating in all of the virtual workshops, or can I choose which ones I want to participate in?
A: You are welcome to join each virtual workshop, but may opt to only attend one. You will be able to view and provide input on all of the recorded workshops, which will each be posted on the municipal MVP website after they are completed.

Q: What if I have special circumstances that prohibit participating in an online format?
A: You can still participate using alternate format materials. Please send an email to Rebecca Cheney, Town Planner, to discuss your needs.

Q: What online meeting platform will be used? Is it easy to join?
A: Skype for Business will be used for the meeting platform. Full instructions will be provided.

Q: I am not very tech savvy. Is there anyone that can help if I have issues with connecting?
A: Yes, we can arrange a test connection in advance of the meeting to make sure that you are all set to access the workshop online portion of the program.

Municipal Vulnerability and Preparedness Pre-Workshop Survey

Westford, Massachusetts

Your community is undertaking an initiative to understand how natural hazards and climate change impact infrastructure, the local economy, people, and the environment. Please use the definitions below as well as Handout 1 to help complete this survey. Your input is greatly appreciated.

Natural hazards are defined as a natural phenomenon that might have a negative effect on humans or the environment. For example:

- A *natural hazard* is like the sun.
- The *risk* from that hazard is sunburn.
- The *vulnerability* includes the length of exposure of skin to the sun.
- The *mitigation action* to reduce risk from the hazard is to apply sunscreen or seek shade.

1. What is your affiliation with the Town of Westford?

2. How often have each of these natural hazards occurred in your community?

	Once a year or more often	Once every 3-5 years	Once in a decade	Once in my lifetime	Unsure/Never
Blizzard	○	○	○	○	○
Nor'easter	○	○	○	○	○
Ice Storm	○	○	○	○	○
Flooding	○	○	○	○	○
Dam Overtopping	○	○	○	○	○
Drought	○	○	○	○	○
Extreme Temperature	○	○	○	○	○
Tornado	○	○	○	○	○
Landslide	○	○	○	○	○
Wildfire	○	○	○	○	○
High Wind	○	○	○	○	○
Thunderstorm	○	○	○	○	○
Microburst	○	○	○	○	○
Hurricane/Tropical Storm	○	○	○	○	○
Earthquake	○	○	○	○	○
Invasive Species	○	○	○	○	○

3. What natural hazards are you concerned about experiencing in the future?

	Very concerned	Moderately concerned	Slightly concerned	Not concerned	Unsure
Blizzard	○	○	○	○	○
Nor'easter	○	○	○	○	○
Ice Storm	○	○	○	○	○
Flooding	○	○	○	○	○
Dam Overtopping	○	○	○	○	○
Drought	○	○	○	○	○
Extreme Temperature	○	○	○	○	○
Tornado	○	○	○	○	○
Landslide	○	○	○	○	○
Wildfire	○	○	○	○	○
High Wind	○	○	○	○	○
Thunderstorm	○	○	○	○	○
Microburst	○	○	○	○	○
Hurricane/Tropical Storm	○	○	○	○	○
Earthquake	○	○	○	○	○
Invasive Species	○	○	○	○	○

4. How concerned are you about climate change impacting your community in the future and exacerbating these existing natural hazards?

○ Not concerned

○ Slightly concerned

○ Moderately concerned

○ Very Concerned

Provide additional detail if desired

5. Which of the following categories are most susceptible to natural hazards in your community? Please rank the community assets in order of vulnerability, 1 being the most vulnerable and 5 being the least vulnerable.

	1	2	3	4	5
People: Loss of life and/or injuries	○	○	○	○	○
Economic: Business interruptions/closures, job losses, etc.	○	○	○	○	○
Infrastructure: Damage/loss of roads, bridges, utilities, schools, etc.	○	○	○	○	○
Cultural/Historic: Damage or loss of libraries, museums, historic properties, etc.	○	○	○	○	○
Environment: Damage, contamination or loss of forests, wetlands, waterways, etc.	○	○	○	○	○
Governance: Ability to maintain order and/or provide public amenities and services	○	○	○	○	○

6. Natural hazards can have a significant impact on a community. Please tell us how important each statement is to you by checking the appropriate box for each.

	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Protecting private property	○	○	○	○	○
Protecting critical facilities (transportation networks, hospitals, fire stations, etc)	○	○	○	○	○
Preventing development in hazard areas	○	○	○	○	○
Enhancing function off natural assets (streams, wetlands, beaches, etc)	○	○	○	○	○
Protecting historic and cultural landmarks	○	○	○	○	○
Protecting and reducing damage to utilities	○	○	○	○	○
Strengthening emergency services (police, fire, ambulance, etc)	○	○	○	○	○
Promoting cooperation among public agencies, citizens, non-profits, academia, and businesses	○	○	○	○	○

7. What specific community assets have helped you get through storm events and aided in recovery after storm events such as blizzards, flooding, extreme heat? Please be specific and list name, location, and owner of the three most important. (Examples include: Gas stations, pharmacies, supermarkets, towing services, etc) You may find it helpful to reference the community asset list included in Handout 1 to answer this question.

Name/Location/Owner

Name/Location/Owner

Name/Location/Owner

8. What infrastructure (examples include: roadways, community buildings, churches, schools, open space, dams, etc) have been impacted by storm events? Please list 3 specific things in Town that you have seen impacts to in the past. You may find it helpful to reference the community asset list included in Handout 1 to answer this question.

Name/Location/Owner

Name/Location/Owner

Name/Location/Owner

9. If there were a loss or inoperability, what major employers, primary economic sectors, and commercial centers would have a severe impact on the community and its ability to recover from a disaster? You may find it helpful to reference the community asset list included in Handout 1 to answer this question.

Name/Location/Owner

Name/Location/Owner

Name/Location/Owner

10. Which populations, groups of people, or communities are less able to respond and recover during a disaster? (examples include: elderly populations, environmental justice populations, special needs schooling, child care, shelters, homeless, etc.) You may find it helpful to reference the community asset list included in Handout 1 to answer this question.

Name/Location/Owner

Name/Location/Owner

Name/Location/Owner

11. Please list the top 3 natural environments in town that the community values and provides protective function to reduce the magnitude of hazard impact and increase resiliency? (examples include: open space, wetlands and waterbodies, trails, recreation areas, etc.) You may find it helpful to reference the community asset list included in Handout 1 to answer this question.

Name/Location/Owner

Name/Location/Owner

Name/Location/Owner

12. Is there any other input or questions you would like to have discussed during the Town's MVP planning process?

Done

Powered by SurveyMonkey
See how easy it is to create a survey.



TOWN OF WESTFORD MUNICIPAL VULNERABILITY PREPAREDNESS

Community Resilience Building Workshop – Societal Vulnerability & Strengths

May 14, 2020

Tighe&Bond

TODAY'S AGENDA

1:00 *Introduction & Workshop Goals*

1:10-1:20 *Natural Hazard Risks and Identified Community Assets -Survey Summary*

1:20-1:30 *Confirm Societal Assets List and Strengths and Vulnerabilities (via Q&A)*

1:30-1:45 *Mitigation Action Definitions and Examples*

1:45-2:15 *Discussion on Mitigation Actions (via Q&A)*

2:15-2:30 *Wrap up and Participant Homework (post workshop survey)*

WHY DO THIS PLANNING?

Help Westford Build Resilience and Preparedness:

- Build on the Town's existing emergency management capabilities
- Plan for more frequent and intense weather events that are linked to climate change
- Engage multiple stakeholders in the planning process
- Improve access to funding for mitigation and adaptation



TOWN OF WESTFORD, INCORPORATED SEPT. 23, 1729

Tighe&Bond

A brief thanks to Westford's MVP Core Team

CORE TEAM

- Carol Gumbart
- Henry Fontaine
- Jeffrey Stephens
- Jeremy Downs
- Joe Targ
- Paul Fox
- Paul Starratt
- Rae Dick
- Rebecca Cheney
- Richard Barrett
- Stephen Cronin
- Tim Whitcomb



Session #1 Presentation



Identify Natural Hazards, Risk Areas and Community Strengths

1:10 PM

WHAT ARE NATURAL HAZARDS?

Poor Urban Drainage
Regional Flooding
Culvert Failure



Inland Flooding



Tsunami



Severe Winter Storm

Blizzards
Snow
Ice Storms



Drought



Average/Extreme Temperatures



Tornadoes



Landslide



Wildfires



Other Severe Weather

Nor'easters
High Wind
Heavy Precipitation
Microbursts



Coastal Flooding



Invasive Species



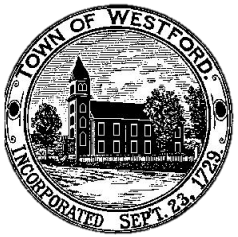
Earthquake



Coastal Erosion



Hurricanes/Tropical Storms



Tighe&Bond

TOP NATURAL HAZARDS – PAST & PRESENT

- Thunderstorms
- High Wind
- Invasive species
- Nor’easter

TOP NATURAL HAZARDS – FUTURE



Invasive Species



Extreme Temperature/Drought



Ice storm



Hurricane/Tropical Storm

Tighe&Bond

WESTFORD'S TOP NATURAL HAZARDS
THE SURVEY SAYS….

Nor'easters

Extreme temperatures

Other severe weather (High winds, thunderstorms, Ice storms, hurricanes/tropical storms, Blizzard, microburst)

Invasive Species

Wildfires



+ **CLIMATE CHANGE**



=

AMPLIFIED RISKS

- Community and regional infrastructure
- Local and regional economies
- Public Health
- Natural resources and our environment

Tighe&Bond

WHAT ARE COMMUNITY ASSETS?



Societal



Infrastructure



Economy



Natural Resources

TOWN OF WESTFORD
INCORPORATED SEPT. 23, 1729

Tighe&Bond

PEOPLE – SOCIETAL ASSETS

- Child Care
- Nursing Homes/ Elderly Housing
- Churches
- Emergency Shelters
- Food Pantry
- Historical Places
- Senior Centers
- Schools
- Libraries
- Veterinary Hospitals
- Boys & Girls Club
- Cemeteries



WESTFORD
FOOD PANTRY

Session #1 Discussion



Societal Assets: Strengths and Vulnerabilities

1:20 PM

Switch to Community Resilience Building Workshop Risk Matrix to review societal assets and their strengths and vulnerabilities

Session #2 Presentation



Identify Actions to Address Vulnerabilities and Protect Strengths

1:30 PM

TYPES OF MITIGATION ACTIONS

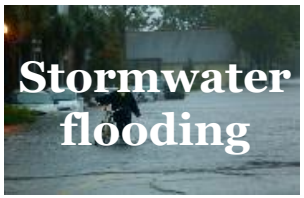


1. Prevention
2. Property Protection
3. Public Education and Awareness
4. Natural Resource Protection and Green Infrastructure (nature-based solutions)
5. Structural Projects
6. Emergency Services Protection

DISCUSSION ITEM: Mitigation Strategies

Hazards







Nature-based solutions

- Open space preservation
- Ecosystem restoration
- Low Impact Development

Municipal benefits



Avoided Costs



Enhanced Safety



Environmental Services

Switch to Community Resilience Building Workshop Risk Matrix to populate mitigation strategies



Session #3

Wrap up and Assignments

2:15 PM

PARTICIPANT ASSIGNMENTS



- **Take the Post Workshop Survey!**
  - https://www.westfordma.gov/1309/Municipal-Vulnerability-Preparedness-Pla
- **Sign up for Additional Workshops**
  - Infrastructural assets: May 21st 10:30-12:00 PM
  - Economic assets: May 28th, 10:30-12:00 PM
  - Environmental assets: June 4th, 10:30-12:00 PM
- **Review the Draft Findings CRB Report**
  - Available on the website in mid-June
- **Attend the Listening Session**

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STILL HAVE QUESTIONS OR COMMENTS?

Contact Information:

- **Gabrielle Belfit, CFM, Senior Environmental Scientist**
  - GCBelfit@tighebond.com
  - 508.304.6362

- **Jennie Moonan, PE, Project Manager**
  - JSMoonan@tighebond.com
  - 781.708.9826



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TOWN OF WESTFORD MUNICIPAL VULNERABILITY PREPAREDNESS

Community Resilience Building Workshop
Built Environment/ Infrastructure Vulnerability & Strengths

May 21, 2020

Tighe&Bond

TODAY'S AGENDA

10:30 *Introduction & Workshop Goals*

10:40-10:50 *Natural Hazard Risks and Identified Community Assets -Survey Summary*

10:50-11:10 *Confirm Infrastructure Assets List and Strengths and Vulnerabilities (via Q&A)*

11:10-11:15 *Mitigation Action Definitions and Examples*

11:15-11:45 *Discussion on Mitigation Actions (via Q&A)*

11:45-12:00 *Wrap up and Participant Homework (post workshop survey)*

WHY DO THIS PLANNING?

Help Westford Build Resilience and Preparedness:

- Build on the Town's existing emergency management capabilities
- Plan for more frequent and intense weather events that are linked to climate change
- Engage multiple stakeholders in the planning process
- Improve access to funding for mitigation and adaptation



TOWN OF WESTFORD, INCORPORATED SEPT. 23, 1729

Tighe&Bond

A brief thanks to Westford's MVP Core Team

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- Jeffery Morrissette
- Jeffery Stephens
- Jeremy Downs
- Joe Targ
- Matthew Hakala
- Matthew Salem
- Paul Fox
- Paul Starratt
- Rebecca Cheney
- Richard Barrett
- Stephen Cronin



WESTFORD'S MVP WEBSITE

https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla



Session #1 Presentation



Identify Natural Hazards, Risk Areas and Community Strengths

1:10 PM

WHAT ARE NATURAL HAZARDS?

Poor Urban Drainage
Regional Flooding
Culvert Failure



Inland Flooding



Tsunami



Severe Winter Storm

Blizzards
Snow
Ice Storms



Drought



Average/Extreme Temperatures



Tornadoes



Landslide



Wildfires



Other Severe Weather

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High Wind
Heavy Precipitation
Microbursts



Coastal Flooding



Invasive Species



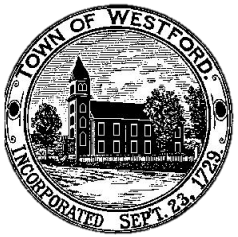
Earthquake



Coastal Erosion



Hurricanes/Tropical Storms



Tighe&Bond

TOP NATURAL HAZARDS – PAST & PRESENT

- Thunderstorms
- High Wind
- Invasive Species
- Nor’easter

TOP NATURAL HAZARDS – FUTURE



Invasive Species



Extreme Temperature/Drought



Ice storm



Hurricane/Tropical Storm

Tighe&Bond

WESTFORD'S TOP NATURAL HAZARDS
THE SURVEY SAYS….

Severe Storms (Thunderstorms, Ice storms, hurricanes/tropical storms)

High Wind

Drought/ Extreme temperatures

Invasive Species



+ **CLIMATE CHANGE**



=

AMPLIFIED RISKS

- Community and regional infrastructure
- Local and regional economies
- Public Health
- Natural resources and our environment

Tighe&Bond

WHAT ARE COMMUNITY ASSETS?



Societal



Infrastructure



Economy



Natural Resources

BUILT ENVIRONMENT – INFRASTRUCTURAL ASSETS

- Emergency Management
- Westford Fire Department Stations
- Westford Police Department Stations
- Cell Towers
- Town Hall
- Electrical substations
- Evacuation Routes
- Roadways
- Culverts
- Bridges
- Stormwater Infrastructure
- Communications Infrastructure
- Gas stations
- Medical facilities
- Supermarkets
- Post office
- Drinking water treatment and distrubtion



Tighe&Bond

Session #1 Discussion



Infrastructure Assets: Strengths and Vulnerabilities

Switch to Community Resilience Building Workshop Risk Matrix to review societal assets and their strengths and vulnerabilities

Session #2 Presentation



Identify Actions to Address Vulnerabilities and Protect Strengths

TYPES OF MITIGATION ACTIONS

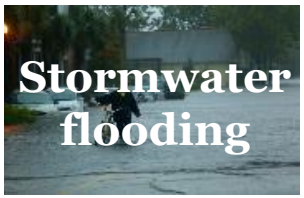


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DISCUSSION ITEM: Mitigation Strategies

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Nature-based solutions

- Open space preservation
- Ecosystem restoration
- Low Impact Development

Municipal benefits



Avoided Costs



Enhanced Safety



Environmental Services

Switch to Community Resilience Building Workshop Risk Matrix to populate mitigation strategies

Session #3



Wrap up and Assignments

PARTICIPANT ASSIGNMENTS



- **Take the Post Workshop Survey!**
  - https://www.westfordma.gov/1309/Municipal-Vulnerability-Preparedness-Pla
- **Sign up for Additional Workshops**
  - Economic assets: May 28th, 10:30-12:00 PM
  - Environmental assets: June 4th, 10:30-12:00 PM
- **Review the Draft Findings CRB Report**
  - Available on the website in mid-June
- **Attend the Listening Session**

Tighe&Bond

STILL HAVE QUESTIONS OR COMMENTS?

Contact Information:

- **Gabrielle Belfit, CFM, Senior Environmental Scientist**
  - GCBelfit@tighebond.com
  - 508.304.6362

- **Jennie Moonan, PE, Project Manager**
  - JSMoonan@tighebond.com
  - 781.708.9826



Tighe&Bond



TOWN OF WESTFORD
MUNICIPAL VULNERABILITY PREPAREDNESS

Community Resilience Building Workshop
Environmental Vulnerability & Strengths

June 4, 2020

Tighe&Bond

TODAY'S AGENDA

10:30 *Introduction & Workshop Goals*

10:35-10:45 *Natural Hazard Risks and Identified Community Assets -Survey Summary*

10:45-11:00 *Confirm Environmental Assets List and Strengths and Vulnerabilities (via Q&A)*

11:00-11:05 *Mitigation Action Definitions and Examples*

11:05-11:25 *Discussion on Mitigation Actions (via Q&A)*

11:25-11:30 *Wrap up and Participant Homework (post workshop survey)*



WHY DO THIS PLANNING?

Help Westford Build Resilience and Preparedness:

- Build on the Town's existing emergency management capabilities
- Plan for more frequent and intense weather events that are linked to climate change
- Engage multiple stakeholders in the planning process
- Improve access to funding for mitigation and adaptation



TOWN OF WESTFORD, INCORPORATED SEPT. 23, 1729

Tighe&Bond

A brief thanks to Westford's MVP Core Team

CORE TEAM

- Carol Gumbart
- Henry Fontaine
- Jeffery Morrissette
- Jeffery Stephens
- Jeremy Downs
- Joe Targ
- Matthew Hakala
- Matthew Salem
- Paul Fox
- Paul Starratt
- Rebecca Cheney
- Richard Barrett
- Stephen Cronin



WESTFORD'S MVP WEBSITE

https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla



Session #1 Presentation



Identify Natural Hazards, Risk Areas and Community Strengths

WHAT ARE NATURAL HAZARDS?

Poor Urban Drainage
Regional Flooding
Culvert Failure



Inland Flooding



Tsunami



Severe Winter Storm

Blizzards
Snow
Ice Storms



Drought



Average/Extreme Temperatures



Tornadoes



Landslide



Wildfires



Other Severe Weather

Nor'easters
High Wind
Heavy Precipitation
Microbursts



Coastal Flooding



Invasive Species



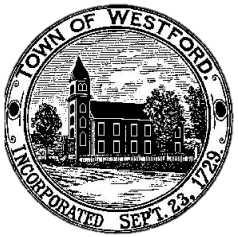
Earthquake



Coastal Erosion



Hurricanes/Tropical Storms



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TOP NATURAL HAZARDS – PAST & PRESENT

- Thunderstorms
- Invasive Species
- High wind
- Nor’easter

TOP NATURAL HAZARDS – FUTURE



Invasive Species



Extreme Temperature / Drought (tied)



Ice storm



Hurricane/Tropical Storm/Thunderstorm/High wind (4 way tie)

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WESTFORD'S TOP NATURAL HAZARDS
THE SURVEY SAYS….

Severe Storms (Thunderstorms, Ice storms, hurricanes/tropical storms)

High Wind

Drought/ Extreme temperatures

Invasive Species



+ **CLIMATE CHANGE**



=

AMPLIFIED RISKS

- Community and regional infrastructure
- Local and regional economies
- Public Health
- Natural resources and our environment

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WHAT ARE COMMUNITY ASSETS?



Societal



Infrastructure



Economy



Natural Resources

NATURAL RESOURCE ASSETS

- Open Space
- Conservation Lands
- Recreation Areas
- Playing Fields
- Rivers
- Ponds/Lakes
- Wetlands
- Floodplains
- Aquifers
- Vernal Pools
- Trees/Tree Cover



Session #1 Discussion



Infrastructure Assets: Strengths and Vulnerabilities

Switch to Community Resilience Building Workshop Risk Matrix to review environmental assets and their strengths and vulnerabilities

Session #2 Presentation



Identify Actions to Address Vulnerabilities and Protect Strengths

TYPES OF MITIGATION ACTIONS

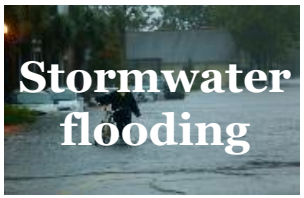


1. Prevention
2. Property Protection
3. Public Education and Awareness
4. Natural Resource Protection and Green Infrastructure (nature-based solutions)
5. Structural Projects
6. Emergency Services Protection

DISCUSSION ITEM: Mitigation Strategies

Hazards







Nature-based solutions

- Open space preservation
- Ecosystem restoration
- Low Impact Development

Municipal benefits



Avoided Costs



Enhanced Safety



Environmental Services

Switch to Community Resilience Building Workshop Risk Matrix to populate mitigation strategies



Session #3

Wrap up and Assignments

PARTICIPANT ASSIGNMENTS



- **Take the Post Workshop Survey!**
  - https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla
  - Distributing to attendees and stakeholders on Monday
- **Review the Draft Findings CRB Report**
  - Available on the website next week
  - https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla
- **Attend the Listening Session**
  - 10:30 to 11:30 AM on Thursday June 18, 2020

STILL HAVE QUESTIONS OR COMMENTS?

Contact Information:

- **Gabrielle Belfit, CFM, Senior Environmental Scientist**
  - GCBelfit@tighebond.com
  - 508.304.6362

- **Jennie Moonan, PE, Project Manager**
  - JSMoonan@tighebond.com
  - 781.708.9826



Tighe&Bond

Name	Affiliation
Morse, Carol	Climate Action Committee
O'Connor, Dylan	Planning Board
O'Donnell, Rose	Friend of East Boston Camps
O'Lalor, Mark	Ag Committee
Peraner-Sweet, Andrea	Select Board
Perkins, Beth	Climate Action Committee
Ross, Jodi	Town Manager
Rowden, Michelle	EEA Coordinator, Northeast Region
Salerno, Eric	Tyngsborough Planner
Salowsky, Steven	Climate Action Committee
Sleger, Mark	Sleger Engineering, owner
Teller, Emily	Climate Action Committee
Theriault, Barbara	Climate Action Committee
Thomas, Susan	Climate Action Committee
Tyndall, Lynn	Healthy Westford Committee
Warren, Mark	Water Department
Waterman, Matt	LandTech Consultants Principal
Woods, Bev	NMCOG, director

strengths and vulnerabilities in the community. The survey will be distributed via email, the MVP website, and/or regular mail if requested.

3. **Distribute recorded presentation on background information**: Tighe & Bond will develop a pre-workshop video including information on climate change and the MVP process. The short video will be recorded and posted on the MVP website for viewing or downloads. This presentation will be made available to workshop participants for independent viewing prior to attending the Virtual CRB Workshop Webinars.

4. **Distribute Virtual CRB Workshop Webinar materials**: Tighe & Bond will develop all materials necessary to participate in the workshop. Materials will be distributed via email, posted on the MVP website, and/or sent by regular mail if requested. Materials will include: (1) a partially, pre-populated CRB Matrix according to the Strengths and Vulnerabilities survey, (2) applicable slides to discuss natural hazard risk for the specific community asset sector featured in the workshop, and (3) a map of the municipality and featured community assets.

5. **Hold Webinars to meet the CRB Workshop requirement**: Tighe & Bond will develop and host 4 separate Virtual CRB Workshop Webinars using Skype. Each meeting will feature one of the Community Asset Categories: infrastructural, societal, natural environment, and economic. During the workshop, attendees will brainstorm mitigation actions for specific community assets, addressing top priority hazards.

6. **Prioritization Polling**: After the completion of all four Virtual CRB Workshop Webinars, Tighe & Bond will develop and distribute a Survey Monkey poll to the Core Team and stakeholders. This poll will include a list of mitigation actions developed during the webinar. Individuals will be asked to rank actions one through five in each of the four categories. This will develop a draft prioritization.

7. **Core Team Meeting**: Tighe & Bond will host a final Core Team meeting via Skype. The goal of the meeting will be to review the results of the prioritization polling and discuss the first Draft MVP Summary of Findings Report.

8. **Distribute Public Meeting materials**: Tighe & Bond will distribute public meeting materials to Core Team members and stakeholders electronically or through mailings if requested. Information about the Public Meeting and directions to participate will also be publicly posted. Materials will include an agenda and copy of the Draft HMP report.

9. **Hold Public Meeting:** Tighe & Bond and the Local Project Manager will host a live, 30-minute public meeting to present the draft HMP report and allow time for a Question & Answer session for community input. The Final Draft HMP report will be available on the MVP website for a 14-day public comment period. This is planned to be completed at a regularly scheduled Planning Board meeting.

10. **Distribute Listening Session materials**: Tighe & Bond will distribute listening session materials to Core Team members and stakeholders electronically or through mailings if requested. Information about the Listening Session and directions to participate will also be publicly posted. Materials will include an agenda and copy of the Draft MVP Summary of Findings Report.

11. **Hold Listening Session:** Tighe & Bond and the Core Team will host a live, one-hour Listening Session on Skype to present the draft MVP Summary of Findings Report and allow time for a Question & Answer session for community input. The Final Draft MVP

Summary of Findings Report will be available on the MVP website for a 14-day public comment period.

12. **MVP Website:** Tighe & Bond will post the recorded Listening Session, Question & Answer dialog, and Final MVP Summary of Findings Report on the MVP website.

The following tables describe the typical format for each meeting and a summary of the proposed format for comparison.

Core Team Meeting

Typical Format	Proposed Format
In-person meeting at Town Hall with representatives from municipal departments and any other core stakeholders.	Use Skype virtual meeting software to conduct meetings with representatives from the Core Team. Pre-meeting materials will be distributed electronically via email.

CRB Workshop

Typical Format	Proposed Format
One 8-hour, or two 4-hour, in person workshops with representatives from municipal departments, local organizations, State agencies, surrounding communities, and other stakeholders	Westford's MVP provider will host four 1 to 1.5 hour Virtual CRB Workshop Webinars using Skype with identified stakeholders and the Core Team. These virtual workshops will address four categories: infrastructural, societal, natural environment, and economic. The Skype webinars will include question and answer periods, live polling and be recorded for later viewing. Workshop preparation materials will be distributed to participants prior to the webinar including instructions as to how to access the webinar. Material distribution is via email, regular mail if requested and posted for downloading on a dedicated Community MVP website. After the webinar, the recorded meetings will be posted on the website. A post-workshop survey will be distributed to participants via email and regular mail if requested. The survey may be completed online, via email, or completed surveys may be mailed in. The total time required for participants will be approximately 8 hours between the pre-meeting work, attending the 4 workshops, and completing the follow up surveys and rankings.

Public Meeting

Typical Format	Proposed Format
Daytime or evening meeting open to all members of the public	Provide meeting materials to stakeholders and the Core Team via email and post on the MVP community website including agenda, draft HMP report, and instructions to access the Listening Session. Hold one, 30-minute meeting as part of a regularly scheduled Planning Board meeting. The final draft HMP report will be available post-meeting for a 14-day review period to allow for additional comment from members of the community. The Town will organize comments received, respond, and post to the MVP community website.

Public Listening Session

Typical Format	Proposed Format
Daytime or evening meeting open to all members of the public	Provide listening session meeting materials to stakeholders and the Core Team via email and post on the MVP community website including agenda, draft MVP report and instructions to access the Listening Session. Hold one, hour long meeting using Skype. The final draft MVP Summary of Findings Report will be available post-meeting for a 14-day review period to allow for additional comment from members of the community. The Town will organize comments received, respond, and post to the MVP community website.

Tighe&Bond

APPENDIX E

Town of Westford Community Assets - Infrastructure

Category	Name	Address
Bridge	I 495 NB - Bridge (NBI)	42.55571583, -71.449554
Bridge	I 495 SB - Bridge (NBI)	42.556046, -71.449911
Bridge	I 495 - Short Span Bridge	42.56366667, -71.43373611
Bridge	I 495 NB - Bridge (NBI)	42.569043, -71.4257
Bridge	I 495 SB - Bridge (NBI)	42.569425, -71.42592883
Bridge	HWY BEAVER BK RD - Bridge (NBI)	42.57248583, -71.478739
Bridge	I 495 NB - Bridge (NBI)	42.577457, -71.41154297
Bridge	I 495 SB - Bridge (NBI)	42.577727, -71.412081
Bridge	ST225 PLEASANT ST - Short Span Bridge	42.58, -71.486569
Bridge	ST225 PLEASANT ST - Bridge (NBI)	42.58032097, -71.486911
Bridge	I 495 - Short Span Bridge	42.58077778, -71.4035
Bridge	HWY TOWN FARM RD - Bridge (NBI)	42.584474, -71.478806
Bridge	HWY MILOT RD - Culvert	42.587459, -71.47697597
Bridge	HWY GRANITEVILLE - Bridge (NBI)	42.592173, -71.45981783
Bridge	HWY BRIDGE ST - Bridge (NBI)	42.592787, -71.46866197
Bridge	HWY BROADWAY ST - Bridge (NBI)	42.59589297, -71.466148
Bridge	HWY RIVER ST - Bridge (NBI)	42.596145, -71.46304997
Bridge	HWY DEPOT RD - Bridge (NBI)	42.597033, -71.435066
Bridge	HWY STONY BRK RD - Bridge (NBI)	42.60269797, -71.41991
Bridge	HWY BROOKSIDE RD - Bridge (NBI)	42.609664, -71.410784
Bridge	ST 40 GROTON RD - Short Span Bridge	42.61032983, -71.45981089
Bridge	HWY RUSSELLS WAY - Bridge (NBI)	42.62800097, -71.42490497
Bridge	HWY RUSSELLS WAY - Bridge (NBI)	42.629693, -71.428126
Bridge	ST 3 SB - Bridge (NBI)	42.64380583, -71.416132
Bridge	ST 3 NB - Bridge (NBI)	42.64393483, -71.41574583
Communication Utilities	Water Tank	
Communication Utilities	Milestone Hill	
Communication Utilities	Nextel	
Communication Utilities	Antennas/Private	
Communication Utilities	Cellular One	
Communication Utilities	MIT/Haystack Obs	
Communication Utilities	Antennas	
Communication Utilities	Nashoba Sky	
Culverts	Townwide	Townwide
Dams	Murray Printing Company Dam	42.58006, -71.487663
Dams	Stony Brook Dam At Graniteville	42.59591, -71.46619
Dams	Westford Depot Dam	42.59704, -71.43495
Dams	Commodore Foods Company Dam	42.60961049, -71.41100633
Dams	Nabnasset Lake Dam	42.619927, -71.41744
Dams	Flushing Pond Dam	42.62325152, -71.44160436
Dams	Long-Sought-for Pond Dam	42.625003, -71.458275
Dams	Fletcher Pond Dam	42.63288357, -71.42519448
Funeral Homes	JA Healy Sons Funeral Home	57 N. Main Street
Gas Station	Cumberland Farms Gas	188 Littleton Rd
Gas Station	Gulf	179 Littleton Rd
Gas Station	Mobil	185 Littleton Rd
Gas Station	United	215 Groton Road
Gas Station	Getty (BP)	262 Groton Road
Gas Station	Shell	498 Groton Road
Gas Station	Citgo	169 Plain Road
Gas Station	Getty (BP)	1 Oak Hill Road
Helicopter Landing Zone	Nashoba Tech HS - Rear	100 Littleton Rd
Helicopter Landing Zone	Papillion Park - Parking lot	102 Tyngsboro Rd
Helicopter Landing Zone	Hamilton Field	170 Plain Street
Helicopter Landing Zone	Blanchard School - Open Area	20 West St
Helicopter Landing Zone	Abbott School - Open Area	25 Depot St
Helicopter Landing Zone	Westford Highway Garage	28 North St
Helicopter Landing Zone	Westford Academy - Open Field	30 Patten Rd
Helicopter Landing Zone	Forge Village - Ball Field	52 W Prescott St
Helicopter Landing Zone	Stony Brook School - Open area	9 Farmers Way
Helicopter Landing Zone	Jack Walsh Field	Carlisle Road
Helicopter Landing Zone	Robins Road - Cul de Sac - 100'x100'	Robins Road

Town of Westford Community Assets - Infrastructure

Category	Name	Address
Medical Facilities	Westford Internal Medicine, PC	133 Littleton Road
Medical Facilities	CVS MinuteClinic	174 Littleton Road
Medical Facilities	Circle Health Westford	198 Littleton Road
Medical Facilities	Westford Counseling Center	319 Littleton Road
Medical Facilities	Greater Lowell Pediatrics of Westford	506 Groton Road
Medical Facilities	Floating Hospital Pediatric Specialty Center	198 Littleton Road
Medical Facilities	China Acupuncture Health Center	175 Littleton Road
Municipal Facilities	Town Hall	55 Main Street
Municipal Facilities	IT Department (Forge Village Fire Station)	E Prescott Street
Municipal Facilities	Parkerville Schoolhouse	Carlisle Road
Municipal Facilities	Recreation Dept Storage (Graniteville Fire Station)	54 Broadway Street
Municipal Facilities	Recreation Department	35 Town Farm Road
Municipal Facilities	School Maintenance Garage (Old Highway Garage)	30 Beacon Street
Post Offices	United States Postal Service - Rt 110/225	301 Littleton Road
Post Offices	United States Postal Service - Forge Village	5 W. Prescott Street
Post Offices	United States Postal Service - Nabnasset	62 Brookside Road
Power Utilities	Electric Substation	24 Toen Farm Road
Power Utilities	Electric Substation	55 Boston Road
Power Utilities	Electric Substation	74 Concord Road
Power Utilities	Power Transmission Line	
Power Utilities	Power Line	
Power Utilities	Power Line	
Power Utilities	Natural Gas Pipeline	
Private Water Facility	Hitchin Post Greens	Chicory Road/Rosebud Lane
Private Water Facility	Graniteville Woods Development	North Main Street
Private Water Facility	Honeysuckle Road Booster Station	Honeysuckle Road
Public Safety	Rogers Fire Station	39 Town Farm Road
Public Safety	Police Central Station & Public Safety Communications	53 Main Street
Public Safety	Fire Department	65 Boston Road
Public Safety	Nabnasset Fire Station	Oak Hill Road
Public Works Facilities	Highway Garage	28 North St
PWS Facility	Nutting Road Water Treatment Plan	17 Nutting Road
PWS Facility	Perchlorate Treatment Facility (inactive)	17 Nutting Rd
PWS Facility	Highway Garage Booster Station	28 North St
PWS Facility	Howard Road Pumping Station	Howard Road
PWS Facility	Forge Village Water Treatment Plant	60 Forge Village Road
PWS Facility	Booster Station No. 3 (Forge Village)	60 Forge Village Road
PWS Facility	Cote Pumping Station	Beacon Street
PWS Facility	Stepinski Pumping Station	Beacon Street
PWS Facility	Boston Road Booster Station	Boston Road
PWS Facility	Fletcher Pumping Station	Concord Road
PWS Facility	Country Road 2 Pumping Station	15 Country Road
PWS Facility	Twin Peaks Tank	Russells Way
PWS Facility	Depot Road Pumping Station	Depot Road
PWS Facility	Forge Village 1 Pumping Station	65 Forge Village Road
PWS Facility	Forge Village 2 Pumping Station	Forge Village Road
PWS Facility	Francis Hill Tank	FRANCIS HILL
PWS Facility	Prospect Hill Tank	Main Street
PWS Facility	Hildreth Hills Booster Station	Monadnock Drive
PWS Facility	Hildreth Hills Tank	Monadnock Drive
PWS Facility	Nutting Road Pumping Station	19 Nutting Road
PWS Facility	Town Farm Road Tank	East Prescott Road
PWS Well	Howard Road Wellfield	
PWS Well	Fletcher Well	
PWS Well	Country Rd. 2 Well	
PWS Well	Forge Village No 1. Wellfield	
PWS Well	Forge Village No. 2 Well	
PWS Well	Stepinski Well	
PWS Well	Cote Well	
PWS Well	Depot Road Well	
PWS Well	Nutting Rd Satellite Wells	
Transportation	IBM Littleton Extension Bus Route	
Transportation	LRTA Route 15 Bus Route	
Transportation	Railroad	

Town of Westford Community Assets - Economic

Category	Company Name	Address
Hardware Stores	Westford ACE Hardware	527 Groton Road
Hardware Stores	MacKay ACE Hardware & Rentals	224 Littleton Road
Major Employers (100+)	Juniper Networks	10 Technology Drive
Major Employers (100+)	Nashoba Valley Technical High School	100 Littleton Road
Major Employers (100+)	Sanborn Head & Assoc. Inc.	1 Technology Park Drive
Major Employers (100+)	Whole Foods Market	160 Littleton Road
Major Employers (100+)	Cynosure	5 Carlisle Road
Major Employers (100+)	Sentry Insurance	3 Carlisle Road
Major Employers (100+)	Market Basket	6A Cornerstone Square
Major Employers (100+)	Mack Technologies	27 Carlisle Road
Major Employers (100+)	Marshalls	11 Cornerstone Square
Major Employers (100+)	Materion Precision Optics	2 Lyberty Way
Major Employers (100+)	Westford Regency Inn	219 Littleton Road
Major Employers (100+)	Keller Williams Realty	3 Lan Drive
Major Employers (100+)	Pediatria	238 Littleton Road
Major Employers (100+)	Westford House	3 Park Drive
Major Employers (100+)	Westford Academy School	30 Patten Road
Major Employers (100+)	Dee Bus Services Inc.	30 Town Farm Road
Major Employers (100+)	Netscout Systems Inc.	310 Littleton Road
Major Employers (100+)	Nashoba Valley Ski Area	79 Powers Road
Major Employers (100+)	Kimball Farm	400 Littleton Road
Oil Delivery Services	J.A. Healy & Sons Oil Company	5 2nd Street
Pharmacies	Walgreens Pharmacy	145 Littleton Road
Pharmacies	CVS Pharmacy	174 Littleton Road
Specialty Grocer	British Delights	63 Powers Road
Supermarkets	Whole Foods Market	160 Littleton Road
Supermarkets	Market Basket	6A Cornerstone Square
Towing Services	Joe's Auto & Towing LLC	496 Groton Road
Towing Services	Whitney Service	107 Main Street
Towing Services	Bob's Auto Services	290 Littleton Road
Tree Removal Services	Scott's Tree & Landscape, Inc.	8 Elliot Road

Town of Westford Community Assets - Societal

Category	Name	Address
Adult Day Care	Millennium Home Adult Day Care	5 Lyberty Way
Affordable Housing	Hawk Ridge	Kestrel Lane
Affordable Housing	Stone Ridge Condos	Stone Ridge Road
Affordable Housing	Brookside Mill	12 Brookside Road
Affordable Housing	Alder Point	354 Groton Road
Affordable Housing	Line Road	14 Line Road
Affordable Housing	Princeton Westford Apartment Homes	16 Littleton Road
Affordable Housing	Tadmuck Meadows	1 Bandon Circle
Affordable Housing	65 Tadmuck Road	65 Tadmuck Road
Affordable Housing	Tadmuck Housing	65 Tadmuck Road
Affordable Housing	Orion Way (1)	14 Orion Way
Affordable Housing	Keyes Corner	100 Nutting Road
Affordable Housing	Rosegate	99 Main Street
Affordable Housing	Residences at Stony Brook	3, 5 and 6 Farmer Way
Affordable Housing	Southgate	5 Southgate Road
Affordable Housing	Cottages in the Woods	Joes Way
Affordable Housing	Juniper Hill Road	Juniper Hill Road
Affordable Housing	Elderberry Estates	1 Silo Path
Affordable Housing	77 Graniteville Road	77 Graniteville Road
Affordable Housing	7 Cross Street	7 Cross Street
Affordable Housing	School Lane	2 School Lane
Affordable Housing	7 Church Street	7 Church Street
Affordable Housing	CHOICE Housing	173 Carlisle Road
Affordable Housing	Graniteville Woods	2 Indian Ridge Terrace
Affordable Housing	Haystack	10 Groton Road
Affordable Housing	Stoneview	6 Stoneview Drive
Affordable Housing	Hanover Westford Hills	2 Robbins Road
Affordable Housing	Hanover Westford Valley	312 Littleton Road
Affordable Housing	Beaver Brook Village	2 Consetvation Lane
Affordable Housing	Concord Place	135 Concord Road
Affordable Housing	Woodlands at Laurel Hills	2 Consetvation Lane
Art and Culture	Parish Center for the Arts	10 Lincoln Street
Cemetery	Hillside Cemetery	Nutting Road
Cemetery	Fairview Cemetery	Main Street
Cemetery	Picking-Wright Cemetery	Groton Road
Cemetery	St. Catherine's Cemetery	Pine Ridge Road
Cemetery	Pine Grove Cemetery	68 Forge Village Road
Cemetery	Russian Brotherhood Cemetery	Patten Road
Cemetery	Westlawn Cemetery	Concord Road
Cemetery	Keyes Cemetery	Jonas Road
Child Care	Westford Children's Learning Center	508 Groton Road
Child Care	Roudenbush Children's Center	65 Main Street
Child Care	Tracy's Tiny Tots Daycare	37 North Street
Child Care	Right at Home Daycare	33 River Street
Child Care	Westford Preschool at St. Mark's	75 Cold Spring Road
Child Care	Westford KinderCare	26 Carlisle Road
Child Care	The Kid's League of Westford	10 Church Street
Child Care	Next Generation Children's Centers	9 Powers Road
Child Care	The Goddard School of Westford	162 Concord Road
Child Care	Acorn Child Care Center	439 Littleton Road
Community Centers	Cameron Senior Center	20 Pleasant Street
Community Centers	Roudenbush Community Center	65 Main Street
Elderly Care	Senior Helpers of Westford	66 Tadmuck Road
Elderly Care	Bridges by EPOCH at Westford	108 Littleton Road
Elderly Care	Samaritan Home Care	234 Littleton Road
Elderly Care	Westford House	3 Park Drive
Elderly Housing	Tadmuck Road Senior Housing	65 Tadmuck Road
Elderly Housing	Village at Mystery Spring	67 Tadmuck Road
Elderly Housing	Graniteville Senior Housing	7 Cross Street

Town of Westford Community Assets - Societal

Category	Name	Address
Food Pantries	Westford Food Pantry	20 Pleasant Street
Libraries	J.V. Fletcher Library	50 Main Street
Museum	Westford Museum	2 Boston Road
Place of Worship	Chabad of Nashoba Valley	26 Tadmuck Road
Place of Worship	Grace Community Church	130 Littleton Road
Place of Worship	First Parish Church United	48 Main Street
Place of Worship	St. Mark's Episcopal Church	75 Cold Spring Road
Place of Worship	Cornerstone Congregational Church	32 Graniteville Road
Place of Worship	United Methodist Church	10 Church Street
Place of Worship	St. Catherine of Alexandria	107 N. Main Street
Place of Worship	Wat Buddhabhavana	25 Milot Road
School	Rita Edwards Miller School	1 Mitchell Way
School	Nabnasset School	99 Plain Road
School	Abbot and Millenium Elementary School	25 Depot Street
School	Stony Brook School	9 Farmers Way
School	Nashoba Valley Technical High School	100 Littleton Road
School	Blanchard Middle School	14 West Street
School	Norman E. Day School	75 East Prescott Street
School	Westford Academy School	30 Patten Road
School	Robinson and Crisafulli Elementary School	13 Robinson Road
School	Col. John Robinson School	60 Concord Road
Special Needs Schools	Westford Integrated Preschool	23 Depot Street
Vulnerable Population	Village at Mystery Spring	67 Tadmuck Road
Environmental Justice Area	Minority Population	North-east corner of Town

Town of Westford Community Assets - Environment

Category	Name	Address
Ball Fields	Jack Walsh Field	Carlisle Road
Beach	Edwards Beach	Williams Avenue
Beach	Forge Pond Town Beach	Pleasant Street
Camp	East Boston Camps at Stony Brook Conservation Lan	Depot Street
Conservation Land	Stony Brook Conservation Land - Recreation Commis	Nutting Road
Field	Graniteville Ballfield/American Legion Field	15 River Street
Field	Greystone Playing Fields (Lot Q)	Russell's Way
Habitat	Certified and potential vernal pools	Town-wide
Open Space	Acton Road Tax Title Parcel 1	Acton Road
Open Space	Acton Road Tax Title Parcel 2	Acton Road
Open Space	Acton Road Tax Title Parcel 3 (Vose Parcel)	Acton Road
Open Space	Acton Road Tax Title Parcel 4	Acton Road
Open Space	Allie Lane Parcel	Allie Lane
Open Space	Anderson Conservation Land 1	Baldwin Road
Open Space	Anderson Conservation Land 2	Hunt Road
Open Space	Arch Bridge 1	Milot Roat
Open Space	Arch Bridge 2	Milot Road
Open Space	B&M Stony Brook Conservation Parcel	Milot Road
Open Space	Balas Conservation Land	Carolina Lane
Open Space	Banbury Drive Conservation Parcel	Banbury Drive
Open Space	Beacon St. Water Department Land	Beacon Street
Open Space	Beaver Brook Conservation Land	Southwick Circle
Open Space	Beaver Brook Village Conservation Land	Conservation Way
Open Space	Beaver Brook/Concord Rd Conservation Land	33 Beaver Brook Road
Open Space	Beers Conservation Land 1	Oakdale Street
Open Space	Beers Conservation Land 2	Sand Beach Road
Open Space	Blue Brook Conservation Land	Flushing Pond Road
Open Space	Boston Rd Drew Orchard	Boston Road
Open Space	Briarwood Drive Tax Title Parcel	Briarwood Drive
Open Space	Brookside Mill Conservation Parcel 1	Brookside Road
Open Space	Brookside Mill Conservation Parcel 2	Brookside Road
Open Space	Brookside Mill Conservation Parcel 3	Brookside Road
Open Space	Brookside Mill Conservation Parcel 4	Brookside Road
Open Space	Brookside Mill Tax Title Parcel 1	Depot Street
Open Space	Byrne Ave Gibbons Land Donation	31 Byrne Avenue
Open Space	Catalog Realty Trust Conservation Land	Old Lowell Road
Open Space	Cider Mill Pond Conservation Land 1 (Taylor Parcel)	Stony Brook Road
Open Space	Cider Mill Pond Conservation Land 2 (MacDougall Parcel)	Lowell Road
Open Space	Cider Mill Pond Conservation Land 3 (Agnew Parcel)	Lowell Road
Open Space	Cline Conservation Land	Littleton Road
Open Space	Cold Spring Rd Municipal Land - West	Cold Spring Road
Open Space	Cold Spring Road Municipal Land - East	Cold Spring Road
Open Space	Coolidge Street Land	Coolidge Street
Open Space	Cote Well Land	North Street
Open Space	Country Rd Well Land	Country Road
Open Space	Country Rd West Future Well Site 1	Country Road
Open Space	Country Rd West Future Well Site 2	Country Road
Open Space	Crescent St. Tax Title Parcel - East	Crescent Street
Open Space	Crescent St. Tax Title Parcel - West	Crescent Street
Open Space	Crest Haven Parcel	Acton Road
Open Space	Dana Drive Conservation Land 1	Dana Drive
Open Space	Dana Drive Conservation Land 2	Dana Drive
Open Space	Dana Drive Conservation Land 3	Dana Drive
Open Space	Day Agricultural and Conservation Land (a.k.a. "The Pumpkin Field")	Graniteville Road
Open Space	Depot St Well Parcel 2	Depot Street
Open Space	Depot St. Well - Parcel 1	Depot Street
Open Space	Drew Boston Road Land	Boston Road

Town of Westford Community Assets - Environment

Category	Name	Address
Open Space	Drew Boston Road Land Access ROW	Boston Road
Open Space	Drew Court Road Parcel 1	Crown Road
Open Space	Drew Court Road Parcel 2	Court Road
Open Space	Drew Crossing Conservation Land	Drew Crossing
Open Space	Drew Ramp Parcel	Boston Road
Open Space	Duffy and Doucette Conservation Land	Keyes Road
Open Space	Edward and Louise Dean Conservation land	Dean Drive
Open Space	Edwards Parcel	Tyngsboro Road
Open Space	Emmet Conservation Land - Durkee Rd. Eminent Domain Taking	Durkee Road
Open Space	Emmet Conservation Land - Gage Parcel (Hapgood and Tuttle Lots 2)	Texas Road
Open Space	Emmet Conservation Land - Gage Parcel (Hapgood and Tuttle Lots)	Durkee Road
Open Space	Emmet Conservation Land - Gage Parcel (Sheperd Lot Part 1)	Texas Road
Open Space	Emmet Conservation Land - Gage Parcel (Sheperd Lot Part 2)	Texas Road
Open Space	Emmet Conservation Land - Gage Parcel (White Lot 1)	Durkee Road
Open Space	Emmet Conservation Land - Gage Parcel (White Lot 2)	Texas Road
Open Space	Emmet Conservation Land - Gage/Kennedy Parcels 1	Powers Road
Open Space	Emmet Conservation Land - Gage/Kennedy Parcels 2	Powers Road
Open Space	Emmet Conservation Land - Gage/Kennedy Parcels 3	Concord Road
Open Space	Emmet Conservation Land - Guidoboni/Masse Parcel	Powers Road
Open Space	Emmet Conservation Land - Harriet Hill Tax Title Parcel 1	Durkee Road
Open Space	Emmet Conservation Land - Harriet Hill Tax Title Parcel 2	Durkee Road
Open Space	Emmet Conservation Land - J. F. White Parcel 1	Texas Road
Open Space	Emmet Conservation Land - J.F. White Parcel 2	Texas Road
Open Space	Emmet Conservation Land - J.F. White Parcel 3	Texas Road
Open Space	Emmet Conservation Land - Kennedy Parcel 1	Texas Road
Open Space	Emmet Conservation Land - Kennedy Parcel 2	Texas Road
Open Space	Emmet Conservation Land - Mahoney and Jansky Parcel 1	Powers Road
Open Space	Emmet Conservation Land - Mahoney and Jansky Parcel 2	Powers Road
Open Space	Emmet Conservation Land - Martin and Mitchell Parcel	Powers Road
Open Space	Emmet Conservation Land - R.S. Realty Trust Parcel	Powers Road
Open Space	Endmoor Road Tax Title Land	Endmoor Road
Open Space	Ennion Tyngsboro Rd. Tax Title Parcel	Tyngsboro Road
Open Space	Fieldstone Drive Conservation Land 1	Fieldstone Drive
Open Space	Fieldstone Drive Conservation Land 2	Fieldstone Drive
Open Space	Flagg Road Conservation Land	Flagg Road
Open Space	Fletcher Well Land 1	Concord Road
Open Space	Fletcher Well Land 2	Concord Road
Open Space	Fletcher Well Land 3	Concord Road
Open Space	Forge Village Rd. Conservation Area	Forge Village Road
Open Space	Forrest Road Land	Forrest Road
Open Space	Genova Conservation Land	Stony Brook Road
Open Space	Georges Tadmuck Ln Conservation Land 1	5 Tadmuck Lane
Open Space	Georges Tadmuck Ln Conservation Land 2	Tadmuck Lane
Open Space	Gifford Drive Tax Title Parcel	Gifford Drive
Open Space	Granite Hill Est. Conservation Parcel 1	Cowdry Hill Road
Open Space	Granite Hill Est. Conservation Parcel 2	Cowdry Hill Road
Open Space	Grassy Pond Conservation Area	Depot Street
Open Space	Great Elm Parcel	Carlisle Road

Town of Westford Community Assets - Environment

Category	Name	Address
Open Space	Grey Fox Lane Conservation Land	Grey Fox Lane
Open Space	Greystone Groton Rd Land (Lot A)	Groton Road
Open Space	Greystone Lot B Conservation Land	Russell's Way
Open Space	Greystone Lot C Conservation Land	Russell's Way
Open Space	Greystone Lot D Municipal Land (Drainage Basin)	Curren Drive
Open Space	Greystone Lot E Municipal Land (Water Tower Road Entrance)	Russell's Way
Open Space	Greystone Lot G Conservation Land	Caldwell Drive
Open Space	Greystone Lot H Conservation Land	Russell's Way
Open Space	Greystone Lot J Municipal Land	Russell's Way
Open Space	Greystone Lot K Conservation Land	Russell's Way
Open Space	Greystone Lot L Conservation Land	Chandler Road
Open Space	Greystone Lot M Conservation Land	Morrison Lane
Open Space	Greystone Lot P Conservation Land	Morrison Lane
Open Space	Groton Rd Gage Land	Groton Road
Open Space	Hassan Conservation Land	Littleton Road
Open Space	Hildreth St. Tax Title Parcel	Hildreth Street
Open Space	Horsehead Conservation Land 1	Beaver Brook Road
Open Space	Horsehead Conservation Land 2	Southwick Circle
Open Space	Horsehead Conservation Land 3	True Bean Way
Open Space	Howard Rd. Well Site 1	Howard Road
Open Space	Howard Rd. Well Site 2	Howard Road
Open Space	Howard Rd. Well Site 3	Howard Road
Open Space	Indian Meeting Ground	Bradford Street
Open Space	Irwin Conservation Land	Howard Road
Open Space	J.P. McKenna Conservation Land	Hyacinth Drive
Open Space	Kate Rose Way Conservation Land	Kate Rose Way
Open Space	Keyes Pond Conservation Land	Keyes Road
Open Space	Keyes Road Tax Title Parcel 1	Keyes Road
Open Space	Keyes Road Tax Title Parcel 2	Keyes Road
Open Space	Kiberd Conservation Land	Monadnock Drive
Open Space	Kloppenburg Conservation Land	Hartford Road
Open Space	Knoll Rd Tax Title Parcel	1 Knoll Road
Open Space	Lakeview St. Tax Title Parcel 1	Lakeview Street
Open Space	Lakeview St. Tax Title Parcel 2	Lakeview Street
Open Space	Lakeview St. Tax Title Parcel 3	Lakeview Street
Open Space	Lakeview St. Tax Title Parcel 4	Lakeview Street
Open Space	Lakeview St. Tax Title Parcel 5	Lakeview Street
Open Space	LaSallette Rd. Land	Lasalleette Road
Open Space	LaSallette Rd. Land	Lasalleette Road
Open Space	LaSallette Rd. land	Lasalleette Road
Open Space	LaSallette Rd. Land	Lasalleette Road
Open Space	Lawton Ave. Conservation Land 1	Lawton Avenue
Open Space	Lawton Ave. Conservation Land 2	Lawton Avenue
Open Space	Leighton Way Conservation Parcel 1	Leighton Way
Open Space	Leighton Way Conservation Parcel 2	Leighton Way
Open Space	LePage Conservation Land	Forge Village Road
Open Space	Littleton Road Conservation Parcel	Littleton Road
Open Space	Lorain Realty Trust Conservation Land	Rome Drive Ext.
Open Space	MacDonald Sawmill Rd Tax Title Parcel	Sawmill Road
Open Space	MacDonald Tyngsboro Rd. Tax Title Parcel	Tyngsboro Road
Open Space	Mark Vincent Drive Tax Title Land	Mark Vincent Drive
Open Space	Martina Gage Town Forest	Gage Road
Open Space	Mass. Electric Conservation Land	Rome Drive
Open Space	Michael Joseph "Joe" and Yvonne Rose Sullivan Land	Blakes Hill Road
Open Space	Mill Pond/Charles G. Sargent Playground	North Main Street
Open Space	Milot Conservation Land	Milot Road
Open Space	Minot's Corner Parcel	Littleton Road
Open Space	Moulton Conservation Land 1	Cold Spring Road

Town of Westford Community Assets - Environment

Category	Name	Address
Open Space	Moulton Conservation Land 2	Old Homestead Road
Open Space	Moulton Conservation Land 3	Longmeadow Road
Open Space	Mystery Spring Woods Conservation Land	Tadmuck Road
Open Space	Nabnasset St. Water Dept. Land 1	Nabnasset Street
Open Space	Nabnasset St. Water Dept. Land 2	25 Nabnasset Street
Open Space	Nabnasset St. Water Dept. Land 3	Nabnasset Street
Open Space	Nutting Rd Well Parcel 1	Nutting Road
Open Space	Nutting Rd Well Parcel 2	Nutting Road
Open Space	Odell W. Prescott St. Land Donation	W Prescott Street
Open Space	Original Academy Site-Boston Rd	Boston Road
Open Space	O'Soro Conservation Land	Moore Avenue
Open Space	Parcel Z, Lakeside Meadows	Muriel Drive
Open Space	Patten Road Tax Title Parcel	Patten Road
Open Space	Picking Conservation Land - East	Gould Road
Open Space	Picking Conservation Land - West	Gould Road
Open Space	Picking Selectmen Land - East	Groton Road
Open Space	Picking Selectmen Land - West	Gould Road
Open Space	Pine Tree Trail Tax Title Parcel 1	20 Pine Tree Trail
Open Space	Pine Tree Trail Tax Title Parcel 2	1 Pine Tree Trail
Open Space	Pond St. Conservation Land - Freedom Park	8 Pond Street
Open Space	Randolph Circle Tax Title Parcel	Randolph Circle
Open Space	Red Line North Parcel	West Street
Open Space	Red Line South Parcel	Forge Village Road
Open Space	River St. Canoe Ramp	River Street
Open Space	Rolling Meadows Conservation Land	Rolling Meadow Lane
Open Space	Rome Drive Tax Title Parcel 1	Rome Drive
Open Space	Rome Drive Tax Title Parcel 2	Rome Drive
Open Space	Russell Bird Sanctuary	65 Forge Village Road
Open Space	Sargent's Town Forest Gift	Groton Road
Open Space	Schlusemeyer Lake Shore Dr S Land	Lake Shore Drive S
Open Space	Schlusemeyer Sycamore Rd Parcel 1	Sycamore Road
Open Space	Schlusemeyer Sycamore Rd Parcel 2	Sycamore Road
Open Space	Schwab Conservation Parcel 1	Rome Drive Ext.
Open Space	Schwab Conservation Parcel 2	Rome Drive Ext.
Open Space	Scott Conservation Land	Cold Spring Road
Open Space	Shelly Lane Conservation Land	Shelly Lane
Open Space	Shipley Swamp Conservation Area	Nutting Road
Open Space	Skating Pond Conservation Land	Hearthstone Road
Open Space	Slifer Conservation Land	Keyes Road
Open Space	Snake Meadow Hill Conservation Parcel 1	Groton Road
Open Space	Snake Meadow Hill Conservation Parcel 2	Groton Road
Open Space	So. Chelmsford Rd 1	S Chelmsford Road
Open Space	So. Chelmsford Rd 2	S Chelmsford Road
Open Space	Socha Shore	Pleasant Street
Open Space	Spalding Town Forest 1	Cold Spring Road
Open Space	Spalding Town Forest 2	Forge Village Road
Open Space	Stony Brook Conservation Land - Conservation Commission Parcel 2	Depot Road
Open Space	Stony Brook Conservation Land - Conservation Commission Parcel 3	River Street
Open Space	Stony Brook Conservation Land - Recreation Commission Parcel 2	River Street
Open Space	Stony Brook Conservation Land - Water Dept. Parcel	River Street
Open Space	Stony Brook Road Conservation Land	Stony Brook Road
Open Space	Sullivan Conservation Land	Rome Drive
Open Space	Swanson Conservation Land	14 Hunt Road
Open Space	Switzer Conservation Land	Lowell Road
Open Space	Tadmuck Swamp North 1	Tadmuck Road
Open Space	Tadmuck Swamp North 2	Chippewa Road
Open Space	Tadmuck Swamp South	Littleton Road

Town of Westford Community Assets - Environment

Category	Name	Address
Open Space	TBG Conservation Land 1	43 Almeria Circle
Open Space	TBG Conservation Land 2	Almeria Circle
Open Space	TBG Conservation Land 3	Almeria Circle
Open Space	Tenney Road Conservation Land (Avalon Real Estate Land)	Tenney Road
Open Space	Tenney Road Conservation Parcel 1	Tenney Road
Open Space	Tenney Road Conservation Parcel 2	Tenney Road
Open Space	Texas Rd Conservation Land	Texas Road
Open Space	Timberlake	Tenney Road
Open Space	Town Farm Rd. Water Dept. Land	Town Farm Road
Open Space	Trailside Way Parcel A Conservation Land	Trailside Way
Open Space	Trailside Way Parcel B Conservation Land	Trailside Way
Open Space	Trailside Way Parcel C Conservation Land	Trailside Way
Open Space	Trailside Way Parcel D Conservation Land	Trailside Way
Open Space	Trailside Way Parcel E Conservation Land	Trailside Way
Open Space	Twin Peaks	Tyngsboro Road
Open Space	Twin Peaks Water Tower Land	Russell's Way
Open Space	Tyngsboro Town Line Gage Parcel-East	Sawmill Road
Open Space	Tyngsboro Town Line Gage Parcel-West	Tenney Road
Open Space	Uncompleted Tax Taking - Cold Spring Road	Cols Spring Lane
Open Space	Varnum Conservation Land	Forge Village Road
Open Space	Verna Williamson Parcel	Acton Road
Open Space	Veterans Memorial Complex Conservation Land 1	Farmer Way
Open Space	Veterans Memorial Complex Conservation Land 2	Nutting Road
Open Space	Veterans Memorial Complex Conservation Land 3	Farmer Way
Open Space	Veterans Memorial Complex Water Department Land	Beacon Street
Open Space	Village View Parcel A-2	Village View Road
Open Space	Vine Brook Road Conservation Parcel	Vine Brook Road
Open Space	Vineyard Rd Ext School Land - North	Vineyard Road Ext
Open Space	Vineyard Rd Ext School Land - South 1	Vineyard Road Ext
Open Space	Vineyard Rd Ext School Land - South 2	Vineyard Road Ext
Open Space	Vineyard Road Conservation Land	Vineyard Road
Open Space	William C. O'Connell Wildlife Sanctuary	Timberlee Lane
Open Space	Williams Ave Conservation Land	Williams Avenue
Open Space	Wilson Parcel	Boston Road
Open Space	Winnek Water Dept Land 1	17 Main Street
Open Space	Winnek Water Dept. Land 2	Main Street
Orchard	Hill Orchard Farm Stand	Hunt Road
Orchard	Hill Orchard West 1	Chamberlin Road
Orchard	Hill Orchard West 2	Chamberlin Road
Park	Captain Stephen Hamilton Ballfield	Plain Road
Park	VFW Softball Field	52 W Prescott Street
Undeveloped Land	Minot's Corner Parcel	Littleton Road
Undeveloped Land	Old Landfill/New Meadow	Cold Spring Road
Waterbody	Stony Brook	MA84B-03 and 04
Waterbody	Tadmuck Brook	MA84B-07
Waterbody	Beaver Brook	MA84B-02
Waterbody	Deep Brook	MA84A-21
Waterbody	Nabnasset Lake	MA84044
Waterbody	Forge Pond	MA84015
Waterbody	Reed Brook (Coldwater Fishery Resource)	MA84B-08
Waterbody	Heart Pond	MA82059
Waterbody	Nashoba Brook	MA82B-14
Waterbody	Burges Pond	
Waterbody	Graniteville Pond	
Waterbody	Kennedys Pond	
Waterbody	Blue Brook	
Waterbody	Boutwell Brook	

Town of Westford Community Assets - Environment

Category	Name	Address
Waterbody	Butter Brook	
Waterbody	Coldspring Brook	
Waterbody	Flushing Pond	
Waterbody	Gilson Brook	
Waterbody	Greystone Pond	
Waterbody	Keyes Pond	
Waterbody	Long Sought For Pond	
Waterbody	Nonset Brook	
Waterbody	Pond Brook	
Waterbody	Snake Meadow Brook	
Waterbody	Tadmuck Swamp	
Waterbody	Vine Brook	
Waterbody	Wetlands	Town-wide

DUNSTABLE

TYNGSBOROUGH

LOWELL

GROTON

CHELMSFORD

LITTLETON

CARLISLE

ACTON

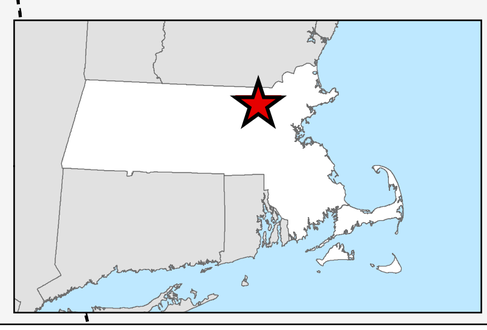
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495

110

225

27



Legend

- Affordable Housing
- Cemetery
- Child Care
- Community Center
- Elderly Care/ Housing
- Food Pantries
- Libraries
- Place of Worship
- School
- Special Needs Schools
- Vulnerable Population
- Limited Access Highway
- Interstate Highway
- Major Road - Collector
- Municipal Properties and Facilities

Tighe&Bond

Based on datalayers provider by MassGIS and Town of Westford, MA

DRAFT

N

0 1,800 3,600

Feet

FIGURE 3
SOCIETAL ASSETS

Community Assets
Municipal Vulnerability Preparedness (MVP)
Planning Grant
Westford, Massachusetts
February 2020

DUNSTABLE

TYNGSBOROUGH

LOWELL

GROTON

CHELMSFORD

LITTLETON

CARLISLE

ACTON

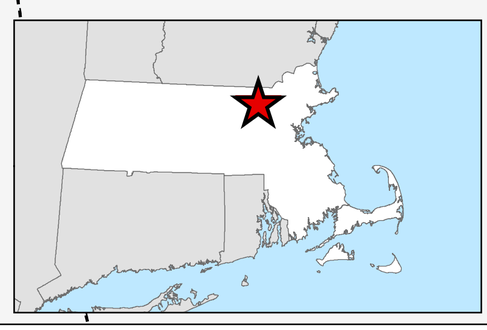
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Legend

- Bridge
- Communication Utilities
- Dams
- Funeral Homes
- Helicopter Landing Zone
- Medical Facilities
- PWS Facility
- Post Offices
- Power Utilities
- Emergency Generator
- Power Utilities
- Transportation Route
- Limited Access Highway
- Interstate Highway
- Major Road - Collector
- Municipal Properties and Facilities

Tighe&Bond

Based on datalayers provider by MassGIS and Town of Westford, MA

DRAFT

N

0 1,800 3,600

Feet

FIGURE 1
BUILT ENVIRONMENT

Community Assets
Municipal Vulnerability Preparedness (MVP)
Planning Grant
Westford, Massachusetts
February 2020

DUNSTABLE

TYNGSBOROUGH

LOWELL

GROTON

CHELMSFORD

LITTLETON

CARLISLE

ACTON

40

110

225

27

495

HW

OIL

Rx

Legend

SubCategory

- HW — Hardware Stores
- Major Employers (100+)
- OIL — Oil Delivery Services
- Rx — Pharmacies
- Supermarkets
- Towing Services
- Tree Services
- Limited Access Highway
- Interstate Highway
- Major Road - Collector
- Municipal Properties and Facilities

DRAFT

N

0 1,800 3,600

Feet

FIGURE 2
ECONOMIC ASSETS

Community Assets
Municipal Vulnerability Preparedness (MVP)
Planning Grant
Westford, Massachusetts
February 2020

Tighe&Bond

Based on datalayers provider by MassGIS and Town of Westford, MA

DUNSTABLE

TYNGSBOROUGH

LOWELL

GROTON

CHELMSFORD

LITTLETON

CARLISLE

ACTON

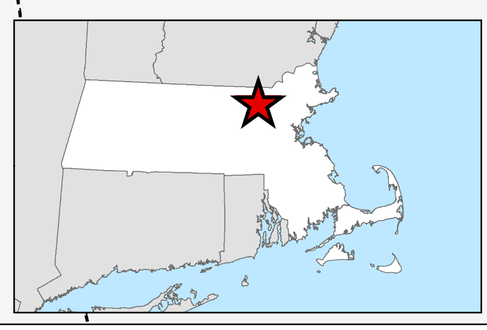
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110

495

225

27



Legend

- Bridge
- Communication Utilities
- Dams
- Funeral Homes
- Helicopter Landing Zone
- Medical Facilities
- PWS Facility
- Post Offices
- Power Utilities
- Emergency Generator
- Power Utilities
- Transportation Route
- Limited Access Highway
- Interstate Highway
- Major Road - Collector
- Municipal Properties and Facilities

Tighe&Bond

Based on datalayers provider by MassGIS and Town of Westford, MA

DRAFT

N

0 1,800 3,600

Feet

FIGURE 1
BUILT ENVIRONMENT

Community Assets
Municipal Vulnerability Preparedness (MVP)
Planning Grant
Westford, Massachusetts
February 2020

Tighe&Bond

APPENDIX F

Basin Specific Climate Change Data

Sudbury-Assabet-Concord (SuAsCo) Basin

Increased Average Temperature

The SuAsCo basin is expected to experience increased average temperatures throughout the 21st century. Maximum and minimum temperatures are also expected to increase throughout the end of the century. These increased temperature trends are expected for annual and seasonal projections. The table below demonstrates how temperature will change over the course of the century.

TABLE 1
Increased Average Temperature

SuAsCo Basin		Observed Baseline 1971-2000 (°F)	Projected Change in 2030s (°F)	Mid-Century Projected Change in 2050s (°F)	Projected Change in 2070s (°F)	End of Century Projected Change in 2090s (°F)
Average Temperature	Annual	48.7	+2.2 to +4.4	+2.9 to +6.3	+3.5 to +9.0	+3.8 to +10.9
	Winter	27.4	+2.2 to +4.9	+2.8 to +7.3	+3.6 to +8.9	+4.0 to +10.2
	Spring	46.8	+1.7 to +3.5	+2.5 to +5.7	+2.7 to +7.9	+3.2 to +9.6
	Summer	69.5	+2.1 to +4.4	+2.7 to +6.9	+3.2 to +10.2	+3.7 to +12.7
	Fall	50.8	+2.2 to +5.0	+3.7 to +6.6	+3.5 to +9.5	+4.0 to +11.7
Maximum Temperature	Annual	59.6	+2.0 to +4.1	+2.7 to +6.3	+3.2 to +9.1	+3.4 to +10.9
	Winter	37.3	+1.9 to +4.4	+2.5 to +6.7	+3.0 to +8.1	+3.4 to +9.4
	Spring	57.9	+1.6 to +3.4	+2.3 to +5.6	+2.6 to +8.0	+3.2 to +9.7
	Summer	80.7	+1.9 to +4.5	+2.6 to +7.1	+3.1 to +10.5	+3.6 to +13.0
	Fall	62.1	+2.4 to +4.8	+3.6 to +6.8	+3.3 to +9.6	+3.8 to +12.1
Minimum Temperature	Annual	37.9	+2.3 to +4.6	+3.1 to +6.4	+3.8 to +9.0	+4.1 to +11.0
	Winter	17.5	+2.5 to +5.5	+3.3 to +7.8	+4.1 to +9.6	+4.6 to +10.9
	Spring	35.8	+1.8 to +3.7	+2.7 to +6.0	+2.8 to +7.7	+3.3 to +9.5
	Summer	58.3	+2.1 to +4.5	+2.9 to +7.2	+3.3 to +9.9	+3.9 to +12.4
	Fall	39.6	+2.1 to +5.2	+3.6 to +6.6	+3.6 to +9.3	+4.1 to +11.6

Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase throughout the 21st century. o Summer mid-century increase of 2.6 °F to 7.1 °F (3-9% increase); end of century increases of 3.6 °F to 13 °F (4-16% increase). o Fall mid-century increase of 3.6 °F to 6.8 °F (6-11% increase); end of century increases by and 3.8 °F to 12.1 °F (6-20% increase).

Seasonally, minimum winter and fall temperatures are expected to see increases throughout the 21st century. o Winter mid-century increase of 3.3 °F to 7.8 °F (19-44% increase); end of century increases by 4.6 °F to 10.9 °F (26-63% increase). o Fall mid-century of 3.6 °F to 6.6 °F (9-17% increase); end of century increases of 4.1°F to 11.6 °F (10-29% increase).

Days with Maximum Temperatures

Due to projected increases in average and maximum temperatures throughout the end of the century, the SuAsCo basin is also expected to experience an increase in days with daily maximum temperatures over 90°F, 95°F, and 100°F. The table below demonstrates this.

TABLE 2
Days with Maximum Temperatures

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Maximum Temperature Over 90°F	Annual	8	+7 to +20	+10 to +35	+12 to +56	+14 to +76
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +0
	Spring	1	+<1[87] to +1	+<1[87] to +2	+<1[87] to +3	+<1[87] to +5
	Summer	7	+7 to +17	+9 to +30	+11 to +46	+13 to +60
	Fall	<1[87]	+<1[87] to +2	+1 to +5	+1 to +9	+1 to +12
Days with Maximum Temperature Over 95°F	Annual	1	+2 to +8	+3 to +17	+4 to +32	+6 to +48
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +0
	Spring	<1[87]	+<1[87] to +<1[87]	+<1[87] to +<1[87]	+<1[87] to +1	+<1[87] to +2
	Summer	1	+2 to +8	+3 to +15	+3 to +28	+5 to +42
	Fall	<1[87]	+<1[87] to +1	+<1[87] to +1	+<1[87] to +3	+<1[87] to +5
Days with Maximum Temperature Over 100°F	Annual	<1[87]	+<1[87] to +2	+<1[87] to +5	+1 to +12	+1 to +22
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +0
	Spring	0	+0 to +<1[87]	+0 to +<1[87]	+0 to +<1[87]	+0 to +<1[87]
	Summer	<1[87]	+<1[87] to +2	+<1[87] to +5	+1 to +11	+1 to +20
	Fall	0	+0 to +<1[87]	+0 to +<1[87]	+0 to +1	+0 to +1

Annually, the SuAsCo basin is expected to see days with daily maximum temperatures over 90°F increase by 10 to 35 more days by mid-century, and 14 to 76 more days by the end of the century. Seasonally, summer is expected to see an increase of 9 to 30 more days with daily maximums over 90°F by mid-century. By end of century, the SuAsCo basin is expected to have 13 to 60 more days

Days with Minimum Temperatures

Due to projected increases in average and minimum temperatures throughout the end of the century, the SuAsCo basin is expected to experience a decrease in days with daily minimum temperatures below 32°F and 0°F. The table below demonstrates this.

TABLE 3
Days with Minimum Temperatures

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Minimum Temperature Below 0°F	Annual	6	-2 to -4	-2 to -4	-2 to -5	-2 to -5
	Winter	6	-2 to -3	-2 to -4	-2 to -4	-2 to -5
	Spring	<1[88]	-0 to +<1[88]	-0 to -0	-0 to -0	-0 to -0
	Summer	0	-0 to -0	-0 to -0	-0 to -0	-0 to -0
	Fall	0	-0 to -0	-0 to -0	-0 to -0	-0 to -0
Days with Minimum Temperature Below 32°F	Annual	143	-12 to -28	-19 to -40	-22 to -55	-24 to -65
	Winter	83	-2 to -7	-3 to -11	-5 to -20	-6 to -25
	Spring	34	-3 to -11	-7 to -15	-8 to -19	-9 to -20
	Summer	0	-0 to -0	-0 to -0	-0 to -0	-0 to -0
	Fall	26	-5 to -11	-8 to -14	-9 to -18	-8 to -20

Seasonally, winter, spring and fall are expected to see the largest decreases in days with daily minimum temperatures below 32°F. Winter is expected to have 3 to 11 fewer days by mid-century, and 6 to 25 fewer days by end of century. Spring is expected to have 7 to 15 fewer days by mid-century, and 9 to 20 fewer days by end of century. Fall is expected to have 8 to 14 fewer days by mid-century, and 8 to 20 fewer days by end of century.

Heating Degree-Days and Cooling Degree-Days

Due to projected increases in average, maximum, and minimum temperatures throughout the end of the century, the SuAsCo basin is expected to experience a decrease in heating degree days and increases in both cooling degree-days and growing degree-days. The table below demonstrates this.

TABLE 4
Heating and Cooling Degree-Days

SuAsCo Basin		Observed Baseline 1971-2000 (Degree-Days)	Projected Change in 2030s (Degree-Days)	Mid-Century Projected Change in 2050s (Degree-Days)	Projected Change in 2070s (Degree-Days)	End of Century Projected Change in 2090s (Degree-Days)
Heating Degree-Days (Base 65°F)	Annual	6535	-544 to -1137	-750 to -1587	-873 to -2094	-984 to -2460
	Winter	3406	-194 to -454	-251 to -669	-316 to -807	-369 to -942
	Spring	1695	-137 to -293	-207 to -473	-225 to -619	-284 to -726
	Summer	90	-29 to -56	-40 to -72	-47 to -81	-48 to -84
	Fall	1340	-166 to -374	-279 to -461	-262 to -639	-276 to -731
Cooling Degree-Days (Base 65°F)	Annual	585	+216 to +456	+285 to +771	+343 to +1197	+398 to +158
	Winter	0	-1 to +2	+0 to +2	+1 to +3	+2 to +4
	Spring	25	+12 to +31	+20 to +62	+24 to +105	+22 to +143
	Summer	505	+158 to +350	+197 to +569	+238 to +860	+282 to +1086
	Fall	49	+30 to +95	+44 to +159	+52 to +254	+77 to +341
Growing Degree-Days (Base 50°F)	Annual	2592	+408 to +822	+546 to +1274	+642 to +1976	+729 to +2475
	Winter	6	-1 to +11	+0 to +15	+4 to +23	+3 to +29
	Spring	314	+66 to +145	+92 to +251	+108 to +398	+120 to +500
	Summer	1795	+192 to +404	+251 to +636	+293 to +934	+342 to +1167
	Fall	469	+113 to +302	+180 to +412	+170 to +621	+217 to +792

Seasonally, winter historically exhibits the highest number of heating degree-days and is expected to see the largest decrease of any season, but spring and fall are also expected to see significant change. The winter season is expected to see a decrease of 7-20% (251 -669 degree-days) by mid-century, and a decrease of 11-28% (369 -942 degree-days) by the end of century. The spring season is expected to decrease in heating degree-days by 12-28% (207 -473 degree-days) by mid-century, and by 17-43% (284 -726 degree-days) by the end of century. The fall season is expected to decrease in heating degree-days by 21-34% (279 -461 degree-days) by mid-century, and by 21-55% (276 -731 degree-days) by the end of century.

Conversely, due to projected increasing temperatures, summer cooling degree-days are expected to increase by 39-113% (197 -569 degree-days) by mid-century, and by 56-215% (282 - 1086 degree-days) by end of century.

Seasonally, summer historically exhibits the highest number of growing degree-days and is expected to see the largest decrease of any season, but the shoulder seasons of spring and fall are also expected to see an increase in growing degree-days. The summer season is projected to increase by 14-35% (251 -636 degree-days) by midcentury, and by 19-65% (342 -1167 degree-days) by end of century. Spring is expected to see an increase by 29-80% (92 -251 degree-days) by mid-century and 38-159% (120 -500 degree-days) by end of century. Fall is expected to see an increase by 38-88% (180 -412 degree-days) by mid-century and 46-169% (217 -792 degree-days) by end of century.

Days with Precipitation Over 1", 2", and 4"

The projections for expected number of days receiving precipitation over one inch are variable for the SuAsCo basin, fluctuating between loss and gain of days. This is demonstrated in the table below.

TABLE 5
Days with Precipitation Over 1", 2", and 4"

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	7	+<1[89] to +2	+1 to +3	+1 to +3	+1 to +4
	Winter	2	-0 to +1	+<1[89] to +1	+<1[89] to +2	+<1[89] to +2
	Spring	1	-0 to +1	-0 to +1	+<1[89] to +1	+<1[89] to +1
	Summer	2	-0 to +1	-0 to +1	-0 to +1	-0 to +1
	Fall	2	-0 to +1	-0 to +1	-0 to +1	-0 to +1
Days with Precipitation Over 2"	Annual	1	-0 to +<1[89]	+<1[89] to +1	+<1[89] to +<1[89]	+<1[89] to +1
	Winter	<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]
	Spring	<1[89]	-0 to +<1[89]	+<1[89] to +<1[89]	-0 to +<1[89]	-0 to +<1[89]
	Summer	<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]
	Fall	<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]
Days with Precipitation Over 4"	Annual	<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]
	Winter	0	-0 to +0	+0 to +0	-0 to +0	-0 to +0
	Spring	0	-0 to +0	+0 to +<1[89]	-0 to +0	-0 to +<1[89]
	Summer	<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]
	Fall	<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]	-0 to +<1[89]

Seasonally, the winter season is generally expected to see the highest projected increase. The winter season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and an increase of 0-2 days by the end of century. The spring season is expected to see an increase in days with precipitation over one inch of -0-1 days by mid-century, and of an increase of 0-1 days by the end of century.

Total Precipitation

Similar to projections for number of days receiving precipitation over a specified threshold, seasonal projections for total precipitation are also variable for the SuAsCo basin. The table below shows total precipitation projections in the SuAsCo Basin.

TABLE 6
Total Precipitation

SuAsCo Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	45.4	+0.2 to +4.8	+0.6 to +6.1	+1.5 to +7.8	+1.2 to +8.0
	Winter	11.2	-0.4 to +2.1	+0.1 to +2.6	+0.5 to +3.2	+0.4 to +4.1
	Spring	11.6	-0.1 to +2.4	+0.0 to +2.1	+0.3 to +2.6	+0.2 to +2.6
	Summer	10.8	-0.2 to +1.5	-0.5 to +2.2	-0.6 to +2.4	-1.1 to +2.2
	Fall	12.0	-1.2 to +1.1	-1.3 to +1.7	-1.8 to +1.6	-1.5 to +1.4

The winter season is expected to experience the greatest change with an increase of 1-23% by mid-century, and of 3-36% by end of century. Projections for the summer and fall seasons are more variable, and could see either a drop or increase in total precipitation throughout the 21st century. The summer season projections for the SuAsCo or basin could see a decrease of 0.5 to an increase of 2.2 inches by mid-century (decrease of 4 to increase of 20%) and a decrease of 1.1 to an increase of 2.2 inches by the end of the century (decrease of 11% to increase of 20%). The fall season projections for the SuAsCo basin could see a decrease of 1.3 to an increase of 1.7 inches by mid-century (decrease of 11% to increase of 14%) and a decrease of 1.5 to an increase of 1.4 inches by the end of the century (decrease of 13% to increase of 11%).

Consecutive Dry Days

Annual and seasonal projections for consecutive dry days, or for a given period, the largest number of consecutive days with precipitation less than 1 mm (~0.04 inches), are variable throughout the 21st century.

TABLE 7
Consecutive Dry Days

SuAsCo Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Consecutive Dry Days	Annual	17	-1 to +1	-0 to +2	-1 to +2	-1 to +3
	Winter	12	-1 to +1	-1 to +1	-1 to +2	-1 to +2
	Spring	11	-1 to +1	-1 to +1	-1 to +1	-1 to +1
	Summer	12	-1 to +2	-1 to +2	-1 to +3	-1 to +2
	Fall	12	-0 to +2	-0 to +3	-0 to +3	-0 to +3

For all the temporal parameters, the SuAsCo basin is expected to see a slight decrease to an increase in consecutive dry days throughout this century. Seasonally, the fall and summer seasons are expected to continue to experience the highest number of consecutive dry days. The fall season is expected to an increase of 0-3 days in consecutive dry days by the end of the century.

Merrimack Basin

Increased Average Temperature

The Merrimack basin is expected to experience increased average temperatures throughout the 21st century. Maximum and minimum temperatures are also expected to increase throughout the end of the century. These increased temperature trends are expected for annual and seasonal projections. Table 8 below shows how temperature will change over the course of the century.

TABLE 8
Average Temperature

Merrimack Basin		Observed Baseline 1971-2000 (°F)	Projected Change in 2030s (°F)	Mid-Century Projected Change in 2050s (°F)	Projected Change in 2070s (°F)	End of Century Projected Change in 2090s (°F)
Average Temperature	Annual	48.1	+2.2 to +4.4	+3.0 to +6.4	+3.6 to +9.1	+3.9 to +10.9
	Winter	26.8	+2.5 to +5.3	+3.2 to +7.8	+4.0 to +9.5	+4.3 to +10.8
	Spring	46.1	+1.7 to +3.5	+2.6 to +5.4	+2.7 to +7.7	+3.3 to +9.4
	Summer	68.8	+2.1 to +4.3	+2.8 to +6.7	+3.2 to +9.9	+3.8 to +12.5
	Fall	50.3	+2.3 to +5.0	+3.3 to +6.7	+3.5 to +9.6	+4.0 to +11.8
Maximum Temperature	Annual	59.1	+2.1 to +4.2	+2.7 to +6.3	+3.3 to +9.1	+3.6 to +10.9
	Winter	36.7	+2.1 to +4.8	+2.8 to +7.3	+3.4 to +8.8	+3.8 to +10.0
	Spring	57.5	+1.6 to +3.4	+2.2 to +5.5	+2.6 to +7.9	+3.2 to +9.4
	Summer	80.5	+1.9 to +4.4	+2.7 to +6.7	+3.1 to +10.2	+3.6 to +12.8
	Fall	61.5	+2.4 to +4.9	+3.5 to +6.9	+3.4 to +9.9	+3.9 to +12.2
Minimum Temperature	Annual	37.0	+2.3 to +4.8	+3.2 to +6.5	+3.9 to +9.1	+4.2 to +11.0
	Winter	16.9	+2.7 to +5.8	+3.6 to +8.3	+4.6 to +10.2	+4.8 to +11.6
	Spring	34.7	+1.9 to +3.8	+2.7 to +5.7	+2.9 to +7.5	+3.4 to +9.3
	Summer	57.1	+2.2 to +4.5	+3.0 to +7.1	+3.4 to +9.7	+4.0 to +12.2
	Fall	39.1	+2.2 to +5.2	+3.5 to +6.6	+3.6 to +9.4	+4.1 to +11.6

Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase throughout the 21st century. Summer mid-century increase of 2.7°F to 6.7°F (3-8% increase); end of century increases of 3.6°F to 12.8°F (4-16% increase). Fall mid-century increase of 3.5°F to 6.9°F (6-11% increase); end of century increases by and 3.9°F to 12.2°F (6-20% increase). Seasonally, minimum winter and fall temperatures are expected to see increases throughout the 21st century. Winter mid-century increase of 3.6°F to 8.3°F (21-49% increase); end of century increases by 4.8°F to 11.6°F (28-68% increase). Fall mid-century of 3.5°F to 6.6°F (9-17% increase); end of century increases of 4.1°F to 11.6°F (11-30% increase).

Days with Maximum Temperatures

Due to projected increases in average and maximum temperatures throughout the end of the century, the Merrimack basin is also expected to experience an increase in days with daily maximum temperatures over 90°F, 95°F, and 100°F, Table 9 below demonstrates this change.

TABLE 9
Average Temperature

Merrimack Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Maximum Temperature Over 90°F	Annual	7	+7 to +20	+11 to +33	+13 to +55	+15 to +74
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +0
	Spring	<1[63]	+<1[63] to +1	+<1[63] to +2	+<1[63] to +3	+<1[63] to +5
	Summer	7	+6 to +17	+9 to +28	+11 to +44	+13 to +58
	Fall	<1[63]	+1 to +3	+1 to +5	+1 to +9	+1 to +13
Days with Maximum Temperature Over 95°F	Annual	1	+2 to +8	+3 to +16	+4 to +31	+6 to +49
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +0
	Spring	0	+<1[63] to +<1[63]	+<1[63] to +<1[63]	+<1[63] to +1	+<1[63] to +2
	Summer	1	+2 to +8	+3 to +14	+4 to +27	+5 to +42
	Fall	0	+<1[63] to +1	+<1[63] to +2	+<1[63] to +4	+<1[63] to +6
Days with Maximum Temperature Over 100°F	Annual	<1[63]	+<1[63] to +2	+<1[63] to +5	+1 to +11	+1 to +22
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +0
	Spring	0	+0 to +<1[63]	+0 to +<1[63]	+0 to +<1[63]	+0 to +1
	Summer	<1[63]	+<1[63] to +2	+<1[63] to +5	+1 to +10	+1 to +20
	Fall	0	+0 to +<1[63]	+<1[63] to +<1[63]	+0 to +1	+0 to +2

Annually, the Merrimack basin is expected to see days with daily maximum temperatures over 90°F increase by 11 to 33 more days by mid-century, and 15 to 74 more days by the end of the century. Seasonally, summer is expected to see an increase of 9 to 28 more days with daily maximums over 90°F by mid-century. By end of century, the Merrimack basin is expected to have 13 to 58 more days.

0.0.0.1 Days with Minimum Temperatures

Due to projected increases in average and minimum temperatures throughout the end of the century, the Merrimack basin is expected to experience a decrease in days with daily minimum temperatures below 32°F and 0°F. This is demonstrated in Table 10 below.

TABLE 10
Days with Minimum Temperatures

Merrimack Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Minimum Temperature Below 0°F	Annual	7	-2 to -4	-2 to -5	-3 to -5	-3 to -5
	Winter	7	-2 to -4	-2 to -4	-2 to -5	-2 to -5
	Spring	<1/64	-0 to +<1/64	-0 to -0	-0 to -0	-0 to -0
	Summer	0	-0 to -0	-0 to -0	-0 to -0	-0 to -0
	Fall	<1/64	-0 to -0	-0 to -0	-0 to -0	-0 to -0
Days with Minimum Temperature Below 32°F	Annual	148	-12 to -30	-19 to -43	-23 to -56	-25 to -66
	Winter	83	-2 to -7	-3 to -12	-5 to -20	-6 to -25
	Spring	37	-4 to -12	-7 to -15	-8 to -19	-9 to -21
	Summer	0	-0 to -0	-0 to -0	-0 to -0	-0 to -0
	Fall	27	-5 to -11	-9 to -15	-9 to -18	-9 to -20

Seasonally, winter, spring and fall are expected to see the largest decreases in days with daily minimum temperatures below 32 °F. Winter is expected to have 3 to 12 fewer days by mid-century, and 6 to 25 fewer days by end of century. Spring is expected to have 7 to 15 fewer days by mid-century, and 9 to 21 fewer by end of century. Fall is expected to have 9 to 15 fewer days by mid-century, and 9 to 20 fewer days by end of century.

Heating Degree-Days and Cooling Degree-Days

Due to projected increases in average, maximum, and minimum temperatures throughout the end of the century, the Merrimack basin is expected to experience a decrease in heating degree days and increases in both cooling degree-days and growing degree-days. This is demonstrated in Table 11 below.

TABLE 11
Heating and Cooling Degree-Days

Merrimack Basin		Observed Baseline 1971-2000 (Degree-Days)	Projected Change in 2030s (Degree-Days)	Mid-Century Projected Change in 2050s (Degree-Days)	Projected Change in 2070s (Degree-Days)	End of Century Projected Change in 2090s (Degree-Days)
Heating Degree-Days (Base 65°F)	Annual	6693	-572 to -1185	-769 to -1621	-914 to -2135	-1032 to -2503
	Winter	3450	-217 to -492	-282 to -714	-353 to -865	-395 to -997
	Spring	1762	-144 to -291	-213 to -449	-225 to -613	-290 to -720
	Summer	106	-34 to -62	-43 to -79	-54 to -90	-54 to -92
	Fall	1381	-160 to -374	-279 to -463	-266 to -649	-285 to -735
Cooling Degree-Days (Base 65°F)	Annual	526	+209 to +444	+283 to +737	+341 to +1154	+399 to +1518
	Winter	0	+1 to +2	+0 to +4	+1 to +4	+2 to +3
	Spring	20	+10 to +30	+19 to +51	+20 to +90	+16 to +126
	Summer	455	+156 to +337	+199 to +542	+236 to +828	+278 to +1057
	Fall	43	+31 to +94	+48 to +167	+55 to +258	+78 to +335
Growing Degree-Days (Base 50°F)	Annual	2466	+406 to +812	+549 to +1226	+641 to +1923	+730 to +2413
	Winter	6	-1 to +11	+2 to +15	+5 to +24	+3 to +32
	Spring	276	+63 to +136	+89 to +239	+110 to +362	+116 to +471
	Summer	1729	+191 to +398	+258 to +614	+297 to +912	+344 to +1147
	Fall	442	+109 to +296	+179 to +416	+169 to +622	+214 to +779

Seasonally, winter historically exhibits the highest number of heating degree-days and is expected to see the largest decrease of any season, but spring and fall are also expected to see significant change. The winter season is expected to see a decrease of 8-21% (282 -714 degree-days) by mid-century, and a decrease of 11-29% (395 -997 degree-days) by the end of century. The spring season is expected to decrease in heating degree-days by 12-25% (213-449 degree-days) by mid-century, and by 16-41% (290 -720 degree-days) by the end of century. The fall season is expected to decrease in heating degree-days by 20-34% (279 -463 degree-days) by mid-century, and by 21-53% (285 -1518 degree-days) by the end of century. Conversely, due to projected increasing temperatures, summer cooling degree-days are expected to increase by 44-119% (199 -542 degree-days) by mid-century, and by 61-233% (278- 1027 degree-days) by end of century.

Seasonally, summer historically exhibits the highest number of growing degree-days and is expected to see the largest decrease of any season, but the shoulder seasons of spring and fall are also expected to see an increase in growing degree-days. The summer season is projected to increase by 15-36% (258 -614 degree-days) by midcentury, and by 20-66% (344 -1147 degree-days) by end of century. Spring is expected to see an increase by 32-86% (89 -239 degree-days) by mid-century and 42-171% (116 -471 degree-days) by end of century. Fall is expected to see an increase by 41-94% (179 -415 degree-days) by mid-century and 49-176% (214 -779 degree-days) by end of century.

Days with Precipitation Over 1", 2", and 4"

The projections for expected number of days receiving precipitation over one inch are variable for the Merrimack basin, fluctuating between loss and gain of days. Precipitation data is shown in Table 12 below.

TABLE 12
Precipitation Over 1", 2", and 4"

Merrimack Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	7	+<1[65] to +2	+<1[65] to +3	+1 to +3	+1 to +4
	Winter	2	-0 to +1	+<1[65] to +1	+<1[65] to +1	+<1[65] to +2
	Spring	2	-0 to +1	-0 to +1	+<1[65] to +1	+<1[65] to +1
	Summer	1	-0 to +<1[65]	-0 to +1	-0 to +1	+0 to +1
	Fall	2	-0 to +1	-0 to +1	-0 to +1	+0 to +1
Days with Precipitation Over 2"	Annual	1	+<1[65] to +<1[65]	+0 to +1	+<1[65] to +1	+<1[65] to +1
	Winter	<1[65]	-0 to +<1[65]	-0 to +1	-0 to +<1[65]	+0 to +<1[65]
	Spring	<1[65]	-0 to +<1[65]	-0 to +<1[65]	-0 to +<1[65]	+0 to +<1[65]
	Summer	<1[65]	-0 to +<1[65]	-0 to +<1[65]	-0 to +<1[65]	+0 to +<1[65]
	Fall	<1[65]	-0 to +<1[65]	-0 to +<1[65]	-0 to +<1[65]	+0 to +<1[65]
Days with Precipitation Over 4"	Annual	<1[65]	-0 to +<1[65]	-0 to +<1[65]	-0 to +<1[65]	+0 to +<1[65]
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +<1[65]
	Spring	0	-0 to +<1[65]	+0 to +<1[65]	-0 to +<1[65]	+0 to +<1[65]
	Summer	<1[65]	-0 to +<1[65]	-0 to +<1[65]	-0 to +<1[65]	+0 to +<1[65]
	Fall	<1[65]	-0 to +<1[65]	-0 to +<1[65]	-0 to +<1[65]	+0 to +<1[65]

Seasonally, the winter season is generally expected to see the highest projected increase. The winter season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and of 0-2 days by the end of century. The spring season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and of an increase of 0-1 days by the end of century.

Total Precipitation

Similar to projections for number of days receiving precipitation over a specific threshold, seasonal projections for total precipitation are also variable for the Marrimack basin. Total Precipitation is shown in Table 13 below.

TABLE 13
Total Precipitation

Merrimack Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	44.2	+0.1 to +4.5	-0.0 to +5.8	+0.9 to +6.9	+0.9 to +7.6
	Winter	10.8	-0.5 to +1.9	-0.0 to +2.4	+0.4 to +3.0	+0.4 to +3.8
	Spring	11.3	-0.1 to +2.2	-0.1 to +2.1	+0.1 to +2.6	+0.2 to +2.5
	Summer	10.3	-0.2 to +1.3	-0.6 to +2.0	-0.8 to +1.8	-1.1 to +1.8
	Fall	11.9	-1.1 to +1.1	-1.1 to +1.5	-1.6 to +1.4	-1.4 to +1.3

The winter season is expected to experience the greatest change with an increase of 0-22% by mid-century, and of 4-35% by end of century. Projections for the summer and fall seasons are more variable and could see either a drop or increase in total precipitation throughout the 21st century. The summer season projections for the Merrimack or basin could see a decrease of 0.6 to an increase of 2.0 inches by mid-century (decrease of 6% to increase of 20%) and a decrease of 1.1 to an increase of 1.8 inches by the end of the century (decrease of 10% to increase of 17%). The fall season projections for the Merrimack basin could see a decrease of 1.1 to an increase of 1.5 inches by mid-century (decrease of 10% to increase of 13% and a decrease of 1.4 to an increase of 1.3 inches by the end of the century (decrease of 12% to increase of 11%).

Consecutive Dry Days

Annual and seasonal projections for consecutive dry days, or for a given period, the largest number of consecutive days with precipitation less than 1 mm (~0.04 inches), are variable throughout the 21st century.

TABLE 14
Consecutive Dry Days

Merrimack Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Consecutive Dry Days	Annual	17	-1 to +1	-0 to +2	-1 to +2	-0 to +3
	Winter	12	-1 to +1	-1 to +2	-1 to +2	-1 to +2
	Spring	12	-1 to +1	-1 to +1	-2 to +1	-1 to +1
	Summer	13	-1 to +1	-1 to +2	-1 to +2	-1 to +2
	Fall	12	-0 to +2	-0 to +2	-0 to +3	-0 to +3

For all the temporal parameters, the Merrimack basin is expected to see a slight decrease to an increase in consecutive dry days throughout this century. Seasonally, the fall and summer seasons are expected to continue to experience the highest number of consecutive dry days. The summer season is expected to experience a decrease of 1 day to an increase of 2 days in consecutive dry days by the end of the century.

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APPENDIX G



TOWN OF WESTFORD MUNICIPAL VULNERABILITY PREPAREDNESS PLANNING

Listening Session

June 18, 2020

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WELCOME

Westford awarded a $36K grant for Municipal Vulnerability (MVP) Community Resilience Building (CRB) Workshop Process

First step in unlocking additional funding opportunities for Westford from FEMA/MEMA and Commonwealth of Massachusetts



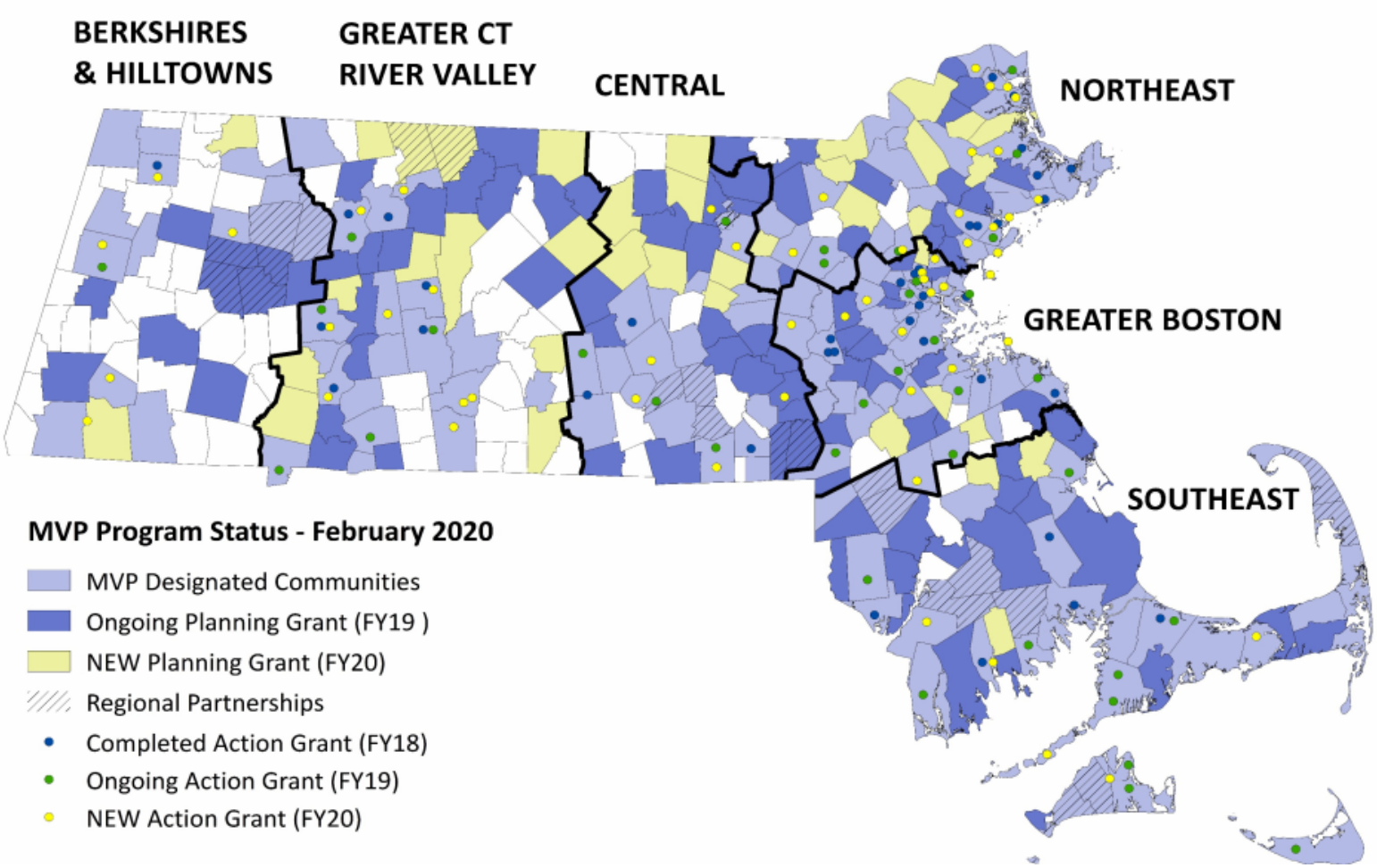
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BACKGROUND ON MVP PROGRAM

MVP Designations
82% of the Commonwealth
287 communities

Action Grant Projects
FY 18: 37
FY 19: 36
FY 20: 54

Total Awards
$33M+ in planning and action grants to date



MVP GRANT AND CRB PROCESS

1. Establish Core Team
2. Complete Evaluation/Assessment
3. Hold Workshops
4. Draft MVP Report
5. **Hold Listening Session**
6. Final MVP Report



A brief thanks to Westford's MVP Core Team



Carol Gumbart
Henry Fontaine
Jeffrey Stephens
Jeremy Downs
Joe Targ
Matthew Salem
Paul Fox
Paul Starratt
Rae Dick
Rebecca Cheney
Richard Barrett
Stephen Cronin
Tim Whitcomb





NATURAL HAZARDS AND CLIMATE CHANGE

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WHAT ARE NATURAL HAZARDS?

Poor Urban Drainage
Regional Flooding
Culvert Failure



Inland Flooding



Tsunami



Severe Winter Storm

Blizzards
Snow
Ice Storms



Drought



Average/Extreme Temperatures



Tornadoes



Landslide



Wildfires



Other Severe Weather

Nor'easters
High Wind
Heavy Precipitation
Microbursts



Coastal Flooding



Invasive Species



Earthquake



Coastal Erosion



Hurricanes/Tropical Storms



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TOP NATURAL HAZARDS – PAST & PRESENT



Thunderstorms



Invasive Species



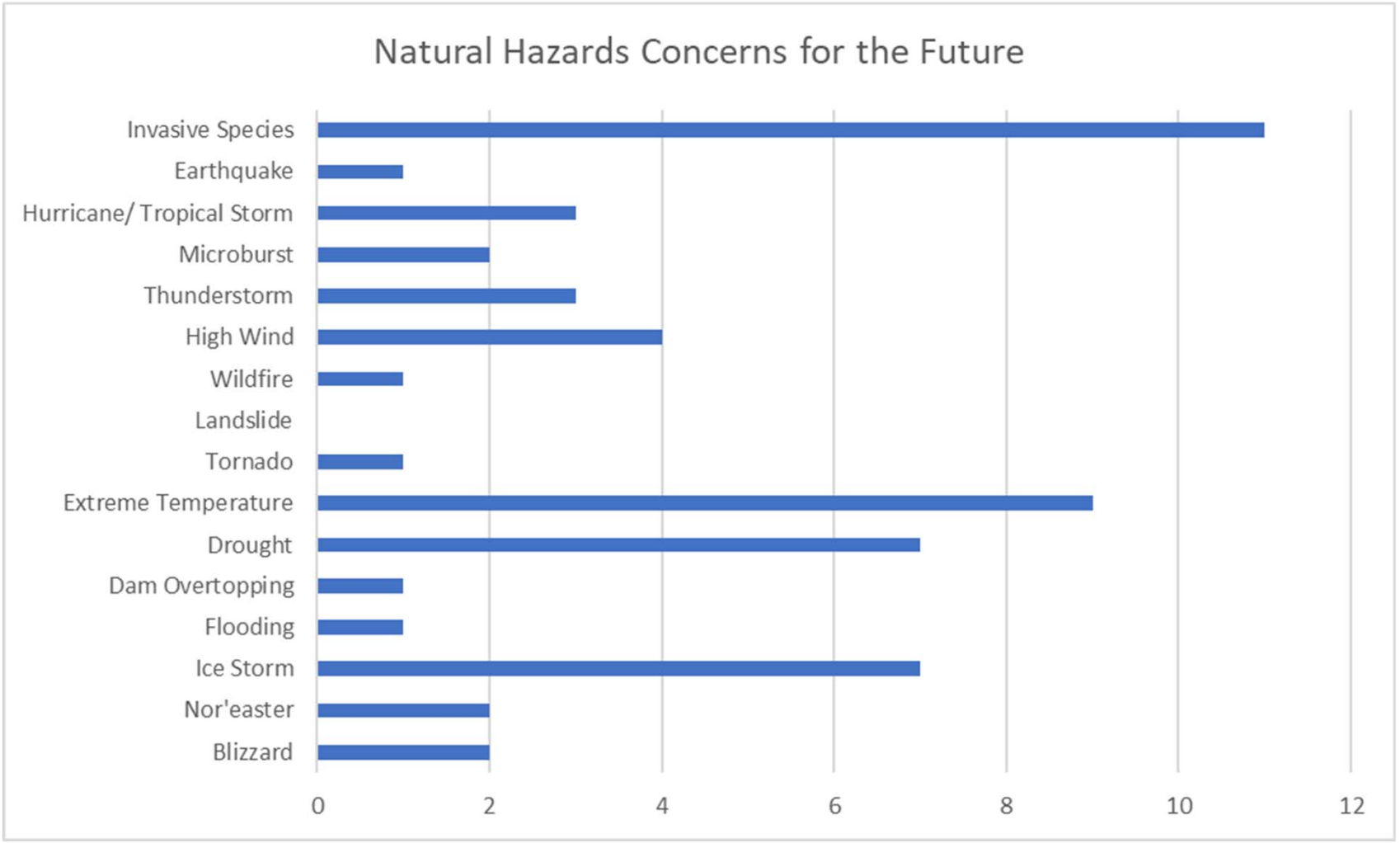
High wind



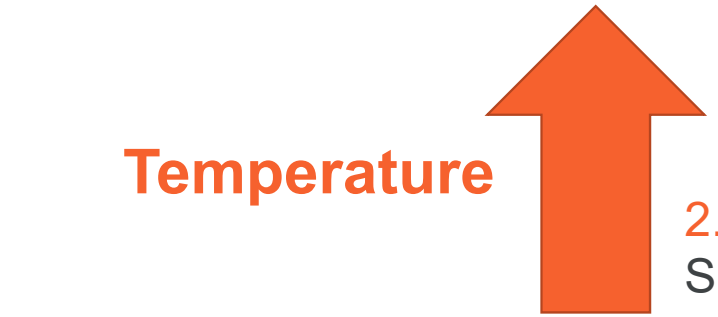
Nor’easter

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TOP NATURAL HAZARDS – FUTURE



MASSACHUSETTS OBSERVED CLIMATE CHANGES



Temperature

2.9°F
Since 1985 (Statewide)



Growing Season

15 Days
Since 1950



Sea Level Rise

11 inches
Since 1922 (Boston)



Heavy Precipitation

55%
Since 1958

resilientma.org

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CHANGES IN PRECIPITATION

SuAsCo Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	45.4	+0.2 to +4.8	+0.6 to +6.1	+1.5 to +7.8	+1.2 to +8.0
	Winter	11.2	-0.4 to +2.1	+0.1 to +2.6	+0.5 to +3.2	+0.4 to +4.1
	Spring	11.6	-0.1 to +2.4	+0.0 to +2.1	+0.3 to +2.6	+0.2 to +2.6
	Summer	10.8	-0.2 to +1.5	-0.5 to +2.2	-0.6 to +2.4	-1.1 to +2.2
	Fall	12.0	-1.2 to +1.1	-1.3 to +1.7	-1.8 to +1.6	-1.5 to +1.4

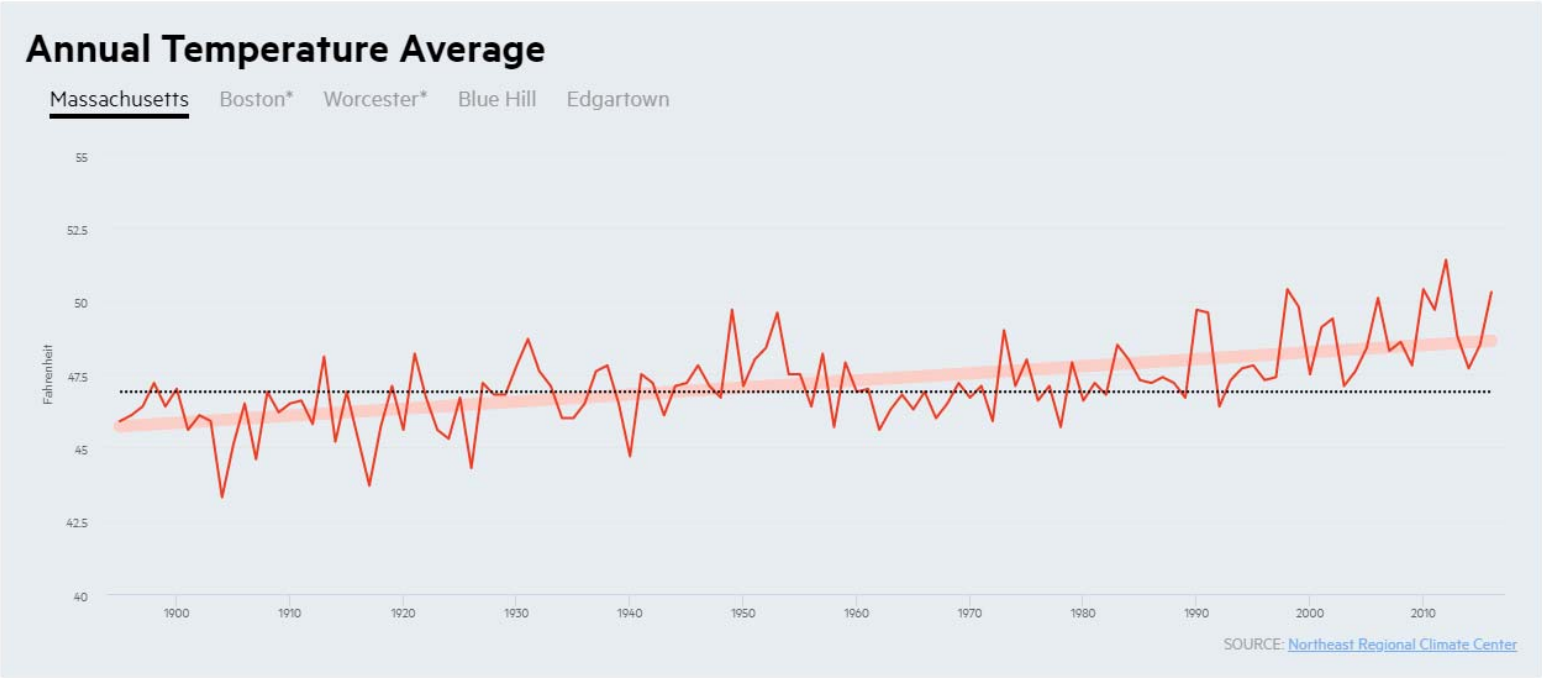
Merrimack Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	44.2	+0.1 to +4.5	-0.0 to +5.8	+0.9 to +6.9	+0.9 to +7.6
	Winter	10.8	-0.5 to +1.9	-0.0 to +2.4	+0.4 to +3.0	+0.4 to +3.8
	Spring	11.3	-0.1 to +2.2	-0.1 to +2.1	+0.1 to +2.6	+0.2 to +2.5
	Summer	10.3	-0.2 to +1.3	-0.6 to +2.0	-0.8 to +1.8	-1.1 to +1.8
	Fall	11.9	-1.1 to +1.1	-1.1 to +1.5	-1.6 to +1.4	-1.4 to +1.3

IMPACTS:

- Episodic droughts
- Concerns over food production and drinking water supply
- Stress on ecosystems
- Flooding



RISING TEMPERATURE



IMPACTS:

- Heat-related illnesses
- Vector borne-diseases
- Health of plants, animals, ecosystems
- Reduced crop production
- Larger energy demand
- Droughts and wildfires

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EXTREME STORMS

Blizzards

- More than 5 in MA since 2011

Nor'easters and Hurricanes

- Upward trend since the 1970s



IMPACTS:

- **Public safety concerns, including increased injuries and mortality**
- **Economic damages and business disruption**
- **Property and infrastructure damage**
- **Impacts on natural resources**

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CLIMATE CHANGES	RELATED NATURAL HAZARDS	PROJECTIONS BY THE END OF THIS CENTURY
Changes in precipitation 	– Inland flooding – Drought – Landslide	– Annual precipitation: Increase up to 16% (+7.3 inches) – Days with rainfall accumulation 1+ inch: Increase up to 57% (+4 days) – Consecutive dry days: Increase 18% (+3 days) – Summer precipitation: Decrease
Sea level rise 	– Coastal flooding – Coastal erosion – Tsunami	– Sea level: Increase 4.0 to 10.5 feet along the Massachusetts coast
Rising temperatures 	– Average/extreme temperatures – Wildfires – Invasive species	– Average annual temperature: Increase up to 23% (+10.8 degrees Fahrenheit) – Days/year with daily minimum temperatures below freezing: Decrease up to 42% (-62 days) – Winter temperatures: Increase at a greater rate than spring, summer, or fall – Long-term average minimum winter temperature: Increase up to 66% (+11.4 degrees Fahrenheit) – Days/year with daily maximum temperatures over 90 degrees Fahrenheit: Increase by up to 1,280% (+64 days) – Growing degree days: Increase by 23% to 52%
Extreme weather 	– Hurricanes/tropical storms – Severe winter storms/nor'easters – Tornadoes – Other severe weather	– Frequency and magnitude: Increase

Note: This plan also assesses earthquakes, but there is no established correlation between climate change and earthquakes.
Source of Climate Change Projections: Northeast Climate Adaptation Science Center at the University of Massachusetts, Amherst.

CLIMATE CHANGE + NATURAL HAZARDS = AMPLIFIED RISK

https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan

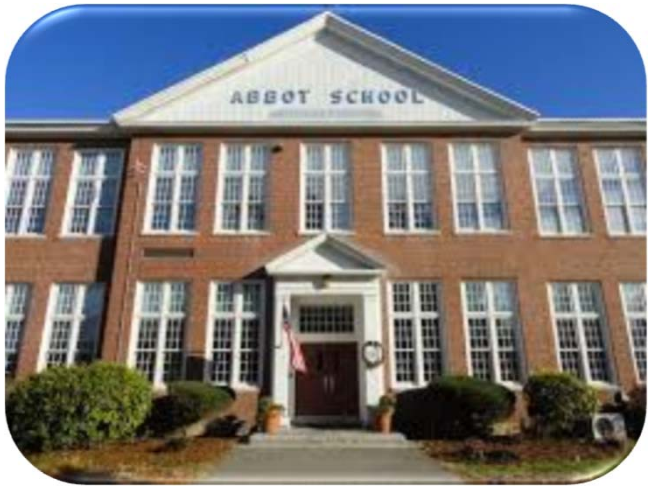


COMMUNITY ASSET INVENTORY

TOWN OF WESTFORD
INCORPORATED SEPT. 23, 1729

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WHAT ARE COMMUNITY ASSETS?



Societal



Infrastructure



Natural Resources



Economy

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PEOPLE – SOCIETAL ASSETS

- **Public Education Facilities and Resources**
- **Buildings that Support Community Needs**
- **Vulnerable Populations**
- **Support Services**



INFRASTRUCTURAL ASSETS

- **Flood Control Infrastructure**
- **Transportation Corridors**
- **Critical Facilities**
- **Communication and Energy**



ECONOMIC ASSETS

- **Essential Goods – Large Retail**
- **Essential Service – Small Business**
- **Large Employers**
- **Other Essential Services – Lodging, Transportation and Utilities**



ENVIRONMENTAL ASSETS

- Hydrologic Resources
- Open Space and Conservation Lands
- Parks and Recreation Areas
- Forestry and Agriculture
- Environmental Health
- Environmental Education





MVP WORKSHOPS

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Overview of the Process (Steps & Tasks)

DURING WORKSHOP

A Prepare for the Workshop
1. Establish a core team with goals.
2. Engage stakeholders.
3. Prepare materials for workshop.
4. Decide on participant arrangements.

B Characterize Hazards
1. Identify past, current, and future impacts.
2. Determine the highest-priority hazards.

C Identify Community Vulnerabilities and Strengths
1. Identify infrastructural vulnerabilities and strengths.
2. Identify societal vulnerabilities and strengths.
3. Identify environmental vulnerabilities and strengths.

D Identify and Prioritize Community Actions
1. Identify and prioritize infrastructural actions.
2. Identify and prioritize societal actions.
3. Identify and prioritize environmental actions.

E Determine the Overall Priority Actions
1. Identify highest-priority actions.
2. Further define urgency and timing.

F Put It All Together
1. Generate final workshop products.

G Move Forward
1. Continue community outreach and engagement.
2. Secure additional data and information.
3. Inform existing planning and project activities.

Community Components



Infrastructural



Societal

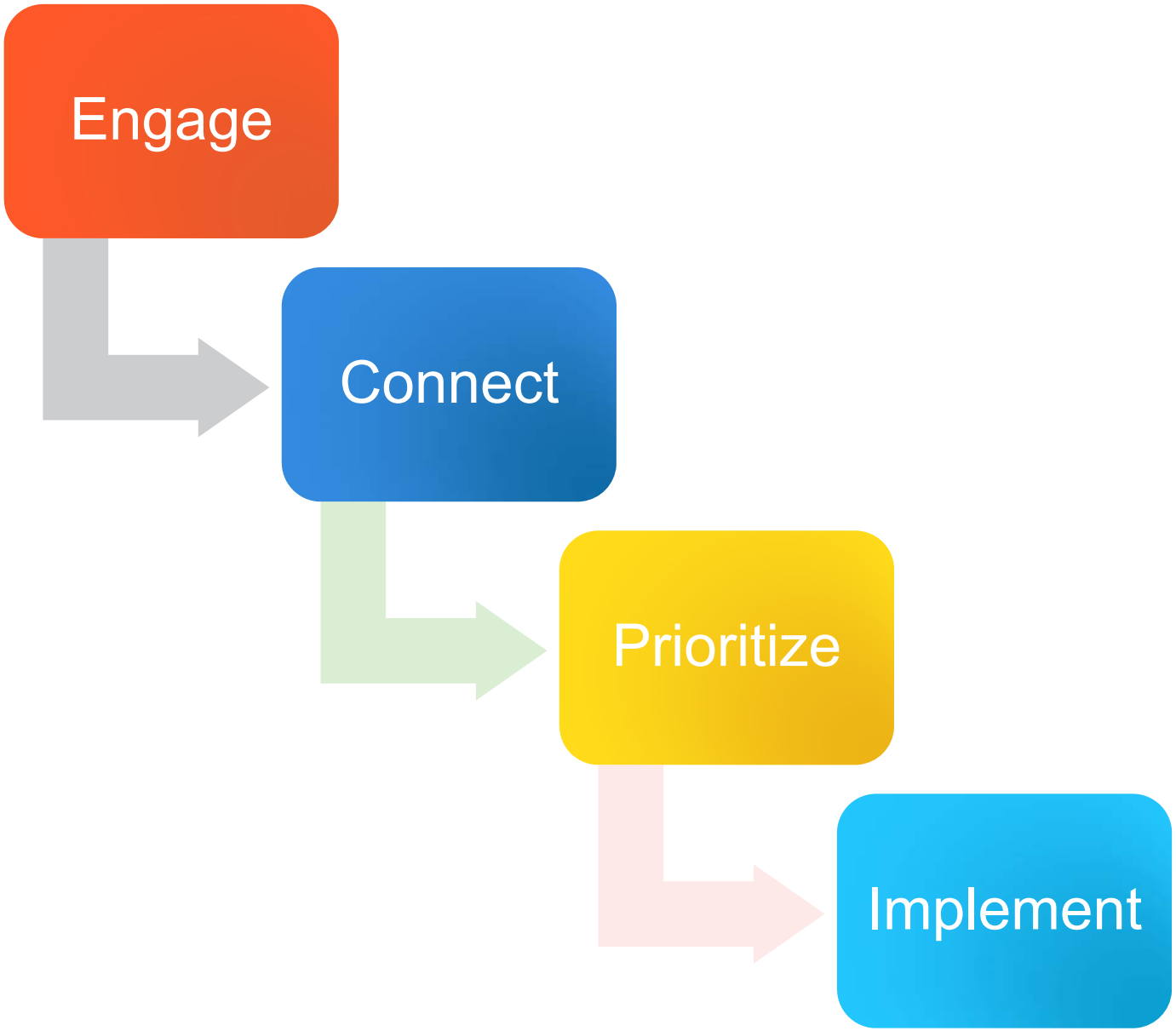


Environmental

https://www.communityresiliencebuilding.com/

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WORKSHOP OBJECTIVES



CRB MATRIX

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

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

V = Vulnerability S = Strength

Westford's Top Natural Hazards

Nor'easters
Extreme temperatures
Other severe weather (High winds, thunderstorms, Ice storms, hurricanes/tropical storms, Blizzard, microburst)
Invasive Species

Westford's Priority Assets

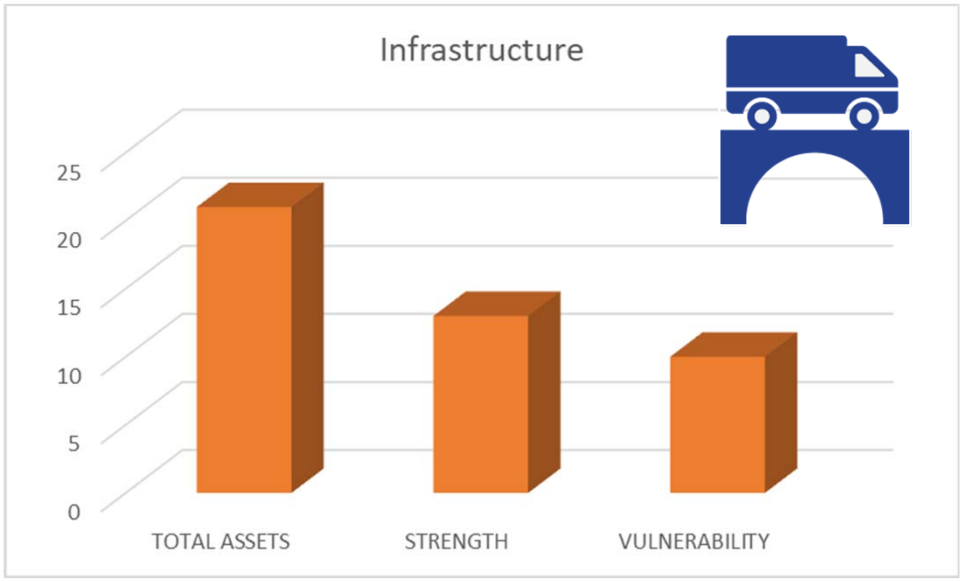
Name	Location	Ownership (Town, State,	Vulnerability (V) or Strength (S)	Actions to Address Westford's Top Hazards
Infrastructural				
Bridges	Town Farm Road Bridge, Graniteville Bridge, Bridge Street Bridge (full list in culvert project including ownership	Mixed	V - if these structures fail, inhibit passage across key locations in Town. S - provide critical emergency access routes	Assessment of DOT inspections and initiation of maintienance and repair/replacement program.
Electric Grid & National Grid	Town-wide	Private	V - when power goes out, serious impact to residences, business, emergency response. S - National Grid response	Continue their trimming programs and emergency resposne. Strategic vegetation program that considers locations of power lines. Just did plantings at Route 110 .. Right under power lines ... fast growing. Also have the high tension wires across town and this is a different system and department within national grid.
Culverts	Keyes Brook Culvert, Vine Brook Culvert, Town wide	Town	S - allow water to travel through Town and reduce flooding. V - when fail, impede transportation	Initiatiation of miantenance /repair replalcemnet program
Roads		Town	V - if fail, environmental impacts and potential for property damage (more for culverts than roads)	Proactive maintenance of roadways.
Gas infrastructure, Tennesee Pipeline goes through section of Town	Town-wide, high pressure gas transmission line - crosses on southern border on Carlisle	Private		Lot of agingging gas infrastructure in Town that needs updating. Many leaks. Sometimes gets coordinated. You may have road that needs to be resurfaced in 2 years, and they have it in a 10 year plan. Typically reach out to gas company before do Town project. Make every attempt while road is open to accomodat If its just resurfacing, they don't often take advtange.
Dams	Murray Printing Company Dam, Nabnasset Lake Dam, additional public and private dams (list in SWMMP)	Mixed	V - overtopping	In March 2010, Nab Dam almost overtopped, and town had to address. Continue required DCR inspections. Implement recommended mitigation/maintenance. Couple years ago WSE did assessment of all dams. Nothing immenent, but do have some deficiencies. These need to get addressed Talk about climate change. ONly three public dams, none of the private dams. Private dams - are these liabilities to Town? This is a risk (move to V). Town has limited ability to control the private locations (greystone doesn't meet state's criteria). Dam located wtihin Mill itself that controls the canal (Penstock (SP)) in Abbot Mill complex. Has a direct effect - if fails, dam is overwhelmed, that water is going to drain the lake and upstream watershed. Education and outreach - need to make sure private dam owners are complying, coordination with state agencies. Follow up with dam group (jennie) about funding. EAPs developed recently for three dams.
Schools	Multiple locations		S - some schools provide shelter space	(Education about hazards and vulerabilities falls under first workshop)

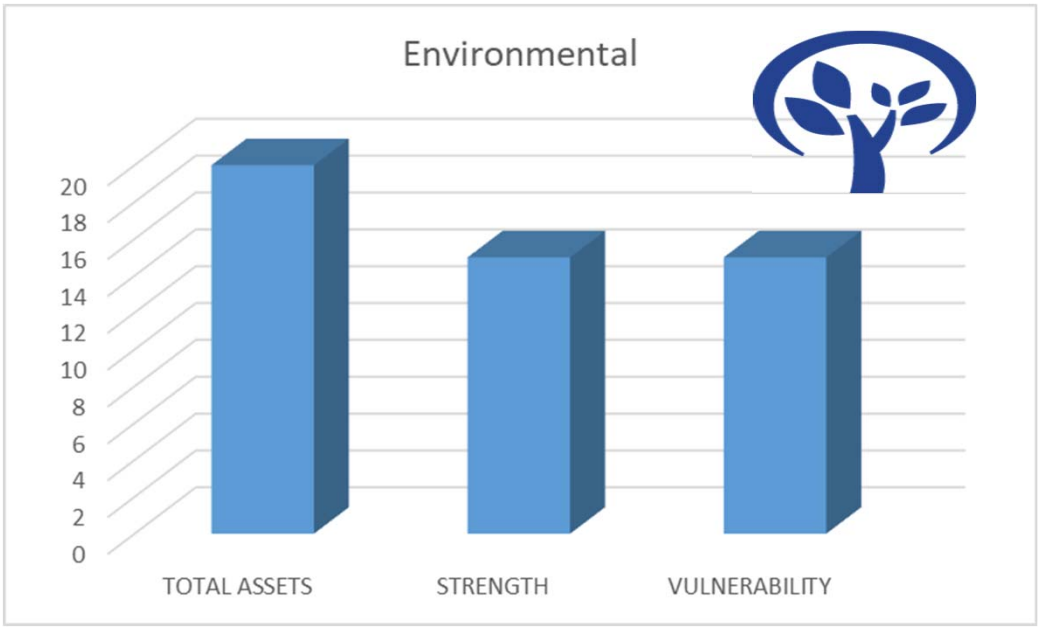
TOWN OF WESTFORD · INCORPORATED SEPT. 23, 1729 ·

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IDENTIFIED STRENGTHS AND VULNERABILITIES







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MITIGATION STRATEGIES

TYPES OF MITIGATION ACTIONS

- Prevention
- Property Protection
- Public Education and Awareness
- Natural Resource Protection and Green Infrastructure
- Structural Projects
- Emergency Services Protection

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EXAMPLE MITIGATION ACTIONS IN WESTFORD

- **Prevention**
  - Perform preventative maintenance on roadways, bridges, and culverts
- **Public Education and Awareness**
  - Use public access channels, focus on what residents can do to mitigate hazards on their property and be prepared for hazards that cannot be mitigated
- **Natural Resource Protection**
  - Land acquisition for flood mitigation
  - Implement a tree inventory and planting program
- **Structural Projects**
  - Update aging/leaking gas infrastructure
- **Emergency Services Protection**
  - Install generators to increase shelters/warming centers

Full list available in draft MVP Report on website

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WHAT'S NEXT?

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NEXT STEPS BEFORE JUNE 30, 2020

- **Complete** MVP Post-Webinar Survey
- **DRAFT** MVP Summary of Findings Report online for public review
- Submit comments to Rebecca Cheney by **June 26th**
- **Final** MVP Summary of Findings Report
- Submit documents to EEA

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MVP ACTION GRANT OPPORTUNITIES

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MVP ACTION GRANTS

- Detailed Vulnerability and Risk Assessment*
- Community Outreach and Education
- Local Bylaws, Ordinances, Plans, and Other Management Measures**
- Redesigns and Retrofits***
- Nature-Based Flood Protection, Drought Mitigation, Water Quality, and Water Infiltration Techniques
- Nature-Based, Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality



* Most common project type

** Second-most common project type

***Third-most common project type

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MVP ACTION GRANTS (CONT)



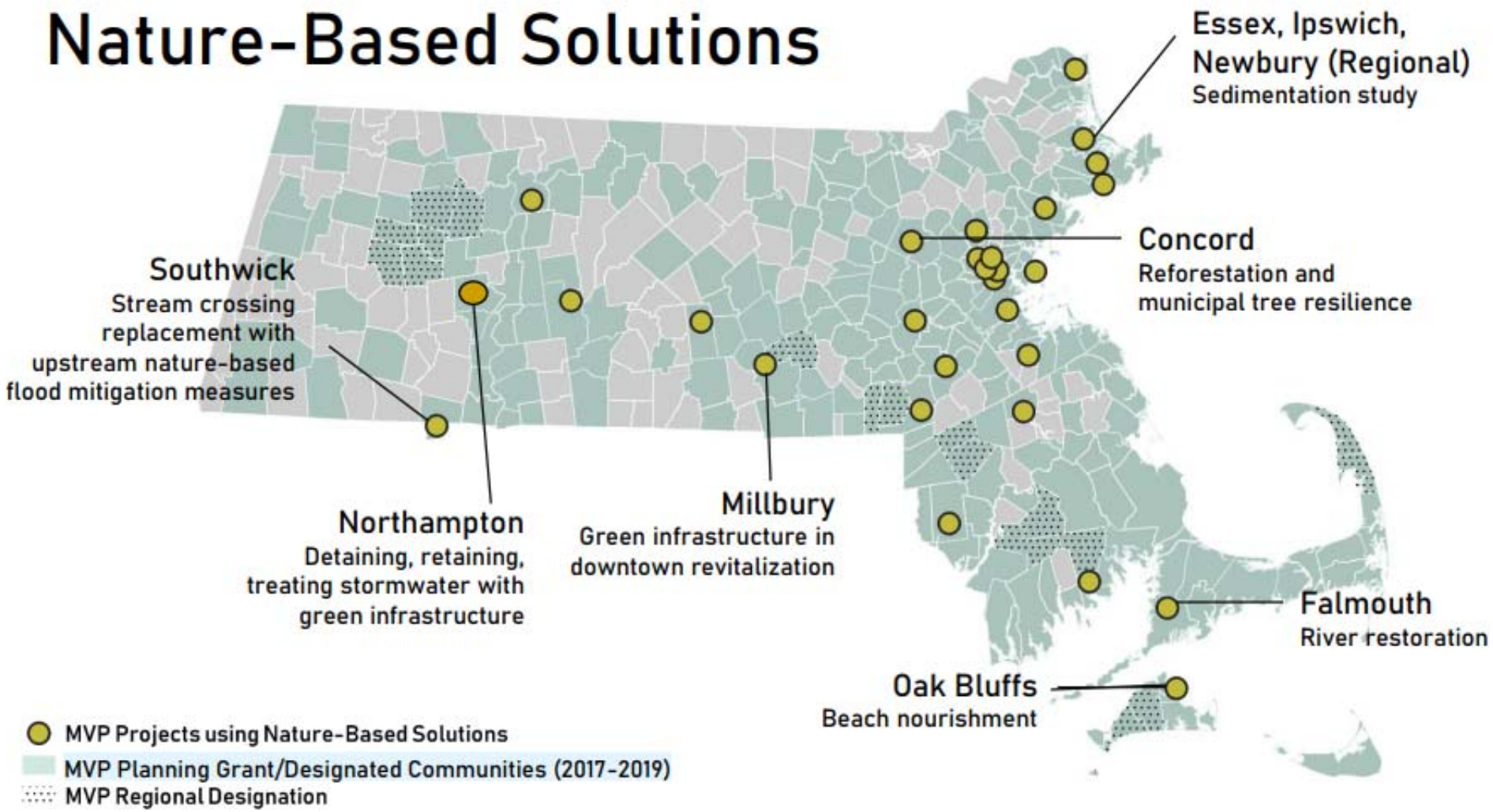
- Nature-Based Solutions to Reduce Vulnerability to other Climate Change Impacts
- Ecological Restoration and Habitat Management to Increase Resiliency

NEW IN 2019

- Energy Resilience
- Chemical Safety
- Land Acquisition for Resilience
- Subsidized Low-Income Housing Resilience Strategies

\+ Expanded eligibility of project location

Nature-Based Solutions



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FOR MORE INFORMATION

- **Rebecca Cheney, City Planner**
  - rcheney@westfordma.gov
  - 978.399.2577
- **Gabrielle Belfit, CFM, Senior Environmental Scientist Scientist**
  - GCBelfit@tighebond.com
  - 508.304.6362
- **Jennie Moonan, PE, Project Manager**
  - JSMoonan@tighebond.com
  - 781.708.9826



- **https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla**

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AND NOW FOR QUESTIONS AND ANSWERS



Westford Listening Session Notes

Attendees

Henry Fontaine

Jennie Moonan, Tighe & Bond

Kristin Dippold, Tighe & Bond

Paul Starratt

Rebecca Cheney, Westford Town Planner

Kathy Lynch

Matthew Salem

Emily Teller

Susan Thomas

Additional Matrix Information

- Cameron Senior Center – Great resource that called everyone over 65 regarding COVID-19 – They provide communication, meals once a month to celebrate birthdays

Mitigation Action Discussion

Prevention:

- Some towns are banning new gas hook ups and are switching to electric only – which is largely in communities that are fully built out. Minimize infrastructure barriers to non-petroleum sources, in Westford may be other options instead of electrical only – maybe heat pumps, which would take you off natural gas/oil. State program provides loans for heat pumps, apply through MassSave.
- Zoning Board of Appeals Meeting – there is new development in Westford, including large apartments by ski area and the 99. One development was approved (21 units) in previously undeveloped area but are struggling to approve 4 units within a previously developed site.
    - The Town should prioritize places to develop – prioritize development in previously developed sites – would require huge education effort for ZBA members and Planning and Conservation.
- They have an Open Space bylaw, but it is outdated and could be improved. They would like to create Natural Resource Overlay Districts. There would be metrics within the zoning bylaws that categories the developability of land, which relates to the number of units a developer may be able to put on a property.
- Westford Climate Action Committee – Talk about requiring LEED Certification/use of solar panels/less destructive or wasteful building materials in new development and municipal buildings. Introduce a code that enhances the town's sustainability efforts
- Water Department/Water Commissioner have jurisdiction over wells through Water Protection Overlay District – They have land rights and development rights – jurisdiction over

wells/aquifers/IWPAs/Zone IIs. Septic is defined by state standards and are some of the most restrictive in the country.

- Map Native American sites in Westford – map and put in Town's GIS – there are some ceremonial sites in Westford. Get on Planning Board's radar for future projects and mapping. There is a site off of Route 40 (these lands may be private). There is also a Native American Women's Fertility Site (stone circle) that was revealed when Grassy Pond went dry. This is something to add to the asset inventory, but make sure that location detail is not expressed.

Property Protection

- Looking to move the IT department to the new Center Building. Currently, the IT Department is in an inadequate building.

Education:

- Partner with local nurseries to provide education on invasive species and push for a focus on native species. There is a huge gap on education here – even the gardeners in town do not have a clear understanding of native versus invasive
    - Lawn maintenance should also be discussed in education – organic lawn design/maintenance, the impacts of fertilizer, mowing education to protect pollinators (This could also be a workshop through the Middlesex Conservation District).
    - A conservation trust parcel was getting mowed and it was not the appropriate time to be mowing that land.
    - Water Department (Mark Warren/Chip Osborne) has hosted organic lawncare education in the past – reach out to him again.
- Provide education to ZBA members, developers, planning, and conservation on how the Town can better prioritize areas of development
- Cameron Senior Center had called residents over 65 and educated them on the COVID-19 crisis – maintaining this chain of communication is vital for the future. They should not be the only agency in town that is connecting with the elderly population.
- Educate the public on the AM station that is activated during emergencies. The frequency is not well known, and there are residents that do not have computers/tablets/cell phones/etc
    - The radio does not need to be charged, in an elongated power outage, devises would have to be charged in a car or accessing the library which is challenging for less mobile residents. The radio is universal.
- Reverse 911 is not widely used, but the Town has the capability to use it. The Town only likes to use this in true emergencies. Using this function regularly is expensive. Its beneficial to restrict use so that people really pay attention to it when it is used.
- Provide sustainability education, conservation and environmental stewardship to students

Natural Resource Protection:

- Allocate more resources towards the Tree Warden position and Tree Planting Program.
- There was recently a tree harvesting study – Fund a program. Revisit this with Susan Thomas.
- Require developers to plant more and bigger trees. Require trees to be replaced if they fail/fall.
- Identify and protect wildlife corridors and map them. These corridors should be protected. Wildlife corridor in culverts and the Town has followed the Stream Crossing Guidelines (for example – they replaced a 30" pipe with a 12' bridge)

- Some people have installed homemade signs regarding turtle crossing

Structural Projects:

- Placing utilities underground would be beneficial on multiple fronts – It is very expensive and underground utilities also have their own maintenance issues – pros and cons to overhead and underground utilities

Emergency Services Protection:

- Police in Westford are proactive about protecting vulnerability citizens and have a system in place for brining home safety with minimal communication
- Have a cooperative agreement with abutting communities regarding firefighters, ambulance, and EMTs

Town of Westford MVP

Mitigation Actions from Workshops

Listening Session Notes

Prevention: Prevention actions are intended to address future development and guide development away from natural hazards. Many of the hazards that impact the region can be reduced by addressing them upfront through code enforcement and regulatory measures. Prevention activities include planning, zoning, building ordinances, subdivision regulations, and requirements to bury utilities.

- Amend zoning bylaws to address heat island effects and increase resiliency by adjusting planting requirements (e.g., native plants, less grass, etc.).
- Update local code for historic properties that would apply if building was renovated or damaged to include natural hazard resiliency considerations.
- For bridges, assessment of MassDOT inspections and initiation of maintenance and repair/replacement program.
- Develop a strategic vegetation program that considers locations of power lines.
- Continue to require inspections of dams (both public and private).
- Create a "Ranger" position that will support management and maintenance of conservation lands, trails, and open space.
    - Discussion items:
        - Banning gas hookups for new construction?
        - Minimize infrastructure barriers to switch to non-petroleum sources, in Westford may be other options instead of electrical only. Heat pumps. Challenges with older houses and cooling.
        - State program provides loans for heat pumps, apply through MassSave
        - Zoning Board of appeals meeting – new development in Westford, not to mention large apartments just constructed by upper
        - One development for 21 houses was approved in previously undeveloped area, many units, and struggling to approve 4 units on previous site – create prioritization across Town about better places to develop (i.e., previously developed sites). Would require huge educational effort for ZBA members and developers, and planning and conservation.
            - Do have an open space residential bylaw, may be outdated, and could be updated like other communities have (Mass Audubon), create natural resource overlay district. It's not the same as prioritizing, but there are metrics in zoning bylaw that would categorize the buildability / developability of land.
            - Talk about requiring LEED Certification or use of solar, or less destructive/wasteful materials… codify if become more sustainable (Was Westford Climate Action group)
        - Juniper Hill project – water dept & commissioners have jurisdiction over wells and aquifers/IWPAs/Zone IIs. Septic is defined by state standards. Town has review processes, including Engineering review.
        - Ceremonial Native American sites in Westford? Map and put in Town's GIS? Get in Planning Boards radar for future projects. Historical committee, Jeff Hall. Some of these lands may be private. Stone circle revealed when Grassy Pond when dry may be a Native American fertility circle.

Property Protection: Property protection actions address individual buildings and reduce risk through modification. Activities include acquisition, building relocation, building elevation, retrofitting, barriers, flood-proofing, utility relocation or flood-proofing, and insurance.

- The Highway Department facility was constructed with only one entrance. If the adjacent property became available, could purchase and add second access. It would be beneficial to increase fuel storage for redundancy for all Town vehicles. Currently only fueling station located at Highway Facility and some other vehicles uses. Fuel will not deliver to facility if there is snow on the ground or predicted for that day, and will not deliver fuel if there are thunderstorms.
- Evaluate Highway Department Building lightening suppression system.
    - Discussion:
        - Proposed new center building – looking to move IT Department

Public Education and Awareness: Public education and awareness actions will inform and remind the public about natural hazards and actions that can be taken to avoid potential damage and injury resulting from a hazard. Activities include providing informational mailings or workshops, community outreach, real estate disclosure of hazards, environmental education, and technical assistance provided on disaster management issues.

- For elderly population, especially those living alone, improve contact and communication if sheltering is required with an extended power outage. Provide or communicate meal service.
    - Discussion:
        - Cameron senior center staff (town had called residents over 65 at start of COVID.
        - The staff are on top of period meal service.
- For all population, especially vulnerable populations, provide education about alternative communication methods (e.g. radio).
    - Discussion:
        - Is there a local station? Yes, there is an AM station that is activated during emergencies. What is frequency?
        - We all assume we can charge devices, but could be out of power for many days. Leaves you with driving your car to devices or accessing library. Less mobile people would find this challenging… radio becomes universal.
        - There are residents that don't have great computer access.
        - Reverse 911 – Town has it (CODE RED), but not heavily used. This is expensive and Westford is strategic about use. Value in restricting use of this and people then pay attention to it.

- Provide information to caregivers of special needs, elderly, other vulnerable populations about what to do, resources during natural hazards. Provide that information in multiple languages.
- Coordinate with schools to provide education to students on natural hazards, vulnerabilities, and resiliency.
    - Discussion:
        - Sustainability education, environmental stewardship.
- Educate private dam owners on inspection, maintenance.
    - Discussion items:
        - Lawn maintenance education (organic lawn design and maintenance). Enhancing education on impacts of fertilizer.
        - Education on mowing schedules and other alternatives on private

property to protect pollinators and species. Consider doing a workshop in Town.
        - Re-reach out to Mark Warren – water department has hosted organic lawncare (Chip Osborne).
    - Discussion items:
        - One development for 21 houses was approved in previously undeveloped area, many units, and struggling to approve 4 units on previous site – create prioritization across Town about better places to develop (i.e., previously developed sites). Would require huge educational effort for ZBA members and developers, and planning and conservation.
        - Native plants & educational efforts. Partner with local nurseries to provide education on non-natives and invasive, there is still a huge gap in people's understanding about species in their yard or at greenhouses.

Natural Resource Protection: Natural resource protection reduces the intensity of hazard effects and improves the quality of the environment. Activities include preservation or restoration of natural systems, open space preservation, state and local floodplain and wetland regulations, stormwater management, watershed protection measures and best management practices, and soil erosion and sediment control.

- For higher density areas (e.g., villages), add trees and stormwater improvements.
    - Discussion:
        - Town has a tree warden already. Allocate more resources to the Tree Warden and planting program.
        - Study about tree harvesting that was released recently. Change carbon sequestration, but if more resources, could do something more. Revisit this with susan.
        - Require developers to plant more and bigger trees and ensure replacement if trees fail.
        - Identify and protect wildlife corridors. Map them. Not encouraging them to interact with people or roads. Buying land? Protecting them.
        - Wildlife corridor in culverts. Critter crossings are used sometimes. ACE Hardware on Groton Road, replaced culvert 30" pipe now 12' bridge, meet stream crossing guidelines.

Structural Projects: Structural projects are actions that control the hazard and directly protect people and property. Such activities include construction and maintenance of berms, dams, floodwalls, channel improvements, drainage improvements, and detention/retention basins.

- Initiate maintenance and repair program for culverts.
- Proactively maintain roadways.
- Implement recommendations of stormwater management master plan, including installation of stormwater best management practices.
    - Discussion:
        - Putting utilities underground to address issues due to downed wires. Extremely expensive to retrofit. Underground utilities can be impacted by wet conditions (pros and cons either way).

Emergency Services Protection: Emergency services protection actions are aimed at protecting emergency services before, during and immediately after an occurrence. Activities include hazard recognition, emergency warning systems, emergency response training, evacuation planning, protection of critical facilities, protection of public facilities, and health and safety maintenance.

- For elderly population, especially those living alone, providing transportation to support people getting to food pantry.
- For elderly care and nursing home facilities, keep inventory of facilities updated, enhance communication on planning, provide assistance with planning. Consider methods to strengthen planning for these facilities and coordination with Town. In addition to communication, understand what services they use related to emergency response.
- Fine tune communication plan related to social media and homeowner/subdivision networks to be strategic for natural hazards.
    - Discussion:
        - Asset: Police in Westford are very proactive about protecting vulnerable citizens (e.g. Alzheimer's), have a system in place for bringing home safety with minimal communication.
        - Does Town have own ambulance and EMTs? All firefighters are EMTs. Have cooperative agreement with abutting communities.

Last input

Town of Westford
PLANNING BOARD
Town Hall, 55 Main Street
Westford, Massachusetts 01886
(978) 692-5524 · Fax: (978) 399-2732

RECEIVED
MAY 14 2020
TOWN CLERK
WESTFORD

MEETING AGENDA
May 18, 2020
7:30 PM Meeting
Via webinar
Please see instructions for participation below

Open Forum

General Business

A. 2020 Hazard Mitigation Plan Update Presentation – Tighe & Bond
The Town of Westford is pleased to share a brief presentation on our community's commitment to creating local resiliency to weather events such as extreme precipitation and flooding, blizzards, drought, and other natural hazards coupled with climate change. Westford was awarded grant funding by the Executive Office of Energy and Environmental Affairs to complete a Community Resilience Building workshop process and prepare a Town-specific Hazard Mitigation Plan update. This presentation will explain the scope of the grant work, review natural hazards that impact Westford and the risk and vulnerability of our facilities, infrastructure, vulnerable populations, and natural resources, and provide an opportunity for your input and questions.

Public Hearing Items

1. PB 1923 DEF SUB SP OSRD SWM – 73 Nutting Road "Wendell Place"
Public hearing to consider the application of ***Kathleen Coyle and William Perry*** *for approval of a* ***Definitive Subdivision Plan*** *in accordance with* ***Section 218-11 of the Subdivision Rules and Regulations,*** *a* ***Special Permit*** *for an* ***Open Space Residential Development*** *in accordance with* ***Section 7.1 of the Zoning Bylaw,*** *and a* ***Stormwater Management Permit*** *in accordance with* ***Chapter 147 of the Town of Westford General Bylaws*** *and any other permit or relief as may be required under the Town of Westford Subdivision and/or Zoning Bylaws in order to create a twenty-three (23) lot subdivision (Wendell Place). The subject property includes five parcels and is located at* ***73 Nutting Road*** *and are identified as Assessor's Map 036 Parcels 0024, 0026, 0027, 0028, and 0029 and lies within the Residence A Zoning District.*

Continued from:
July 15, 2019
September 9, 2019
October 7, 2019 (No discussion)
October 21, 2019 (No discussion)
November 4, 2019 (No discussion)
November 18, 2019 (No discussion)
December 2, 2019 (No discussion)
December 16, 2019 (No discussion)
January 6, 2020 (No discussion)
February 3, 2020 (No discussion)
March 2, 2020 (No discussion)

March 16, 2020 (No discussion – meeting canceled)
May 4, 2020

2. **PB 2017 MOD DEF SUB – St. Augustine Drive**
*Public hearing to consider the application of **Connell Real Estate Trust** for a **Modification to a Definitive Subdivision Plan** in accordance with Section 218-11 of the Subdivision Rules and Regulations to modify a previously approved definitive subdivision to upgrade a portion of the St. Augustine roadway from a minor street to a secondary street to provide improved access to an adjoining subdivision, and to request additional waivers from the construction standards including slopes, tree planting and sidewalks (and any other waivers as may be required under the Town of Westford Subdivision Rules and Regulations). The subject property is identified as **St. Augustine Drive** and lies within the Residence A (RA) zoning district.*

Continued from: *April 6, 2020*
May 4, 2020

The Applicant has requested postponement without discussion to June 1, 2020

3. **PB 2014 PRE SP OSRD – 0, 19, 33 & 35 Hartford Road**
*Public hearing to consider the application of **KMR Real Estate, LLC** for a for a **Preliminary Subdivision Plan Review** in accordance with **Section 218-11 of the Subdivision Rules and Regulations, and** a **Special Permit** for an **Open Space Residential Development** in accordance with **Section 7.2 of the Westford Zoning Bylaw** in order to create a subdivision with up to nine (9) lots (and any other permit or relief as may be required under the Town of Westford Zoning or General Bylaws). The subject properties are located at 0, 19, 33 & 35 Hartford Road and identified as Assessor's Map 020 Parcel 0076 Lot 0000, Map 020 Parcel 0075 Lot 0001, Map 020 Parcel 0074 Lot 0007 and Map 020 Parcel 0074 Lot 0008 and located in the Residence A (RA) zoning district.*

Continued from: *March 16, 2020 (No discussion – meeting canceled)*
April 6, 2020
May 4, 2020 (No discussion)

General Business continued

B. **41 & 43 Lowell Road (DHD Adams Realty Trust) – Lots 2 and 3 on Plan Book 245 Plan 143**
Discuss proposal to sell and convert two lots subject to M.G.L. Chapter 61A to residential use and possible recommendation regarding the Town's right of first refusal to purchase

C. **BOA 2010 VAR – 0 & 37 Carlisle Road**
Non-binding discussion regarding an application to the Board of Appeals by SMurph, LLC for a Variance to allow more than one principal structure per lot (23 dwellings on 2 lots). The property is located at 0 & 37 Carlisle Road in the Residence A Zoning District

Correspondence, Reports and Updates

Instructions for participation:

Options available to access the Planning Board meeting remotely:

1. Register to watch the meeting through the GotoWebinar website at: https://attendee.gotowebinar.com/register/9171738887793286157 After registering, you will receive a confirmation email. There are basic instructions on how to use GoToWebinar available at: **https://www.youtube.com/watch?v=IQ3Xwwgbd8Y**

2. You may call in and listen on any phone (landline or cellphone) by dialing +1 (415) 655-0060 and using meeting code 209-554-447.

3. WCAT will record the meeting and it will be available within a few days of the meeting date. Please see their website for more details: **https://www.westfordcat.org/**

If you do not have access to one of these methods of participation, please submit written comments to Rebecca Cheney, Town Planner, rcheney@westfordma.gov by 3 pm on May 18, 2020.

If any member of the public wishing to attend this meeting seeks special accommodations in accordance with the Americans with Disabilities Act, please contact the Permitting Department at (978) 692-5524 or email etoothaker@westfordma.gov



WESTFORD HAZARD MITIGATION AND MUNICIPAL VULNERABILITY PREPAREDNESS PLANNING

Public Meeting

May 18, 2020 7:30 to 8 PM

Tighe&Bond

WELCOME



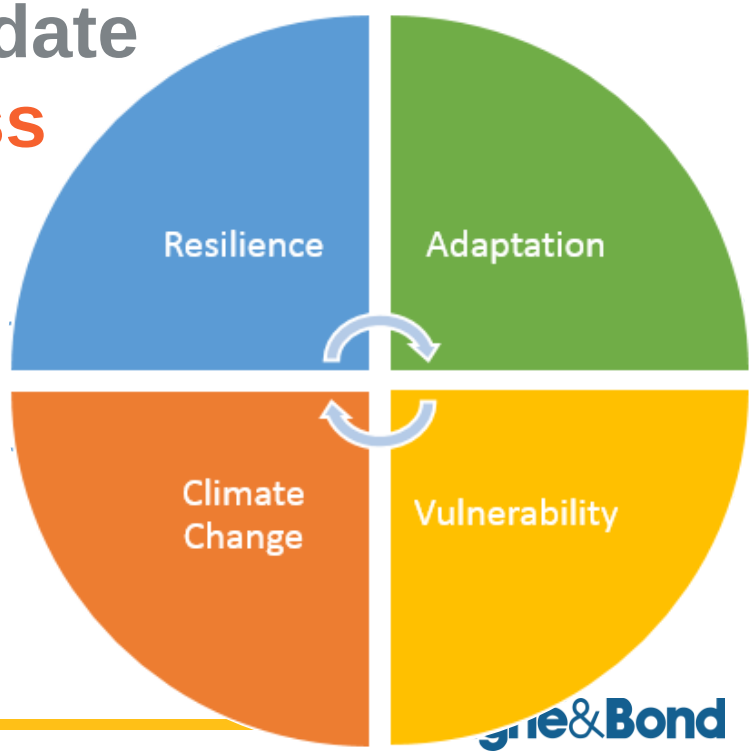
Westford awarded $36K grant for

- Municipal Vulnerability Preparedness (MVP) Community Resilience Building (CRB) Workshop Process; and
- Draft Hazard Mitigation Plan (HMP) Update

First step in unlocking additional funding opportunities for Westford from FEMA/MEMA and Commonwealth of Massachusetts

MVP/HMP GRANT AND CRB PROCESS

1. Establish Core Team
2. Complete Evaluation/Assessment
   - Natural Hazard Risks
   - Community Assets
   - Multi-Hazard Vulnerability Assessment
   - Capabilities Assessment
   - Mitigation Strategies
3. Draft Hazard Mitigation Plan Update
4. Hold Public Meeting mid-process
5. Hold MVP Workshops
6. Draft MVP Report
7. Hold Listening Session
8. Final MVP Report



PURPOSE OF PUBLIC MEETING

- **Required** to comply with Federal HMP guidance and contract with EEA
- **Introduce Hazard Mitigation and Municipal Vulnerability Planning** and **provide an update** on work completed to date
- Provide opportunity for **Q&A**

A brief thanks to Westford's MVP Core Team

CORE TEAM

- Carol Gumbart
- Henry Fontaine
- Jeffrey Stephens
- Jeremy Downs
- Joe Targ
- Paul Fox
- Paul Starratt
- Rae Dick
- Rebecca Cheney
- Richard Barrett
- Stephen Cronin
- Tim Whitcomb



BACKGROUND

EXECUTIVE ORDER 569 9.16.16

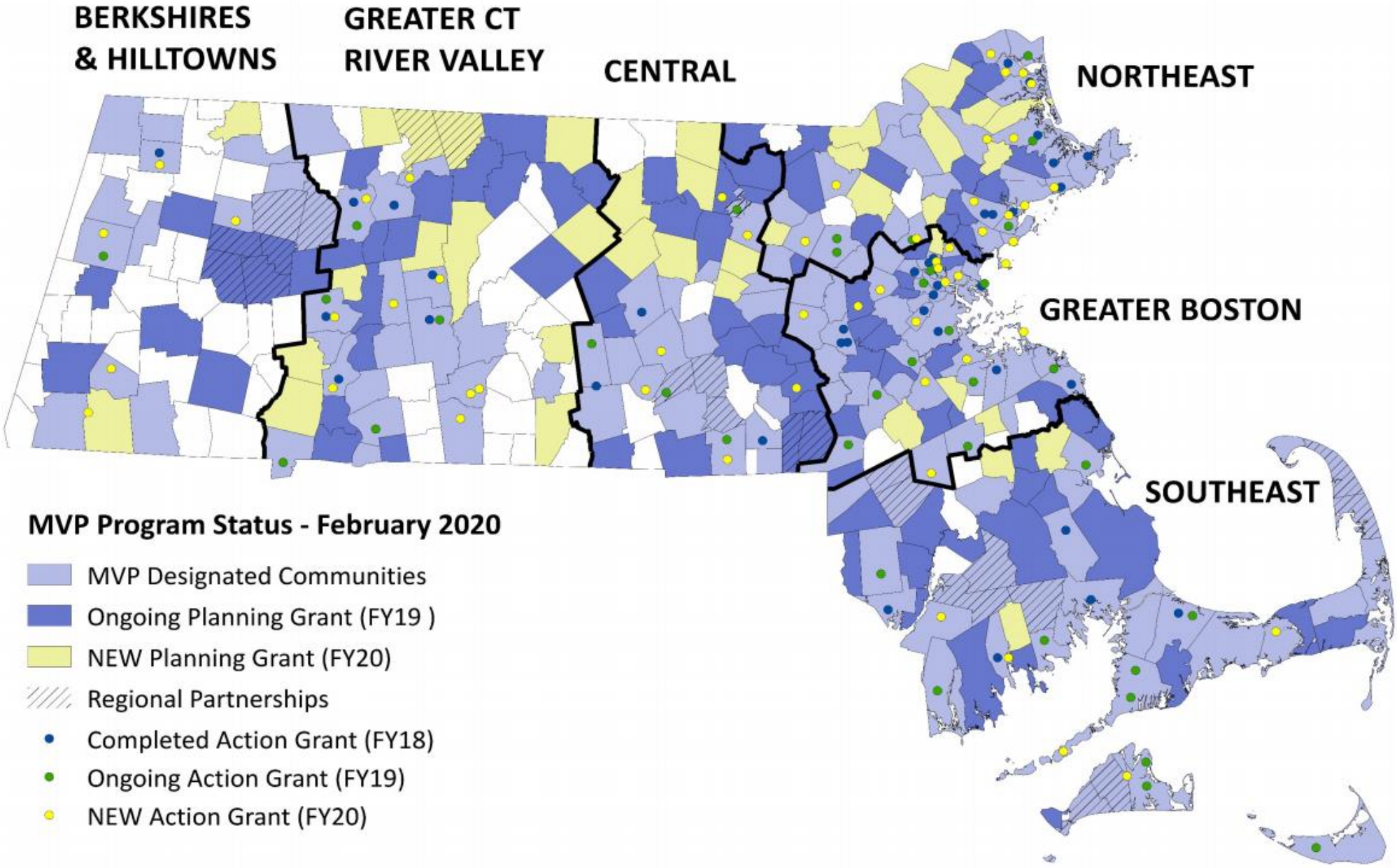


ENVIRONMENTAL BOND BILL 8.21.18



- $2.4 billion bond bill with focus on climate change resiliency
- Over $200 million authorized for climate change adaptation
- **Codifies EO 569, including the MVP Program**

BACKGROUND

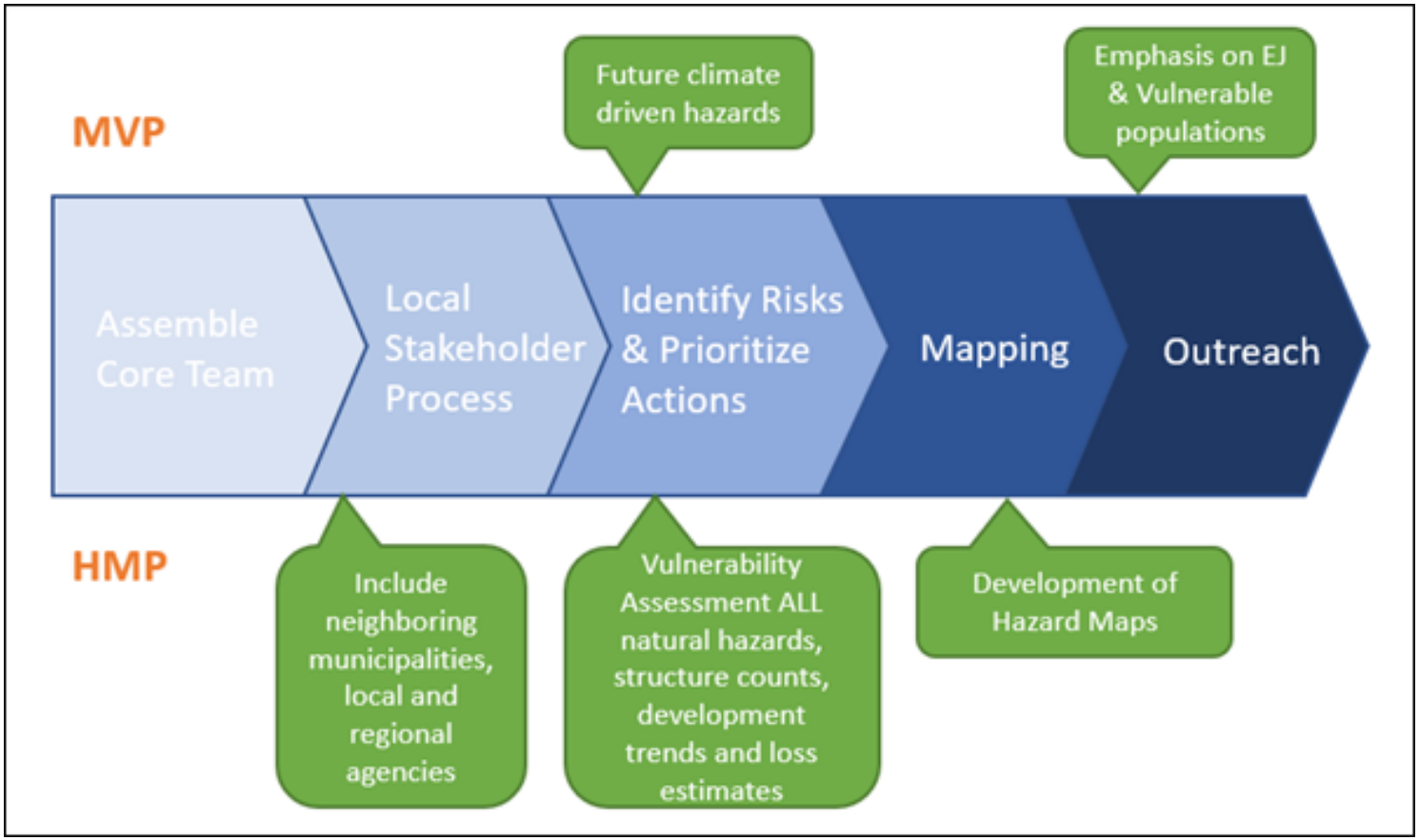

BERKSHIRES & HILLTOWNS
GREATER CT RIVER VALLEY
CENTRAL
NORTHEAST
GREATER BOSTON
SOUTHEAST
MVP Program Status - February 2020
MVP Designated Communities
Ongoing Planning Grant (FY19)
NEW Planning Grant (FY20)
Regional Partnerships
Completed Action Grant (FY18)
Ongoing Action Grant (FY19)
NEW Action Grant (FY20)

BACKGROUND ON HAZARD MITIGATION PLANNING

- **FEMA Requirements:**
  - Disaster Mitigation Act of 2000, 44 CRF Part 201.6
  - *FEMA Local Mitigation Plan Review Guidance, October 2011*
  - *FEMA Local Mitigation Planning Handbook, March 2013*
- **Westford included in Northern Middlesex Regional Hazard Mitigation Plan, approved August 2015.**
  http://www.nmcog.org/Websites/nmcog/images/Hazard_Mitigation_Plan_FEMA_approved_8_15.pdf
- **To maintain eligibility for FEMA/MEMA funding, must update plan every 5 years**
- **Commonwealth of Massachusetts State Hazard Mitigation & Climate Adaptation Plan 2018 must be considered in update**

HOW DO THE MVP AND HMP PROCESSES OVERLAP?

The MVP effort supplements the HMP process by providing a statewide and major watershed specific climate change data to use in the natural hazard risk assessment and a consistent methodology for public engagement through the Community Resilience Building (CRB) workshops.



WHY DO THIS PLANNING?

Help Westford Build Resilience and Preparedness:

- Build on the Town's existing emergency management capabilities
- Plan for more frequent and intense weather events that are linked to climate change
- Engage multiple stakeholders in the planning process
- Improve access to funding for mitigation and adaptation





COMMUNITY ASSET INVENTORY

Tighe&Bond

COMMUNITY ASSET CATEGORIES

FEMA defines a community asset as anything that is important to the character and function of a community.

FEMA Community Asset Categories	Critical Sectors	Characteristics of Community Assets
People	Schools, Vulnerable Populations, Cultural Facilities	Areas of greater population density, or population with unique vulnerabilities or less able to respond and recover during a disaster.
Built Environment	Critical Municipal Facilities, Water, Wastewater, Energy, Stormwater, Transportation, Cultural Resources	Critical facilities necessary for a community's response to and recovery from emergencies, infrastructure critical for public health and safety, economic viability, or needed for critical facilities to operate.
Economy	Marinas, Business and Industry	Major employers, primary economic sectors and commercial centers where loss or inoperability would have severe impact on the community and ability to recover from a disaster.
Natural Environment	Natural Resources	Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc.

PEOPLE – SOCIETAL ASSETS

- Child Care (e.g. Roudenbush Children's Center, Westford KinderCare, etc.)
- Places of worship
- Cemeteries
- Emergency shelters
- Westford Food Pantry
- Historical Places
- Nursing Homes/elderly housing/elderly care
- Cameron Senior Center and Roudenbush Community Center
- J.V. Fletcher Library
- Schools
- Village at Mystery Spring
- Westford Museum
- Parish Center for the Arts



WESTFORD
FOOD PANTRY

BUILT ENVIRONMENT – INFRASTRUCTURE ASSETS

- Fire and Police facilities
- Water treatment and distribution
- Culverts (town-wide) and bridges
- Dams (private and town-owned) and bridges
- Town Hall and other municipal buildings
- Medical facilities (e.g., CVS Minute Clinic, Westford Counseling Center)
- Power grid
- Public safety communications
- Schools/town shelters





ECONOMIC ASSETS

- Banks
- Funeral Homes (Main Street, Pleasant Street)
- Gas Stations
- Supermarkets (Whole Foods, Market Basket)
- Hardware Store (ACE Hardware)
- Kimball Farm
- Nashoba Valley Ski Area
- Oil Delivery (e.g. JA Healy & Sons)
- Pharmacies (CVS, Walgreens)
- Major employers (e.g., Juniper Networks, Netscout system, etc.)
- Tree removal services
- Veterinary hospitals





ENVIRONMENTAL ASSETS

- Conservation lands and open space
- Wetlands and Waterbodies throughout town (e.g., Stony Brook, Nabnasset Lake, Forge Pond, Beaver Brook, etc.)
- Habitat (including vernal pools)
- Trails (Nashua River Trail)
- Well contribution areas
- Parks, fields (e.g. VFW softball field)
- East Boston Camps
- Beaches (Edwards and Forge Pond)







NATURAL HAZARD RISK AND VULNERABILITY ASSESSMENT

Tighe&Bond

WHAT ARE NATURAL HAZARDS?


Inland Flooding


Tsunami


Severe Winter Storm

Blizzards
Snow
Ice Storms


Drought


Average/Extreme Temperatures


Tornadoes


Landslide


Wildfires


Other Severe Weather

Nor'easters
High Wind
Heavy Precipitation
Microbursts


Hurricanes/Tropical Storms


Invasive Species


Earthquake

HISTORICAL EVENTS

- October 1963 Earthquake
  - Magnitude 4.5 earthquake
- October 1970 Tornado
  - Killed one person and caused between $50,000 and $500,000 in damages
- Winter of 1995
  - Snowfall reached over 126 inches
- May 2007 Brush/Wildland Fire
  - Spread across several acres and to a home
- December 2008 Ice Storm
  - Brought down trees and power lines
- August 2011 Hurricane Irene
  - Widespread power outage
- October 2011 Halloween Storm
  - Power out for six days



- March 2018 Nor'easter
  - Westford received over 20 inches of snow from a winter nor'easter

NATURAL HAZARD RISK INDEX

Type of Natural Hazard	History of Occurrence in Westford	Hazard Probability	Hazard Frequency	Geographic Extent	Severity of Impact	Hazard Risk Ranking
Hydrological Hazards						
Inland Flooding	Yes	2	3	1	1	7
Drought	Yes	3	2	3	2	10
Atmospheric Hazards						
Extreme Temperatures	Yes	4	3	3	2	12
Hurricanes/ Tropical Storms	Yes	2	0	3	2	7
Nor'easters	Yes	4	3	3	3	13
Other Sever Weather – High Winds and Thunder storms	Yes	4	3	3	2	12
Severe Winter Storm – Snow, Ice, and Blizzard	Yes	4	3	3	2	12
Tornadoes	Yes	1	0	1	3	5
Microburst	Yes	4	3	1	3	11
Geologic Hazards						
Earthquake	Yes	2	1	3	4	10
Other Hazards						
Wildfires	Yes	3	2	2	4	11
Invasive Species (including algae)	Yes	4	3	3	1	11

WESTFORD'S TOP HAZARDS

- **Input on past, present, and future hazards based on public perception being provided via survey:**
  - https://www.surveymonkey.com/r/8BZDR87

- **Top hazard risk ranking by Core Team:**
  - Nor'easters
  - Severe Weather (e.g. thunderstorms, high wind) & Winter storms (e.g., ice and blizzards)
  - Extreme Temperature
  - Invasive Species



AMPLIFIED RISKS



CLIMATE CHANGE

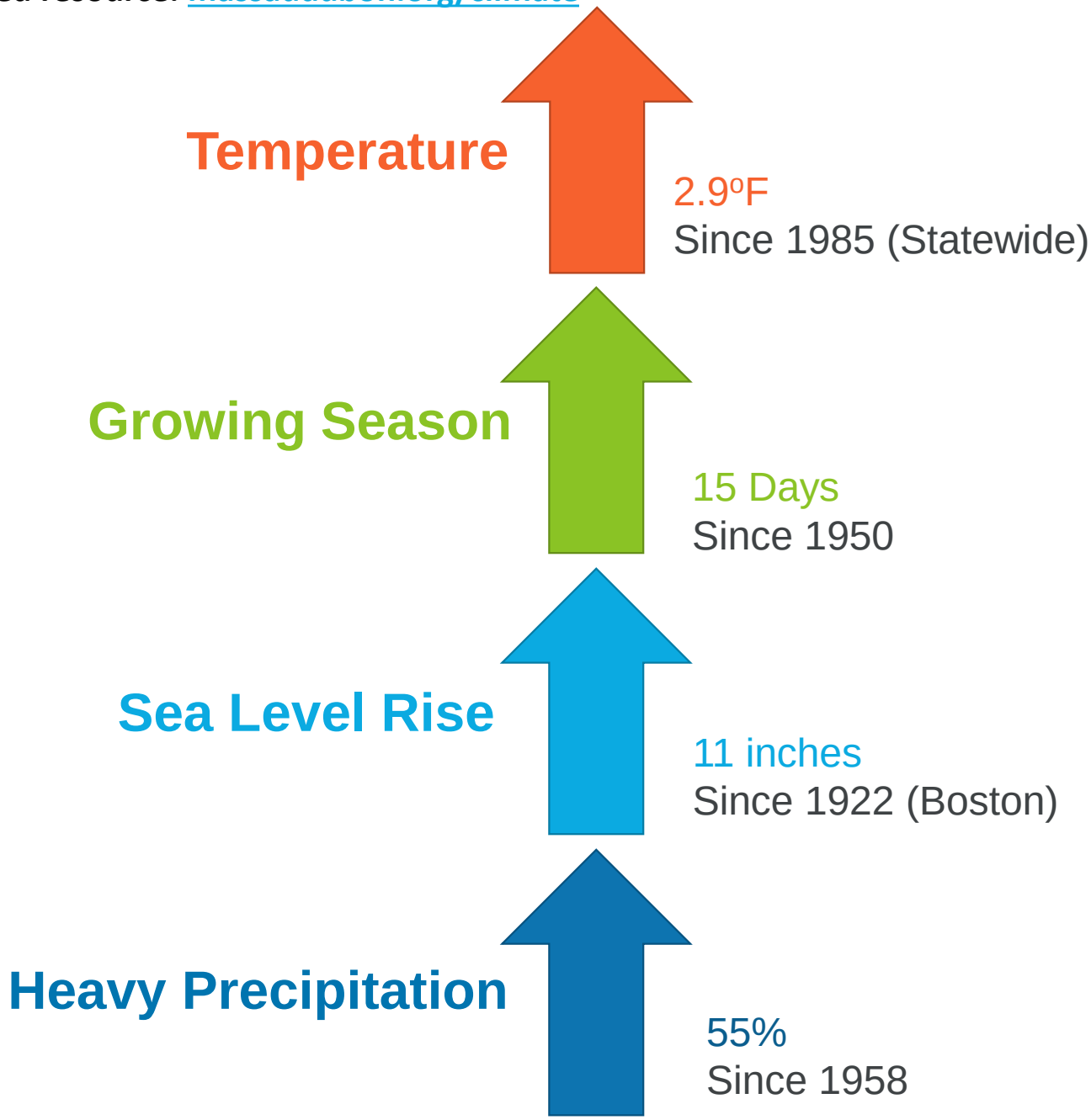
Tighe&Bond

CLIMATE CHANGE REFERENCES FOR MVP PROCESS

- **Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan, September 2018**
  - https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan
- **Massachusetts Climate Clearinghouse**
  - https://resilientma.org/
- **Statewide and Major Watershed (Basin) Climate Change Projections**
  - https://www.mass.gov/files/ma-statewide-and-majorbasins-climate-projections-final.pdf

MASSACHUSETTS OBSERVED CLIMATE CHANGES

Recommended resource: massaudubon.org/climate



MASSACHUSETTS CLIMATE PROJECTIONS

By end of century:

Changes in precipitation

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

Rising temperatures

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

Sea level rise

- 4-10.5 feet along the MA coast

Extreme weather

- Increase in frequency and magnitude



CHANGES IN PRECIPITATION

Nashua Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	45.9	+0.4 to +4.9	+1.2 to +6.3	+2.3 to +7.9	+1.3 to +8.4
	Winter	11.0	-0.3 to +1.9	+0.2 to +2.5	+0.4 to +3.3	+0.6 to +4.3
	Spring	11.8	-0.0 to +2.2	+0.1 to +2.0	+0.5 to +3.0	+0.1 to +2.9
	Summer	11.3	-0.3 to +1.5	-0.3 to +2.2	-0.6 to +2.2	-1.1 to +2.2
	Fall	11.8	-1.1 to +1.1	-1.2 to +1.8	-1.6 to +1.7	-1.4 to +1.5

IMPACTS OF CHANGING PRECIPITATION

- Episodic droughts
- Concerns over food production and drinking water supply
- Stress on ecosystems
- Flooding

EXTREME STORMS

Blizzards

- There have been more than 5 in Massachusetts since 2011

Nor'easters and Hurricanes

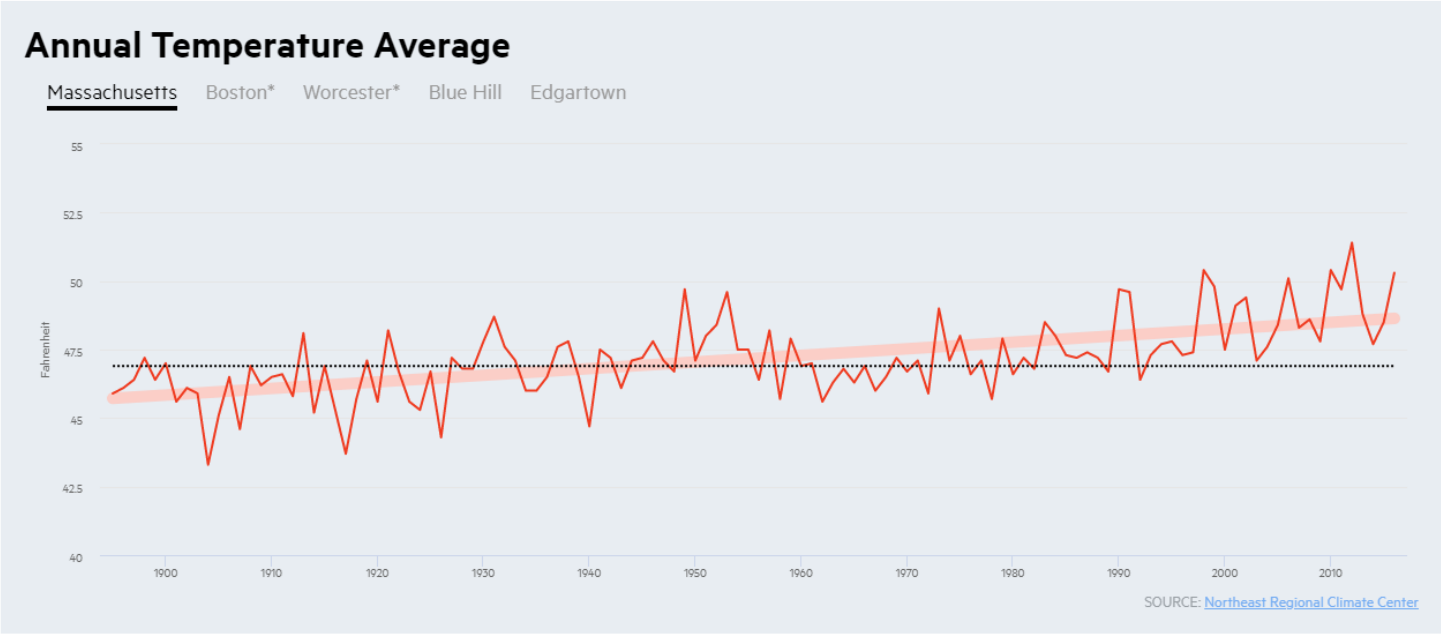
- Upward trend since the 1970s



IMPACTS OF EXTREME STORMS:

- **Public safety concerns, including increased injuries and mortality**
- **Economic damages and business disruption**
- **Property and infrastructure damage**
- **Natural resources**

RISING TEMPERATURE



IMPACTS OF RISING TEMPERATURE:

- Heat-related illnesses
- Vector borne-diseases
- Health of plants, animals, ecosystems
- Reduced crop production
- Larger energy demand
- Droughts and wildfires



MITIGATION STRATEGIES FOR VULNERABLE ASSETS

Tighe&Bond

TYPES OF MITIGATION ACTIONS

1. Prevention
2. Property Protection
3. Public Education and Awareness
4. Natural Resource Protection and Green Infrastructure
5. Structural Projects
6. Emergency Services Protection



MVP WORKSHOPS

In progress now

Tighe&Bond

THURSDAYS AT 10:30 AM

1. Workshop #1: 5/14/2020 on Societal Assets and People

2. Workshop #2: 5/21/2020 on Infrastructure

3. Workshop #3: 5/28/2020 on Economy

4. Workshop #4: 6/4/2020 on Environment and Natural Resources

Sign up on Town website or contact Rebecca Cheney
https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla

WORKSHOP OBJECTIVES

- Hear from stakeholders who can help evaluate our community's strengths and vulnerabilities of residents, infrastructure, and natural resources
- Understand connections between natural hazards and local planning/mitigation efforts
- Develop and prioritize resiliency actions for the municipality, organizations, businesses, neighborhoods, and community groups
- Identify opportunities to advance actions that reduce the impact of hazards and increase resiliency in the community





Community Resilience Building
WORKSHOP GUIDE



www.CommunityResilienceBuilding.org



resilient **MA**

Climate Change Clearinghouse for the Commonwealth

ResilientMA.org

Tighe&Bond

NEXT STEPS BEFORE JUNE 30, 2020

- Complete draft Hazard Mitigation Plan for Town staff and public review
- Hold listening session
- Selectmen vote to submit Hazard Mitigation Plan to FEMA
- Submit documents to EEA and FEMA



GRANT OPPORTUNITIES

HOW DOES THIS PROCESS BENEFIT WESTFORD?



MVP Community Designation = Eligibility for MVP Action Grants

Once approved, HMP = Eligibility for FEMA Hazard Mitigation Grants



OPEN DISCUSSION & QUESTIONS

Contact Information:



- **Rebecca Cheney, Town Planner**
  - Rcheney@westfordma.gov
  - (978) 399-2577
- **Janet Moonan, PE, Project Manager**
  - JSMoonan@tighebond.com
  - (781) 708-9826

Information on Town's website at:

- https://www.westfordma.gov/1309/Municiple-Vulnerability-Preparedness-Pla

HMP/MVP Public Meeting
Town of Westford Planning Board Meeting

ATTENDEES: Darrin Wizst, Mike Bonenfant, Jeff Morrissette, Dylan O'Connor, Janet Moonan, Tighe & Bond, Kate Hollister, Gary Lavelle, Matt Salem, Rebecca Cheney

DATE: May 28, 2020

On May 28, 2020, the HMP/MVP Process was discussed at the Town of Westford's Planning Board Meeting. The meeting was held virtually due to COVID-19 restrictions. A recording of the meeting can be found at the link below.

Meeting Summary

Janet Moonan, PE, from Tighe & Bond gave a 20 minute presentation on the HMP/MVP Process and opened the floor to discussion afterwards. Presentation is included as an attachment.

Discussion items included:

- Where to locate the HMP/MVP packet that includes survey information, mapping, general information, etc.
    - Response: Information can be located on the Town's HMP/MVP website. Additionally, a copy of the presentation will be sent after the meeting.
- How increased rainfall, storms, etc. are being taken into consideration within the Town.
    - The State has already adjusted the amount of rainfall for storm categorizations and more changes are in the works.
    - Engineering Department considers these factors when planning and reviewing projects.
- Culverts, bridges, and other projects can be considered within this funding however, nature based solutions are preferred.
- Confirmation that cell towers are listed in the assets list.
- Topics not applicable under this grant will be covered in Emergency Management Planning documents.

Meeting Recording

https://www.westfordcat.org/watch-online/government/meetings-coverage/planning-board/episode/5-18-2020-webinar

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APPENDIX H

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

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

V = Vulnerability **S** = Strength

Westford's Priority Assets				Westford's Top Natural Hazards Nor'easters Extreme temperatures Other severe weather (High winds, thunderstorms, Ice storms, hurricanes/tropical storms, Blizzard, microburst) Invasive Species	Priority	Time
Name	**Location**	**Ownership (Town, State, Federal, Private)**	**Vulnerability (V) or Strength (S)**		**H - M - L**	**S**hort **L**ong **O**ngoing
				Actions to Address Westford's Top Hazards		
Elderly Population	Throughout Town	Private	V - If living alone at home they may have not be able to get out as often, may need assistance to get food or assistance with evacuation S - experience of having survived many natural hazard disasters and being creative in up with solutions that are based on those experiences	Improve contact and communication if sheltering is required with an extended power outage. Provide or communicate meal service.	M	Short
Elderly Living Alone	Throughout Town	Private	S - Town has a special population registry (~111 people), most are seniors	Providing transportation to support people getting to food pantry,	M	Ongoing
Senior Center	Cameron Senior Center, Route 225	Town	S - Already has a backup generator	None identified	-	-
Minority Population	Throughout Town	Private	V - There is a significant population of specific minorities in Westford.	Need to consider population in planning and emergency preparedness.	M	Ongoing
Westford Nursing Home	Littleton Road	Private	V - staffing can be an issue during a natural hazard	Keep inventory of facilities updated, enhance communication on planning, provide assistance with planning. Consider methods to strengthen planning for these facilities and coordination with Town.	M	Ongoing
Low Income Housing, including veterans	North Street, Carlisle Road	Private	S - Provides safe housing and services during natural hazard, V - communication systems could be affected by natural hazards	In addition to communication, some coordination with services they use, about emergency response. If people don't have cell phones, internet, etc. There are situations where everyone is trying to get service and can't get through, need redundancy. Additional communication infrastructure? Cell towers.	M	Ongoing
Caregivers	Throughout Town	Private	S - help people recover from situations by providing support, V - may not be able to provide services to individuals as readily as a facility or Town	Providing information to caregivers of special needs, elderly, other vulnerable populations about what to do, resources to call. Provide that information in multiple languages if needed.	M	Short
Higher density area	Villages, cluster subdivisions (e.g., townhouse developments, apartments)	Private	V - denser areas in Town, therefore a storm could affect greater grouping of population	Potential mitigation action to add trees, stormwater improvements. Maybe amend zoning bylaw to address heat island effects and planting requirements, less grass, native plants, think about it from a resilience perspective.	H	Ongoing
Bridges by EPOC	Littleton Road	Private	V - 54 bed assisted living facility for Alzheimer's, could need extensive assistance S - Town helps them exercise plan once in a while, Facility is on a generator, and is required to have an evacuation plan and CEMP on-site.	Improve communication	M	Short
Adult day center	Various locations	Private	V - these are typically single family homes	Improve communication	M	Short
Historic districts	Five throughout town	Private/State	S - areas give Westford important historic character, help with property values. V - old buildings not designed for specific natural hazards	Updating local code that would apply if a building was being renovated or was damaged to consider mitigation of natural hazards and ADA compliant.	L	Long
Communication Network	Facebook	Private	S - helps different groups receive information, neighbor helping neighbor type network. There's a lot of platforms including social media, ties into different populations and churches. We have platforms like carrot connection. A lot of people do communicate. There are disadvantages (e.g. Hanover Westford), it's 400 apartments and whole community. Westford does not have town-wide list service. Town has reverse RAID. May be able to connect with folks on the management team for those developments (may have something internal). When paving in subdivision, all have homeowners/subdivision network, and want to expand a way of communicating - reaching out to everyone in community, even if have small network, could email, instead of answer phone.	Fine tune communication plan to be strategic for natural hazards.	M	Short
Churches	Various locations	Private	S - help people recover from situations by providing support and networking, and sometimes provide space. Typically these are not used as shelters (e.g. backup power doesn't exist). They are a strength and can offer individual families resources.	None identified	-	-
Shelters	Blanchard School/ Cameron Senior Center	Town	S - have used Senior Center overnight, can house 30 people, after that scale up and use a school	Maintain these facilities and communication about their availability.	M	Ongoing
Westford Food Pantry	20 Pleasant Street	Town	S - provides food during natural hazards	Coordinate with food pantry to determine if they have plans during severe weather/etc.	M	Ongoing
Westford Community Garden	Graniteville Road	Town	S - provide food during natural hazards. Water available to site, and electricity to pump. Scouts have made shelter to get out sun.	Could be education around community garden and other gardens around town, to plant drought resistant plants or native plants.	M	Ongoing
Medical Reserve Core	Based out of Westford	State/Federal	S - 520 person volunteer person, serves both medical and non-medical needs. 2/3 of them are medical-related volunteers. Range anywhere from doctor to nurse practitioners, coordinated by Town, serve seven communities (Lowell Chelmsford, Dracut, Billerica, Tyngsboro and Tewksbury). V - That group can always use resources - isn't a large budget to support MRC. Funded by medical reserve core funds, state and feds, and donations and grants.	Continue to support program.	H	Ongoing
Group homes	77 Graniteville Road, Line Road, Plain Road, Around Nab	Private	S - Town requires coordination with facilities during response activities	Improve communication	M	Ongoing
Bridges	Town Farm Road Bridge, Graniteville Bridge, Bridge Street Bridge (full list in culvert project including ownership	Mixed	V - if these structures fail, inhibit passage across key locations in Town. S - provide critical emergency access routes	Assessment of DOT inspections and initiation of maintenance and repair/replacement program.	M	Ongoing
Electric Grid & National Grid	Town-wide	Private	V - when power goes out, serious impact to residences, business, emergency response. S - National Grid response	Continue their trimming programs and emergency response. Strategic vegetation program that considers locations of power lines.	M	Short
Culverts	Keyes Brook Culvert, Vine Brook Culvert, Town wide	Town	S - allow water to travel through Town and reduce flooding, V - when fail, impede transportation	Initialization of maintenance /repair replacement program	H	Short
Roads	Town-wide	Town	V - if fail, environmental impacts and potential for property damage (more for culverts than roads)	Proactive maintenance of roadways.	H	Ongoing
Gas infrastructure, Tennessee Pipeline goes through section of Town	Town-wide, high pressure gas transmission line - crosses on southern border on Carlisle	Private	V - Lot of aging gas infrastructure in Town that needs updating. Many leaks.	Continue to attempt coordination with roadway and water work. Town typically reaches out to gas company before do Town project. Make every attempt while road is open to accommodate. If its just resurfacing, gas company may not take advantage.	H	Ongoing
Dams	Murray Printing Company Dam, Nabnasset Lake Dam, additional public and private dams (list in SWMMP)	Mixed	V - overtopping. In March 2010, Nab Dam almost overtopped, and town had to address. Couple years ago consultant did assessment of all three town-owned dams. Nothing imminent, but do have some deficiencies. These need to get addressed. Need to consider climate change. Emergency Action Plans developed/updated recently. V - Private dams - are liabilities to Town. Town has limited ability to control the private locations (Greystone doesn't meet state's criteria), dam located within Mill itself that controls the canal in Abbot Mill complex has a direct effect - if fails, dam is overwhelmed, that water is going to drain the lake and upstream watershed.	Continue required DCR inspections. Implement recommended mitigation/maintenance. Education and outreach - need to make sure private dam owners are complying, coordination with state agencies.	H/M	Ongoing
Schools	Multiple locations	Town	S - some schools provide shelter space	Education about hazards and vulnerabilities	L	Long
Police Central Station	53 Main Street	Town	S - Dispatch center is located at this facility. Recently combined fire and police into central dispatch. this site provides emergency response V - Generator is holding up pretty well, it's on capital replacement plan, and discussed addressing during future building projects. Agreed it is a major component needed to support operations.	Maintain facility.	H	Ongoing
Fire Department	65 Boston Road, Nab. Fire Station on Oak Hill Road, Rogers Fire 39 Town Farm Road	Town	S - provides emergency response	Continue to work on upgrades to emergency communications receiver and transmitters. FCC is supposed to come up with a relocation plan for t-band spectrum channels that affect fire and police by February 2021 unless they extend the date or there is legislation to prevent this from happening. Monitor situation	H	Ongoing
Highway Department	28 North Street	Town	S - provides response to natural hazards	Only built with one entrance - would be ideal if adjacent property became available to add second access. Beneficial to increase fuel storage for redundancy for all Town vehicles. Currently only fuel highway and some other vehicles at this site. Fuel will not deliver to facility if there is snow on the ground or predicted for that day, and will not deliver fuel if thunderstorms. Building is 15 years old, re-evaluate lightening suppression system, some have been previously compromised	L	Short/Long
Westford Public Works	TBD	Town	S - provides response to natural hazards	Town manager is evaluating Public Works Department to consolidate these functions.	H	Short
Town Hall	55 Main Street	Town	S - provides information to residents and offices for public services V - biggest worry is cellar flooding and making sure there's a backup. There's a bunch of mechanical equipment in basement. All buildings in Town that have basements with mechanical systems need backup water removal. In Town Hall, do have a lot of paper storage, mostly stored in basement, some in vault, as time goes on it becomes a complicated storage issue. Records management, do have redundancy in a lot of it, some of it is about state records law.	Need more space for physical records and change in state's allowance for scanned documents to satisfy some of those permanent record requirements. One of places considered is new to be built town center building, that is only potential.	H	Short
Gas Stations	Cumberland Farm (188 Littleton Rd), Gulf (179 Littleton Road), Mobil (185 Littleton Road), United (215 Groton Road), Getty/BP (262 Groton Road, 1 Oak Hill Road), Shell (498 Groton Road), Citgo (169 Plain Road),	Private	S - provide gas, and in some cases snacks, in emergency. V - if power goes out, these facilities don't work. One of the vulnerably is that gas stations are located in two parts of town. Two on Littleton road, the other two are on Route 40. Two areas of impact, and there are no gas stations in Town. S - Have a fairly extensive hazardous materials storage application managed by Town, and requires following a plan, to protect from spills and leaks.	Inventory of gas stations and which facilities would be able to operate during natural hazard.	L	Long

Community Resilience Building Risk Matrix

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

V = Vulnerability **S** = Strength

Westford's Priority Assets

Westford's Top Natural Hazards

Nor'easters
Extreme temperatures
Other severe weather (High winds, thunderstorms, Ice storms, hurricanes/tropical storms, Blizzard, microburst)
Invasive Species

Name	Location	Ownership (Town, State, Federal, Private)	Vulnerability (V) or Strength (S)	Actions to Address Westford's Top Hazards	Priority H - M - L	Time S Short L Long O Ongoing
Cell Towers & Antennas	Multiple locations	Private	S - provides community with communication. V - Not all cell towers have backup generators or are reliable in storm events. When it's time to renew lease, carriers are dropping leases. This is a major hole in places that you previously did have that service. Not all of those have backup power, so if power is lost, you also compromise that signal.	One of the things we can do is to communicate to people... AM radio system and people have this in their car. Could do inventory and coordination.	H	Short
Drinking water treatment, wells, and distribution including pumping stations	Town-wide, specific	Town	S - and V - Redacted to post online	Continue with Water Departments master plan implementation	H	Ongoing
Secondary Salt Shed	30 Beacon Street	Town	S - strength because it provides second location for deicing V - Built in 1997, and roof /shingles are about at end of useful life. Whole idea is keeping the approx. 5000 tons of salt from getting wet.	Evaluate structure and put on a capital replacement list.		
Information Technology Center	Redacted to post online.	Town	V - central servers, email, Town documents, central hub for all things internet, fiber run through there, some redundancies, but if building were wiped out, would be a big issue.	Trying to create redundancies in system. Have a secondary system at highway garage. Town-wide need to keep maintaining UPS (power supply) in case something goes down. Mike wells and Paul Fox. Plan is as part of Town annex building proposed, that would be central IT dept., and second hub would also be housed at Westford Academy, which is in process of being upgraded with generator (card readers, data storage, phones, internet, etc.)	H	Short
Communications infrastructure	Police, Fire, Highway towers, Behind Town Hall/Police station, there is an AM radio antenna	Town	S - multiple locations with repeaters, repeater antennas around Town. Important to maintain Town Public Safety and Highway on their own (current it's redundant). Town's communication system is in good shape.	Could improve capabilities	H	Ongoing
Wastewater Facilities	Town has various locations with wastewater systems, and numerous private systems (e.g. new apartment complex, hotels)	Town system and private systems	S - Town staff maintain facilities, program replacement needs, and facilities are alarmed	None identified	-	-
Railroad	Stony Brook line	Private	Line comes from Groton and exists through N Chelmsford. One of the heaviest traveled freight routes in New England..anything that goes to north/nh/Maine. Owned by Pan Am. Also a site used for switching cars out. S - transportation of goods. V- derailment and spills including risk to Public Water Supply, risk to river and environment	Railroad has an updated ERP. Due to not having a railroad yard in Westford, the crew utilize the mobile plan when going through Westford, however the hazmat material instructions that they train on also gives the crews directions along with an 8 hour hazmat class that is federally required.	L	Short
Interstates	495 and Route 3	MassDOT	S - MassDOT has their own response plans.	Coordinate with MassDOT to understand what plans are.	H	Short
Fire Department Landing Zones	Various locations	Town	S - There are 11 landing zones, 2 of which are plowed through winter. Emergency response and public health, state police have access as well V - other zones may need additional snow removal to get a helicopter in during winter storms, some are athletic fields.	Consider cost/benefit of snow removal for emergency landing zones not currently plowed.	L	Long
Aquifers	Mapped in MassGIS	N/A	V - Vulnerable to invasive species, period low water flow followed by flooding, perchlorate, pesticides and fertilizers, new erosion due to new buildings which removes buffer land around waterbodies. S - subcommittee in Healthy Westford that may add links to website S - Water Dept. has been working on Stony Brook restoration - working on keeping flow and measuring water levels. S - Use of fertilizer and reducing use of fertilizer and deicer are part of Water Dept's public education. S- Conservation Comm. has similar requirements, and requires Native Plant restoration. V - use of chemicals on lawns and agriculture and impacts on groundwater and wells.	Could do education about lawn maintenance, septic system maintenance Update language on Water Dept Website Planning Board update language to encourage native plantings? Put information about conservation land and dog leashing in information received at time of dog license renewal	M/L	Short
Conservation Lands	Emmet Lands, Stony Brook Conservation Lands/East Boston Camps	Town, Private	V - Pet waste from dog walking causing trash and nutrients/pathogens, overuse causes other problems such as erosion and litter. V / S - During COVID19 period, these are being used for walking in woods, seen dirt bikers there, there is a pond in middle of land (Nashoba Pond) S - conservation trust has programs, Stream team for water quality measurements, Mile a Minute weekly poll and water chestnut poll (annual, during growth season), S - really a well used location, people of all ages use for recreation, resource for public health	Citizen education about invasive. More education about use (dogs, motor vehicles, etc.) - enhanced or different approach. Town counsel confirmed dogs have to be leashed. Greater enforcement on dog walking? Animal control has been great at helping educate. More of a ranger position? Not enforcement but more about education (existing Town resources are stretched, need to recognize that)	L	Long
Floodplain	Mapped by FEMA	All	S - Last year, the FEMA firm maps were in process of being updated for basically north of 495 (Merrimack), anticipate review and approval in next year to 18 months.	Land acquisition for flood mitigation. Inventory of properties for purchase.	M	Ongoing
Forge Beach	Pleasant Street	Town	S - Beach testing at 14 beaches - monitor water quality	None identified	-	-
Forge Pond		N/A	V - invasive species in lakes and ponds, stormwater runoff contributing pollutants to waterbodies, water quality issues, erosion S- Healthy lakes and ponds initiative, contract out for management each year	Stormwater management LID, retrofits. Erosion control projects	H	Ongoing
Keyes Pond		N/A	V - invasive species in lakes and ponds, stormwater runoff contributing pollutants to waterbodies, water quality issues, erosion S- Healthy lakes and ponds initiative, contract out for management each year	Stormwater management LID, retrofits. Erosion control projects	H	Ongoing
Long Sought for Pond		N/A	V - invasive species in lakes and ponds, stormwater runoff contributing pollutants to waterbodies, water quality issues, erosion S- Healthy lakes and ponds initiative, contract out for management each year	Stormwater management LID, retrofits. Erosion control projects	H	Ongoing
Nabnasset Lake		N/A	V - invasive species in lakes and ponds, stormwater runoff contributing pollutants to waterbodies, water quality issues, erosion S- Healthy lakes and ponds initiative, contract out for management each year	Stormwater management LID, retrofits. Erosion control projects	H	Ongoing
Open Space - All	Various locations	Town, Private	S - Westford has an Open Space and recreation Plan that has been approved by EOEEA (conditionally) V - dumping, trash, invasive species, erosion	See other actions	-	-
Open Space - Connected	Various locations	Town, Private	V - erosion S - OSRP talks about connectivity. It's a goal, whenever looking at development. Rivers and stream are great corridors, and stony brook going east/west. Westford works with Neighboring communities (e.g. Littleton) and how to connect with their open space	Continue to maintain and foster corridors	M	Ongoing
Stony Brook Watershed	Watershed	N/A	V - lack of watershed-based planning across various sectors	Consider planning and managing on a watershed basis both with corridors and wildlife conservation	L	Long
Trails	Various locations	Town, Private	S - Scouts often maintain or build new trails and bridges. Westford healthy committee work hard to keep trails clean, Town has extensive trails in Town, well mapped, and well marked. Volunteer trail crews do a lot of the maintenance. Conservation Trust helps support trail access. Great mapping. Healthy Westford committee that has a sub-committee for walking Westford - have a whole plan for making Westford walkable.	Implementation of the Stormwater Management Master Plan for water quality and drainage benefits. Hinges on funding through the Stormwater Fee.	H	Ongoing
Tree Cover	Throughout Town	Town, Private	V - don't have an active tree planting program. National Grid cut down 1000 trees along roadway, planned for 1000 more this year. Reduces shade. S - grant in process for highway department to plant trees	Consider tree inventory and planting program. We need to have a understanding of which species are best at climate change and promote planting of those species.	M	Long
Vernal Pools	Throughout Town	State/Federal	S - state and local rules avoid encroaching on these important locations and prohibiting development. S - the state does have the layer for potential certified vernal pools, and is on Town's GIS - have it available and people can use it to check if working near potential vernal pool	Residents can do vernal pool certifications, volunteers can help with capacity issues . Could any of these be under Westford Academy community service work? Potentially!	M	Long
Wetlands	Throughout Town	N/A	S - Local wetlands bylaw V- Beavers especially at pond outlets and culverts	Citizens need information about how to determine if fill/loam is clean.	M	Short
Invasive Species	Throughout Town	All	V - both terrestrial and aquatic issues with invasive plants	Mapping of invasive to prioritize most problematic and most sensitive resource area. Education to residents on Town website or as handout available about how to identify them, how to remove them, etc.	L	Long
Developable Land	Throughout Town	Mostly private	V - Zoning bylaw is strong, but committee may grant variances S - order of conditions requires clean fill to avoid invasive and seeds, along with avoiding contamination. Conservation Commission does a good job prohibiting storage of fuels and undesirable liquids within buffer zone.	Town-wide invasive species mitigation plan.	M	Ongoing
Landfill/Fields/Open Spaces	Throughout Town	Various	S - Management of fields is done by both Water Dept and parks, and now are postponing mowing old dump late into season to allow for pollination	Strategy to come up with comprehensive mowing schedule to consider pollination and nesting	M	Short
Forest	Throughout Town	Various	S /V - The Forrest Committee focus is financial, and there is a forest management plan. The committee isn't able to do everything they want due to limited funding, however they do prune and manage.	Continue to support Committee	M	Ongoing
Town Common		Town	S - Rec Dept trying to use organic methods	Continue to attempt practice	M	Ongoing
Open Spaces	Throughout Town	Various	V - Landfill area mowing - could be meadowlarks nesting and timing is crucial for mowing. Applies beyond landfill.	Strategy to come up with comprehensive moving schedule to consider pollination and nesting	M	Ongoing
Conservation Lands	Throughout Town	Various	V - all of our conservation lands have challenges with adjacent residents, camping, yard waste, landscaping encroaches	Conservation Commission has a sub-committee about borders and boundaries, and talking about boundary marking.	M	Ongoing
Natural Buffer	Throughout Town	Various	V - Require buffers, but then Town staff get stuck cleaning up and maintaining	Continue to require buffers	M	Ongoing

Tighe&Bond
Engineers | Environmental Specialists

APPENDIX D

Capability Assessment Worksheet

Planning and Regulatory

Plans	Yes/No Year	Does the plan address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan	Yes; 2009	Under the purview of the Planning Board (with assistance from Conservation) there are not specific projects identified, but its inclusion can be used to implement mitigation actions.
Capital Improvements Plan	Yes	The Town Manager's budget includes a yearly update to capital improvements, and the budget is approved on a yearly basis at Town Meeting. This is both a short-term and long-term capital plan. While these plans are not specifically developed to address natural hazards, there are projects that do mitigate impacts of events such as severe winter storms, extreme weather, flooding, etc.) These plans can be used to implement additional mitigation actions identified during the MVP/HMP planning process.
Economic Development Plan	Yes; 2009	The Economic Development Plan is part of the 2009 Master Plan which addresses environmental hazards. The Economic Development Plan identifies locations for development which - by the investment - could contribute mitigate flooding and open space issues. A hazard for all communities is a diversity of housing opportunities for populations (including vulnerable residents like the elderly or poor) and ways to address those issues are included in the Plan.
Local Emergency Operations Plan	Yes	Comprehensive Emergency Plan is in the process of being updated as of 2020
Continuity of Operations Plan	Yes	
Transportation Plan	Yes	In addition to the protocols set up by the Fire Department for ambulatory transportation, the department of public works coordinates the plowing during snow storms and roadway improvement, the Council on Aging budgets and plans transit to and from their complex with residents. The Town is covered under the NMCOG Regional Transportation Plan.
Stormwater Management Plan	Yes; 2019	Westford has a written Stormwater Management Plan that documents compliance with EPA's MS4 General Permit. Though specific projects are not yet identified, this plan includes operation and maintenance of the storm drain system and a requirement for the Town to identify locations to install structural stormwater best management practices that may reduce the volume or rate of stormwater runoff.
Community Wildfire Protection Plan	No	There is no local community Wildfire protection plan; however, should there be an issue there is close collaboration with state partners and other local fire department.
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)	Yes	DPW is conducting a town-wide culvert inventory and asset management program plan, which will help the town identify projects to mitigate hazards due to inland flooding and could help identify invasive species issues.
Building Code, Permitting, and Inspections	**Yes/No**	**Are codes adequately enforced?**
Building Code	Yes	Version/Year: 9th Edition, 2015 ICC
Building Code Effectiveness Grading Schedule (BCEGS) Score	No	Score: The building department does not track this.
Fire department ISO rating	No	
Site plan review requirements	Yes	Site Plan General Review Standards can be found in Section 9.4.7.1 of the Westford Zoning Bylaw
Land Use Planning and Ordinances	**Yes/No**	**Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?**
Zoning ordinance	Yes	The Westford Building Commissioner is the code enforcement officer for zoning, and maintains a close relationship with other town departments that perform environmental enforcements (Health, Fire, and Conservation). The Planning Department and Planning Board have the capabilities to condition projects to mitigate development and address impacts. There is also a Zoning By-Law review committee that updates the zoning every 5 years.
Subdivision ordinance	Yes	The Planning Board administers subdivision, and can condition projects to reduce hazards. There is a Full Time Planning Director that guides the Planning Board and advises them on the best path forward.
Floodplain ordinance	Yes	Section 8.2 of the Zoning Bylaw contains the floodplain overlay district
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	Yes	
Flood insurance rate maps	Yes	
Acquisition of land for open space and public recreation uses	Yes	Westford has adopted the Community Preservation Act (in 2016) and there are funds available for the purchase of land for open space and recreation. There is a Community Preservation Committee that makes suggestions to Town Meeting, so there is the reduction potential and administration in place to mitigate potential hazards in the future.
Other		

Administrative and Technical

Administration	Yes/No	Describe capability Is coordination effective?
Planning Commission	Yes	The Planning Board grants variances, special permits, and does site plan review and permitting. Additionally, the Board analyzes and can recommend zoning changes to Town Meeting for enactment. When a project is submitted to the Board, plans are distributed to departments for comments, and those involved in hazard mitigation (Police, Fire, Health, Conservation) can advise on potential changes to improve the community. This is highly effective.
Mitigation Planning Committee	No	
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Yes	•DPW has an annual catch basin cleaning contract. Additionally, DPW staff performs additional cleaning and maintenance as needed. • DPW routinely sweeps streets which minimizes localized flooding by keeping catch basin grates clear of leaves and debris. Additionally, DPW performs pre-storm inspection and cleaning of drainage structures in known problem areas. • DPW, throughout the year, removes dead trees within public rights of way. • Conservation includes remediation requirements if there are invasive species on a project site through the wetlands permitting process.
Mutual aid agreements	Yes	The Fire Department has a mutual aid agreement with multiple abutting communities, and the Police Department is part of NEMLEC (North Eastern Massachusetts Law Enforcement Council).
Staff	**Yes/No FT/PT**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	Yes; FT	
Floodplain Administrator	Yes; FT	
Emergency Manager	No	
Community Planner	Yes; FT	The Town Planner has a close working relationship with all departments, and strategizes on the best means to increase the quality of life for residents - especially abutters to projects. The Director relies on the expertise of peers in police and fire to address potential hazards.
Civil Engineer	Yes; FT	There are two (2) licensed civil engineers on staff. Public Works staff are aware of hazards and mitigation.
GIS Coordinator	Yes; FT	No regulations to enforce
Other		

Technical	Yes/No	Describe capability Has capability been used to assess/mitigate risk in the past?
Warning systems/services (Reverse 911, outdoor warning signals)	Yes	The Town of Westford has a Reverse 911 system, as well as signage available that can alert residents to hazards.
Hazard data and information		
Grant writing	Yes	Multiple departments have all applied for and received multiple grants for various types of mitigaiton projects.
Hazus analysis		
Other		

Financial

Funding Resource	Access/ Eligibility (Yes/No)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Yes	The Town has allocated funding for capital improvement projects, as well as equipment for the police and fire departments. The Town's strategic plans looks years in the future (including maintenance costs) to address a multitude of risks.
Authority to levy taxes for specific purposes	Yes	
Fees for water, sewer, gas, or electric services	Yes	Water revenue is used to fund drinking water projects. Gas and electric utilities are managed by private energy utility.
Impact fees for new development	No	
Storm water utility fee	Yes	Stormwater utility is used to fund stormwater related projects and became effective July 2020.
Incur debt through general obligation bonds and/or special tax bonds	Yes	
Incur debt through private activities		
Community Development Block Grant	Yes	Westford is eligible for Community Development Block Grants through Massachusetts. The program could allow for future mitigation actions (such as infrastructure and planning).
Other federal funding programs	Yes	
State funding programs	Yes	Chapter 90 funds are used for roadways, and Westford has previously used the regional TIP (Transportation Improvement Program).
Other		

Education and Outreach

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Yes	Local Emergency Preparedness agencies include the Upper Merrimack Valley Medical Reserver Corps and other state/federal agencies
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Yes	The Water Department has education materials on water conservation via newsletters and the living lab at Norma E Day School
Natural disaster or safety related school programs	Yes	Social media is used for outreach on seasonal and timely fire and life safety issues.
StormReady certification		
Firewise Communities certification	No	This is not applicable in the community.
Public-private partnership initiatives addressing disaster-related issues	Yes	Although the local business and economic development groups (Middlesex West Camber of Commerce) do not specifically focus on hazard mitigation, the COVID-19 pandemic demonstrated that these are great venues for disseminating important updates and information to companies at a time of crisis.
Other		