MULTI-HAZARD MITIGATION PLAN
TOWN OF MILFORD, MASSACHUSETTS

June 1, 2018

PREPARED FOR:

Town of Milford, Massachusetts

PREPARED BY:

GZA GeoEnvironmental, Inc.

1350 Main Street, Suite 1400 | Springfield, MA 01103

413-726-2100

32 Offices Nationwide

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File No. 15.0166551.00

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MILFORD BOARD OF SELECTMEN

Room 11, Town Hall, 52 Main St. (Route 16), Milford, Massachusetts 01757-2679
Phone 508-634-2303 Fax 508-634-2324

Michael K. Walsh, Chairman
William D. Buckley
William E. Kingkade Jr.

Richard A. Villani
Town Administrator

CERTIFICATE OF ADOPTION
Town of Milford, MASSACHUSETTS
BOARD OF SELECTMEN
A RESOLUTION ADOPTING THE *MULTI-HAZARD MITIGATION PLAN*

WHEREAS, the Town of Milford established a Local Working Group Committee to prepare the Hazard Mitigation plan; and

WHEREAS, the Town of Milford participated in the development of the *MULTI-HAZARD MITIGATION PLAN;*

and WHEREAS, the *MULTI-HAZARD MITIGATION PLAN* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Milford and

WHEREAS, a duly-noticed public meeting was held by the TOWN OF MILFORD On November 9, 2017 for the public and municipality to review prior to consideration of this resolution; and

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

NOW, THEREFORE BE IT RESOLVED that the Town of Milford BOARD OF SELECTMEN, formally approves and adopts the *MULTI-HAZARD MITIGATION PLAN,* in accordance with M.G.L. c. 40.

ADOPTED AND SIGNED this 20th Day of August, 2018

MILFORD BOARD OF SELECTMEN

M. K. Walsh
Michael K. Walsh, Chairman

William D. Buckley

William E. Kingkade Jr.

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this local Hazard Mitigation Plan (HMP) Update, also known as a single jurisdiction Hazard Mitigation Plan, is to help the Town of Milford (the Town) and its residents understand natural hazards, minimize the potential impacts of those natural hazards, and reduce the impact of damages from these natural hazards by implementation of actions aimed at reducing or eliminating long-term risks to life and property.

This local HMP Update (also referred to herein as the Plan) identifies natural hazards facing the Town, assesses vulnerabilities, and presents recommendations on how to mitigate the impacts of typical natural hazards. The Plan has been drafted with significant input from Town officials. The Plan will be reviewed by the Town and its residents and then submitted for review and approval by the Massachusetts Emergency Management Agency (MEMA) and by the Federal Emergency Management Agency (FEMA).

By establishing this HMP, the Town of Milford is a safer, more disaster-resilient community and achievement of the following goals identified in the FEMA *Local Mitigation Planning Handbook*:

- Protect public safety and prevent loss of life and injury;
- Reduce harm to existing and future development;
- Prevent damage to the Town's economic, cultural, and environmental assets;
- Speed the recovery of governmental operations and businesses after disasters;
- Reduce disaster response costs and risks to first responders; and
- Help accomplish other objectives within the community.

1.2 PLANNING REQUIREMENTS

The Federal Disaster Mitigation Act, passed in 2000, amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act requires state, tribal, and local governments to develop and adopt FEMA-approved hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance. This planning requirement does not affect disaster assistance funding. According to the Stafford Act, the hazard mitigation plan must meet the requirements of 44 CFR Chapter 1, Part 201 for FEMA approval.

Previously, the Metropolitan Area Planning Council (MAPC) assisted the Town of Milford and seventeen other communities in the development of a regional multiple-hazard mitigation plan, with a local annex for the Town to meet the requirements of the Disaster Mitigation Act (Town of Milford Metro Boston South/West Hazard Mitigation Plan Local Annex, prepared by MAPC and approved by FEMA December 9, 2010). That plan, herein referred to as the 2010 Plan, expired on December 9, 2015. This Plan has been prepared to update and replace the 2010 Plan.

Having an approved and adopted local HMP allows the Town of Milford to maintain eligibility to receive FEMA funding from the Hazard Mitigation Assistance (HMA) grant programs which includes the following:

- Hazard Mitigation Grant Program (HMGP) – assists in the implementation of long-term mitigation planning and projects following a Presidential declared major disaster declaration
- Pre-Disaster Mitigation (PDM) – provides funds annually for hazard mitigation planning and projects
- Flood Mitigation Assistance (FMA) – provides funds annually for planning and projects to reduce or eliminate risk of flood damage to buildings insured under the National Flood Insurance Program (NFIP)

1.3 WHAT IS HAZARD MITIGATION?

Natural disasters can cause loss of life and damage properties and infrastructure, affecting the Town's economic, social, and environmental wellbeing.

Hazard mitigation planning is the process of determining how to reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards (44 CFR § 201.2). These long-term strategies include planning, policy changes, programs, projects, and other activities.

In the *Local Mitigation Planning Handbook*, FEMA identifies the benefits of mitigation planning as:

- Identifying actions for risk reduction that are agreed upon by stakeholders and the public.
- Focusing resources on the highest risks and vulnerabilities.
- Building partnerships between citizens, organizations, and businesses.
- Increasing education and awareness of hazards.
- Communicating priorities to state and federal officials.
- Aligning risk with other community objectives.

1.4 PLAN ORGANIZATION AND UPDATE INFORMATION

The structure and organization of this Hazard Mitigation Plan update was developed based on guidance from the FEMA Local Mitigation Planning Handbook (March 2013) as well as the 2013 Massachusetts State Hazard Mitigation Plan (2013 State Plan).

Many portions of this Plan include updates to the information that was included in the 2010 Plan. The following sections include specific updated information:

- Section 3.0 Community Profile: Details regarding population characteristics, land use, community services, infrastructure, and natural and cultural resources have been updated to reflect the most recently available data and input from the Town Working Group.
- Section 4.0 Hazards, Vulnerabilities, and Risk: The description of hazards has been updated to reflect the most recently available data, as well as relevant information from the 2013 State Plan which is more recent than Milford's prior Hazard Mitigation Plan. The Risk Assessment process has been updated to be consistent with the

guidance in the 2013 FEMA Local Mitigation Planning Handbook, which was not available for the preparation of Milford's 2010 Plan.

- Section 5.0 Hazard Mitigation Strategies: This section presents a summary of the mitigation measures that were proposed in the prior plan, the status of completion of those measures, and whether they are included in this plan update. Additional mitigation measures that were not included in the prior plan are also included.

2.0 THE PLANNING PROCESS

2.1 PLANNING PROCESS HISTORY AND OVERVIEW

This Plan is an update to the Town of Milford Metro Boston South/West Hazard Mitigation Plan Local Annex, prepared by MAPC and approved by FEMA December 9, 2010 (i.e., 2010 Plan). The 2010 Plan was prepared as part of a regional multiple-hazard mitigation plan for 18 communities, including Milford. The 2010 Plan was funded by a grant from the Federal Emergency Management Agency (FEMA) under the Pre-Disaster Mitigation (PDM) Program.

In 2015, the Town of Milford prepared and submitted a grant application under FEMA's PDM Grant Program to prepare an updated Multi-Hazard Mitigation Plan for the Town. The Town was awarded with a PDM grant in April of 2016 and selected GZA GeoEnvironmental, Inc. in July of 2016 to prepare the plan update.

The schedule for preparation of this plan update is summarized below.

Task/Meeting	**Date**
Project Initiation Meeting	8/16/16
Working Group Meeting #1	12/15/16
Working Group Meeting #1A	4/5/17
Public Meeting #1	4/24/17
Working Group Meeting #2	6/14/17
Draft Plan provided to Town of Milford	9/29/17
Working Group Meeting #3	10/18/17
Public Meeting #2	11/09/17

2.2 PUBLIC PARTICIPATION

Public participation included a project initiation meeting, meetings of the Local Working Group, and two public meetings to include and gather feedback for inclusion in this plan from members of the public throughout the planning process.

2.2.1 Project Initiation Meeting

A project initiation meeting was held between GZA and the Milford Town Engineer and Highway Surveyor. The purpose of the meeting was to establish the Local Working Group and develop the planning process for updating the plan.

2.2.2 The Local Working Group

The Local Working Group consisted of local community representatives including the Town Administrator, Town Engineer, Highway Surveyor, Town Planner, Police Chief, Fire Chief, Sewer Department Director of Operations, and representatives from the Milford Water Company. Working Group meetings were held on December 15, 2016, and April 5, and June 14, 2017.

The purpose of each Working Group meeting is summarized as follows:

- Working Group Meeting #1 (12/15/2016) – Review and discuss inventory of assets and characterization of natural and man-made hazards.
- Working Group Meeting #1A (4/5/2017) – Review and discuss hazards and Risk Assessment process.
- Working Group Meeting #2 6/14/2017) – Review Risk Assessment results, and discuss mitigation strategies, including previous plan's mitigation strategies and re-affirm or modify as appropriate.

2.2.3 Public Meetings

Two public meetings were held to present the plan to the public at Board of Selectmen meetings on April 24, 2017 and November 9, 2017. The meetings were held in the Milford Town Hall and publicized as part of the regular Selectman's meetings. At the first public meeting, a presentation was given to provide background on the Hazard Mitigation Planning and update process, review mitigation measures implemented from the 2010 plan, and to describe the Town's assets inventory, hazards characterization, and risk assessment. In addition, a survey was provided for public input, but participation was limited. Prior to the second public meeting, the draft Plan update was sent to the Local Working Group and Selectmen for review. The Local Working Group then made the draft Plan available to all Town departments and agencies, as well as the public by uploading the draft Plan to the Town's website and making copies of the plan available upon request for public review. At the second public meeting, the complete draft Plan was presented. Copies of the presentations and meeting materials are included in Appendix C.

The agendas and attendance lists for participation in the Working Group meetings and Public meetings are included in Appendices A and B, respectively.

3.0 COMMUNITY PROFILE

3.1 OVERVIEW

The Town of Milford is a thriving community of 28,000 residents, located along I-495, with easy access to Boston, Worcester, and Providence over major highways (see Figure 1 – USGS Topographic Plan). Milford, incorporated in 1780, offers many advantages to residents and visitors alike- an education system with modern facilities and excellent curriculum offerings, newly constructed or rehabilitated municipal buildings, playing fields and parks for active and passive recreation, a multi-use trail (Milford Upper Charles Trail), major shopping plazas, a revitalized downtown, an active Cultural Center, a regional hospital, and a variety of restaurants and hotels. Sports and the arts are both an integral part of the community fabric; Milford has a reputation for developing excellent musicians and athletes. Political awareness is encouraged early; as a result, many Milford residents have embraced careers in public service, both at the local and state level.

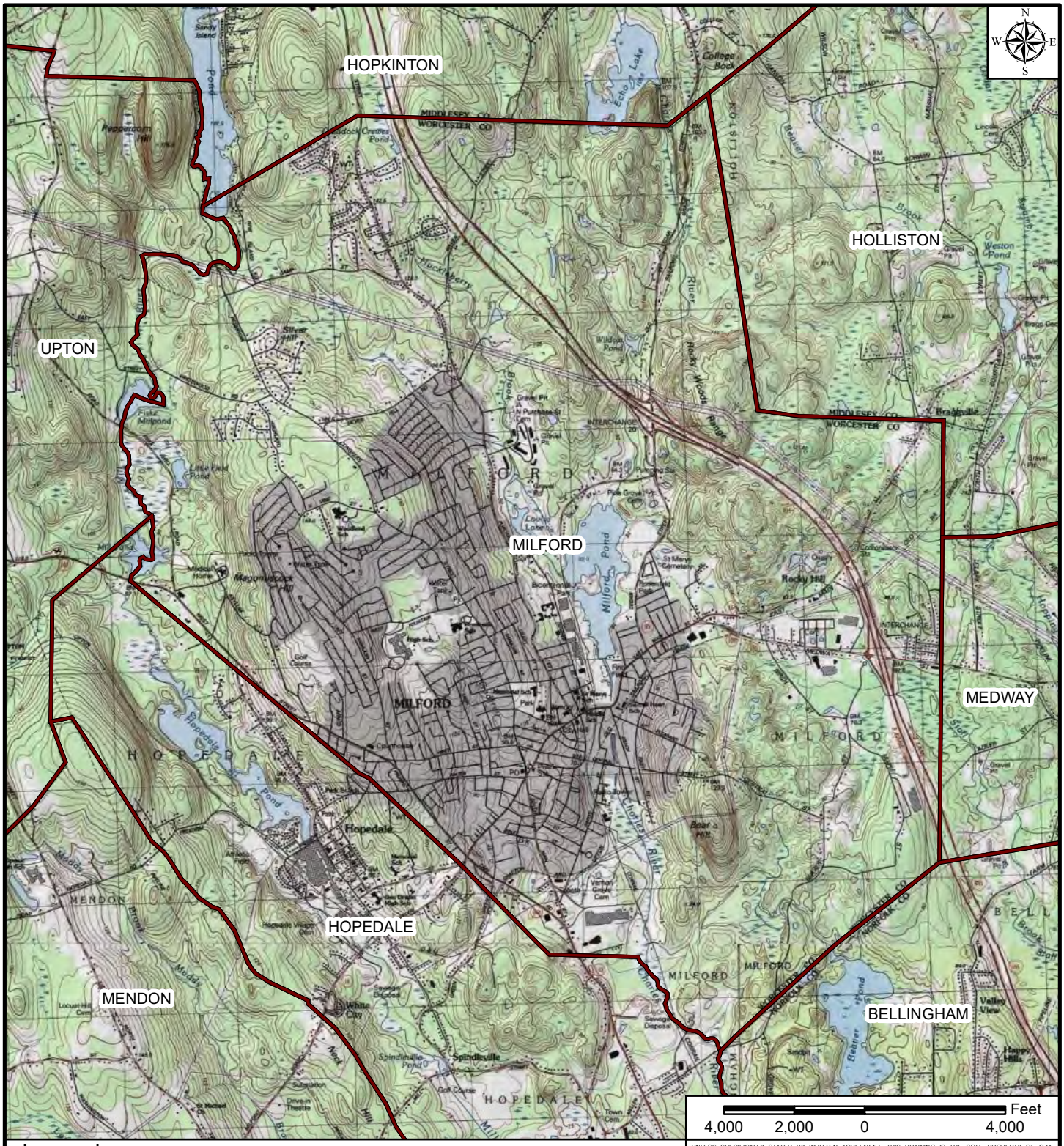
The Town of Milford is in Worcester County in south-central Massachusetts, bordered by Upton on the west; Hopkinton on the north; Holliston, Medway, and Bellingham on the east; and Hopedale on the south. Milford is 18 miles southeast of Worcester; 30 miles southwest of Boston; and 22 miles north of Providence, Rhode Island. Principal highways are Interstate Route 495, the outer belt around Boston, and State Routes 16, 85, and 140, which connect Milford to other towns in the Blackstone River Valley National Heritage Corridor. The Massachusetts Turnpike (Interstate Route 90) passes to the north through Upton and Grafton. Commuter rail service to Back Bay Station and South Station, Boston, is available from the neighboring Town of Franklin. CSX and Grafton and Upton Railroad provide freight service to Milford. The MetroWest Regional Transit Authority (MWRTA) operates bus service within Milford and throughout the MetroWest Region, connecting to Framingham and the MBTA system. The Hopedale Industrial Park Airport, a General Aviation (GA) facility, is located off Route 140 in Hopedale.

Milford's earliest and most prominent industries included granite quarrying and the manufacture of boots and shoes. Milford is known the world over for its unique pink granite, discovered by 1860 and quarried for many years thereafter. Milford pink granite continues to grace the exteriors of museums, government buildings, monuments and railroad stations in Boston, New York, Washington D.C. and Paris. Much of Milford's growth occurred early in the 20th century, as the Draper Mills and other factories boomed, which established the location of the Town's major infrastructure. The Town's location along the busy I-495 corridor suggests that development pressures will continue to affect Milford in the future. Milford belongs to the Southwest subregion of the MAPC. The Town is governed by a Board of Selectmen with a Town Administrator. The Town operates under the open town meeting format. The 2010 population was 27,999 people and there were 10,872 total households.

> *(Narrative updated from Town of Milford Metro Boston South/West Hazard Mitigation Plan Local Annex (MAPC, 2010), based on information provided by the Town of Milford website at http://www.milford.ma.us/; the Milford Comprehensive Plan (2003); Milford Historical Commission; United States Census Bureau).*

3.2 POPULATION CHARACTERISTICS

Based on the 2010 Census data, the total population of Milford is 27,999. Over 25% of the population speaks a language other than English at home. The central and western portions of the Town are more densely populated, while the northern and eastern portions of the Town contain less than 1,000 people per square mile, as shown on Figure 2 – Population Density.



Legend

Town Boundaries

4,000 2,000 0 4,000 Feet

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Multi-Hazard Mitigation Plan

USGS Topographic Plan

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GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI (USGS TOPO MAPS), REMAINING DATA FROM MASSGIS (2016).

FIGURE 1

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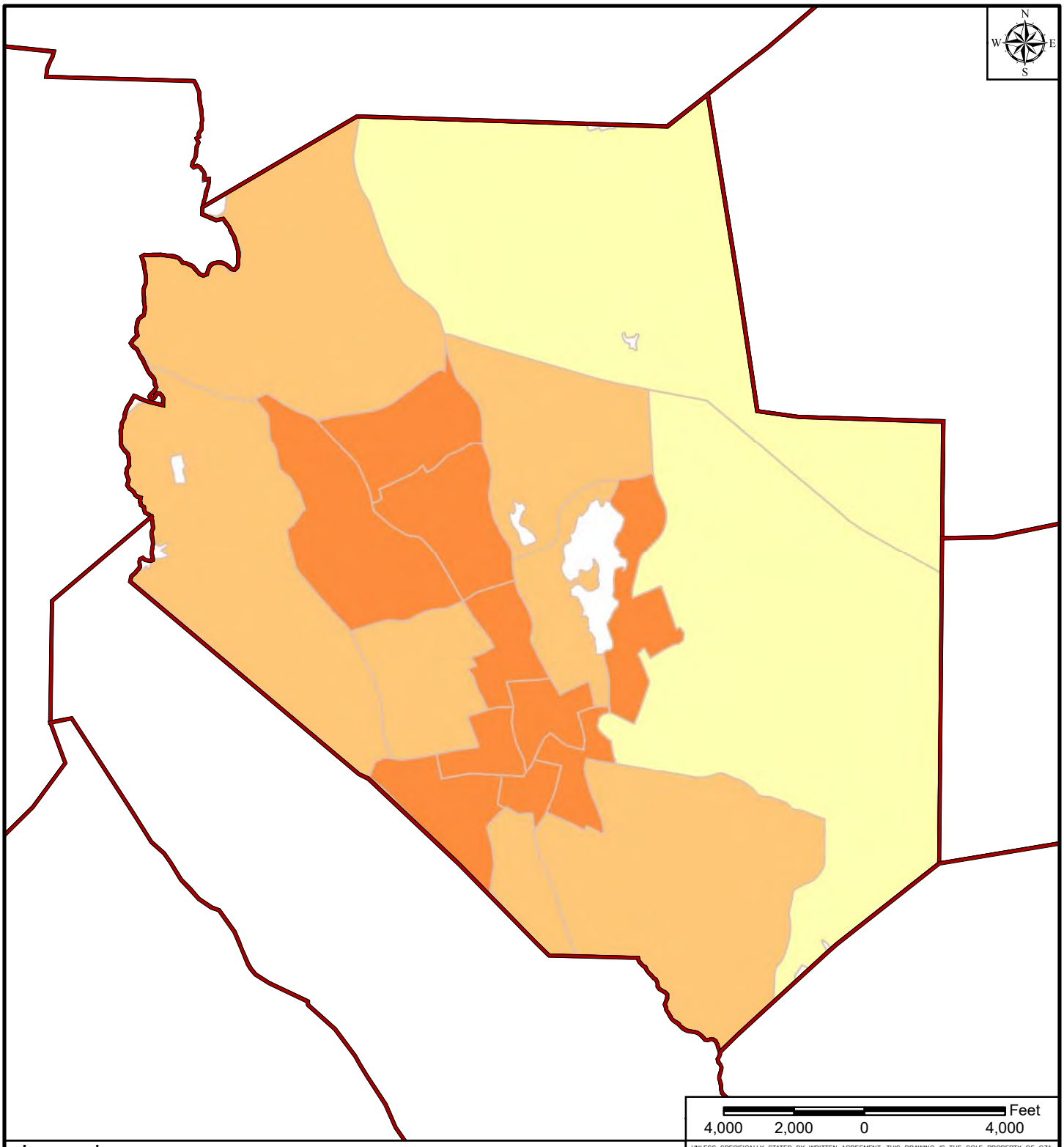

Legend

2016 USA Population Density by Census Block

- 0 - 1,000 people per sq mi
- 1,000 - 4,000 people per sq mi
- 4,000 - 22,000 people per sq mi

Town Boundaries

4,000 2,000 0 4,000 Feet

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Multi-Hazard Mitigation Plan

Population Density

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GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: POPULATION DENSITY DATA FROM ESRI, REMAINING DATA FROM MASSGIS (2016).

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The Social Vulnerability Index (SOVI) is a measure of a town's vulnerability to environmental hazards. The index was created using 29 socioeconomic factors, which research has suggested contribute to a reduction in a community's ability to prepare for, respond to, and recover from hazards (USC, 2017). Areas are ranked as High, Medium High, Medium, Medium Low, and Low, with higher values indicating areas more at risk. The SOVI for the Town is categorized as Medium for the southern portion of the Town and Medium Low for the northern portion of the Town, as shown in Figure 3 – Social Vulnerability Index (SOVI).

Support, High Occupancy, and Vulnerable Populations in Milford are shown on Figure 4. These include elderly housing, long-term care facilities, schools, and children's daycare centers, as well as the Milford Regional Medical Center.

3.3 LAND USE

3.3.1 Existing Land Use

According to the Town's Comprehensive Plan (2003), land use is most dense in and surrounding the downtown area, and becomes less dense moving out towards the periphery of the Town.

The most recent land use statistics available from the state are based on digital ortho-imagery captured in April 2005. Table 1 shows the acreage and percentage of land in 25 categories, which is presented in Figure 5 – Land Use. The highest percentage of Town land use is forest at 39% of the total area. If the five residential categories are aggregated, residential uses make up the next highest land use at approximately 33% of the area of the Town.

Table 1. Land Use Distribution for Milford

Land Use	Area (acres)	Percent of Total
Cropland	5	<0.1
Pasture	11	0.1
Forest	3,735	38.9
Non-Forested Wetland	386	4.0
Mining	10	0.1
Open Land	31	0.3
Participation Recreation	90	0.9
Water-Based Recreation	2	<0.1
Multi-Family Residential	475	5.0
High Density Residential	270	2.8
Medium Density Residential	1,737	18.1
Low Density Residential	629	6.5
Commercial	338	3.5
Industrial	422	4.4
Transitional	92	1.0
Transportation	238	2.5
Waste Disposal	2	<0.1
Water	153	1.6

Land Use	Area (acres)	Percent of Total
Powerline/Utility	206	2.1
Urban Public/Institutional	94	1.0
Cemetery	70	0.7
Orchard	4	<0.1
Forested Wetland	550	5.7
Very Low Density Residential	46	0.5
Brush land/Successional	10	0.1
TOTAL	**9,606**	**100**

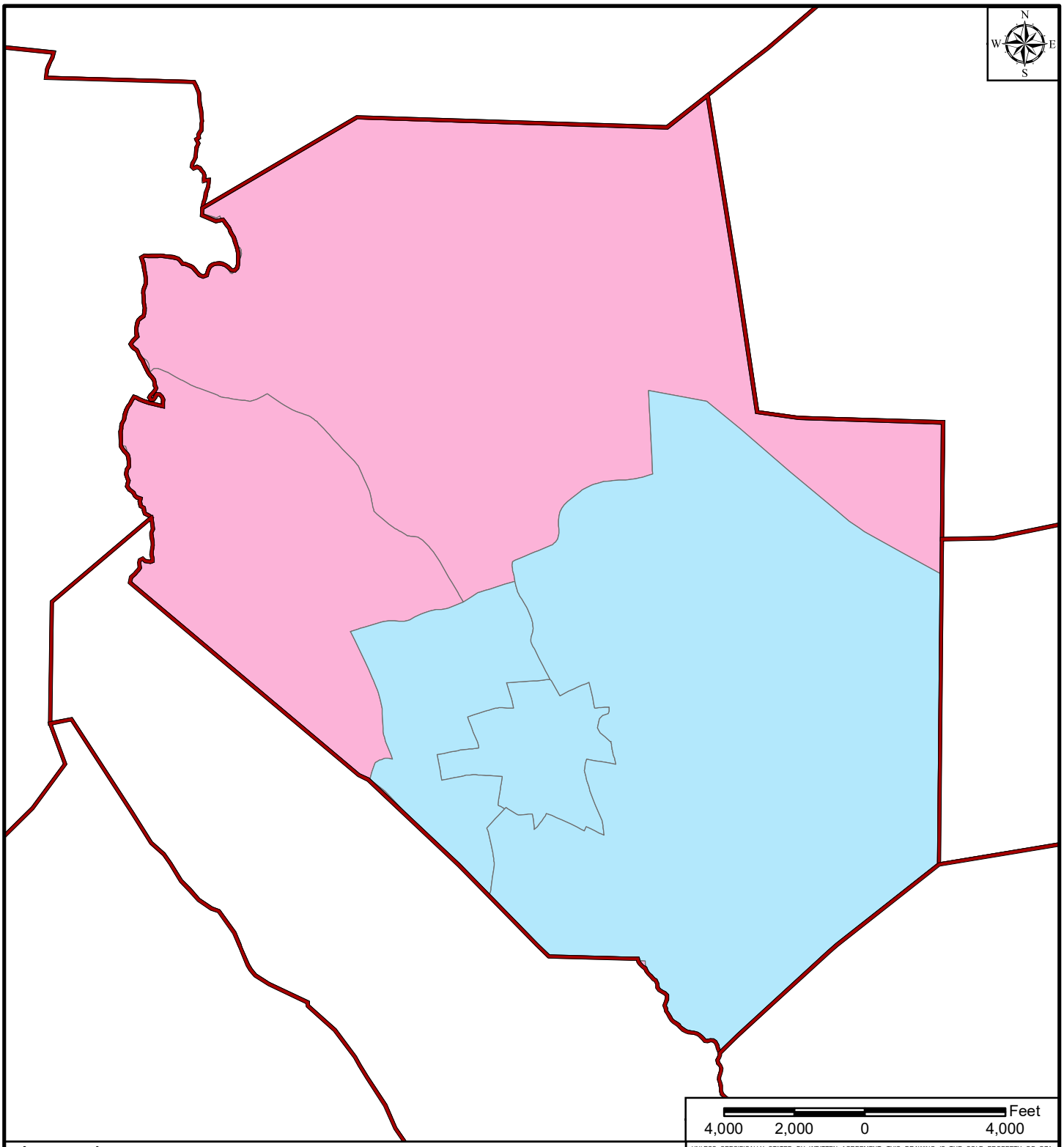
For more information on how the land use statistics were developed and the definitions of the categories, please go to http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/lus2005.html.

Open Space: The Town owns over 1,100 acres of wooded lands. Of that, there are approximately 692 acres of land under the jurisdiction of the Conservation Commission, including 186 acres of permanent open space with a conservation restriction for The Trustees of Reservations.

Specifically, the Conservation Commission controlled lands are located as follows, as shown on Figure 6 – Open Space:

1. Charles River Headwaters Area: 325± acres (includes "Waldenwoods" CR)
2. Town Forest & Environs: 197± acres (includes Louisa Lake Area)
3. Milford Pond & Environs: 67± acres
4. Mill River Corridor: 55± acres
5. Craddock Crews Pond Area: 7± acres
6. Great Meadows/Stall Brook Area: 39± acres

Areas by Zoning District are presented in Table 2 below and in Figure 7 - Zoning. Requirements for residential zones (RA, RB, RC and RD) range from 0.25 to 2 acres per dwelling unit and comprise 76 percent of Milford's total zoning area. Industrial zones (IA, IB, IC) comprise 16 percent of Milford's total zoning area.



4,000 2,000 0 4,000 Feet

Legend

SOVI by Census 2000 Block Groups

- Medium
- Medium Low
- Town Boundaries

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Multi-Hazard Mitigation Plan

Social Vulnerability Index (SOVI)

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Engineers and Scientists
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PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: SOCIAL DATA FROM USC HVRI, REMAINING DATA FROM MASSGIS (2016).

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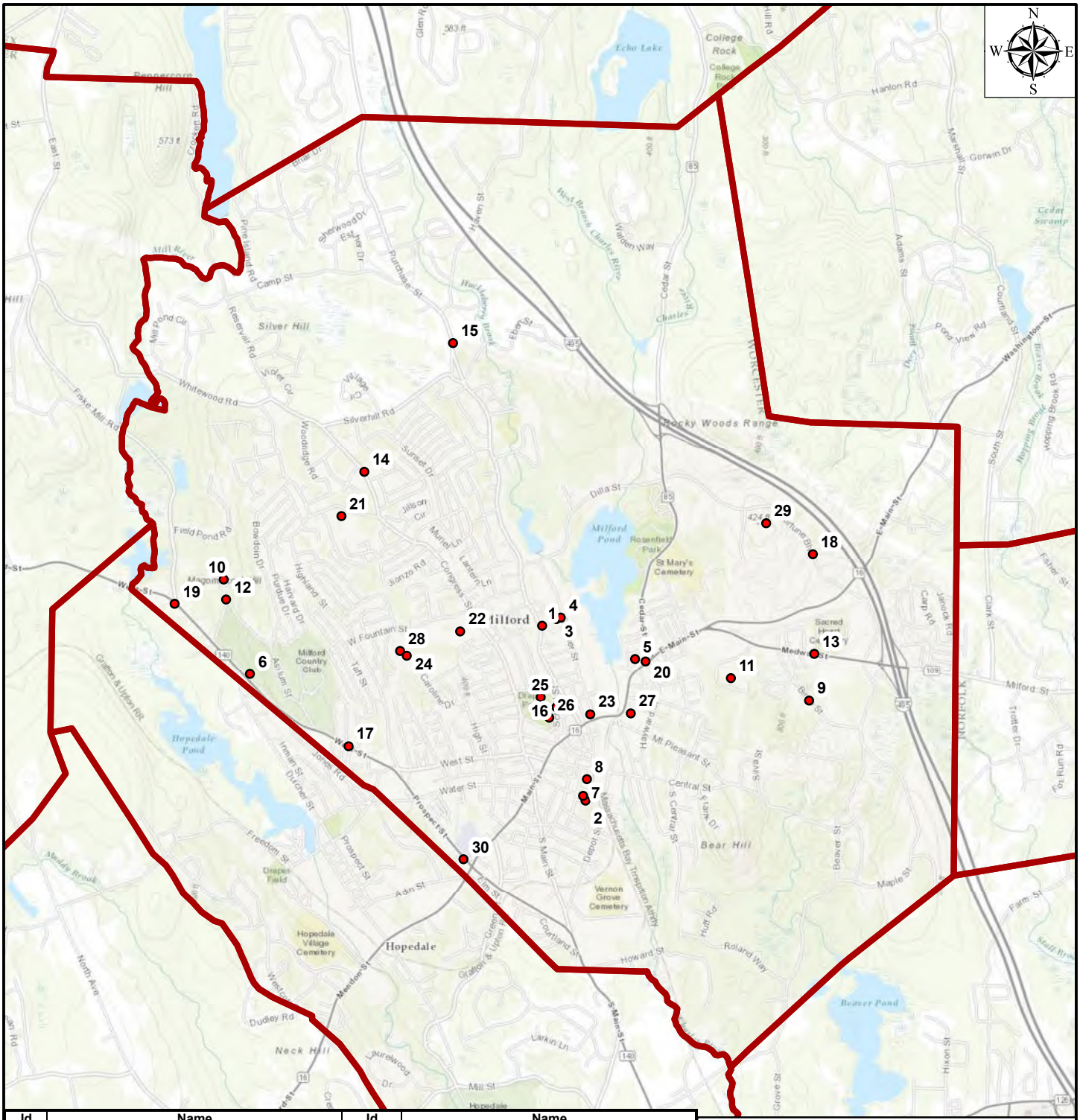

Id	Name	Id	Name
ELDERLY HOUSING		15	Little Stars
1	Greenleaf Terrace	16	Mother Hubbard
2	Fairfield Court	17	The Children's Korner
3	Birmingham Court	18	Rise and Shine Academy
4	Milford Housing Authority	19	Kids and Co West
5	Maher Court	20	Tracey and Becky Daycare Center
ASSISTED LIVING		**SCHOOL**	
6	Whitcomb House	21	Woodland School
7	Blair House Long Term Care Facility of Milford	22	Brookside School
8	Blair House of Milford Assisted Living	23	Milford Middle East School- Closed
9	Cornerstone	24	Milford High School
NURSING HOME		25	Memorial School
10	Countryside Health Care	26	Stacy Middle School
11	Sunbridge Care and Rehab for Milford	27	Milford Catholic Elem School
12	Geriatric Authority of Milford	28	Shining Star Early Childhood Center
CHILDREN'S DAYCARE		29	Evergreen Center School
13	Kids and Co	**HOSPITAL**	
14	Kinder Kare	30	Milford Regional Medical Center

Feet

4,000 2,000 0 4,000

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Multi-Hazard Mitigation Plan

Support, High Occupancy, and Vulnerable Populations

PREPARED BY:
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Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, TOWN BOUNDARY, LTC, HOUSING AND SCHOOL DATA FROM MASSGIS (2016)

FIGURE
4

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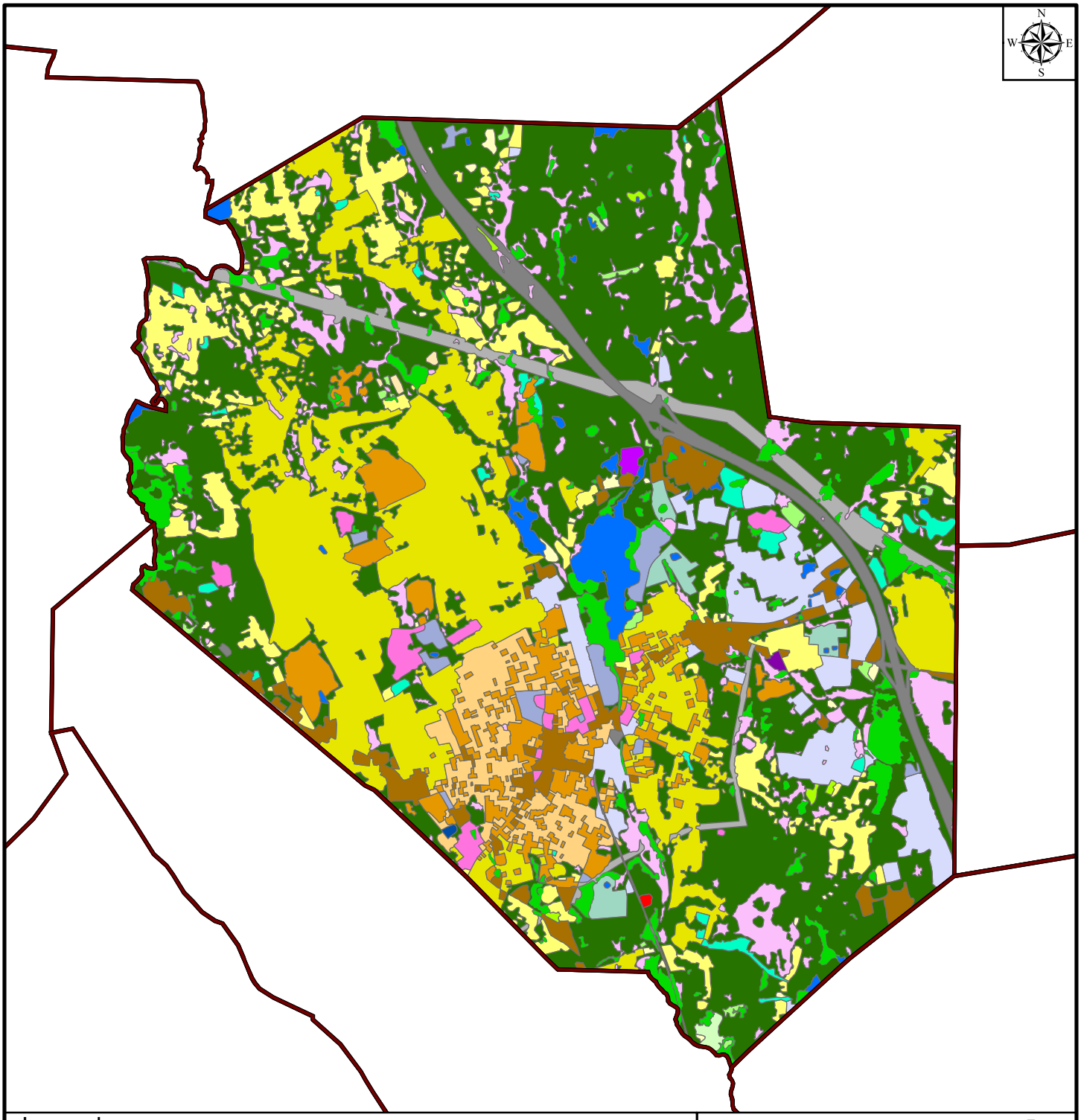

Legend

- Town Boundaries
- Brushland/Successional
- Cropland
- Forest
- Forested Wetland
- Non-Forested Wetland
- Cemetery
- Commercial
- Industrial
- Mining
- Multi-Family Residential
- High Density Residential
- Medium Density Residential
- Low Density Residential
- V. Low Density Residential
- Open Land
- Orchard
- Participation Recreation
- Pasture
- Powerline/Utility
- Transitional
- Transportation
- Urban Public/Institutional
- Waste Disposal
- Water
- Water-Based Recreation

4,000 2,000 0 4,000 Feet

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Multi-Hazard Mitigation Plan

Land Use

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GZA GeoEnvironmental, Inc.
Engineers and Scientists
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PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: MASSGIS (2016).

FIGURE
5

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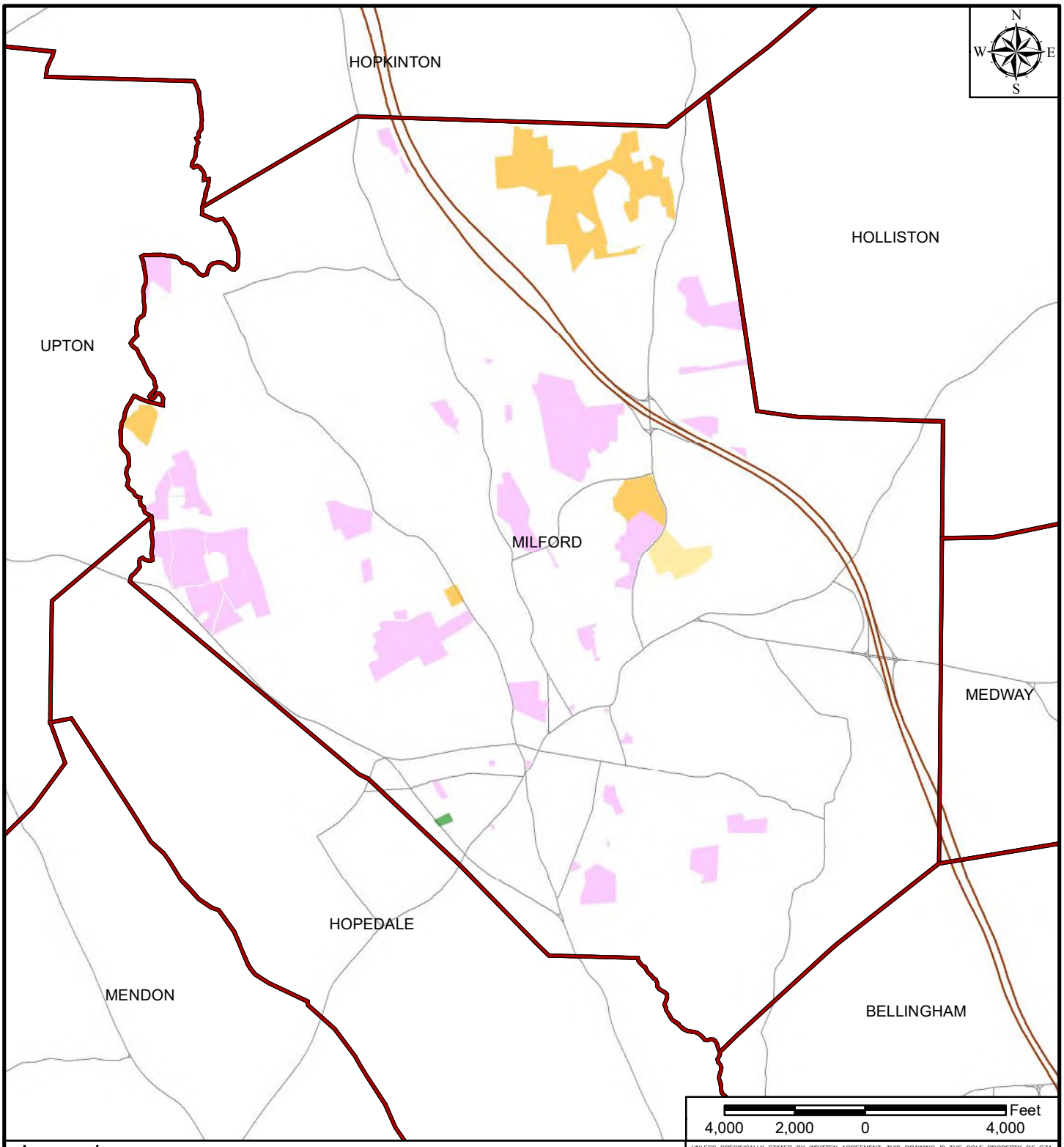

Legend

Type of Protected and Recreational Open Space

- DCR-State Parks & Recreation
- Private
- Municipal
- Non-Profit
- Town Boundaries

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Multi-Hazard Mitigation Plan

Open Space

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Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: MASSGIS (2016).

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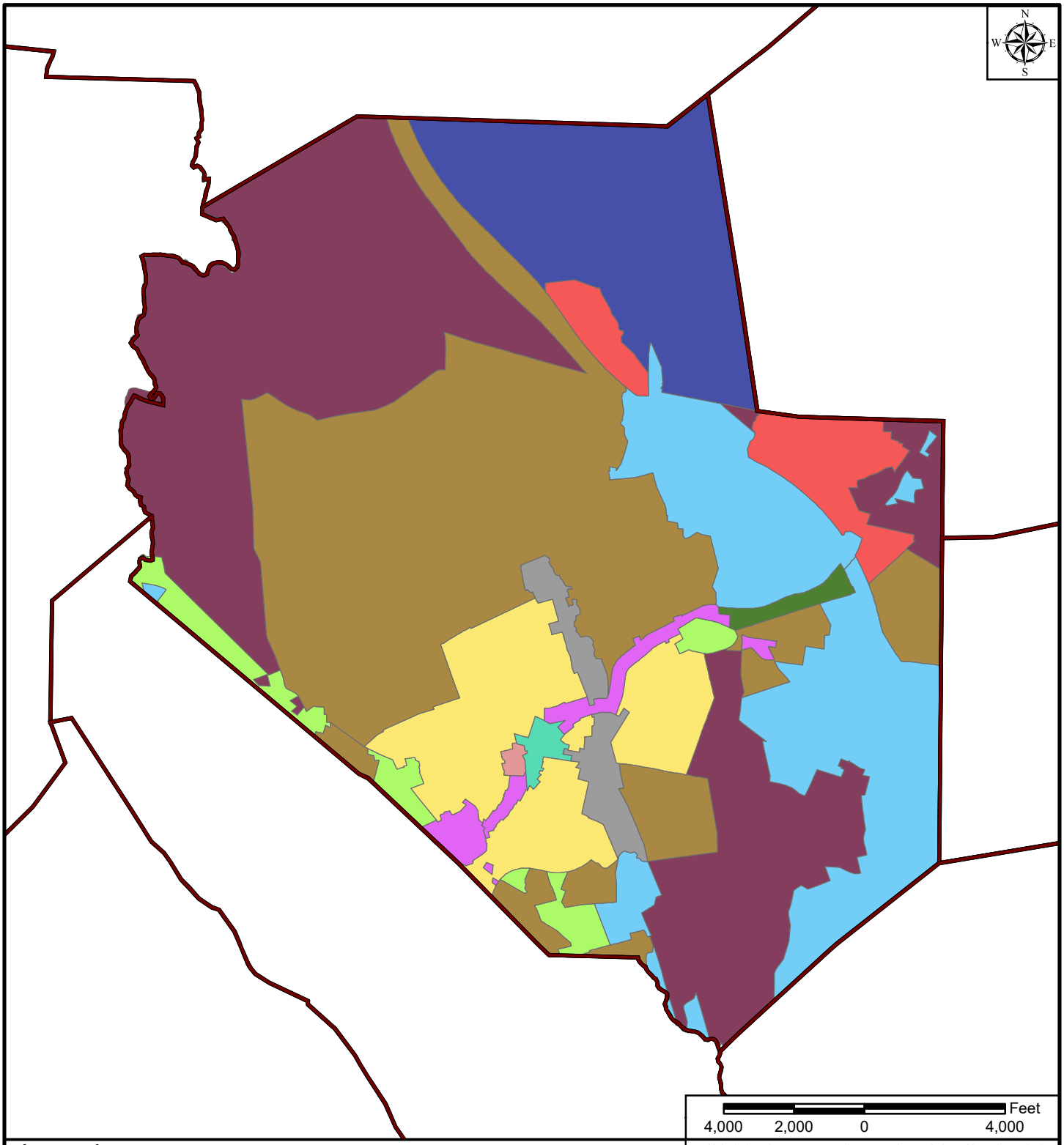
FIGURE
6



Legend

- Town Boundaries
- Business Park
- Central Commercial A
- Neighborhood Commercial B
- Highway Commercial C
- Central Industrial A
- Highway Industrial B
- Highway & Neighborhood Industrial C
- Office Residential
- General Residential
- Single Family Residential
- Rural Residential C
- Rural Residential D

Feet

4,000 2,000 0 4,000

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Multi-Hazard Mitigation Plan

Zoning

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: ZONING DATA FROM TOWN OF MILFORD, REMAINING DATA FROM MASSGIS (2016).

DATE:	PROJECT NO.	DRAWN BY:	CHECKED BY:	FIGURE
September 2017	15.0166551.00	JRB	TEJ	7

Table 2. Areas by Zoning District (January 2017)

Zone	Description	Area (Acres)	% of Total
RA	General Residential	800	8.3
RB	Single-Family Residential	2,743	28.5
RC	Rural Residential	2,719	28.3
RD	Rural Residential	1,045	10.9
OR	Office Residential	59	0.6
BP	Business Park	326	3.4
CA	Central Commercial	32	0.3
CB	Neighborhood Commercial	94	1.0
CC	Highway Commercial	231	2.4
IA	Central Industrial	169	1.8
IB	Highway Industrial	1,358	14.1
IC	Highway and Neighborhood Industrial	45	0.5
	Total	**9,621**	**100**

3.3.2 Potential Future Land Uses

The 2010 Hazard Mitigation Plan included a build-out analysis summary and identified areas within Milford that were likely to be developed in the future. The build-out analysis has not been updated, but is included in Appendix D for reference. The Local Working Group provided information to update the status of the potential future development areas. The current status of these potential development areas, as well as additional areas not previously identified, are listed below.

These areas are shown on Figure 8 – New Development, and are described below. Developments are broken down into four categories; Recent Development (already built, but may not be represented on the Ortho map); Under Construction; Future Development (Projects that have submitted site plans, that are in the permitting process, or have passed the permitting process, but construction has not begun); and Potential Development (land or parcels that could be developed in the foreseeable future but have had no formal site plans submitted). The letters A through S correspond to each of the nineteen development areas identified in the descriptions below, and also refer to the letters on Figure 8.

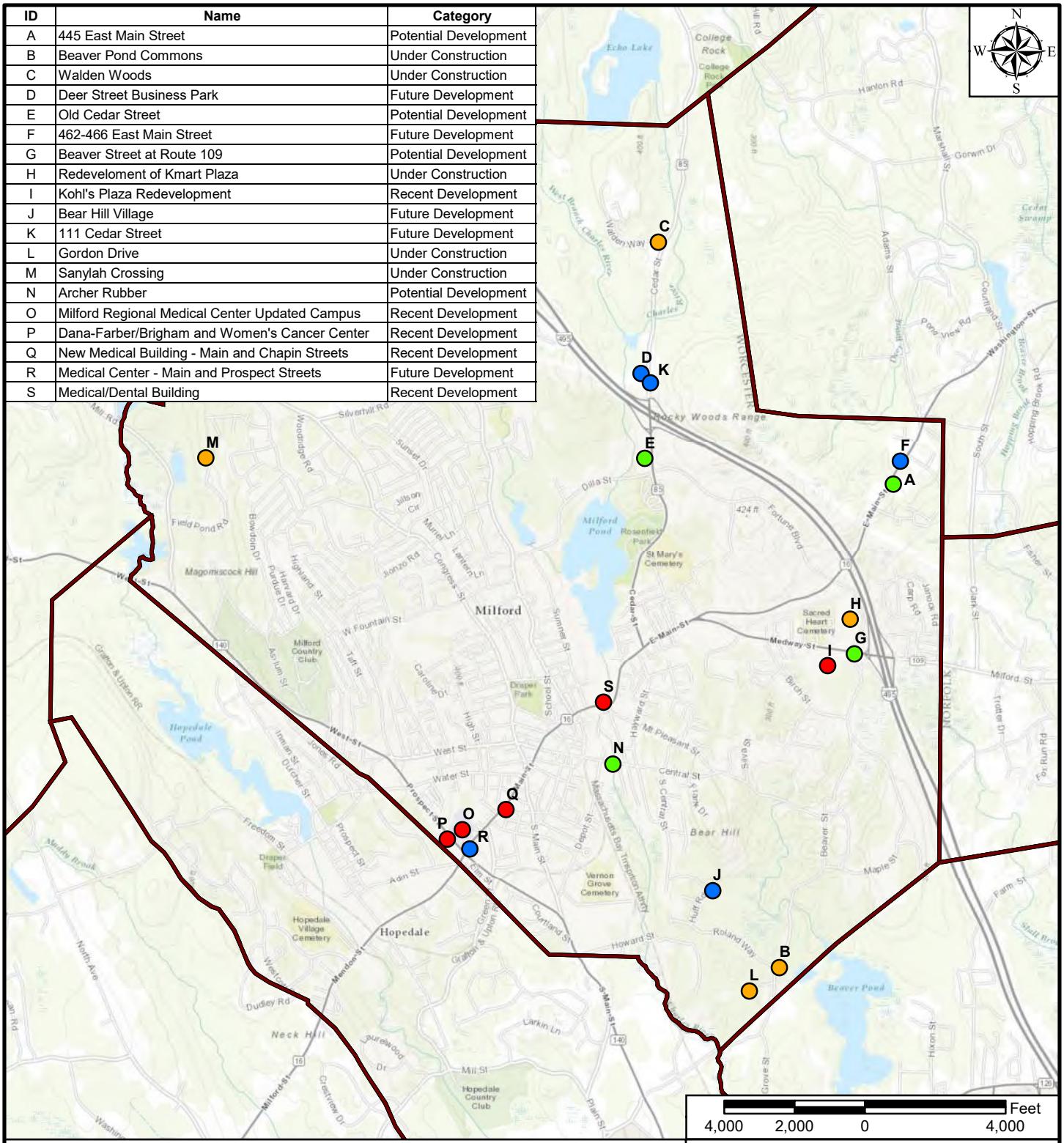
A) 445 East Main Street (Potential Development)

The prior development proposal, which proposed to redevelop a vacant commercial site that formerly housed the American Athletic Club into affordable and market-rate housing under Chapter 40B of the Massachusetts General Laws (MGL), has been withdrawn. There is currently a proposal under review to drain and fill the old quarry pond located at this site, but no specific redevelopment has been proposed.

B) Beaver Pond Commons (Under Construction)

This Chapter 40B project is being developed into 73 condominium units by Afonso Real Estate. The parcel is located adjacent to an industrial park at the Bellingham town line. Beaver Pond Commons is currently under construction and units are for sale.

ID	Name	Category
A	445 East Main Street	Potential Development
B	Beaver Pond Commons	Under Construction
C	Walden Woods	Under Construction
D	Deer Street Business Park	Future Development
E	Old Cedar Street	Potential Development
F	462-466 East Main Street	Future Development
G	Beaver Street at Route 109	Potential Development
H	Redevelopment of Kmart Plaza	Under Construction
I	Kohl's Plaza Redevelopment	Recent Development
J	Bear Hill Village	Future Development
K	111 Cedar Street	Future Development
L	Gordon Drive	Under Construction
M	Sanylah Crossing	Under Construction
N	Archer Rubber	Potential Development
O	Milford Regional Medical Center Updated Campus	Recent Development
P	Dana-Farber/Brigham and Women's Cancer Center	Recent Development
Q	New Medical Building - Main and Chapin Streets	Recent Development
R	Medical Center - Main and Prospect Streets	Future Development
S	Medical/Dental Building	Recent Development



Legend

- Town Boundaries

Category

- Future Development
- Potential Development
- Recent Development
- Under Construction

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Multi-Hazard Mitigation Plan

New Development

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, LOCATIONS FROM TOWN, REMAINING DATA FROM MASSGIS (2016).

DATE:	PROJECT NO.	DRAWN BY:	CHECKED BY:	FIGURE
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C) Waldenwoods (Under Construction)

This development of 165± condominium units (one- and two-unit townhouses) is substantially complete. Forty-one of these units are deed restricted for adults over 55 years old. The Town issued the developer a waiver to allow development of this density. The parcel was zoned for 2 acre lots, but by allowing a cluster development, the Town preserved 185.69 acres as open space. The open space was deeded to the Milford Conservation Commission with Conservation Restriction held by The Trustees of Reservations. The cluster development will reduce impervious surface and help mitigate adverse effects to the nearby Charles River.

D) Deer Street Business Park (Future Development)

This parcel is zoned "BP", Business Park. The Town is encouraging high tech research and development firms as tenants. The site abuts the Charles River Watershed area, and the developer, Gutierrez, is in the permitting process and has submitted an Environmental Impact Report (EIR) for MEPA review. The developer has already conducted traffic studies and recommended mitigation measures to Rt. 85 and a signal light at the south bound ramp of I-495 at exit 20. The northbound ramp already has a signal light. The majority of land located on the northern portion of this parcel is town-owned. The Town is looking to place this land under conservation jurisdiction, and eventually make it deed restricted. The Town expects a site plan to be submitted in early 2017, and Deer Street and the first lot to be developed later in 2017.

E) Old Cedar Street (Potential Development)

This parcel is zoned for commercial development and will likely be developed with retail and commercial office parks. The Town desires to relocate Old Cedar Street to connect with Dilla Street to provide better customer access. There is potential for a redevelopment project to be revived in 2017.

F) 462-466 East Main Street (Future Development)

This location is subject to a current development proposal, "Robsham Village", a Chapter 40B project to construct 300 rental residential units in two (2), five (5)-story, 150-unit buildings on 116.9 acres. Of the 300 units, 77 would be restricted as affordable housing. A comprehensive permit application has not yet been submitted to the Zoning Board of Appeals.

G) Beaver Street at Route 109 (Potential Development)

This parcel, located south of Route 109, is zoned for future commercial development, but there are two distinct development barriers. Beaver Street, which is located to the west of the proposed development, is a one-way road with development guidelines that restrict development within a certain distance of the road. Also, since the Stall Brook floodplain is located just south of the identified parcel, development on this site will require MEMA review. There are no specific development proposals for this parcel.

H) Redevelopment of Former Kmart Plaza (Under Construction)

At the time of preparation of this Plan update, the former KMart plaza, located at the northwest corner of Beaver Street and Medway Road (Route 109), was in the process of being redeveloped into a new strip shopping center, called Milford Crossing.

I) Redevelopment of Kohls Plaza (Recent Development)

The parcel located at the southwest corner of Beaver Street and Medway Road (Route 109) was recently redeveloped into a strip shopping center, including a Kohls Department store and other retail stores and restaurants.

J) Bear Hill Village (Future Development)

A proposal to develop this 118.96-acre parcel into 147 detached single-family units has been proposed by Afonso. The project is currently before the Planning Board for approval. The project will extend Casey Drive east to Beaver Street.

K) 111 Cedar Street (Future Development)

Volta Oil is proposing to build a gas station with a convenience store and drive-thru on the vacant parcel east of Dear Street. Currently, the land is used to house cell phone towers. The project has an approved special permit from Zoning Board of Appeals and is currently under site plan review with the planning board.

L) Gordon Drive (Under Construction)

A project to build 18 single family house lots is currently under construction. The project will extend Gordon Drive southwest to Mellen Street in Bellingham.

M) Sanylah Crossing (Under Construction)

Sanylah Crossing is a 36-lot subdivision of single family homes, which will extend Field Pond Road back to Fiske Mill Road. The project was approved by the Milford Planning Board in 2013 and is currently under construction.

N) Archer Rubber (Potential Development)

The existing “Archer Rubber” factory building at 213 Central Street is slated to be demolished in early 2017. No specific redevelopment is proposed for the five-acre parcel.

O) Milford Regional Medical Center Updated Campus (Recent Development)

The Milford Regional Medical Center, located to the north of the intersection of Main Street with Prospect Street, recently redeveloped and expanded its campus with construction of a new building and expanded parking.

P) Dana-Farber/Brigham and Women’s Cancer Center (Recent Development)

The Dana-Farber/Brigham and Women’s Cancer Center was recently constructed at 20 Prospect Street, located across from the Milford Regional Medical Center main campus.

Q) Southwest Corner of Main and Chapin – New Medical Building (Recent Development)

The property to the south of the intersection of Main Street with Chapin Street was redeveloped in 2015-2016 into a new medical office building with associated parking.

R) Medical Center at South side of Main Street and East Side of Prospect (Future Development)

The construction of a medical center south of Main Street and east of Prospect Street has received permit approvals, but had not yet been constructed as of the preparation of this plan update.

S) Medical/Dental Building (Recent Development)

A new medical/dental office building with associated parking was constructed between 2015-2016, on a parcel that had been vacant since 2010, located on the north side of Main Street (Route 16) and west of the Charles River.

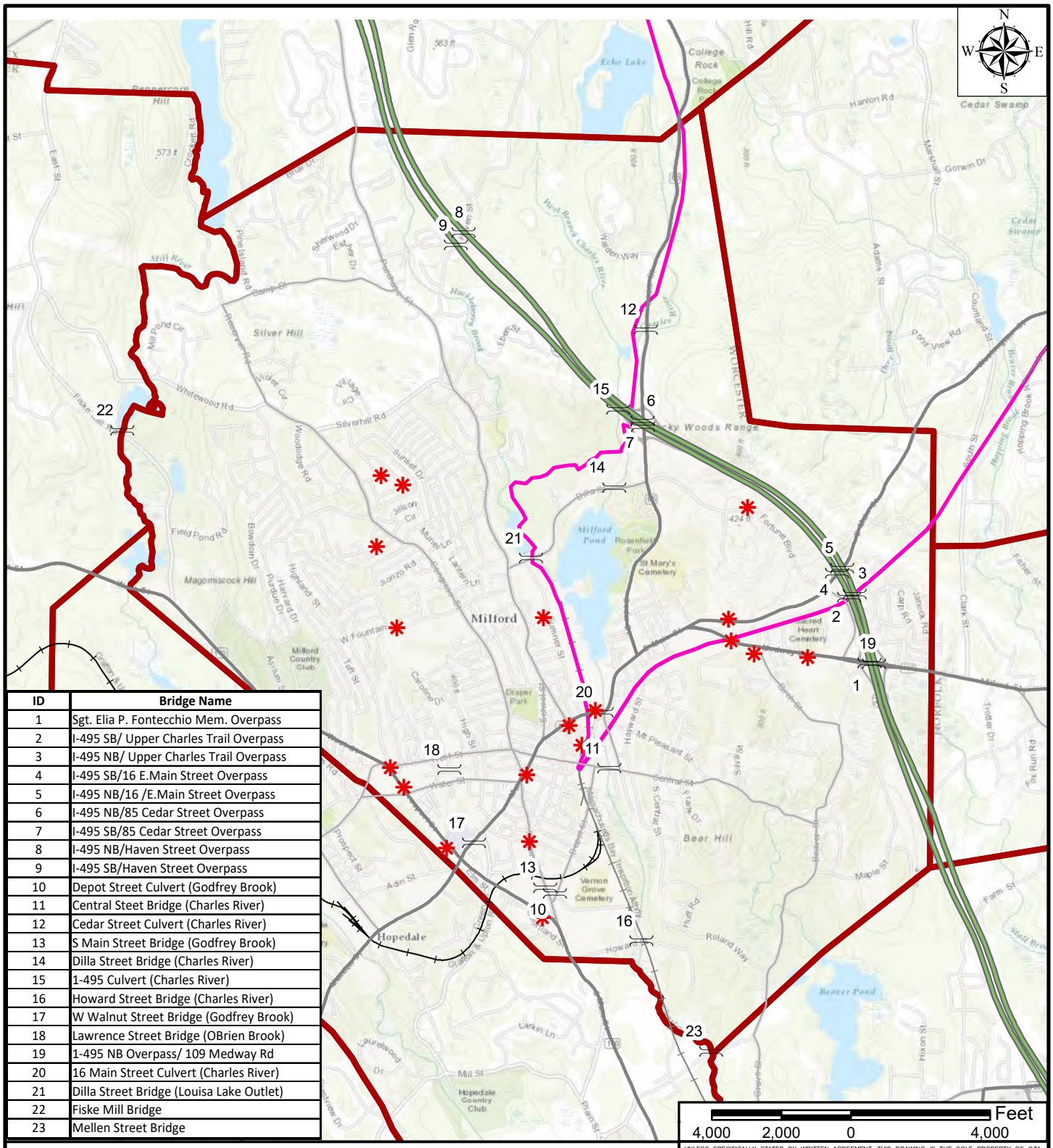
3.4 TRANSPORTATION NETWORK

The road transportation network in Milford includes an Interstate Highway (I-495), State Routes, and local, non-numbered roadways. I-495 crosses the Town between its northern boundary and its southeast corner, and two exit/entrance ramps are located within the Town at State Routes 109 and 85. State Routes 109, 85, 16, and 140 pass through Milford. Numerous bridges and culvert crossings are located within Town. Major bridges are listed as follows and shown on Figure 9 – Public Infrastructure:

Table 3. Major Bridges

Figure ID	Bridge Name
1	Sgt. Elia Fontecchio Memorial Overpass
2	I-495 Southbound Upper Charles Trail Overpass
3	I-495 Northbound Upper Charles Trail Overpass
4	I-495 Southbound Route 16 (Main Street) Overpass
5	I-495 Northbound Route 16 (Main Street) Overpass
6	I-495 Northbound Route 85 (Cedar Street) Overpass
7	I-495 Southbound Route 85 (Cedar Street) Overpass
8	I-495 Northbound Haven Street Overpass
9	I-495 Southbound Haven Street Overpass
10	Depot Street Culvert (Godfrey Brook)
11	Central Street Bridge (Charles River)
12	Cedar Street Culvert (Charles River)
13	South Main Street Bridge (Godfrey Brook)
14	Dilla Street Bridge (Charles River)
15	I-495 Culvert (Charles River)
16	Howard Street Bridge (Charles River)
17	West Walnut Street Bridge (Godfrey Brook)
18	Lawrence Street Bridge (O'Brien Brook)
19	I-495 Northbound Route 109 (Medway Road) Overpass
20	Route 16 (Main Street) Culvert (Charles River)
21	Dilla Street Bridge (Louisa Lake Outlet)
22	Fiske Mill Bridge (Mill River)
23	Mellen Street Bridge (Charles River)

The MetroWest Regional Transit Authority (MWRTA) operates two (2) bus service routes within Milford and throughout the MetroWest Region, connecting to Framingham and the MBTA bus and commuter rail system. There is no commuter rail within Milford. The nearest commuter rail stop is in Franklin.



ID	Bridge Name
1	Sgt. Elia P. Fontecchio Mem. Overpass
2	I-495 SB/ Upper Charles Trail Overpass
3	I-495 NB/ Upper Charles Trail Overpass
4	I-495 SB/16 E.Main Street Overpass
5	I-495 NB/16 /E.Main Street Overpass
6	I-495 NB/85 Cedar Street Overpass
7	I-495 SB/85 Cedar Street Overpass
8	I-495 NB/Haven Street Overpass
9	I-495 SB/Haven Street Overpass
10	Depot Street Culvert (Godfrey Brook)
11	Central Steet Bridge (Charles River)
12	Cedar Street Culvert (Charles River)
13	S Main Street Bridge (Godfrey Brook)
14	Dilla Street Bridge (Charles River)
15	1-495 Culvert (Charles River)
16	Howard Street Bridge (Charles River)
17	W Walnut Street Bridge (Godfrey Brook)
18	Lawrence Street Bridge (OBrien Brook)
19	1-495 NB Overpass/ 109 Medway Rd
20	16 Main Street Culvert (Charles River)
21	Dilla Street Bridge (Louisa Lake Outlet)
22	Fiske Mill Bridge
23	Mellen Street Bridge

Legend

- MWRTA Bus Stops
- Major Bridges

MassDOT Major Roads
- Interstate
- U.S. Highway
- State Route
- Non-numbered Road

Bike Trail
- Upper Charles Trail

Railroads by Ownership
- CSX
- G and U

Town Boundary

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Multi-Hazard Mitigation Plan

Public Infrastructure

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: ESRI, MASSGIS (2016), MASSDOT, MWRTA, GOOGLE MAPS

FIGURE
9

DATE: September 2017
PROJECT NO. 15.0166551.00
DRAWN BY: ARD
CHECKED BY: TEJ

The nearest airport to Milford is the Hopedale Industrial Park Airport, a General Aviation (GA) facility, located at 1 Airport Road in Hopedale. The nearest major airports are Boston Logan International Airport in Boston, and T.F. Green Airport (regional airport) in Warwick, Rhode Island.

Rail service in Milford is provided by CSX and Grafton and Upton Railroad (GURR). One rail-line enters Milford from the south and terminates at Central Street near the intersection with South Bow Street. A second line intersects with the first line near Depot Street and runs in a general south-westerly direction into Hopedale. The nearest distribution hub is the South County Distribution Hub in Hopedale.

The Upper Charles Trail in Milford is a converted abandoned rail bed that extends from the town center north to the Hopkinton town line, east to the border of Holliston and south to the Milford Senior Center. The trail extends 6.58 miles through Milford, and is a portion of a proposed 25-mile trail that, in its entirety, will incorporate the communities of Ashland, Sherborn, Holliston, and Hopkinton. The trail provides opportunities for biking and walking.

The transportation network in Milford is presented in Figure 9 – Public Infrastructure.

3.5 ESSENTIAL SERVICES

Essential Services in Milford are presented in Figure 10. These include facilities related to public safety and health care, town and regional services, and utilities and communications. More information about these services are described below.

3.5.1 Public Safety and Health Care

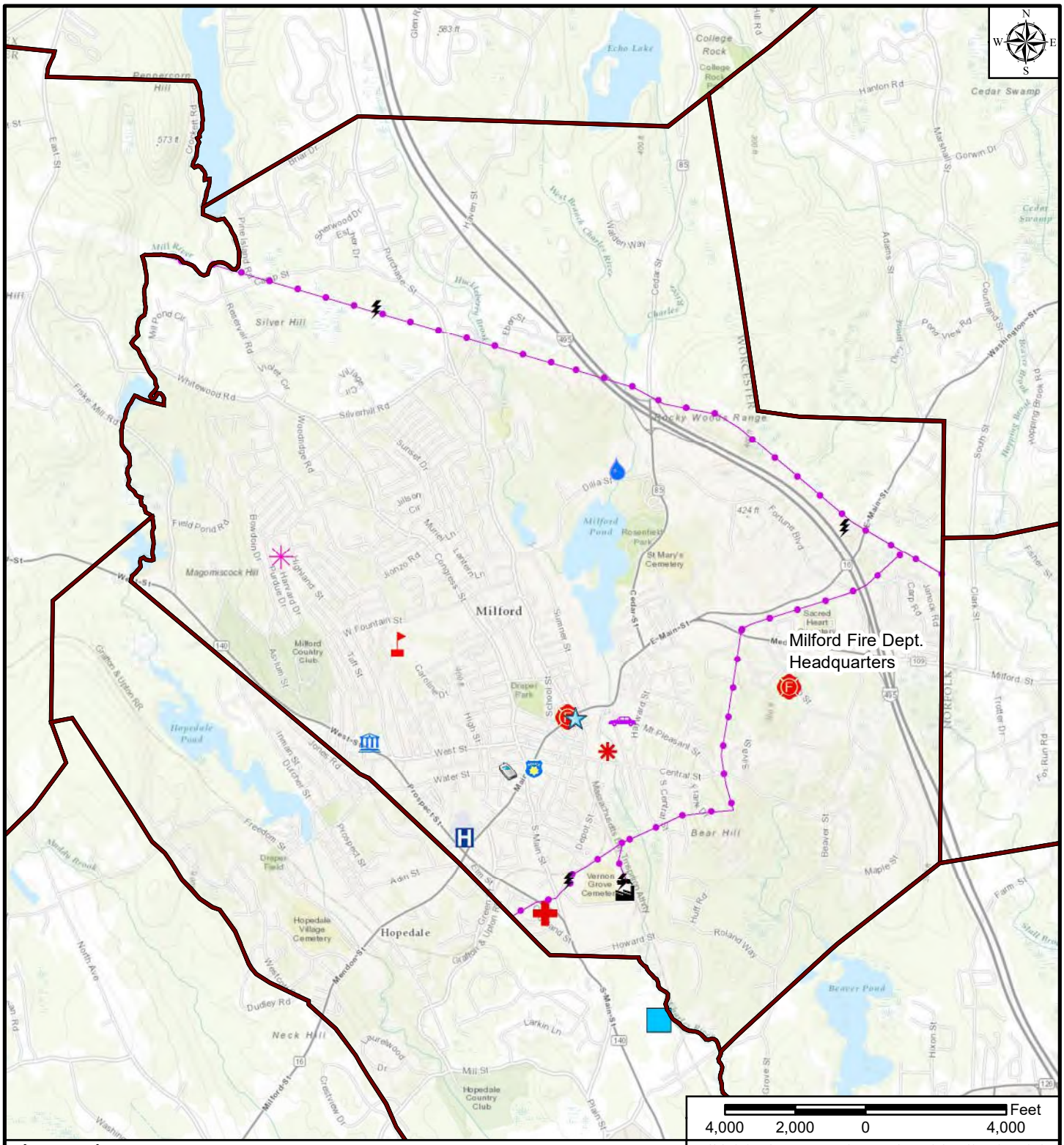
Public safety within the Town of Milford is the responsibility of the local Police Department, Fire Department, and Highway Department. The Milford Police Department Headquarters is located at 250 Main Street in Milford and houses the Town's Emergency Operations Center, as well as the Public Safety Communications Center (dispatch). Other communications equipment is located at the cell tower on Highland Street, and antennae at the Spruce Street and Birch Street fire stations. The Town has a community notification system via Blackboard Connect. The entire Town is considered one single emergency service zone, which is serviced by the Milford Police Department.

The Fire Department has its headquarters at 21 Birch Street, and a second station at 1 Spruce Street. The Fire Department includes 32 firefighters, 6 lieutenants, 1 deputy chief and fire chief. In addition to fire suppression and emergency medical services the overall capabilities and resources of the department include vehicle extrication, trench rescue, building collapse, confined space rescue, fire and arson investigation, code enforcement, plan review and public fire and life safety education.

The Highway Department, located at 12 Front Street, is responsible for maintenance of the Town's roadways and stormwater drainage system. Operations include snow removal, fall leaf pickup, paving, and issuance of trench and street opening/curb cut permits.

The community emergency shelter is located at Milford High School at 31 West Fountain Street in Milford.

Milford Regional Medical Center (MRMC) is a non-profit, full-service, acute-care, community and regional teaching hospital serving a region of 20-plus towns, located at the intersection of Routes 140 and 16 in Milford, MA. MRMC includes an emergency department, Maternity Center, and Cancer Center providing care from Dana-Farber/Brigham and Women's Cancer Center. Community Emergency Medical Services (EMS) offers ambulance service within Milford and regionally.



Feet
4,000 2,000 0 4,000

Legend

- Town Boundaries
- Town Hall
- Milford Police Dept. and Emergency Op. Ctr.
- Fire Stations
- Milford Water Company
- Wastewater Treatment Plant
- Fresenius Kidney Care
- Emergency Shelter-Milford High School
- Highway Department
- Milford Power
- Electric Transmission Line
- Substation/ Generating Station
- Verizon
- Communications Tower
- Milford Regional Medical Center
- Registry of Motor Vehicles
- Milford District Court

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Multi-Hazard Mitigation Plan

Essential Services

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, REMAINING DATA FROM MASSGIS (2016) AND TOWN OF MILFORD.

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September 2017	15.0166551.00	JRB	TEJ

FIGURE
10

One of its operation bases is located at 68 Depot Street in Milford, and houses Milford 911 Emergency Paramedic units P1 & P2, which are solely dedicated to the Milford 911 system. Other health care facilities in Milford include the Fresenius Kidney Care (dialysis) facility at 42 Cape Road.

3.5.2 Utilities

National Grid is the electric provider in Milford, and gas service is provided by Eversource. Comcast and Verizon provide cable and telecommunications services, respectively.

Milford Power LP is a natural gas-fired power station located at 108 National Street. Major transmission lines connected to this power station extend to the southwest into Hopedale, and to the northeast to connect to another transmission line that runs from northwest to southeast across the northern side of Milford.

3.5.3 Water Supply

The Milford Water Company (MWC), an investor-owned company headquartered in town supplies most of the Town with water. MWC currently obtains its water supply from a combination of groundwater and surface water sources, which include the Charles River, the Echo Lake reservoir, the Dilla Street wells, and the Clark's Island wells. MWC also maintains a facility off Depot Street that purifies water collected from five wells located along Godfrey Brook. All wells are constructed in sand-and-gravel aquifers with depths ranging from 22 feet to 52 feet. Because of this relatively shallow nature, the wells are more vulnerable to potential contamination.

MWC was recognized by MassDEP at the 2015 Public Water System Awards Program for their outstanding performance as a public water system. Approximately 90% of all Milford residents and businesses are served by this public water supply.

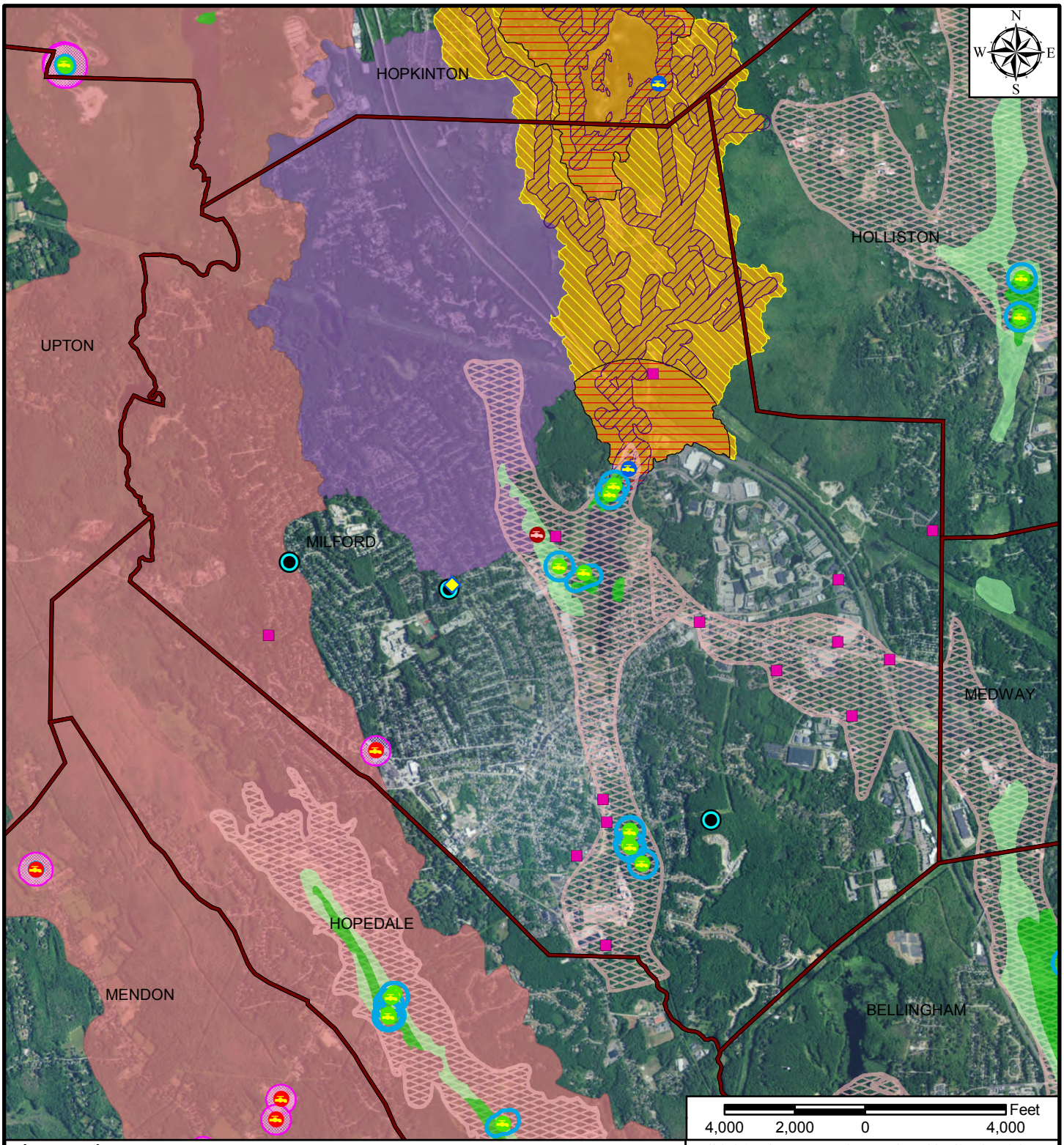
From 2009 to 2015, the percentage of water that remains unaccounted for has ranged from 6-16%. Unaccounted for Water may be due to water loss through leaks (actual losses), differences between master meter and service meter totals (paper losses), and/or unmetered municipal uses such as fire-fighting.

Public water supplies, water protection areas, and surface water supply watersheds are presented on Figure 11 – Water Supply and Wastewater.

3.5.4 Wastewater & Treatment

The Town of Milford began protecting the quality of water in the Charles River in 1906, when they constructed a slow sand filtration plant to treat the Town's waste water. Over the decades there have been many changes and upgrades to the facility. Today, Milford owns and operates one of the most advanced waste water plants in the area.

The advanced waste water treatment facility is capable of treating an average of over 4 million gallons a day before it is discharged to the Charles River. This facility uses a combination of physical, chemical, and biological processes to remove more than 98% of organic and solid pollutants. In addition, the facility generates ultraviolet light for disinfection. This ultraviolet disinfection eliminates more than 99.9% of all disease-causing organisms. The treatment facility also removes nutrients such as phosphorus. Phosphorus is reduced to near non-detectable levels assuring minimal impact to the Charles River by the waste water treatment facility.



Legend

Public Water Supplies
- Community Groundwater Source
- Surface Water Intake
- Non-Community Groundwater Source
- Emergency Surface Water

Aquifers
- High Yield
- Medium Yield

Wellhead Protection Areas
- DEP Approved Zone I
- DEP Approved Zone II
- IWPA

Surface Water Protection Areas
- ZONE A
- ZONE B
- ZONE C

Surface Water Supply Watersheds Type
- Surface Water (Active/Inactive)
- Emergency Surface Water
- Rhode Island Source

- Booster Stations
- Pump Stations
- Water Storage Towers
- Town Boundaries

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Multi-Hazard Mitigation Plan

Water Supply/Wastewater

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI (2016), PUMP STATION AND WATER TOWER DATA FROM TOWN, REMAINING DATA FROM MASSGIS (2016).

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November 2017	15.0166551.00	JRB	TEJ

FIGURE
11

Public sewer services approximately 95 percent of Milford's residences and business. Disposal and treatment occurs at the Milford Wastewater Treatment Plant, located in the adjacent community of Hopedale. The Milford Sewer Department manages all aspects of public sewerage, such as issuing permits for connection, inspecting installations, and maintaining building and permit records.

When the treatment plant was built in 1902, it was a combined sewer/storm-water system. Since 1986, when the plant was upgraded, stormwater has been treated separately. However, over 50 percent of the existing sewer pipes were laid pre-1950 and are made of clay, which is now deteriorating. Infiltration and sanitary sewer overflows (SSOs) have been a significant problem during storm events. However, the Milford Sewer Department regularly conducts several programs to address existing and potential SSOs. These include annual and monthly flushing of specific areas within the sewer collection system to reduce the frequency, duration and volumes of SSOs that could potentially occur, an infiltration/inflow removal program, and a sump pump removal program. Each year, the Sewer Department cleans and performs closed circuit television (CCTV) inspections of sewer main, and performs chemical grouting of joints and service connections.

Pump stations are presented in Figure 11 – Water Supply and Wastewater.

3.6 OTHER INFRASTRUCTURE

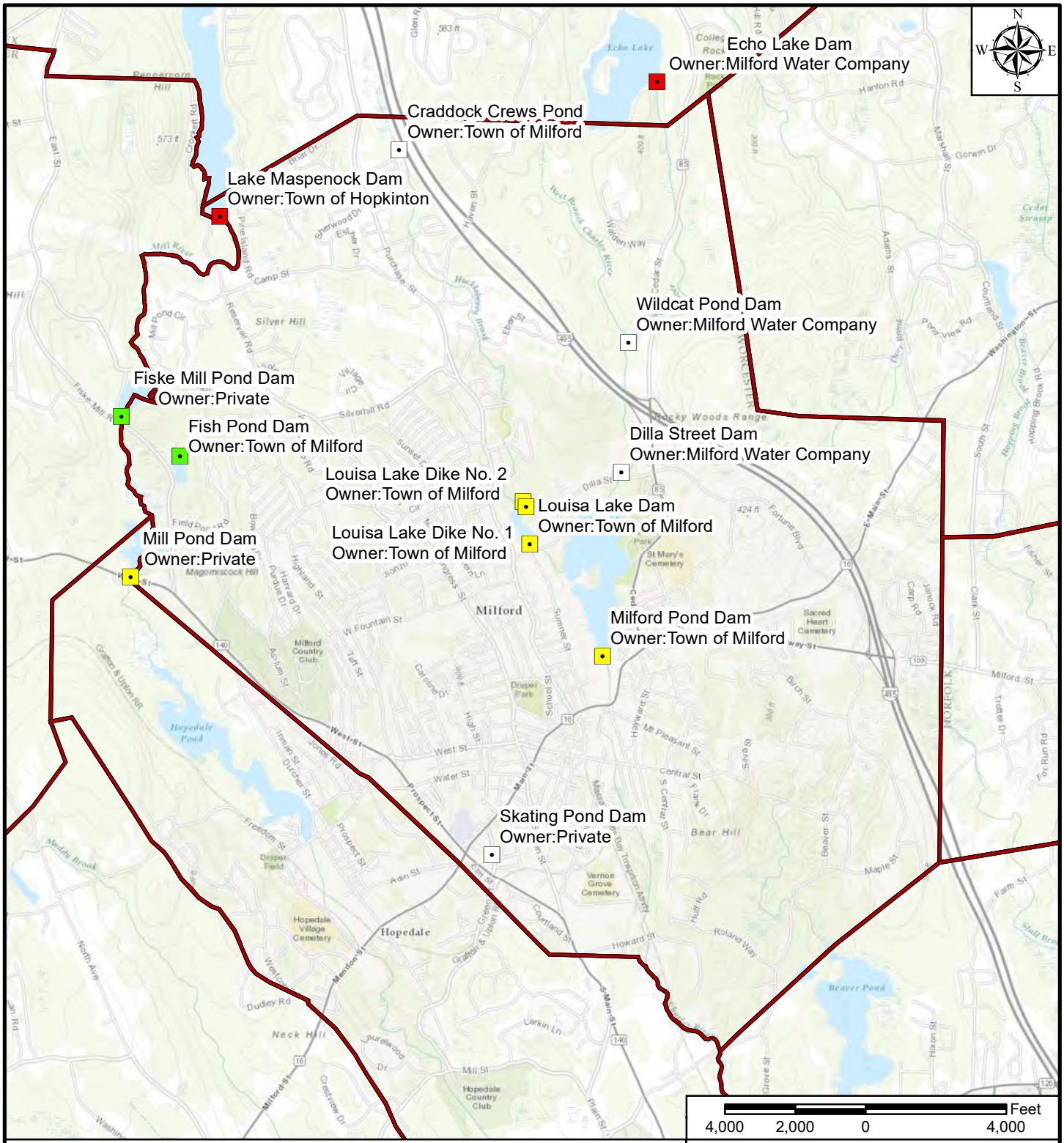
Dams within the Town of Milford are presented on Figure 12 – Dams. The majority of dams in Milford are significant or low hazard dams. The Lake Maspenock Dam, a High hazard dam, is located at the northwest corner of the Town within Milford, but is owned by the Town of Hopkinton. The Echo Lake Dam, also a High hazard dam, is located in Hopkinton, just outside of the Milford town boundary, but is owned by the Milford Water Company. The Lake Maspenock Dam discharges to the Mill River, which defines the boundary between Milford and the neighboring Town of Upton. If this dam were to breach, the flood wave might potentially impact properties within Milford. A breach of the Echo Lake Dam would send a flood wave down the Charles River and into the Town of Milford.

The Milford Highway Department maintains a separate storm sewer system to collect and convey stormwater runoff from municipal roadways and properties. The system is a network of catch basins, manholes, stormwater drainage pipes, and outfalls. Some treatment of runoff is provided. The most recently available mapping of the Town's drainage pipes and outfalls is presented in Figure 13 – Stormwater. The system serves to manage local drainage and minimize flooding of roadways and municipal properties.

Facilities regulated by MassDEP's Bureau of Air and Waste, formerly the Bureau of Waste Prevention (DEP BWP Major Facilities) located in Milford are shown in Figure 14 – Landfills and Hazardous Materials Facilities. These include facilities with Air Operating Permits (AIR), Hazardous Waste Recyclers (HWR), Large Quantity Generators of MA-regulated Hazardous Waste (LQG_MA), Large Quantity Generators of EPA/RCRA-regulated Hazardous Waste (LQG_RCRA), and Large Quantity Toxic Users (LQTU). One closed landfill is located in Milford, on the east side of Milford Pond.

3.7 NATURAL (ECOLOGICAL) RESOURCES AND CLIMATE

Milford lies within two regional watersheds, the Blackstone River watershed and the Charles River watershed (see Figure 15 – Water Resources). Only a small portion of the Town, the northwest corner beyond the Mill River, lies within the Blackstone watershed. The majority of land area in Milford lies within the Charles River watershed, with the Charles River and related aquifers supplementing the Town's water supply.



Legend

Dams with Hazard Class

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

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Multi-Hazard Mitigation Plan

Dams

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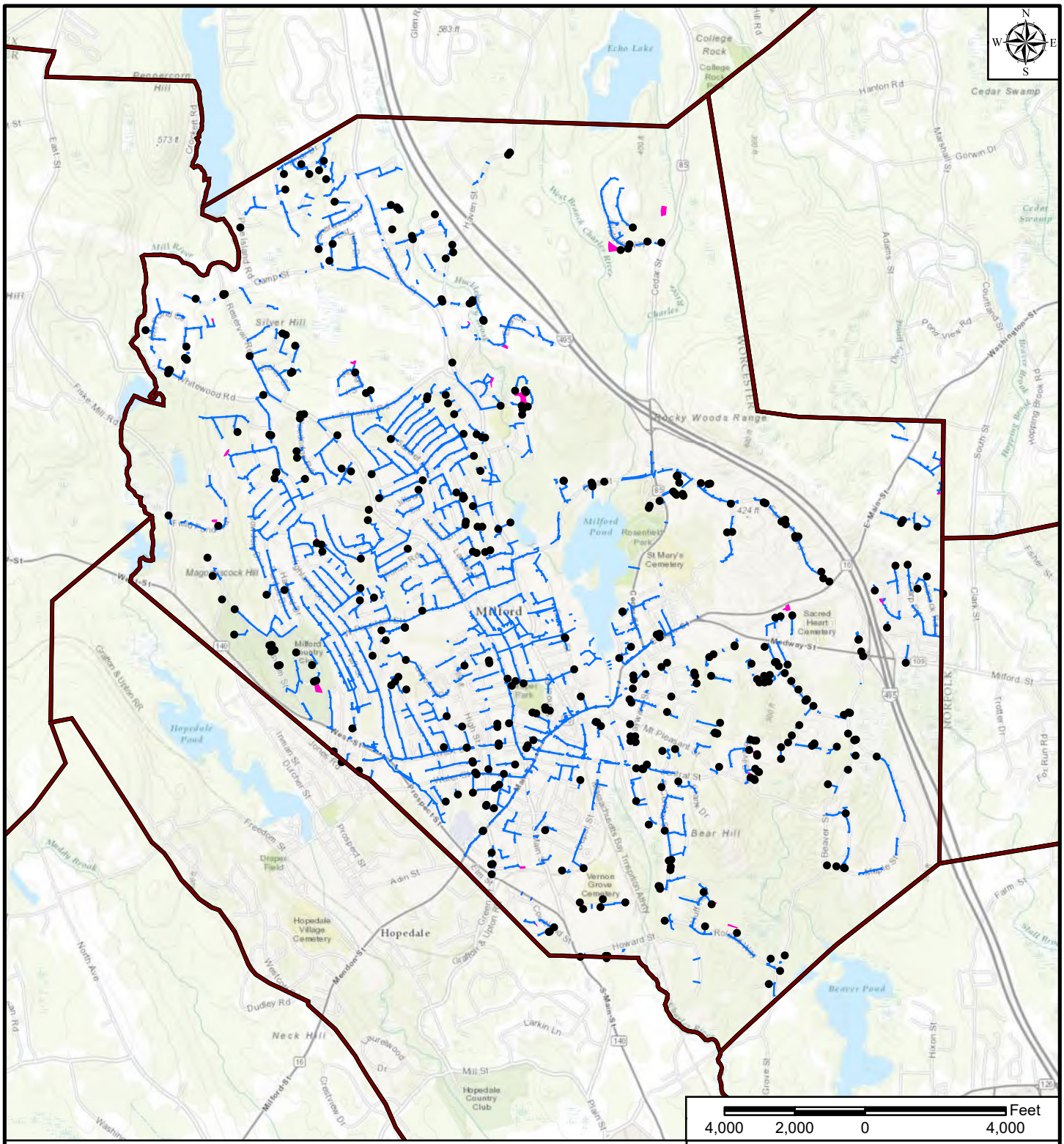
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, TOWN BOUNDARY AND DAMS DATA FROM MASSGIS (2016), SUPPLEMENTAL DAM INFO FROM TOWN.

DATE:	PROJECT NO.	DRAWN BY:	CHECKED BY:	FIGURE
September 2017	15.0166551.00	JRB	TEJ	12



Legend

- Town Boundaries
- Stormwater Outfalls
- Pipes/Culverts
- BMP Locations

Note that catch basins and manholes are not shown due to scale of plan.

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Multi-Hazard Mitigation Plan

Stormwater

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

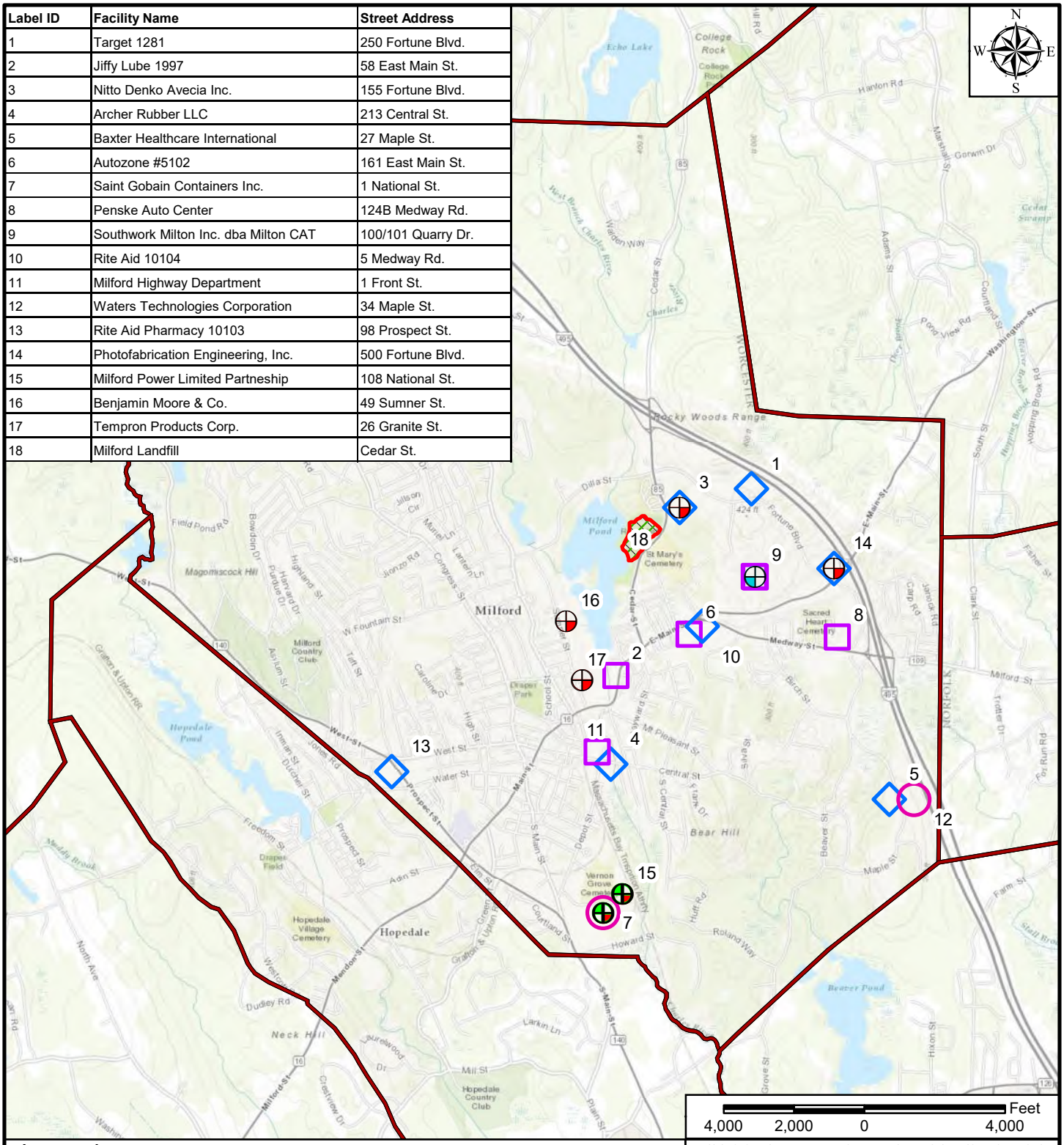
PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, STORMWATER SYSTEM DATA (JUNE 2016) FROM TOWN OF MILFORD, REMAINING DATA FROM MASSGIS (2016).

DATE:	PROJECT NO.	DRAWN BY:	CHECKED BY:
September 2017	15.0166551.00	JRB	TEJ

FIGURE
13

Label ID	Facility Name	Street Address
1	Target 1281	250 Fortune Blvd.
2	Jiffy Lube 1997	58 East Main St.
3	Nitto Denko Avecia Inc.	155 Fortune Blvd.
4	Archer Rubber LLC	213 Central St.
5	Baxter Healthcare International	27 Maple St.
6	Autozone #5102	161 East Main St.
7	Saint Gobain Containers Inc.	1 National St.
8	Penske Auto Center	124B Medway Rd.
9	Southwork Milton Inc. dba Milton CAT	100/101 Quarry Dr.
10	Rite Aid 10104	5 Medway Rd.
11	Milford Highway Department	1 Front St.
12	Waters Technologies Corporation	34 Maple St.
13	Rite Aid Pharmacy 10103	98 Prospect St.
14	Photofabrication Engineering, Inc.	500 Fortune Blvd.
15	Milford Power Limited Partneship	108 National St.
16	Benjamin Moore & Co.	49 Sumner St.
17	Tempron Products Corp.	26 Granite St.
18	Milford Landfill	Cedar St.



Legend

- Town Boundaries
- Milford Landfill - Closed
- DEP BWP Major Facilities - Air Permit
- DEP BWP Major Facilities - Hazardous Waste Recycler
- DEP BWP Major Facilities - Large Quantity Toxic User

Large Quantity Generators (LQG)

- EPA/RCRA-Regulated
- MA-Regulated
- MA and EPA/RCRA-Regulated

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Multi-Hazard Mitigation Plan

Landfills and Hazardous Materials Facilities

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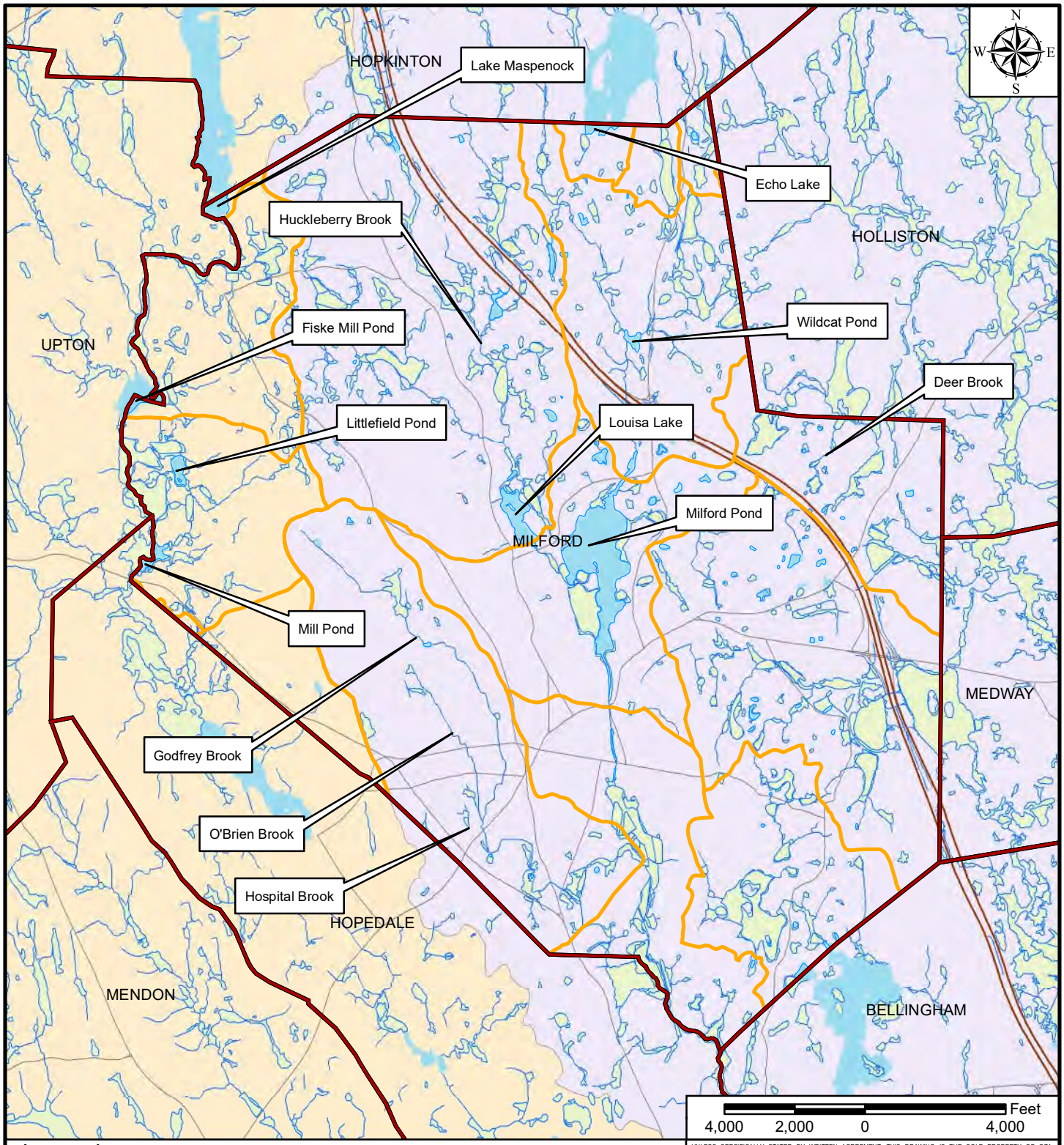
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, REMAINING DATA FROM MASSGIS (2016).

DATE:	PROJECT NO.	DRAWN BY:	CHECKED BY:	FIGURE
September 2017	15.0166551.00	JRB	TEJ	14



Legend

- Hydrologic Connection
- Waterbody
- Wetland
- Sub Basins
- Major Routes
- Major Roads
- Town Boundaries
- Blackstone Watershed
- Charles River Watershed

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Multi-Hazard Mitigation Plan

Water Resources

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PREPARED FOR:
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MASSACHUSETTS

SOURCES: MASSGIS (2016).

FIGURE
15

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The Charles River is 80 miles in length. Its total watershed area is 308± square miles and encompasses all or part of 35 municipalities. Echo Lake, the reservoir that forms the headwaters of the Charles River, lies along the Town boundary between Milford and Hopkinton, and thus the Town is considered to be part of the upper watershed. Since 1995, the water quality of the Charles River has improved dramatically, and is now clean enough for recreational boating nearly year-round, and safe for swimming 70% of the time, according to the Environmental Protection Agency (EPA). The greatest sources of pollution to the river are Combined Sewer Overflows (CSOs) and non-point source pollution, especially from stormwater runoff.

The quantity of water available for residential and commercial use is also threatened by overuse, which has lowered groundwater levels in the watershed and decreased stream flow.

Other significant waterbodies within Milford include Louisa Lake, Milford Pond, Wildcat Pond, Little Field Pond, Deer Brook, Huckleberry Brook, Godfrey Brook, O'Brien Brook, and Hospital Brook. Waterbodies which are located on the borders of the Town include Echo Lake, North Pond, Fiske Mill Pond, and Mill Pond. It must be noted that within the Charles River Watershed, in general, flooding within the lower watershed (Boston metro area) is controlled with dams and channelization, while wetlands and other natural storage areas are relied upon to protect the area from flooding in the upper and middle watersheds.

Photo 1. Milford Pond (2002)

The Public Water Supply Watershed which encompasses a large portion of the northern part of the Town is considered an Outstanding Resource Water (ORW), as shown in Figure 16 – Ecological Resources. Outstanding Resource Waters include Class A Public Water Supply Waters and other waters designated at the discretion of MassDEP under 314 CMR 4.00, including wetlands bordering Outstanding Resource Waters and vernal pools.

Estimated and Priority Habitats associated with the Massachusetts Natural Heritage and Endangered Species Program (MA NHESP) are associated with Milford Pond, the Mill River at the northwest corner of the Town, and the Charles River and nearby upland area north of Milford Pond, as shown on Figure 16 – Ecological Resources. Priority Habitat is based on the known geographical extent of habitat for all state-listed rare species, both plants and animals, and is codified under the Massachusetts Endangered Species Act (MESA). Habitat alteration within Priority Habitats may result in a take of a state-listed species, and is subject to regulatory review by the Natural Heritage & Endangered Species Program. Estimated Habitats are a sub-set of the Priority Habitats, and are based on the geographical extent of habitat of state-listed rare wetlands wildlife and is codified under the Wetlands Protection Act (WPA), which does not protect plants. State-listed wetland wildlife species are protected under the Massachusetts Endangered Species Act as well as the Wetlands Protection Act.

The Commonwealth of Massachusetts, in general, has a humid continental climate with temperatures in Milford that average 79°F to 84°F in the summer and 37°F to 42°F in the winter. Based on monthly climate normals (1981-2010) from the National Weather Service, the total annual normal precipitation in Milford is approximately 49 inches. Snowfall typically occurs from the months of November to April and totals approximately 45 inches per year. The Milford area is subject to a variety of weather events, including hurricanes, tropical storms, nor'easters, thunderstorms, blizzards, and extreme heat/droughts and cold.

3.8 CULTURAL AND HISTORIC SITES

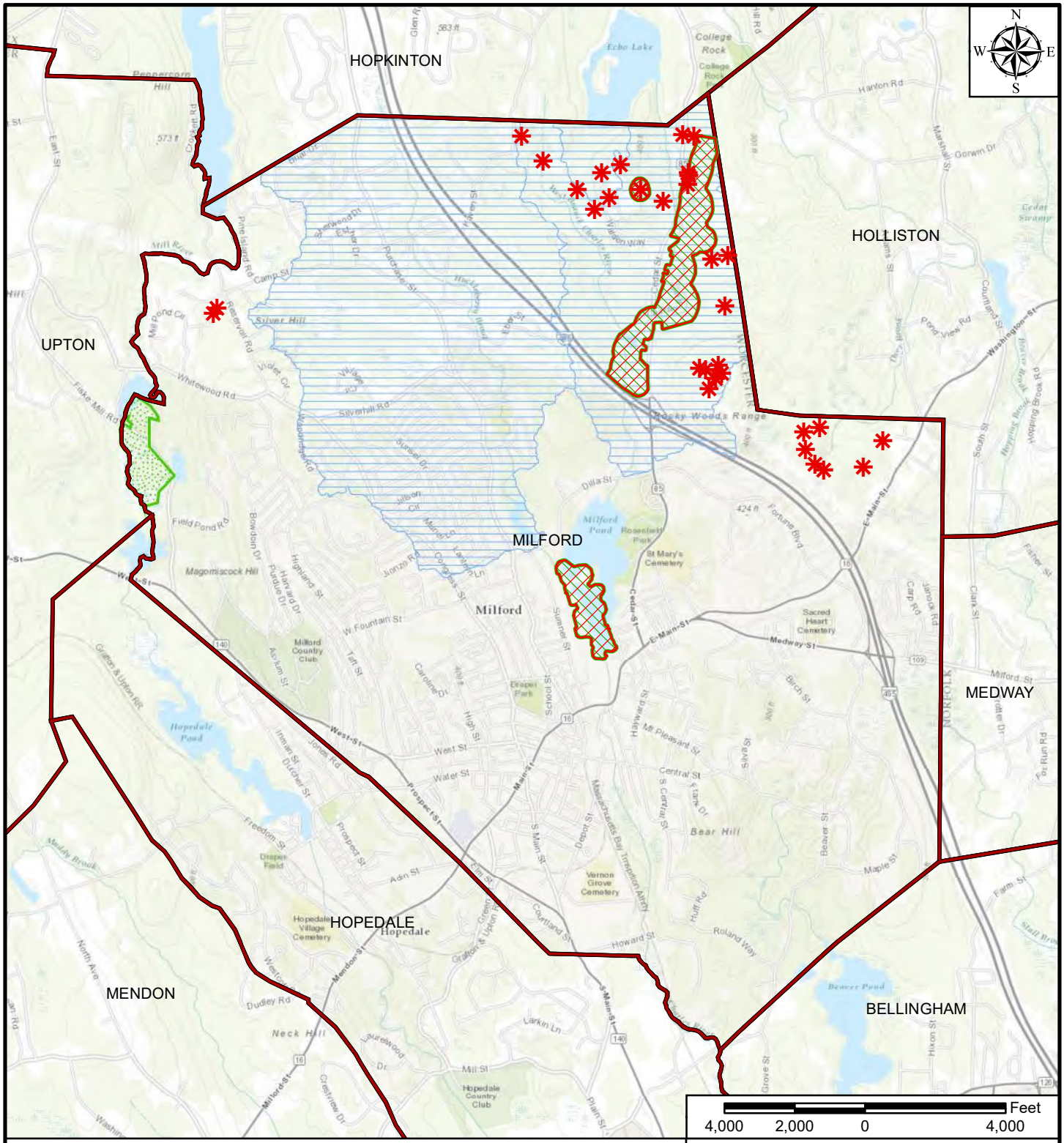
There are four (4) properties within the Town that are listed on the National Register of Historic Places. These include Gillon Block (Ring and Welch Building) at 189 Main Street, Memorial Hall (Milford Historical Commission) at 30 School Street, Thom Block (Flat Iron Building – Craddock Hotel) at 83-89 Main Street, and Milford Town Hall at 52 Main Street, which has a preservation restriction. In addition, National Register listed Historic Districts include the Hopedale Village Historic District and the Prospect Heights Historic District. There are multiple individual properties within these historic districts. These sites are shown on Figure 17 – Historic Resources.

3.9 EXISTING PLANS

A number of plans were reviewed to garner issues related to natural hazards. These plans include:

- Comprehensive Plan, 2003
- Godfrey Brook Feasibility Study, 2007
- MA State Building Code (see discussion in Appendix E)
- Regulations For "Residential" Leaf Program, 2016
- Milford Water Company Rules and Regulations, 2013
- NPDES Stormwater Phase II Annual report, 2017

- Rules and Regulations Relating to the Subdivision of Land, 2012
- Town Ordinances, Open Burning Rules, 2008
- Wetlands Administration By-Law, Article 33
- Zoning By-Laws, 2015, including Article V, Flood Plain District



Feet

4,000 2,000 0 4,000

Legend

- Certified Vernal Pools
- NHESP Estimated Habitats
- NHESP Priority Habitats
- Outstanding Resource Water Public Water Supply Watershed
- Forest Stewardship Program Properties

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Multi-Hazard Mitigation Plan

Ecological Resources

PREPARED BY:
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www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, REMAINING DATA FROM MASSGIS (2017).

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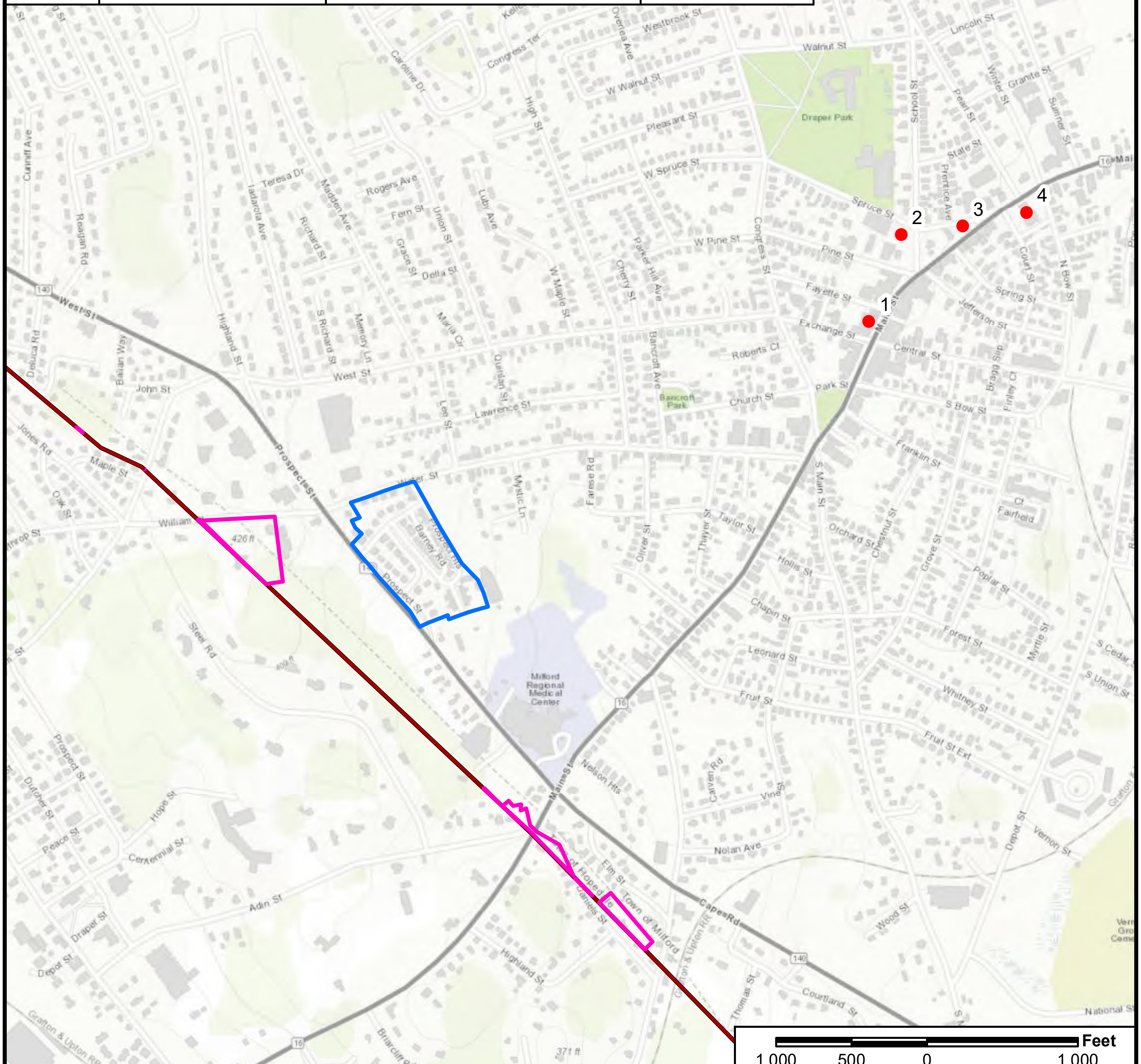
National Register of Historic Places Individual Properties

Label ID	Historic Name	Common Name	Street Address
1	Gillon Block	Ring and Welch Building	189 Main St
2	Memorial Hall	Milford Historical Commission	30 School St
3	Thom Block	Flat Iron Building - Craddock Hotel	83-89 Main St
4	Milford Town Hall	N/A	52 Main St



Legend

- National Register Listed Individual Properties (see table for summary)
- National Register Listed Hopedale Village Historic District
- National Register Listed Prospect Heights Historic District
- Town Boundaries

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Multi-Hazard Mitigation Plan

Historic Resources

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Engineers and Scientists
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MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, REMAINING DATA FROM MASSGIS (2016).

DATE:	PROJECT NO.	DRAWN BY: / CHECKED BY:	FIGURE
September 2017	15.0166551.00	JRB / TEJ	17

4.0 HAZARDS, VULNERABILITIES, AND RISK

4.1 OVERVIEW

The FEMA Local Mitigation Planning Handbook (March 2013) defines a natural hazard as a source of harm or difficulty created by a meteorological, environmental, or geological event, and vulnerability as the characteristics of community assets that make them susceptible to damage from a given natural hazard. The 2013 State Plan provides an in-depth overview of natural hazards in Massachusetts. The state plan indicates that Massachusetts is subject to the following natural hazards: floods, severe weather (high winds, thunderstorms, tornadoes, extreme temperatures, drought), severe winter weather, nor'easters, coastal erosion, dam failure, hurricanes, urban fires and wildfires, landslides, earthquakes, and tsunami. Many of these hazards may also be present in the Town of Milford, and are described in this section. Hazards which are not applicable in Milford include coastal erosion and tsunamis due to the Milford's inland location.

Each hazard description includes a general overview and a summary of its location, extent, previous occurrences, and probability of future events in Milford, as well as a description of the Town's vulnerabilities to each hazard. Impacts to hazards resulting from climate change are also described in this section.

Risk may be defined as the potential for damage, loss, or other impacts created by the interaction of natural hazards with community assets. The risk assessment is the product or process that collects information and assigns values to risks for the purpose of informing priorities, developing or comparing courses of action, and informing decision making (FEMA Local Mitigation Planning Handbook, March 2013). A risk assessment conducted to determine the potential impacts of natural hazards to the people, economy, and built and natural environments of the Town of Milford is described at the end of this section.

4.2 FLOOD HAZARDS

There are several types of flood hazards which frequently impact the Town of Milford and Massachusetts. Flooding is often the result of frequent weather events, such as coastal storms, nor'easters, heavy rains, and tropical storms or hurricanes. Flooding may be riverine flooding, urban drainage flooding, or may be due to ground failures, ice jams, or in less common cases, due to dam failures. The following subsections include discussions for each type of flooding.

4.2.1 Riverine (Inland) & Urban Drainage Flooding

Riverine flooding includes flooding caused by river flows which overtop the riverbanks and spread into the surrounding floodplain or other low-lying areas. Flooding is often caused by heavy rains resulting from thunderstorms, nor'easters, tropical storms, and hurricanes. In addition, the spring rainy season is a particularly hazardous time, as runoff from winter snowfalls saturates much of the Town's wetlands and fills the Town's streams and brooks. A heavy or severe rain event at this time of year can often overwhelm the natural flood storage areas of the Town and create flood hazards on streets and around residential and business areas in town.

Urban drainage flooding is flooding that occurs typically in developed areas, when heavy rains overwhelm the existing drainage system. The drainage system may be undersized, or improperly functioning due to damage or lack of maintenance. Typically, when the drainage system is initially constructed, it is sized for a given magnitude of storm event and development condition. As the watershed becomes more developed in the future, the increase in impervious cover can cause higher peak runoff flows that the drainage system can no longer accommodate; thus, more frequent and smaller storm events may result in flooding of surrounding streets and properties.

Within populated areas in Milford, flooding occurs in a handful of select areas; however, the Town has been able to avoid significant damages by passing aggressive zoning, wetland, watershed, and groundwater regulations.

Flooding may result in road closures and property damages such as flooding of basements, and in some cases, the Fire Department may be called in to help pump out basements. The Milford Highway Department has been effective at replacing or repairing undersized culverts, drainage systems, bridges, dams, and other structures that regulate flow.

Photo 2. Flooding in Milford along Godfrey Brook

Location

The majority of the Town of Milford is within the Charles River watershed, with a small portion of the northwestern portion of Town located in the Blackstone River watershed. Riverine, or inland flooding, occurs within or near floodplains as presented in Figure 18 – Flood Zones. Floodplains for the 1% annual chance ("100-year") and the 0.2% annual chance ("500-year") flood hazards are found throughout Milford, mainly along the Town's water ways.

The 2010 Hazard Mitigation Plan identified local areas within Milford that were subject to flooding or appear to have a higher risk of flooding. The Local Working Group provided information to update the status of these locally identified areas of flooding as a part of this Plan update. Not all of these areas necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The areas and their current source of flooding status (e.g. riverine, sewer, etc.) are listed below.

The numbers identified below correspond to the numbers on Figure 19 - Hazard Areas. The numbers do not reflect priority order.

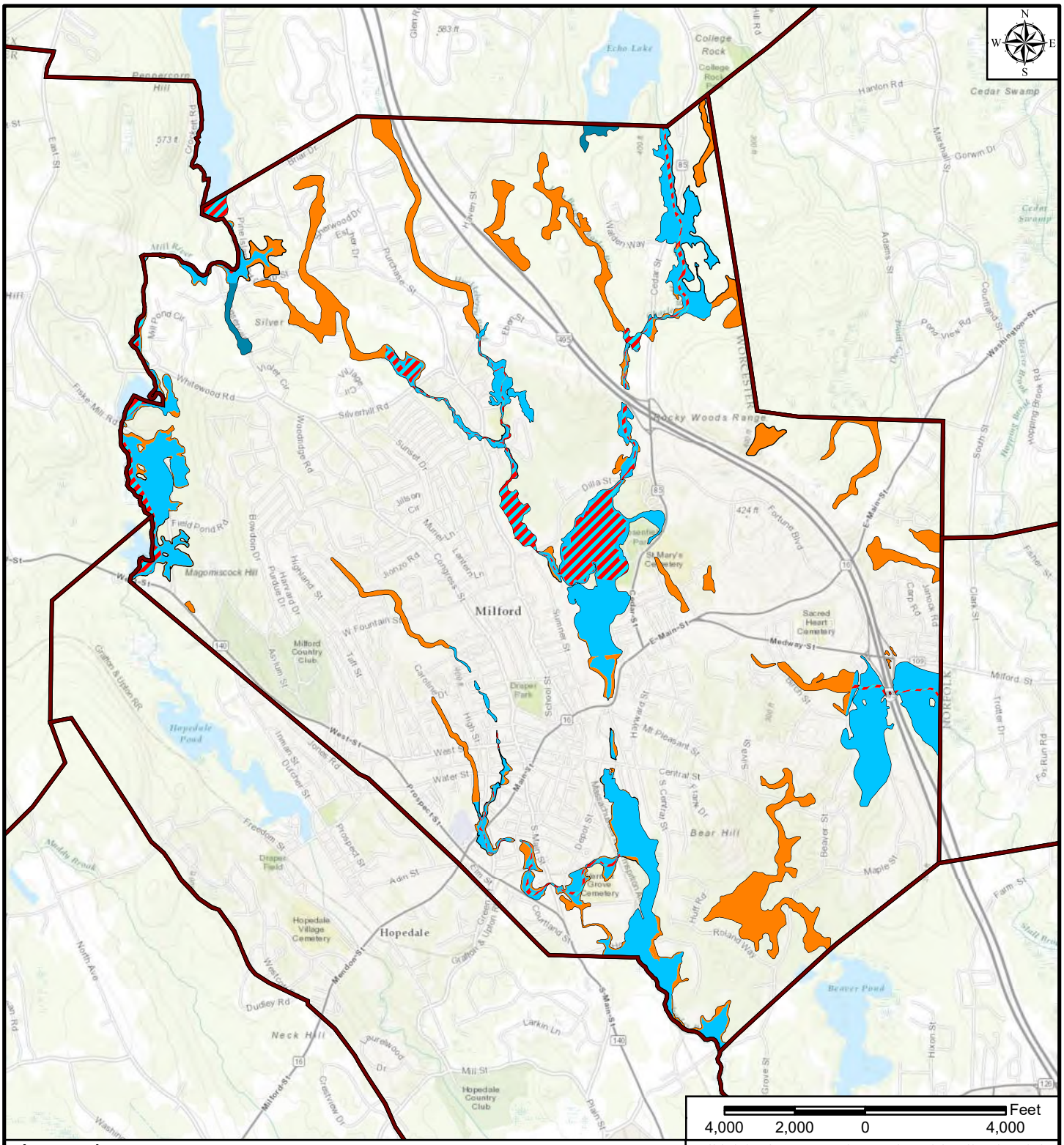
1) Beach Street and Central Street (Flooding)

At the intersection of Beach Street and Central Street the Charles River comes close to exceeding its banks and potentially flooding the street and the surrounding properties. The Charles Rivers intersects downtown Milford through a series of old stone wall channels, and through above and underground culverts. At the former "Archer" rubber factory at Beach Street, the river flows through an old underground culvert system and around a modern above ground channel. The area surrounding Beach Street is populated with several single-family homes (east of the river) and several businesses (west of the river). In addition, the Milford Highway Department yard and garage building is located near the bank of the Charles River upstream of Central Street. These properties are susceptible to flooding in large rain storms. In 2010, the channel and underground culvert were cleared of debris and sediment to improve flow conditions, and a dam behind the "Archer" rubber factory building was removed. However, there is still potential for flooding, as observed by the Town during large flow events, potentially due to an undersized culvert.

2-4) Godfrey Brook (2), Hospital Brook (3), and O'Brien Brook (4) (Flooding)

Godfrey Brook is an intermittent tributary of the Charles River with a watershed of approximately two square miles (1,320 acres). O'Brien Brook and Hospital Brook are intermittent tributaries of Godfrey Brook, with sub-watershed sizes of approximately 203 acres and 272 acres, respectively. The channels of Godfrey, O'Brien, and Hospital Brooks typically are lined with stone masonry walls constructed in the 1930's, except in the extreme upper reaches where the channels remain natural.

Photo 3. Failure of Godfrey Brook Channel Stone Walls (2006)



Legend

- Town Boundaries
- A, 1% Annual Chance Flood
- AE, 1% Annual Chance Flood
- AE, Regulatory Floodway
- X, 0.2% Annual Chance Flood
- X, Minimal Flood Hazard

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Multi-Hazard Mitigation Plan

Flood Zones

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Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, FLOOD ZONE DATA FROM FEMA, REMAINING DATA FROM MASSGIS (2016).

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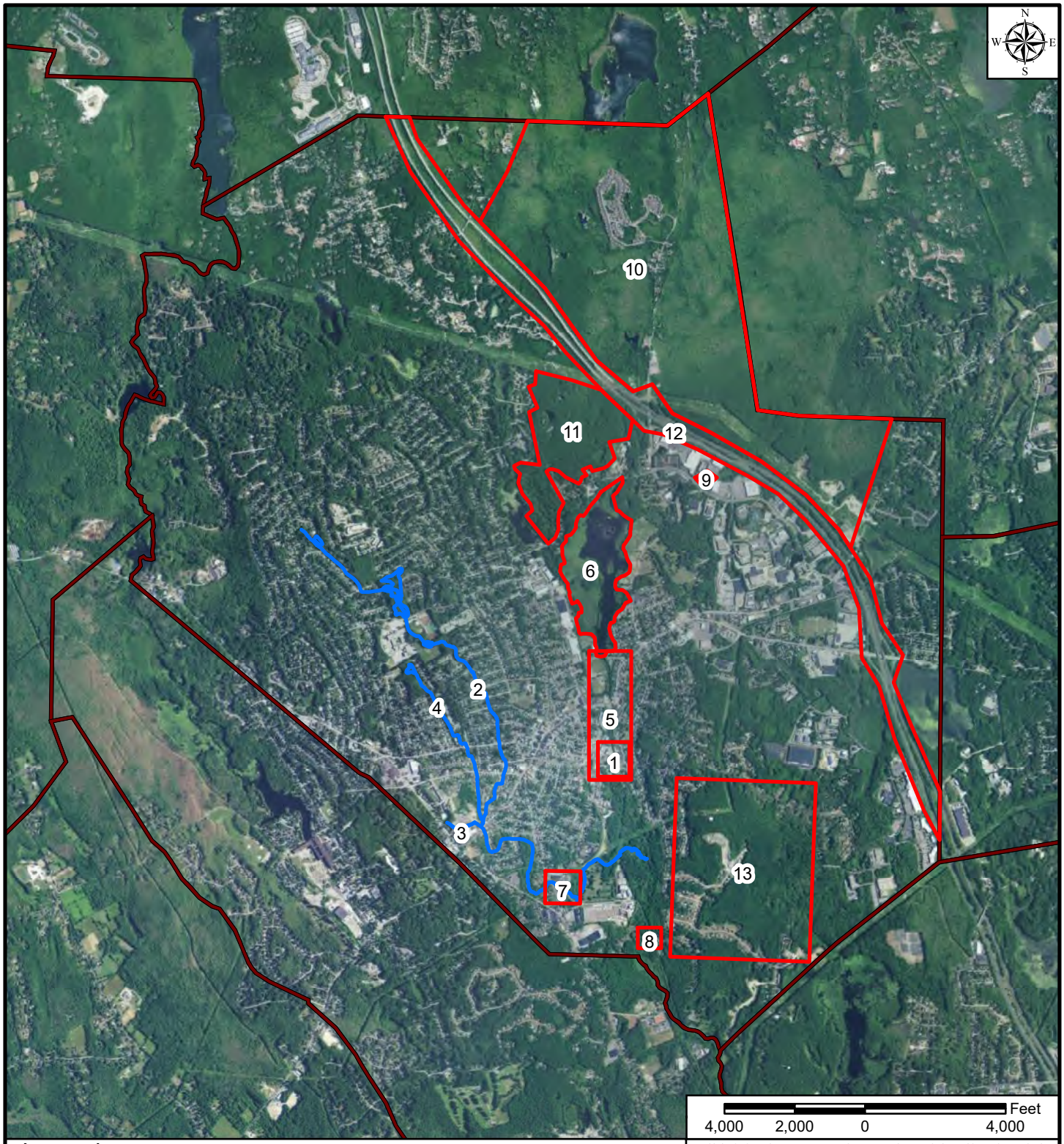

4,000 2,000 0 4,000 Feet

Legend

Hazard Areas | Brooks | Town Boundaries

ID	Hazard Area	Hazard Type
1	Beach St./Central St.	Flooding
2	Godfrey Brook	Flooding
3	Hospital Brook	Flooding
4	O'Brien Brook	Flooding
5	Milford Pond Dam	Flooding
6	Milford Pond	Flooding
7	Depot St. at National St.	Flooding

ID	Hazard Area	Hazard Type
8	Charles River at Howard St.	Flooding
9	Quarry behind Lowes	Flooding
10	Cedar St. Area	Fire
11	Town Forest and Shadow Brook	Fire
12	I-495 Corridor	Fire
13	Bear Hill	Fire

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Multi-Hazard Mitigation Plan

Hazard Areas

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PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, TOWN BOUNDARY AND MHC CULTURAL RESOURCES DATA FROM MASSGIS (2016).

DATE:	PROJECT NO.	DRAWN BY:	CHECKED BY:
September 2017	15.0166551.00	JRB	TEJ

FIGURE
19

According to the Godfrey Brook Feasibility Study (2006), the condition of the channel walls ranges from good to extremely poor and failing. Some channel walls have completely fallen into the brook. Some portions of the stone walls have been replaced with walls of mass concrete as emergency repairs where extreme failures have occurred due to heavy storms. Godfrey and O'Brien Brooks are culverted under street crossings at many locations, or bridged with simple slab spans and stone abutments.

Development within the watersheds has resulted in increased volume and flow rates causing flooding and advanced deterioration of the channel walls. Also, the brooks may exceed their banks in large rain storms. The walls of all three brooks are deteriorated and have collapsed in many areas. This is largely because the walls were built nearly 80 years ago and have gone beyond their reasonable design lifespan of 30 to 50 years. Wall failures result in the release of sediment and debris which cause upstream backups and downstream erosion.

In 2000, the Town built an underground diversionary culvert that conveys flood flows from Godfrey and O'Brien Brooks from Water Street to Vine Street; however, the threat of severe flooding still persists. The Godfrey Brook Feasibility Study examines methods to restore the stream channels and mitigate damages caused by the Godfrey Brook, O'Brien Brook and Hospital Brook. Mitigation of these brooks is a high priority for the Town.

As of the 2010 Hazard Mitigation Plan, the Town has replaced and enlarged the culverts that convey Godfrey Brook beneath Church Street, Congress Terrace, and Main Street, and has repaired the Godfrey Brook channel in the immediate vicinity of those culvert replacements.

5-6) Milford Pond Dam (5) and Milford Pond (6) (Flooding)

Milford Pond is prone to flooding in large storm events. There are several properties, formerly summer cottages, and now permanent residents that reside within the Pond's natural floodplain. A recent pond restoration project may mitigate future flooding. However, the Town would need to conduct a hydraulic analysis study to determine the risk of future flooding and appropriate mitigation measures.

7) Depot Street at National Street (Flooding)

This parcel has been subject to frequent flooding due to an undersized culvert. Flooding results in roadway flooding. Enlarging the culvert could potentially mitigate the flooding.

8) Charles River at Howard Street (Flooding)

During large storms, the water level of the Charles River rises and has the potential to exceed its banks and flood Howard Street. Flooding could result in serious property damage at this location. However, the Local Working Group indicated that they have not seen flooding at this location.

9) Quarry Near the Lowes (Flooding)

There is a small quarry behind the Lowes home improvement store. This quarry had exceeded its banks numerous times prior to the 2010 Hazard Mitigation Plan and flooded the intersection at Cedar Street and Dilla Street. Opposite the pond, there are several businesses. These businesses reside on a hill and water running down their driveways added to the flooding. Since the 2010 Hazard Mitigation Plan, the Town has made repairs to the drainage system under Cedar Street, which addressed the primary flooding problems. However, a second quarry downstream of the quarry at Lowes has begun to present concerns about flooding.

In addition, several other areas were identified as hazards in the 2010 HMP, all of which have been mitigated since that time, as discussed below. These areas are not shown on Figure 19.

1) West Street (Sewer)

As of the 2010 Hazard Mitigation Plan, the Milford Sewer Department replaced an undersized sewer pipe in West Street, which has mitigated the sewer overflows which used to occur on West Street during large rain storms.

Photo 4. Sewer Overflow

2) Orange Street and Vine Street (Sewer)

As of the 2010 Hazard Mitigation Plan, the Milford Sewer Department installed a new sewer interceptor at Orange Street and Vine Street, which has mitigated the sewer overflows which used to occur during large rain storms.

3) High School (Flooding)

In the 2005 Mother's Day storm, the high school basement flooded due to water running off abutting residential driveways. The Town has since rebuilt the parking lot and installed a new drainage system. The high school is the Town mass care shelter, emergency dispensing site and pandemic alternate care sit. As of the 2010 plan, the high school has relocated and elevated the emergency generator to an external building platform.

4) Highland Street at Elizabeth Drive (Sewer)

Infiltration and inflow repair work that has been performed since the 2010 Hazard Mitigation Plan has corrected the problems of sewerage backing up on to the street and into several house basements during large storms.

Extent

Inland flooding in Massachusetts is forecast and classified by the National Weather Service's Northeast River Forecast Center as minor, moderate, or severe based upon the types of impacts that occur. Minor flooding is considered a "nuisance only" degree of flooding that causes impacts such as road closures and flooding of recreational areas and farmland. Moderate flooding can involve land with structures becoming inundated. Major flooding is a widespread, life-threatening event (State Plan, 2013).

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity can also be evaluated by examining peak discharges (State Plan, 2013).

Previous Occurrences

Based on the NOAA Storm Events Database, there have been over 50 flood events which occurred in Worcester County between 1996 and August 2017. Some of these events involved flooding of the Charles River downstream of Milford. Previous occurrences of riverine flooding in Milford have likely occurred along Godfrey and O'Brien Brooks and the Charles River (see location summary above). According to the NOAA Storm Events Database, heavy rain associated with Tropical Storm Hanna in September 2008 ranged from three and a half inches to six and a half inches, which resulted in widespread street flooding. In Milford, this resulted in the washing out of a one-hundred-foot section of Stonybrook Road.

Probability of Future Events

Statewide, it is estimated that the Commonwealth may experience a flood event of disaster declaration proportions once every 3 years (State Plan, 2013). The term "100-year flood" refers to a flood that has a 1% chance of being equaled or exceeded in any given year, and a "500-year flood" has a 0.2% chance of being equaled or exceeded in any given year. The FEMA flood maps, effective July 4, 2011, and Flood Insurance Study (FIS) profiles for Worcester County, Massachusetts (July 16, 2014) provide estimated flood extents, depths, and flows for the 100-year and 500-year floods. From a statistical perspective, a flood with a magnitude equal to that of the FEMA 100-year flood has a 1% probability of occurring in any year. However, the "100-year flood" may occur multiple times in one year, or not occur for several years. Smaller floods (e.g., the "10-year flood", "5-year flood", etc.) are smaller in magnitude but have a greater probability of occurring in any given year.

4.2.2 Ground Failures

Ground failures include mud floods, mudflows, subsidence, liquefaction, and fluvial erosion. The various types of ground failures may be described as follows:

1. Mud floods: Floods that carry large amounts of sediment, which can at times exceed 50% of the mass of the flood, and often occur in drainage channels and adjacent to mountainous areas.

2. Mudflows: A specific type of landslide that contains large amounts of water and can carry debris as large as boulders.

3. Subsidence: The process where the ground surface is lowered from natural processes, such as consolidation of subsurface materials and movements in the Earth's crust, or from manmade activities such as mining, inadequate

fill after construction activity, and oil or water extraction. When ground subsides, it can lead to increasing the risk of flooding by exposing low-lying areas to ground water and areas with a high likelihood of overbank flooding.

4. Liquefaction: Water-laden sediment behaves like a liquid during an earthquake.

5. Fluvial Erosion: The process where the river undercuts a bank, usually on the outside bend of a meander, causing sloughing and collapse of the riverbank. Fluvial erosion can also include scouring and downcutting of the stream bottom, which can be a problem around bridge piers and abutments (State Hazard Mitigation Plan, 2013).

Location

These types of ground failures, other than fluvial erosion, are not likely to occur within Milford. Fluvial erosion may occur along the rivers and streams within Milford, in locations where the channel and banks are not reinforced by hardened structures (concrete, gabions, etc.). The potential for fluvial erosion exists along the Charles River, Huckleberry Brook, Deer Brook, Hospital Brook, and portions of Godfrey and O'Brien Brooks.

Photo 5. Erosion along Hospital Brook (2006)

Extent

The strength and magnitude of a ground failure is related to the severity of the resulting flooding and associated damage. The extent of ground failures in Milford is limited primarily to fluvial erosion, which has occurred along the channels of Godfrey, O'Brien, and Hospital Brooks, which typically are lined with stone masonry walls constructed in the 1930's that are failing in many locations. Some channel walls have completely fallen into the brook. Erosion has occurred or has the potential to occur along these channels, which collectively, have a total length of almost 15,000 linear feet. Some portions of erosion failures along these brooks have required emergency repairs.

Previous Occurrences

There are few known previous occurrences of ground failures in Milford. As stated previously, erosion has occurred along the channels of Godfrey, O'Brien, and Hospital Brooks. Town records available as far back as 1956 indicate that funds have long been appropriated for repair of Godfrey and O'Brien Brooks channel walls. In the fall of 2005, major storms resulted in flood damage with repair costs of approximately $51,000. Prior maintenance repairs have been conducted at West Street, which crosses both Godfrey and O'Brien Brooks, West Spruce Street over Godfrey Brook, and Lawrence Street over O'Brien Brook. The culverts conveying Godfrey Brook at Church Street, and Congress Terrace and Main Street were replaced and upgraded in 2012 and 2017, respectively.

Probability of Future Events

Based on the lack of prior occurrences of ground failures in Milford, the probability of future events is low, other than cases of fluvial erosion.

4.2.3 Ice Jam

An ice jam is an accumulation of ice at a given location within a river which restricts the flow of water. The formation of an ice jam can cause a dam effect, allowing water to build up upstream and result in potential flooding. The sudden failure of an ice dam can create a downstream flash flood that results in damage to property and infrastructure.

Location

Ice jams have been reported on various rivers and brooks throughout Massachusetts, according to the CRREL Ice Jam Database, maintained by the US Army Corps of Engineers. None have occurred within Milford.

Extent

The strength and magnitude of an ice jam is related to the severity of the resulting flooding.

Previous Occurrences

According to the Ice Jam Database, there have been 230 ice jams reported in Massachusetts between 1869 and 2015 with a total of four ice jams have been reported on the Charles River, which occurred in Waltham and Needham, downstream of Milford.

Probability of Future Events

Based on the lack of previous occurrences of ice jams in Milford, the probability of future ice jams within or impacting the Town is less likely.

4.2.4 Dam Failures

A failure of a dam can lead to a sudden, rapid, uncontrolled release of water to the downstream channel, floodplain and surrounding low-lying areas. In Massachusetts, dams that are classified as High or Significant Hazard dams have the potential to cause loss of life, as well as property damage, due to a failure. All High Hazard and some Significant Hazard dams are required to have an Emergency Action Plan (EAP), per the Massachusetts Dam Safety Regulations, 302 CMR 10.11, which delineates the potential area of flooding in the event of a dam failure, and outlines roles and responsibilities for identifying and responding to an emergency at the dam.

Causes of dam failure vary from natural causes such as prolonged rainfall, landslides, earthquakes, or erosion, to human causes such as improper maintenance and design, negligent operation, or sabotage and terrorism. Dam failures are categorized into three groups: overtopping, in which the water level exceeds the top of the dam; excessive seepage, in which water seeps through the ground; and structural failure, where part of the dam doesn't complete its job sufficiently (National Weather Service, http://www.floodsafety.noaa.gov/hazards.shtml , 8/30/17).

Location

According to data provided by MassGIS, there are 12 dams within or on the boundaries of Milford. High hazard dams include the Lake Maspenock Dam, located on the northwestern boundary of Milford, and the Echo Lake Dam, located just north and upstream of the Town. The Milford Pond Dam, owned by the Town of Milford and centrally located within the Town, is a Significant Hazard dam. Other Significant Hazard dams include the Mill Pond Dam on the western boundary of the Town and Louisa Lake Dam, also located centrally within the Town.

Photo 6. Louisa Lake Dam

Extent

The severity of potential impacts from a dam failure is reflected by the dam's hazard classification. The Massachusetts Dam Safety Regulations, 302 CMR 10.06, defines hazard classifications as shown in Table 4:

Table 4. Dam Hazard Classification

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

Previous Occurrences

Dam failure or levee breaches can occur with little warning. Intense storms may produce a flash flood in a few minutes or hours while other failures and breaches can take much longer to occur, from days to weeks (National Weather Service, http://www.floodsafety.noaa.gov/hazards.shtml, 8/30/17).

The 2013 State Plan identified eight previous dam failures in Massachusetts. None of these dam failures resulted to dams that would impact Milford.

Probability of Future Events

The specific probability of future dam failures in Massachusetts is not known. Based on 2010 data from the Department of Conservation and Recreation, there may be up to approximately 450 dams that have been rated as Poor or Unsafe condition. In Milford, Fish Pond Dam, owned by the Town of Milford, was rated in Poor condition in 2010 that may increase the likelihood of failure. However, this dam is a Low Hazard dam, so failure would be expected to cause minimal damage.

The Milford Pond Dam, a Significant Hazard Dam, is in need of minor repairs that the Town is planning to address in the next 5 years. There is no evidence that the dam is in imminent danger of failure.

The Lake Maspenock Dam, a High Hazard dam located in Milford, but owned and operated by Hopkinton, is currently in the process of being upgraded. This dam is over 100 years old and badly in need of repairs. If this dam were to give way, it could result extensive to catastrophic downstream flooding to residential communities within Milford.

The Echo Lake Dam, a High Hazard dam, has an EAP, to guide response in the event of an emergency at the dam.

4.3 SEVERE WEATHER

For the purposes of this Hazard Mitigation Plan update, severe weather described in this section includes storms that result in high winds and/or heavy rainfall, such as hurricanes, tropical storms, Nor'Easters, thunderstorms, tornadoes, and microbursts, as well as extreme heat and droughts.

4.3.1 Hurricanes/Tropical Storms/Nor'Easters

A tropical cyclone is a rotating low-pressure weather system that has organized thunderstorms but no fronts (a boundary separating two air masses of different densities). Tropical cyclones with maximum sustained surface winds of less than 39 miles per hour (mph) are called tropical depressions. Those with maximum sustained winds of 39 mph or higher are called tropical storms. When a storm's maximum sustained winds reach 74 mph, it is called a hurricane.

Hurricanes originate in the Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico, the eastern North Pacific Ocean, and, less frequently, the central North Pacific Ocean. A six-year rotating list of names, updated and maintained by the World Meteorological Organization, is used to identify these storms.

"Hurricane Season" begins on June 1 and ends on November 30, although hurricanes can, and have, occurred outside of this time frame (NOAA National Ocean Service, https://oceanservice.noaa.gov/facts/hurricane.html, 8/22/17).

A Nor'easter is a storm along the East Coast of North America, so called because the winds over the coastal area are typically from the northeast. These storms may occur at any time of year, but are most frequent and most intense between September and April. Nor'easters typically bring precipitation in the form of heavy rain or snow, as well as winds of gale force, rough seas, and, occasionally, coastal flooding to the affected regions (National Weather Service Nor'easter Information, http://www.nws.noaa.gov/om/winter/noreaster.shtml , 11/29/16).

Wind-related hazards can cause falling trees that result in power outages from downed trees. Tree limbs can also cause property and vehicle damage, impact roadways, and in rare instances, cause loss of life. These storms may be accompanied by lightning, which can spark fires.

Location

Hurricane and tropical depression tracks which have passed within 30 nautical miles of Milford are presented in Figures 20 and 21. In these figures, the Town of Milford's approximate location is denoted with a star. A hurricane or tropical depression track is the line that delineates the path of the eye of a hurricane or tropical storm. The Town experiences the impacts of the wind and rain of hurricanes and tropical storms regardless of whether the storm track passed directly through the Town.

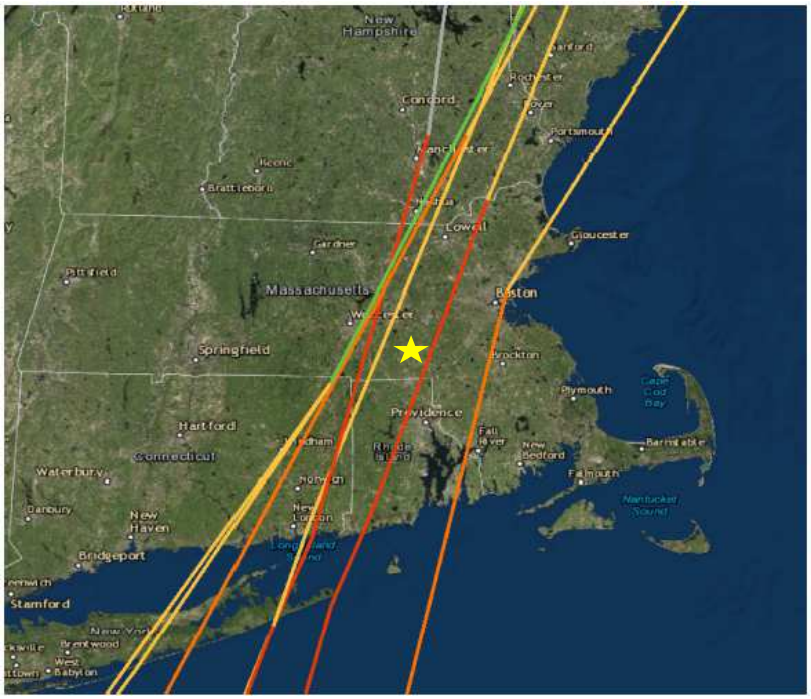


Figure 20. NOAA Historical Hurricane Tracks within 30 Nautical Miles of Milford

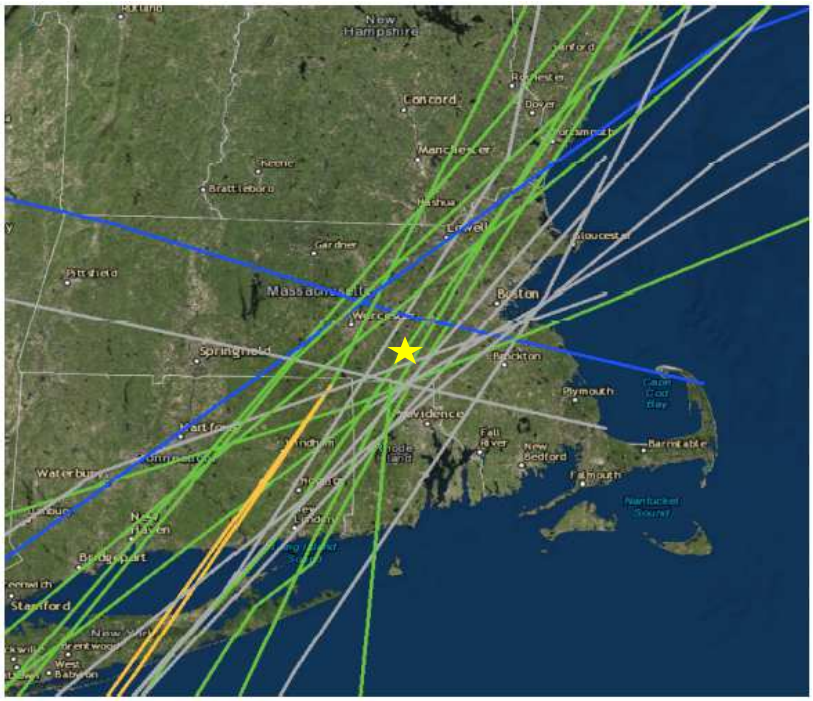


Figure 21. NOAA Historical Tropical Depression Tracks within 30 Nautical Miles of Milford

Nor'easters usually develop in the latitudes between Georgia and New Jersey, within 100 miles east or west of the East Coast. These storms progress generally northeastward and typically attain maximum intensity near New England and the Maritime Provinces of Canada. The heavily populated region between Washington D.C., Philadelphia, New York and Boston, the "I-95 Corridor," is especially impacted by Nor'easters (National Weather Service Nor'easter Information, http://www.nws.noaa.gov/om/winter/noreaster.shtml, 09/27/17).

Extent

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating, or category, based on a hurricane's maximum sustained winds. The higher the category, the greater the hurricane's potential for property damage (NOAA National Ocean Service, https://oceanservice.noaa.gov/facts/hurricane.html, 8/22/17).

Previous Occurrences

The hurricanes and tropical storms associated with the storm tracks shown in Figures 20 and 21 above are listed as follows:

- Tropical Storm Hanna, August 28 to September 8, 2008
- Tropical Storm Barry, May 31 to June 5, 2007
- Tropical Storm Floyd, September 7 to September 19, 1999
- Tropical Storm Bertha, July 5 to July 17, 1996
- Tropical Storm Chris, August 21 to August 30, 1988
- Unnamed Tropical Storm, September 12 to September 15, 1961
- Hurricane Donna, August 29 to September 14, 1960
- Hurricane Carol, August 25 to September 1, 1954
- Unnamed Tropical Storm, May 13 to May 18, 1916
- Unnamed Tropical Storm, July 31 to August 5, 1915
- Unnamed Tropical Storm, May 24 to May 31, 1908
- Unnamed Tropical Storm, June 12 to June 17, 1902
- Unnamed Tropical Storm, September 20 to September 25, 1897
- Unnamed Tropical Storm/Hurricane, October 1 to October 12, 1894
- Unnamed Tropical Storm, September 6 to September 13, 1888
- Unnamed Tropical Storm, August 14 to August 24, 1888
- Unnamed Tropical Storm, September 10 to September 20, 1876
- Unnamed Hurricane, September 7 to September 9, 1869
- Unnamed Tropical Storm, October 28 to October 30, 1866
- Unnamed Tropical Storm, November 1 to November 3, 1861
- Unnamed Hurricane, September 11 to September 17, 1858
- Unnamed Tropical Storm, October 16 to October 19, 1851

Some well know Nor'easters include the notorious Blizzard of 1888, the "Ash Wednesday" storm of March 1962, the New England Blizzard of February 1978, the March 1993 "Superstorm" and the recent Boston snowstorms of January and February 2015. Past Nor'easters have been responsible for billions of dollars in damage, severe economic, transportation and human disruption, and in some cases, disastrous coastal flooding. Damage from the worst storms can exceed a billion dollars (National Weather Service Nor'easter Information, http://www.nws.noaa.gov/om/winter/noreaster.shtml, 09/27/2017).

Probability of Future Events

NOAA's National Hurricane Center predicts and tracks hurricanes, which occur, on average, 12 times a year in the Atlantic basin (NOAA National Ocean Service, https://oceanservice.noaa.gov/facts/hurricane.html, 8/22/17). According to the 2013 State Plan, there is a 6 to 30% chance that a hurricane will impact Massachusetts in any given year, and nor'easters may occur approximately 1 to 2 times per year in Massachusetts.

4.3.2 High Winds/Thunderstorms/Tornadoes/Microburst

A thunderstorm is characterized by lightning and thunder and usually produces gusty winds, heavy rain, and sometimes hail. Cumulonimbus clouds produce lightning, which locally heats the air to 50,000 degrees Celsius, which in turn produces an audible shock wave, known as thunder. Tornadoes can also be generated during these events.

Three basic ingredients are required for a thunderstorm to form: moisture, rising unstable air (air that keeps rising when given a nudge), and a lifting mechanism. Every thunderstorm has an updraft (rising air) and a downdraft (sinking air). Sometimes strong downdrafts known as downbursts can cause tremendous wind damage, similar to that of a tornado. A small (< 2.5-mile path) downburst is known as a "microburst" and a larger downburst is called a "macroburst."

A "derecho" is a widespread, long-lived wind storm associated with a band of rapidly moving showers or thunderstorms variously known as a squall line, bow echo, or quasi-linear convective system. Although a derecho can produce destruction similar to that of a tornado, the damage typically occurs in one direction along a relatively straight swath. As a result, the term "straight-line wind damage" sometimes is used to describe derecho damage (http://www.spc.noaa.gov/misc/AbtDerechos/derechofaq.htm). Derechos can occasionally occur in Massachusetts.

The peak season for severe thunderstorms in the northeast is June through August, although thunderstorms also occur in the spring and fall, and thunder can occur during winter snow storms. Thunderstorms in Massachusetts are usually accompanied by rainfall; however, during periods of drought, lightning from thunderstorm cells can result in fire ignition. Thunderstorms with little or no rainfall are rare in New England but have occurred.

Hazards from thunderstorms include high winds, lightning, torrential downpours, and hail. Thunderstorms can spawn tornadoes and cause flash floods, downed trees and power lines, power outages, and mudslides. Roads may become impassable due to flooding, downed trees, or a landslide. Power lines may be downed due to high winds, and services such as water or phone may not be able to operate without power. Lightning can cause severe damage and injury. Fatalities are uncommon, but can occur.

Lightning strikes primarily occur during the summer months. There were 38 lightning deaths in the U.S. in 2016, none of which occurred in Massachusetts (http://www.lightningsafety.noaa.gov/fatalities.shtml). Populations located outdoors are considered at risk and more vulnerable to a lightning strike compared to being inside a shelter. Moving to a lower risk location will decrease a person's vulnerability.

Location

Thunderstorms can strike in all regions of the U.S.; however, they are most common in the central and southern states. The atmospheric conditions in these regions of the country are most ideal for generating these powerful storms. It is estimated that there are as many as 40,000 thunderstorms each day worldwide. Figure 22 shows the average number of thunderstorm days throughout the U.S. The most thunderstorms are seen in the southeast states, with Florida having the

highest incidences (80 to over 100 thunderstorm days each year). This figure indicates that Massachusetts experiences between 10 and 20 thunderstorm days each year.

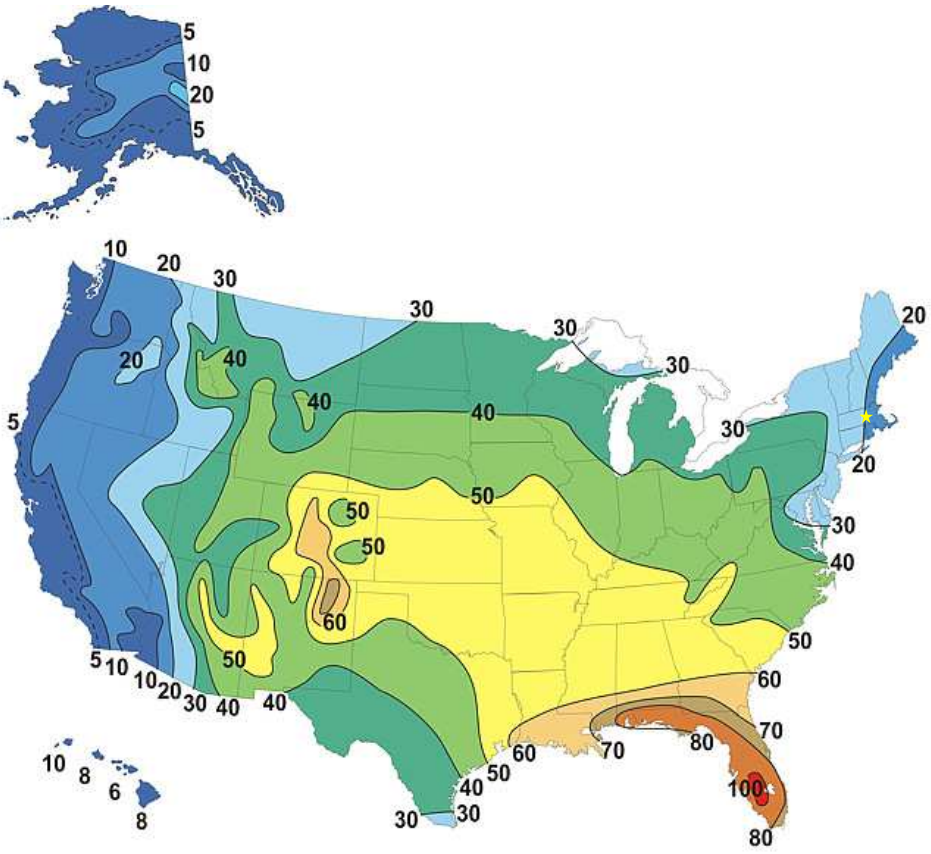


Figure 22. Average Annual Number of Thunderstorms in U.S.
(Source: http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.html)

Extent

An average thunderstorm is 15 miles across and lasts 30 minutes; severe thunderstorms can be much larger and longer. According to the National Weather Service, a severe thunderstorm is a thunderstorm that produces a tornado, winds of at least 58 mph (50 knots or ~93 km/h), and/or hail at least 1" in diameter. Structural wind damage may imply the occurrence of a severe thunderstorm. A thunderstorm wind equal to or greater than 40 mph (35 knots or ~64 km/h) and/or hail of at least ½" is defined as approaching severe (http://www.weather.gov/bgm/severedefinitions).

The intensity of tornadoes is measured by the Enhanced Fujita (EF) Scale, which was implemented in 2007 to correct some limitations of the original Fujita Scale, which has been in use since the 1970's. The EF Scale incorporates Damage Indicators and a measure of Degree of Damage (DOD). When using the EF-Scale to determine a tornado's EF-rating, begin with the 28 Damage Indicators. Each one of these indicators has a description of the typical construction for that category of indicator. Then, the next step is to find the Degree of Damage (DOD). Each DOD in each category is given an expected estimate of wind speed, a lower bound of wind speed and an upper bound of wind speed (http://www.spc.noaa.gov/efscale/).

Previous Occurrences

Tornadoes which have occurred in Worcester County, Massachusetts, between 1950 and August 2017 have ranged in severity from F0 to F4, with more recent tornadoes rated under the EF scale ranging from EF0 to EF3. There has not been a tornado in Massachusetts rated higher than F4 (NOAA Storm Events Database). On July 4, 2006, severe thunderstorms produced wind damage in extreme eastern Worcester County, near the Norfolk County line. In Milford, a tree was brought down onto a house on Mead Avenue, and wires were brought down on East Main Street. In Hopedale, the thunderstorms brought down several trees along Green Street as well as many large branches. As the storms progressed into Norfolk County, they brought down a large tree onto a house on Beach Street in Franklin. Golf ball sized hail was reported in Franklin and Wrentham, in the Lake Pearl section. In Walpole, two large tree limbs came down on Winter and Summer Streets. Wind damage was a little more widespread in Foxborough, where many trees were brought down in the state park, and one large tree fell onto South Street. Although the storms weakened as they headed into Plymouth County, frequent cloud-to-ground lightning caused considerable damage. Many homes were struck by lightning from West Bridgewater to Rockland, Abington, Hull, and Hingham (NOAA Storm Events Database).

Other severe thunderstorms reported in Milford occurred on August 5, 2005, August 7, 2008, June 5, 2010, and July 28, 2015 (NOAA Storm Events Database).

According to the 2010 Plan, Milford sustained damages from a microburst in the mid 1990's. The storm also knocked down power lines and caused minor to major property damages from downed limbs and debris.

Tornadoes which have occurred in Massachusetts include the June 1, 2011 tornado which traveled from Westfield to Charlton, staying on the ground for one hour and ten minutes, along a path 39 miles long ("2011 New England Tornado Outbreak", Wikipedia, https://en.wikipedia.org/wiki/2011_New_England_tornado_outbreak). The tornado caused significant damage to the City of Springfield and surrounding towns, and resulted in 300 injuries and 500 homeless in Springfield, and 3 deaths overall within Hampden County (NOAA Storm Prediction Center Annual U.S Killer Tornado Statistics, http://www.spc.noaa.gov/climo/torn/fatalmap.php#). One of the most recent tornadoes in Massachusetts occurred on February 27, 2017 and touched down in Conway (Franklin County) and Goshen (Hampshire County). It was the first time a tornado had been reported in Massachusetts during the month of February, with records dating back to 1950 (Boston Globe, February 27, 2017, https://www.bostonglobe.com/metro/2017/02/27/tornado-confirmed-western-massachusetts/x4F61JlYIIqpJvOO0Q8r0H/story.html). One of the nearest tornadoes to Milford occurred in Hopkinton on May 3, 1976 (NOAA Storm Events Database).

Probability of Future Events

Figure 22 above indicates that Massachusetts experiences between 10 and 20 thunderstorm days each year. The NOAA National Centers for Environmental Information Storm Events Database indicates that 406 thunderstorm wind events were reported in Worcester County between 1950 and November 2016 (https://www.ncdc.noaa.gov/stormevents/).

Tornadoes can also occur anywhere in Massachusetts, although relatively infrequently. A total of 39 tornadoes have been reported in Worcester County for the period of record between 1950 and 8/17/2017, according to the NOAA Storm Events Database. According to the NOAA's Storm Prediction Center – U.S. Annual Tornado Maps (1952-2011), the average annual number of tornados for an averaging period of 1991-2010 in Massachusetts was 1.

4.3.3 Extreme Heat/Droughts

According to NOAA, Massachusetts is made up of three climate divisions: Western, Central, and Coastal. Figure 23 shows the climate divisions of Massachusetts, with the approximate location of the Town depicted with a star.

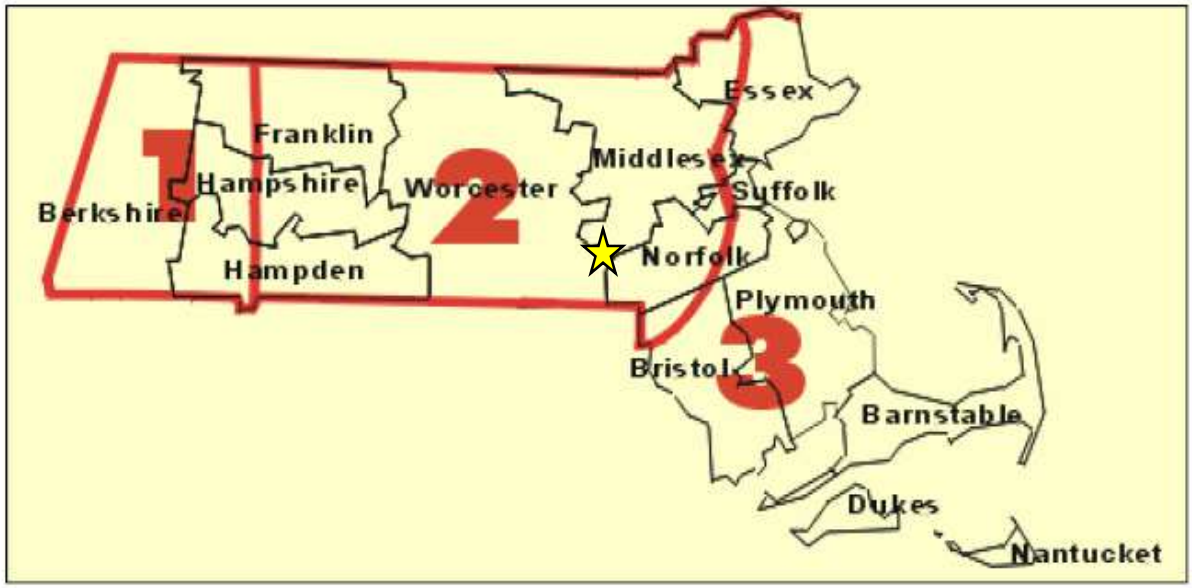


Figure 23. Climate Divisions of Massachusetts (State Hazard Mitigation Plan, 2013)

Extreme heat, in Massachusetts, is usually defined as a period of three or more consecutive days on which the daily high temperature is 90°F or greater, considered a Heat Wave by the National Weather Service in Boston. These prolonged periods of excessively hot weather may be accompanied by high humidity.

Heat waves cause more fatalities in the U.S. than the total of all other meteorological events combined. In the period from 1985 to 2016, the heat-related mortality rate was about 2.9 per 100,000 people in Boston (Climate Ready Boston Executive Summary, December 2016). From 1979-2014, excessive heat exposure caused in excess of 8,000 deaths in the United States (EPA, May 2014). During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

The Massachusetts Executive Office of Energy and Environmental Affairs defines drought as "a period of unusually persistent dry weather that continues long enough to cause serious problems such as crop damage, water supply shortages, and habitat loss. The severity of the drought depends upon how acute the water deficit is, the duration, and the size of the affected area". Drought can impact water supply and result in conditions favorable for brush and other outside fires.

Location

Extreme heat and droughts can occur anywhere in Massachusetts, including Milford. Urbanized areas with greater amounts of pavement and buildings can see higher temperatures due to the "urban heat island effect". These areas become higher in temperature than rural areas as dark pavements absorb heat during the day and radiate it slowly at night, keeping night-time ground surface temperatures elevated.

Extent

The National Weather Service in Boston issues Excessive Heat Warnings when the daytime heat indices reach 105°F or greater for 2 or more hours. A Heat Advisory is issued when the daytime heat indices reach 100-104°F for 2 or more hours.

The Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature. The National Weather Service will initiate alert procedures when the Heat Index is expected to exceed 105-110°F (depending on local climate) for at least two consecutive days. The Heat Index values were derived for shady, light wind conditions, and exposure to full sunshine can increase heat index values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can be extremely hazardous (http://www.nws.noaa.gov/om/heat/heat_index.shtml). The following Heat Index Chart (Figure 24) presents the likelihood of heat disorders occurring at different combinations of temperature and relative humidity.

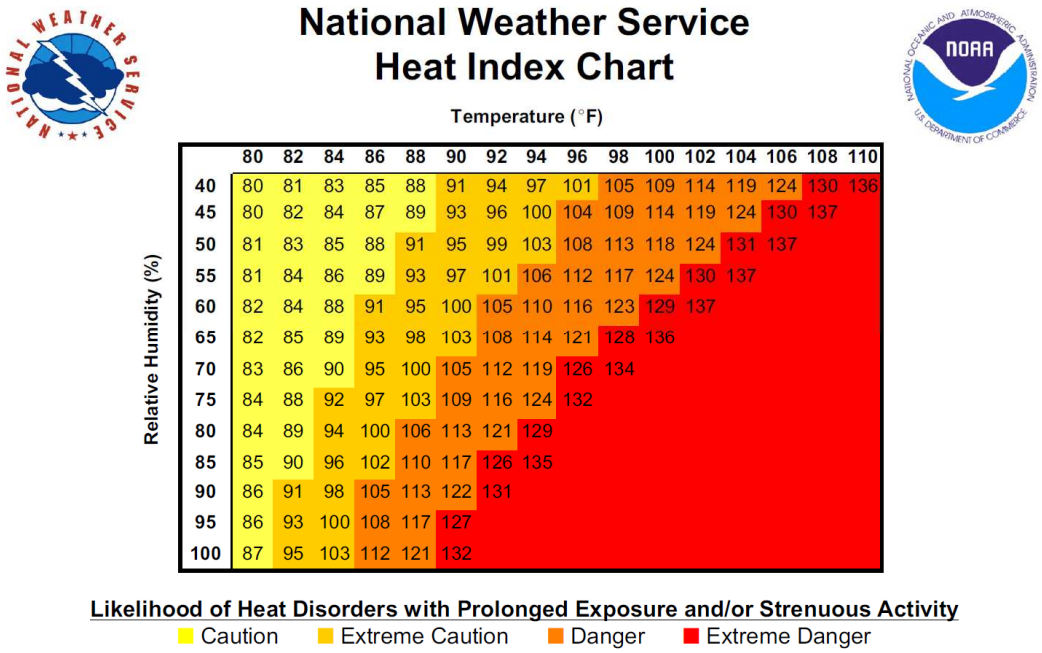


Figure 24 – National Weather Service Heat Index Chart

The highest temperature recorded in Massachusetts was 107°F on August 2, 1975, in Chester and New Bedford, according to NOAA (https://www.ncdc.noaa.gov/extremes/scec/records).

The Massachusetts Drought Management Plan (May 2013) defines Drought Action Levels for appropriate levels of response given the severity of the drought, assessed on a regional basis. The regions include Western, Central, Connecticut River Valley, Northeast, Southeast, and Cape and Islands. Drought severity is characterized by five levels including Normal, Advisory, Watch, Warning, and Emergency. The determination of drought level is based on seven indices including Standardized Precipitation Index, Crop Moisture Index, Keetch-Byram Drought Index, Precipitation, Groundwater levels, Streamflow levels, and Index Reservoir levels.

Previous Occurrences

According to the 2013 State Plan, there have been 43 warm weather events since 1995, ranging from Record Warmth/Heat to Excessive Heat events.

In 2015, nationally, 45 people died as a result of extreme heat, up dramatically from the 2014 total of 20 but down from the 92 fatalities in 2013. This number is well below the 10-year average for heat related fatalities, 113. There were no heat related deaths reported in Massachusetts during 2015. In 2015, the most dangerous place to be was in a permanent home, likely with little or no air conditioning, where 15 people died. For the third consecutive year, Nevada numbered by far the most heat victims, 25, more than double the state's 2014 total of 12. As in the past, extreme heat most strongly affected adults aged 50+, with 33 deaths (73%). Sadly, the next highest age-range was children 0-9, many left in vehicles. Once again, more males, 32 (71%), than females, 13 (29%), were killed by heat (NOAA 2015 Heat Related Fatalities).

According to the 2013 State Plan, multi-year droughts occurred in 1879-83, 1908-12, 1929-32, 1939-44, 1961-69, and 1980- 83. The most recent drought reaching a Warning Drought Action Level throughout most regions of the Commonwealth occurred in the summer through early winter of 2016, according to a table of Recent Drought History provided by the Massachusetts Executive Office of Energy and Environmental Affairs (http://www.mass.gov/eea/docs/dcr/watersupply/rainfall/drought-status-history.pdf)

Probability of Future Events

Extreme heat is likely to occur every year in Massachusetts, although not every year will see extreme heat events.

In Massachusetts, five droughts met the criteria for Emergency level in the period between 1850 and 2012: in 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought period is viewed as the most severe drought to have occurred in modern times in Massachusetts given the period of record for precipitation data because of its long duration. On a monthly basis over the 162-year period of record, there is a one percent (1%) chance of being in a drought Emergency (MA Drought Management Plan, May 2013).

4.4 SEVERE WINTER WEATHER

Severe winter weather as described in this section includes snow and blizzards, ice storms and extreme cold.

4.4.1 Snow and Blizzards

As defined by the National Weather Service, a blizzard is a snowstorm with sustained winds or frequent gusts to 35 miles an hour or greater; and considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than a quarter of a mile) for a period of 3 hours or longer.

As expected, several public safety issues can arise during snow storms. Impassible streets are a challenge for emergency vehicles and affect residents and employers. Snow-covered sidewalks force people to walk in streets, which are already less safe due to snow, slush, puddles and ice. Large piles of snow can also block sight lines for drivers, particularly at intersections. Not all residents are able to clear their properties, especially the elderly. Refreezing of melting snow can cause dangerous roadway conditions.

The Town provides standard snow plowing operations, and clearing snow has not posed any significant challenges. The Town has sufficient storage space and snow removal equipment.

Location

Snow and blizzards can occur throughout Massachusetts, including within all portions of Milford.

Extent

NOAA's National Centers for Environmental Information produces the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two thirds of the U.S. The RSI ranks snowstorm impacts on a scale from 1 to 5, as shown in the following table (Table 5). RSI is based on the spatial extent of the storm, the amount of snowfall, and the juxtaposition of these elements with population. Including population information ties the index to societal impacts. Currently, the index uses population based on the 2000 Census (NOAA; https://www.ncdc.noaa.gov/snow-and-ice/rsi/, 8/29/17).

Table 5. Regional Snowfall Index

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

The average annual snowfall for Milford is 25 to 50 inches based on the Average Annual Snowfall map as shown in Figure 25, with the approximately location of the Town of Milford depicted with a star.

Previous Occurrences

The NOAA Storm Events database reports the occurrence of two blizzards in Worcester County on February 8-9, 2013 and January 26-28, 2015. Details about these two blizzards, as described by the NOAA Storm Events Database, are included below. A total of 77 days of heavy snow events occurred in Worcester County between 1996 and 2017, including the two blizzard events, according to the NOAA Storm Events database.

February 8-9, 2013:

This blizzard deposited 2 to 2.5 feet of snow in most locations over southern New England. Isolated thunderstorms were common across the entire region during the height of the storm. The band of heaviest snowfall, with 3 to 5 inches per hour for several hours, extended from southwest NH to central and western CT.

The Blizzard of 2013 also produced a prolonged period of very strong winds Friday night along the MA and RI coasts. Gusts exceeded hurricane force (74 mph) at a few locations. Gale force gusts (to 50 mph) continued on the MA coast through Saturday afternoon. The strong winds, combined with a wet snow, led to extensive power outages from downed trees and wires in southeast coastal MA and in southern RI. Elsewhere, farther inland, the snow became drier and did not cling to trees like it did along the south and southeast coast of New England. Damaging gusts to 60 mph were recorded as far west as Worcester County, MA. Wind gusts of 35 to 50 mph were common elsewhere in southern New England.

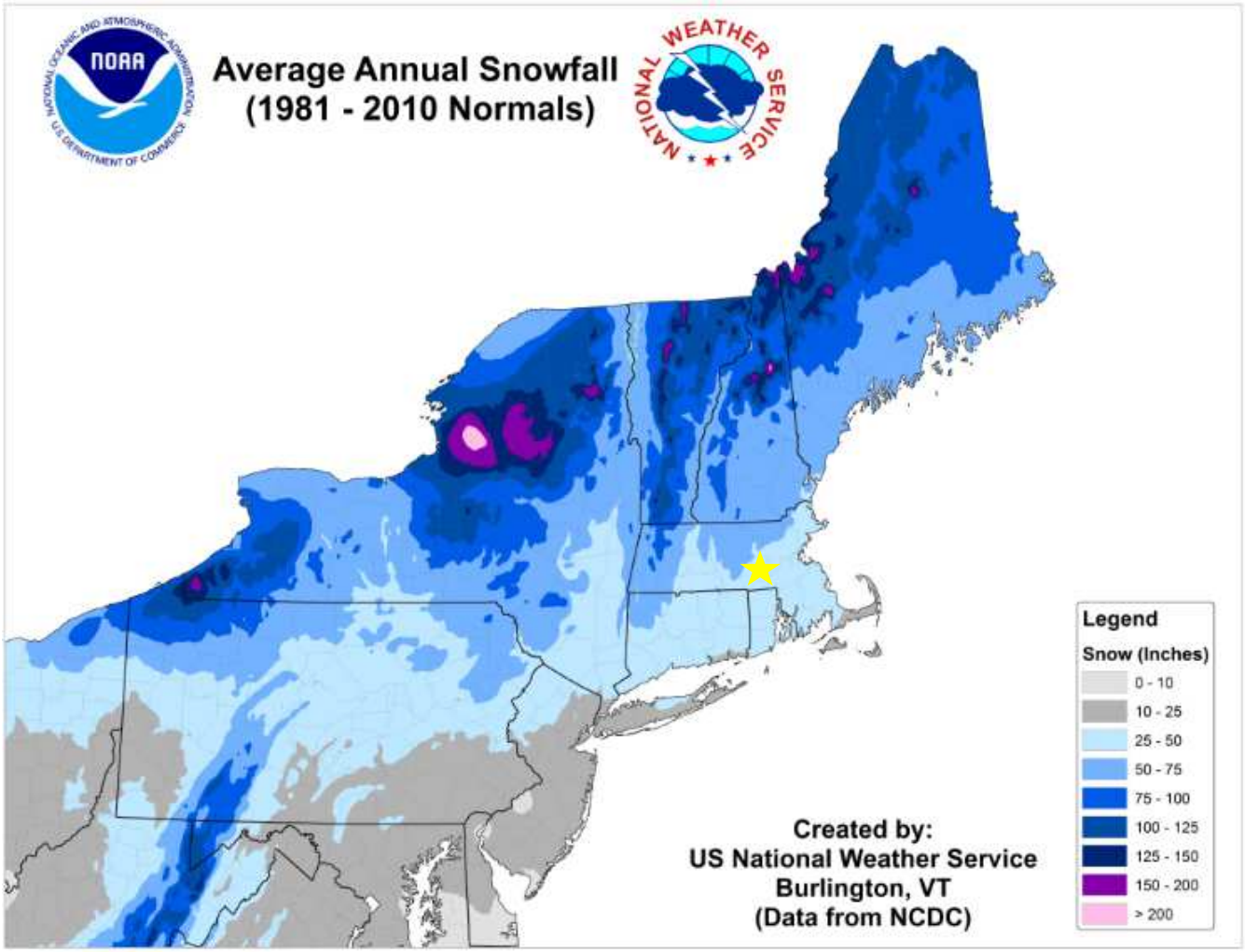


Figure 25. Average Annual Snowfall
(http://www.weather.gov/btv/winter)

January 26-28, 2015:

An historic winter storm brought heavy snow to southern New England with blizzard conditions to much of Rhode Island and eastern Massachusetts, beginning during the day on Monday, January 26 and lasting into the early morning hours of Tuesday, January 27. The highest snowfall totals, averaging 2 to 3 feet, extended from extreme northeast Connecticut and northwest Rhode Island into much of central and northeast Massachusetts, including greater Boston. Some of the highest totals reported include Hudson, MA (36 inches), Acton, MA (34 inches), Thompson, CT (33.5 inches), and Methuen, MA (31.5 inches). Much of southeast Massachusetts and the rest of Rhode Island received 1 to 2 feet of snow.

At its peak, snowfall rates of 2 to 3 inches per hour were common. In Massachusetts, blizzard conditions were officially reported in Marshfield (14 hours), Hyannis (13 hours), Nantucket (11 hours), Boston (9 hours), Chatham (9 hours), Worcester (7 hours), and Beverly (3 hours). Several other locations fell just short of the required criteria (3 consecutive hours of blizzard conditions) including Fitchburg, New Bedford, Falmouth, and Martha's Vineyard in Massachusetts and Smithfield in Rhode Island.

Daily snowfall records were set for January 27 in Boston (22.1 inches, previous record 8.8 inches in 2011) and Worcester (31.9 inches, previous record 11.0 in 2011). In Worcester, the snowfall total of 34.5 inches was the greatest on record (dating back to 1892), breaking the previous record of 33.0 inches on March 31 to April 1, 1997. In Boston, the total of 24.6 inches was the sixth highest on record (dating back to 1872).

The Blizzard of January 2015 produced very strong winds late Monday into Tuesday near the Massachusetts and Rhode Island coasts where gusts of 50 to 65 mph were common. Gusts reached hurricane force at a few locations in Massachusetts including Nantucket (78 mph), Chatham (75 mph), Humarock (74 mph), and Aquinnah (74 mph).

The governor of Massachusetts declared a travel ban that began on January 27th at midnight and was lifted county-by-county as conditions allowed. Power outages were few (limited mainly to Cape Cod and the Islands) but had a high impact as all power was out on the island of Nantucket. Logan International Airport was closed through 6 am January 28th. A total of 116 cities and towns declared local states of emergency during this storm, activating their Emergency Operations Centers. Most Amtrak, ferry, train, and bus service was suspended for January 27th, prior to the storm. Over 40 shelters opened, serving a total of 450 individuals. Two fatalities were reported as a result of this storm: a 97-year-old man who died while trying to clear a carbon dioxide vent at his home in Yarmouth and a 53-year-old man in New Bedford who died while snow blowing his neighbor's driveway. President Obama issued a federal disaster declaration for the eastern parts of Massachusetts for this storm, allowing federal assistance for emergency work and repairs to facilities damaged by the storm.

Probability of Future Events

Based on the record of previous occurrences, heavy snow events are likely to occur approximately 3-4 times per year in Worcester County, on average. Blizzards occur much less frequently.

4.4.2 Ice Storms

Rain that falls and freezes on contact with cold surfaces is called freezing rain, while sleet is precipitation that freezes in the air before hitting the ground in the form of ice pellets. Heavy accumulations of ice can bring down trees or tree branches that may damage utility wires, causing power and communications outages, which may take days to repair. Even slight accumulations of ice result in slippery conditions for motorists and pedestrians. The National Weather Service will issue an Ice Storm Warning for a quarter-inch or more of ice accumulation. For ice accumulation of less than one quarter-inch, a Freezing Rain Advisory will be issued.

Location

Ice storms can occur throughout Massachusetts, including in Milford. They may be more likely to impact areas at higher elevations.

Extent

The severity of ice storms may best be measured by the level of ice accumulation and the subsequent duration of the frozen conditions. Heavy ice accumulation is more likely to result in damage to trees and utilities, requiring more time to recover from the storm. Weather patterns following the ice storm will impact the duration of frozen conditions. Warming temperatures following the storm will reduce the overall impact and allow repair of damages to occur more quickly, while below-freezing temperatures that persist will lengthen the overall duration, resulting in more time needed to repair utilities and restore safe driving and walking conditions.

The Sperry–Piltz Ice Accumulation Index, or SPIA Index™, is an ice accumulation and ice damage prediction index that uses an algorithm of researched parameters that, when combined with National Weather Service forecast data, predicts the projected footprint, total ice accumulation, and resulting potential damage from approaching ice storms.Figure 26 below provides the ice damage index with damages and impacts increasing in severity based on a scale from 0 to 5.

ICE DAMAGE INDEX	DAMAGE AND IMPACT DESCRIPTIONS
0	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
2	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
3	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 – 5 days.
4	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 – 10 days.
5	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.

Figure 26. SPIA Index
(Image ref. http://www.spia-index.com/index.php)

The following link provides the current 24-hour forecast window for the northeastern United States free of charge: http://www.spia-index.com/neIce.php.

Previous Occurrences

Five ice storms are recorded in the NOAA Storm Events Database for Worcester County between 1998 and 2008. In November 2002, a major ice storm caused significant damage from the Connecticut River Valley into Worcester County and the Merrimack Valley. There were numerous reports of downed trees, limbs, and power lines as a result of one-half inch of icing. An estimated 18,000 customers were left without power because of the storm, some for as much as four days. In December 2008, over one-half inch of ice accumulated on exposed surfaces and resulted in 300,000 customers without power in Massachusetts. Due to the widespread nature of the storm, it took up to two weeks to restore power to all customers. A Presidential Major Disaster Declaration was issued for seven Massachusetts counties (including Worcester County) as a result of the storm (NOAA Storm Events Database) resulting in close to $52 Million in FEMA Public Assistance Grants (https://www.fema.gov/disaster/1813) .

Probability of Future Events

Severe winter weather is likely to occur every year in Massachusetts. The probability of future ice storms in Milford is high, although a severe ice storm may not occur every year.

4.4.3 Extreme Cold

Extreme cold events are when temperatures drop well below normal for the given area and time of year. The following warnings and advisories are issued by the National Weather Service in Boston regarding extreme cold:

- Freezing Warning – When minimum shelter temperature drops to 32°F or lower during the growing season.
- Frost Advisory – Issued under clear, light wind conditions with forecast minimum shelter temperature at 33-36°F during the growing season.
- Wind Chill Warning – Wind chill index is -25°F or lower for at least three hours using only sustained wind.
- Wind Chill Advisory - Wind chill index is between -15°F and -24°F for at least three hours using only sustained wind.

Extreme cold can be hazardous to people without adequate shelter and/or heat. Heating sources can be impacted by power failures due to winter storms. Infants and the elderly are more at risk of serious or life-threatening health problems from extreme cold. Secondary hazards may include risk of fires or carbon monoxide poisoning from space heaters, generators, inadequately cleaned or vented fireplaces, or use of candles.

Extreme cold can result in icy roads and walkways that aren't easily de-iced by typical de-icing treatments. Extended cold temperatures can result in freezing of saltwater coastal bays and harbors, interfering with transportation of goods and people, fishing and other industries reliant on access to these waters.

According to the Local Working Group, water main breaks are infrequent. As of the preparation of the 2010 Plan, the Town repaired the two primary areas where water main breaks regularly occurred. Water main breaks may be caused due to the expansion of water in frozen pipes and occur most frequently in mid-winter. Any damage sustained from water main breaks is minimal and it is not seen as a significant problem to the Town.

Location

Extreme cold can occur throughout Massachusetts, including in Milford.

Extent

The National Weather Service Wind Chill Chart (Figure 27) indicates the amount of time in which frostbite may occur on exposed skin based on temperature and wind speed. The National Weather Service maintains a Wind Chill Calculator, which calculated wind chill based on temperature and wind speed, at http://www.wpc.ncep.noaa.gov/html/windchill.shtml.

Previous Occurrences

There were 53 extreme cold deaths in 2015, up from 43 in 2014. This number is well above the 10-year average of 32 cold-related deaths. For the 8th consecutive year, Illinois retained the dubious distinction of having the most cold-related deaths, 12, followed by Tennessee, 9; and Pennsylvania and Kentucky, 8. There were no cold related deaths reported in Massachusetts. The most extreme cold deaths in 2015 occurred outside totaling 35 (66%). The hardest hit age ranges in 2014 were 80-89, which accounted for 13 deaths (25%) and 60-69, which accounted for 8 (15%). More men, 34 (64%), were victims than women, 19 (36%) (NOAA 2015 Cold Related Fatalities). Reported cold-related fatalities between 1988 and 2015 total 830, nationally (NOAA 76-Year List of Severe Weather Fatalities http://www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf).

Wind Chill Chart

Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Figure 27. National Weather Service Wind Chill Chart

The lowest temperature recorded in Massachusetts was -35°F on January 5, 1904 in Taunton, February 15, 1943 in Coldbrook, and January 12, 1981 in Chester, according to NOAA (https://www.ncdc.noaa.gov/extremes/scec/records).

The following are some of the lowest temperatures recorded in Massachusetts for the period from 1895 to present (Source: NOAA, www.ncdc.noaa.gov.):

• Blue Hills, MA –21°F

• Boston, MA –12°F

• Worcester, MA –19°F

Probability of Future Events

Although the exact probability of future extreme cold events is not defined, it is likely that Massachusetts will experience such events in the future.

4.5 FIRE

Fire hazards are categorized as both urban fires and wildfires for the purposes of this plan update, as described in the following sections.

4.5.1 Urban Fire

Urban fires are fires within developed areas that impact structures or vehicles. Although fires can start from numerous causes, major fires are often the result of other hazards, such as storms, earthquakes, gas leaks, transportation accidents, hazardous material spills, criminal activity (arson), or terrorism. Small structural fires, which occur more frequently, can result from mundane events such as cooking, smoking, equipment/appliance malfunctions, etc. (2013 State Plan).

Location

Urban fires may occur in any developed areas within Milford, including the compact downtown areas as well as the residential, suburban fringes of the Town. Fires can spread more quickly in densely developed areas, particularly where there is a large concentration of wood frame construction. Abandoned or vacant buildings are susceptible to fires set accidentally or intentionally.

Extent

The extent of fires can be somewhat difficult to describe as there is not a universally accepted scale. The extent of fires may be described by size of the fire, extent of damages or casualties, or by the amount of time or types of resources required to extinguish the fire (usually expressed in number of ‘alarms’). Documentation of environmental conditions (topography and landscape, drought, wind, extreme temperatures) may also help to describe the extent.

According to the National Fire Protection Association (NFPA), in 2015, there were 1,345,500 fires reported in the United States. These fires caused 3,280 civilian deaths, 15,700 civilian injuries, and $14.3 billion in property damage.

- 501,500 were structure fires, causing 2,685 civilian deaths, 13,000 civilian injuries, and $10.3 billion in property damage.
- 204,500 were vehicle fires, causing 500 civilian fire deaths, 1,875 civilian fire injuries, and $1.8 billion in property damage.
- 639,500 were outside and other fires, causing 95 civilian fire deaths, 825 civilian fire injuries, and $252 million in property damage. (NFPA, http://www.nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/fires-in-the-us, 8/28/17)

The 2011-2015 annual average number of fire deaths in Massachusetts was 36 (NFPA, 2017). In 2016, there were 31,889 fires in Massachusetts, resulting in 56 civilian deaths, 295 civilian injuries, and $258.6 million in property damage (MA Department of Fire Services, Division of Fire Safety). In Worcester County, there were 2,208 structure fires and 374 vehicle fires in 2015 (Ostroskey, 2015). The fire statistics for Milford are listed in the following table, based on the most recent County Profiles compiled by the Massachusetts Fire Incident Reporting System (MFIRS).

Table 6. Milford Fire Statistics (MFIRS)

	Total Fires	Structure Fires	Vehicle Fires	Other Fires	Total Arsons	Structure Arsons	Vehicle Arsons	Other Arsons
2011	81	53	3	25	9	3	0	6
2012	112	49	13	20	3	2	0	1
2013	147	48	12	87	2	1	0	1
2014	104	50	11	43	1	1	0	0
2015	99	36	11	52	1	1	0	0

Previous Occurrences

Of the 25 largest fire losses in the United States, according to the NFPA, two occurred in Massachusetts, including the Great Boston Fire of 1872, and a textile mill fire in Methuen in 1995. The total losses, adjusted to 2015 dollars, were $1.5 billion and $777 million, respectively (NFPA, Largest Fire Losses in the United States, www.nfpa.org, 8/28/17).

In Milford, there were 36 structure fires, 11 vehicle fires, and 52 other fires reported to the Massachusetts Fire Incident Reporting System (MFIRS) for 2015 (Ostroskey, 2015).

Probability of Future Events

Although a specific probability for future urban fires is difficult to define, it is reasonable to assume that the risk and occurrences of urban fire will continue in Milford, based on data regarding past occurrences.

4.5.2 Wildfire

A wildfire is a non-structure/vehicle fire that occurs in undeveloped, wildland vegetated areas, including grass, brush/shrub, and forested areas. Wildfires occur when natural vegetation is ignited naturally, such as by lightning, or by human activity. Sometimes, wildfires are set intentionally for management of vegetation or to limit accidental fire risk. Wildfires may be unnoticed at first. Unnoticed fires often can spread to the urban-wildland interface and threaten developed areas.

Location

The Local Working Group identified the following brush fire hazard areas. The numbers correspond to the numbers on Figure 19 – Hazard Areas. The numbers do not reflect priority order. The areas shrink in size as surrounding development limits the area available for brush fires.

10) Cedar Street Area (Fire)

The area around Cedar Street sustains multiple brush fires every year. Most of these fires are small, but some are larger. There is a potential for severe fires, especially during dry summers and fall months.

11) Town Forest and Shadow Brook (Fire)

The Town Forest and Shadow Brook sustain multiple brush fires every year. This is a high pedestrian/recreational use area which results in frequent brush fires. Most of fires are small, but some are larger. There is a potential for severe fires, especially during dry summers and fall months.

12) I-495 Corridor (Fire)

The Fire Department frequently responds to small brush fires caused by discarded cigarettes along Interstate 495. Typically, these fires cause little to no damage as they are small and far from existing property.

13) Bear Hill (Fire)

Bear Hills sustains multiple brush fires every year. Most of these fires are small, but some are larger. There is a potential for severe fires, especially during dry summers and fall months.

Extent

Fuels, topography, and weather are three primary factors which influence wildfire behavior.

There were 9,100 brush, trash, and other outside fires in Massachusetts in 2014. Of those fires, 4,627 fires were trees, grass, and brush fires (Ostroskey, 2014).

Table 6 above lists the number of “other” fires which have occurred in Milford between 2011 and 2015. In Milford, in 2015, there were 52 “other” fires, which includes brush fires and outside fires (Ostroskey, 2015). The majority of these fires occurred near I-495 by discarded cigarettes and in areas of public open space. There have been no reports of significant property damage or deaths related to brush fires. Apparatus listed on the Milford Fire Department’s website indicates that the Town has all-terrain vehicles capable of fighting remote brush fires located off existing roadways.

Previous Occurrences

The most recent wildfire in Massachusetts occurred on July 22, 2016 on Joint Base Cape Cod in Barnstable County, according to the NOAA Storm Events Database. The fire was started by lightning and was contained to 125 acres after 36 hours. The NOAA Storm Events database lists one wildfire as having occurred in Worcester County, in April 2012. The fire, resulting from dry and windy conditions, burned about one acre of meadowlands in Dedham.

Probability of Future Events

The number of brush fires each year is variable and usually increases during years of dry spring and summer (Ostroskey, 2014). According to the USDA USFS 2014 wildfire hazard potential (WHP) map, the potential for wildfires in Milford is low to very low. The WHP map can help to inform evaluations of wildfire risk or prioritization of fuels management needs across very large landscapes (millions of acres). The WHP map depicts the relative potential for wildfire that would be difficult for suppression resources to contain. Areas mapped with higher WHP values represent fuels with a higher probability of experiencing torching, crowning, and other forms of extreme fire behavior under conducive weather conditions, based primarily on 2010 landscape conditions (https://www.firelab.org/project/wildfire-hazard-potential).

4.6 GEOLOGIC HAZARDS

Geologic hazards include earthquakes and landslides, as described below.

4.6.1 Earthquake

An earthquake is ground movement or shaking that occurs because of two pieces of the earth's crust slipping past each other along a fault. Often, an earthquake can have aftershocks, which are additional, smaller earthquakes that occur after the primary earthquake. Earthquakes are a hazard with multiple impacts beyond the obvious building collapse. Buildings may suffer structural damage which may or may not be readily apparent. Earthquakes can cause major damage to roadways and bridges, 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 non-structural 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.

Location

The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth. The focal depth of an earthquake is the depth from the surface to the region where the earthquake's energy originates (the focus). The epicenter of an earthquake is the point on the Earth's surface directly above the focus (2013 State Plan).

In New England, earthquake epicenters do not typically follow the major mapped faults of the region. Because earthquakes have been detected all over New England, seismologists suspect that a strong earthquake could be centered anywhere in the region. (2013 State Plan). The Weston Observatory at Boston College has mapped significant earthquakes (magnitude 5 or greater) that have occurred around New England, as shown in Figure 28 (with the approximate location of the Town depicted with a star).

Extent

Seismic waves are the vibrations from earthquakes that travel through the Earth and are recorded on instruments called seismographs. The magnitude or extent of an earthquake is a seismograph-measured value of the amplitude of the seismic waves. The moment magnitude scale gives the most reliable estimate of earthquake size, measured at the source of the

earthquake. Moment is a physical quantity proportional to the slip on the fault times the area of the fault surface that slips and is related to the total energy released in the earthquake. The moment can be estimated from seismograms and from geodetic measurements. The moment is then converted into the moment magnitude by a standard formula. The moment magnitude provides an estimate of earthquake size that is valid over the complete range of magnitudes (https://www.usgs.gov/faqs/moment-magnitude-richter-scale-what-are-different-magnitude-scales-and-why-are-there-so-many).

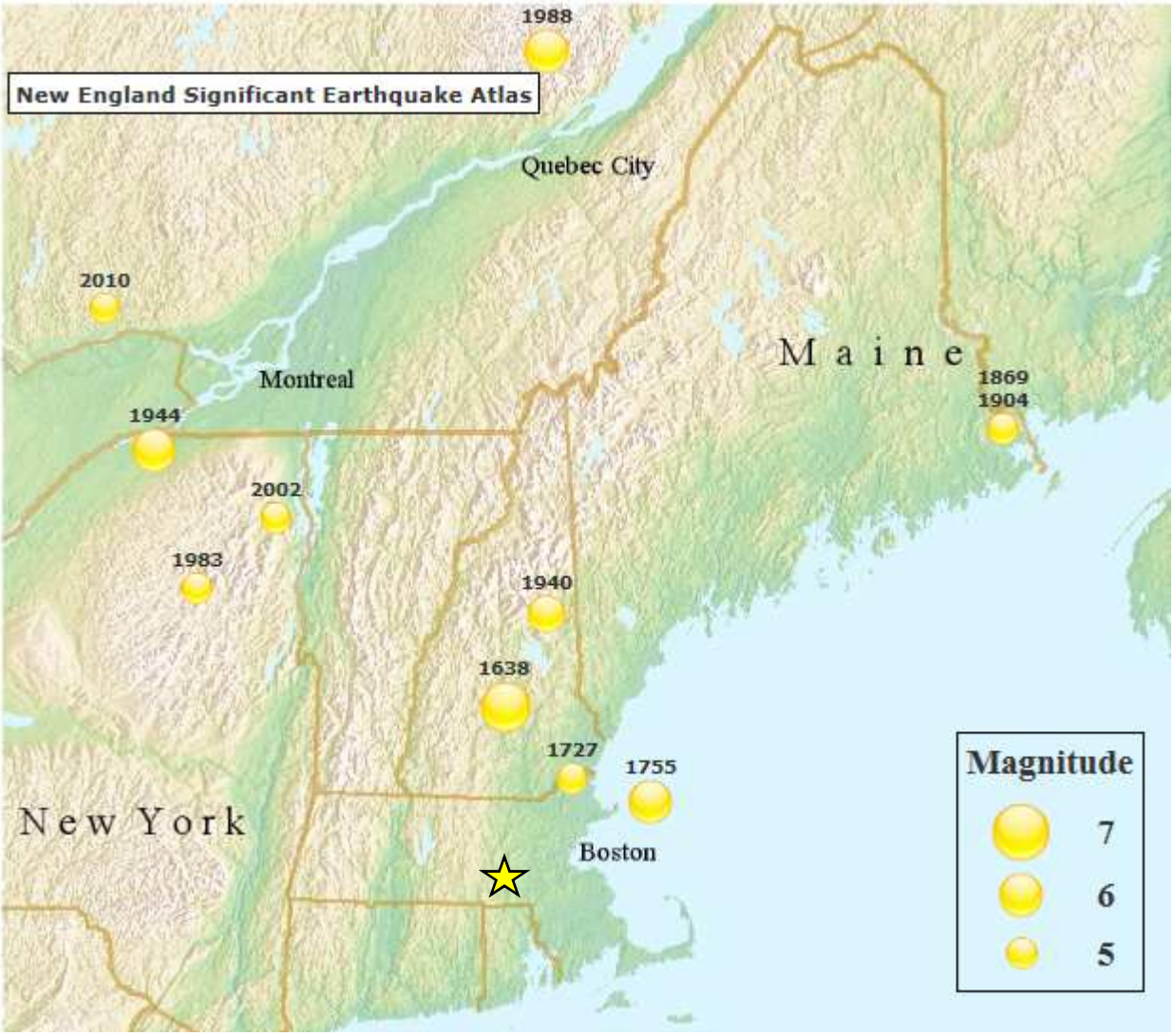


Figure 28. Significant Earthquakes in New England
(Weston Observatory, Boston College, http://aki.bc.edu/quakes_historical.htm)

The intensity of an earthquake is based on the observed effects of ground shaking on people, buildings, and natural features, and varies with location. Intensity is expressed by the Modified Mercalli Scale; a subjective measure that describes how strongly an earthquake was felt at a particular location. The Modified Mercalli Scale expresses the intensity of an earthquake's effects in a given locality in values ranging from I to XII (2013 State Plan).

Seismic hazards are often expressed in terms of Peak Ground Acceleration (PGA) and Spectral Acceleration (SA). USGS defines PGA and SA as the following: 'PGA is what is experienced by a particle on the ground. Spectral Acceleration (SA) is approximately what is experienced by a building, as modeled by a particle mass on a massless vertical rod having the same natural period of vibration as the building'. Both PGA and SA can be measured in g (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). PGA and SA hazard maps provide insight into location specific vulnerabilities. More specifically, a PGA earthquake measurement shows three things: 1) the geographic area affected, 2) the probability of an earthquake of each given level of severity, and 3) the strength of ground movement (severity) expressed in terms of percent of acceleration force of gravity (%g). In other words, PGA expresses the severity of an earthquake and is a measure of how hard the earth shakes (or accelerates) in a given geographic area (2013 State Plan).

Previous Occurrences

According to the USGS Earthquake Catalog data search, there have been 20 earthquakes of magnitude 2.5 or greater which have occurred in Massachusetts or off the coast since 1974. The largest was a magnitude 3.7 which occurred near the Quabbin Reservoir in 1994. There was one aftershock of magnitude 3.3 associated with this earthquake (https://earthquake.usgs.gov/earthquakes/search/, 8/27/17).

One of the largest earthquakes in Massachusetts history was a magnitude between 6.0 and 6.3 which occurred in 1755 off the coast of Cape Ann. It damaged hundreds of buildings in Boston and was felt as far north as Nova Scotia and as far south as South Carolina (Wikipedia, 1755 Cape Ann earthquake, https://en.wikipedia.org/wiki/1755_Cape_Ann_earthquake, 8/27/17).

In 2002, Milford sustained a magnitude 2.5 earthquake. The epicenter was located at Little Field Pond (2010 Milford HMP).

The most recent earthquake in the northeast occurred in Maine, on 8/18/2017, as recorded by the Weston Observatory at Boston College.

Probability of Future Events

Figure 29 shows the PGA values (6 percent to 16 percent of g) for the Commonwealth that have a 2-percent chance of being exceeded in 50 years. If it were to occur, this earthquake would likely have moderate to strong perceived shaking and very light to light potential damage (2013 State Plan).

4.6.2 Landslide

A landslide is movement of earth down a slope, and includes rock falls and shallow debris flows. Landslides may be caused by gravity acting on an over steepened slope, or saturation by water, which is a primary cause of landslides in Massachusetts (State Plan, 2013). Landslides can result from human activities that destabilize a slope, including construction activities, or can occur as a secondary impact from another natural hazard such as wildfires, heavy rains, flooding, or earthquakes.

Impacts from landslides can result in structural damage to buildings, the blockage of transportation corridors, and sedimentation of water bodies.

Location

According to the 2013 State Hazard Mitigation Plan, the greatest risk for landslides in Massachusetts is along the Connecticut River valley and in the greater Boston area. The Massachusetts Geological Survey at University of Massachusetts Amherst has developed the "Slope Stability Map of Massachusetts" which presents predicted stability

zones throughout the Commonwealth. Figure 30, below, presents an excerpt from the map showing predicted slope stability within the Town of Milford. The relative slide ranking designates the relative hazard ranking for the initiation of shallow slides on unmodified slopes. Based on this map, the relative slide ranking in Milford is predominantly low to very low. There are some areas in the vicinity of the I-495 corridor that have a moderate relative slide ranking.

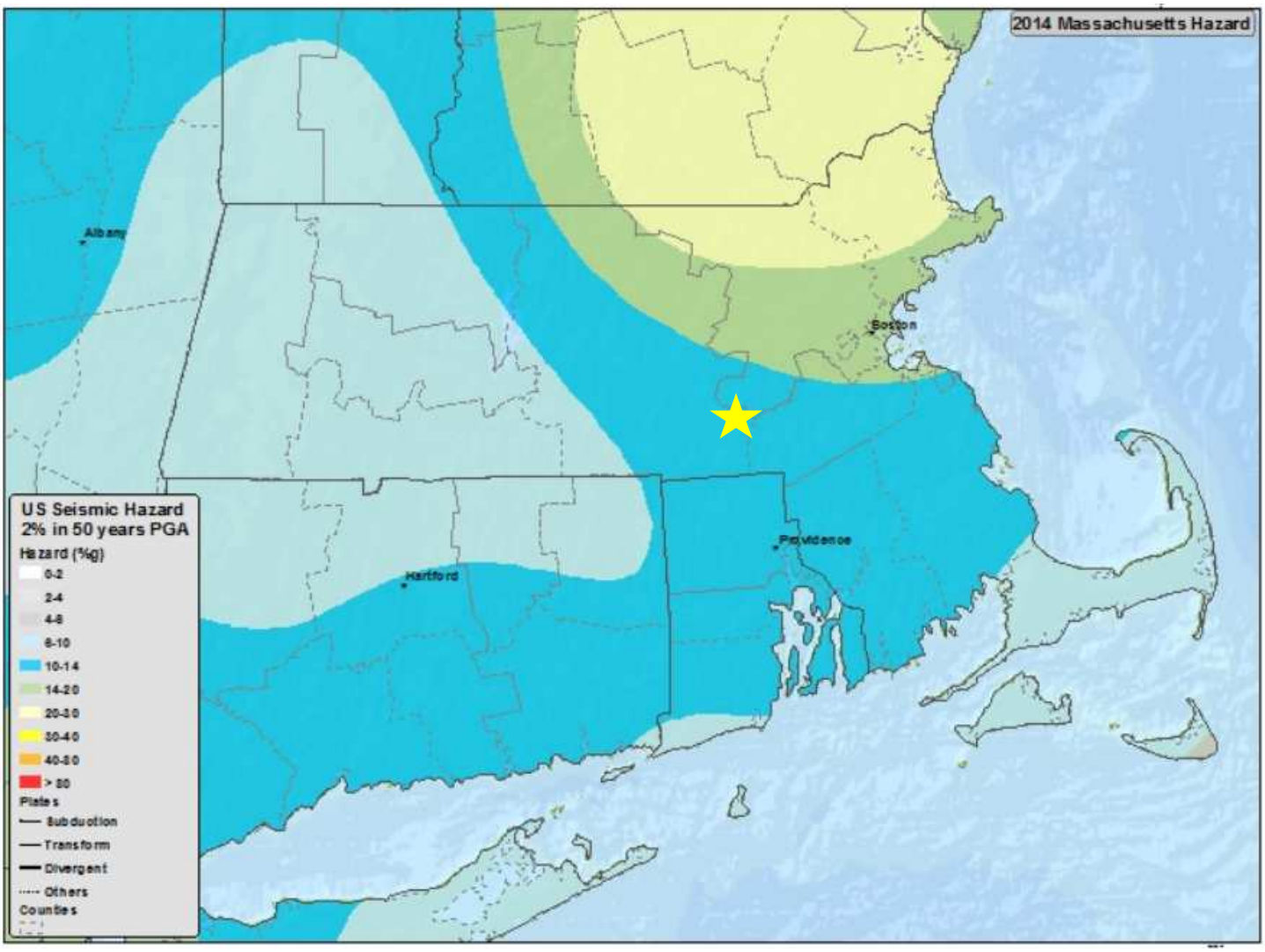
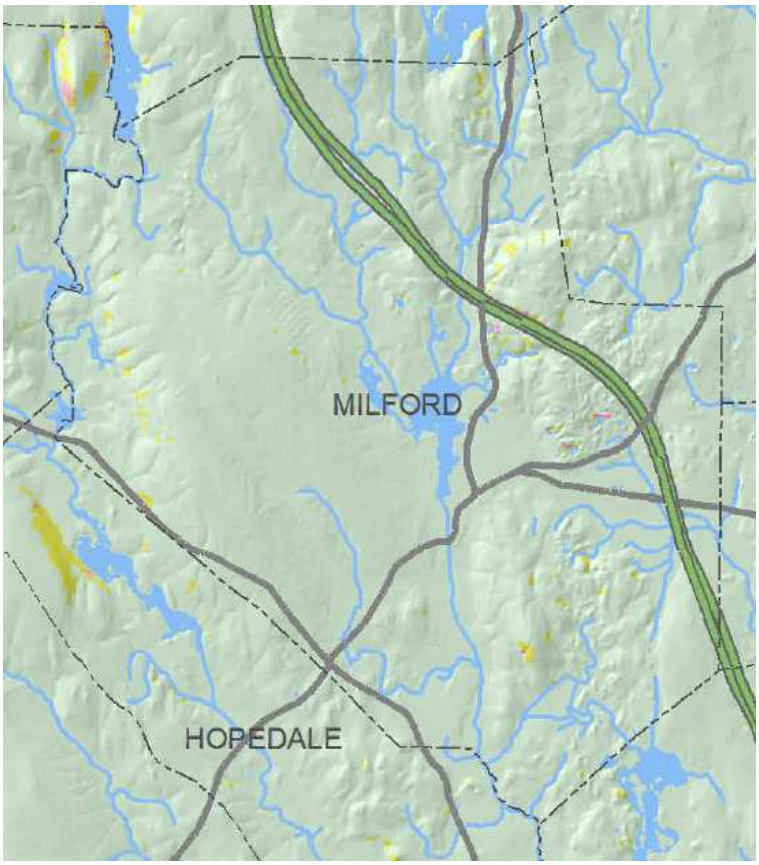


Figure 29. USGS 2014 Seismic Hazard Map

Extent

Landslide hazard is often represented by landslide incidence and/or susceptibility, defined below:

- Landslide incidence is the number of landslides that have occurred in a given geographic area. High incidence landslides result in impacts to greater than 15-percent of a given area; medium incidence results in impacts to 1.5 to 15-percent of an area; and low incidence results in impacts to less than 1.5-percent of an area (State Plan, 2013).



Map Color Code	Predicted Stability Zone	Relative Slide Ranking[1]
	Unstable	High
	Upper Threshold of Instability	
	Lower Threshold of Instability	Moderate
	Nominally Stable	Low
	Moderately Stable	
	Stable	Very Low

Figure 30. Excerpt from Slope Stability Map of Massachusetts: Sheet 2-Northeastern Massachusetts
(MA Geological Survey, UMass Amherst, 2013)

Previous Occurrences

The 2013 State Plan does not include any recorded instances of landslides in Milford. Even though landslides may not be highly likely in Milford, the following listing of previous landslide occurrences in Massachusetts since 2010 provide an overview of what damages may result according to the State Plan:

- On March 14, 2010, widespread rainfall across portions of Massachusetts totaled between three and six inches. This resulted in major flooding across eastern Massachusetts. A state of emergency was declared which led to a FEMA disaster declaration (DR-1985). In Essex County, heavy rain resulted in the rapid erosion of a hill slope in Topsfield. This resulted in a mudslide across Route 1, which closed the road in both directions between Salem Road and the Danvers town line.

- On March 7, 2011, heavy rains fell across coastal and interior New England. The heavy rain, combined with melting snow, resulted in flooding of tributaries and major rivers. In Franklin County, in the Town of Greenfield, a water-soaked ridge near the Green River Cemetery gave way, resulting in a mudslide 13 inches deep that slid over Meridian and Water Streets. Three cars were buried, and the mud was up the foundations of three homes. This resulted in the evacuation of 17 people and approximately $100,000 in property damage.

- In August 2011, Hurricane Irene caused damage throughout portions of the Commonwealth, including a 5.8-mile section of Route 2 that was closed from West Charlemont to South County Road in Florida due to erosion and undercutting of the roadway, damage to retaining walls, debris flows, landslides, and bridge damage. Estimated cost of temporary repairs was $23.5 million.

- In October 2011, additional slides also occurred in Deerfield after the October 31, 2011 snowstorm causing clogging of culverts under the railroad and Routes 5 and 10 leading to siltation of a wetland and subsequent flooding of nearby homes.

Probability of Future Events

According to the State Plan, there may be one to three landslide events which occur in Massachusetts each year. Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods, or wildfires, so landslide frequency is often related to the frequency of these other hazards.

As indicated by Figure 30, above, Milford is classified as having a low risk for landslides. There are not many steep slopes in the Town and the Local Working Group concurs that landslides are not a major threat or occurrence in Milford. Rather, there may be localized issues of erosion during construction, as a result of development, or as a result of clearing vegetation.

4.7 CLIMATE CHANGE IMPACTS

Climate change is a long-term change in the Earth's climate and encompasses increases in ambient temperature, sea level rise, and shifting seasonal and weather patterns. Climate change is not a hazard in and of itself, but it can impact the severity, duration, frequency, and probability of occurrence of other natural hazards.

According to the Massachusetts Climate Change Adaptation Report, "By the end of the century, under the high emissions scenario of the Intergovernmental Panel on Climate Change (IPCC), Massachusetts is set to experience a 3° to 5°C (5° to 10°F) increase in average ambient temperature, with several more days of extreme heat during the summer months. Days with temperatures greater than 32°C (90°F) are predicted to increase from 5 to 20 days annually that Massachusetts experiences today to between 30 to 60 days annually; while up to 28 days annually are predicted to reach above 38°C (100°F), compared to up to two days annually today (Frumhoff et al., 2006, 2007). Sea surface temperatures are also predicted to increase by 4°C (8°F) (Dutil and Brander, 2003; Frumhoff et al., 2007; Nixon et al., 2004), while winter precipitation—mostly in the form of rain—is expected to increase by 12 to 30 percent. The number of snow events is predicted to decrease from five each month to one to three each month (Hayhoe et al., 2006)" (EOEEA, September 2011).

Of the hazards discussed in this section, climate change is expected to impact flood hazards, severe weather, and fire most significantly. Winter precipitation is expected to increase by 20-30 percent, and could occur more as rain than as snow. Heavy rainfall is likely to occur more frequently and more intensely, and likely to result in more frequent and more severe floods. Precipitation patterns may shift to prolonged wet and dry periods, leading to increased frequency of short-term droughts (Union of Concerned Scientists 2017). Brush and other outside fires may be more likely to occur in waves that crest every two to three years mostly due to the dry and hot weather patterns in the spring and summer that allow for an increased vulnerability of vegetation to brush fires (Ostroskey, 2014).

Climate change will likely result in human health impacts from more frequent and severe extreme heat events, and adverse impacts to air quality (Union of Concerned Scientists 2017).

4.8 RISK ASSESSMENT

4.8.1 Introduction

A risk assessment was conducted to determine the potential impacts of natural hazards to the people, economy, and built and natural environments of the Town of Milford. The risk assessment informs the mitigation planning process, which identifies and prioritizes actions that can help reduce risk of impacts from hazards. The risk assessment was performed based on guidance provided by the FEMA Local Mitigation Planning Handbook, and involved collaboration of the Local Working Group during meetings held on December 15, 2016, April 5, 2017, and June 14, 2017.

The risk assessment process requires a description of the hazards, identification of community assets, analysis of risk, and summary of vulnerability. Hazards are described in this plan in Sections 4.1 through 4.7, and community assets are identified in Section 3.

The Local Working Group utilized three methods to analyze risk, including Exposure Analysis, Historical Analysis, and Scenario Analysis. These methods and the results of each analysis method are described in more detail in the following sections.

4.8.2 Exposure Analysis

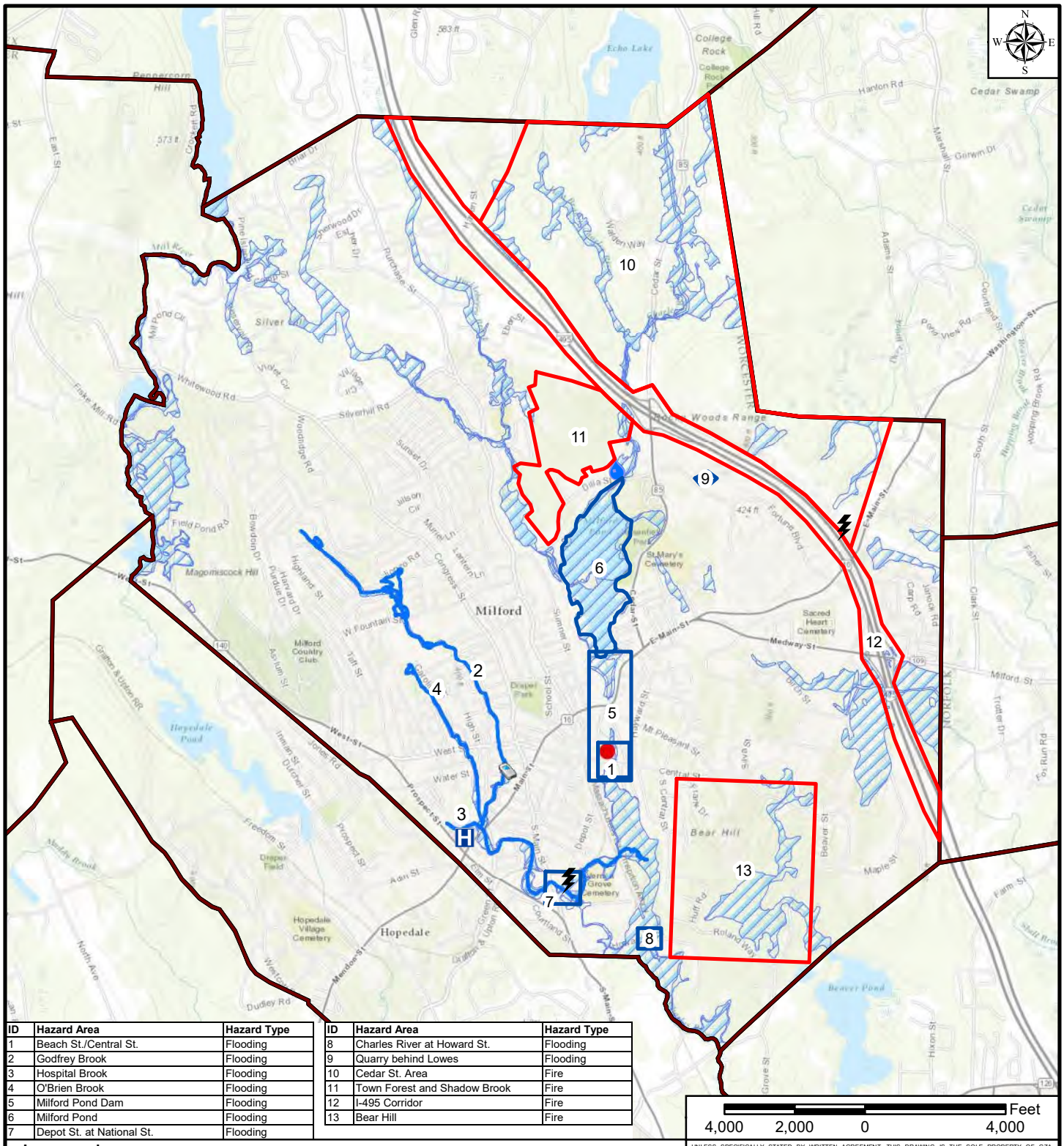
Exposure Analysis identifies community assets which are located within specified hazard areas. This analysis was performed by overlaying mapping of Milford community assets with hazard areas that were identified by the Local Working Group. In the case of Milford, the mapped hazard areas were limited to flood and wildfire areas, as described in Sections 4.2.2 and 4.5.2, respectively. Figure 31 - Risk Assessment, presents the identified hazard areas overlain onto the community assets. Only those community assets located within hazard areas are shown on the figure. Based on this analysis, the community assets which may be impacted by flooding include:

- Milford Highway Department,
- Verizon building,
- Milford Regional Medical Center,
- Electrical Substation, and
- Milford Water Company.

There is also one electrical substation located within a wildfire hazard area.

4.8.3 Historical Analysis

Historical analysis uses information on impacts and losses from previous hazard events to predict potential impacts and losses during a similar future event. For the purposes of this plan update, the Historical Analysis involved a review of previous Federal Presidential Disaster Declarations in Massachusetts and in Worcester County, and Repetitive Loss Properties within the Town of Milford.



ID	Hazard Area	Hazard Type
1	Beach St./Central St.	Flooding
2	Godfrey Brook	Flooding
3	Hospital Brook	Flooding
4	O'Brien Brook	Flooding
5	Milford Pond Dam	Flooding
6	Milford Pond	Flooding
7	Depot St. at National St.	Flooding

ID	Hazard Area	Hazard Type
8	Charles River at Howard St.	Flooding
9	Quarry behind Lowes	Flooding
10	Cedar St. Area	Fire
11	Town Forest and Shadow Brook	Fire
12	I-495 Corridor	Fire
13	Bear Hill	Fire

Feet
4,000 2,000 0 4,000

Legend

- Hazard Areas - Fire
- Hazard Areas - Flooding
- Town Boundaries
- Brooks with Hazard Areas
- FEMA Flood Zones
- Substations in Hazard Areas
- Milford Regional Medical Center
- Milford Water Company
- Verizon
- Highway Department

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Multi-Hazard Mitigation Plan

Risk Assessment

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MILFORD
MASSACHUSETTS

SOURCES: BASEMAP FROM ESRI, REMAINING DATA FROM MASSGIS (2016) AND TOWN OF MILFORD.

DATE:	PROJECT NO.	DRAWN BY:	CHECKED BY:
September 2017	15.0166551.00	JRB	TEJ

FIGURE
31

Presidential Disaster Declarations

Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. §§ 5121-5207 (the Stafford Act), a Governor of a State affected by an emergency or a disaster can submit a request for a declaration by the President of the United States that a major disaster exists. The President can declare a major disaster for any natural event, including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought, or, regardless of cause, fire, flood, or explosion, that the President determines has caused damage of such severity that it is beyond the combined capabilities of state and local governments to respond. A major disaster declaration provides a wide range of federal assistance programs for individuals and public infrastructure, including funds for both emergency and permanent work (FEMA, "The Disaster Declaration Process", https://www.fema.gov/disaster-declaration-process).

A list of historical disaster declarations is available online from FEMA. The following table (Table 7) presents disaster declarations which have been made since 2005 in Massachusetts. Those table entries listed in bold also occurred in Worcester County. These lists of disaster declarations are current as of August 2, 2017. As can be observed from the list of previous disaster declarations, the most common disaster type in Worcester County is winter storms with flooding.

Table 7. Major Disaster Declarations in Massachusetts 2005-2017

Disaster*	Declaration Date
Severe Winter Storm, Snowstorm & Flooding (DR-4214)	**April 13, 2015**
Severe Winter Storm, Snowstorm & Flooding (DR-4110)	**April 19, 2013**
Hurricane Sandy (DR-4097)	December 19, 2012
Severe Storm & Snowstorm (DR-4051)	**January 6, 2012**
Tropical Storm Irene (DR-4028)	September 3, 2011
Severe Storms & Tornadoes (DR-1994)	**June 15, 2011**
Severe Winter Storm & Snowstorm (DR-1959)	March 7, 2011
Severe Storm & Flooding (DR-1895)	**March 29, 2010**
Severe Winter Storm & Flooding (DR-1813)	**January 5, 2009**
Severe Storms & Inland Coastal Flooding (DR-1701)	May 16, 2007
Severe Storms & Flooding (DR-1642)	May 25, 2006
Severe Storms & Flooding (DR-1614)	November 10, 2005

*Table entries listed in **bold** are Disaster Declarations that were applicable in Worcester County.

National Flood Insurance Program (NFIP) Participation

The Town of Milford has been a participating member of the National Flood Insurance Program (NFIP) since 07/05/1984. Since the 2010 Plan Update, the Town adopted the revised Flood Insurance Rate Maps (FIRM) that identifies the revised special flood hazard areas (SFHA) for the Town that became effective on July 4, 2011. The Town uses these revised FIRMS as the regulatory standard for floodplain management activities as per 44 Code of Federal Regulations (CFR) Part 60.3. This is one example that highlights the Town's active and continued compliance with NFIP requirements since 2010. As a part of this plan update, the Town will continue to maintain compliance with NFIP requirements as outlined in 44 Code of Federal Regulations Part 60.1 – 60.3 through active coordination with the Massachusetts Emergency Management Agency (MEMA) and monitoring of updates that may potentially affect changes to the management of the Town's floodplain.

Repetitive Loss Properties

Most recently the Town According to the FEMA Flood Insurance Manual, Effective April 1, 2017, a Repetitive Loss Structure is defined as a National Flood Insurance Program (NFIP)-insured structure that has had at least 2 paid flood losses of more than $1,000 each in any 10-year period since 1978, and a Severe Repetitive Loss Building is any building that:

1. Is covered under a Standard Flood Insurance Policy made available under this title;

2. Has incurred flood damage for which:

    a. 4 or more separate claim payments have been made under a Standard Flood Insurance Policy issued pursuant to this title, with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or

    b. At least 2 separate claims payments have been made under a Standard Flood Insurance Policy, with the cumulative amount of such claim payments exceed the fair market value of the insured building on the day before each loss.

As of 10/31/2016, there is one Repetitive Loss Property (RLP) and zero Severe Repetitive Loss Properties (SRLP) within the Town of Milford, as provided by the Massachusetts NFIP Coordinator. The address of the RLP is protected under the Privacy Act of 1974, 5 U. S. C. section 552(a); however, it may be noted that flooding of this property is likely associated with Godfrey Brook. The RLP is residential.

Table 8 below provides an overview of NFIP information for the Town of Milford. FEMA maintains a database on these flood insurance policies and claims, which can be found at https://www.fema.gov/policy-claim-statistics-flood-insurance. Overall, as of the 2010 Plan, the number of flood insurance policies, as well as coverage and premiums, losses, and total payments have increased.

Table 8. Flood Insurance Policies and Claims in Milford

Item	2010 Plan (as of 1/31/07)	Plan Update (as of 4/30/17)
Flood insurance policies in force	27	36
Coverage amount of flood insurance policies	$ 5,848,100	$8,995,000
Premiums paid	$24,157	$47,562
Total losses (all losses submitted regardless of the status)	15	20
Closed losses (Losses that have been paid)	8	12
Open losses (Losses that have not been paid in full)	0	0
CWOP losses (Losses that have been closed without payment)	7	8
Total payments (Total amount paid on losses)	$29,991.33	$64,559.74

4.8.4 Scenario Analysis

Scenario analysis reviews specific hazard types and predicts the impacts of an event or particular type of an event. This level of analysis considers potential impacts to infrastructure, people, and economics, as well as likelihood or frequency of the event. For this plan, the Scenario Analysis included two parts: (1) Level 1 HAZUS analysis for earthquakes, hurricanes, and flooding, and (2) a Hazard Index Summary completed by the Local Working Group.

HAZUS Analysis

A Level 1 HAZUS analysis was performed using the HAZUS Flood, Hurricane and Earthquake modules. A Level 1 HAZUS analysis calculates basic estimates of earthquake, flood and hurricane wind losses based on national databases and expert-based analysis parameters included in the HAZUS software. The data used for this analysis included the HAZUS "default" data included in the HAZUS software and 2010 US Census Data. FEMA notes in the HAZUS-MH Flood Model User Manual that at the local level, a Level 1 analysis is most appropriate as an initial loss estimation study to determine where more detailed data collection and analysis are warranted. Therefore, this Level 1 Loss estimation using the FEMA HAZUS-software provides a planning level indication of the overall risk to property and business that may warrant additional analysis and evaluation. This analysis is not intended, or suitable, for establishing the flood, earthquake, or hurricane related risk of any specific parcel or property. The results of HAZUS can be overly conservative. Regardless, the results are useful for planning, in particular to demonstrate the potential future effects due flooding, hurricane-wind and seismic hazard events.

As noted by FEMA, potential loss estimated analyzed by HAZUS include:

- **Physical damage,** to residential and commercial buildings, schools, critical facilities, and infrastructure;
- **Economic loss**, including lost jobs, business interruptions, repair, and reconstruction costs;
- **Social impacts**, including estimates of shelter requirements, displaced households, and population exposed to scenario floods, earthquakes, and hurricanes (https://www.fema.gov/HAZUS)

There are 9,085 buildings in Milford, with a total building replacement value (excluding contents) of $3,761 million (2010 dollars). Table 9 presents the total building value in Milford. Approximately 89% of the buildings (representing about 67% of the total value) are residential. Table 10 provides an overview of the expected damage and loss categories that will be the focus of this scenario analysis based on the results generated from the Earthquake, Flood and Hurricane HAZUS module runs.

Table 9. Building Exposure and Occupancy Type in Milford

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,519,776	67%
Commercial	880,445	23%
Industrial	256,367	7%
Agricultural	5,082	<1%
Religion	35,777	1%
Government	31,372	1%
Education	32,198	1%
Total	**3,761,017**	**100%**

Table 10. Milford HAZUS Expected Damage and Loss Categories

Impacts
DIRECT DAMAGE
General Building Stock
Essential Facilities
DIRECT LOSSES
Shelter Needs
INDIRECT LOSSES
Economic Loss • Property Damage • Business Interruption

The HAZUS results are presented in the following sections by hazard type.

FLOOD SCENARIO RESULTS

The Town of Milford has experienced impacts from riverine flooding from the Charles River and tributaries including Godfrey Brook. The Town identified several areas that are particularly at risk of flooding during large flow events along these waterways.

The analysis used the default building stock from HAZUS as presented categorically in Table 10 above. Table 11 below shows the estimated damages and losses for the 100-year (1%), and 500-year (0.2%) flood events for: 1) buildings, 2) essential facilities, 3) displaced people and sheltering, and 4) Economic Losses from the 100-year and 500-year flood event.

Building Damages Summary

In Milford, six buildings would experience damages from a 100-year event with five buildings incurring moderate damages. Table 11 below shows the estimated damages for the 100-year and 500-year flood events for buildings, essential facilities, displaced people and sheltering that indicates that a slight increase in building damages occurs from the 100-year to the 500-year flood event. No buildings are expected to experience severe damages or destruction based on these results.

Essential Facilities Summary

The police and emergency operations facilities would maintain functionality up to the 500-year flooding event. The Fire station located at 21 Birch Street is expected to incur moderate damages during a 500-year event and would lose some degree of functionality. It is important to note that these results are somewhat inconclusive because the default HAZUS data did not include the Milford Regional Medical Center or the fire station located at 1 Spruce Street in the analysis. Additional analysis would need to be conducted to determine the potential for additional damages on these two assets.

Sheltering Requirements Summary

HAZUS calculated the number of households displaced and the number of people that may require shelter due to damages from flooding events. Based on the HAZUS results, 288 households would be displaced and 479 people would require shelter for the 100-year flooding event. Table 11 shows that this number increases for the 500-year flooding event. It is important to note that the number of people requiring shelter is greater than the number of displaced households for each event. This result is likely due to the types of buildings that will be impacted which are mostly commercial and

industrial buildings. If the flooding events were to occur during standard business operations, these building types would include larger numbers of people than residential structures resulting in the increased demand for short-term shelters.

Economic Losses Summary

The HAZUS results include economic loss calculations for the direct property damage and business disruption. Direct damages typically include the costs to repair structural damages to the building (e.g. foundation walls, anchorage systems, and staircases attached to the building) and replace building contents (e.g. portable and window air conditioners, personal belongings such as clothing, furniture, and electronic equipment). Business interruption costs are impacts tied to the inability of a business to function due to a hurricane event. Table 11 presents the economic losses for property damages to residential and all buildings as well as business interruption. These results indicate that commercial and industrial facilities will incur the largest economic losses during each flooding event.

Table 11. HAZUS Level 1 Damage Estimates from Riverine Flooding

	100-YR	**500-YR**
Building Damages (# of Buildings)		
# of Buildings with Minor Damage (1-10%)	1	1
# of Buildings with Moderate Damage (11-40%)	5	9
# of Buildings with Severe Damage (41-50%)	0	0
Destruction	0	0
TOTAL	6	10
Essential Facilities Building Damages (Lose of Use > 1 Day)	**100-Yr**	**500-Yr**
Emergency Operations Center	0	0
Fire	0	1
Hospitals	N/A	N/A
Police	0	0
Schools	0	0
TOTAL	**0**	**0**
Sheltering Requirements	**100-Yr**	**500-Yr**
Displaced Households (# Households)	288	381
Short-Term Shelter (# People)	479	665
Economic Losses (in $1,000s of dollars)	**100-Yr**	**500-Yr**
Residential Property	4,630	7,580
Total Property	22,500	30,820
Business Interruption	22,650	31,000

HURRICANE WINDS SCENARIO RESULTS

Even though Milford is inland from the coast, the Town will likely experience increasing order of magnitude impacts from hurricane wind events with increasing intensity that have a lower probability of occurrence especially from hurricanes with storm tracks that move directly through or in close proximity to Milford. Table 12 below shows the estimated damages for the 100-year (1%), and 500-year (0.2%) hurricane-wind events for: 1) buildings, 2) essential facilities, 3) displaced people and sheltering, and 4) Economic Losses from the 100-year and 500-year hurricane-wind events.

Table 12. HAZUS Level 1 Damage Estimates from Hurricane-Winds Events

	100-YR	**500-YR**
Building Damages (# of Buildings)		
# of Buildings with Minor Damage (1-10%)	341	1,586
# of Buildings with Moderate Damage (11-40%)	37	316
# of Buildings with Severe Damage (41-50%)	1	20
Destruction	0	6
TOTAL	**379**	**1,928**
Essential Facilities Building Damages (Lose of Use > 1 Day)	**100-Yr**	**500-Yr**
Emergency Operations Center	0	0
Fire	0	0
Hospitals	N/A	N/A
Police	0	0
Schools	0	11
TOTAL	**0**	**11**
Sheltering Requirements	**100-Yr**	**500-Yr**
Displaced Households (# Households)	14	106
Short-Term Shelter (# People)	4	22
Economic Losses (in $1,000s of dollars)	**100-Yr**	**500-Yr**
Residential Property	15,318	58,349
Total Property	16,502	68,990
Business Interruption	1,034	7,546

Building Damages Summary

The analysis used the default building stock from HAZUS as presented categorically in Table 12 above. In Milford, 379 buildings would experience damages from a 100-year event with most buildings incurring minor damages. Table 12 shows the building damages for the 100-year and 500-year event indicates a large increase in building damages occurs from the 100-year to the 500-year event where over 1,900 buildings incur Minor to Moderate damages.

Essential Facilities Summary

Each of the fire, police and emergency operations facilities would maintain functionality up to the 500-year hurricanes winds event. Each of the eleven schools would lose some degree of functionality during a 500-year event. It is important to note that these results are somewhat inconclusive because the default HAZUS data did not include the Milford Regional Medical Center or the fire station located at 1 Spruce Street in the analysis. Additional analysis would need to be conducted to determine the potential for additional damages on these two assets.

Sheltering Requirements Summary

HAZUS calculated the number of households displaced and the number of people that may require shelter due to damages from hurricane-wind events. Based on the HAZUS results, 14 households would be displaced and 4 people would require shelter for the 100-year hurricane winds event. Table 12 shows that the households begin to experience impacts starting at the 100-year event in relatively small numbers that increase during a 500-year event. It is important to note that the number of people requiring shelter is significantly less than the number of displaced households for each event with 22 people requiring shelter during a 500-year event.

Economic Losses Summary

The HAZUS results include economic loss calculations for the direct property damage and business disruption. Direct damages typically include the costs to repair structural damages to the building (e.g. foundation walls, anchorage systems, and staircases attached to the building) and replace building contents (e.g. portable and window air conditioners, personal belongings such as clothing, furniture, and electronic equipment). Business interruption costs are impacts tied to the inability of a business to function due to a hurricane event. Table 12 presents the economic losses for property damages to residential and all buildings as well as business interruption.

EARTHQUAKE SCENARIO RESULTS

Based on an analysis of the 2013 Commonwealth of Massachusetts State Multi-Hazard Mitigation Plan the HAZUS earthquake analysis used a Level 5 magnitude to conduct the statewide analysis. In addition, the 9th edition of the Massachusetts Building Code (MBC 9th Edition) includes building standards for new construction and substantial improvements that require that such structures be built to withstand a design-level earthquake corresponding to 2/3 of a 2500-year earthquake event. Therefore, to be consistent with the 2013 State Plan and MBC 9th Edition, this earthquake analysis was conducted using a Level 5 magnitude earthquake as the hazard input for the 1000-year and 2500-year earthquake events. Table 13 shows the estimated damages for the 1000-year and 2500-year earthquake events for: 1) buildings, 2) essential facilities, 3) displaced people and sheltering, and 4) Economic Losses from the 1000-year and 2500-year earthquake events.

Building Damages Summary

Table 13 presents the HAZUS results that indicates at least 86 buildings will be moderately damaged for the 1000-year event and 251 building buildings will be moderately damaged resulting from a 2500-year event. It is likely that the structures incurring most of the damages may be older structures that were built to lower standards than the current building requirements included in the recently adopted 9th edition of the Massachusetts Building Code (MBC 9th Edition).

Table 13. HAZUS Level 1 Damage Estimates from Earthquake Events

	1000-YR	**2500-YR**
Building Damages (# of Buildings)		
# of Buildings with Minor Damage (1-10%)	326	798
# of Buildings with Moderate Damage (11-40%)	75	217
# of Buildings with Severe Damage (41-50%)	10	31
Destruction	1	3
TOTAL	412	1049
	1000-Yr	**2500-Yr**
Essential Facilities Building Damages (Lose of Use > 1 Day)		
Emergency Operations Center	0	0
Fire	0	0
Hospitals	N/A	N/A
Police	0	0
Schools	0	0
TOTAL	0	0
	1000-Yr	**2500-Yr**
Sheltering Requirements		
Displaced Households (# Households)	13	41
Short-Term Shelter (# People)	7	23
Economic Losses (in $1,000s of dollars)	**1000-Yr**	**2500-Yr**
Residential Property	$7,000	$13,730
Total Property	$27,480	$47,660
Business Interruption	$2,990	$8,430

Essential Facilities Summary

Each of the fire, police and emergency operations facilities would maintain greater than 50% functionality during the 1000-year and 2500-year earthquake event. It is important to note that these results are somewhat inconclusive because the default HAZUS data did not include the Milford Regional Medical Center or the fire station located at 1 Spruce Street in the analysis. Additional analysis would need to be conducted to determine the potential for additional damages on these two assets and loss of functionality.

Sheltering Requirements Summary

HAZUS calculated the number of households displaced and the number of people that may require shelter due to damages from each earthquake event. Table 13 shows that the households begin to experience impacts starting at the 1000-year event that increase during the 2500-year event; however, the number of displaced families is still relatively small considering the low probability of such an earthquake event occurring. Additionally, the numbers of residents requiring sheltering is even lower for both earthquake events as noted in Table 13.

Economic Losses Summary

The HAZUS results include economic loss calculations for the direct property damage and business disruption as defined in the hurricane-winds analysis. Table 13 presents the economic losses for property damages to residential and all buildings as well as business interruption that indicates that the Town will experience a total of $13.7 Million and $47.7 Million in economic losses resulting from the 1000-year and 2500-year earthquake events, respectively.

Hazard Index Summary

The Local Working Group ranked hazards in terms of impacts to the Town of Milford based on likelihood/frequency, severity/magnitude, and potential impact area. Each category was provided a score based on the following criteria as shown in Table 14 below.

Each member of the Local Working Group assigned point values within each category to each hazard. For each hazard, the points from each category were summed, and the total points for each hazard were averaged among the total point scores from the eight members of the Local Working Group, as shown in Table 15.

As indicated in Table 15, Severe Winter Weather and Severe Weather hazards were ranked most highly by the Local Working Group for the Town of Milford. Urban drainage flooding and urban fire also ranked highly. Geologic hazards, and flooding from dam failures, ground failures, and ice jams were considered to result in the least impacts to the Town.

Table 14. Hazard Assessment

Likelihood/Frequency		
Point Value	**Category**	**Characteristics**
0	Very Low	Events that occur less often than once in 100 years (Less than 1% probability per year)
1	Low	Events that occur from once in 50 years to once in 100 years (1% to 2% probability per year)
2	Medium	Events that occur from once in 5 years to once in 50 years (2% to 20% probability per year)
3	High	Events that occur more frequently than once in 5 years (Greater than 20% probability per year)

Impacts		
Point Value	**Category**	**Characteristics**
0	Minor	Limited and scattered property damage, limited damage to public infrastructure and essential services not interrupted, limited injuries or fatalities.
1	Serious	Scattered major property damage, some minor infrastructure damage, essential services are briefly interrupted, some injuries and/or fatalities.
2	Extensive	Widespread major property damage, major public infrastructure damage (up to several days for repairs), essential services are interrupted from several hours to several days, many injuries and/or fatalities.
3	Catastrophic	Property and public infrastructure destroyed, essential services stopped, numerous injuries and fatalities.

Impact Area Assessment		
Point Value	**Category**	**Characteristics**
1	small	In unpopulated areas, without structures or critical facilities
2	Medium	In unpopulated areas, but with structures or critical facilities
3	Large	In close proximity to population/structures and critical facilities

Table 15. Hazard Index Summary – Compilation of Scores from Local Working Group Members

Hazard	Hazard Type	WG-Member 1	WG-Member 2	WG-Member 3	WG-Member 4	WG-Member 5	WG-Member 6	WG-Member 7	WG-Member 8	Average
Snow and Blizzards	Severe Winter Weather	9	6	8	7	8	6	7	9	7.5
High Winds/Thunderstorms	Severe Weather	9	7	No score	7	8	6	7	8	7.4
Ice Storms	Severe Winter Weather	9	6	7	7	8	6	7	7	7.1
Urban Drainage Flooding	Flood	9	7	No score	7	8	6	7	5	7.0
Extreme Cold	Severe Winter Weather	9	6	8	6	8	6	4	9	7.0
Hurricanes/Tropical Storms/Nor'easters	Severe Weather	9	5	No score	7	7	6	7	7	6.9
Urban Fire	Fire	9	7	7	7	4	7	4	9	6.8
Extreme Heat/Droughts	Severe Weather	8	6	No score	6	8	5	6	8	6.7
Tornadoes/Microburst	Severe Weather	9	5	No score	4	7	7	7	7	6.6
Riverine Flooding	Flood	9	5	No score	7	No score	6	7	5	6.5
Wildfire	Fire	9	7	4	6	5	4	4	4	5.4
Earthquakes	Geologic Hazards	6	3	5	5	1	5	6	8	4.9
Dam Failures	Flood	3	4	6	2	0	4	4	7	3.8
Ground Failures	Flood	9	0	No score	2	5	2	0	4	3.1
Ice Jam	Flood	2	0	3	1	4	1	0	3	1.8
Landslide	Geologic Hazards	6	0	2	1	1	1	0	3	1.8

5.0 HAZARD MITIGATION STRATEGIES

5.1 GOALS AND OBJECTIVES

Hazard mitigation goals which were included in the 2010 Plan were reviewed by the Local Working Group. The Working Group elected to continue to adhere to these goals in the new plan, with a minor modification to goal #1 to include water quality and water production impacts. The following eight goals were endorsed by the Working Group:

1. Prevent and reduce the loss of life, injury, public health impacts (including water quality and water production impacts), and property damages resulting from all major natural hazards.
2. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
3. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees, and boards.
4. Prevent and reduce the damage to public infrastructure resulting from all hazards.
5. Encourage the business community, major institutions, and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.
6. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
7. Ensure that future development meets federal, state, and local standards for preventing and reducing the impacts of natural hazards.
8. Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

5.2 MITIGATION MEASURES

5.2.1 Mitigation Measures Completed

The following table (Table 16) lists the mitigation measures that were identified in the 2010 Plan, other than existing Town-wide mitigation. The table was presented to the Local Working Group at the meeting on June 14, 2017, to review the status of each mitigation measure and to determine if it was deemed still applicable for this plan update, as documented in the table.

Table 16. Update to Mitigation Measures from 2010 Plan

Mitigation Measure Name /Location	Description	2010 Priority	Measure Completed?	Include in Plan Update?	Assigned Priority	Comments
Flooding Hazards						
Beach Street and Central Street	Channel restoration, increasing the underground culvert size	High	Yes	Yes	High	In 2010, the channel and underground culvert were cleared of debris and sediment to improve flow conditions, and a dam behind the "Archer" rubber factory building was removed. However, there is still potential for flooding, as observed by the Town during large flow events, potentially due to an undersized culvert. Factory building has been removed; there is a need to have a structural evaluation of the Central Street bridge crossing; the Town is currently working on obtaining funding.
West Street (Sewer Overflow)	Increase sewer main size	Medium	Yes	No		Sewer overflows have been mitigated
Godfrey Brook & O'Brien Brook	Channel restoration, culvert replacements	High	Partially	Yes	High	3 culverts and portions of channel have been replaced
Orange Street and Vine Street (Sewer Overflow)	Increase sewer main size	Medium	Yes	No		Installed new sewer interceptor which has mitigated the sewer overflows
High School	Relocate and elevate the emergency generator to external building platform	High	Yes	No		
Milford Pond Dam (Dam breach flooding)	Dam repairs	High	No	Yes	Medium	This item is included in the Town's capital improvements plan for the next 5± years. The repairs required are not major and include items such as brush clearing and repair of gates.

Mitigation Measure Name /Location	Description	2010 Priority	Measure Completed?	Include in Plan Update?	Assigned Priority	Comments
Milford Pond	Aquatic restoration of the pond	Medium	Yes	No		
Milford Pond	Hydraulic analysis to identify mitigation measures		No	Yes		The most recent dam inspection report indicates the need for a hydraulic analysis. This item to be included as part of the Milford Pond Dam repairs.
Depot Street at National Street	Enlarge culvert	Medium	No	Yes	Low	The culvert is more than 70% blocked from the installation of a sewer main that was completed several years ago. The brook has backed up on rare occasions but has not caused any damage. The Town cleans the area at the culvert where the pipe crosses on a regular basis to eliminate any possible flooding. There also are not any houses or properties in the immediate area that have ever been affected, but the road has been shut down on at least two occasions. The culvert hydraulics should be evaluated and an enlarged or modified culvert designed and constructed if necessary.
Highland Street at Elizabeth Road (Sewer Overflow)	Increase sewer main size	Medium	No	No		Sewer main has not been replaced; However, infiltration and inflow removal has mitigated the sewer overflows.
Quarry near the Lowes	Drainage study/ drainage system upgrades	Low	Yes	Yes	High	The Town has made repairs to the drainage system under Cedar Street, which addressed the primary flooding problems. However, a second quarry downstream of the quarry at Lowes has begun to present concerns about flooding. The second quarry presents a flooding risk to Route 85.
Town-wide Open Space Protection	Revise/adopt by-laws for protection of open space to ensure that future development does not increase flooding	High	No	No		Existing regulations are sufficient to address this.

Mitigation Measure Name /Location	Description	2010 Priority	Measure Completed?	Include in Plan Update?	Assigned Priority	Comments
Town-wide Development Regulations	Revise/adopt by-laws to ensure that future development does not increase flooding	High	No	No		Existing regulations are sufficient to address this.
Inter-municipal communication	Enhance communication with neighboring municipalities regarding water resources which cross town borders	Medium	No	Yes	Low	
Town-wide Public Education on water	Increase public awareness to reduce contaminants and hazardous materials from entering water sources in the cases of flooding	Medium	Yes	No		This measure is implemented as part of the Town's MS4 stormwater permit. Catch basins within Town are marked for no dumping.
Charles River at Howard Street	Downstream restoration of the Charles River	Low	No	No		This area has been rebuilt. Local Working Group indicated that they have never observed flooding at this location.
Fire						
Town-wide Setback Requirements	Town regulation for minimum 75-foot backyard setback to minimize risk from brush fires, by keeping a buffer between vegetated/forested areas and structures	Medium	No	No		Typically, no development around areas that have brush fires. Existing regulations are sufficient to address this.

Mitigation Measure Name /Location	Description	2010 Priority	Measure Completed?	Include in Plan Update?	Assigned Priority	Comments
Town-wide Public Education on Brush Fire Prevention	education of the public at conservation areas (signage) and for homeowners in close proximity to forest areas	Medium	No	No		Deemed not necessary by the Working Group.
Multi-Hazard						
Town-wide Emergency Communication	Acquire wireless communication system	Medium	Yes	No		The Town uses "Connect CTY" (similar to a reverse 911 system), which has been in place for more than 5 years.
Town-wide GIS mapping	Acquire GIS software and mapping technology to create an inventory of water, drainage, transportation, sewer, electrical infrastructure, as well as aid emergency response	High	20% completed.	Yes	High	Continue to implement.

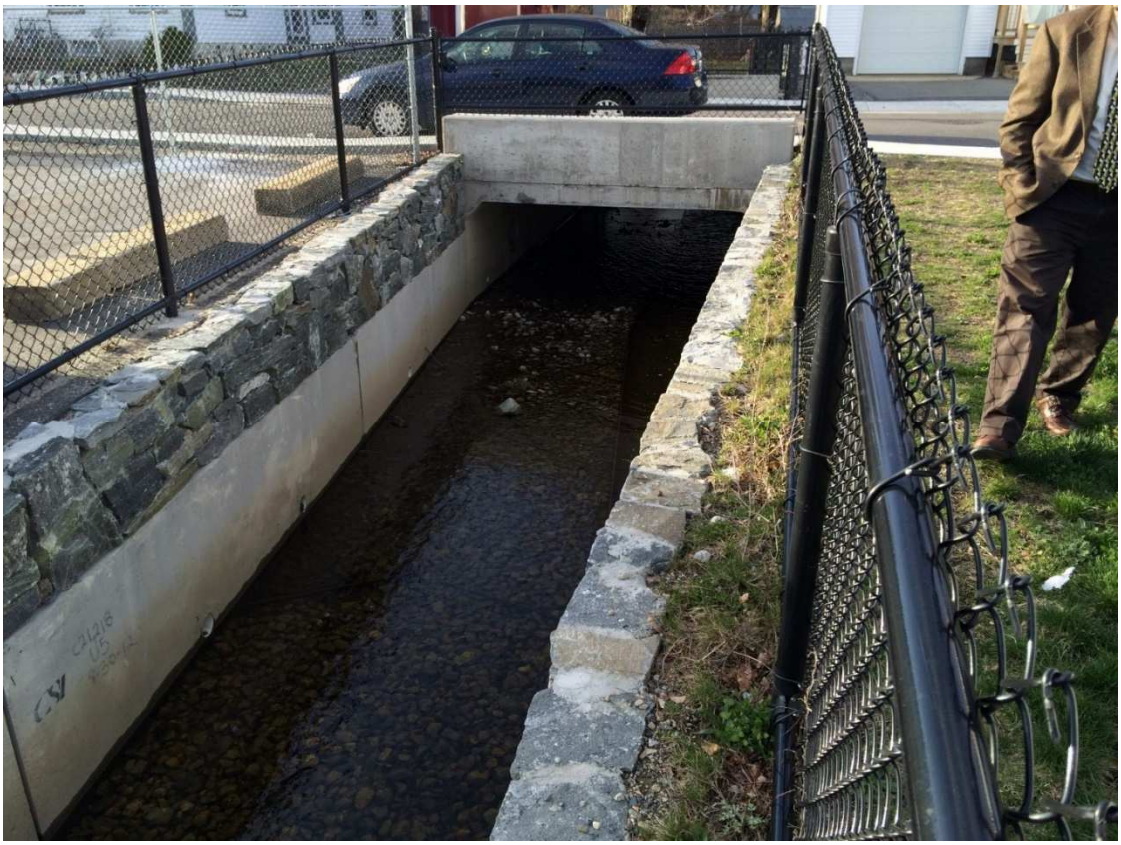


Photo 7. Godfrey Brook Culvert Replacement at Church Street (HMGP Grant #1813-22)

5.2.2 Existing Town-Wide Mitigation

The existing Town-wide mitigation programs described in the 2010 Plan are listed and described in the table below (Table 17). The Local Working Group reviewed these mitigation programs and changes since the 2010 Plan are also described in the table. These programs are mechanisms that the Town utilizes on a regular basis to address various hazards.

In addition to the mitigation programs listed in the table below, the Town has adopted many regulations and bylaws that serve to reduce flooding, preserve open space, and protect the community from natural hazards. Some key regulations that are applicable to hazard mitigation include:

- Massachusetts State Building Code (780 CMR)
- Town of Milford Wetlands Administration Bylaw
- Town of Milford Zoning Bylaw (includes Article V Flood Plain District)
- Town of Milford Rules and Regulations Relating to the Subdivision of Land (includes Article VIII Flood Hazard Regulations)
- Milford Stormwater Bylaw

It is important to note that the Town has taken an active role in integrating measures outlined in the 2010 Plan into many of the applicable regulations outlined above, as needed. For example, the Town updated Article V Flood Plain District of the Milford Zoning Bylaw to reflect the changes made to the SFHA based on the Town's adoption of the revised and effective FIRMS from July 4, 2011. Other examples are outlined in Tables 16 above and 17 below. The Town will continue to integrate mitigation measures as outlined in this plan into other relevant Town planning mechanisms, when appropriate. Additional details outlining this process are included in Section 7.

The Town does not currently find a need to expand its existing capabilities for implementing mitigation, which have remained consistent since the 2010 Plan. However, over the next five years and as part of the next update to the Town's Multi-Hazard Mitigation Plan, the Town will consider if existing capabilities need to be expanded. An analysis of the need for expanded capabilities will include review of potential barriers to expansion such as those related to funding, personnel, equipment, regulations, authority, community consensus, and others.

Table 17. Existing Town-Wide Mitigation (2010 HMP)

	Description	Changes since 2010?
GENERAL - MULTI-HAZARDS		
Enforcement of the State Building Code	The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.	See Appendix E
Comprehensive Emergency Management Plan	Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan. The CEMP is available online through secure access for town personnel	
Multi-Department Review of Developments	Multiple departments, such as the Town Administrator, Planning, Zoning, Health, Highway, Fire, Police, and Conservation, review all subdivision and site plans prior to approval	
Portable Water Pumps	Rivers and ponds in town are available to be tapped into for water supply if necessary	
FEMA Resources	A tanker task force is available though State Fire mobilization. FEMA has 8-12 tankers that can be deployed anywhere in the US within 72 hours.	
Emergency Generators	The town has invested in backup emergency generators for its public safety facilities. These generators give the town the ability to sustain operations during the event of an emergency	The Milford Water Company also has a portable generator.
Centralized Public Safety Dispatch	The town utilizes joint communications and dispatch for public safety.	

	Description	Changes since 2010?
Five-Day Clean Drinking Water Plan	The town has negotiated with the Milford Water Company to ensure that in the event of an emergency or natural hazard, the town will have five days of 100% filtered water capabilities	This is no longer applicable.
FLOOD-RELATED HAZARDS		
Participation in the National Flood Insurance Program (NFIP)	Milford participates in the National Flood Insurance Program. NFIP provides access to funds in the case of flood related damages.	
Street Sweeping	The Milford Highway Department conducts year-round street sweeping. All streets are swept at least once per year or as needed in select areas of town. The Highway Department begins street sweeping as soon as possible each spring.	
Catch Basin Cleaning	All Town catch basins are cleaned out once a year. This service is contracted out.	
Leaf Removal	The Milford Highway Department has a scheduled leaf removal program	
Minimize use of road sand to prevent drainage system clogging	The town uses a mixture of sand and salt with a bit more salt in the mix. This is done to minimize the amount of sand that enters catch basins and streams. Roads are treated when needed for winter storms	
The Massachusetts Stormwater Policy	This policy is applied to developments within the jurisdiction of the Conservation Commission.	
FIRE HAZARDS		
Permits Required for Outdoor Burning	The Fire Department requires a written permit for outdoor burning. The property-owner must come into the Fire Station and fill out a form.	The permit required is no longer a written permit.
Fire Hydrant Regulations	The Milford Water Company regulates that fire hydrants be installed at all new developments at the expense of the developer. Hydrants are spaced / located as directed by the Milford Fire Department	
Subdivision Review	The Fire Department is involved in reviewing subdivision plans from conceptual design through occupancy to ensure that there is adequate access for fire trucks and an adequate water supply	
All Terrain Vehicles	The town maintains all-terrain vehicles for fighting forest fires. These vehicles provide access to remote areas that otherwise would not be reachable	

WIND HAZARDS		
Tree Trimming	The Tree Department and local electric company, National Grid, conducts regular tree trimming. The town responds to downed tree limbs caused by winds, lightning strike reports and other weather-related incidents	
WINTER HAZARDS		
Snow disposal	The town does not do any snow disposal except for removing snow at the library	
Roadway treatments	The town uses a mixture of sand and salt with a bit more salt in the mix. This is done to minimize the amount of sand that enters catch basins and streams. On Route 85, from Dilla Street to the Hopkinton town line, the town uses low salt due to the nearby drinking water facility	

5.2.3 Mitigation Actions Identification and Action Plan Benefit/Cost Review

GZA solicited suggestions for mitigation measures at the Local Working Group meeting on 6/14/17 and developed a list of potential mitigation measures to be reviewed by the Local Working Group. The measures were evaluated regarding whether or not they should be included in the Plan update (yes or no). A table of the mitigation measures considered and documentation of those selected for inclusion in this plan update is included in Appendix G. The plan includes seventeen (17) new mitigation measures, in addition to those described in the above sections.

The Local Working Group evaluated various benefit/cost review approaches for prioritizing local mitigation actions including those outlined in FEMA's March 2013 Local Mitigation Planning Handbook, other local plans and FEMA's STAPLEE method. Based on this evaluation the Local Working Group developed an approach based on FEMA's March 2013 Local Mitigation Planning Handbook that included elements based broadly on the benefit/cost review approach outlined in the City of Portland Oregon's 2016 Mitigation Action Plan.

The benefits of the proposed projects were weighed against estimated costs as part of the project prioritization process. The Local Working Group performed the benefit/cost review by applying a qualitative rating system of high, medium and low to both benefits and costs as follows:

Benefits

High: Action will support compliance with a legal mandate or, once completed, will have an immediate impact on the reduction of risk exposure to life and property.

Medium: Once completed, action will have a long-term impact on the reduction of risk exposure to life and property, has a substantial life safety component, or project will provide an immediate reduction in the risk exposure to property.

Low: Long-term benefits of the action are difficult to quantify in the short term.

Costs

High: Would require an increase in revenue via an alternative source (i.e., bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.

Medium: Could budget for under existing work-plan but would require a reapportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.

Low: Possible to fund under existing budget. Project is or can be part of an existing ongoing program or would not require substantial effort to initiate or appropriate funds.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly. To support the benefit/cost review the Local Working Group also estimated the length of time and project costs for each mitigation action as follows.

Estimated Cost

To support the benefit/cost review the Local Working Group estimated the cost for implementation of each mitigation action as presented below.

Low: Less than $50,000

Medium: between $50,000 - $100,000

High: over $100,000

Estimated Timeline

For actions where funding is already available or that have already begun to be implemented, the action or strategy is identified as "ongoing." Since most of the actions were identified as a part of this plan update, most do not currently have funding. Therefore, the following timeframes are based on the amount of time it would take upon receiving funding. The estimated timeframes included 1-2 years, 3-5 years, 5+ years, and ongoing.

5.2.4 Mitigation Actions Plan Prioritization

Priority

Based on an evaluation of the results of the benefit/cost review, the Local Working Group prioritized each mitigation action and strategy using the following qualitative rating system of high, medium and low.

High Priority: An action that has benefits that exceed cost, has funding secured or is an ongoing project. High priority actions can be completed in the short-term or mid-term (1 to 5 years) or are projects that are long-term projects that can be initiated in the short-term and will have large positive impacts once completed.

Medium Priority: An action that has benefits that exceed costs, and for which funding has not yet been secured, but is eligible for funding. Actions can be completed in the short- or mid-term, once funding is secured, or are projects that are long-term projects that can be initiated in the short-term and will have large positive impacts once completed.

Low Priority: An action that will mitigate the risk of a hazard, that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for grant funding, and for which the time line for completion is long-term or uncertain. Low priority actions may be eligible for grant funding from other programs that have not yet been identified. Financing is unknown, and they can be completed over the long term.

The Local Working Group prioritized the mitigation action plan based on the results of the benefit/cost review of the proposed actions as presented in Table 18. In addition to the benefit/cost review results based on the elements outlined above, Table 18 provides details for each action relative to the agencies responsible for leading and coordinating the implementation of each action and potential funding sources.

Table 18. Mitigation Actions Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Costs	Priority	Responsible Agencies	Potential Funding Sources
MULTIPLE HAZARDS							
Monitor implementation of Hazard Mitigation Plan	High	Low	Ongoing	Low	Medium	Planning & Engineering	Town of Milford
Identify all potential hazards to Town-owned facilities before major repairs, or the construction of new facilities, to minimize future impacts from natural hazards, particularly flooding, storm damage, erosion, and high winds	Medium	Medium	Ongoing	Low	High	Town of Milford	Town of Milford
Prepare an evacuation plan	Medium	Medium	1-2 years	Medium	Medium	Fire and Police Departments, Emergency Services	FEMA, Town of Milford
Identify generator needs in critical facilities such as Town Hall, Community Center, High School, etc. (A generator is currently located at the high school)	Medium	Low	1-2 years	Low	Medium	Planning & Engineering	Town of Milford
FLOOD HAZARDS							
Beach Street and Central Street Channel Restoration and increasing the size of the underground culvert	High	Medium	3-5 years	High	High	Highway Dept., Planning & Engineering	FEMA, Town of Milford
Godfrey Brook & O'Brien Brook Channel restoration, culvert replacements	High	High	3-5 years	High	High	Highway Dept., Planning & Engineering	FEMA, Town of Milford
Revise and update regulatory floodplain maps.	High	Low	Ongoing	Low to Medium	High	Planning & Engineering	Town of Milford

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Costs	Priority	Responsible Agencies	Potential Funding Sources
FLOOD HAZARDS							
Continue to participate in National Flood Insurance Program (NFIP) (or other) training offered by the State and/or FEMA that addresses flood hazard planning and management	High	Low	Ongoing	Low	Medium	Planning & Engineering	Town of Milford
Develop Emergency Action Plans for Milford Pond Dam and Louisa Lake Dam	High	High	1-2 years	Low to Medium	Medium	Planning & Engineering	MA Office of Dam Safety, Town of Milford
Enlarge culvert at Depot Street at National Street	High	High	3-5 years	High	Low	Highway Dept., Planning and Engineering	FEMA, Town of Milford
Develop a Stormwater Master Plan (town-wide Stormwater Study to identify additional areas to improve and mitigate future flooding)	Medium	Medium	3-5 years	Medium	High	Highway Dept., Planning and Engineering	Town of Milford
Conduct drainage study to identify drainage system upgrades at Quarry near the Lowes Hardware	Medium	Medium	1-2 years	Medium	High	Highway Dept., Planning and Engineering	Town of Milford
Evaluate benefits and whether or not to participate in Community Rating System (CRS)	Medium	Low	1-2 years	Low	Medium	Planning & Engineering	Town of Milford
Develop an Emergency Operations Plan for the Highway Department, regarding potential flooding from nearby Charles River	Medium	Medium	1-2 years	Low	Medium	Highway Dept., Police and Fire Departments	Town of Milford

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Costs	Priority	Responsible Agencies	Potential Funding Sources
FLOOD HAZARDS							
Dam repairs (i.e. minor repairs including brush clearing and repair of gates) and hydraulic analysis to identify additional mitigation measures at Milford Pond Dam	Medium	Low	3-5 years	Medium	Medium	Planning & Engineering	MA Office of Dam Safety, Town of Milford
Incorporate the procedures for tracking high water marks following a flood into emergency response plans.	Medium	Low	1-2 years	Low	Medium	Highway Dept., Police and Fire Departments	Town of Milford
Enhance communication with neighboring municipalities on water resources across town borders	Medium	Low	Ongoing	Low	Low	The Milford Water Company	Town of Milford
Establish "green infrastructure" program to link, manage, and expand existing parks, preserves, greenways, etc.	Medium	Medium	3-5 years	Low to Medium	Low	Conservation Commission	EPA, Town of Milford
Town-wide GIS Mapping: Acquire GIS software and mapping technology to create an inventory of water, drainage, transportation, sewer	Medium	Medium	ongoing	Low to Medium	High	Planning and Engineering	Town of Milford
SEVERE WEATHER							
Educate citizens regarding the dangers of extreme heat and cold and the steps they can take to protect themselves when extreme temperatures occur	High	Medium	1-2 years	Low	Low	Town of Milford	FEMA, Town of Milford
Organize outreach to vulnerable populations, including establishing and promoting accessible heating or cooling centers in the community	High	Medium	1-2 years	Low	Low	Town of Milford	FEMA, Town of Milford

MITIGATION ACTIONS	Benefits	Costs	Timeline	Estimated Costs	Priority	Responsible Agencies	Potential Funding Sources
CLIMATE CHANGE							
Conduct a Town-wide climate change vulnerability assessment	High	Low	Ongoing	Low	Medium	Town of Milford (all local agencies and departments)	MA EEA, Town of Milford
Integrate climate change considerations into design and plan review process for future development and redevelopment projects	High	Medium	Ongoing	Low	Medium	Planning Board, Planning and Engineering	Town of Milford
Identify ways for businesses and residents to reduce their vulnerability to future impacts from Climate Change	High	Medium	1-2 years	Low	Medium	Town of Milford, Planning and Engineering	FEMA, MA EEA, Town of Milford
Integrate the results of the Town-wide climate change vulnerability assessment into the next Plan Update	Medium	Medium	3-5 years	Low	Medium	Planning and Engineering	MA EEA, FEMA, Town of Milford

6.0 REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

Some hazard mitigation issues are strictly local, while other issues are shared across local jurisdictional boundaries and involve cooperation between two or more municipalities. A third level of mitigation (regional) includes interagency collaboration among state, regional or federal agency partners.

The Milford Planning Board is the primary Town agency responsible for regulating development in town. Feedback to the Planning Board was ensured through the participation of the Milford Town Planner on the Local Working Group. The Town of Milford regularly collaborates with local and regional stakeholders such as the Massachusetts Department of Conservation and Recreation (DCR) and the Town of Hopkinton on projects involving hazard mitigation activities. As a part of developing this plan update, the Town coordinated with DCR to update pertinent repetitive loss property and NFIP claims related details for the Town. Local and regional entities were provided an opportunity to participate and provide input at the two public meetings held in April and November of 2017. The Town will continue to collaborate with local and regional agencies as a part of the implementation of actions outlined in this plan update. Below is a more detailed overview of the regional and intercommunity considerations for this plan update.

6.1 REGIONAL PARTNERS

In Milford, mitigating natural hazards, particularly flooding, is more than a local issue. Some natural hazards not only impact Milford but also impact both neighboring communities and state agencies responsible for maintaining shared waterways and public infrastructure. As an example, the drainage systems that serve the Town of Milford are a complex system of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including but not limited to the Town of Milford, the Department of Conservation and Recreation (DCR), the Army Corps of Engineers, Massachusetts Highway Department (MHD) and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operations, and maintenance of these structures are integral to the flood hazard mitigation efforts of the Town, neighboring communities, and the Commonwealth of Massachusetts. These agencies also operate under the same constraints as the Town does, including budgetary and staffing constraints and numerous competing priorities. The Town will continue to collaboratively partner with other agencies by working together to develop solutions that reduce the impacts from regional natural hazards that are consistent with the priorities outlined in the mitigation strategies outlined in this Plan.

6.2 REGIONAL FACILITIES WITHIN MILFORD

Major facilities owned, operated and maintained by federal, state, regional or private entities in Milford include: I-495, and State Routes 16 and 140 (MassDOT), the Milford Regional Medical Center, Whitcomb House (assisted living), Cornerstone (assisted living), Blaire House of Milford Assisted Living, Blaire House Long Term Care Facility, Geriatric Authority of Milford Nursing and Rehabilitation Center, Sunbridge Care and Rehabilitation, Countryside Health Care, Fresenius Kidney Care, Milford Power and various electrical substations, Registry of Motor Vehicles, and Milford District Court. The Massachusetts National Guard Headquarters is no longer located in Milford.

6.3 INTER- COMMUNITY CONSIDERATIONS

Milford, as well as its surrounding communities are undergoing significant development. To avoid impacts from any residential and commercial development, communication between Milford and the surrounding communities is vital. The Town will include future development considerations as a part of the input considered in the review processes. The Town will also work with neighboring communities to build similar considerations into their review processes to eliminate the potential for residual impacts from shared natural hazards such as riverine and urban flooding, as well as fire.

Maintaining adequate drainage, floodplains, and water quality of the Charles River is an important consideration for Milford and the surrounding communities. The Charles River runs through 35 communities, through Boston and into the Atlantic Ocean.

The Maspenock Dam is an important regional consideration. The dam resides in Milford, but is owned and operated by the Town of Hopkinton. The dam recently underwent repairs and if it were to fail, it would flood numerous homes in northern Milford. The Town will continue to partner with the Town of Hopkinton in coordinating monitoring updates on the status of the Maspenock Dam. To support this effort, the Town will participate in any emergency response exercises related to response activities planned by Hopkinton. Lastly, the Town will maintain an emergency contact from the Town of Milford who will be responsible for mobilizing emergency response activities to support the Town in the event of a potential dam failure.

7.0 PLAN ADOPTION AND MAINTENANCE

Adopting, implementing, monitoring, evaluating, and updating the Town's local multi-hazard mitigation plan are vital tasks to sustaining a viable plan that will assist the community in becoming more resilient to natural hazards long into the future. An overview of how the Town will carry out each of these tasks is outlined in the following sections.

7.1 PLAN ADOPTION

A public meeting was held on April 24, 2017 as a part of the Board of Selectmen's meeting to present the planning process and natural hazards characterizations for the Town and to solicit input and feedback from the public on the Draft Milford Multi-Hazard Mitigation Plan Draft Plan) before being finalized. The Draft Plan was provided to the Town on September 29, 2017 for review and distribution to the public and local stakeholders. The Town posted the Draft Plan on the Town website on October 26, 2017 for public review and input. Based on feedback provided at the public meeting and received from the public online, the Draft Plan was revised on November 29, 2017 and posted on the Town website. The Town then submitted the Draft Plan to the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA) for review. Upon receiving conditional approval of the plan by FEMA, the plan was presented and adopted by the Milford Board of Selectmen on ADD MONTH XX, 2018. A copy of the plan adoption is included at the front of this document.

7.2 PLAN IMPLEMENTATION

The implementation of this Plan Update commenced upon its formal adoption by the Board of Selectmen and official approval by MEMA and FEMA. Section 5 details the mitigation strategy that prioritizes the various actions identified to reduce the impacts from future natural hazards. The Local Hazard Mitigation Working Group will be responsible for overseeing the implementation of the plan.

In addition, the Local Hazard Mitigation Work Group will identify existing planning documents and regulations where relevant policies and actions outlined in this Plan may be incorporated to improve the potential for the implementation of mitigation actions across related programs and agencies. Relevant programs, policies, and/or regulations may include updates to existing polices and regulations such as the following.

- Updates to the Local Building Code based on changes outlined in the new 9th Edition of the Massachusetts building Code
- Town Ordinances, Open Burning Rules, 2008
- Wetlands Administration By-Law, Article 33
- Zoning By-Laws, 2015, including Article V, Flood Plain District

7.3 PLAN MONITORING AND EVALUATION

On an annual basis, the Local Hazard Mitigation Working Group, led by the Town Engineer, will coordinate a meeting to review the plan progress over the last year. This plan review will include an evaluation of hazard mitigation activities such as ongoing projects, changes in developing new mitigation actions resulting from a natural disaster event, changes in local, State and federal regulations that may impact the implementation of future projects, and modification of existing actions. As a part of this process, the working group will evaluate and assess the effectiveness the action items outlined in the plan

have been in achieving the plan goals and objectives. The results of this evaluation will be posted to the Town website to gather public input on the progress of the plan as well as to provide the public with the opportunity to provide additional mitigation activities for the working group's consideration.

A review and evaluation of the Town's Multi-Hazard Mitigation Plan will be conducted on a 5-year basis in compliance with the 2000 Disaster Mitigation Act and Part 201.6 of 44 Code of Federal Regulations (CFR). In the event of a major disaster event impacting the Town of Milford, the Town may update the plan at that time with actions to address unexpected impacts resulting from the damages to the community, if needed.

7.4 POTENTIAL FEDERAL AND STATE FUNDING SOURCES

Several of the proposed resilience projects and actions are eligible activities for funding under FEMA Hazard Mitigation Assistance Grants.

7.4.1 Pre-Disaster Mitigation (PDM)

The purpose of PDM is to reduce overall risk to communities and structures from future hazard events including coastal flooding, while also assisting communities in recovering more quickly from future natural disasters. PDM funds mitigation planning and project grants designed to reduce future losses in advance of potential disaster. Funding for PDM and FMA is appropriated by Congress annually and awarded on a nationally competitive basis. Many of the proposed hazard mitigation projects and actions are eligible activities for funding under PDM. https://www.fema.gov/pre-disaster-mitigation-grant-program (09/28/17)

7.4.2 Flood Mitigation Assistance (FMA)

The purpose of the FMA program is to reduce or eliminate insurance claims under the National Flood Insurance Program (NFIP). FMA provides funding to States, Territories, federally-recognized tribes and local communities for projects that reduce or eliminate long-term risk of flood damage to structures insured under the NFIP. FMA funding is available for flood hazard mitigation projects, plan development and management costs. Funding for PDM and FMA is appropriated by Congress annually and awarded on a nationally competitive basis. https://www.fema.gov/flood-mitigation-assistance-grant-program (09/28/17)

7.4.3 Hazard Mitigation Grant Program (HMGP)

FEMA's HMGP provides funding to municipalities, states, regional planning entities, and other eligible applicants to help communities implement hazard mitigation measures following a Presidential major disaster declaration. The most recent disaster declaration in Massachusetts was announced on April 13, 2015 - Massachusetts Severe Winter Storm and Snowstorm (DR-4214). A declaration typically opens up a host of disaster recovery and mitigation programs to assist states in recovering from and mitigating the future impacts from all natural hazards.

The funding for FEMA's HMGP is 15% of the total assessed damages for a given disaster for states that meet FEMA's standard Mitigation Plan requirements, which applies to the state of Massachusetts. The HMGP application period is open for one year from the disaster declaration date. To date there have been over $81.8 Million in Public Assistance (PA) Grants obligated, which is a FEMA Recovery grant program resulting in an additional $12.27 Million in HMGP funding available to the State for DR-4214. https://www.fema.gov/hazard-mitigation-grant-program (09/28/17)

All three HMA programs are managed by MEMA with support from Department of Conservation and Recreation (DCR).

There are currently no open disasters in Massachusetts under HMGP. The application period for the Fiscal Year (FY) 2017 PDM and FMA grant programs is June 28 – October 16, 2017. The application process for PDM and FMA is conducted through an online application process using FEMA's eGrants system.

7.4.4 HUD Disaster Recovery and Resiliency Grants:

Community Development Block Grant – Disaster Recovery (CDBG-DR)

Similar to FEMA's HMGP, HUD provides disaster recovery grants to help municipalities like Milford and the State recover from Presidentially-declared disasters, especially in low-income areas. The goal of these grants is to rebuild the impacted areas and provide critical funding to start the recovery process. The CDBG-DR program allows for the funding of a wide range of recovery activities including planning activities that aide communities and neighborhoods that may otherwise not recover because of a lack of resources. Funds from this program support owner-occupied housing, multi-family housing, infrastructure, small business express, and planning.

7.4.5 US Department of Agriculture's (USDA) and other Grants:

Natural Resources Conservation Services (NRCS)

The NRCS is the US Department of Agriculture's (USDA) leading agency providing voluntary technical and financial assistance to conservation districts, private land-owners, tribal governments, and other organizations to help sustainably manage, conserve and improve natural resources at the local level. Two financial programs that offer funding support in response to natural hazards are outlined as follows.

Emergency Watershed Protection Program (EWP)

Congress established the EWP to assist public and private landowners in response to emergencies resulting from natural hazards including coastal flooding and storms. The mission of the EWP program is to assist people and conserve natural resources by reducing the future impacts to public safety and property caused by floods, coastal storms and other natural hazards. The NRCS is the managing agency for the EWP program that includes two focus areas which are: EWP-Recovery and EWP-Floodplain Easement (FPE).

The EWP-Recovery provides recovery assistance to public and private landowners as a result of a natural disaster that requires a 25% local match with the NRCS providing a 75% match for the construction cost for emergency measures. The EWP-FPE provides assistance to privately-owned lands or lands owned by a local or state government that have been damaged by flooding at least once within the previous calendar year or have been subject to flood damage at least twice within the previous ten years.

Watershed & Flood Prevention Operations (WFPO) Program

The Watershed Protection and Flood Prevention Act of 1954 authorizes the NRCS to provide technical and financial assistance to states, local and tribal governments (project sponsors) for the planning and implementation of approved watershed plans. The NRCS works with local sponsors to protect and restore watersheds from damage caused by erosion, floodwater and sediment, to conserve and develop water and land resources, and to solve natural resource and related economic problems on a watershed basis. In Massachusetts, the project sponsor for watershed projects is the Massachusetts Department of Conservation and Recreation (MA DCR). The MA DCR provides assistance for the implementation of measures outlined in approved plans, and is focusing their efforts on reducing flood damages.

Appendix A – Meeting Agendas

Town of Milford
Hazard Mitigation Plan Update (PDM 15-03)
Kick-Off Meeting

AGENDA

Welcome and Introductions

Your Grant Coordinator and Contract Specialist from MEMA will explain their roles in the grant process during this meeting. It is also important for MEMA to understand who will be managing the grant for the sub-recipient as well as who will be responsible for overseeing the scope of work (construction or planning), quarterly reporting, and financial reimbursement.

Scope of Work Review

The FEMA approved scope of work can be found in your "Record of Environmental Consideration". This is the only work that you are authorized to do under this grant. Any work done outside of the approved scope of work is not eligible for reimbursement. If at any time a change needs to be made to your scope of work, it must be approved by FEMA. This process can be lengthy so please notify your grant coordinator as soon as possible if you are considering a change may be necessary.

Record of Environmental Consideration - Review / Discussion

An extensive environmental review has been done by FEMA prior to the award of your grant. This document is the result of that environmental assessment and outlines any and all special conditions that must be taken into account when completing the project. This document also provides information on permits that must be obtained in conjunction with the project. It is important that anyone involved with the project be familiar with this document.

Contract – Terms and Conditions

The terms and conditions of the grant are part of the contract that was signed by both MEMA and the sub-recipient. A copy of the terms and conditions has been included with this kickoff package. We will review several of these items during this meeting.

Quarterly Reporting

Providing quarterly reports are a condition of your grant. A reminder email will be sent to you prior to the due date. The quarterly report is a tool that facilitates project management for both MEMA and the sub-recipient. Each quarter MEMA mitigation staff reviews the quarterly reports and contacts the sub-recipient with any questions on the progress of your project.

Reimbursement Requests (See "Reimbursement Checklist")

Backup documentation and proof of payment is required for all payment requests. When requesting funds, please refer to the "REIMBURSEMENT CHECKLIST" that is included with this kickoff package. This document details all components that are required for reimbursement.

Grant Closeout

Once the project is complete in accordance with the approved Scope of Work, a final site visit is required with MEMA and FEMA. In addition, as-built plans and associated documents must be submitted to MEMA. A closeout certificate must be signed by the sub-recipient sent and returned to MEMA.

Questions

Should you have any questions at any time during this project, please feel free to contact us:

Shelly O'Toole
Hazard Mitigation Grants Coordinator
508 820-1443
Michelle.O'Toole@massmail.state.ma.us

Beth Dubrawski
Hazard Mitigation Contract Specialist
508 820-1425
Beth.Dubrawski@massmail.state.ma.us

Town of Milford Multi-Hazard Mitigation Plan Update

Kick-Off Meeting

August 16, 2016

Agenda

1. Discuss Town's goals for the project
2. Discuss existing information and data
3. Proposed Working Group
4. Schedule

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting #1

December 15, 2016

Agenda

1. Background
2. Proposed Table of Contents
3. Inventory of Assets
4. Characterize the Hazards
5. Risk Assessment Methodology

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting #1

December 15, 2016

Background & Overview

1. Prior plan – The Town's prior HMP, entitled, "Town of Milford Metro Boston South/West Hazard Mitigation Plan, Local Annex" was approved by the Federal Emergency Management Agency (FEMA) on December 9, 2010; and thus, has expired as of December 9, 2015. Prior plan was a regional plan prepared by the Metropolitan Area Planning Council.
2. FEMA grant eligibility

FEMA UNIFIED HAZARD MITIGATION ASSISTANCE (HMA) GRANTS

PROGRAM		FUNDING SOURCE	HMP STATUS
HAZARD MITIGATION GRANT PROGRAM	HMGP	Tied to Disaster Declaration	Approved Plan must be in place at time of grant award*
PRE-DISASTER MITIGATION	PDM	Re-authorization on-going in Congress	Approved Plan must be in place by the grant application deadline and at the time of grant award*
FLOOD MITIGATION ASSISTANCE	FMA	Re-authorization on-going in Congress	Approved Plan must be in place by the grant application deadline and at the time of grant award*

HMP = Hazard Mitigation Plan
*Except for planning grants to update a HMP

3. Project initiation meeting – August 16, 2016 – GZA, Scott Crisafulli, Mike Dean
4. Working group meetings – see schedule
5. Public meetings – Board of Selectmen; invites and advertising

Town of Milford Multi-Hazard Mitigation Plan Update

Schedule

Task/Meeting	Proposed Date
Project Initiation Meeting	8/16/16
Working Group Meeting #1 (*GZA present progress on Tasks through 4b*)	12/15/16
Potential Working Group Meeting #1A (as needed)	3/13/17
Public Meeting #1 (*GZA present progress on Tasks through 4c*)	3/20/17*
Working Group Meeting #2 (*GZA present progress on Tasks through 4e*)	5/15/17
Draft Plan provided to Town of Milford	9/01/17
Potential Working Group Meeting #2A (as needed)	9/11/17
Public Meeting #2 (*GZA present progress on Tasks through 4f*)	9/18/17*
Final Draft Plan provided to Town of Milford	10/16/17

*Public Meetings to be scheduled during Board of Selectmen Meetings. Dates are tentative and subject to change based on Board of Selectmen meeting schedule.

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting #1

December 15, 2016

Inventory of Assets

1. Review figures
2. Land Use
    a. Confirm Town-owned conservation land
    b. Review development projects
3. Water system narrative
    a. Updates since 2010 (new treatment plant)
    b. Water demand and supply projections
    c. Storage adequacy
    d. Supply capacity under standby power and/or largest source unavailable
4. Wastewater narrative – request a copy of the latest Tata & Howard I/I study report, and other reports to provide an overview and recent changes
5. Important historic/cultural resources in the Town -other than those listed on National Register of Historic Places (Irish Round Tower in St. Mary's Cemetery, statues, etc.)

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting #1

December 15, 2016

Characterize the Hazards

1. Flooding (see pg. 29 of existing HMP)
    - Beach Street and Central Street (Flooding)
    - Godfrey Brook & Hospital Brook (Flooding)
    - O'Brien Brook (Flooding)
    - West Street (Sewer)
    - Orange Street and Vine Street (Sewer)
    - High School (Flooding)
    - Milford Pond (Flooding)
    - Depot Street at National Street (Flooding)
    - Highland Street at Elizabeth Road (Sewer)
    - Charles River at Howard Street (Flooding)
    - Quarry Near the Lowes (Flooding)
2. High winds
    - Microburst in mid-1990's – any other events?
3. Extreme cold
    - Number of water main breaks per year?
4. Fire hazards (see pg. 33 of existing HMP)
    - Cedar Street Area (Fire)
    - Town Forest and Shadow Brook (Fire)
    - I-495 Corridor (Fire)
    - Bear Hill (Fire)

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting #1A

April 5, 2017

Agenda

1. Project Status
2. Schedule
3. Hazards and Risk Assessment

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting #2

June 14, 2017

Agenda

1. Project Status / Schedule
2. Risk Assessment Results
3. Mitigation Strategies

On April 24, 2017 at 7:00 P.M. in Room 3 of the Milford Town Hall, 52 Main Street, the Board of Selectmen will conduct a public meeting to introduce the update to the Town of Milford's Multi-Hazard Mitigation Plan. During the meeting, the public is invited to make comments or suggestions. All comments received from the public will be documented and considered for inclusion in the Plan.

The Multi-Hazard Mitigation Plan is a process designed to reduce the loss of life and property during times of hazardous events. Once the Plan update has been completed, it will be submitted to the Massachusetts Emergency Management Agency (MEMA) for review and comment, and then will be given to the Federal Emergency Management Agency (FEMA) for final review.

The Plan will be designed to mesh with and support MEMA's statewide Hazard Mitigation Plan. This will help increase coordination between local, state, and federal agencies during times of disaster. In addition, by having an updated Multi-Hazard Mitigation Plan approved by FEMA, the Town of Milford will be entitled to apply for future federal relief dollars to fund specific mitigation projects, designed to reduce and/or eliminate vulnerabilities resulting from disaster events in Milford.

Home

Town of Milford Multi-Hazard Mitigation Plan Meeting

POSTED ON: OCTOBER 26, 2017 - 3:10PM

The Town of Milford is conducting a public meeting to review the update to the Town of Milford Multi-Hazard Mitigation Plan on November 9th 2017 in Room 3, Town Hall, 52 Main Street, Milford MA at 12:30 pm.

The focus of the public meeting is to present the hazard risk assessment and updated hazard mitigation strategies included in the draft plan update. The public is invited to attend the meeting and make comments/suggestions on the draft plan update. All comments received from the public will be documented and will be considered for inclusion in the plan.

The Multi-Hazard Mitigation Plan is a planning tool designed to reduce the loss of life and property during times of hazardous events. Once the Plan update has been completed, it will be submitted to the Massachusetts Emergency Management Agency (MEMA) for review and comment, and to the Federal Emergency Management Agency (FEMA) for final review and approval.

The Plan is designed to mesh with and support MEMA's statewide Hazard Mitigation Plan. This approach will help increase coordination between local, state, and federal agencies during times of disaster. In addition, by having an updated Multi-Hazard Mitigation Plan approved by FEMA, the Town of Milford will be eligible to apply for future federal relief dollars to fund specific mitigation projects, designed to reduce and/or eliminate vulnerabilities resulting from disaster events in Milford.

Attachment	Size
"Draft" Town of Milford Multi-Hazard Mitigation Plan 09-29-2017	14.12 MB

Appendix B – Meeting Attendance Lists

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting #1

December 15, 2016

Attendance

NAME	AFFILIATION/ADDRESS	EMAIL	PHONE
Michael Dean	Town Engineer		508-478-0059
John MAININI	WWTP	JMAININI@milfordwwtp.com	
David Condrey	MWC	dcondrey@milfordwater.com	508-473-5110
Vin Farese	MWC	vfarese@milfordwater.com	508-473-5110
William Lookey JR	Milford Fire	WLookey@MilfordFire.org	508-400-6337
RICK VILLANI	TOWN ADMIN	RVILLANI@TOWNOFMILFORD.COM	508-634-2303
TOM O'LOUGHLIN	POLICE CHIEF	CHIEF@MILFORDPOLICE.ORG	508-473-1113
Laura Dunkin	Town Planner	ldunkin@townofmilford.com	508-634-2317
Scott Consalfulli	Highway Surveyor	SCONSALFULLI@TOWNOFMILFORD.COM	508 473-1274

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting #1A

April 5, 2017

Attendance

NAME	AFFILIATION/ADDRESS	EMAIL	PHONE
David Condrey	Milford Water Co	dcondrey@milfordwater.com	473-5110
Bill Toohey	Milford Fire	WToohey@milfordfire.org	508-473-2056
Michael Dean	Town Engineer		
John Mainini	Milford WWTP		
James Fahey	Milford Police	jfahey@milfordpolice.org	508 473-1113
Scott Crisafulli	Highway	scrisafulli@TownofMilford.com	508-473-1274
Rick Villani	Town Admin	rvillani@townofmilford.com	508-634-2303
Larry Duke	Town Planner		

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting #2

June 14, 2017

Attendance

NAME	AFFILIATION/ADDRESS	EMAIL	PHONE
Michael Dean	Town Engineer		
Bill Lackey	Fire Chief		
Rick Villani	Town Admin	rvillani@townofmilford.com	(508) 634-2303
Tom O'Loughlin	Police Chief	chief@milfordpolice.org	508-473-1113

Town of Milford Multi-Hazard Mitigation Plan Update

Working Group Meeting # 3

October 18, 2017

Attendance

NAME	AFFILIATION/ADDRESS	EMAIL	PHONE
Larry Dunlap	Town Planner	ldunlap@townofmilford.com	508-634-2317
Michael Dean	Town Engineer	mdean@townofmilford.com	508-634-2317
William Touhey	Fire Chief	WTouhey@MilfordFire.org	508-473-2256
Vincent Farese	Operations Manager MWC	vfarese@milfordwater.com	774-244-1002
David Condrey	Milford Water Co	dcondrey@milfordwater.com	508-234-0468
Rick Villani	Town Admin.	rvillani@townofmilford.com	(508) 634-2303
Scott Crisafulli	Highway Surveyor	scrisafulli@townofmilford.com	508 473-1274
Tom O'Loughlin	Police Dept	Chief@milfordpolice.org	508-473-1113

Town of Milford Multi-Hazard Mitigation Plan Update

Public Meeting

April 24, 2017

Attendance

NAME	AFFILIATION/ADDRESS	EMAIL	PHONE
William Buckley	Selectman / Town Hall	bill.buckley7@verizon.net	
Michael Walsh	Selectman / Town Hall	MKWJS81@msn.com	508-304-2921
Rick Villani	Town Admin / Town Hall	rvillani@townof milford.com	(508) 634-2303
Jean DeToma	Admin Assistant to the Town Admin.	JDeToma@ Town of Milford.com	508-634-2303
Scott Crisafulli	Highway Surveyor	SCrisafulli@ Townofmilford.com	508-473-1274
William J. Touhey Jr	Milford Fire	Wtouhey@milfordfire.org	508-473-2556
Tom O'Loughlin	Police Chief	chief@milford police.org	508-473-1113
Michael Dean	Town Engineer	mdean@townofmilford.com	~~508~~ 508-634-2317

Town of Milford Multi-Hazard Mitigation Plan Update

Public Meeting #2

November 9, 2017

Attendance

NAME	AFFILIATION/ADDRESS	EMAIL	PHONE
Michael Dean	Town Engineer		
Larry Dunkin	Town Planner		
Vik Pareek	Milford Water		
Bill Tookey	Milford Fire		
Rick Vitani	Town Admin.		
Jamie Wheelock	Resident		

Appendix C – Public Meeting Materials

Proactive By Design.
Our Company Commitment

Town of Milford
Multi-Hazard Mitigation Plan Update

April 24, 2017

OVERVIEW

- Hazard Mitigation Plan Background
- 2010 Milford HMP
  - Hazards
  - Accomplishments
- HMP Update
  - Planning Process
  - Assets Inventory
  - Hazards Characterization
  - Risk Assessment
- Next Steps

HAZARD MITIGATION PLANNING BACKGROUND

PURPOSE: Hazard Mitigation planning is a proactive effort to identify actions that can reduce the dangers to life and property from natural hazard events, such as hurricanes, tornadoes, winter storms and earthquakes.

REQUIREMENTS: The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five year intervals.

2010 MILFORD HAZARD MITIGATION PLAN
Primary Hazards Identified

- Flooding
- Brush Fires
- Wind Hazards (hurricanes, micro-bursts)
- Winter Hazards (snow, ice)

2010 MILFORD HAZARD MITIGATION PLAN
Implementation of Mitigation Measures

Flooding

- Beach Street and Central Street
- Godfrey, O'Brien, and Hospital Brooks
- High School
- Quarry behind Lowes

2010 MILFORD HAZARD MITIGATION PLAN
Implementation of Mitigation Measures

Sewer Overflow

- West Street
- Orange and Vine Streets
- Highland Street at Elizabeth Drive

MILFORD HAZARD MITIGATION PLAN UPDATE
Planning Process

Local Team	
Town Administrator	Rick Villani
Town Engineer	Michael Dean
Town Planner	Larry Dunkin
Highway Surveyor	Scott Crisafulli
Milford Sewer Department	John Mainini
Milford Water Company	David Condrey, Vin Farese
Milford Police Department	Tom O'Loughlin
Milford Fire Department	William Touhey, Jr.

MILFORD HAZARD MITIGATION PLAN UPDATE
Planning Process

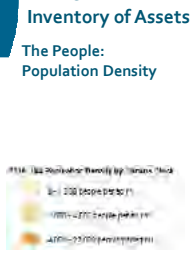
Planning Meetings	Date
Project Initiation Meeting	8/16/16
Working Group Meeting	12/15/16
Working Group Meeting	4/5/17

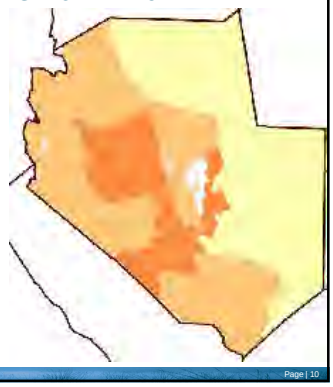
MILFORD HAZARD MITIGATION PLAN UPDATE
Planning Process

Public Meetings	Date
Meeting #1	TODAY
Meeting #2	September 2017

MILFORD HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The People:
Population Density





MILFORD HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The People:
Support, High Occupancy, and Vulnerable Populations

MILFORD HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The Places:
Essential Services

MILFORD HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

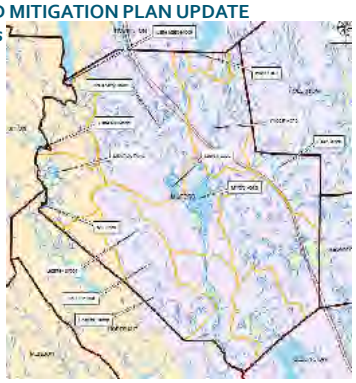
The Places:
Transportation

MILFORD HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The Places:
Historic Resources

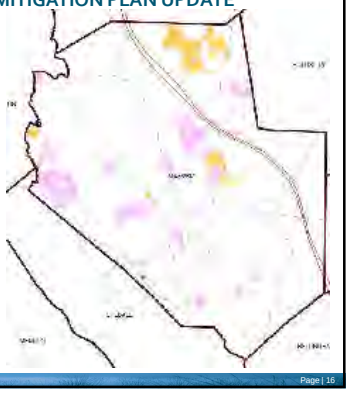
MILFORD HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The Environment:
Water Resources



MILFORD HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

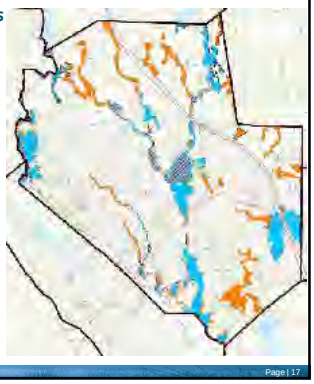
The Environment:
Open Space



MILFORD HAZARD MITIGATION PLAN UPDATE
Characterize the Hazards

Flood Hazards

- Riverine Flooding
- Urban Drainage Flooding
- Ground Failures
- Ice Jam



MILFORD HAZARD MITIGATION PLAN UPDATE
Characterize the Hazards

Flood Hazards

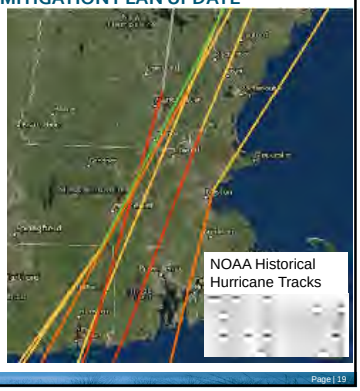
- Dam Failures

MILFORD HAZARD MITIGATION PLAN UPDATE

Characterize the Hazards

Severe Weather

- Hurricanes/ Tropical Storms/ Nor'Easters
- High Winds/ Thunderstorms/ Tornadoes/ Microburst
- Extreme Heat/ Droughts



MILFORD HAZARD MITIGATION PLAN UPDATE

Nor'Easters and Wind

2013 Image of Nemo: NASA's Earth Observatory 2013

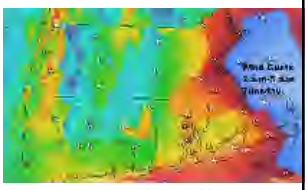


Image Source: Dave Epstein, Boston Globe 01-24-2017

MILFORD HAZARD MITIGATION PLAN UPDATE

Characterize the Hazards

Severe Winter Weather

- Snow and Blizzards
- Ice Storms
- Extreme Cold

MILFORD HAZARD MITIGATION PLAN UPDATE

Characterize the Hazards

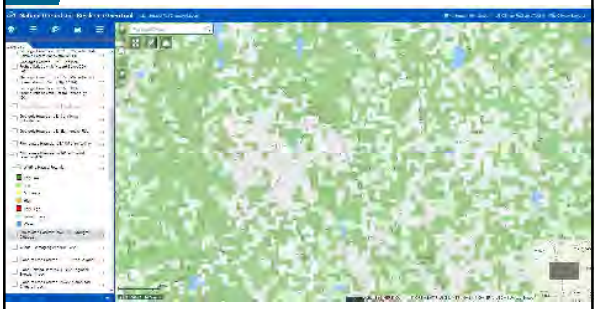
Fire

- Urban Fire
- Wildfire

Brush fire on I-495 in Andover and Lawrence.
(Image Credit: Dustin Fitch)

MILFORD HAZARD MITIGATION PLAN UPDATE

WILD FIRE RISK

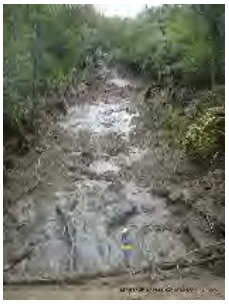


MILFORD HAZARD MITIGATION PLAN UPDATE

Characterize the Hazards

Geologic Hazards

- Earthquake
- Landslide



Landslide, Savoy, MA

MILFORD HAZARD MITIGATION PLAN UPDATE
Characterize the Hazards

Locally Identified Hazards

- Flooding
- Fire

MILFORD HAZARD MITIGATION PLAN UPDATE
Characterize the Hazards

Climate Change Impacts

- Increased storm frequency and severity, temperature, and precipitation
- Erosion, flooding, water pollution
- More climate extremes (wet and dry periods)
- Decreased factors of safety
- Changes in natural flora and fauna

MILFORD HAZARD MITIGATION PLAN UPDATE
Temperature Changes

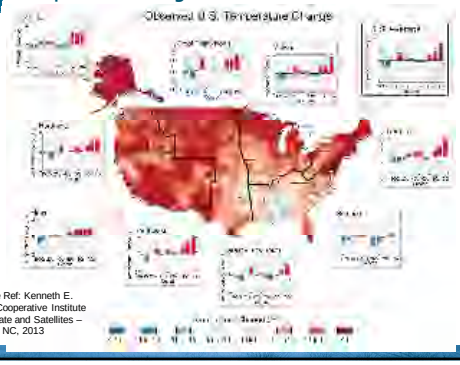


Image Ref: Kenneth E. Kunkel, Cooperative Institute for Climate and Satellites – NC, 2013

MILFORD HAZARD MITIGATION PLAN UPDATE
Precipitation Changes

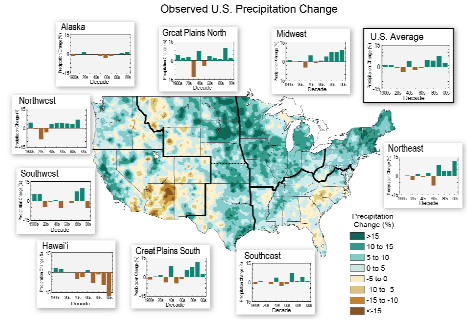


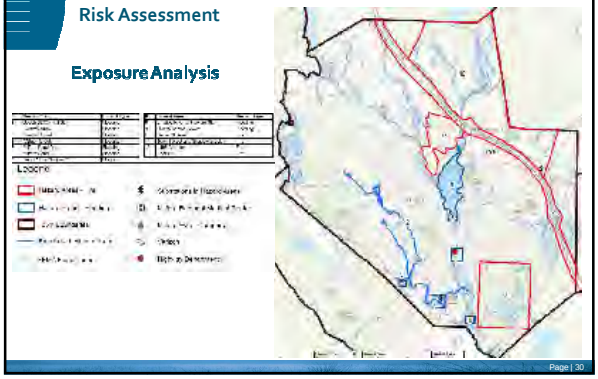
Image Ref: Peterson et. al. 2013

MILFORD HAZARD MITIGATION PLAN UPDATE
Risk Assessment

- Exposure Analysis
- Historical Analysis
- Scenario Analysis

MILFORD HAZARD MITIGATION PLAN UPDATE
Risk Assessment

Exposure Analysis



MILFORD HAZARD MITIGATION PLAN UPDATE
Risk Assessment - Historical Analysis - Disaster Declarations

Disaster	Date
Severe Winter Storm, Snowstorm & Flooding	April 13, 2015
Severe Winter Storm, Snowstorm & Flooding	April 19, 2013
Explosions	April 17, 2013
Hurricane Sandy	December 19, 2012
Hurricane Sandy	October 28, 2012
Severe Storm & Snowstorm	January 6, 2012
Severe Storm	November 1, 2011
Tropical Storm Irene	September 3, 2011
Hurricane Irene	August 26, 2011
Severe Storms & Tornadoes	June 15, 2011
Severe Winter Storm & Snowstorm	March 7, 2011
Hurricane Earl	September 2, 2010
Water Main Break	May 3, 2010
Severe Storm & Flooding	March 29, 2010
Severe Winter Storm & Flooding	January 5,2009
Severe Winter Storm	December 13, 2008
Severe Storms & Inland Coastal Flooding	May 16, 2007
Severe Storms & Flooding	May 25, 2006
Severe Storms & Flooding	November 10, 2005
Severe Storms & Flooding	October 19, 2005

MILFORD HAZARD MITIGATION PLAN UPDATE
Risk Assessment - Historical Analysis - Disaster Declarations - Worcester County

Disaster Declarations	Date
FEMA DR 4214 - Severe Winter Storm, Snowstorm & Flooding	April 13, 2015
FEMA DR 4110 - Severe Winter Storm, Snowstorm & Flooding	April 19, 2013
FEMA DR 4051 - Severe Storm & Snowstorm	January 6, 2012
FEMA DR 1994 - Severe Storms & Tornadoes	June 15, 2011
FEMA DR – 1895 - Severe Storm & Flooding	March 29, 2010
FEMA DR – 1813 - Severe Winter Storm & Flooding	January 5,2009

MILFORD HAZARD MITIGATION PLAN UPDATE
Risk Assessment

Historical Analysis - Repetitive Loss Properties

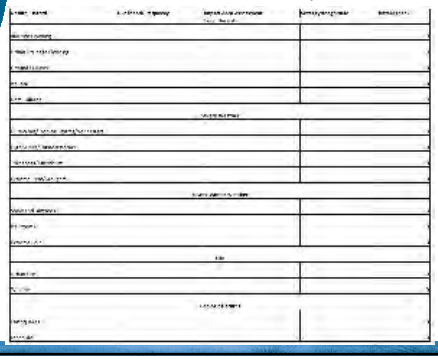
A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. Currently there are over 122,000 RL properties nationwide.

There is one RL property in Milford.

MILFORD HAZARD MITIGATION PLAN UPDATE
Risk Assessment

Scenario Analysis

MILFORD HAZARD MITIGATION PLAN UPDATE
Risk Assessment - Hazard Index Summary



MILFORD HAZARD MITIGATION PLAN UPDATE
Next Steps

- Finalize Risk Assessment
- Mitigation Strategies
- Plan Adoption
- Maintenance

MILFORD HAZARD MITIGATION PLAN UPDATE
Next Steps

Task / Meeting	Proposed Date
Working Group Meeting	5/15/17
Draft Plan for Local Team Review	9/1/17
Working Group Meeting	9/11/17
Public Meeting	9/18/17
Final Draft Plan	10/16/17

MILFORD HAZARD MITIGATION PLAN UPDATE
Next Steps

- MEMA review and comment on Final Draft Plan.
- Revise Final Draft Plan based on MEMA's comments.
- FEMA review and comment.
- Revise Plan based on FEMA's comments and re-submit.
- MEMA/FEMA notify Town that the Plan is "Approvable Pending Adoption"
- Town Board of Selectmen must formally "adopt" the Final Plan.
- Notify MEMA/FEMA of local adoption of the plan.

Proactive By Design.
Our Company Commitment

Town of Milford
Multi-Hazard Mitigation Plan Update

Questions?

Rosalie Starvish (rosalie.starvish@gza.com)

Sam Bell (samuel.bell@gza.com)

Town of Milford Multi-Hazard Mitigation Plan Update

Public Meeting – Board of Selectmen

April 24, 2017

PUBLIC INPUT SURVEY

Who do you represent?

A resident of the Town of Milford
A business in the Town of Milford
A neighboring community
Other: _____

What do you think are the most valuable assets of the Town of Milford?:

In your opinion, what are the top three hazards in the Town of Milford?

Flooding
Severe Weather (such as hurricanes, thunderstorms, tornadoes)
Severe Winter Weather (such as snow and ice storms, extreme cold)
Fire
Earthquakes/landslides

For the hazards listed above, are there any specific problem areas in Town that you have observed?:

-Survey continued on other side-

Town of Milford Multi-Hazard Mitigation Plan Update

Public Meeting – Board of Selectmen

April 24, 2017

Please provide any ideas that you may have for mitigating (fixing) the problem areas:

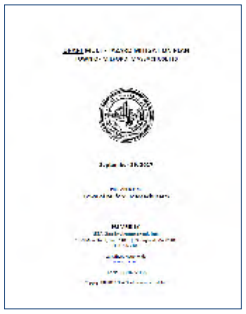
Proactive By Design.
Our Company Commitment

Town of Milford
Multi-Hazard Mitigation Plan Update

November 9, 2017

OVERVIEW

Hazard Mitigation Plan Update Overview
- Planning Process
- Assets Inventory
- Hazards Characterization
- Risk Assessment
- Mitigation Strategies
- Next Steps



PLANNING PROCESS

Local Team	
Town Administrator	Rick Villani
Town Engineer	Michael Dean
Town Planner	Larry Dunkin
Highway Surveyor	Scott Crisafulli
Milford Sewer Department	John Mainini
Milford Water Company	David Condrey, Vin Farese
Milford Police Department	Tom O'Loughlin
Milford Fire Department	William Touhey, Jr.

PLANNING PROCESS

Planning Meetings	Date
Project Initiation Meeting	8/16/16
Working Group Meeting	12/15/16
Working Group Meeting	4/5/2017
Working Group Meeting	6/14/2017
Working Group Meeting	10/18/2017

Public Meetings	Date
Meeting #1	April 24, 2017
Meeting #2	TODAY

ASSETS INVENTORY

Essential Services

ASSETS INVENTORY

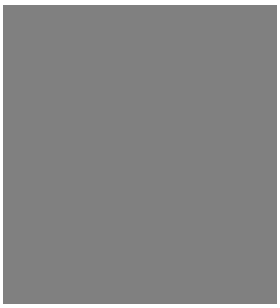
Support, High Occupancy, and Vulnerable Populations

Id	Name	Id	Name
ACTIVE/LY HOUSING		15	Little Stars
1	Greenleaf Terrace	16	Mother Hubbard
2	Hartfield Court	17	The Children's Korner
3	Birmingham Court	18	Wee and Shine Academy
4	Milford Housing Authority	19	Kids and Co West
5	Walker Court	20	Tracey and Becky Daycare Center
ASSISTED LIVING		**SCHOOL**	
6	Ashbrook Hostel	21	Woodland School
7	Blue House Long Term Care Facility of Milford	22	Brookside School
8	Blue House of Milford Assisted Living	23	Milford Middle East School - Closed
9	Cornerstone	24	Milford High School
NURSING HOME		25	Memorial School
10	Countryside Health Care	26	Stacy Middle School
11	Sunbridge Care and Rehab for Milford	27	Milford Catholic Elem School
12	Fantastic Authority of Milford	28	Whiting Star Early Childhood Center
CHILDCARE'S DAYCARE		29	Evergreen Center School
13	Kids and Co.	**HOSPITAL**	
14	Kinder Kare	30	Milford Regional Medical Center

MILFORD HAZARD MITIGATION PLAN UPDATE

ASSETS INVENTORY

Transportation



MILFORD HAZARD MITIGATION PLAN UPDATE

ASSETS INVENTORY

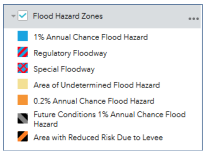
Water Resources

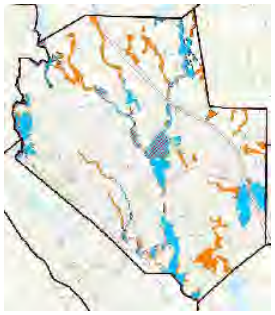
MILFORD HAZARD MITIGATION PLAN UPDATE

HAZARDS CHARACTERIZATION

Flooding

- Riverine Flooding
- Urban Drainage Flooding
- Ground Failures
- Ice Jam





MILFORD HAZARD MITIGATION PLAN UPDATE

HAZARDS CHARACTERIZATION

Severe Weather

- Hurricanes/Tropical Storms/ Nor'Easters
- High Winds/Thunderstorms/ Tornadoes/ Microburst
- Extreme Heat/ Droughts

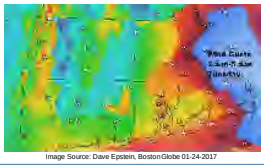


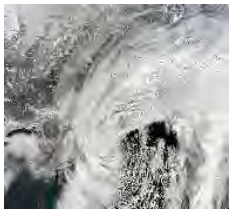
Image Source: Dave Epstein, Boston Globe 01-24-2017

MILFORD HAZARD MITIGATION PLAN UPDATE

HAZARDS CHARACTERIZATION

Severe Winter Weather

- Snow and Blizzards
- Ice Storms
- Extreme Cold



2013 Image of Nemo: NASA's Earth Observatory 2013

MILFORD HAZARD MITIGATION PLAN UPDATE

HAZARDS CHARACTERIZATION

Fire

- Urban Fire
- Wildfire

Brush fire on I-495 in Andover and Lawrence.
(Image Credit: Dustin Fitch)

MILFORD HAZARD MITIGATION PLAN UPDATE

HAZARDS CHARACTERIZATION

Locally Identified Hazards

- Flooding
- Fire

ID	Hazard Area	Hazard Type
1	Beach St./Central St.	Flooding
2	Godfrey Brook	Flooding
3	Hospital Brook	Flooding
4	O'Brien Brook	Flooding
5	Milford Pond Dam	Flooding
6	Milford Pond	Flooding
7	Depot St. at National St.	Flooding

ID	Hazard Area	Hazard Type
8	Charles River at Howard St.	Flooding
9	Quarry behind Lowes	Flooding
10	Cedar St. Area	Fire
11	Town Forest and Shadow Brook	Fire
12	I-495 Corridor	Fire
13	Bear Hill	Fire

MILFORD HAZARD MITIGATION PLAN UPDATE

HAZARDS CHARACTERIZATION

Climate Change Impacts

- Increased storm frequency and severity, temperature, and precipitation
- Erosion, flooding, water pollution
- More climate extremes (wet and dry periods)
- Decreased factors of safety
- Changes in natural flora and fauna

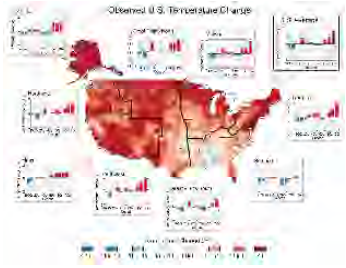


Image Ref: Kenneth E. Kunkel, Cooperative Institute for Climate and Satellites – NC, 2013

MILFORD HAZARD MITIGATION PLAN UPDATE

HAZARDS CHARACTERIZATION

Precipitation Changes

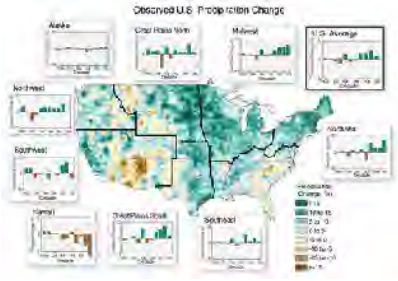


Image Ref: Peterson et. al. 2013

MILFORD HAZARD MITIGATION PLAN UPDATE

RISK ASSESSMENT

- Exposure Analysis
- Historical Analysis
- Scenario Analysis

MILFORD HAZARD MITIGATION PLAN UPDATE

RISK ASSESSMENT

Exposure Analysis

ID	Hazard Area	Hazard Type
1	Beach St./Central St.	Flooding
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MILFORD HAZARD MITIGATION PLAN UPDATE

RISK ASSESSMENT

Historical Analysis - Disaster Declarations - Worcester County

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RISK ASSESSMENT

Historical Analysis – Repetitive Loss Properties

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There is one (1) RL property in Milford.

Hazard Index Analysis

Likelihood/Frequency		
Point Value	Category	Characteristics
0	Very Low	Events that occur less often than once in 100 years (Less than 1% probability per year)
1	Low	Events that occur from once in 50 years to once in 100 years (1% to 2% probability per year)
2	Medium	Events that occur from once in 5 years to once in 50 years (2% to 20% probability per year)
3	High	Events that occur more frequently than once in 5 years (Greater than 20% probability per year)

Severity/Magnitude		
Point Value	Category	Characteristics
0	Minor	Limited and scattered property damage, limited damage to public infrastructure and essential services not interrupted, limited injuries or fatalities.
1	Serious	Scattered major property damage, some minor infrastructure damage, essential services are briefly interrupted, some injuries and/or fatalities.
2	Extensive	Widespread major property damage, major public infrastructure damage (up to several days for repairs), essential services are interrupted from several hours to several days, many injuries and/or fatalities.
3	Catastrophic	Property and public infrastructure destroyed, essential services stopped, numerous injuries and fatalities.

Impact Area Assessment		
Point Value	Category	Characteristics
1	Small	In unpopulated areas, without structures or critical facilities
2	Medium	In unpopulated areas, but with structures or critical facilities
3	Large	In close proximity to population/structures and critical facilities

Hazard Index Scale

- Likelihood/Frequency
- Severity/Magnitude
- Impact Area Assessment

Primary Hazards Identified Based on Hazard Index Analysis Results

Winter Hazards
- Snow and Blizzards
- Ice Storms
- Extreme Cold

- Wind Hazards
  - High winds/Thunderstorms
  - Hurricanes
- Flooding
  - Urban Drainage Flooding

Hazard	Hazard Type	Average
Snow and Blizzards	Severe Winter Weather	7.5
High Winds/Thunderstorms	Severe Weather	7.4
Ice Storms	Severe Winter Weather	7.1
Urban Drainage Flooding	Flood	7.0
Extreme Cold	Severe Winter Weather	7.0
Hurricanes/Tropical Storms/Nor'easters	Severe Weather	6.9
Urban Fire	Fire	6.8
Extreme Heat/Droughts	Severe Weather	6.7
Tornadoes/Microburst	Severe Weather	6.6
Riverine Flooding	Flood	6.5
Wildfire	Fire	5.4
Earthquakes	Geologic Hazards	4.9
Dam Failures	Flood	3.8
Ground Failures	Flood	3.1
Ice Jam	Flood	1.8
Landslide	Geologic Hazards	1.8

RISK ASSESSMENT

Scenario Analysis

Estimated Losses and Damages

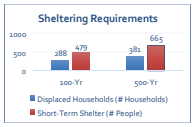
Buildings Damages (Town-wide)
- Essential Facilities Buildings Damages
- Sheltering Requirements
- Economic Losses
  - Property
  - Business Interruption

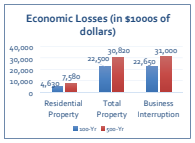
RISK ASSESSMENT

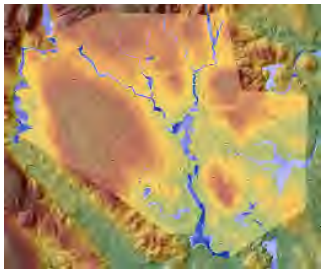
Scenario Analysis - Buildings Loss Exposure

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,519,776	67%
Commercial	880,445	23%
Industrial	256,367	7%
Agricultural	5,082	<1%
Religion	35,777	1%
Government	31,372	1%
Education	32,198	1%
Total	3,761,017	100%

HAZUS-MH Level 1 Analysis - Flooding Risk Summary

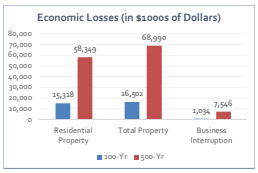


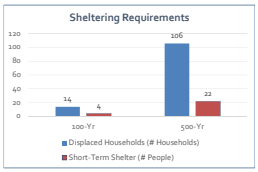




Risk Assessment - HAZUS-MH Level 1 Analysis

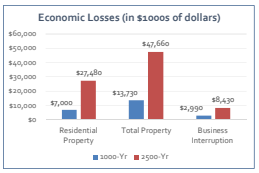
Hurricane-Wind Risk Summary

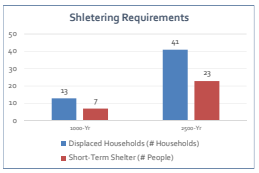




Risk Assessment - HAZUS-MH Level 1 Analysis

Earthquake Risk Summary





Mitigation Strategy Goals

1. Prevent and reduce the loss of life, injury, public health impacts (including water quality and water production impacts), and property damages resulting from all major natural hazards.
2. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
3. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees, and boards.
4. Prevent and reduce the damage to public infrastructure resulting from all hazards.

Mitigation Strategy Goals

5. Encourage the business community, major institutions, and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.
6. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
7. Ensure that future development meets federal, state, and local standards for preventing and reducing the impacts of natural hazards.
8. Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

2010 MHMP Update Completed Mitigation Measures

Flooding

- Beach Street and Central Street - Channel restoration, increasing the underground culvert size*
- Godfrey, O'Brien, and Hospital Brooks - Channel restoration, culvert replacements
- High School - Relocate and elevate the emergency generator to external building platform
- Quarry behind Lowes - Drainage study/ drainage system upgrades*

* Additional mitigation measures included in current MHMP Update

2010 MHMP Update Completed Mitigation Measures

Sewer Main Upgrades

- West Street
- Orange and Vine Streets
- Highland Street at Elizabeth Drive

NEW MITIGATION MEASURES

Overview

- Multi-Hazards – 4 new measures
- Flooding Related Hazards – 7 new measures
- Severe Weather – 2 new measures
- Climate Change – 4 new measures

Multi-Hazards - New Mitigation Measures

MITIGATION ACTION	PRIORITY
1. Monitor implementation of Hazard Mitigation Plan	Medium
2. Identify all potential hazards to Town-owned facilities before major repairs, or the construction of new facilities, to minimize future impacts from natural hazards, particularly flooding, storm damage, erosion, and high winds	High
3. Prepare an evacuation plan	Medium
4. Identify generator needs in critical facilities such as Town Hall, Community Center, High School, etc. (A generator is currently located at the high school)	Medium

Flood-Hazards - New Mitigation Measures

MITIGATION ACTION	PRIORITY
1. Develop an Emergency Operations Plan for the Highway Department, regarding potential flooding from nearby Charles River.	Medium
2. Develop a Stormwater Master Plan (town-wide Stormwater Study to identify additional areas to improve and mitigate future flooding)	High
3. Establish "green infrastructure" program to link, manage, and expand existing parks, preserves, greenways, etc.	Low
4. Incorporate the procedures for tracking high water marks following a flood into emergency response plans.	Medium
5. Revise and update regulatory floodplain maps.	High

Flood-Hazards - New Mitigation Measures

MITIGATION ACTION	PRIORITY
1. Continue to participate in National Flood Insurance Program (NFIP) (or other) training offered by the State and/or FEMA that addresses flood hazard planning and management	Medium
2. Develop Emergency Action Plans for Milford Pond Dam and Louisa Lake Dam	Medium

Severe Weather - New Mitigation Measures

MITIGATION ACTION	PRIORITY
1. Educate citizens regarding the dangers of extreme heat and cold and the steps they can take to protect themselves when extreme temperatures occur	Low
2. Organize outreach to vulnerable populations, including establishing and promoting accessible heating or cooling centers in the community	Low

Climate Change - New Mitigation Measures

MITIGATION ACTION	PRIORITY
1. Conduct a Town-wide climate change vulnerability assessment	Medium
2. Integrate the results of the Town-wide climate change vulnerability assessment into the next Plan Update	Medium
3. Integrate climate change considerations into design and plan review process for future development and redevelopment projects	Medium
4. Identify ways for businesses and residents to reduce their vulnerability to future impacts from Climate Change	Medium

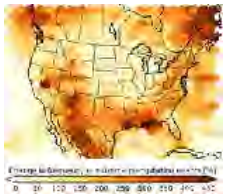
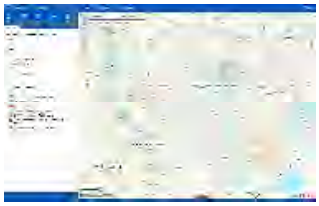


Image Ref: NSF/NCAR December 2016)

2010 MHMP Mitigation Measures to include in Plan Update

All Hazards

- Depot Street at National Street – Enlarge Culvert
- Highland Street at Elizabeth Road (Sewer Overflow) - Increase sewer main size
- Inter-municipal communication - Enhance communication with neighboring municipalities regarding water resources which cross town borders
- Town-wide GIS mapping - inventory of water, drainage, transportation, sewer, electrical infrastructure, as well as aid emergency response



Next Steps

- MEMA review and comment on Final Draft Plan.
- Revise Final Draft Plan based on MEMA's comments.
- FEMA review and comment.
- Revise Plan based on FEMA's comments and re-submit.
- MEMA/FEMA notify Town that the Plan is "Approvable Pending Adoption"
- Town Board of Selectmen must formally "adopt" the Final Plan.
- Notify MEMA/FEMA of local adoption of the plan.

Proactive By Design.
Our Company Commitment

Town of Milford
Multi-Hazard Mitigation Plan Update

Questions?

Jennifer Burke (jennifer.burke@gza.com)

Sam Bell (samuel.bell@gza.com)

Appendix D – Build-Out Analysis

Existing Plans

A number of plans were reviewed to garner issues related to natural hazards. These plans include:

- Comprehensive Plan, 2003
- Godfrey Brook Feasibility Study, 2007
- Regulations For "Residential" Leaf Program, 2006
- Milford Water company Rules and Regulations, 2006
- NPDES Stormwater Phase II Annual report, 2005
- Rules and Regulations Relating to the Subdivision of Land, 2004
- Town Ordinances, Open Burning Rules, 2008
- Milford Water Company, Rules and Regulations, 2006
- Wetlands Administration By-Law, Article XXX
- Zoning By-Laws, 2007

Potential Future Land Uses

In 2000, MAPC, under contract to the Executive Office of Environmental Affairs, prepared a buildout analysis for every community in the Boston region. A buildout analysis is a tool to help communities understand the potential impacts of future growth that might occur given the amount of developable land remaining and how that land is zoned.

The buildout is based on available land within each zoning district and it estimates the number of additional housing units and commercial development that could be accommodated. Generally, the projections account only for as-of-right development. The results of the 2000 Census were not released when MAPC performed the analyses.

Table 2:
Buildout Impacts in Milford, MAPC Analysis

Developable Land Area (acres)	3,006
Additional Residents	5,817
Additional K-12 Students	920
Additional Residential Units	2,299
Additional Commercial/Industrial (sq. ft.)	8,820,043
Additional Roadway at Buildout (miles)	28

According to the updated build-out analysis, there are 3,006 acres of developable land in Milford. This number is different than the 2116.7 acres of vacant land listed by the town assessor's office for several reasons. First, the developable land total excludes wetlands that cannot be developed under Massachusetts law. Second, the 3,006 acres includes several parcels not listed by the town as vacant, but are underutilized and have major additional development capacity. Finally, of the 778 vacant parcels in Milford, 211 parcels totaling 19.3 acres are less than the minimum 8,000 s.f. needed to build on (average 3,980 s.f.).

Appendix E – State Building Code Discussion

Massachusetts Building Code 8th Edition

Due to the location of portions of Milford within a FEMA flood hazard zone, future site design and construction is required to comply with the flood provisions of the Massachusetts Building Code (MBC) Base Code, currently in the 8th edition. The MBC 8th edition is comprised of the International Building Code 2009 (IBC), several companion IBC-codes and a separate document with Massachusetts amendments to the IBC-codes. The MBC 8th Edition includes flood-related provisions of IBC 2009 and (by reference) ASCE 24-05. The MBC 8th Edition references the FEMA BFE when defining flood design requirements.

Regulations related to the design and construction of buildings in flood hazard areas are presented in Appendix G: Flood-Resistant Construction of the IBC and MBC 8th edition amendments. This appendix, in conjunction with Section 1612 and other code sections, provides the minimum state flood requirements for the proposed development. The current MBC 8th Edition (for construction requirements in flood hazard areas) amends use of ASCE 24-05 relative to elevation requirements and references Section 1612 and Appendix G, as follows:

Table 8 – Flood Structure Elevation Requirements Massachusetts Building Code 8th Edition

	Special Flood Hazard Area (SFHA)	Elevation Requirement
Minimum Elevation of Lowest Floor (including basement)	Zone A	BFE or above
Minimum Elevation of Bottom of Lowest Horizontal Structural Member	Coastal High Hazard Areas (Zone V)	BFE + 2 feet

An exception is that the lowest floor for non-residential structures may be constructed below the BFE provided it is designed in accordance with referenced standard ASCE 24 (Section 6.2, Dry Flood proofing, Edition 24-05).

Massachusetts Building Code 9th Edition (Proposed)

The 9th Edition of the Massachusetts Building Code (MBC) Base and Special Regulation has been drafted and will take effect on January 1, 2018. The changes included in the proposed 9th Edition of 780 CMR (Base Volume & Special Regulations) 2-14-17 Version (Proposed MBC 9th Edition) will result in more stringent flood design requirements (see table below). The Proposed MBC 9th Edition will incorporate by reference many standards outlined in the most recent edition of ASCE 24 (edition 24-14). In accordance with ASCE 24-14, the proposed buildings are Flood Design Class is Class 2.

Table 9 – Proposed Flood Structure Elevation Requirements Massachusetts Building Code 9th Edition

	Flood Hazard Area	Flood Design Class 1	Flood Design Class 2	Flood Design Class 3	Flood Design Class 4
Minimum Elevation* of Top of Lowest Floor (Zone A: ASCE 24-14 Table 2-1)	Zone A	BFE + 1 ft.	BFE + 1 ft.	BFE + 1 ft.	BFE + 2 ft. or 500-year flood elevation, whichever is higher
Minimum Elevation of Bottom of Lowest Horizontal Structural Member (Zone V: ASCE 24-14 Table 4-1)	Zone V	BFE + 2 ft.	BFE + 2 ft.	BFE + 2 ft.	BFE + 2 ft. or 500-year flood elevation, whichever is higher
Minimum Elevation Below which Flood-Damage-Resistant Materials Shall be used (ASCE 24-14 Table 5-1)	Zone A	BFE + 1 ft.	BFE + 1 ft.	BFE + 1 ft.	BFE + 2 ft. or 500-year flood elevation, whichever is higher
	Zone V	BFE + 2 ft.	BFE + 2 ft.	BFE + 2 ft.	BFE + 2 ft. or 500-year flood elevation, whichever is higher
Minimum Elevation of Utilities and Equipment (ASCE 24-14 Table 7-1)**	Zone A	BFE + 1 ft	BFE + 1 ft.	BFE + 1 ft.	BFE + 2 ft. or 500-year flood elevation, whichever is higher
	Zone V	BFE + 2 ft	BFE + 2 ft.	BFE + 2 ft.	BFE + 2 ft. or 500-year flood elevation, whichever is higher
Minimum Elevation of Dry Flood Proofing of Non-Residential & Non-Residential Portions of Mixed-Use Buildings (ASCE 24-14 Table 6-1)	Zone A	BFE + 1 ft.	BFE + 1 ft.	BFE + 1 ft.	BFE + 2 ft. or 500-year flood elevation, whichever is higher
	Zone V	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Minimum Elevation of Wet Flood	Zone A	BFE + 1 ft.	BFE + 1 ft.	BFE + 1 ft.	BFE + 2 ft. or 500-year flood elevation, whichever is higher

	Flood Hazard Area	Flood Design Class 1	Flood Design Class 2	Flood Design Class 3	Flood Design Class 4
Proofing*(ASCE 24-14 Table 6-1)**	Zone V	Not Permitted	Not Permitted	Not Permitted	Not Permitted

* **Flood Design Class 1 structures shall be allowed below the minimum elevation if the structure meets the wet flood proofing requirements of ASCE 24-14 Section 6.3.**

** **Unless otherwise permitted by ASCE 24-14 Chapter 7.**

*** **Only if permitted in ASCE 24-14 Section 6.3.1.**

Note: In V zones location of utilities and equipment to the indicated level is required. Location of utilities and equipment at elevations below the indicated levels is not allowed, except as specifically noted in ASCE 24-14, Section 7.

The proposed MBC 9th Edition is consistent with the current MBC 8th Edition in that the proposed MBC 9th Edition does not regulate Coastal A Zones differently than AE zones. These changes will go into effect on January 1, 2018. However, the Baker Administration (EEA) has submitted language to the Board of Building Regulations & Standards (BBRS) that would modify the statewide building code by adopting Coastal A zone maps**.** The BBRS will be reviewing the language at its public hearing on November 14 and a vote is expected in January. If adopted, the Coastal A zone maps would take effect on July 1, 2018.

Appendix F – Resources

Appendix F - Resources

Annual Water Quality Report, Milford Water Company, 2015

Community Emergency Medical Services website (http://community-ems.com/index.php), 2017

Comprehensive Plan, prepared for the Town of Milford Master Plan Steering Committee by: The Metropolitan Area Planning Council. With the Environmental Institute, Department of Landscape Architecture, and Regional Planning University of Massachusetts Amherst, 2003

County Profiles, 2015 Fire Data Analysis, MFIRS, Ostroskey, Peter J., State Fire Marshal, MA Division of Fire Safety, Fire Data and Public Education Unit.

DEP-Reviewed Performance Standards for Massachusetts Public Water Suppliers, 2009 through 2015.

Federal Emergency Management Agency (FEMA), Local Mitigation Planning Handbook, March 2013.

Federal Emergency Management Agency (FEMA), National Flood Insurance Program Flood Insurance Manual, April 2017.

Federal Emergency Management Agency, Flood Insurance Rate Maps for Milford, MA

Godfrey Brook Feasibility Study, prepared by Baystate Environmental Consultants, Inc., 2007

MA Executive Office of Environmental Affairs, Buildout Analysis for Milford, 2000

Massachusetts Climate Change Adaptation Report, Executive Office of Energy and Environmental Affairs and the Adaptation Advisory Committee, September 2011

Massachusetts: Confronting Climate Change in the U.S. Northeast, Union of Concerned Scientists

Massachusetts Fire Incident Reporting System 2014 Annual Report, Ostroskey, Peter J., State Fire Marshal, Commonwealth of Massachusetts Department of Fire Services.

Massachusetts State Building Code (780 CMR), 9th Edition, Board of Building Regulations and Standards, October 20, 2017

Milford Regional Medical Center website (http://www.milfordregional.org/), 2017

Milford Sewer Department website (http://milford.ma.us/pages/departments/sewer-department.php), 2017

Mitigation Action Plan, City of Portland, Oregon (ftp://ftp02.portlandoregon.gov/pbem/MitigationActionPlan-FullText/2016_PortlandMAP_AgencyReviewDraft_2016-09-29.pdf), 2016

Natural Heritage and Endangered Species Program website (http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/), 2017

State Hazard Mitigation Plan. Commonwealth of Massachusetts, 2013.

State and Local Mitigation Planning How-To Guides. FEMA.

Town of Milford, Rules and Regulations Relating to the Subdivision of Land, 2004

Town of Milford, Comprehensive Emergency Management Plan

Town of Milford On-Line Zoning Ordinances.

Town of Milford Metro Boston South/West Hazard Mitigation Plan Local Annex, Metropolitan Area Planning Council, Final Plan Approved by FEMA December 9, 2010

Town of Milford Public Safety website (http://milfordpublicsafety.com/wb/pages/home.php), 2017

Upper Charles Trail website (http://www.uppercharlestrail.org/), 2017

U.S. Census.

U.S. Environmental Protection Agency, Urban Waters – The Charles River (https://www.epa.gov/charlesriver), 2017

U.S. Fire Death Rates by State, National Fire Protection Association (NFPA), July 2017

- Regulations For "Residential" Leaf Program, 2016
- Milford Water Company Rules and Regulations, 2013
- NPDES Stormwater Phase II Annual report, 2017
- Rules and Regulations Relating to the Subdivision of Land, 2012
- Town Ordinances, Open Burning Rules, 2008
- Wetlands Administration By-Law, Article 33

Zoning By-Laws, 2015, including Article V, Flood Plain District

Appendix G – Other Suggested Mitigation Strategies

Other Suggested Mitigation Strategies

	Include in plan update?		Assign Priority		
	Yes	**No**	**High**	**Medium**	**Low**
GENERAL - MULTI-HAZARDS					
Monitor implementation of Hazard Mitigation Plan	X			X	
Identify all potential hazards to Town-owned facilities before major repairs, or the construction of new facilities, to minimize future impacts from natural hazards, particularly flooding, storm damage, erosion, and high winds	X		X		
Prepare an evacuation plan	X			X	
Identify generator needs in critical facilities such as Town Hall, Community Center, High School, etc. (A generator is currently located at the high school)	X			X	
FLOOD-RELATED HAZARDS					
Evaluate benefits and whether or not to participate in Community Rating System (CRS)					
Develop an Emergency Operations Plan for the Highway Department, regarding potential flooding from nearby Charles River	X			X	
Develop a Stormwater Master Plan (town-wide Stormwater Study to identify additional areas to improve and mitigate future flooding)	X		X		

	Include in plan update?		Assign Priority		
	Yes	**No**	**High**	**Medium**	**Low**
FLOOD-RELATED HAZARDS					
Establish "green infrastructure" program to link, manage, and expand existing parks, preserves, greenways, etc.	X				X
Incorporate the procedures for tracking high water marks following a flood into emergency response plans.	X			X	
Revise and update regulatory floodplain maps.	X		X		
Continue to participate in National Flood Insurance Program (NFIP) (or other) training offered by the State and/or FEMA that addresses flood hazard planning and management	X			X	
Develop Emergency Action Plans for Milford Pond Dam and Louisa Lake Dam	X			X	
FIRE HAZARDS					
Assess feasibility of NFPA FireWise Program for urban environmental education of homeowners on reducing brush and mulch fires		X			
SEVERE WEATHER					
Educate citizens regarding the dangers of extreme heat and cold and the steps they can take to protect themselves when extreme temperatures occur	X				X
Organize outreach to vulnerable populations, including establishing and promoting accessible heating or cooling centers in the community	X				X

	Include in plan update?		Assign Priority		
	Yes	**No**	**High**	**Medium**	**Low**
CLIMATE CHANGE					
Conduct a Town-wide climate change vulnerability assessment	X			X	
Integrate the results of the Town-wide climate change vulnerability assessment into the next Plan Update	X			X	
Integrate climate change considerations into design and plan review process for future development and redevelopment projects	X			X	
Identify ways for businesses and residents to reduce their vulnerability to future impacts from Climate Change	X			X	