Town of Tyringham
Natural Hazard Mitigation Plan Update

Tyringham, Massachusetts

Local Natural Hazard Mitigation Plan Update

Prepared in accordance with the requirements presented in the FEMA Local Mitigation Plan Review Guide and the Local Mitigation Handbook

Prepared by:
GZA GeoEnvironmental, Inc.

Prepared For:
The Town of Tyringham, Massachusetts

March 10, 2021

Photo credit: Town of Tyringham (https://www.tyringham-ma.gov/)

GZA GeoEnvironmental, Inc.

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INSERT IMAGE OF THE TOWN'S RESOLUTION
ADOPTING THE HAZARD MITIGATION PLAN

INSERT IMAGE OF FEMA'S APPROVAL LETTER

QUICK PLAN REFERENCE GUIDE

The following provides a Quick Reference Guide to the Town of Tyringham Natural Hazard Mitigation Plan Update:

STEP 1: UNDERSTAND THE PLANNING PROCESS

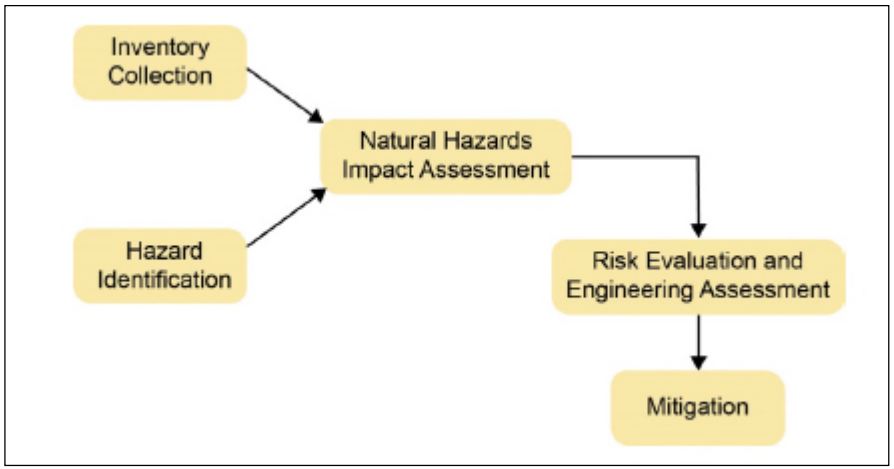
Section 2 - Planning Process describes the planning process and identifies the members of the Local Planning Team (LPT) that participated in the Plan development. **Attachment 6** presents public outreach documentation.

STEP 2: INVENTORY TOWN ASSETS (COMMUNITY PROFILE)

Section 3 - Community Profile presents a brief overview of the Town assets. **Attachment 1** provides a detailed description of these assets, including the Town population, and an inventory of Essential and Lifeline Systems, High Potential Loss Facilities, Transportation Infrastructure, and Town Facilities and Zoning Districts and General Building Stock.

STEP 3: IDENTIFY NATURAL HAZARDS

Section 4 - Natural Hazard Risk identifies and summarizes the natural hazards applicable to the Town. **Attachment 2** provides the detailed description of relevant natural hazards. The hazards are characterized including past hazard events and expected probability of occurrence. Future climate-related changes to severe weather and climate-related hazards are also presented based on the current available science.



Conceptual Steps in Assessing and Mitigating Losses due to Natural Hazards (FEMA)

STEP 4: ASSESS NATURAL HAZARD IMPACTS AND RISK

Section 4 - Natural Hazard Risk also presents the results of an assessment of the vulnerability of the Town to the natural hazards. **Attachment 3** provides a detailed hazard vulnerability assessment. FEMA HAZUS-MH simulations were performed for Hurricane (probabilistic), Flood (1% and 0.2% Annual Exceedance Probability [AEP] floods), and Earthquake (2% in 50 years). The simulation results are presented in **Attachment 4**.

STEP 5: MITIGATION PLAN AND IMPLEMENTATION

Sections 5, 6 and 7 present mitigation strategies and actions, regional and intercommunity considerations and plan implementation details. **Attachment 3** provides the basis for ranking natural hazard priorities. **Attachment 5** presents state and federal hazard mitigation and response grant funding sources. References and resources, and key contacts are presented in **Attachments 7** and **8.**

UNDERSTANDING NATURAL HAZARD RISK

This Natural Hazard Mitigation Plan Update is intended to provide the Town of Tyringham with a risk-based approach to making planning decisions. In simple terms...

Risk = the probability of an event occurring x the consequences of that event

Risk can be assessed qualitatively or quantitatively. The evaluation of the risks associated with Tyringham's natural hazards required: 1) identifying the type of natural hazard(s) applicable to Tyringham; 2) evaluating their probability of occurrence; and 3) evaluating their consequences. For example, a flood could impact Tyringham resulting in damage to property, injury or death and/or other economic or natural resource impacts. Different flood conditions (water level, limit of flooding, etc.) are associated with different probabilities of occurrence and different degrees of consequences. By characterizing the hazard, evaluating its probability and evaluating the consequences, the likelihood that these consequences will be experienced is determined. Once the consequences are understood in this way, value and risk-based planning decisions can be made.

Quantitative Risk Assessment

Quantitative assessment of natural hazard risk typically defines hazard probability in terms of Annual Exceedance Probabilities (AEP). The AEP refers to the probability that an event (e.g. , a specific flood water level) will be experienced or exceeded in any given year. For example, the 1% AEP event has a 1 in 100 chance of being met or exceeded in any given year. This probability is often described in terms of a recurrence interval. The recurrence interval is also a statistical indication of the probability of an event and can be considered as the "expected" frequency of an event, on average and over a long period of time. The 100-year recurrence interval is consistent with a 1% AEP. Estimates of AEP are typically presented as "mean" values and have uncertainty represented by lower and upper bounds.

Quantitative estimates of natural hazard probabilities, to be statistically meaningful, require long periods of record of actual historical hazard data or use of other statistical methods. Certain natural hazards such as earthquakes have been defined quantitatively by the federal government (FEMA, USGS and/or the US Army Corps of Engineers), and these values have been used for this Plan. For other natural hazards (e.g., Hail), this Plan has used limited historical data to extrapolate probabilities. While not statistically valid, the extrapolated estimates are useful in categorizing likelihood of occurrence (e.g., high to very low). Even though these "quantitative" values are presented in the Plan, the reader should be aware that they are not statistically meaningful due to the limited period of record of historical data.

Evaluating Consequences

This Plan Update evaluates the consequences associated with natural hazards in several different ways. The FEMA HAZUS-MH software is used to calculate losses (e.g. building damage) associated with hurricanes (high winds), flooding and earthquakes. For the other natural hazards, the consequences were extrapolated from available historical data. Similar to the estimated probabilities for these hazards, this approach is not statistically valid; however, it is useful for categorizing the consequences (minor to catastrophic).

Risk Over Time

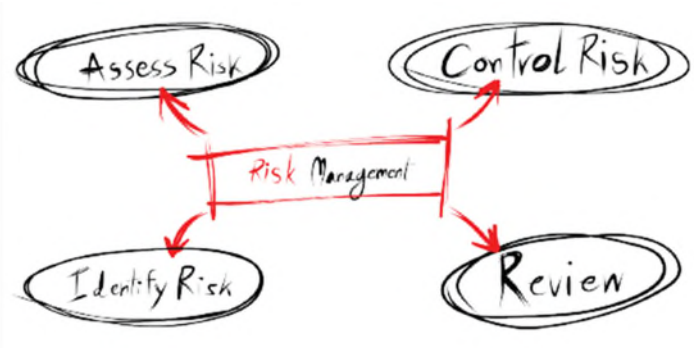
While AEPs and recurrence intervals define the annual risk (i.e., risk in any given year), the risk of experiencing that same hazard event at least once will increase when longer periods of time are considered. For example, the 1% AEP flood has a 1 in 4 chance (25%) of occurring at least once over a 30-year period.

Climate Change

Climate change can effect the risk of severe weather and climate-related hazards. For example, a flood level that has a 1% AEP today may have a much higher probability of occurrence in the future due to increased precipitation.

Low Probability is not the Same as Impossible

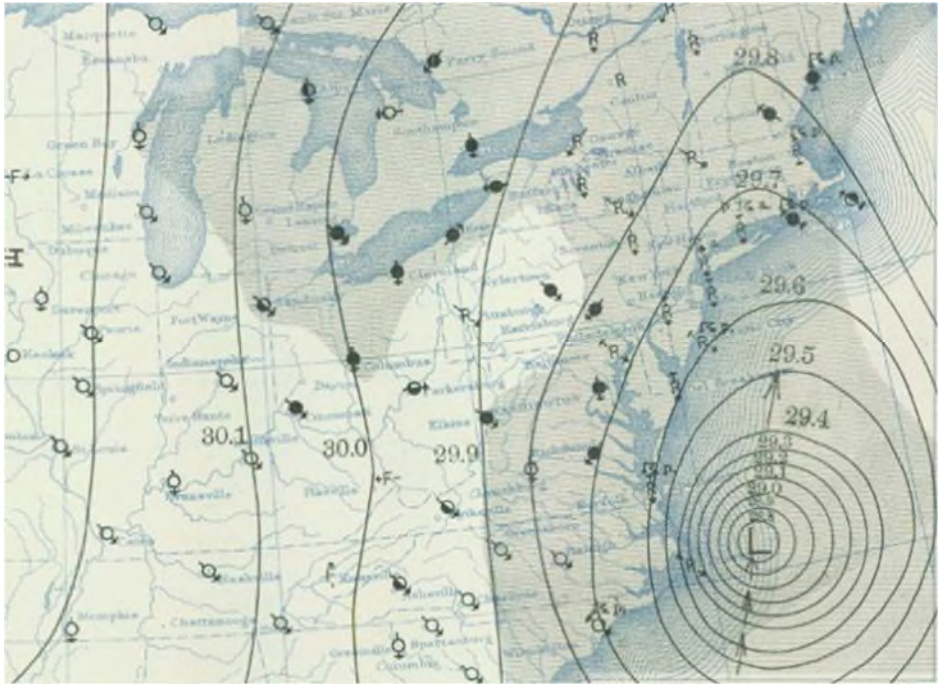
Even though a hazard is predicted to have a low probability of occurrence, that does not mean it cannot happen. For example, a major hurricane is unlikely to occur at Tyringham based on the available historical data, but it could happen - it is just predicted to be a low probability for planning purposes.



Risk Management Planning Process

Section 1: Plan Introduction

SECTION 1- INTRODUCTION



Historical Surface Weather Map of the Hurricane of 1938 on September 9, 1938

PURPOSE OF PLAN

The following presents the Natural Hazard Mitigation Plan Update for the Town of Tyringham, Massachusetts. The Town of Tyringham is a rural residential and agricultural community of about 450 residents, located in Berkshire County, about 40 miles northwest of Springfield. The Town is situated within the valley of Hop Brook, with its main thoroughfare, Main Road, running northwest-southeast along the valley and roughly parallel to Hop Brook.

Tyringham is vulnerable to severe weather and riverine flooding within the Hop Brook valley. The Town is also vulnerable to climate-related hazards (e.g., extreme heat and cold) and geologic hazards (e.g., earthquakes). The Town has developed this Plan to identify the risks and vulnerabilities associated with natural disasters and to develop long-term strategies for protecting people and property from future hazard events.

Ultimately, the goal of the Plan Update is to enable action to reduce loss of life and property by lessening the impact of natural disasters.

The development of the Plan Update enables the Town to:

- Increase education and awareness about the Town's vulnerability to natural hazards;
- Build partnerships for risk reduction involving government, organizations, businesses, and the public;
- Identify long-term, broadly-supported strategies for risk reduction;
- Align risk reduction with other state, tribal, or community objectives;
- Identify implementation approaches that focus resources on the greatest risks and vulnerabilities; and
- Communicate priorities to potential sources of funding.

PLAN REQUIREMENT

In addition, FEMA requires state, tribal, and local governments to develop and adopt hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects. Jurisdictions must update their hazard mitigation plans and re-submit them for FEMA approval every five years to maintain eligibility.

Previously, the Berkshire Regional Planning Commission (BRPC) assisted the Town of Tyringham and eighteen other communities in the development of the Berkshire County Hazard Mitigation Plan, with a local natural hazard risk assessment for the Town to meet the requirements of the Disaster Mitigation Act (Berkshire County Hazard Mitigation Plan, prepared by BRPC, February 8, 2012). This Plan has been prepared to update and replace the 2010 Plan.

The Commonwealth of Massachusetts encourages local municipalities to take ownership of the multi-hazard mitigation planning process by pursuing and developing local multi-hazard mitigation plans (MHMP).

Section 2: Planning Process

SECTION 2 - PLANNING PROCESS

The FEMA planning process includes the following steps:

1. Organize the Planning Process and Resources

At the start, focus on assembling the resources needed for a successful mitigation planning process. This includes securing technical expertise, defining the planning area, and identifying key individuals, agencies, neighboring jurisdictions, businesses, and/or other stakeholders to participate in the process. The planning process for local and tribal governments must include opportunities for the public to comment on the plan.

2. Assess Natural Hazard Risks

Identify the characteristics and potential consequences of hazards. It is important to understand what geographic areas each hazard might impact and what people, property, or other assets might be vulnerable.

3. Develop Mitigation Strategies

Develop long-term strategies for avoiding or minimizing the undesired effects of disasters. The mitigation strategy addresses how the mitigation actions will be implemented and administered.

4. Adopt and Implement the Plan

Once FEMA has received the adoption from the governing body and approved the plan, the state, tribe, or local government can bring the mitigation plan to life in a variety of ways, ranging from implementing specific mitigation projects to changing aspects of day-to-day organizational operations. To ensure success, the plan must remain a relevant, living document through routine maintenance. The state, tribe, or local government needs to conduct periodic evaluations to assess changing risks and priorities and make revisions as needed.

The Town of Tyringham followed this process, including:

- Organizing a diverse local planning team.
- Retaining GZA to provide technical and planning expertise.
- Providing opportunities for the public to comment on drafts of the plan prior to final plan approval.
- Providing opportunities for neighboring communities and local and regional agencies involved in natural hazard mitigation activities that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.
- Reviewing and incorporating applicable existing plans, studies, reports, and technical information into the plan.

Figure credit FEMA/Jenny Burmester – Aug 21, 2017

The Town assembled a Local Planning Team (LPT) with critical Town leadership responsibilities. The LPT was tasked with providing oversight and guidance in developing the Plan.

LOCAL PLANNING TEAM MEMBERS

- Town Administrator & Assistant Emergency Manager - Molly Curtin-Schaefer
- Building Department – Larry Gould, Building Inspector/Floodplain Administrator
- Highway Department – Noah Choquette, Road Superintendent
- Fire Department– Charles Slater Jr., Chief/Forest Fire Warden
- Conservation Commission – Laura Lee Bertram, Clerk
- Police – Patrick Holian, Chief
- Emergency Management - Jim Curtin

SECTION 2 - PLANNING PROCESS cont.

The LPT conducted three formal working group meetings to provide input and guidance in developing the plan throughout the planning process. The meetings were held on 09/22/2020, 11/10/2020, and 01/12/2021. The purpose of each working group meeting is summarized below:

- Working Group Meeting No. 1: Reviewed, discussed and finalized the inventory of Town assets as presented in Section 3 and **Attachment 1**. LPT members also provided details on previous natural hazard occurrences that impacted the Town.
- Working Group Meeting No. 2: Reviewed and discussed natural and climate change related hazard characterizations with respect to Tyringham as presented in Section 4 and **Attachment 2**. Reviewed, discussed the HAZUS Risk Assessment results for flooding, hurricane-wind and earthquake hazards. Based on a review of the HAZUS results and hazard characterizations the LPT ranked hazards for the Town using a consistent criteria as presented in Section 4 and **Attachment 3**.
- Working Group Meeting No. 3: Discussed and prepared the hazard mitigation strategy for Tyringham including goals and specific mitigation actions by hazard. The LPT then conducted a benefit-cost review of each mitigation action using a consistent criteria as in Sections 4 and 5.

The LPT held additional working meetings on 02/03/2021, 02/16/2021, and 03/11/2021 to further refine the mitigation actions and prioritization.

Due to the COVID-19 pandemic, posting the plan on the Town website was utilized for outreach in lieu of public meetings in person. The plan was posted online on xxxxxxx, and comments were received via email until xxxxx. The availability of the plan was publicized on the Town's website, through email notifications, and by posting in public locations. The comments received are included in **Attachment 6**.

EXISTING PLAN REVIEW

Several existing plans, reports and regulatory programs were reviewed by GZA and relevant details were incorporated as part of this Natural Hazard Mitigation Plan, including:

- Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 9/2018
- Berkshire County Hazard Mitigation Plan, February 8, 2012
- Berkshire County Comprehensive Economic Development Strategy (CEDS), Berkshire Regional Planning Commission, 2017
- Sustainable Berkshires Status Report, January 2019
- 2020 Berkshire County Regional Transportation Plan, Berkshire Regional Planning Commission, July 23, 2019
- Outdoor Recreation Plan Berkshire County 2020, Berkshire Regional Planning Commission
- Goose Pond Dam Emergency Action Plan, February 2016
- Tyringham Zoning By-Laws (including all amendments), 8/2017
- Rules and Regulations Governing the Subdivision of Land in Tyringham, Massachusetts, as amended, 4/9/2007
- Tyringham Disaster Recovery Information
- The Regional Plan for the Berkshires, Berkshire Regional Planning Commission, May, 2000
- Sustainable Berkshires, Long-Range Plan for Berkshire County, 3/20/2014

Section 3: Community Profile

SECTION 3 - COMMUNITY PROFILE OVERVIEW

The Town of Tyringham is a rural residential and agricultural community of about 450 residents, located in Berkshire County, about 40 miles northwest of Springfield (see **Figure 1**). As described in the 2012 *Berkshire County Hazard Mitigation Plan* (BRPC), Berkshire County is the westernmost region of Massachusetts, and is characterized by the Taconic Hills along its western border with New York and the Hoosac Range and Berkshire Hills along its eastern border. As such, the county is well defined by these physical features which historically have acted as barriers to travel and commerce. The Town is bordered to the north and west by Lee, to the west by Great Barrington, to the south by Monterey, and to the east by Otis and Becket. The Town has a total area of 18.6 square miles with approximately 1% of that area being water. Tyringham was incorporated as a Town in 1767.

The Town is governed by a three-member Board of Selectmen, Town Administrator and traditional New England Open Town Meeting. The Town is also one of thirty-two cities and towns within the Berkshire Regional Planning Commission (BRPC), supporting regional land use, transportation, community and economic development, public health and environmental planning.

Attachment 1 provides a detailed description of Town's community profile including population, building stock, essential facilities and lifeline systems and natural resources. The following pages provide a brief overview.

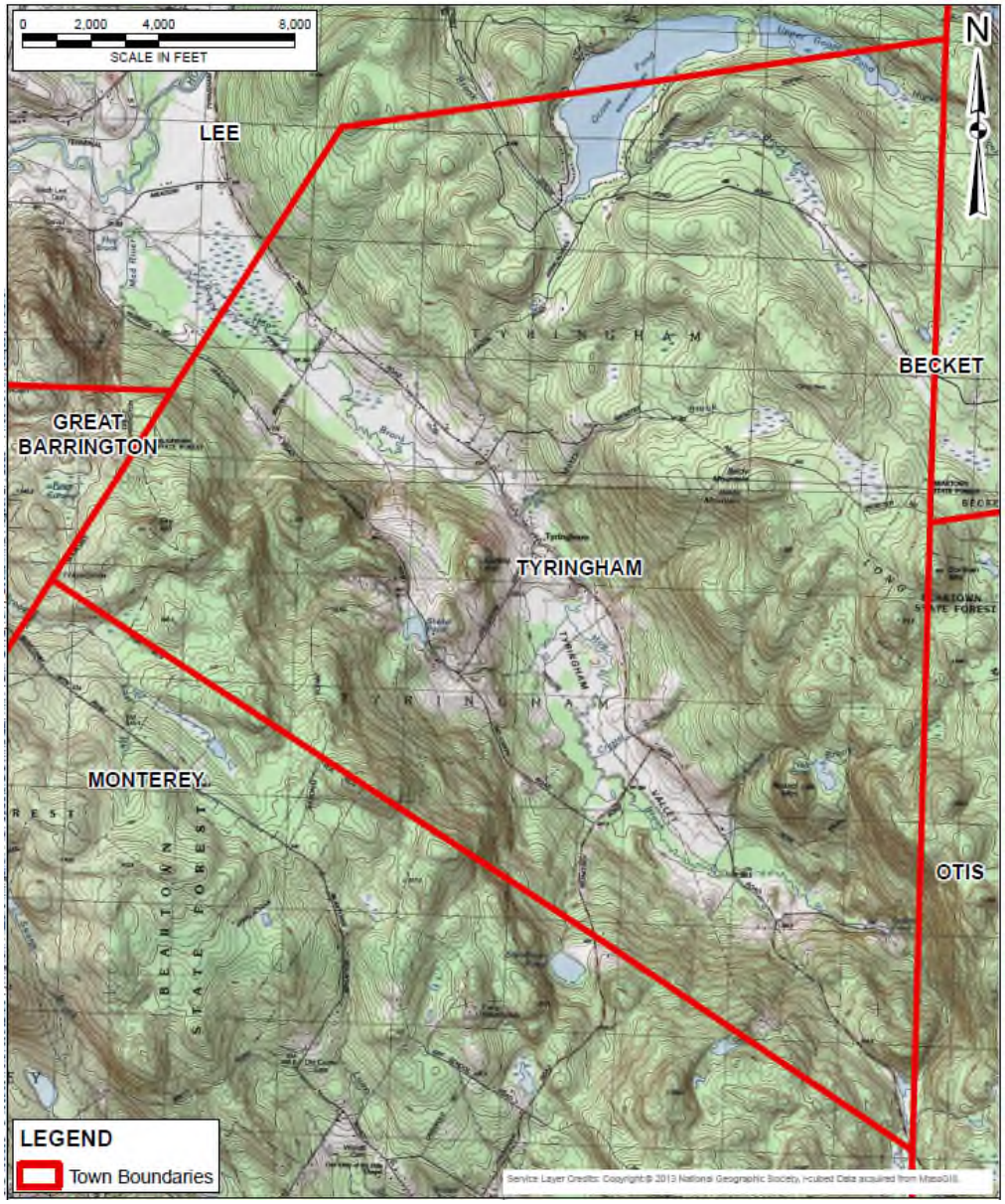


Figure 1: Tyringham Site Locus and Town Limits

Community Profile Snapshot:

Per the United States Census Bureau American Community Survey 5-year estimates (2018):

Age and Sex:

Population:	452
Population change since 2010*:	125 (+38%)

**Tyringham population of 327 listed in 2012 Berkshire County Hazard Mitigation Plan*

Percent female / male:	54% / 46%
Age:	
persons <18 years:	13%
persons 18 to 64 years:	47%
persons ≥ 65 years:	40%

Race:

White alone:	95%
Black or African Amer. alone:	1%
Amer. Indian or Alaska Native alone:	0%
Asian alone:	0%
Two or more races:	0%
Hispanic or Latino:	4%
White alone, not Hispanic or Latino:	95%

Education:

High school graduate or higher:	97.9%
Bachelor's degree or higher:	43.5%

Economy:

In civilian labor force, total, greater 16 years: (2012 to 2016)	60.6%
In civilian labor force, female, greater 16 years: (2012 to 2016)	58.6%

Income and Poverty:

Median household income:	$78,750
Per capita income:	$56,162
Persons in poverty:	10.9%

Family and Living Arrangements:

Households:	182
Persons per Household:	2.3
Language spoken at home other than English, greater than 5 years:	9%
Median house cost:	$400,000
Percent owner-occupied:	88%

Population Density:

24.3/sq. mile

Social Vulnerability Index:

Tyringham's Overall Social Vulnerability: Lowest Vulnerability; The Social Vulnerability Index is Slightly Elevated for Household Composition/Disability.

Community Profile Snapshot:

Building Stock: 291 Buildings

- 95.7% Residential (building exposure: $93.21M)
- 2.6% Commercial (building exposure: $2.57M)
- 0.7% Religion (building exposure: $638,000)
- 0.6% Industrial (building exposure: $631,000)
- Total building exposure: $97.37M (see Attachment 4 for more details)

Support, High Occupancy and Vulnerable Population Facilities:

- Council on Aging meets at Town Hall
- Sisters of the Visitation of Holy Mary

Land Use/Land Cover (MassGIS; 583 Parcels), % by area:

- 0.4% Residential
- 0.7% Other Impervious/Right of Way
- 91.2% Undeveloped/Forest
- 6.3% Agricultural
- 1.4% Developed Open Space

Districts:

- Agriculture / Residential

Future Development:

- No future developments currently planned

Historic Districts:

- 3 properties and 1 historic district on National Register of Historic Places

Transportation Infrastructure:

- Town Roads
- 11 MassDOT Bridges
- No Rail

Essential Facilities:

- Emergency Management
- Emergency Communications (Berkshire County Sheriff)
- Police
- Fire and Rescue
- Highway Department
- Designated Shelter

Lifeline Systems:

- No public water supply system (private wells)
- Private on-site septic
- Electricity (Eversource)
- Natural Gas (Berkshire Gas)
- Telecommunications (Charter and Verizon)

Hazardous Materials:

- MA Bureau of Waste Prevention Land Disposal Site (transfer station)

High Potential Loss Facilities:

- Goose Pond High Hazard Dam

Natural Resources:

- Two regional watersheds (Housatonic River with very small segment of Town in the Farmington River)
- Natural Heritage and Endangered Species (MA NHESP)
- Nearly 3,000 acres dedicated open space / recreational lands

Section 4: Natural Hazard Risk

SECTION 4 - NATURAL HAZARD RISK OVERVIEW

GZA conducted a Natural Hazard Risk Assessment to evaluate the potential consequences of natural hazards to the people, economy, and built and natural environments of the Town of Tyringham. The FEMA Multi-Hazard HAZUS-MH program was used to evaluate economic losses due to seismic, flood and hurricane hazards. The HAZUS -MH simulation results are presented in **Attachment 4**. The hazards were ranked using a scoring system based on the likelihood/frequency, severity/magnitude, and potential impact area (see **Table 1**). Each hazard category was provided a score based on the criteria shown in **Attachment 3**. For each hazard, the product of the points from each category was determined and the hazards ranked from highest value to lowest. The details of the risk assessment and how the hazards were ranked are presented in **Attachments 2 and 3.**

The top 3 ranked hazards include:

- Flooding  **1**

  Although the extent of riverine flooding is limited to the river valley and floodplain areas of Town, it is highly-ranked (just behind hurricanes/tropical storms) due to: 1) flood inundation impacts to the Town's essential facilities along Hop Brook; and 2) impacts to transportation infrastructure. Flooding caused by poor drainage or beaver dams may post a hazard in other areas not necessarily impacted by riverine flooding.

- Hurricanes/Tropical Storms  **2**

  Severe wind, and related damages during hurricanes is ranked first due to its relatively high probability of occurrence, its coincidence with heavy rainfall and flooding and its potential for wide-spread damage. In particular, a hurricane strike at or near Tyringham with a 1% probability of occurrence (100-year recurrence interval) would be catastrophic (similar to the 1938 and 1954 hurricanes). High winds caused by thunderstorms or tornadoes are also ranked highly.

- Severe Winter Weather  **3**

  Severe winter weather (greater than 10-inches snowfall) most frequently occur during nor'easters, coincident with high winds, cold temperatures and blizzard conditions. Winter storms present risks due to transportation impacts (limited use of roadways), cold temperatures (including wind chill) and the potential for structure damage (roof failures). Their relative high probability of occurrence makes severe winter weather as a high ranked hazard.

Table 1: Tyringham Natural Hazard Ranking based on the hazard frequency of occurrence, severity and extent of impact area.

Severe Weather Hazards:	**Hazard Index**
Severe Wind:	
Hurricanes/Tropical Storms	**7**
Thunderstorms	6
Tornadoes	6
Lightning	5
Intense Rainfall	5
Hail	5
Flood:	
Riverine Flooding	**7**
Poor Drainage Flooding	6
Beaver Dams	6
Severe Winter Weather:	
Snow and Blizzards	**7**
Ice Storms	7
Climate-Related Hazards:	
Extreme Temperature:	
Heat	5
Cold	6
Drought	5
Wildfire	2
Geologic Hazards:	
Earthquake	5
Landslides	1
Tsunami	0
Secondary Hazard:	
Dam Failure	**5**

SECTION 4 - NATURAL HAZARD RISK OVERVIEW

Table 2 presents a summary of the predicted hazard likelihood of occurrence/frequency, severity/magnitude and impact area for each natural hazard that is relevant to Tyringham. The hazard probability of occurrence (frequency) is characterized as:

Frequency:

Very Low: Events that occur less frequently than once in 1,000 years (less than 0.1% per year).

Low: Events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year)

Medium: Events that occur from once in 10 years to once in 100 years (1% to 10% per year).

High: Events that occur more frequently than once in 10 years (greater than 10% per year).

The hazard impact in part is characterized as follows:

Severity:

Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., 1 or 2 communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.

Serious: Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.

Extensive: Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.

Catastrophic: Property and public infrastructure destroyed; essential services stopped, thousands of injuries and fatalities.

Climate change will have an effect on Severe Weather Hazards and Climate-Related Hazards. **Table 3** compares key components of Tyringham's climate today to changes predicted by the year 2050. The impact of certain climate change effects on the Town such as precipitation increases and flooding are predictable. The impact of other effects such as the increase in the frequency and duration of Heat Waves are less predictable. However, these Climate-Related hazards are predicted to become a high priority for Tyringham over the next decade.

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
SEVERE WEATHER HAZARDS			
Severe Wind:			
Hurricanes/Tropical Storms/ Nor'easters	• Hurricane Wind Warning (>74mph): 1% AEP (75-year recurrence interval); **Medium**	Catastrophic	Town-wide
Thunderstorms (wind >58 mph)	• Within Berkshire County: 81% AEP or minimum of 1-year to 2-year recurrence interval (57 years with 1 or more events over 70 years); **High**	Serious	Town-wide or portions of Town
Tornadoes	• Tornadoes within Berkshire County: 20% AEP or 5-year recurrence interval (14 years with 1 or more events over 70 years); **High** • Major tornado within Berkshire County: 3% AEP or 35-year recurrence interval; **Medium**	Serious	Town-wide or portions of Town
Lightning	• Events resulting in fatality, injury and/or damage within Berkshire County: 43% AEP or 2.3-year recurrence interval; **High**	Minor (fatality risk is very low)	Town-wide or portions of Town
Intense Rainfall	• 15% AEP or 6-7-year recurrence; **High**	Minor	Town-wide or portions of Town
Hail (≥ 3/4 inch)	• 54% AEP or 2 year recurrence interval (35 years with 1 or more events over 65 years); **High**	Minor	Town-wide or portions of Town
Flooding:			
Riverine Flooding	• 50% AEP (2-year recurrence interval); **High**	Serious	Portions of Town
Poor Drainage Flooding	• Flash Flooding within Berkshire County: 75% AEP or 1.3-year recurrence; **High**	Serious	Portions of Town

Table 2: Tyringham Natural Hazard Overview

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
SEVERE WEATHER HAZARDS			
Severe Winter Weather:			
Snowfall	• 50% AEP or 2-year recurrence interval Heavy Snowfall; **High**	Minor	Town-wide
Ice Storms	• 23% AEP or 4-year recurrence interval Ice Storms. **High**	Minor	Town-wide or portions of Town
CLIMATE-RELATED HAZARDS			
Extreme Temperatures:			
Heat	• Excessive Heat (multi-day period with higher than normal Heat Index) near Tyringham (Berkshire County): 11% AEP or 1 event every 9 years. **Medium**	Minor	Town-wide
Cold	• Extreme Cold/Wind Chill: 35% AEP or 3 year recurrence interval; **High**	Minor	Town-wide
Drought	• Drought near Tyringham (Berkshire County): 5% AEP or 20-year re-currence interval; **Medium** • Massachusetts experiences extended, multi-year droughts about every 20 years; **Medium**	Minor (could be Serious if affects Water Supply)	Town-wide
Wildfire	• The historical data indicates that the probability of wildfire within Tyringham is low. Quantitative probabilities of occurrence are not available. Likelihood may coincide with drought. **Low**	Serious	Portions of Town 84% of Town area is forest

Table 2 cont.: Tyringham Natural Hazard Overview

Natural Hazard	Likelihood/Frequency	Severity/Magnitude	Impact Area
GEOLOGIC HAZARDS			
Earthquake	• The occurrence of historic earthquakes, PGA, and Site Class indicate that the seismic risk at Tyringham is low; **Low**	Serious	Town-wide
Landslide	• According to the Commonwealth of Massachusetts 2013 State Hazard Mitigation Plan, the area near Tyringham has low potential for landslides; **Low**	Minor	Town-wide

Town climate considerations:

Periods of colder temperatures occur at Tyringham and can cause wind chill conditions. Wind chill conditions example:

- 0° F and 25 mph sustained wind speeds, 30-minute exposure
- 5° F and 55 mph sustained wind speeds, 30-minute exposure

The severity and magnitude of extreme heat events at Tyringham is, in part, dependent upon: 1) demographics; and 2) the capability of residents to get cool (e.g. air conditioners in homes). Tyringham's demographic data indicates that certain sectors of the population may be at a greater than average vulnerability:

- 40% of Tyringham's population is older than 65 years
- 11% of Tyringham's population is at the poverty level

About earthquakes at Tyringham

1. The direct earthquake risk to Tyringham is due to the ground motion that results during the earthquake. The 10% in 50 years (500-year recurrence interval) ground motion would be experienced as light to moderate perceived shaking and none to very light damage. The 2% in 50 years (2,500-year recurrence interval) ground motion would be experienced as very strong perceived shaking and moderate damage. Based on HAZUS-MH simulations of Tyringham and Monterey (combined), 60 buildings are predicted to experience damage, ranging from slight to extensive, from the 2,500-year (2% in 50 years) recurrence interval earthquake. The estimated economic losses are about $1.13 million for the 2,500-year event. An earthquake strong enough to cause damage to the natural gas pipelines crossing through Tyringham could result in severe damage and loss of life.

Table 2 cont.: Tyringham Natural Hazard Overview

Climate Change and Tyringham

Tyringham Climate Today	Tyringham Climate 2050
Temperature: The average temperature is about 58°F. • The average low temperature in Winter (December, January and February) ranges from 12°F to 20°F, with the coldest temperature occurring during January. • The average high temperature in Summer (July and August) ranges from 82°F to 81°F, with the coldest temperature occurring during January. • Days above 90°F (based on state-wide data): 10 to 12 days • Heat Index above 105°F(based on state-wide data): 5 to 8	Temperature: The average temperature could be between 2°F and 8°F higher than today. • Average Summer temperature (based on state-wide data): could be between 2°F and 8°F higher than today. • Days above 90°F (based on state-wide data): 20 to 40 days • Heat Index above 105°F(based on state-wide data): 16 • Spring will arrive sooner, summers will grow hotter, and the weather will become more extreme with swings between above-average winter temperatures to extreme cold with large snowfall events.
Intense Precipitation: • The 25-year recurrence interval, 24-hour rainfall at Tyringham: 6.32 inches (NOAA Atlas 14)	Intense Precipitation: Within the Northeast U.S., from 1996 to 2014, the amount of intense rainfall (heaviest 1% of all daily events) was about 50% higher than the period of 1901 to 1995. The frequency and intensity of intense rainfall is expected to increase.

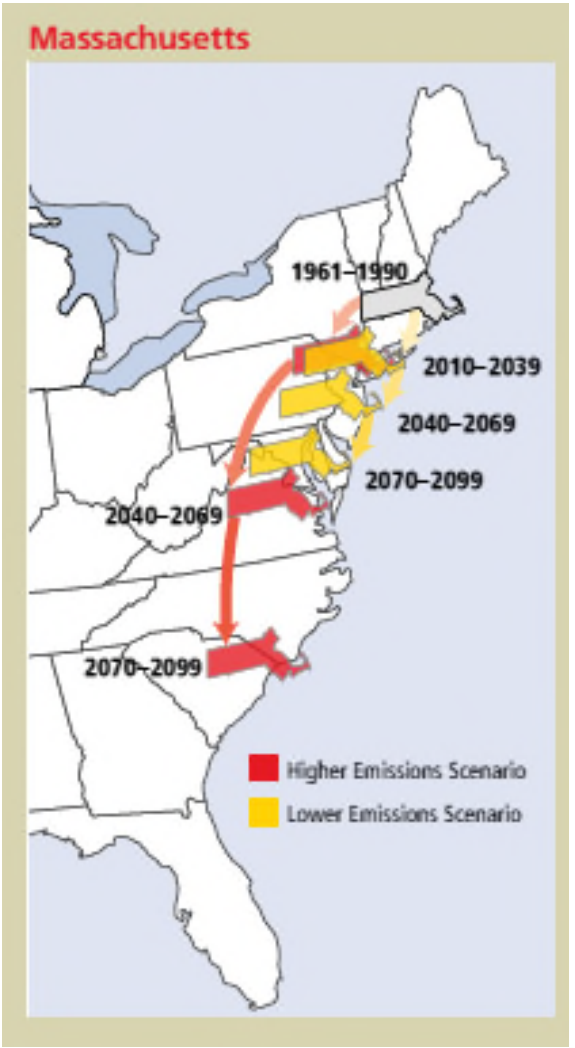


Figure 2: Latitudinal Changes in Regional Climate (source Union of Concerned Scientists)

Table 3: Climate Change and Tyringham

Section 5: Natural Hazard Mitigation Strategies

SECTION 5 - NATURAL HAZARD MITIGATION STRATEGIES

HAZARD RISK MITIGATION GOALS

The Tyringham Local Planning Team (LPT) met on February 11, 2021 to review proposed hazard mitigation goals. The following eleven goals were endorsed by the team.

Mitigation Goals

1. Reduce the loss of life, property, infrastructure, and environmental and cultural resources from natural disasters.
2. Investigate, design and implement structural projects that will reduce and minimize the risk of flooding.
3. Investigate and implement projects that will reduce and minimize the risk of non-flooding hazards.
4. Increase the capacity of local Emergency Managers, DPWs, and Fire, Police and Health Departments to plan for and mitigate natural hazards.
5. Increase public awareness of natural hazard risks and mitigation activities available to them.
6. Improve the quality of the data for the region as it pertains to natural hazards.
7. Improve existing local policies, plans, regulations, and practices to reduce or eliminate the impacts of natural hazards.
8. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
9. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.
10. Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards including impacts from climate change.
11. Work with surrounding communities, regional, the Commonwealth and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

Tyringham has an organizational structure in-place to plan for and respond to natural disasters (see Key Contacts in **Attachment 8**). **Table 4** presented on the following page summarizes existing town-wide hazard mitigation measures already in place in Tyringham and which were presented in the 2012 Berkshire County Hazard Mitigation Plan. The LPT reviewed this list and identified that there have been no significant changes to these measures. Other town-wide applicable hazard mitigation capabilities which are available to the Town are listed in **Table 5**. **Table 6** lists the mitigation measures that were identified in the 2012 Berkshire County Hazard Mitigation Plan, other than existing town-wide mitigation. The table was presented to the LPT on January 12, 2021 to review the status of each mitigation measure to document the progress made since 2012 and to determine if it was deemed still applicable for this plan update, as documented in the table.

HAZARD RISK MITIGATION MEASURES

Prioritization

During the LPT Working Group Meeting on February 11, 2021, mitigation measures were prioritized based on a benefit/cost review process based on local knowledge of the hazard areas, cost information, timeline estimate for implementation and an assessment of benefits and costs.

The LPT evaluated various 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. The LPT developed an approach based on FEMA's March 2013 *Local Mitigation Planning Handbook (*that includes elements derived from the City of Portland Oregon's 2016 Mitigation Action Plan). This approach utilizes a qualitative benefit/cost analysis (although less detailed than used for FEMA's Hazard Mitigation Assistance (HMA) Grants Programs). The approach qualitatively rates benefit and costs in terms of: high, medium and low, 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 (over $50,000):** Would require an increase in revenue via an alternative source (i.e., municipal bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.

Costs, continued.

- **Medium ($10,000—$50,000):** Could budget for under existing capital budget 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 (Less than $10,000):** 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.

EXISTING CAPABILITY	DESCRIPTION
GENERAL MULTI-HAZARDS	
Enforcement of the State Building Code	The 9th Edition of the Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood resistant design, flood-proofing and snow loads.
FLOOD-RELATED HAZARDS	
Participation in the National Flood Insurance Program (NFIP)	Tyringham participates in the NFIP. NFIP provides access to funds in the case of flood related damages.
Floodplain District Bylaw	Floodplain District bylaw requires all development, including structural and nonstructural activities, be in compliance with state building code requirements for construction in a floodplain.
Beaver Management	Tyringham proactively works to manage the beavers and beaver dams in town, in coordination with Town Board of Health, Conservation Commission, and MA Division of Fish & Game.
Stormwater System / Maintenance	The Tyringham Highway Department conducts regular maintenance of the stormwater system. Drainage system components are replaced/upgraded as needed where flooding occurs.

Table 4: Existing Hazard Mitigation Capabilities presented in the 2012 *Berkshire Regional Hazard Mitigation Plan*

EXISTING CAPABILITY	DESCRIPTION
GENERAL MULTI-HAZARDS	
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.
Subdivision Review	Multiple Town of Tyringham departments, such as the Board of Selectmen, Zoning, Planning Board, Building Inspector, Board of Health, Road Superintendent, Fire, Police, Historical Commission and Conservation Commission, review all subdivision and site plans prior to approval.
Portable Water Pumps	Rivers and ponds in town are available to be tapped into if necessary for fire-fighting support.
FEMA Resources	A tanker task force is available through 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 a backup emergency generator for Town Hall. This generator gives the town the ability to sustain operations during the event of an emergency.
Centralized Public Safety Dispatch	The Town utilizes joint communications and dispatch for public safety (Berkshire County Sheriff's 9-1-1 Dispatch Center).
FLOOD-RELATED HAZARDS	
The Massachusetts Stormwater Policy	This policy is applied to developments within the jurisdiction of the Conservation Commission.
SEVERE WEATHER HAZARDS	
Roadway Treatments: Minimize use of road sand to prevent drainage system clogging	The Town uses only salt on paved roads to treat the roads when needed for winter storms. This is done to eliminate the amount of sand that enters catch basins and streams. Sand is used on dirt roads only.
Tree Trimming	The Town of Tyringham conducts regular tree trimming, with the use of a tractor shared by the Towns of Otis and Becket. Utility companies also provide support, including funding. The town responds to downed tree limbs caused by winds, lightning strike reports and other weather-related incidents.
FIRE-RELATED HAZARDS	
Permits Required for Outdoor Burning	The Fire Department requires a permit for outdoor burning. Permits are issued via an online application through Berkshire County (bcburnpermits.com).

Table 5: Existing Hazard Mitigation Capabilities

ID	Category of Action	Description of Action	Action Has Been Implemented / Completed? - Y/N/Partial	Include in Updated Plan? - Y/N	Priority: High / Medium / Low	Comments
1	Property Protection, Emergency Services Protection – Flooding	Retrofit the town hall and the Highway Department to protect from flooding	Y	Y	High	A berm was constructed behind the town hall, highway garage, and library/ post office in 2013. The berm height was recently increased, and reinforced with geotextile fabric & matting to prevent erosion. In addition, a check valve was installed in a nearby catch basin to prevent back flow for further protection of the town hall. Include mitigation action in updated plan related to continued inspection & maintenance of the berm.
2	Prevention – Flooding	Request that FEMA recalculate and delineate the 100-year floodplain for Tyringham, using new computer-generated floodplain data	Partial	N	N/A	Re-mapping by FEMA is currently underway for Tyringham (Housatonic watershed). The Town continues to participate in FEMA meetings regarding the re-mapping process. Include mitigation action in updated plan to continue participation in related FEMA meetings.
3	Prevention – Flooding	Strictly enforce the Tyringham Flood Plain Bylaw	Partial	Y	High	The Town Planning Board is working on an updated bylaw, which is expected to be approved in Town Meeting May, 2021. Include this mitigation action in updated plan as a Town-wide mitigation measure.
4	Prevention – All Hazards	Limit the expansion infrastructure in hazard-prone areas	Partial	N	N/A	This is very general and is addressed by other actions.
5	Prevention – Flooding	Insure the integrity of large beaver dams or breach them in a controlled manner	Y	Y	High	The Town of Tyringham proactively manages beavers and beaver dams, working closely with the Board of Health, Conservation Commission, and MA Department of Fish & Game. Combine mitigation actions 5, 6, 7 and include in updated plan to continue proactive beaver management.

Table 6: Update to Mitigation Measures from 2012 Berkshire Regional Hazard Mitigation Plan

ID	Category of Action	Description of Action	Action Has Been Implemented / Completed? - Y/N/Partial	Include in Up-dated Plan? - Y/N	Priority: High / Medium / Low	Comments
6	Prevention - Flooding	Continue to work with Mass. Fish & Game to investigate perma-nent measures to minimize beaver im-pacts	Y	Y	High	
7	Prevention - Flooding	Investigate the cost of hiring a private contractor to install and maintain beaver control devices	Y	Y	High	
8	Property Protection, Emergency Services Protection – Flooding	Investigate possible protection measures to protect the fire-house from flood events	Y	Y	High	The Tyringham Volunteer Fire Company is pursuing permits to construct a new firehouse, either in the same location with flood mitigation measures, or in a new location outside of the floodplain.
9	Prevention - Winter Storms, Severe Storms, Hurricane & Tropical Storms	Work with the utilities to ensure power lines are clear of debris throughout town, but especially around Goose Pond and are-as over 100 feet	Y	Y	High	The Town participates in a program for regular tree removal. The Town shares a tractor, purchased by the utility company, with the neighboring Towns of Otis and Becket, which is used to clear roads of debris. Include this mitigation action in updated plan as a Town-wide mitigation measure.
10	Public Edu-cation, Prevention – Flooding, Dams	Send letter to dam owners informing them of their inspec-tion and mainte-nance responsibilities.	Y	Y	High	The Town communicates with private property owners to confirm that dam in-spections are completed, and maintains records of completed inspections. Com-bine mitigation actions 10, 11, 12 and include in updated plan to continue track-ing and maintaining dam inspection records.

Table 6 cont.: Update to Mitigation Measures from 2012 Berkshire Regional Hazard Mitigation Plan

ID	Category of Action	Description of Action	Action Has Been Implemented / Completed? - Y/N/Partial	Include in Updated Plan? - Y/N	Priority: High / Medium / Low	Comments
11	Prevention – Flooding, Dams	Work with the owner of the Shaker Pond dam to develop an EAP	Y	Y	High	
12	Prevention – Flooding, Dams	Work with the owner of the South House dam to get the dam inspected and categorized and to ensure that it is in good condition	Y	Y	High	
13	Public Education – All Hazards	Provide leaflets to landowners in hazard-prone areas that discuss hazard mitigation	N	N	N/A	
14	Emergency Services Protection, Public Education – All Hazards	Conduct local disaster response drills and feature them in local news media	Y	Y	High	Town regularly attends REPC meetings. Fire department trains each month.
15	Public Education – All Hazards	Develop and publicize local and regional evacuation routes and shelter locations	Y	N	N/A	The Town has developed local evacuation routes, including winter vs. summer routes for roads that are closed in the winter. These include five routes to evacuate the center of Tyringham to the neighboring towns of Lee, Otis, or Monterey.

Table 6 cont.: Update to Mitigation Measures from 2012 Berkshire Regional Hazard Mitigation Plan

ID	Category of Action	Description of Action	Action Has Been Implemented / Completed? - Y/N/Partial	Include in Updated Plan? - Y/N	Priority: High / Medium / Low	Comments
16	Emergency Services Protection – All Hazards	Develop formal and legally-binding Mutual Aid Agreements for emergency response teams and DPWs	Y	Y	Medium	Continue to Review and Update Current Mutual Aid agreements.
17	Emergency Services Protection – All Hazards	Fill communications gaps by adding new towers where necessary, using existing towers and structure were possible	N	N	N/A	Adequate communications towers are available for emergency service, the Town does not have need for a tower in Tyringahm
18	Emergency Services Protection – All Hazards	Increase local and regional emergency response training	Y	N	N/A	This action is redundant (see action 14)
19	Emergency Services Protection, Property Protection - All Hazards	Re-evaluate shelter capacity for Tyringham residents and determine each shelter's structural ability to withstand natural disaster events	Y	N	N/A	The Town has an agreement with the neighboring Town of Lee for additional sheltering at Lee Elementary School, if needed. Add expanded contact info from email to be sent by LL
20	Emergency Services Protection - All Hazards	Seek the creation of additional shelters where the needs are greatest	N	N	N/A	N/A. See action 19

Table 6 cont.: Update to Mitigation Measures from 2012 Berkshire Regional Hazard Mitigation Plan

ID	Category of Action	Description of Action	Action Has Been Implemented / Completed? - Y/N/Partial	Include in Updated Plan? - Y/N	Priority: High / Medium / Low	Comments
21	Emergency Services Protection - All Hazards	Expand and formalize local agreements for use of shared mass care shelters in the event of a disaster	Y	N	N/A	See action 19.
22	Emergency Services Protection, Property Protection - All Hazards	Determine ability of town governmental centers to withstand a variety of natural hazard events, most notably flooding	N	N	N/A	This action is redundant (see actions 1 & 26).
23	Emergency Services Protection - All Hazards	Develop evacuation protocols for equipment and paperwork from town hall	Y	N	N/A	All important files, documents, and tools have been moved to above the flood elevation, as determined by water line from previous flood events. Include new mitigation action to digitize town records for further protection.
24	Emergency Services Protection - All Hazards	Conduct inventory and prioritization of vital files and equipment that should be protected from loss during disaster	Y	N	N/A	The Town purchased fire and flood-proof safes for the storage of all records throughout town hall. Include new mitigation action to digitize town records for further protection.
25	Emergency Services Protection - All Hazards	Conduct training drill for removal of vital files and equipment	N	N	N/A	
26	Property Protection - All Hazards	Identify historic structures, businesses and critical facilities located in hazard-prone areas, including floodplains and dam failure inundation areas	Y	N	N/A	Town Hall, library, and post office are vulnerable to flooding. Actions taken to protect these structures covered in other mitigation actions.

Table 6 cont.: Update to Mitigation Measures from 2012 Berkshire Regional Hazard Mitigation Plan

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 LPT also estimated the length of time for each mitigation action as follows:

Estimated Timeline

For actions where funding is already available the action or strategy is identified as "ongoing." Since most of the actions were identified as a part of preparing this initial plan, most do not currently have funding. Therefore, length of time for implementation of each mitigation action is 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.

MITIGATION ACTION PRIORITIZATION

Based on an evaluation of the results of the benefit/cost review, the LPT 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 LPT prioritized the mitigation action plan based on the results of the benefit/cost review of the proposed actions as presented in **Table 7** on the next four pages. In addition to the benefit/cost review results based on the elements outlined above, **Table 7** provides details for each action relative to the agencies responsible for leading and coordinating the implementation of each action and potential funding sources.

MITIGATION ACTIONS	Benefits	Costs	Timeline	Priority	Responsible Agencies	Potential Funding Sources
MITIGATION HAZARDS						
Action 1. Continue to participate in local disaster response drills with REPC	Medium	Low	Ongoing	Medium	Town of Tyringham, Regional Emergency Planning Committees (REPC)	Department of Homeland Security, MEMA
Action 2. Digitize Town records to further minimize risk of loss due to natural hazards.	Medium	High	3-5 years	Low	Town Clerk, Tyringham office administrators, EMD, Fire & Police	Town of Tyringham
Action 3. Implement Local Hazard Mitigation Plan	High	Low	Ongoing	High	Planning Department (Lead), All Town Departments and Town Administrator	Town of Tyringham
Action 4. Consider climate change resiliency in the repair, replacement, or construction of new Town-owned facilities, to minimize future impacts from natural hazards, particularly flooding, storm damage, erosion, and high winds	High	Low	Ongoing	High	Town of Tyringham, Planning Department, Board of Selectmen	Town of Tyringham
Action 5. Identify electrical back-up generator needs (new or replacement) in critical facilities such as Town Hall, etc. and purchase as needed	High	High	3-5 years	Medium	Town of Tyringham, Highway Dept., EMD, Fire & Police	MEMA FEMA MA Department of Conservation and Recreation (DCR) Town of Tyringham
Action 6. Continue to Review and Update Current Mutual Aid agreements	Medium	Low	Ongoing	Medium	Fire and Police Departments, Emergency Services	MEMA Town of Tyringham

Table 7: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Priority	Responsible Agencies	Potential Funding Sources
FLOOD HAZARDS						
Action 7. Inspect and maintain berm which protects Town Hall, Highway Department, Library and Post Office from flooding from Hop Brook	Medium	Low	Ongoing	High	Town of Tyringham	Town of Tyringham
Action 8. Culvert Improvement Projects for the Town: Breakneck Road Bridge, Beach Road; and/or Town-wide Culvert Assessment	Medium	Medium to high	Ongoing	Medium	Highway Dept.	FEMA Town of Tyringham
Action 9. Participate in reviews of regulatory floodplain maps updates and revisions being prepared by FEMA.	High	Low to Medium	Ongoing	High	Town Administrator, Planning Dept. Fire and Police HWY Dept., Floodplain Manager Building Dept., Board of Selectmen	FEMA
Action 10. Continue to pursue development of new firehouse, either relocated out of floodplain, or with integrated flood protection measures	High	High	Ongoing	High	Tyringham Volunteer Fire Company	MEMA/FEMA, Town of Tyringham, Tyringham Volunteer Fire Company
Action 11. 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	High	Town Administrator, Planning Dept. Building Dept. Floodplain Manager	FEMA MEMA DCR Town of Tyringham

Table 7 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Priority	Responsible Agencies	Potential Funding Sources
FLOOD HAZARDS						
Action 12. Enhance communication with neighboring municipalities on water resources across Town borders	Low	Low	Ongoing	Low	Tyringham Conservation Commission	Housatonic Valley Association Town of Tyringham Town of Lee Town of Otis
Action 13. Evaluate the possibility of participating in FEMA's Community Rating System (CRS) program that would result in reducing the cost of NFIP premiums while improving flood resiliency.	High	Medium	1-2 years	High	Town Administrator; All Departments	NFIP DCR MEMA Town of Tyringham
Action 14. Plan for land acquisition and other steps to develop a public-safety complex at a location outside of the floodplain, to include facilities for police, fire, highway, and emergency management.	High	High	3-5 years	Medium to High	Tyringham Volunteer Fire Company Police Department Highway Department	FEMA/MEMA EOEEA Town of Tyringham
CLIMATE RELATED HAZARDS						
Action 15. Conduct a Town-wide climate change vulnerability assessment to receive designation from MA EEA under the MA Municipal Vulnerability Preparedness (MVP) Program	High	Low to Medium	1-2 years	Medium	Town Administrator and all Town agencies and departments	EOEEA, Town of Tyringham
Action 16. Consider integrating climate change considerations into design and plan review process for future development and redevelopment projects	Medium	Low	Ongoing	High	Planning Board, Building Department	EOEEA, MEMA, Town of Tyringham

Table 7 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

MITIGATION ACTIONS	Benefits	Costs	Timeline	Priority	Responsible Agencies	Potential Funding Sources
GEOLOGIC HAZARDS: EARTHQUAKE						
Action 17. Consider completing a detailed quantitative study of the seismic risk to natural gas pipelines and include an alternatives analysis to identify seismic retrofit measures based on the results of the quantitative study.	High	Low to Medium	3-5 years	Low	Town of Tyringham	EOEEA, MEMA, Town of Tyringham
SECONDARY HAZARDS: DAM FAILURE						
Action 18. Continue to track inspection and maintenance by private dam owners; maintain records of inspections and Emergency Action Plans (Goose Pond, Shaker Pond, Steadman Pond dam in Monterey)	Medium	Low	Ongoing	High	Town of Tyringham Emergency Management, Private dam owners	Town of Tyringham

Table 7 cont.: Natural Hazard Mitigation Action Matrix & Prioritization

Section 6: Regional and Inter-community Relationships

SECTION 6 - REGIONAL AND INTERCOMMUNITY CONSIDERATIONS

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

The Tyringham Planning Board is the primary Town agency responsible for regulating development in town. As a part of developing this updated natural hazards mitigation plan, the Town coordinated with the Massachusetts Department of Conservation and Recreation to update pertinent repetitive loss property and NFIP claims related details for the Town. Local, regional and state entities were provided an opportunity to provide input via the online posting of the draft plan. The Town will continue to collaborate with local, regional and state agencies as a part of the implementation of actions outlined in this plan. Below is a more detailed overview of the regional and intercommunity considerations for this plan.

REGIONAL PARTNERS

As one of the smallest towns in Massachusetts, based on population, Tyringham relies on regional partners and neighboring municipalities to provide or supplement a variety of services. The Town has mutual aid agreements with area municipalities for the provision of public health, fire, police, and emergency management services. The Town utilizes the Berkshire County Sheriff's 9-1-1 Dispatch Center, located at 467 Cheshire Road in Pittsfield, MA., which also provides a community emergency notification system (Reverse 911). The Berkshire Regional Planning Commission offers services to its member towns, including Tyringham, consisting of community planning and economic development, data and information services, emergency preparedness planning, environmental and energy planning, public health, transportation planning, and regional initiatives such as educational and recreational resources. Tyringham is a member of the Southern Berkshire Regional Emergency Planning Committee, which exists to enhance cooperative regional emergency planning, including procedures to deal with hazardous materials emergencies, right-to-know requirements, and community awareness, as well as preparing for emergencies and disasters.

REGIONAL FACILITIES WITHIN TYRINGHAM

There are no major regional facilities within the Town of Tyringham. The Sisters of the Visitation of Holy Mary monastery, located at 14 Beach Road, offers daily mass and public presentations with attendees visiting from the surrounding Berkshire County communities.

INTERCOMMUNITY CONSIDERATIONS

Tyringham is dependent on access to neighboring towns for services such as schools, childcare, emergency, hospital and medical services, and grocery shopping. Students from Tyringham attending public school from Kindergarten through 12th grade attend the public schools in neighboring Lee.

The potential impacts of a breach of Goose Pond Dam to the neighboring town of Lee is an important consideration. According to the dam's Emergency Action Plan and inundation mapping, a breach of Goose Pond Dam would flood low-lying areas along Goose Pond Brook in Tyringham and Lee. The flood wave might impact major roads in Lee, such as Routes 20, 109 and 90 (the Massachusetts Turnpike), and impact areas along Hop Brook and the Housatonic River.

Section 7: Plan Adoption and Implementation

SECTION 7- PLAN ADOPTION AND IMPLEMENTATION

Adopting, implementing, monitoring, evaluating, and updating the Town's Local Natural Hazard Mitigation Plan are necessary steps 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.

PLAN ADOPTION

The Draft Plan was provided to the Town on March 10, 2021 for review and distribution to the public, and local, regional and state stakeholders. The Town posted the Draft Plan on the Town website on March 30, 2021 for public review and input. Due to the COVID-19 pandemic, posting the plan on the Town website was utilized for outreach in lieu of public meetings in person. Based on feedback received from the public online, the Draft Plan was revised on May 3, 2021. 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 approved by the Tyringham Board of Selectmen on **ADD MONTH XX, 2021**. A copy of the plan adoption letter is included in the front of this plan.

PLAN IMPLEMENTATION

The implementation of the Plan commences 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. A local hazard mitigation working group (including the LPT) will be responsible for overseeing the implementation of the plan.

In addition, the Local Planning Team (LPT), that includes Town officials as presented in Section 2, 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, or those to be developed, such as the following:

- Updates to the Local Building Code based on changes outlined in the new 9th Edition of the Massachusetts Building Code
- Tyringham Master Plan (forthcoming)
- Goose Pond Dam Emergency Action Plan Update
- Town Bylaws, Open Burning Regulations
- Zoning By-Laws, 2017
- Tyringham Subdivision Regulations, 2007

PLAN MONITORING AND EVALUATION

On an annual basis, the LPT led by the Town Administrator, 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, evaluation and update of the Town's 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 Tyringham, the Town may update the plan at that time with actions to address unexpected impacts resulting from the damages to the community, if needed.

FEDERAL AND STATE FUNDING SOURCES

Several of the proposed hazard mitigation projects and actions may be eligible activities for funding under the three FEMA Hazard Mitigation Assistance (HMA) Grant Programs. The FEMA HMA Grant Programs include two non-disaster mitigation grant programs that include the Flood Mitigation Assistance (FMA) grant and the Building Resilient Infrastructure and Communities (BRIC) grant programs, and one post-disaster mitigation grant program that is the Hazard Mitigation Grant Program (HMGP). State and federal Funding source details are presented in **Attachment 5.**

Attachment 1: Community Profile

Community Profile Overview

This section of the Plan presents details about the Town assets which categorically include:

- People
- Support, High Occupancy and Vulnerable Population facilities;
- Essential Facilities including emergency response, police, fire, hospitals, etc.;
- Lifeline Systems including water, wastewater, electrical power, etc.;
- High Potential Loss Facilities, including high hazard dams; and
- Transportation Infrastructure.

Demographic Overview

Per the U.S. Census Bureau (2018) American Community Survey 5-year estimates:

Age and Sex:

Population:	452
Population change since 2010*:	125 (+ 38%)

**Tyringham population of 327 listed in 2012 Berkshire County Hazard Mitigation Plan*

Percent female/male:	54%/46%
Age:	
persons <18 years:	13%
persons 18 to 64:	47%
persons ≥ 65 years:	40%

Race:

White alone:	95%
Black or African Amer. alone:	1%
Amer. Indian or Alaska Native alone:	0
Asian alone:	0%
Two or more races:	0%
Hispanic or Latino:	4%
White alone, not Hispanic or Latino:	95%

Education:

High school graduate or higher:	97.9%
Bachelor's degree or higher:	43.5%

Economy:

In civilian labor force, total, greater 16 years: (2012 to 2016)	60.6%
In civilian labor force, female, greater 16 years: (2012 to 2016)	58.6%

Income and Poverty:

Median household income:	$78,750
Per capita income:	$56,162
Persons in poverty:	10.9%

Family and Living Arrangements:

Households:	182
Persons per Household:	2.3
Language spoken at home other than English, greater than 5 years:	9%
Median house cost:	$400,000
Percent owner-occupied:	88%

Population Density: 24.3/sq. mile

The Town has a total area of 18.9 square miles that includes 17.5 square miles of land and 1.4 square miles of water. It is a rural, residential community with steep, forested hillsides rising up from Tyringham Valley through which Hop-Brook, the town's main stream, flows.

Demographics

Based on the U.S. Census Bureau (2018) American Community Survey 5-year estimates, the population per square mile is 24.3, which is lower than the average for Massachusetts as a whole (839) and Berkshire County (141.6). (**Figure 1-1**)

The number of residents has increased from 327 in the 2010 US Census to 452 (estimated) in 2018. Tyringham includes a largely white population, representing about 96% of all residents. Hispanics or Latinos make up the largest, and only, single minority group at 4% of all residents.

The population includes 13% of residents under the age of 18, 47% between the ages of 18 to 64, and 40% who are 65 years or older.

There are 182 households, with an average household size of 2.3.Tyringham has 43.1% of its housing units classified as vacant, which is double the percentage in Berkshire County (20.1%). A housing unit is classified as vacant by the U.S. Census if no one is living in it at the time of the interview, or if the unit is entirely occupied by persons who have a usual residence elsewhere (seasonal housing units).

The median household income in Tyringham was $78,750, which is above the median averages of $68,563 for the Commonwealth and $55,190 for Berkshire County. Poverty is at 10.9% which is slightly higher than the Commonwealth rate of 10.4% but less than the County rate of 12%.

Housing costs are $400,000 for the median value, owner-occupied housing unit compared to the Commonwealth at $333,100 and Berkshire County at $208,500. 88% of the housing units are owner-occupied compared to 62.1% for Massachusetts and 68.9% for Berkshire County.

Social Vulnerability

The term Social Vulnerability describes how resilient a community is to external stresses, such as natural hazards, on human health. The Social Vulnerability Index (SVI) employs U.S. Census Bureau variables to identify neighborhoods that may need additional support in preparing for hazards or recovering from disasters, and is a useful tool for emergency response planners and public health officials. U.S. Census Bureau data to determine the social vulnerability of every census tract (census tracts are subdivisions of counties for which the Census Bureau collects statistical data). The SVI ranks each tract

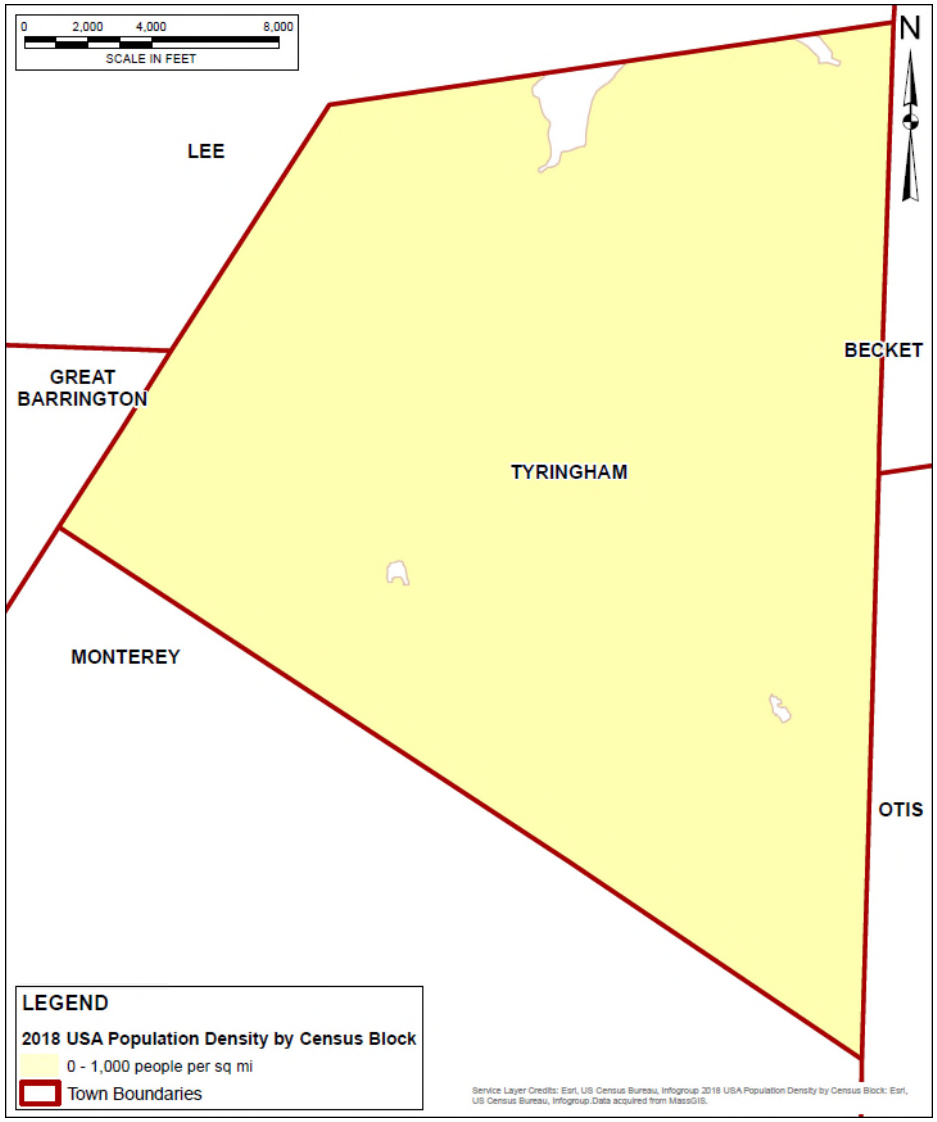


Figure 1-1: Population Density

on 15 social factors, including poverty, lack of vehicle access, and crowded housing, and groups them into four related themes: 1) Socioeconomic status; 2) Household Composition/Disability; 3) Minority status and language; and 4) English language proficiency, housing, and transportation. Each tract receives a separate ranking for each of the four themes, as well as an overall ranking.

Census Tract 9332 includes Tyringham and the neighboring Town of Monterey.

The SOVI for the entire census tract is categorized as Very Low, as shown in **Figure 1-2**.

The ranking for each of the four themes listed above was identified using the SVI Interactive Map for SVI Year 2016 (https://svi.cdc.gov/map.html). The rankings are summarized in **Table 1-1**.

Theme	SVI	Description
Socioeconomic	0 - 0.25	Lowest Vulnerability
Household Composition / Disability	0.25 - 0.5	Slightly Elevated
Minority / Language	0 - 0.25	Lowest Vulnerability
Housing / Transportation	0 - 0.25	Lowest Vulnerability

Table 1-1: Tyringham Social Vulnerability Profile Analysis
https://svi.cdc.gov/map.aspx
Centers for Disease Control and Prevention/ Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. Social Vulnerability Index 2018 Database Massachusetts. data-and-tools-download.html. Accessed on 9/14/2020.

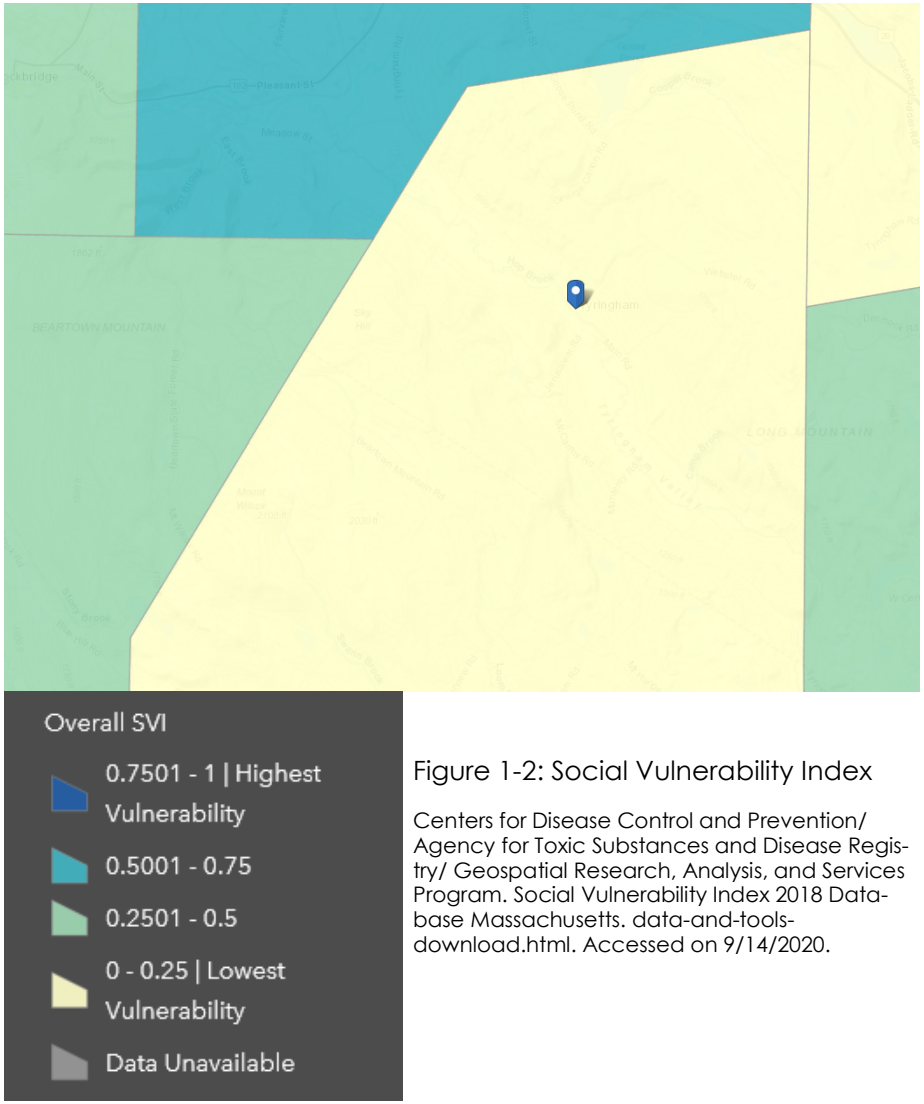


Figure 1-2: Social Vulnerability Index

Centers for Disease Control and Prevention/ Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. Social Vulnerability Index 2018 Database Massachusetts. data-and-tools-download.html. Accessed on 9/14/2020.

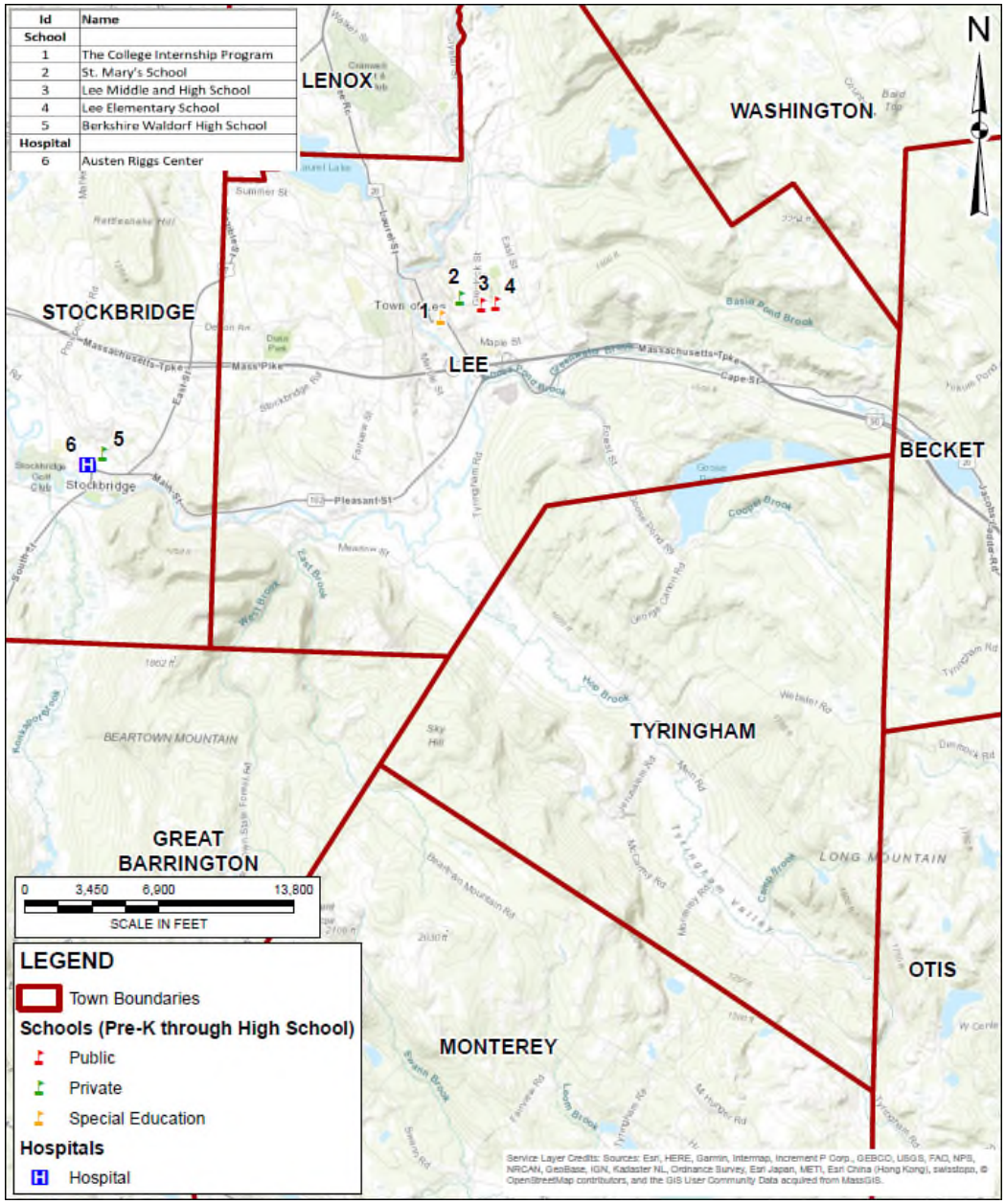


Figure 1-3: Support, High Occupancy and Vulnerable Population Facilities

Support, High Occupancy and Vulnerable Populations

There are very few Support, High Occupancy, and Vulnerable Populations in Tyringham. Students from Tyringham attending public school from Kindergarten through 12th grade attend the public schools in neighboring Lee, shown on **Figure 1-3**. The nearest hospitals are Fairview Hospital in Great Barrington, MA and Berkshire Medical Center in Pittsfield, MA. Elderly housing, long-term care facilities, and children's daycare centers are located in the neighboring towns of Lee, Great Barrington, Lenox, Monterey, Otis, and Stockbridge. The Town has a Council on Aging which meets at Town Hall for socialization and exercise. A monastery, Sisters of the Visitation of Holy Mary, is located at 14 Beach Road in Tyringham.

Land Use (Existing)

According to MassGIS parcel data, Tyringham has 583 land parcels, broken down by general land use category as shown in **Table 1-2** and presented in **Figure 1-4**. About 0.4% (by area) of land in the Town is identified as residential. About 6.3% (by area) of land is identified as agricultural. The Tyringham Valley, through which Hop Brook flows, contains farmlands and Tyringham Cobble, a conservation area, and was identified as a Land Protection Target Area by the Berkshire Natural Resources Council (The Regional Plan for the Berkshires, Berkshire Regional Planning Commission, May, 2000).

Open Space: The majority of open space lands in the Town are held privately, under land trust, or by the federal government, as shown on **Figure 1-5**. The Town owns a 1.5 - acre town park, which is occupied by a ball field and children's play area and is managed by the Town of Tyringham Parks Commission. The Town also owns a 4 - acre parcel that is home to the Town pool. A 10 - mile segment of the Appalachian Trail meanders through Tyringham, protected by a combination of federal, state, and land trust protected lands.

The open space and recreational lands within the Town of Tyringham are presented on **Table 1-3**.

The Town of Tyringham is entirely zoned as Agriculture / Residential District, as shown on **Figure 1-6**. This district permits uses by right including one or two family dwellings, agriculture, religious or educational uses, small home-based business, and solar energy systems or solar arrays not greater than one acre. The Town also includes one overlay district, the Floodplain District. The Floodplain District includes all Zone A flood hazard areas designated on the Tyringham Flood Hazard Boundary Maps issued by FEMA.

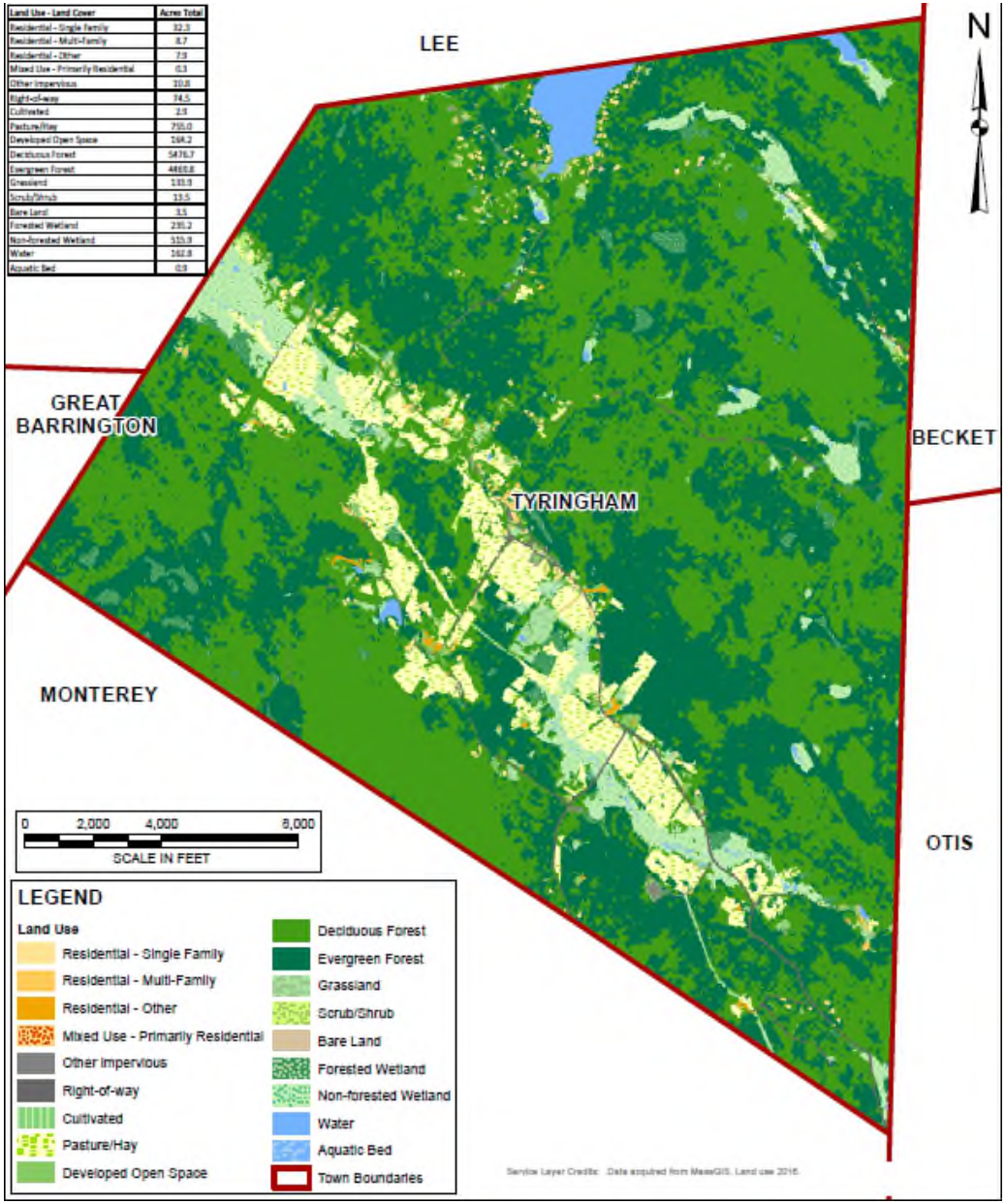


Figure 1-4: Existing Land Use

Land Use / Land Cover	Acres Total	Acres (%)
Residential:		
Single-Family	32	0.3%
Multi-Family	9	0.1%
Other Residential	8	0.07%
Mixed Use—Primarily Residential	0	0.0%
Other Impervious	11	0.09%
Right-of-Way	74	0.6%
Agricultural	758	6.3%
Developed Open Space	164	1.4%
Forest:		
Deciduous Forest	5477	45.4%
Evergreen Forest	4470	37.0%
Forested Wetland	235	1.9%
Vacant Land:		
Grassland	134	1.1%
Scrub/Shrub	14	0.1%
Bare Land	3	0.03%
Non-forested Wetland	516	4.3%
Water	163	1.3%
Aquatic Bed	1	0.01%
TOTAL	12,069	100.0%

Table 1-2 Land Use / Land Cover (MassGIS)

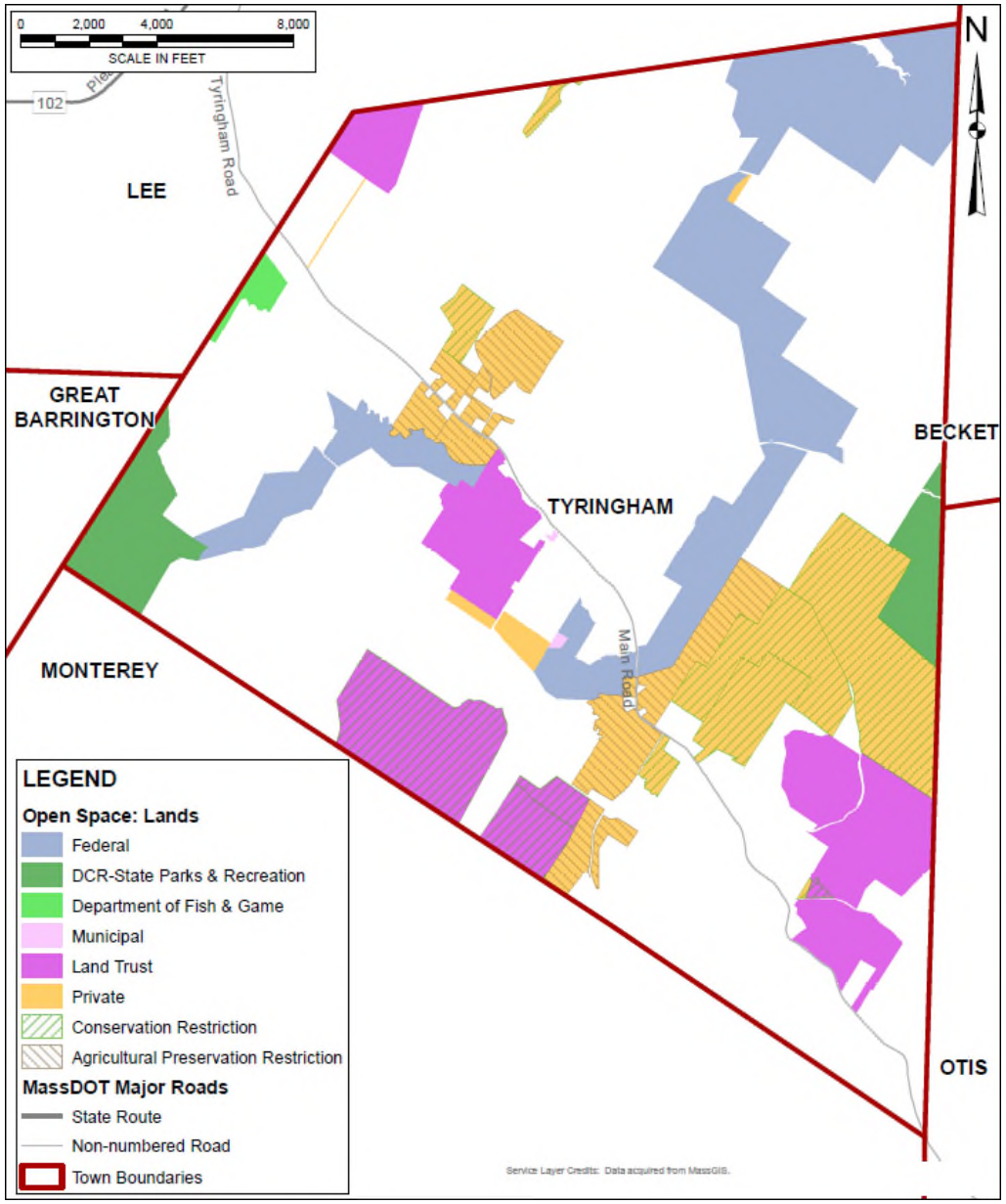


Figure 1-5: Open Space

	Acres	Owner
Steadman Pond WCE -Wildlife Sanctuary	34.77	Berkshire Natural Resources Council
Beartown State Forest	382.50	DCR -Division of State Parks and Recreation
Hop Brook WMA -Wildlife Sanctuary	36.23	Department of Fish and Game
Appalachian Trail Corridor	12.77	Howard - Jerusalem Road LLC
Tyringham WCE -Wildlife Sanctuary	315.84	Howard - Jerusalem
Appalachian Trail Corridor	1,453.12	National Park Service
Ashintully Gardens -Park	136.41	The Trustees of Reservations
McLennan Reservation - Conservation Area	340.97	The Trustees of Reservations
Tyringham Cobble - Conservation Area	217.48	The Trustees of Reservations
Town Park	1.45	Town of Tyringham
Tyringham Pool	4.13	Town of Tyringham
Appalachian Trail Corridor	30.12	Urquhart Sidney H
Total	2,965.79	

Table 1-3 Open Space /Recreational Lands in Tyringham (Outdoor Recreation Plan, Berkshire County 2020 (BRPC)

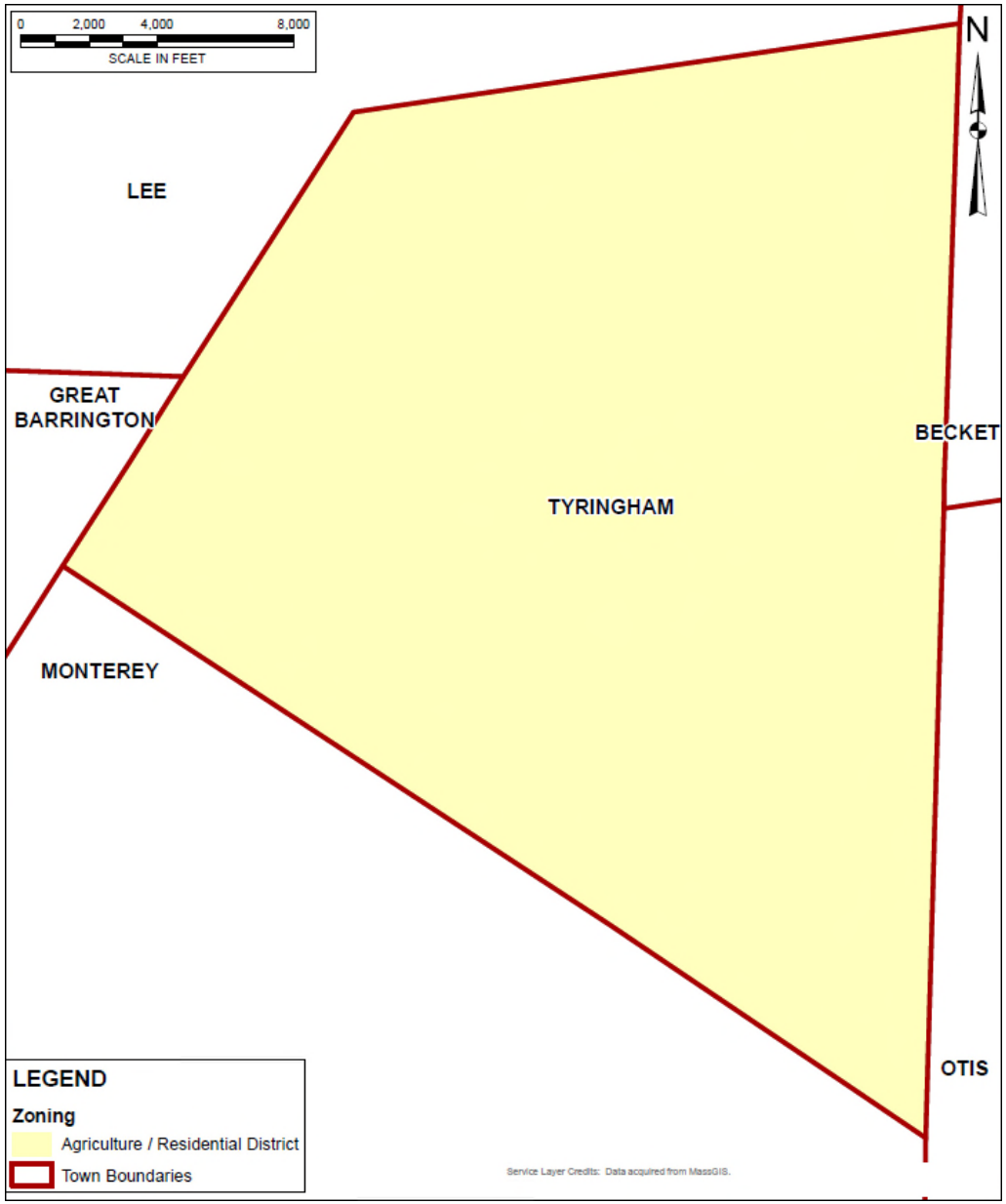


Figure 1-6: Zoning Map

Land Use (Future)

The Sustainable Berkshires Executive Summary (BRPC) presents a *Future Land Use Map* which identifies areas where specific development patterns and associated land uses are desired by the Berkshire County region. Municipalities are encouraged to adhere to the land use categories depicted on the *Future Land Use Map* for zone changes and development policies. In Tyringham, the identified land use categories include Resource Conservation (very low density), Rural Residential (low density), and Outdoor Recreation Neighborhood (medium to high density) around Goose Pond. These land use categories adhere closely to the existing development patterns within the Town. At the time of preparation of this Hazard Mitigation Plan, there were no planned developments in Tyringham.

Transportation Infrastructure

According to the 2012 Berkshire County Hazard Mitigation Plan, "Berkshire County is serviced by one interstate highway (Rt. 90, also known as the Massachusetts Turnpike) and several main roadways. The Turnpike is the major east-west route, which travels through the southern section of the region. Other east-west routes are Route 20 in the south, Route 9 in the central region, and Route 2 in the north. Major north-south roadways are Routes 7 and 8".

According to the MassDOT Road Inventory Municipal Data Viewer, there are 27.276 miles of roads in Tyringham, with 25.575 miles (94%) under the jurisdiction of the Town. The remaining roadways are unaccepted, but there are no roadway miles under the jurisdiction of MassDOT.

The Berkshire Regional Transit Authority (BRTA) bus route nearest to Tyringham is located in the neighboring Town of Lee. The Tyringham Council on Aging offers transportation for seniors for doctor appointments or other reasons.

The Berkshires has four local airports, the Pittsfield Municipal Airport; the Harriman-and-West Airport, North Adams' municipal airport; and the Walter J. Koladza Airport, Great Barrington's commercial airport (2012 Berkshire County Hazard Mitigation Plan). According to the *Infrastructure and Services* section of *Sustainable Berkshires, Long-Range Plan for Berkshire County*, the Pittsfield Municipal Airport offers business and casual travel access to the region via private and chartered aircraft. The nearest international airport is Bradley International Airport in Windsor Locks, Connecticut.

Numerous bridges and culvert crossings are located within Town, as shown on **Figure 1-7**. Major (MassDOT) bridges are listed as follows in **Table 1-4**.

No rail systems currently provide commuter or other types of freight service to Tyringham. Rail passenger service is offered by AMTRAK daily on its "Lakeshore Limited" route from Boston to Chicago through Pittsfield. The schedule does not allow travel to Boston without an overnight stay (*Infrastructure and Services* section of *Sustainable Berkshires, Long-Range Plan for Berkshire County).*

Figure ID	Bridge Name
1	Meadow Street, in Lee - Over Hop Brook
2	Breakneck Road - Over Hop Brook
4	Jerusalem Road - Over Hop Brook
5	Main Road - Over Hop Brook
6	Main Road - Over Hop Brook
8	Monterey Road - Over Hop Brook
9	Fenn Road - Over Camp Brook
10	Main Road - Over Camp Brook
11	Main Road - Over Hop Brook

Table 1-4 MassDOT Bridges in Tyringham

Monterey Road over Hop Brook (#8 on Figure 1-7) was being replaced during the preparation of this Hazard Mitigation Plan update. Jerusalem Road over Hop Brook (#4 on Figure 1-7) is slated for replacement in 2024.

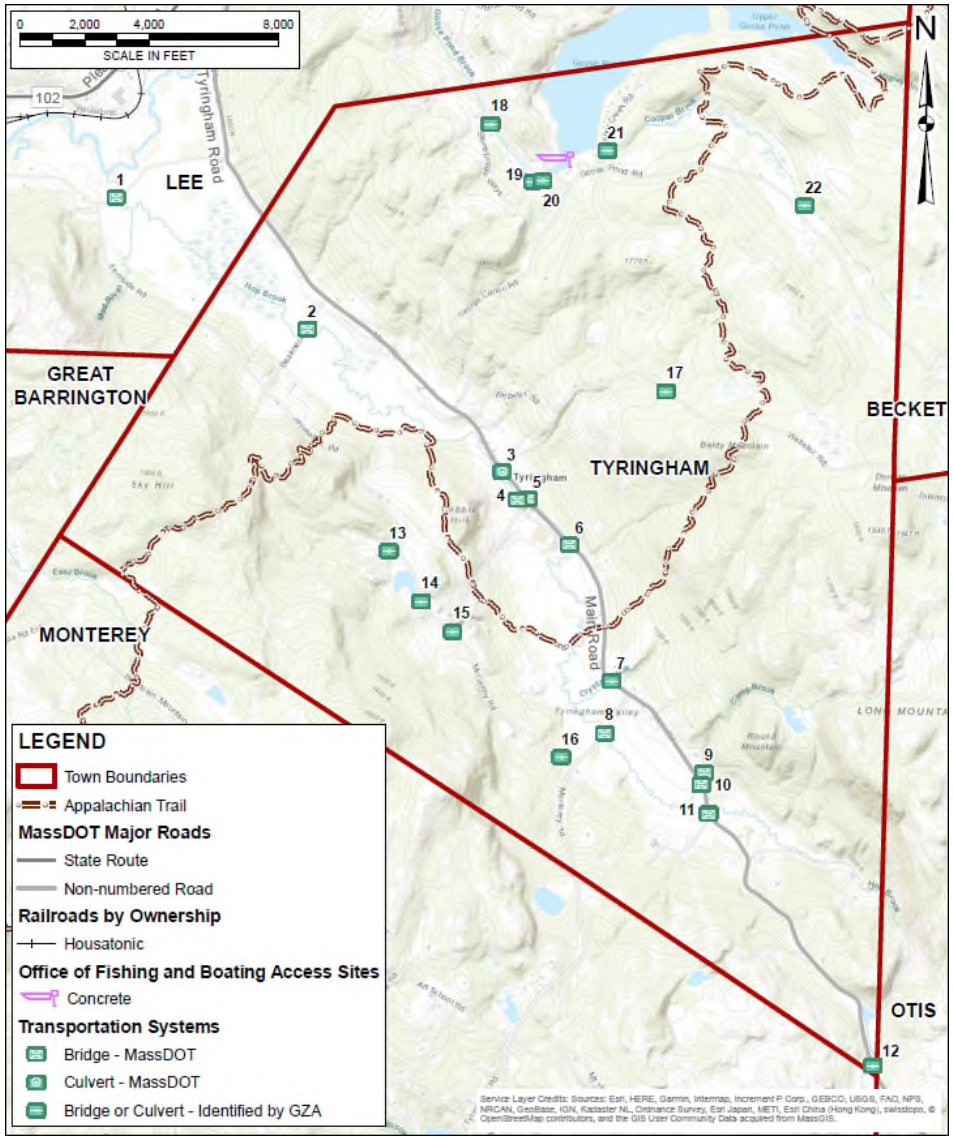


Figure 1-7: Transportation Infrastructure

Essential Facilities and Lifeline Systems

Essential Facilities and Lifeline Systems in Tyringham are presented in **Figure 1-8**. Essential facilities include facilities that provide critical services including public safety (e.g. police, fire, emergency shelters), health care, and town and regional services necessary for response during and after natural disasters. More information about these services are described below. Lifeline Systems include power generation and transmission, communication systems, potable water supply and sanitary wastewater treatment.

Public Safety and Health Care

Public safety within the Town of Tyringham is the responsibility of the local Police Department, Fire Department, Emergency Management, and Highway Department. The Tyringham Police Department and Highway Department are located at 116 Main Road and the Fire Department is located at 100 Main Road, in Tyringham.

The Police Department consists of 3 officers, plus the Chief. The Fire Department in Tyringham is an all-volunteer fire department with 13 volunteers. The fire staff includes the Fire Chief / Forest Fire Warden, Deputy Fire Chief / Deputy Forest Fire Warden, 1st Assistant Fire Chief, and 2nd Assistant Fire Chief. The Fire Department includes First Responders with ambulatory services provided from the neighboring Town of Lee, under a mutual aid agreement with Lee, Lenox and Becket Amb. Berkshire County. The Department is tasked with providing fire protection (fire prevention and fire extinguishing), emergency medical response, search and rescue, fire education and a host of other services. The department has several 4 x 4 vehicles, all terrain vehicles, and snowmobiles, and a water truck.

The Town utilizes the Berkshire County Sheriff's 9-1-1 Dispatch Center, located at 467 Cheshire Road in Pittsfield, MA., which also provides a community emergency notification system (Reverse 911). A microwave communication tower is located on George Cannon Road.

The Highway Department is responsible for maintaining the Town's roadways, parks, playgrounds, and town cemeteries. The Highway Department also maintains town vehicles. The Town Garage is located at 116 Main Road, and additional Highway Department facilities are located at 27 Monterey Road.

The Town has mutual aid agreements with area municipalities for the provision of public health, fire, police, and emergency management services.

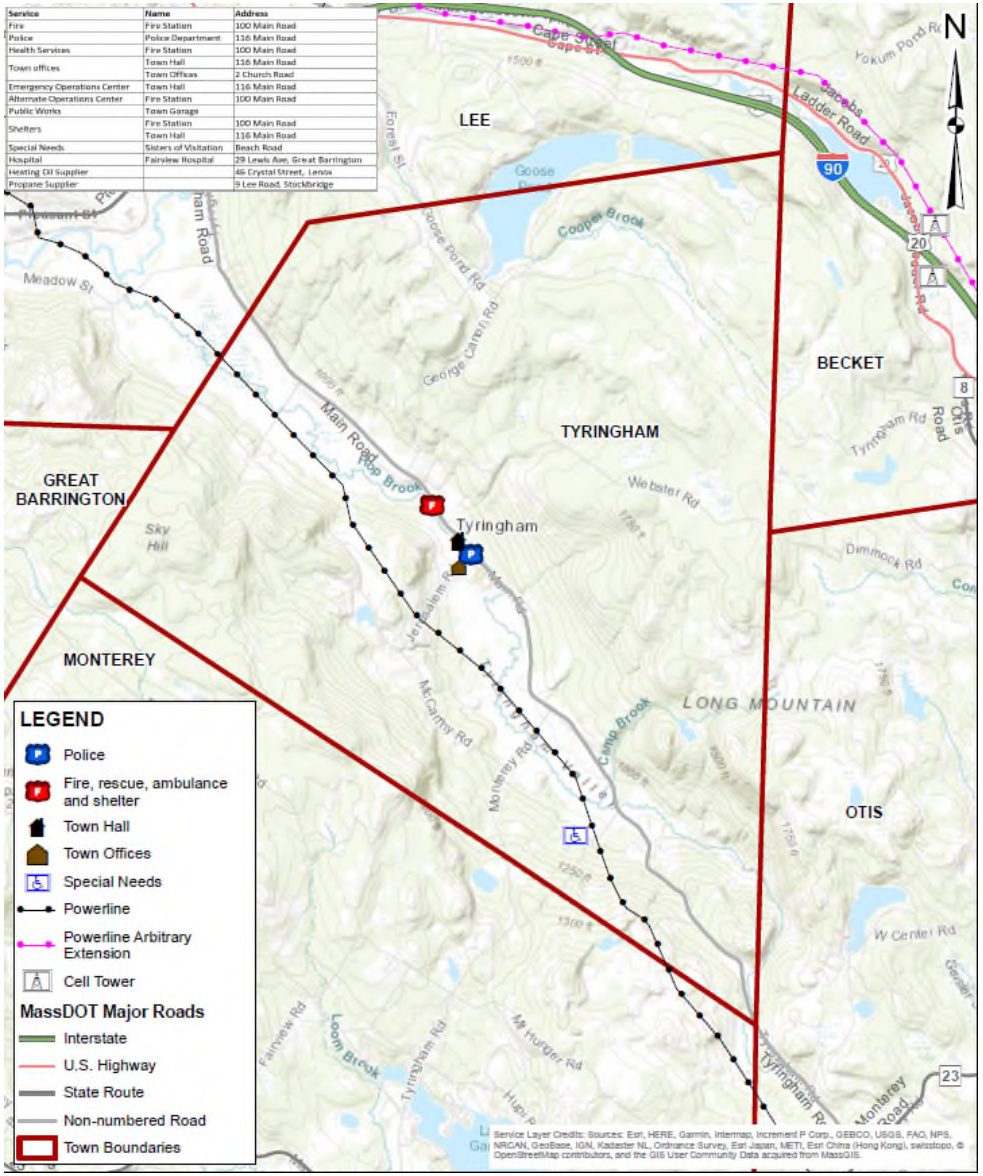


Figure 1-8: Essential Facilities and Lifeline Systems

The community emergency shelters are located at the Fire Station at 100 Main Road and the Town Hall at 116 Main Road. The Town has an agreement with the Town of Lee for the use of Lee Elementary School as additional sheltering capacity, if needed.

Utilities

Gas service in Berkshire County is provided by Berkshire Gas. Three major natural gas service pipelines traverse Tyringham (See **Figure 1-9**). Cell phone service is available from AT&T, Sprint, and Verizon, but "dead cell zones" are scattered throughout Berkshire County (Sustainable Berkshires Executive Summary, BRPC). Cell service is poor within Tyringham. Eversource is the electric provider in Tyringham. Cable, internet, and telephone service is provided by Charter via fiber optic cable that was installed in early 2020. Telephone service is also provided by Verizon.

Every municipality in Berkshire County has access to the Massachusetts Broadband Institute (MBI) Network, an open-access fiber-optic network created by the Broadband Act in 2008. The MBI network extends into Tyringham (*Infrastructure and Services* section of the *Sustainable Berkshires, Long-Range Plan for Berkshire County*, 3/20/2014).

Water Supply

Tyringham does not have a municipal water supply system. There are no Public Water Systems in Tyringham. Drinking water is provided to residents and Town facilities via private wells or springs. There are a few private wells in the town which have shown indications of limited supply. There is a general concern by some residents about the possibility of well contamination from deicing materials used on roadways. However, there have been no reports of contamination being detected.

Water Pollution Control

Wastewater from residential and Town properties in Tyringham is managed by on-site septic systems.

From the *Infrastructure and Services* section of the *Sustainable Berkshires, Long-Range Plan for Berkshire County* (BRPC, 3/24/2014): "Much of the land in the Berkshires is unsuitable for on-site septic systems due to the nature and composition of the soils. As a result, the region is experiencing a number of failed septic systems that have the potential to contaminate the environment. To upgrade these systems is costly. Some communities, such as Hinsdale, have chosen to extend sewer service to critical areas where failing systems are a problem. This is a special concern to lake communities where a high density of homes around lakes is common and inadequate/poor treatment is affecting the health of the lake." However, there are no reported concerns with septic systems in the Town of Tyringham.

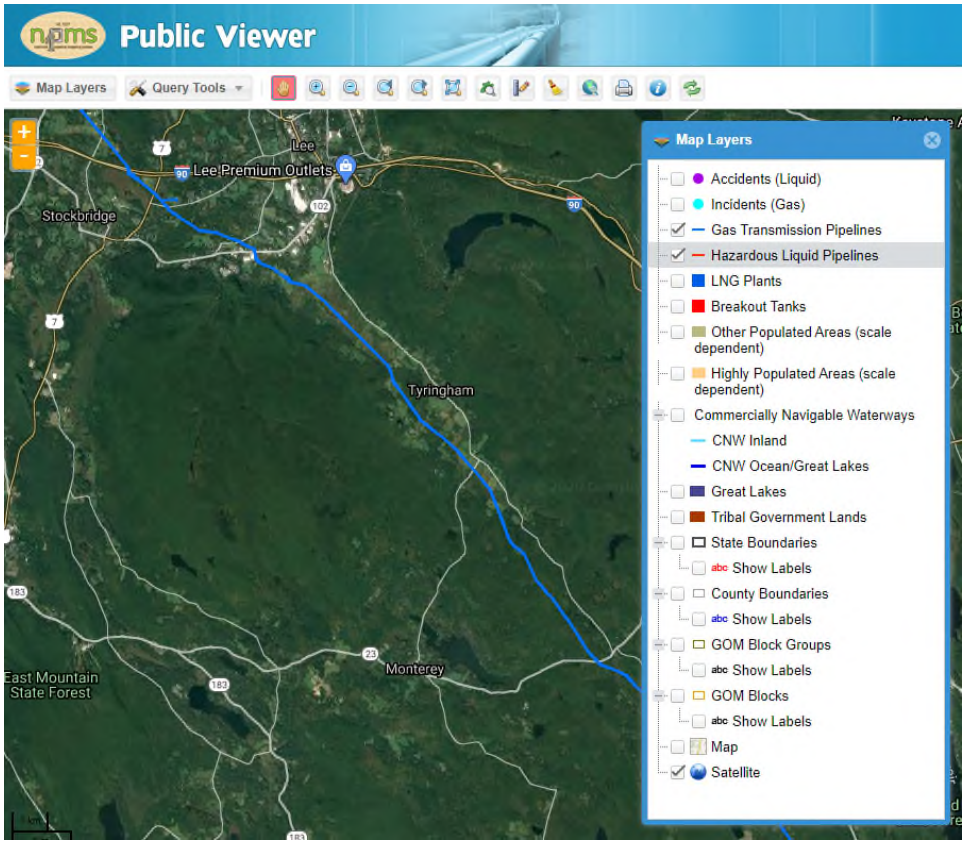


Figure 1-9: Gas Transmission Pipeline through Tyringham (Source: National Pipeline Mapping System, Pipeline and Hazardous Materials Safety Administration)

High Potential Loss Facilities: Dams

Goose Pond Dam: Goose Pond is retained by a Large Size, High Hazard potential earthen embankment dam. The dam is located east of Cooper Town Road off of Goose Pond Road (**Figure 1-10**). This dam is owned and operated by the Goose Pond Dam Maintenance District. A flood wave from a dam breach would potentially inundate properties near the dam and along Goose Pond Road before leaving Tyringham and entering Lee. The dam length is under 285 linear feet and the dam height is about 27 feet.

Shaker Pond Dam: A second, Significant Hazard dam, is located in the southwestern area of the Town, off of Jerusalem Road, between Brace Hill Road and McCarthy Road. This dam is privately owned.

South House Pond Dam and **Schell Dam** are both privately owned.

Goose Pond and Dam (in red)

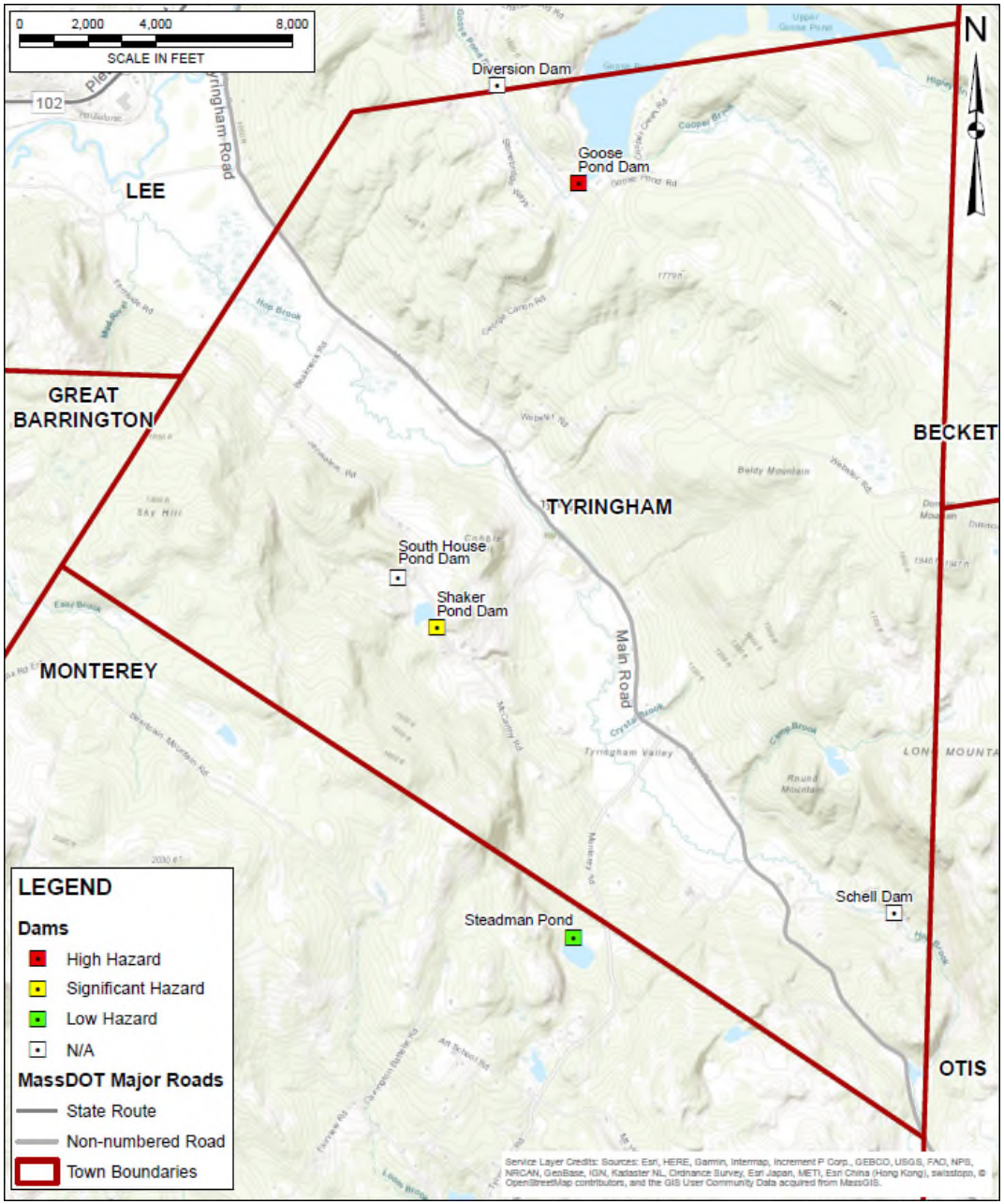


Figure 1-10: Dams in Tyringham

Stormwater Management

The Tyringham Highway Department maintains a separate stormwater system to collect and convey stormwater runoff from municipal roadways and properties. There are a few road-stream culvert crossings with direct drains that collect and convey stormwater runoff into the culvert. A former drainage ditch along Main Road was converted to a subsurface diversion pipe to protect septic systems from being flooded. The Tyringham Highway Department maintains these stormwater system components as needed.

Hazardous Materials Facilities and Landfills

There is one facility regulated by MassDEP's Bureau of Air and Waste, formerly the Bureau of Waste Prevention (DEP BWP Major Facilities) located in Tyringham as shown in **Figure 1-11.** The facility is the BWP Land Disposal Site (landfill) located on Monterey Road, near the intersection with McCarthy Road. The property is currently operated as a transfer station and is also used by the Town Highway Department to store equipment and supplies.

Natural Resources

Tyringham lies primarily within the Housatonic River watershed, with a small portion in the Farmington River watershed (see **Figure 1-12**). Hop Brook is one of the major streams in the Town and flows roughly parallel to Main Road in a north-westerly direction. Other streams include Merry Brook, Crystal Brook, Camp Brook, Cooper Brook and Higley Brook. The water bodies include part of Goose Pond, Shaker Pond, South House Pond, Sodom Pond, and a number of approximately 1 acre plus beaver ponds (Berkshire County Hazard Mitigation Plan, BRPC, February 8, 2012).

Endangered and Priority Habitats associated with the Massachusetts Natural Heritage and Endangered Species Program (MA NHESP) are associated primarily with Hop Brook, as shown on **Figure 1-13**. 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, 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.

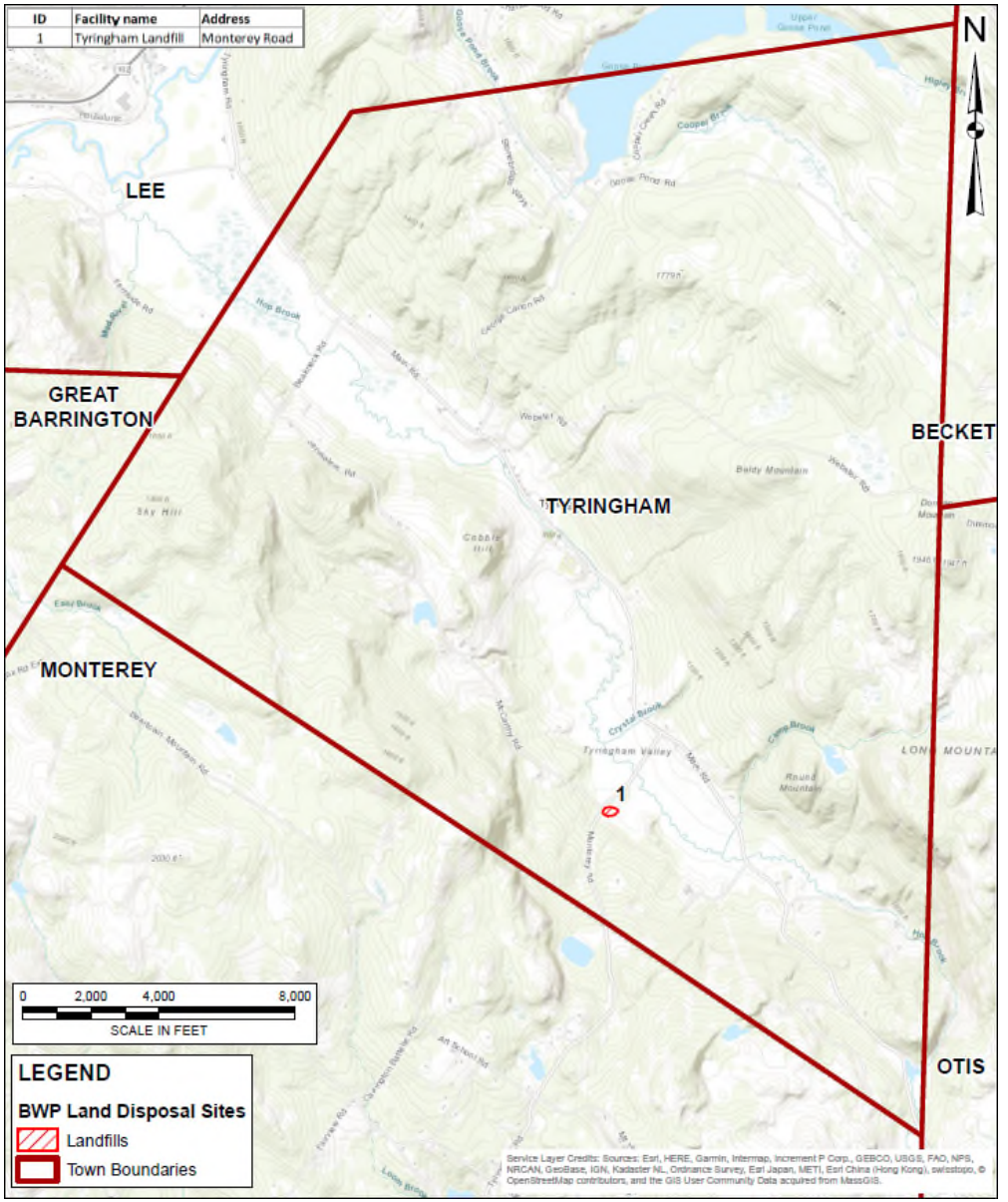


Figure 1-11: Hazardous Materials Facilities and Landfills

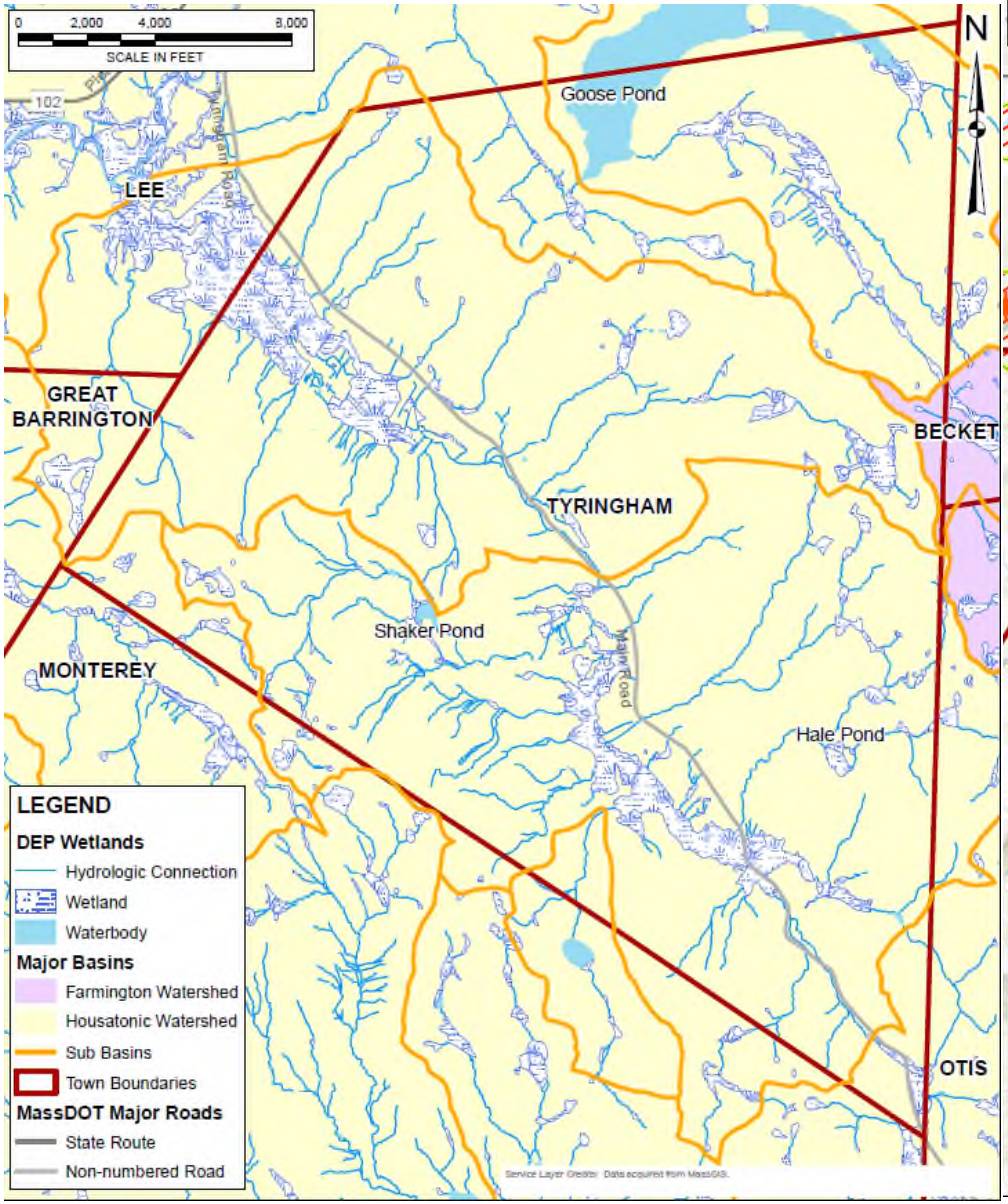


Figure 1-12: Water Resources

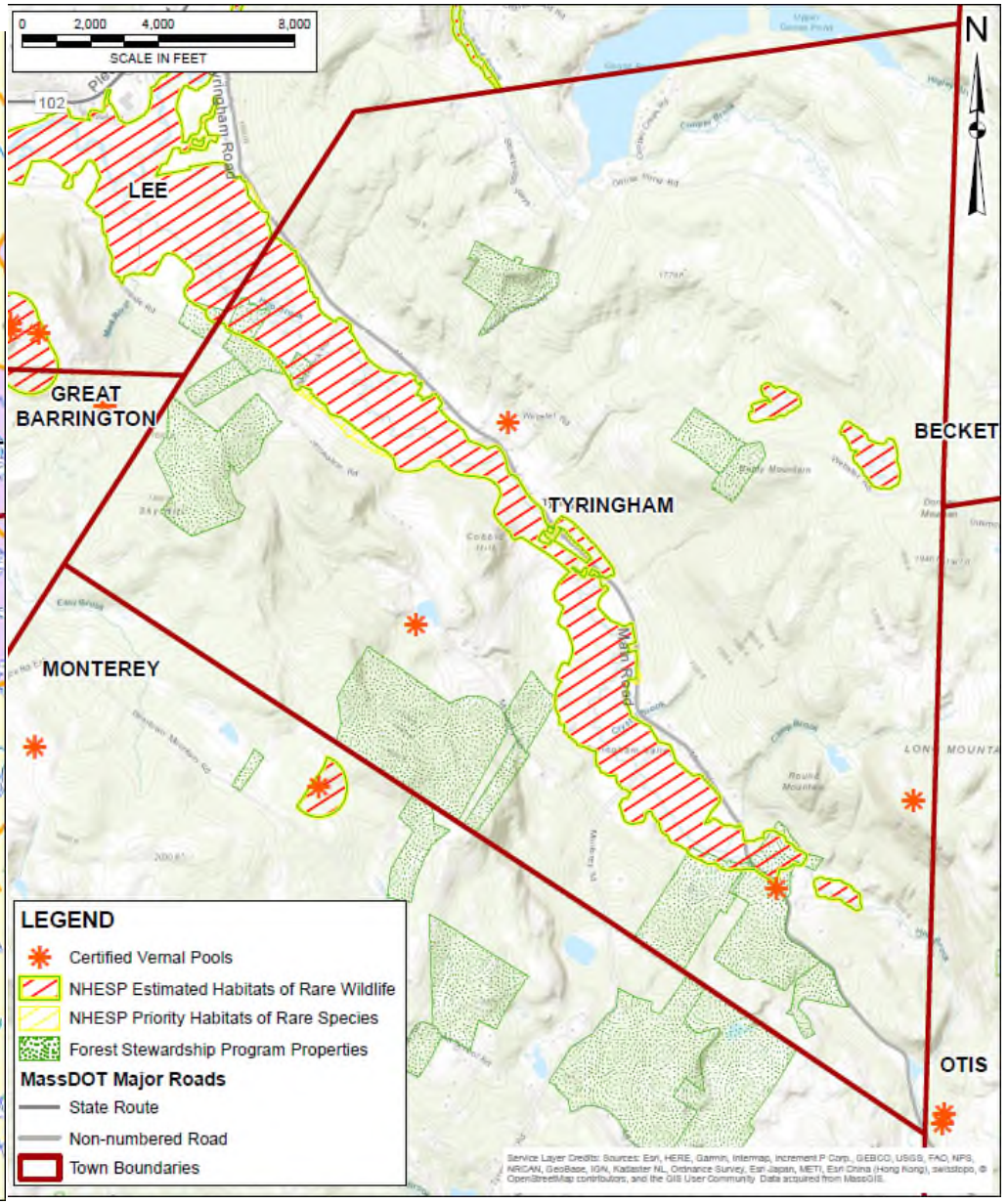


Figure 1-13: Natural Resources/Endangered Species

Cultural and Historic Sites

The Tyringham Library, Methodist Episcopal Society of Tyringham, and Tyringham Cemetery are listed on the National Register of Historic Places, as shown on **Figure 1-14**. These properties are located at 118 Main Road, 128-130 Main Road, and Church Road, respectively. The Methodist Episcopal Society of Tyringham is known locally as the Union Church of Tyringham. The Tyringham Shaker Settlement Historic District is also listed on the National Register. This comprises an area located along Jerusalem Road that includes some buildings remaining from the historic village.

The Town is currently pursuing the nomination of the Tyringham School House to the National Register of Historic Places. Built in 1782, the building is a former two-room school house located at 2 Church Road that is currently used for town offices. Tyringham Cobble is noted in the *Historic Preservation* section of *Sustainable Berkshires, Long-Range Plan for Berkshire County* (BRPC, 3/20/2014) as having historic, cultural, and/or natural value in Berkshire County.

The Town has a demolition delay bylaw for the purpose of protecting significant buildings within the Town. The Building Inspector consults with the Tyringham Historical Commission prior to issuing demolition permits. If the Historical Commission determines that the building is preferably preserved, a delay period of 12 months is imposed (Sustainable Berkshires Executive Summary, BRPC).

Building in Tyringham Shaker Settlement, *Photo courtesy of the Library of Congress*

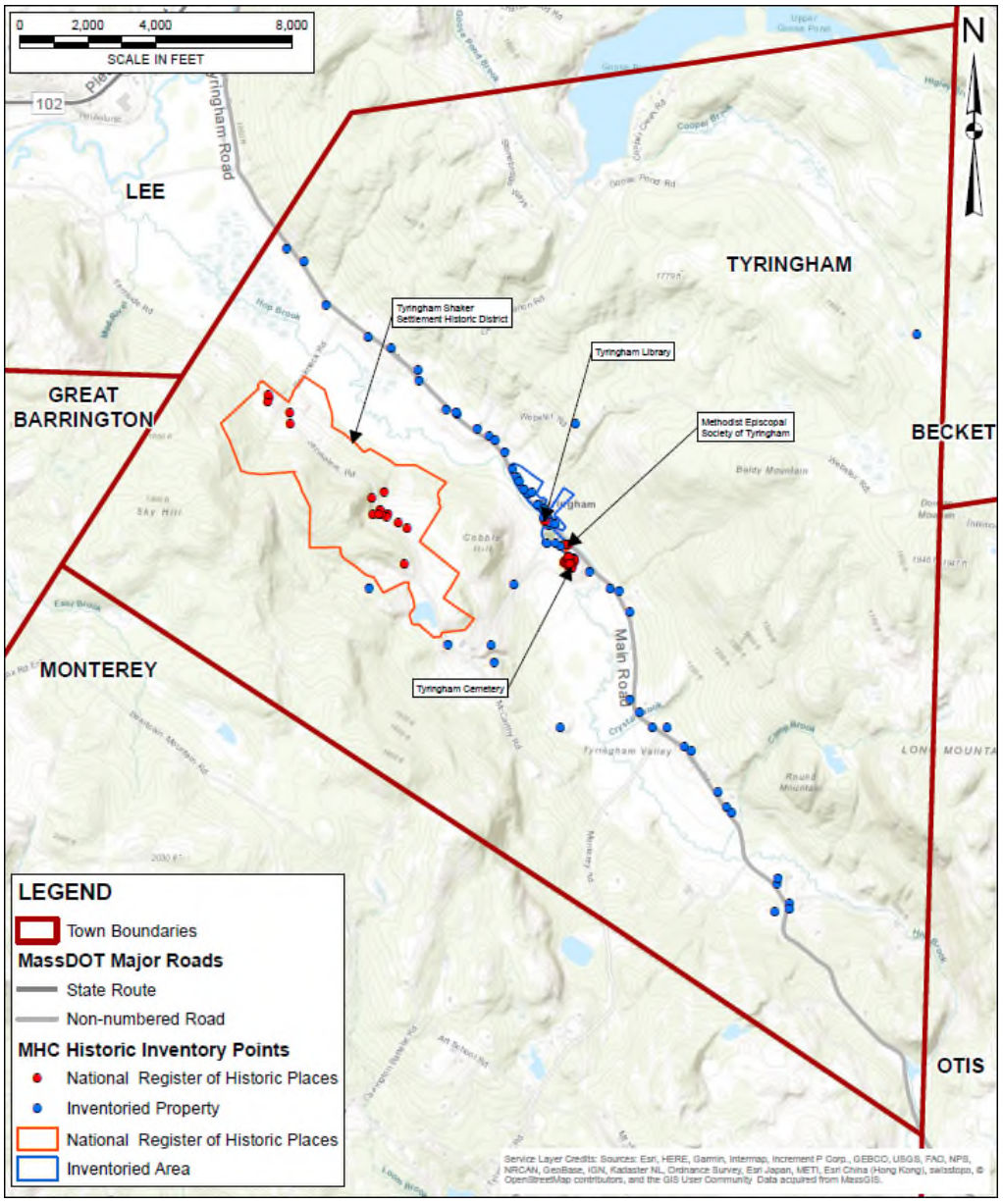


Figure 1-14: Historic Resources

Attachment 2: Natural Hazards

NATURAL HAZARDS OVERVIEW

Natural hazards are **natural events** that threaten lives, property, and other assets. Within Massachusetts, natural hazards typically include:

- Severe Weather Hazards such as Hurricanes and Tropical Storms, Nor'easters, Lightning, Intense Rainfall, Hail, Heavy Snowfall and Ice Storms.
- Climate-Related Hazards such as extreme heat and cold, drought and wildfire.
- Geologic Hazards such as earthquakes, landslides and tsunamis.

Severe weather hazards, including hurricanes, tropical storms and nor'easters can result in high winds and flooding. These flood events will become worse in the future due to climate-related changes to storm frequency and intensity. Flooding can result in the secondary hazards of erosion and bridge or culvert failure. Severe weather hazards can also result in high winds, lightning, hail, intense rainfall and tornadoes.

Localized intense rainfall can result in urban flooding where existing stormwater management capacity is exceeded. It can also result in flash flooding of streams and rivers and exceedance of water reservoir dam capacity.

Hazard Probability

Natural hazards can often be predicted, including predicting their likelihood of occurrence. The probability of a specific natural hazard occurring is typically defined in terms of its annual exceedance probability (AEP). This refers to the probability that a hazard condition will be met or exceeded in any given year. In lieu of the AEP, the term recurrence interval (in years) is often used.

Climate Change

Climate change, a result of increased greenhouse gas emissions and secondary effects, will significantly impact certain natural hazards. Storm intensity may increase, resulting in increased flood elevations. There is high scientific consensus that climate change will result in increased rainfall intensity within Massachusetts as well as increased frequency of extreme rainfall events. There is also scientific consensus that climate change will result in extended periods of extreme heat (heat waves) and cold.

TYRINGHAM NATURAL HAZARDS

GZA performed an analysis of multiple natural hazards and identified those hazards that are relevant to the Town of Tyringham. These are presented in **Table 2-1**. These hazards are characterized in detail in the following pages.

Severe Weather Hazards:
Severe Wind:
Hurricanes/Tropical Storms
Thunderstorms
Tornadoes
Lightning
Intense Rainfall
Hail
Flood:
Riverine/Overbank Flooding
Dam Failure/Beaver Dams
Poor Drainage Flooding
Severe Winter Weather:
Snowfall
Ice Storms
Climate-Related Hazards:
Extreme Temperature:
Extreme Heat
Extreme Cold
Drought
Wildfire
Geologic Hazards:
Earthquake

Table 2-1: Natural Hazards applicable to Tyringham

Severe Weather Hazards: Severe Wind

SEVERE WIND 

Severe wind (including high to extreme wind) will typically occur in the Town as a result of: 1) tropical storms and hurricanes; 2) extratropical nor'easters; 3) severe thunderstorms; and 4) tornadoes. Severe thunderstorms and tornadoes are convective weather events. Extreme "straight line" convective wind events include microbursts, macrobursts and derechos. Derechos are widespread, long-lived, and violent convectively-induced "straight-line" windstorms associated with a fast moving band of severe thunderstorms,. "Thunderstorm winds", arising from convection are winds with speeds greater than 58 mph or winds of any speed producing, damage, injury or fatality.

Severe wind poses a threat to life, building structures, and essential facilities (e.g., electrical utilities) due to the effects of wind loads, flying debris, and/or downed trees and power lines. Severe wind will typically cause the greatest damage to lightly-constructed structures, in particular manufactured homes. Downed 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. During hurricanes and tropical storms, high winds can also occur coincident with intense rainfall and during nor'easters, high winds can occur coincident with snow (blizzards), rain and a snow/rain mix.

Wind speeds are categorized by the National Weather Service (NWS) based on potential for structure damage and public health risk, with a distinction between sustained (1-minute duration) wind speeds and gust (3 second duration) wind speeds:

- Wind Advisory: 1) sustained winds of 31 to 39 mph for an hour or more; and/or 2) wind gusts of 46 to 57 mph for any duration.
- High Wind Watch/Warning: 1) sustained winds of 40 mph for one hour or more; or 2) wind gusts of 58 mph or higher for any duration.
- Hurricane Warning: sustained winds of 74 mph or higher or frequent (for more than 2 hours) gusts of 74 mph or greater associated with a tropical cyclone.
- Extreme Wind: 1) surface winds of 115 mph or greater associated with a derecho or sustained hurricane winds.
- Severe Thunderstorm Watch/Warning: winds of 58 mph or higher and/or hail 1-inch in diameter or larger.

The 9th edition of the Massachusetts State Building Code (using ASCE 7-10) utilizes wind gusts as the basis for structure design (**Table 2-2**).

Design Wind Speeds for Buildings and Other Structures

The 9th edition of the Massachusetts State Building Code wind speed design requirements (in terms of 3-second gust) are:

- Risk Category I: 126 mph - 300 year recurrence interval;
- Risk Category II: 136 mph - 700 year recurrence interval; and

Mean Recurrence Interval (yrs)	3-second Gust (mph)
10	80
25	91
50	100
100	110
300	126
700	136
1,700	147

Table 2-2: ASCE 7-10 Wind speed Mean Recurrence Intervals (3-second peak gust in mph)

- Risk Categories III-IV: 147 mph - 1,700 year recurrence interval.

Historical Occurrence at Tyringham and Vicinity

During 1996 through June 2020, Berkshire County experienced 35 days of High Wind events with estimated gusts of about 58 to 69 mph resulting in about $204,000 in property damage and no deaths. Between 1950 and 2020, Berkshire County had 223 days with Thunderstorm (convective) winds resulting in 1 death, 6 injuries and $1.073M damage. (Source: NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/)

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following High Winds probability at and near Tyringham:

- High Winds within Berkshire County: 75% AEP or minimum of 1-year to 2-year recurrence interval (18 years with 1 or more events over 24 years)

Climate Change Effects and Severe Wind Occurrence

The attribution of high wind events to climate change is uncertain. There is moderate scientific consensus, that the intensity and frequency of intense hurricanes could increase within southern New England due primarily to the increase in sea water temperature along the East Coast. There is lower confidence, and less understanding, in the attribution of increased extratropical nor'easters and thunderstorms frequency and intensity to climate change.

HURRICANES

Hurricanes, tropical storms and tropical depressions are tropical cyclones - rotating low pressure weather systems that have organized thunderstorms but no pressure 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 between 39 mph and 73 mph are tropical storms. Hurricanes are tropical cyclones with sustained wind speeds of 74 mph or higher.

East Coast hurricanes originate in the Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. 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).

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). A major hurricane (Categories 3, 4 and 5) has sustained wind speeds of 111 mph or higher on the Saffir-Simpson Hurricane Wind Scale.

Historic hurricane and tropical storm tracks which have passed within 100 nautical miles of Tyringham are presented in **Figures 2-1 and 2-2**. Historic hurricane tracks which have passed within 100 nautical miles of Tyringham are presented in **Figure 2-3**. The Hurricane of 1938 was a Category 3 hurricane with wind speeds of about 115 to 70 mph as it weakened while tracking through Massachusetts. Tropical Storm Irene tracked directly through Tyringham and caused notable damage consisting of culvert failures and severe erosion throughout Western Massachusetts and Vermont. Four hurricanes have tracked within 50 miles of Tyringham during NOAA's period of record. Nine hurricanes or tropical storms have tracked within 20 miles of Tyringham, including:

Florence, 2018; Cat 1 at landfall	Hurricane of '38; 1938; Cat 3 at landfall
Doria, 1971: Tropical Storm at landfall	Irene, 2011; Tropical Storm at landfall
Able, 1952; Cat 2 at landfall	Four unnamed hurricanes/tropical storms between 1867 and 1924; Tropical Storm to Cat 3 at landfall

Table 2-3: Hurricane tracks within 20 miles of Tyringham

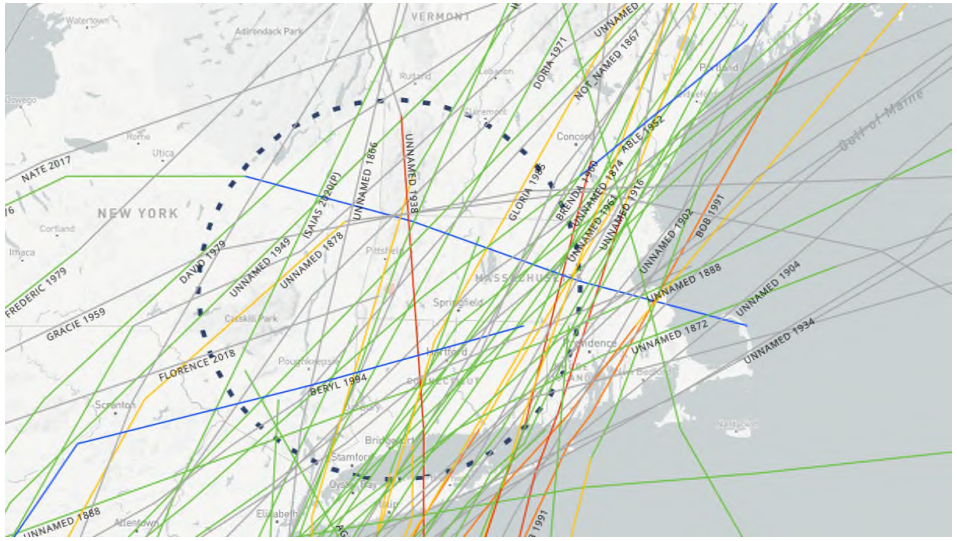


Figure 2-1: Hurricanes and Tropical Storms within 100 nautical miles of Tyringham (Source: NOAA Historical Hurricane Tracks mapping tool https://oceanservice.noaa.gov/news/historical-hurricanes/)

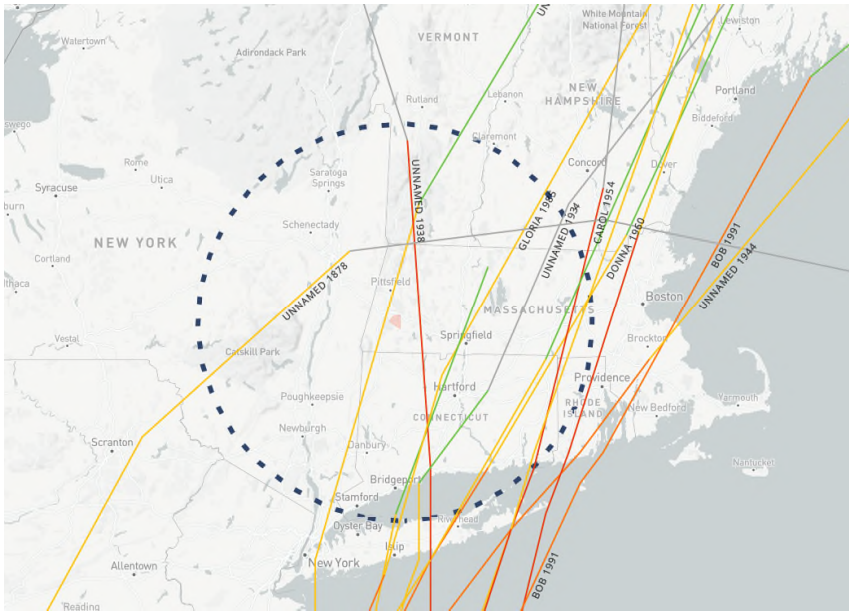


Figure 2-2: Hurricanes within 100 nautical miles of Tyringham

Hurricane recurrence intervals reflect the frequency at which hurricanes can be expected to occur within a given distance of a given location. The total number of hurricane strikes along the southern New England coastline between 1900 and 2010 is about 2 to 3 (**Figure 2-3**). **Figures 2-4 and 2-5** shows hurricane recurrence intervals (aka return periods) for hurricanes passing within 50 miles of various locations. In the vicinity of Tyringham, the hurricane passing recurrence interval is about 18 years. In simpler terms, this means that a hurricane is likely to pass near Tyringham, on average, about 5 times per 100 years. In the vicinity of Tyringham, the recurrence interval for major hurricanes striking or passing near (Cat 3 and above) is about 70 to 75 years. **Figure 2-6** shows the zones of origin and tracks for different months during the hurricane season. These figures depict average conditions. Hurricanes can originate in different locations and travel much different paths from the average. Regardless, they provide a good sense of the general pattern of hurricane tracks. The likelihood of a hurricane tracking near Tyringham is much greater during the months of August through October.

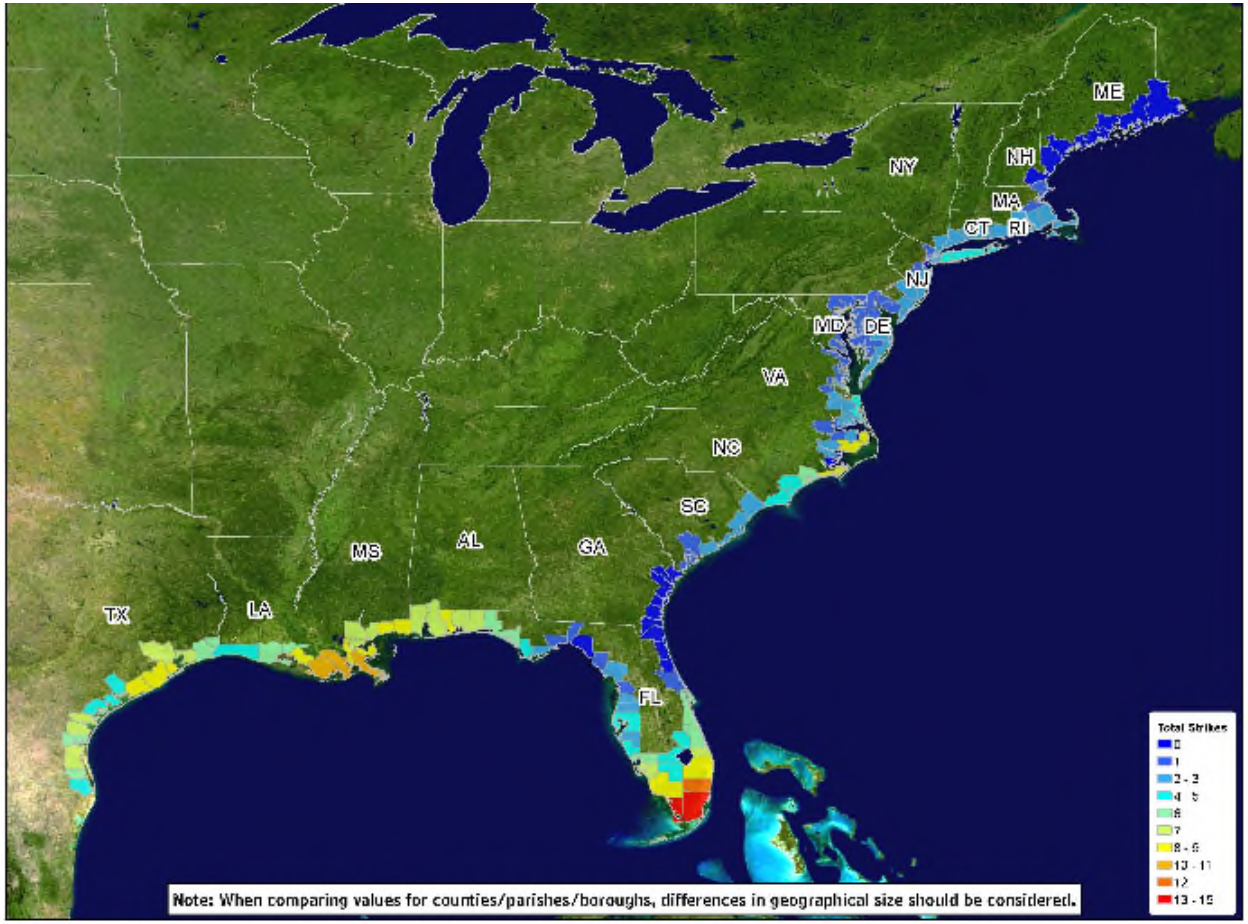
Historical Occurrence at Tyringham and Vicinity

The recurrence interval of a hurricane passing in the vicinity of Tyringham is about 18 years, for hurricanes that might strike between New Jersey and Connecticut, based on Figure 2-5. In the vicinity of Tyringham, the recurrence interval for major hurricanes (Cat 2 and above) is about 70 to 75 years, for hurricanes that might strike between New Jersey and Connecticut, based on Figure 2-5.

Estimated Probability of Occurrence at and near Tyringham

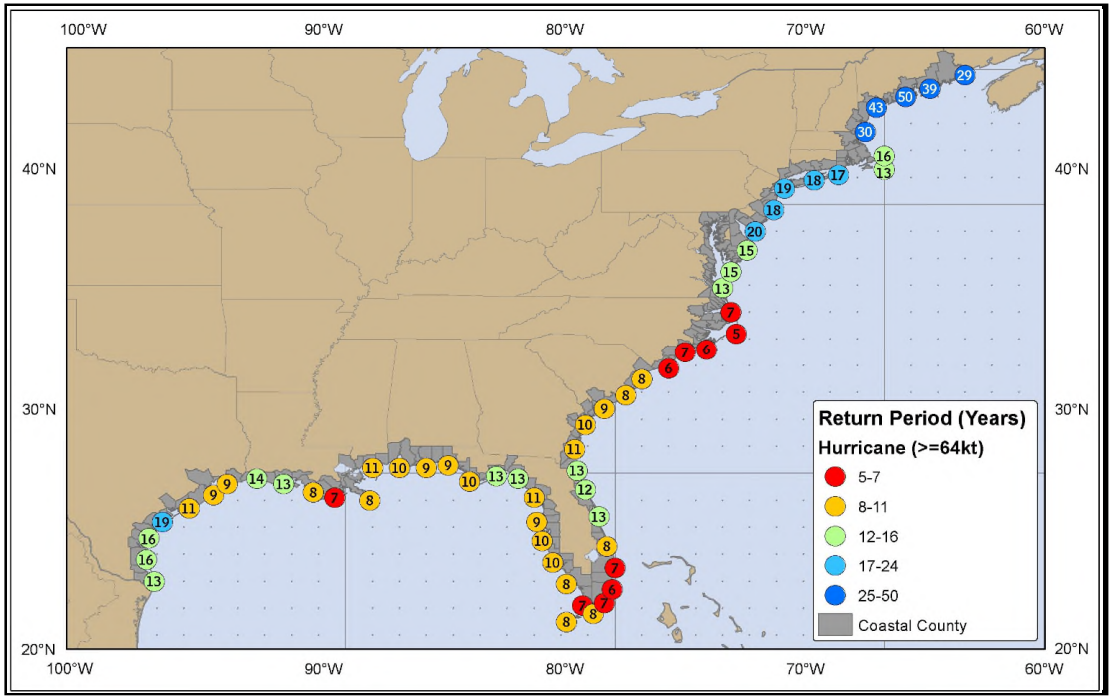
The results indicate the following hurricane strike probability at and near Tyringham:

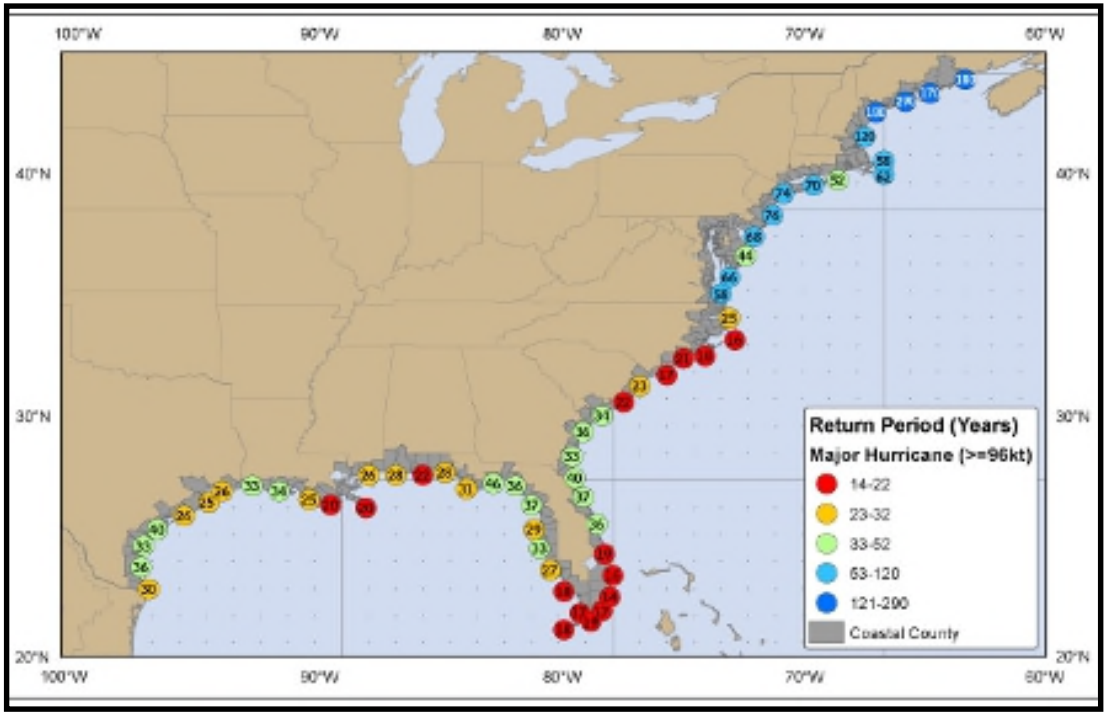
- All Hurricanes: 6% AEP or 18-year recurrence interval
- Major (≥ Cat 3) Hurricanes: 1% or 75-year recurrence period



Total number of major hurricane strikes by counties/parishes/boroughs, 1900-2010

Figure 2-3: Hurricane Strikes (source - NOAA)





Figures 2-4 and 2-5: Hurricane Recurrence Interval (all hurricanes - top and major hurricanes - bottom)
(Source: (Source: https://www.nhc.noaa.gov/climo/#bac

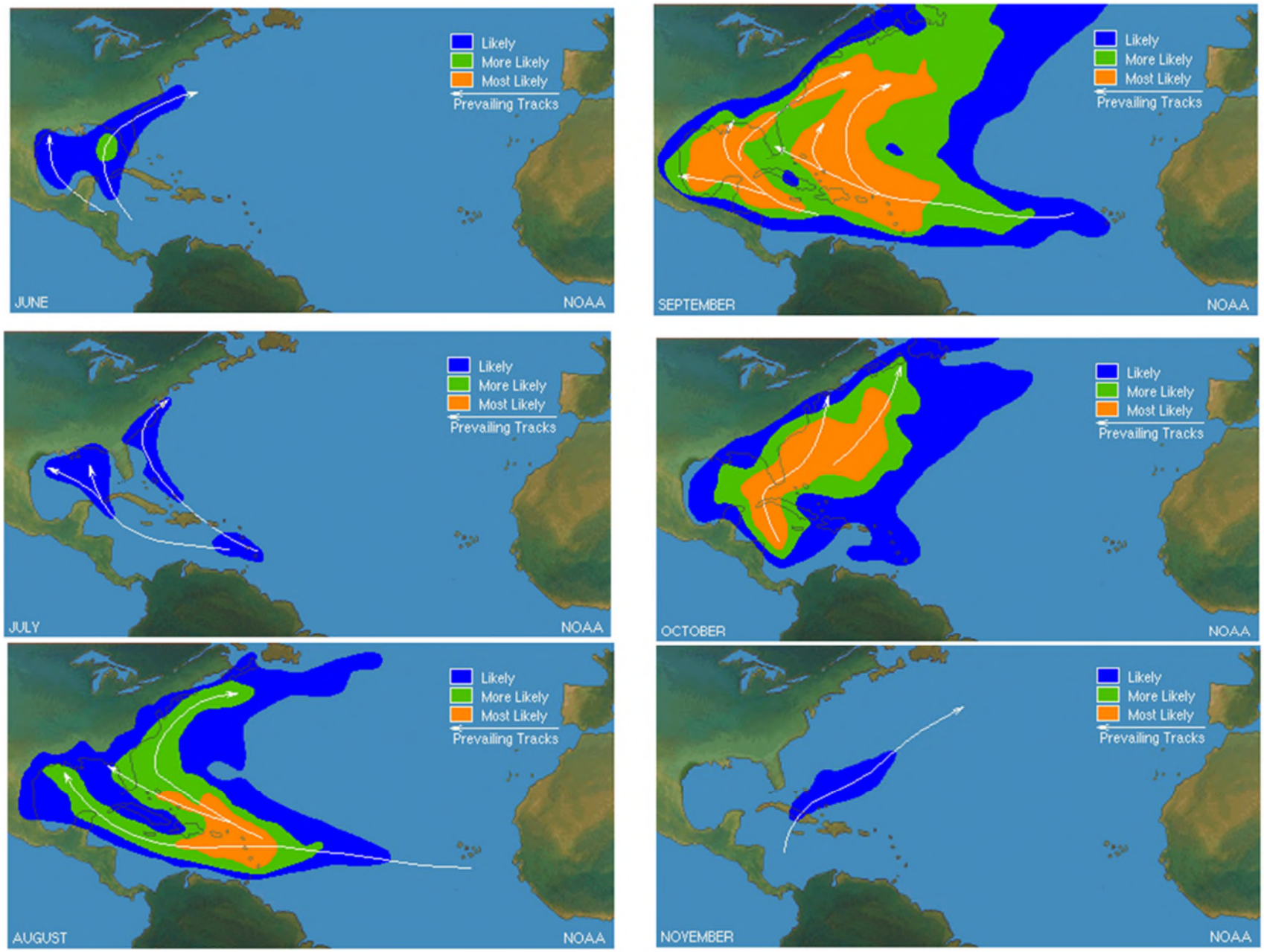


Figure 2-6: Hurricane Origin and Track Probability by Month

THUNDERSTORMS

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."

The peak season for severe thunderstorms in the Northeast U.S. is June through August, although thunderstorms also occur in the Spring and Fall, and thunder can occur during winter snow storms. Hazards from thunderstorms include high to extreme 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 12 lightning deaths in the U.S. in 2020, none of which occurred in Massachusetts (http://www.lightningsafety.noaa.gov/fatalities.shtml).

Figure 2-7 shows the average number of thunderstorm days throughout the U.S. Massachusetts, including Berkshire County, experiences between 20 and 30 thunderstorm days each year.

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; and
- An approaching severe thunderstorm is a thunderstorm with winds equal to or greater than 40 mph (35 knots or ~64 km/h) and/or hail of at least ½"

Observed structural wind damage may imply the occurrence of a severe thunderstorm. Hail of 1" or greater can damage property such as plants, roofs and vehicles. http://www.weather.gov/bgm/severedefinitions

Derechos: Based on climatology, Massachusetts is located in a zone where derechos are predicted to occur about 1 every four years (typically during April to August).

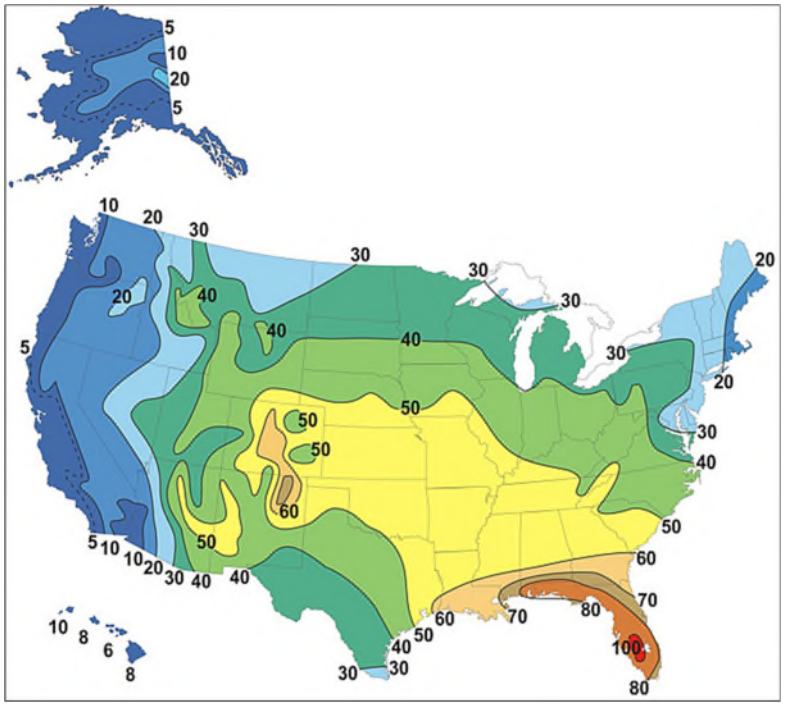


Figure 2-7: Average Annual Number of Thunderstorms in U.S.
(Source: http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.html)

Historical Occurrence at Tyringham and Vicinity

Between 1950 and 2020, Berkshire County had 223 days with Thunderstorm (convective) winds resulting in 1 death, 6 injuries and $1.073M damage.

Forty-three of these events resulted in damage and 5 events resulted in death or injury. Of these, 3 thunderstorm events impacted the Town of Tyringham, in July 1994, July 2015, and February 2017. None of these storms resulted in injuries, deaths, or damage. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/ For this database, thunderstorm winds are defined as speeds of at least 58mph or of any speed producing a fatality, injury or damage.

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following thunderstorm wind probability at and near Tyringham (within Berkshire County):

- Thunderstorm Winds within Berkshire County: 81% AEP or minimum of 1-year to 2-year recurrence interval (57 years with 1 or more events over 70 years)

TORNADOES

A tornado is a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. The destruction caused by tornadoes ranges from light to catastrophic depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings and particularly manufactured homes. Tornadoes are more likely to occur during the months of March through May and tend to form in the late afternoon and early evening.

Since 2007, tornadoes have been categorized according to the Enhanced Fujita scale:

Scale	Wind speed estimate		Potential damage
	mph	km/h	
EF0	65–85	105–137	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86–110	138–177	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111–135	178–217	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136–165	218–266	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations are badly damaged.
EF4	166–200	267–322	Devastating damage. Well-constructed and whole frame houses completely leveled; cars and other large objects thrown and small missiles generated.
EF5	>200	>322	Incredible damage. Strong-framed, well-built houses leveled off foundations are swept away; steel-reinforced concrete structures are critically damaged; tall buildings collapse or have severe structural deformations; some cars, trucks, and train cars can be thrown approximately 1 mile (1.6 km).

Table 2-4: Enhance Fujita Scale for Tornadoes

Prior to 2007, tornadoes were categorized according to the Fujita Tornado Intensity Scale:

Scale	Wind Speed Estimate (mph)	Potential Damage
Category F0:	Gale tornado (40-72 mph)	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
Category F1	Moderate tornado (73-112 mph)	Moderate damage. The lower limit is the beginning of hurricane wind speed; peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads.
Category F2	Significant tornado (113-157 mph)	Considerable damage. roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
Category F3	Severe tornado (158-206 mph)	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.
Category F4	Devastating tornado (207-260 mph)	Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.
Category F5	Incredible tornado (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile sized missiles fly through the air in excess of 100 yards; trees debarked; incredible phenomena will occur.

Table 2-5: Original Fujita Tornado Intensity Scale

Tornadoes can also occur anywhere in Massachusetts, although relatively infrequently. Between 1950 and 2018, there were 171 tornado events within Massachusetts including 103 days with damage, 23 days with injury or death and 8 days with deaths, resulting in $534M damages. The data for this period for the State is presented below:

Magnitude	No of Days with Event	No. of Injuries	No. of Deaths	Property Damage
F0/EF0	27	6	1	$391,000
F1/EF1	54	37	1	$6,707,000
F2/EF2	27	9	2	$16,043,000
F3/EF3	5	221	4	$235,900,000
F4/E4	3	1288	97	$275,000,000

Magnitude	Avg. No of Events/year	Avg. No. of Injuries/Event	Avg. No. of Deaths/Event	Avg. Property Damage/ Event
All	1.7	13.4	1	-
F0/EF0	0.4	0.2	0.04	$14,481
F1/EF1	0.8	0.7	0.02	$124,204
F2/EF2	0.4	0.3	0.07	$594,185
F3/EF3	0.07	44.2	0.8	$47,180,000
F4/E4	0.04	429.3	32.3	$91,666,667

Table 2-6: Massachusetts Tornado Data for the period of 1950 to 2018

Tornado risk is calculated from the destruction path that has occurred within 30 miles of the location. Details for Berkshire County are presented in **Table 2-6.** The tornadoes were generally weak. The 1973 and 1995 tornadoes, however, were severe and of relatively long duration. A total of 15 days with tornadoes were reported in Berkshire County for the period of record between 1950 and 2020, according to the NOAA Storm Events Database. **Figure 2-8** shows the start and end points and tracks of the Berkshire County tornadoes in the vicinity of Tyringham. These tornadoes ranged in severity from F0 to F4, with more recent tornadoes rated under the EF scale at EF1. These tornadoes occurred between the months of March and October.

Date	Location	Fujita	Fatalities	Injuries	Length(miles)
7/12/1955	Berkshire County, Massachusetts	F2	0	0	0.5
9/7/1958	Berkshire County, Massachusetts	F0	0	0	2.3
10/3/1963	Berkshire County, Massachusetts	F1	0	0	3
3/1/1966	Berkshire County, Massachusetts	F2	0	0	0
8/11/1966	Berkshire County, Massachusetts	F2	0	0	8
6/18/1970	Berkshire County, Massachusetts	F1	0	0	18.7
8/28/1973	Berkshire County, Massachusetts	F4	4	36	6.4
7/13/1975	Berkshire County, Massachusetts	F2	0	0	0.3
7/27/1978	Berkshire County, Massachusetts	F0	0	0	0.1
7/11/1984	Berkshire County, Massachusetts	F1	0	0	0.5
5/29/1995	N. Egremont, Berkshire County, Massachusetts	F4	3 (N. Egremont)	24 (N. Egremont)	300
7/3/1997	Florida, Monterey, West Otis, Richmond, Berkshire County, Massachusetts	F1-F2	0	0	10
8/20/2004	Pittsfield, Berkshire County, Massachusetts	F0	0	0	1
6/29/2005	Great Barrington, Berkshire County, Massachusetts	F0	0	0	200
7/27/2014	North Adams Jct, Berkshire County, Massachusetts	EF1	0	0	0.25

Table 2-7: Berkshire County, Massachusetts Tornado Data for the period of 1950 to 2020

Historical Occurrence at Tyringham and Vicinity

Of the 15 tornadoes in Berkshire County, the tornadoes during August, 1973 and July, 1997 resulted in the largest degree of damages at $25 Million and $3.065 Million, respectively. The August, 1973 (F4) tornado resulted in 4 deaths and 36 injuries. Another F4 tornado in May, 1995 resulted in few monetary damages, but 3 deaths and 24 injuries. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following tornado probability at and near Tyringham (within Berkshire County):

- Tornadoes within Berkshire County: 20% AEP or 5-year recurrence interval (14 years with 1 or more events over 70 years)
- Major tornado (F4 and larger) within Berkshire County: 3% AEP or 35-year recurrence interval

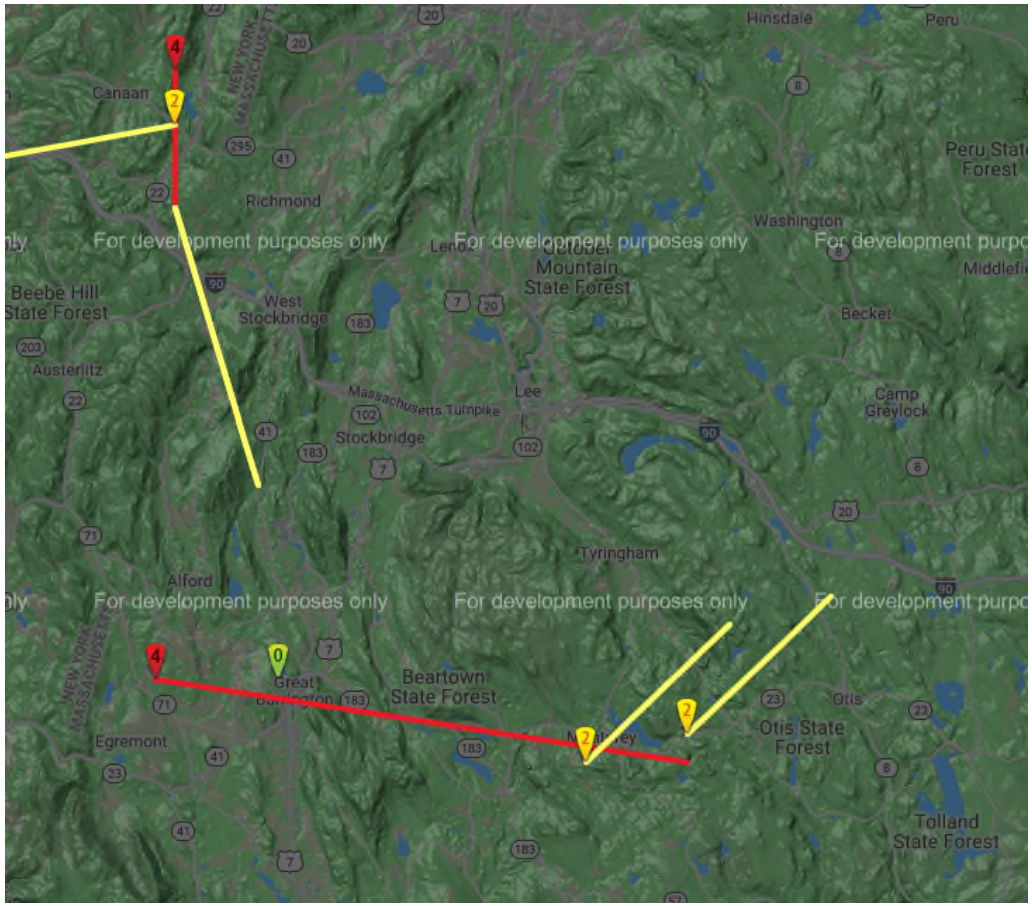


Figure 2-8: Location of Berkshire County Tornadoes in the vicinity of Tyringham
http://www.tornadohistoryproject.com

Severe Weather Hazards: Lightning

LIGHTNING

Lightning is the second most common storm-related killer in the United States. It causes several billion dollars in property damage each year and kills several dozen people. It is a frequent cause of wildfires and costs airlines billions of dollars per year in extra operating expenses.

Lightning is a giant spark of electricity in the atmosphere between clouds, the air, or the ground. In the early stages of development, air acts as an insulator between the positive and negative charges in the cloud and between the cloud and the ground. When the opposite charges builds up enough, this insulating capacity of the air breaks down and there is a rapid discharge of electricity that we know as lightning. The flash of lightning temporarily equalizes the charged regions in the atmosphere until the opposite charges build up again. Lightning can occur between opposite charges within the thunderstorm cloud (intra-cloud lightning) or between opposite charges in the cloud and on the ground (cloud-to-ground lightning).

Massachusetts, including Berkshire County, has a moderate risk associated with Lightning strikes relative to other states. **Figures 2-9** and **2-10** show the number of fatalities and relative fatality rates by state. In Massachusetts, there have been 6 Lightning fatalities during the period of 2005 and 2014 (an average of less than 1 per year).

Historical Occurrence at Tyringham and Vicinity

Since 1997, Berkshire County has experienced 15 Lightning events and 13 days with Lightning resulting in about $242k in property damage, 4 injuries and no deaths. No events were reported within Tyringham.

NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following Lightning probability at and near Tyringham (within Berkshire County):

- Lightning Events resulting in fatality, injury and/or damage within Berkshire County: 43% AEP or 2.3-year recurrence interval (10 years with 1 or more events over 23 years)

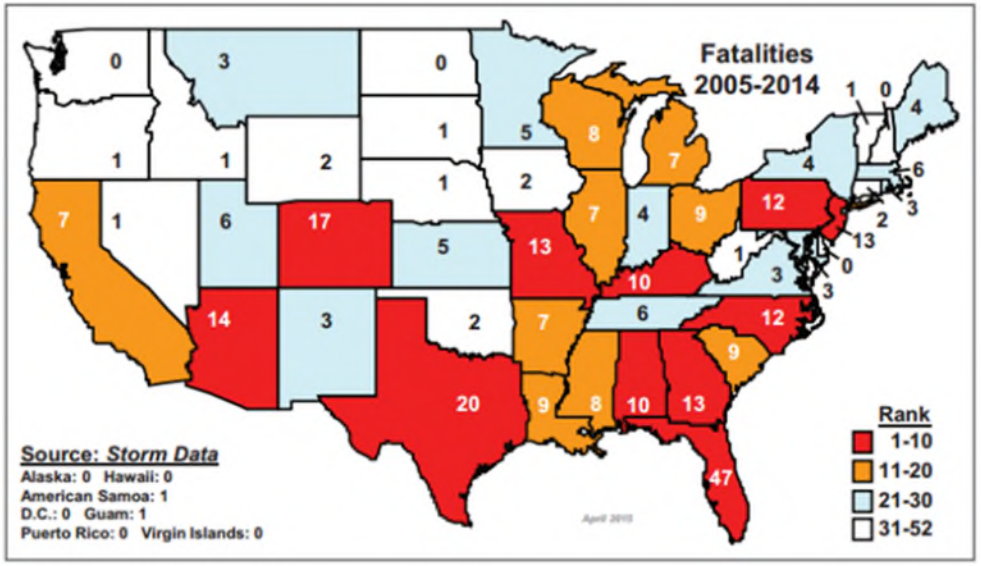


Figure 2-9: Lightning Fatalities by State, 2005-2014; (Source: Vaisala)

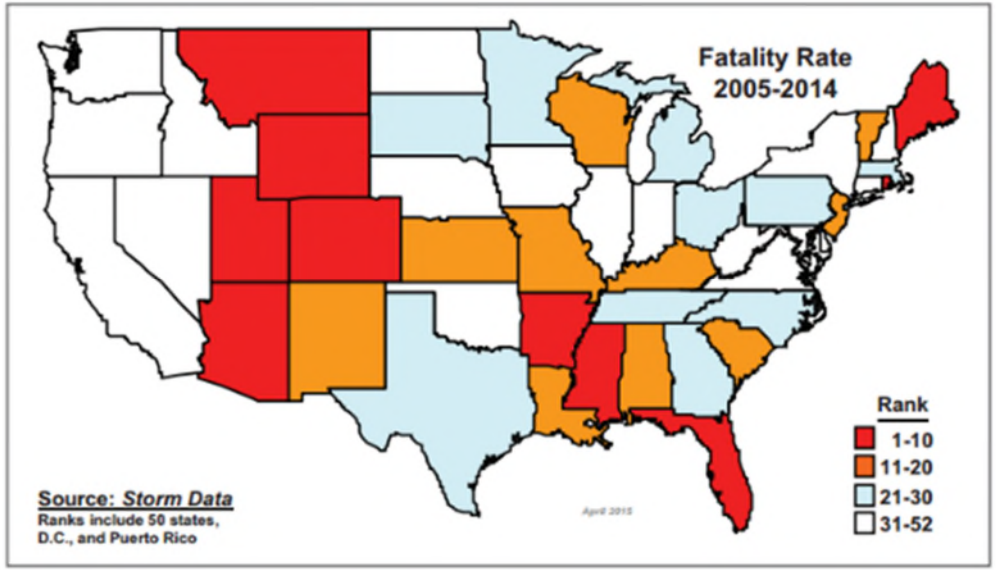


Figure 2-10: Lightning Fatalities Weighted by Population, 2005-2014; (Source: Vaisala)

Severe Weather Hazards: Intense Rainfall

INTENSE RAINFALL

Intense, heavy rainfall can result in localized flooding including flash flood events. Several factors contribute to intense precipitation flooding including rainfall intensity and duration. Other factors include the presence of streams and rivers, soil type, ground cover, drainage and the capacity of stormwater infrastructure. **Table 2-8** presents precipitation projections for Tyringham developed by NOAA Atlas 14 Precipitation Frequency Data Server (https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html).

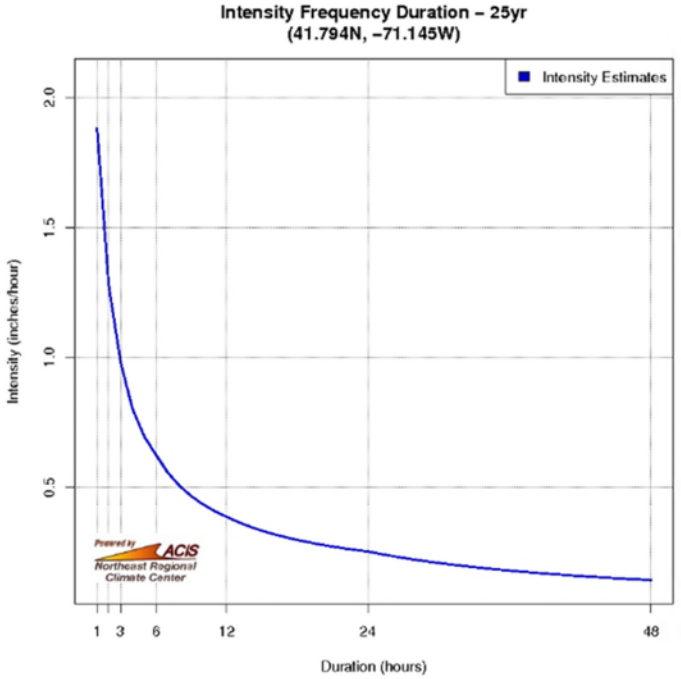


Figure 2-11: Massachusetts Rainfall Intensity-Duration for the 25-year Recurrence Interval Rainfall

PRECIPITATION FREQUENCY ESTIMATES (rainfall in inches)										
by duration for ARI (years):	1	2	5	10	25	50	100	200	500	1000
5-min:	0.322	0.381	0.478	0.558	0.669	0.753	0.839	0.929	1.05	1.14
10-min:	0.456	0.54	0.677	0.791	0.947	1.07	1.19	1.32	1.49	1.62
15-min:	0.537	0.635	0.796	0.93	1.12	1.26	1.4	1.55	1.75	1.91
30-min:	0.762	0.901	1.13	1.32	1.57	1.77	1.97	2.18	2.47	2.69
60-min:	0.988	1.17	1.46	1.7	2.03	2.29	2.55	2.82	3.18	3.47
2-hr:	1.27	1.48	1.83	2.11	2.5	2.81	3.11	3.42	3.83	4.15
3-hr:	1.45	1.69	2.09	2.42	2.87	3.22	3.57	3.94	4.45	4.85
6-hr:	1.75	2.1	2.65	3.12	3.75	4.23	4.74	5.33	6.22	6.96
12-hr:	2.07	2.57	3.39	4.07	5.01	5.69	6.45	7.43	9	10.4
24-hr:	2.41	3.08	4.17	5.08	6.33	7.23	8.25	9.62	11.9	13.9
2-day:	2.82	3.61	4.9	5.98	7.46	8.53	9.74	11.4	14.1	16.5
3-day:	3.12	3.98	5.38	6.55	8.15	9.31	10.6	12.4	15.3	17.9
4-day:	3.39	4.29	5.78	7.01	8.7	9.93	11.3	13.2	16.2	18.9
7-day:	4.09	5.1	6.76	8.13	10	11.4	12.9	14.9	18.1	21
10-day:	4.8	5.86	7.6	9.05	11	12.5	14.1	16.1	19.4	22.2
20-day:	7.01	8.13	9.96	11.5	13.6	15.1	16.8	18.8	21.7	24.2
30-day:	8.84	9.99	11.9	13.4	15.6	17.2	18.9	20.8	23.5	25.7
45-day:	11.1	12.3	14.3	15.9	18.2	20	21.7	23.5	25.9	27.7
60-day:	12.9	14.2	16.3	18.1	20.5	22.4	24.3	26	28.2	29.8

ARI = Annual Recurrence Interval

Table 2-8: Predicted Rainfall Intensity by Duration and Recurrence Interval for Tyringham

While there is no specific, single set of criteria that defines "intense rainfall", the rainfall intensities associated with a 25-year recurrence interval are a reasonable benchmark (a 1 in 4 chance of being met or exceeded in any given year). These are presented for Massachusetts including Berkshire County in **Figure 2-11**. This figure indicates short duration intensities on the order of 1.5 to 2 inches per hour and longer duration intensities on the order of an average 0.25 inch per hour over 24 hours (one and two day total rainfall amounts of about 6 and 7 inches, respectively).

Historical Occurrence at Tyringham and Vicinity

During the period between 2007 and 2020, Berkshire County experienced 2 days with Heavy Rain events, an average of about 1 event every 6.5 years, with no documented property damages, injuries or death. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following intense rainfall probability at and near Tyringham (within Berkshire County):

- Intense Rainfall within Berkshire County: 4% AEP or 25-year recurrence

Severe Weather Hazards: Hail

HAIL

Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Hailstorms frequently accompany thunderstorms, so their locations and spatial extents overlap. Large hail (greater than 1 inch in diameter) can be destructive. Hail can cause substantial damage to vehicles, roofs, landscaping, and other areas of the built environment. U.S. agriculture is typically the resource most affected by hail storms, which cause severe crop damage even during minor events. A recent risk, due to the widespread use of solar panels, is hail-related damage to solar panels.

Hail storms are fairly common in Massachusetts, including Tyringham. For this period of 1990 to 2018, Massachusetts hail data indicates:

- 1990-2004: 127 days (an average of 8 event per year), with 0 injuries, 0 deaths and $222K property damage (average property damage of $1,800 per event)
- 2005-2009: 78 days (an average of 16 events per year), with 0 injuries, 0 deaths and $269K property damage (average property damage of $3,500 per event)
- 2010-2018: 81 days (an average of 9 events per year), with 0 injuries, 0 deaths and $3.03M property damage (average property damage of $37,500 per event)

Per HomeAdvisor.com, the average per building cost, nationally, to repair hail, wind or storm damage is $6,640 ranging from $400 to $30,000.

The Hail Risk Score (**Table 2-9**) provides a short-to-medium term view of future hail risk based on the last 10 years of ultra-high resolution radar data. The score is based on a scale of 1 to 10, with the lowest score of 1 representing Very Low hail risk (damaging hail unlikely in the next 5-10 years) and the highest score of 10 representing Extreme hail risk (damaging hail very likely every year).

The Hail Risk Score for Tyringham (reference stormersite.com) is 1.

Hail Risk Score	Hail Risk	Hail Risk Guidance
1	Very low	Damaging Hail unlikely in next 5-10 years
2	Very Low to Low	Damaging Hail likely every 5 years
3	Low	Damaging Hail likely every 2-4 years
4	Low to Moderate	Damaging Hail likely every 2-3 years
5	Moderate	Damaging Hail likely every other year
6	Moderate	Damaging Hail very likely every other year
7	Moderate to High	Damaging Hail likely every 1-2 years
8	High	Damaging Hail very likely every 1-2 years
9	Very High	Damaging Hail likely every year
10	Extreme	Damaging Hail very likely every year

Table 2-9: Hail Risk Score Classifications

Historical Occurrence at Tyringham and Vicinity

For the period of 1955 to 2020, there have been 99 hail events in Berkshire County including 13 hail days with damage (resulting in $72.2K property damage; average property damage of about $5,500 per event) and no fatalities. None of these events occurred in Tyringham. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following hail probability at and near Tyringham (within Berkshire County):

- 54% AEP or 2 year recurrence interval (35 years with 1 or more events over 65 years)

Severe Weather Hazards: Flood

FLOOD

A flood is the partial or complete inundation of normally dry land. The various types of flooding include riverine flooding, coastal flooding, and shallow flooding. Common impacts of flooding include damage to personal property, buildings and infrastructure; bridge and road closures; service disruptions; and injuries or even fatalities.

The Town is vulnerable to:

- **Riverine flooding**. There are many inland wetlands and streams within Tyringham. Hop Brook, which flows roughly parallel to Main Road, the main thoroughfare through Town, has a FEMA-mapped floodplain of Zone A (1% annual chance of flooding).
- **Rainfall events.** Inland (poor drainage) flooding associated with large rainfall events, in particular within areas with impervious surfaces, poor drainage and inadequate stormwater management.
- **Beaver dams**. Many localized flooding issues are associated with beaver dams blocking culverts. There is a risk of flooding that could be caused by the failure of beaver dams, causing ponded water to flood downstream areas.

The Town is not vulnerable to other types of flooding including:

- **Coastal Flooding.** Tyringham is not located near the coast.

Riverine 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 can saturate wetlands and fill the streams and brooks. A heavy or severe rain event at this time of year can often overwhelm natural flood storage areas and create flood hazards on streets and around residential areas.

One of the most costly floods in Berkshire County occurred in January of 1996 when an intense area of low pressure which was located over the Mid-Atlantic region on Friday morning, January 19th, produced unseasonably warm temperatures, high dewpoints and strong winds. This resulted in rapid melting of one to three feet of snow. In addition to the rapid snowmelt one to three inches of rain fell as the system moved northeast along the coast. This resulted in the flooding of many small streams across Berkshire County. The Green River, in Great Barrington, also flooded which washed out some side roads and the Williams River, also in Great Barrington, flooded some farmland, with combined damages of $500,000. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/.

FEMA Flood Hazard Determination

Through FEMA's flood hazard mapping program, Risk Mapping, Assessment and Planning (MAP), FEMA identifies flood hazards, assesses flood risks and partners with states and communities to provide accurate flood hazard and risk data to guide them to mitigation actions. Flood hazard mapping is an important part of the National Flood Insurance Program (NFIP), as it is the basis of the NFIP regulations and flood insurance requirements. FEMA maintains and updates data through Flood Insurance Rate Maps (FIRMs) and risk assessments. In Tyringham, the "Flood Hazard Boundary Map" published in 1974 was converted to a FIRM in 2005, without changes. The Special Flood Hazard Areas (shaded areas) shown on the FIRM are designated Zone A and all other (unshaded) areas are designated Zone X. Zone A is the flood having a one percent chance of being equaled or exceeded in any given year. This is the regulatory standard also referred to as the "100-year flood". These areas within Tyringham are associated with Hop Brook and Cooper Brook between Pond Road and Goose Pond. Zone X are areas of minimal flood hazard. The Zone A areas in Tyringham do not have determined Base Flood Elevations (BFEs).

Historical Occurrence at Tyringham and Vicinity

For the period of 1996 to 2020, there have been 25 days with flood events in Berkshire County, including 4 days with property damage (resulting in $512k of damage), no injuries and no deaths. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/ .

The Town LPT identified riverine flood concerns at the Beach Road culvert and the Breakneck Road bridge over Hop Brook.

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following flood probability at and near Tyringham (within Berkshire County):

- 50% AEP or 2 year recurrence interval (12 years with 1 or more events over 24 years)

Climate Change Effects and Riverine Flood Occurrence

There is high confidence, within the scientific community, that the frequency and severity of riverine flooding will increase within southern New England due primarily to the increase in precipitation frequency and intensity.

Intense Rainfall and Poor Drainage Flooding

Intense, heavy rainfall can result in localized flooding including flash flood events. Risks due to intense rainfall are predominantly associated with flash flooding and are typically related to the capacity of the existing stormwater infrastructure to manage stormwater run-off. High velocity stormwater flow can also occur during these events. Damages can include localized flooding, damage to property and vehicles and potentially safety risk to the public.

Historical Occurrence at Tyringham and Vicinity

- During the period between 1996 and 2020, Berkshire County experienced 13 days with Heavy Rain events, an average of about 1 event day every other year, with no documented property damages, injuries or death. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/
- During the period between 1996 and 2020, Berkshire County experienced 46 days with Flash Flood events, an average of about 2 event days per year. Twenty event days included property damage at a total cost of $1.032 Million. Two event days included crop damage at a total cost of $4,000. There were no injuries or death. No Flash Flood events were reported in Tyringham. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/
- The Town LPT identified flooding issues at 189 Main Road, 146 Main Road, and 116 Main Road.

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following flash flooding probability at and near Tyringham (within Berkshire County):

- Flash Flooding due to Intense Rainfall within Berkshire County: 75% AEP or 1.3-year recurrence

Effects of Climate Change

The attribution of rainfall intensity and frequency has high confidence. Average annual precipitation in the Northeast increased 10 percent from 1895 to 2011, and precipitation from extremely heavy storms has increased 70 percent since 1958. During this century, average annual precipitation and the frequency of heavy downpours are likely to keep rising. Average precipitation is likely to increase during winter and spring, but not change significantly during summer and fall.

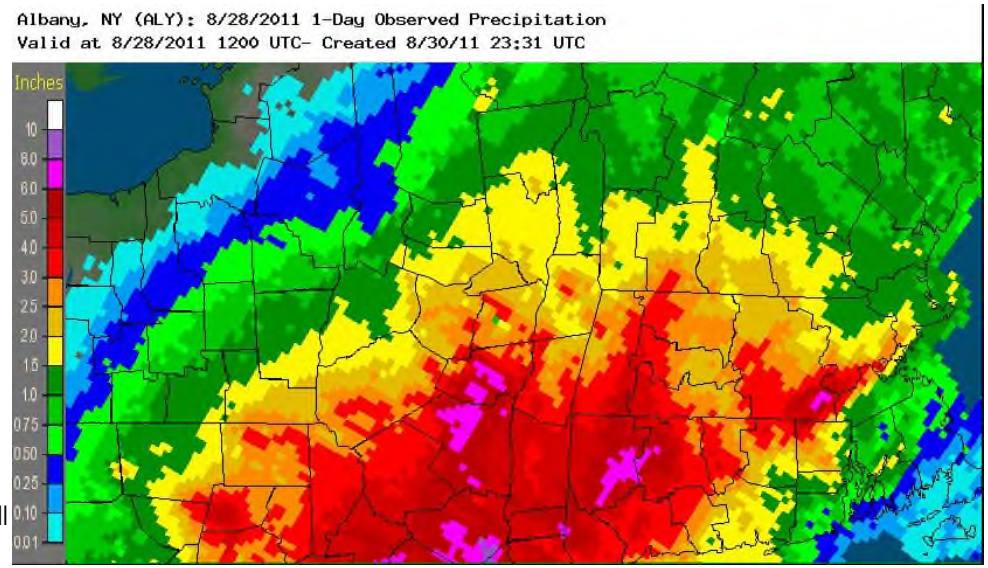


Figure 2-12: August 28, 2011 (Tropical Storm Irene) 1-Day Total Rainfall (weather.gov)

Beaver Dam Related Flooding

From the 2012 Berkshire County Hazard Mitigation Plan (BRPC):

Beavers are active throughout Berkshire County. MassWildlife estimates that the beaver population has almost tripled between 1996 and 2004, from an estimated 24,000 to 70,000 (MassWildlife, 2004)). The exponential growth has been attributed to several factors, including an increase in suitable habitat, an increase in wetland protection and a decrease in the hunting and trapping of the animals.

Beavers are a beneficial and integral part of the regional ecosystem. By damming brooks and other water flows beavers help to expand wetland areas, which provide important habitat and allows for increased infiltration and groundwater recharge. The very instinct which drives beavers to dam waterways and create water impoundments is the same instinct that drives beavers to clog culverts.

Hazardous conditions are created when impounded water backs up onto developed properties, when roadways are flooded or washed out, and when dams that hold back large impoundments endanger properties downstream.

Damage to roadways is a serious and chronic problem across the region. Beavers plug culverts and create impoundments that back up and over roadbeds. Hazardous driving conditions are created when roadways are flooded. Damage to the roadbed occurs when moving water erodes or undermines the road, and when the soil supporting the roadbed becomes saturated with water and settles or shifts. Gravel roads erode or are washed out. The overall stability of paved roads decreases as the pavement becomes stressed and potholes are formed. Local highway departments in neighboring New York State spend approximately 19 workdays and $2,500 in repair costs annually for each beaver-obstructed culvert (Jensen & Curtis, 1999).

Some of the beaver dams across the county are as large as man-made dam, impounding sizable ponds and wetlands. Unlike man-made dams, the exact size of the dams and the impoundments, and the condition of these dams is largely unknown. The extent of damage that would be caused by failure or breaching of any of these dams is therefore also unknown.

Historical Occurrence at Tyringham and Vicinity

The 2012 Berkshire County Hazard Mitigation Plan noted several locations within Tyringham impacted by beavers, as follows:

- Goose Pond Road, which is partially a dirt road, has beaver problems at the Copper Brook culvert. The plugging of the culvert by the beavers has caused the road to flood.
- Beavers around Beach Road have caused the water to approach the bridge. There is concern of damage to the bridge and flooding due to the beavers.
- There is a beaver dam in a wetland north of Main Road. If that dam breeches, land all the way down to Main Road will be flooded.
- There are beaver dams throughout the floodplain of Hop Brook, causing high water in some locations and low water flows in other locations.
- There are a number of other beaver ponds throughout the surrounding hillsides that when breached cause flash flooding conditions through the center of town.

The Town indicated that the problems at Copper Brook culvert have diminished in recent years, but identified more recent beaver activity at Sodom Road, in the South end down Main Road to Webster Road, off of Main Road.

Estimated Probability of Occurrence at and near Tyringham

It is expected that beaver activity will continue to persist in Tyringham, as suitable habitat is expected to remain relatively constant over the next decade.

Severe Weather Hazards: Winter Weather

SEVERE WINTER WEATHER: SNOWFALL

Severe winter weather includes large snow events, blizzards and ice storms. As defined by the National Weather Service, a blizzard is a snowstorm with sustained winds or frequent gusts of 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. 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 **Table 2-10**. RSI is based on the spatial extent of the storm, the amount of snowfall, and the juxtaposition of these elements with population density and societal impacts. Currently, the index uses population data based on the 2000 Census. A similar storm index is the Northeast Snowfall Impact Scale (NESIS), also shown below. Reference NOAA; https://www.ncdc.noaa.gov/snow-and-ice/rsi/

Severe winter weather in Massachusetts is almost always associated with nor'easters. **Table 2-11** summarizes the major nor'easters that occurred between the 1880's and now in the Northeast U.S. and includes RIS and NESI values (if available). Ref. https://gis.ncdc.noaa.gov/maps/ncei/rsi

Figure 2-13 indicates the average annual snowfall amounts for the Northeast U.S. The average snowfall per year near Tyringham is 50 to 75 inches per year .

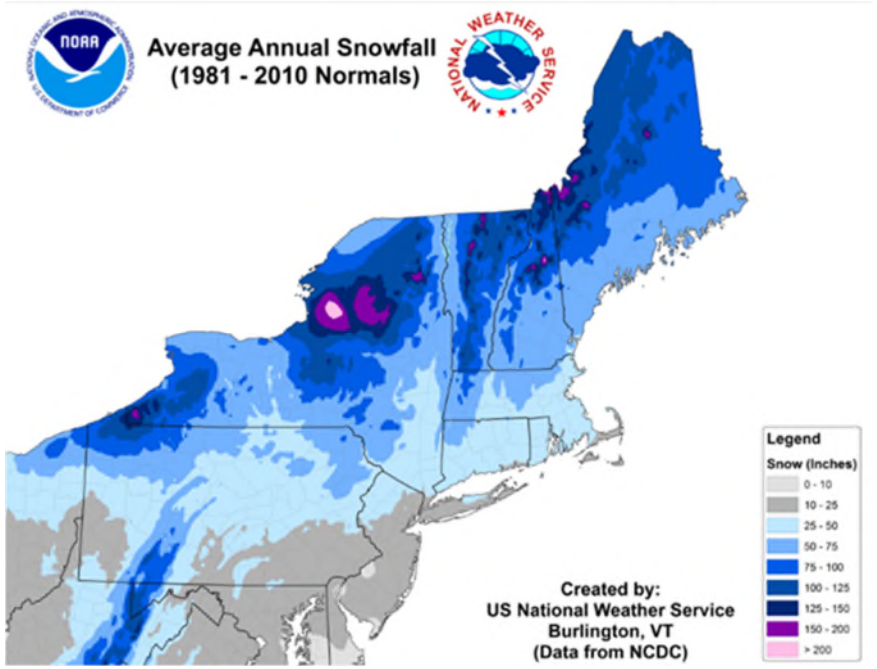


Figure 2-13: Average Annual Snowfall (http://www.weather.gov/btv/winter)

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

Category	NESIS Value	Description
1	1-2.5	Notable
2	2.5-4	Significant
3	4-6	Major
4	6-10	Crippling
5	10+	Extreme

Table 2-10: Regional Snowfall Index (RSI) and Northeast Snowfall Impact Scale

Table 2-11: Major Historical Nor'easters in the New England Region

Event	Northeast Category/RSI Value	Date	Description
Great Blizzard of 1888	NA	March 11-14, 1888	One of the worst blizzards in U.S. history. Dropped 40–50 inches (100–130 cm) of snow, killed 400 people, mostly in New York.
Great Appalachian Storm of November 1950	4/14.5	November 24-30, 1950	A very severe storm that dumped more than 30 inches (76 cm) of snow in many major metropolitan areas along the eastern United States, record breaking temperatures, and hurricane-force winds. The storm killed 353 people.
The Blizzard of'58	3/7.9	February 16-17, 1958	This coastal storm brought heavy snow and strong winds to the Northeast and resulted in 19.4 inches of snow in Boston.
	0/0	March 3-5, 1960	This wind-driven snowstorm brought whirling snow from Virginia to New York, before blowing into New England. Left 19.8 inches of
Ash Wednesday Storm of 1962	1/1.8	March 5-9, 1962	Caused severe tidal flooding and blizzard conditions from the Mid-Atlantic to New England, killed 40 people.
February Blizzard	5/34.0	February 24-27, 1969	This storm lasted several days and left 26.3 inches of snow in Boston.
Eastern Canadian Blizzard of March 1971	4/10.8	March 3-5, 1971	Dropped over 32 inches (81 cm) of snow over areas of eastern Canada, killed at least 30 people.
Groundhog Day Gale of 1976	NA	February 1-5, 1976	Caused blizzard conditions for much of New England and eastern Canada, dropping a maximum of 56 inches (140 cm) of snow.
January Blizzard	2/5.4	January 20-21, 1978	The January blizzard occurred just a couple of weeks before the infamous Blizzard of '78 and left 21.4 inches of snow in Boston.
Northeastern United States blizzard of 1978	5/18.4	February 5-7, 1978	A catastrophic storm, which dropped over 27 inches (69 cm) of snow in areas of New England, killed a total of 100 people, mainly people trapped in their cars on metropolitan Boston's inner beltway
1991 Storm (the "Perfect Storm," combined Nor'easter/hurricane)	0/0	October 28-November 2, 1991	Very unusual storm which evolved into a hurricane, tidal surge caused severe damage to coastal areas, especially Massachusetts,
December 1992 nor'easter	2/4.7	December 10-12, 1992	A powerful storm which caused severe coastal flooding throughout much of the northeastern United States.
1993 Storm of the Century	5/22.1	March 12-15, 1993	The Superstorm of 1993 which affected the entire eastern U.S., parts of eastern Canada and Cuba. It caused 6.65 billion (2008 USD) in damage, and killed 310 people.
Christmas 1994 nor'easter	NA	December 22-26, 1994	An intense storm which affected the east coast of the U.S., and exhibited traits of a tropical cyclone.
North American Blizzard of 1996	5/21.8	January 6-10, 1996	Severe snowstorm which brought up to 4 feet (120 cm) of snow to areas of the mid-Atlantic and northeastern U.S.
April Fools Storm	2/4.7	March 31-April 1, 1997	This April Fools storm dropped more than 2 feet of snow in Boston.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
North American Blizzard of 2003	4/14.7	February 14-22, 2003	Dropped over 2 feet (61 cm) of snow in several major cities, including Boston, and New York City, affected large areas of the Northeastern and Mid-Atlantic U.S., and killed a total of 27 people.
North American Blizzard of 2005	NA	January 20-23, 2005	Brought blizzard conditions to southern New England and dropped over 40 inches (100 cm) of snow in areas of Massachusetts.
North American Blizzard of 2006	2/5.0	February 11-13, 2006	A powerful storm that developed a hurricane-like eye when off the coast of New Jersey. It brought over 30 inches (76 cm) of snow in some areas and killed 3 people.
April 2007 nor'easter	0/1.0	April 13-17, 2007	An unusually late storm that dumped heavy snow in parts of Northern New England and Canada and heavy rains elsewhere. The storm caused a total of 18 fatalities.
November 2009 nor'easter	0/0	November 11-17, 2009	Formed from the remnants of Hurricane Ida, produced moderate storm surge, strong winds and very heavy rainfall throughout the mid-Atlantic region. It caused US$300 million (2009) in damage, and killed six people.
December 2009 North American blizzard	1/2.8	December 16-20, 2009	A major blizzard which affected large metropolitan areas, including New York City, Philadelphia, Providence, and Boston. In some of these areas, the storm brought up to 2 feet (61 cm) of snow.
March 2010 nor'easter	0/0.3	March 12-16, 2010	A slow-moving nor'easter that devastated the Northeastern United States. Winds of up to 70 miles per hour (110 km/h) snapped trees and power lines, resulting in over 1 million homes and businesses left without electricity. The storm produced over 10 inches (25 cm) of rain in New England, causing widespread flooding of urban and low-lying areas. The storm also caused extensive coastal flooding and beach erosion.
December 2010 North American blizzard	2/3.4	December 5, 2010-January 15, 2011	A severe and long-lasting blizzard which dropped up to 36 inches (91 cm) of snow throughout much of the eastern United States.
January 8–13, 2011 North American blizzard and January 25–27, 2011 North American blizzard	2/3.4	January 8-13 and January 25-27, 2011	In January 2011, two nor'easters struck the East Coast of the United States just two weeks apart and severely crippled New England and the Mid-Atlantic. During the first of the two storms, a record of 40 inches (100 cm) was recorded in Savoy, Massachusetts. Two people were killed.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
2011 Halloween nor'easter	1/2.6	October 28-November 1, 2011	A rare, historic nor'easter, which produced record breaking snowfall for October in many areas of the Northeastern U.S., especially New England. The storm produced a maximum of 32 inches (81 cm) of snow in Peru, Massachusetts, and killed 39 people. After the storm, the rest of the winter for New England remained very quiet, with much less than average snowfall and no other significant storms to strike the region for the rest of the season.
November 2012 nor'easter	0/0.3	November 7-10, 2012	A moderately strong nor'easter that struck the same regions that were impacted by Hurricane Sandy a week earlier. The storm exacerbated the problems left behind by Sandy, knocking down trees that were weakened by Sandy. It also left several residents in the Northeast without power again after their power was restored following Hurricane Sandy. Highest snowfall total from the storm was 13 inches (33 cm), recorded in Clintonville, Connecticut.
Late December 2012 North American storm complex	3/9.2	December 17-31, 2012	A major nor'easter that was known for its tornado outbreak across the Gulf Coast states on Christmas day as well as giving areas such as northeastern Texas a white Christmas. The low underwent secondary cyclogenesis near the coast of North Carolina and dumped a swath of heavy snow across northern New England and New York, caused blizzard conditions across the Ohio Valley, as well as an ice storm in the mountains of the Virginia and West Virginia.
Early February 2013 North American blizzard	3/NA	February 7-18, 2013	An extremely powerful and historic nor'easter that dumped heavy snow and unleashed hurricane-force wind gusts across New England. Many areas received well over 2 feet (61 cm) of snow, especially Connecticut, Rhode Island, and eastern Massachusetts. The highest amount recorded was 40 inches (100 cm) in Hamden, Connecticut, and Gorham, Maine, received a record 35.5 inches (90 cm). Over 700,000 people were left without power and travel in the region came to a complete standstill. The storm killed 18 people. Left 24.9 inches of snow in Boston and 22.8 inches in Providence.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
March 2013 nor'easter	1/1.6	March 1-21, 2013	A large and powerful nor'easter that ended up stalling along the eastern seaboard due to a blocking ridge of high pressure in Newfoundland and pivoted back heavy snow and strong winds into the Northeast United States for a period of 2 to 3 days. Many officials and residents were caught off guard as local weather stations predicted only a few inches (several centimeters) of snow with a change to mostly rain. Contrary to local forecasts, many areas received over one foot (30 cm) of snow, with the highest amount being 29 inches (74 cm) in Milton, Massachusetts. Several schools across the region, particularly in the Boston, Massachusetts, metropolitan area, remained in session during the height of the storm, not knowing the severity of the situation. Rough surf and rip currents were felt all the way southwards towards Florida's east coast.
January 2015 North American Blizzard	3/6.2	January 23-31, 2015	Unlike recent historical winter storms, there was no indication that a storm of this magnitude was coming until about 3 days in advance. The Blizzard began as an Alberta Clipper in the Midwestern States, which was forecast to transfer its energy to a new, secondary Low Pressure off the coast of the Mid Atlantic and move northeastward and pass to the south and east of New England. Several reports of over 30 inches (76 cm) across the State of Massachusetts, breaking many records. A maximum of 36 inches (91 cm) was recorded in at least four towns across Worcester County in Massachusetts and the city of Worcester itself received 34.5 inches (88 cm), marking the city's largest storm snowfall accumulation on record. The city of Boston recorded 24.6 inches (62 cm), making it the largest storm snowfall accumulation during the month of January and the city's sixth largest storm snowfall accumulation on record. On the coast of Massachusetts, Hurricane Force gusts up to around 80 mph (130 km/h) along with sustained winds between 50 and 55 mph (80 and 89 km/h) at times, were reported. The storm also caused severe coastal flooding and storm surge. The storm bottomed out to a central pressure of 970 mb (970 hPa). By January 28, the storm began to pull away from the area.
October 2015 North American storm complex	0/0	September 29-October 2, 2015	In early October, a low pressure system formed in the Atlantic, Tapping into moisture from Hurricane Joaquin, the storm dumped a huge amount of rain, mostly in South Carolina.

Table 2-11: Major Historical Nor'easters in the New England Area cont.

Event	Northeast RSI/ NESIS Category	Date	Description
January 2016 United States blizzard (also known as Winter Storm Jonas, Snowzilla, or The Blizzard of 2016 by media outlets)	4	January 19-29, 2016	This system dumped 2 to 3 feet (61 to 91 cm) of snow in the East Coast of the United States. States of Emergencies were declared in 12 States in advance of the storm as well as by the Mayor of Washington D.C. The blizzard also caused significant storm surge in New Jersey and Delaware that was equal to or worse than Hurricane Sandy. Sustained damaging winds over 50 mph (80 km/h) were recorded in many coastal communities, with a maximum gust to 85 mph (137 km/h) on Assateague Island, Virginia. A total of 55 people died due to the storm.
February 2017 United States blizzard (also known as Winter Storm Niko and The Blizzard of 2017 by media outlets)	4.17.8	February 6-11, 2017	Forming as an Alberta clipper in the northern United States on February 6, the system initially produced light snowfall from the Midwest to the Ohio Valley as it tracked southeastwards. It eventually reached the East Coast of the United States on February 9 and began to rapidly grow into a powerful nor'easter, dumping 1 to 2 feet (30 to 61 cm) across the Northeast Megapolis. The storm also produced prolific thunder and lightning across Southern New England. Prior to the blizzard, unprecedented and record-breaking warmth had enveloped the region, with record highs of above 60 °F (16 °C) recorded in several areas, including Central Park in New York City. Some were caught off guard by the warmth and had little time to
October 2017 nor'easter	0/0	October 28-31, 2017	An extratropical storm absorbed the remnants of Tropical Storm Philippe. The combined systems became an extremely powerful nor'easter that wreaked havoc across the Northeastern United States and Eastern Canada. The storm produced sustained tropical storm force winds along with hurricane force wind gusts. The highest wind gust recorded was 93 mph (150 km/h) in Popponesset, Massachusetts. The storm caused over 1,400,000 power outages. Damage across New England, especially in Connecticut, Massachusetts, and Rhode Island, was extreme. This was due to the combination of the high winds, heavy rainfall, saturated ground, and most trees still being fully leaved. Some residents in Connecticut were without power for nearly a week following the storm. Heavy rain in Quebec and Eastern Ontario, with up to 98 mm (3.9 in) in the Canadian capital region of Ottawa, greatly interfered with transportation.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
January 2018 North American blizzard	4/17.8	January 2-6, 2018	A powerful blizzard that caused severe disruption along the East Coast of the United States and Canada. It dumped snow and ice in places that rarely receive wintry precipitation, even in the winter, such as Florida and Georgia, and produced snowfall accumulations of over 2 feet (61 cm) in the Mid-Atlantic states, New England, and Atlantic Canada. The storm originated on January 3 as an area of low pressure off the coast of the Southeast. Moving swiftly to the northeast, the storm explosively deepened while moving parallel to the Eastern Seaboard, causing significant snowfall accumulations. The storm received various unofficial names, such as Winter Storm Grayson, Blizzard of 2018 and Storm Brody. The storm was also dubbed a "historic bomb cyclone".
March 1-3, 2018 nor'easter (also known as Winter Storm Riley or False Tropical Storm Riley by media outlets)	2/4.4	March 1-5, 2018	A very powerful nor'easter that caused major impacts in the Northeastern, Mid-Atlantic and Southeastern United States. It originated as the northernmost low of a stationary front over the Midwest on March 1, which moved eastward into the Northeast later that night. A new low pressure system rapidly formed off the coast on March 2 as it slowly meandered near the coastline. It peaked later that day and began to gradually move out to sea by March 3. Producing over 2 feet (24 in) of snow in some areas, it was one of the most significant March snowstorms in many areas, particularly in Upstate New York. In other areas, it challenged storm surge records set by other significant storms, such as Hurricane Sandy. It also produced widespread damaging winds, with gusts well over Hurricane force strength in some areas across Eastern New England as well as on the back side in the Mid-Atlantic via a sting jet. Over 2.2 million customers were left without power.
March 6-8, 2018 nor'easter (also known as Winter Storm Quinn by media outlets)	1/2.2	March 2-9, 2018	A powerful nor'easter that affected the Northeast United States. It came just days after another nor'easter devastated much of the Northeast. Frequent cloud to ground Thundersnow as well as snowfall rates of up to 3 inches (7.6 cm) an hour were reported in areas around the Tri-State Area, signaling the rapid intensification of the storm. Late in the afternoon, an eye-like feature was spotted near the center of the storm. It dumped over 2 feet of snow in many areas across the Northeast, including many areas in New England where the predominant precipitation type was rain for the previous storm. Over 1 million power outages were reported at the height of the storm due to the weight of the heavy, wet snow on trees and power lines. Many people who lost power in the previous storm found themselves in the dark again.

Table 2-11: Major Historical Nor'easters in the New England Region cont.

Event	Northeast RSI/ NESIS Category	Date	Description
March 12-14, 2018 nor'easter (also known as Winter Storm Skylar by media outlets)	1/2.2	March 11-14, 2018	A powerful nor'easter that affected portions of the Northeast United States. The storm underwent rapid intensification with a central millibaric pressure dropping down from 1001 mb to 974 mb in just 24 hours. This was the third major storm to strike the area within a period of 11 days. The storm dumped over up 2 feet of snow and brought Hurricane force wind gusts to portions of Eastern New England. Hundreds of public school districts including, Boston, Hartford, and Providence were closed on Tuesday, March 13.
March 20–22, 2018 nor'easter (also known as Winter Storm Toby by media outlets)	1/1.6	March 20-22, 2018	A powerful nor'easter that became the fourth major nor'easter to affect the Northeast United States in a period of less than three weeks. It caused a severe weather outbreak over the Southern United States on March 19th before moving off of the North Carolina coast on March 20th and spreading freezing rain and snow into the Mid-Atlantic States after shortly dissipating later that night. A new low pressure center then formed off of Chesapeake Bay on March 21st and then became the primary nor'easter. Dry air prevented most of the precipitation from reaching the ground in areas in New England such as Boston, Hartford, and Providence, all of which received little to no accumulation, in contrast with what local forecasts had originally predicted. In Islip, New York at the height of the storm, snowfall rates of up to 5 inches per hour were reported. 8 inches was reported at Central Park and over 12 inches was reported in many locations on Long Island as well in and around New York City and in parts of New Jersey.

Historical Occurrence at Tyringham and Vicinity

Between 1996 and 2020, there were a total of 29 Heavy Snow event days in Berkshire County, with one day with property damage and no injuries or fatalities. Heavy Snow in the NOAA database is defined as snow accumulation meeting or exceeding locally/ regionally 12 and/or 24 hour warning criteria: typically 4, 6 or 8 inches or more within 12 hours or 6, 8 or 10 inches or more in 24 hours. Storms including strong winds or other types of precipitation are classified as Winter Storms instead of Heavy Snow events. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/ .

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following Heavy Snowfall probability at and near Tyringham:

- Average annual snowfall of 50 to 75 inches
- 50% AEP or 2 year recurrence interval Heavy Snowfall (12 years with 1 or more events over 24 years)

Effects of Climate Change

The attribution of Heavy Snowfall events to climate change and understanding is moderate. High sea surface temperatures, increased atmospheric moisture and polar vortex conditions may result in an increased frequency of Heavy Snowfall.

SEVERE WINTER WEATHER: ICE STORMS

Ice storms are an occasional component of severe winter weather. 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. Ice can increase the weight of branches by 30 times. A 1/2-inch accumulation on power lines can add 500 lbs. of weight. Even slight accumulations of ice result in slippery conditions for motorists and pedestrians.

The National Weather Service issues:

- an Ice Storm Warning for a quarter-inch or more of ice accumulation
- a Freezing Rain Advisory for ice accumulation of less than one quarter-inch

Ice storms are relatively rare events in Massachusetts, including Tyringham.

Historical Occurrence at Tyringham and Vicinity

There were three Ice Storm event days recorded in the NOAA Storm Events Database for Berkshire County between 2007 and 2020, with no reported property damage, deaths, or injuries. Between 1990 and 2018, there were a total 6 days with ice storm events in Massachusetts (an average of 0.3 event per year), resulting in 1 injury and $45.4M property damage.

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following Ice Storm probability at and near Tyringham:

- 23% AEP or 4 year recurrence interval Ice Stormsl (3 years with 1 or more events over 13 years)

Effects of Climate Change

The attribution of Ice Storm events to climate change and understanding is low to moderate. High sea surface temperatures, increased atmospheric moisture and polar vortex conditions may result in an increased frequency of Ice Storms.

Extreme Temperatures

EXTREME TEMPERATURE: HEAT

The National Weather Service in Albany, NY 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
- A Heat Wave is defined as 3 or more days of temperatures of 90° F or above.

Heat Index

The Heat Index, also known as the Apparent Temperature, is a subjective measure of what it feels like to the human body when relative humidity is factored into the actual air temperature. Relative humidity is a measure of the amount of water in the air compared with the amount of water that air can hold at the current temperature. The body cools itself through the evaporation of perspiration or sweat. However, when the relative humidity is high, the increased moisture content in the air decreases the evaporation of perspiration or sweat. For example, a hot and very humid air mass with a temperature of 94 degrees and a relative humidity of 45 percent yields an apparent temperature of 100 degrees. Holding the temperature constant and increasing the relative humidity to 60 percent yields an apparent temperature of 110° F.

The National Weather Service will initiate alert procedures when the Heat Index is expected to exceed 100° F to 104° F (depending on local climate). Under these conditions, sunstroke and heat exhaustion are likely, and physical activity or being outside for long periods is risky, potentially leading to heat stroke.

These dangerous heat days pose the greatest threat to children and the elderly, and to people who don't have easy access to air conditioning. 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. (http://www.nws.noaa.gov/om/heat/heat_index.shtml).

From 1979-2016, more than 9,000 Americans have died in the United States from heat related ailments (EPA, 2016). During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

The highest temperature recorded in Massachusetts was 107°F on August 2, 1975, in Chester and New Bedford. According to the 2018 State Hazard Mitigation and Climate Adaptation Plan, there have been 43 warm weather events since 1995, ranging from Record Warmth/Heat to Excessive Heat events. During 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).

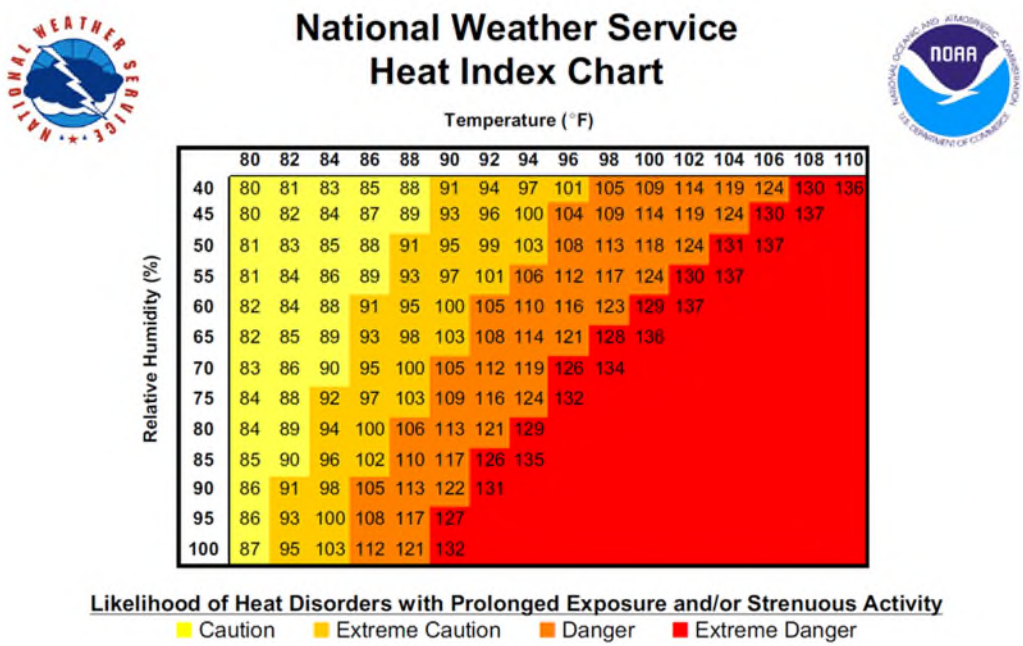


Figure 2-14: Heat Index Chart

Historical Occurrence at Tyringham and Vicinity

Between 2000 and 2020, there were a total of 2 events with Excessive Heat in Berkshire County and no fatalities or injuries. These included March 8, 2000 and July 1, 2018. The event on March 8 was attributed to higher than normal temperatures for the season (high 60s to near 70 degrees). Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Tyringham

The results indicate that the probability of Excessive Heat near Tyringham (Berkshire County) is:

- 11% AEP or 1 event every 9 years.

Additional Heat Effects

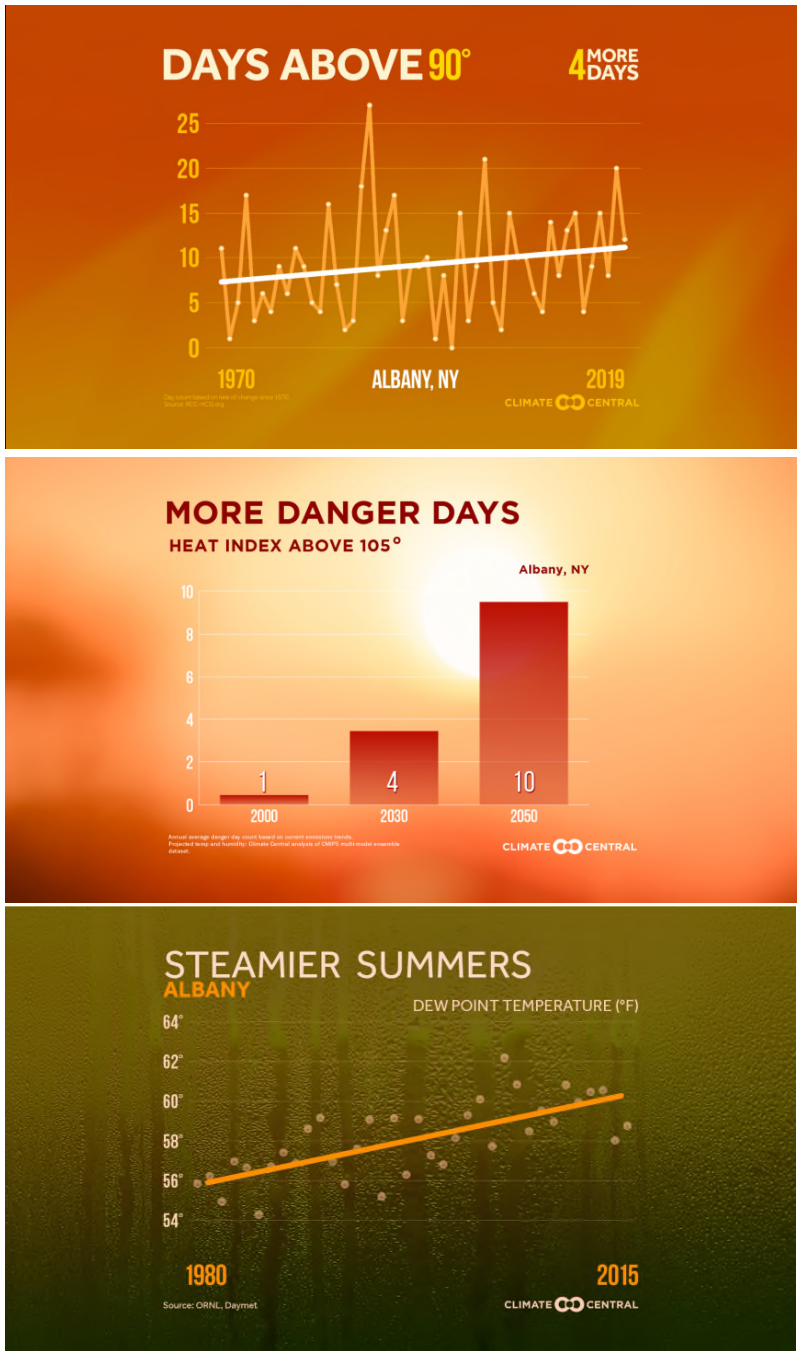
In addition to the Heat Index, air quality is a significant issue related to extreme temperature. Summers in the U.S. bring more than just searing, dangerously hot days. When the air is stagnant and there is little air circulation, hot weather can trigger high levels of air pollution that can have health consequences. High temperatures on sunny days make ground-level ozone (a major component of smog) form much more readily. An EPA study looking at more than 20 years of measurements across most of the rural areas in the eastern U.S. found that harmful ozone concentrations increased nearly linearly as temperatures increased and named the effect the "climate penalty on ozone."

Effects of Climate Change

The confidence of attribution of Excessive Heat to climate change, and understanding, is high. High global temperatures are effecting temperatures at the local level, including Tyringham.

Massachusetts currently experiences between 5 and 8 days per year when the Heat Index is expected to exceed 105° F. By 2050, that number could grow to 16 days per year. The number of Heat Wave days in Massachusetts is expected to increase from about 11 to 30 days per year (the period of 2000 to 2030) to about 40 days per year by the year 2050. **Figure 2-15** shows the increase in days above 90° F for Albany, NY. **Figure 2-16** shows the predicted range of days above 105° F for Albany through 2050.

As summers get hotter from the increase in greenhouse gases, they are also getting stickier. More evaporation occurs in a warming atmosphere, and on a world where water covers nearly three-quarters of the surface, it means an increase in water vapor in the air. During the period of 1980 to 2015, the dew point temperature increased from about 59 ° F to 62 ° F. as presented on **Figure 2-17.**



Figures 2-15 through 2-17: Days Above 90 degrees (top); Days with Heat Index above 105 degrees (middle); Dew Point Temperature

Effects of Climate Change

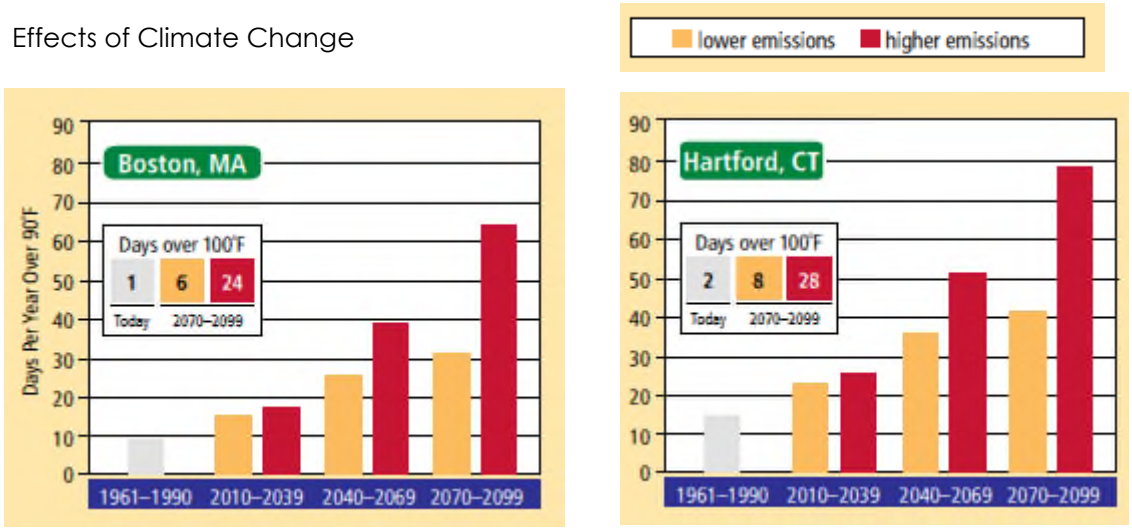


Figure 2-18: Predicted Days above 90° F and 100° F (source Union of Concerned Scientists)

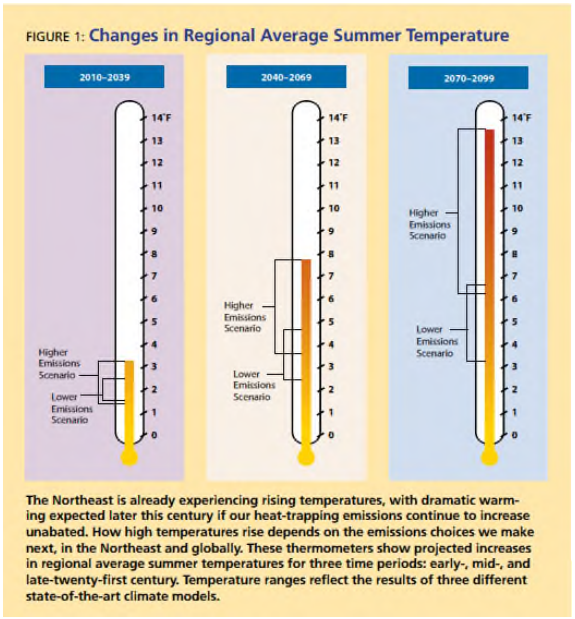


Figure 2-19: Predicted Rise in Average Northeast U.S. Temperatures (source Union of Concerned Scientists)

In addition to the effect of climate change on extreme heat events, the overall increase in global and local temperature averages will significantly change climate patterns within the Northeast U.S., including Tyringham. Spring will arrive sooner, summers are growing hotter, and the weather is becoming more extreme with swings between above-average winter temperatures to extreme cold with large snowfall events. Per the Union of Concerned Scientists summary reports, if global greenhouse gas emissions continue, the Northeast can expect dramatic temperature increases and other climate changes within the next several decades. Recent observations indicate that these effects are already underway, including within Massachusetts. Average summer temperatures may increase between 6° F and 14° F by 2100 (see **Figure 2-19**). The overall effect will be a shift in the Massachusetts climate equivalent to that historically experienced in lower latitudes, ranging between the Chesapeake Bay area to South Carolina (see **Figure 2-20**).

With its setting in the Berkshire mountains, Tyringham benefits from higher elevations and tree cover.

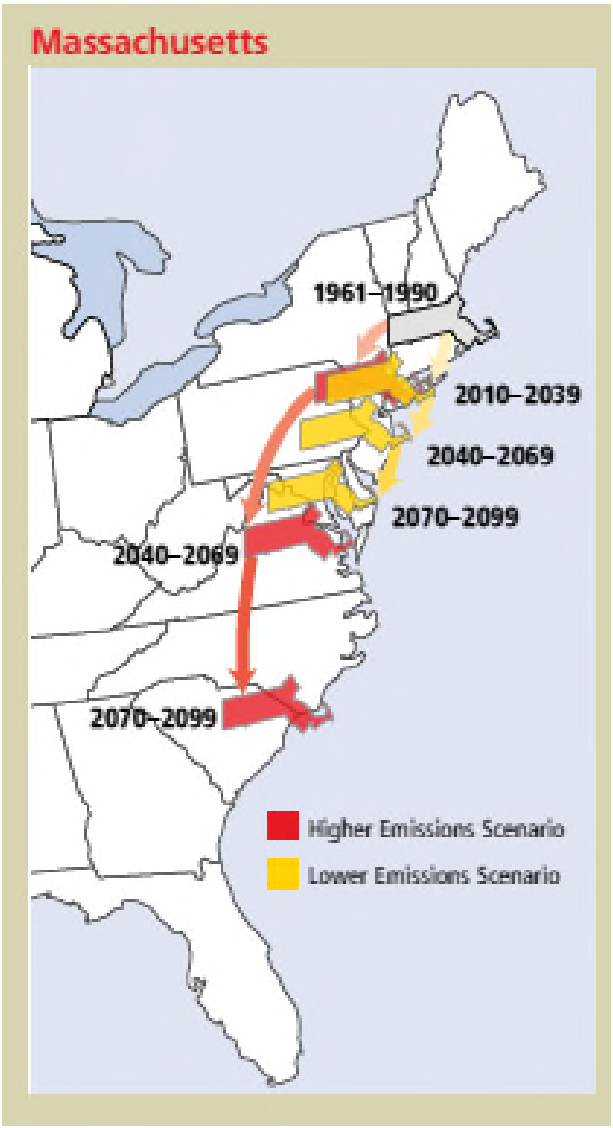


Figure 2-20: Latitudinal Changes in Regional Climate (source Union of Concerned Scientists)

EXTREME TEMPERATURE: COLD

Extreme cold events are generally defined as a prolonged period of excessively cold weather. Extreme cold conditions are often, but not always, part of winter storms. Winter in Massachusetts almost always includes periods of extreme cold weather. Exposure to cold can cause frostbite or hypothermia and has the potential to become life-threatening. Although anyone can suffer from cold-related health issues, some people are at greater risk than others, such as:

- Older adults
- Young children
- Those who are sick; and
- Those without adequate shelter.

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.

The following extreme cold warnings and advisories are issued by the National Weather Service (NWS):

- 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.

The National Weather Service Wind Chill Chart 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, as a period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria (typical value around -35° F or colder). Ref. http://www.wpc.ncep.noaa.gov/html/windchill.shtml.

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).

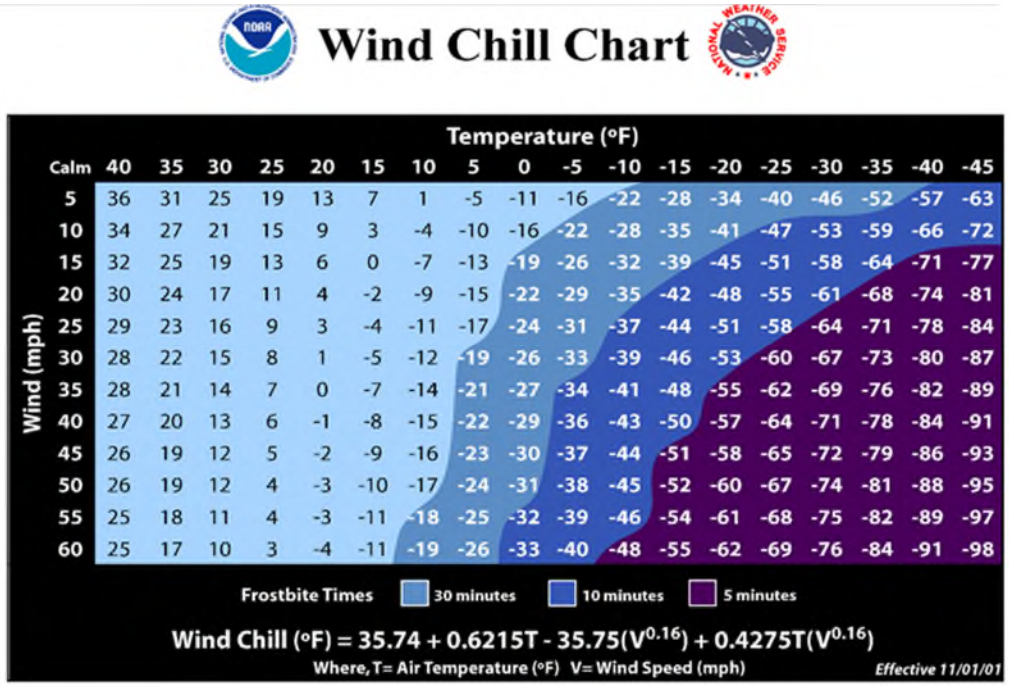


Figure 2-21: Wind Chill Chart

Nationally, there have been 887 recorded cold fatalities since 1988, with a 10 year average of 33 fatalities/year. http://www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf

Historical Occurrence at Tyringham and Vicinity

Between 2000 and 2020, Berkshire County has experienced 12 event days with an Extreme Cold/Wind Chill event resulting in no fatalities or injuries. Ref. NOAA Storm Events Database https://www.ncdc.noaa.gov/stormevents/

Estimated Probability of Occurrence at and near Tyringham

The results indicate the following Extreme Cold/Wind Chill probability at and near Tyringham:

- 35% AEP or 3 year recurrence interval (7 years with 1 or more events over 20 years)
- The average low temperature during January (the average coldest month) at Tyringham is 11.6°F.

Effects of Climate Change

The confidence of attribution of Extreme Cold to climate change, and understanding, is moderate. It appears that warming trends have weakened polar vortex winds resulted in meandering of these winds. This condition allows cold Arctic air to dip further south, resulting in a variable New England winter with temperatures varying from above-average warm to periods of extreme cold.

Drought

DROUGHT

Droughts occur when there has not been enough rainfall and water levels get low, in particular when precipitation and other water resources fall below expectations but the demand for water remains. They can happen anywhere in the United States, and droughts increase the risk of other hazards like wildfires, flash floods, and possible landslides or debris flows. Drought is a slow-onset hazard that can last for months or years. Droughts are generally classified into different types including:

- meteorological drought - lack of precipitation
- agricultural drought - lack of soil moisture
- hydrologic drought - reduced streamflow or groundwater levels.

As a hazard, it has the potential to impact many aspects of life, including two of our most important needs: drinking water and food. Because of the long duration of droughts, the impacts can last for years and can ripple through a community over time.

Drought is an important issue in Massachusetts and the Town due to effects on agricultural and water resources. Town residents obtain their drinking water from private wells, which can be effected by drought.

Massachusetts maintains a Drought Management Plan and five levels of drought are used to characterize drought severity and response: Normal; Advisory; Watch; Warning; and Emergency. A determination of drought level in Massachusetts is based on seven indices: Standardized Precipitation Index (SPI); Crop Moisture Index; Keetch-Byram Drought Index (KBDI); Precipitation Index; Groundwater Level Index; Stream Flow Index; and Reservoir Index. Additional climatological indices used nationally include: Standardized Precipitation-Evapotranspiration Index (SPEI), Palmer Drought Severity Index (PDSI) and Rainfall Deciles are standard climatological drought indices. Drought levels are declared on a regional basis. Massachusetts has identified six statewide drought regions. The Town is located within the Western Region.

During the summer of 2002, one-third of the U.S., including Massachusetts, experienced drought conditions. Based on historical Palmer Drought Severity Indices, Massachusetts has experienced multi-year drought periods in 1879-83, 1910-19, 1928-39, 1964-69, and 1985-95. The most severe drought on record in the northeastern United States was during 1961-69. For the period of 1895 to 1995, Massachusetts experienced low PDSIs (indicating drought conditions) about 6 to 10 percent of the time, indicating the relative probability of drought. Water supplies and agriculture were affected because of the severity and long duration of the drought. Precipitation was less than average beginning in 1960 in western Massachusetts and beginning in 1962 in eastern Massachusetts.

Historical Occurrence at Tyringham and Vicinity

August 1999 was the peak of the long term drought across Western Massachusetts that began in July of 1998. The fourteen month stretch, ending in August, saw rainfall and melted snowfall throughout the region tallying up to only about 80 percent of normal.

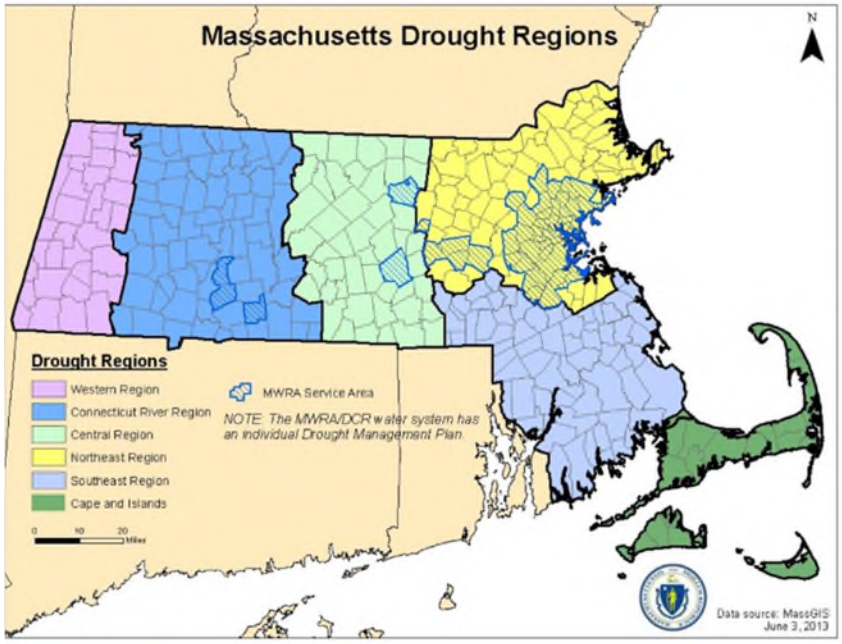


Figure 2-22: Massachusetts Drought Regions

The long term drought combined with the heat of the summer, resulted in a drought warning across the Berkshires. The drought resulted in low levels of streams, and many wells went completely dry. Most communities implemented voluntary or mandatory water restrictions. Ref. NOAA Storm Events Database.

Estimated Probability of Occurrence at and near Tyringham

Based on recent drought history (1999 to 2020), Berkshire County has been impacted by drought once in 21 years. Based on this limited data:

- The probability of Drought near Tyringham (Berkshire County) is 5% AEP or 1 event every 20 years.
- Massachusetts experiences extended, multi-year droughts about every 20 years

Effects of Climate Change

The confidence of attribution of Drought to climate change is moderate. Increased air temperatures and evapotranspiration can increase drought potential. In the Northeast U.S, the relationship between increased rainfall intensity and drought is uncertain.

Wildfire

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.

Tyringham is 84% forest, which presents potential area for wildfires to occur. The Local Planning Team reported that small brushfires occur on occasion and are typically caused by residential backyard burning. 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).

In Tyringham during 2018, there were 0 fires (Ostroskey, 2018). There have been no reports of significant property damage or deaths related to brush fires or wildfire.

Historical Occurrence at Tyringham and Vicinity

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 zero (0) wildfires as having occurred in Berkshire County between 1950 and 2020.

Estimated Probability of Occurrence at and near Tyringham

The historical data indicates that the probability of wildfire within Tyringham is low. Quantitative probabilities of occurrence are not available. The number of brush fires each year is variable and usually increases during years of dry spring and summer (Ostroskey, 2018).

Effects of Climate Change

The confidence of attribution of Wildfire to climate change is low. Increased air temperatures and evapotranspiration, as well as increases in drought, can increase Wildfire potential.

Figure 2-23: This map layer portrays the Wildfire Hazard Potential (WHP), developed by the U.S. Forest Service's (USFS) Fire Modeling Institute to help inform assessments of wildfire risk or prioritization of fuels management needs across large landscapes. (arcgis.com)

Earthquake

EARTHQUAKE

Earthquakes occur as the result tectonic activity. An earthquake is sudden ground motion or trembling caused by an abrupt release of accumulated strain acting on the tectonic plates that comprise the Earth's crust along faults. Although earthquakes have caused much less economic loss annually in the United States than other hazards such as floods, they have the potential for causing great and sudden loss. Within 1 to 2 minutes, an earthquake can devastate part of an area through ground-shaking, surface fault ruptures, and ground failures. 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. The effects of earthquakes are: 1) ground shaking; 2) ground displacement; and 3) loss of soil strength (liquefaction). Ground shaking is represented by the Peak Ground Acceleration (PGA) and spectral acceleration (SA) response. The PGA reflects the ground acceleration at the top of bedrock. Thick deposits of soil over bedrock will modify (typically increase) the acceleration, resulting in ground surface accelerations that are greater than the PGA. Liquefaction is a function of soil type and density. Earthquake intensity is characterized by: 1) the Richter Scale; and 2) the Modified Mercalli Scale. Seismic hazards include damage to structures and infrastructure, landslides and tsunamis.

The National Seismic Hazard Maps (NSHM) (and the hazard model from which they are derived) are used by engineers who construct buildings to determine how strongly a particular site might be shaken by earthquakes. The NSHMs compile known earthquake sources, their distance from the site in question, and other seismological and geological information to project potential maximum expected ground motions at a site over a particular period of time (50 years).

Soil deposits above bedrock are classified based on shear wave velocity according to Site Class. Site Class Definitions are presented in **Table 2-13**. The geologic data indicates that the majority of Tyringham consists of shallow glacial till or bedrock with sand and floodplain alluvium along the Hop Brook valley.

Figure 2-24 presents the significant earthquakes in New England. **Figure 2-25** presents the 2% probability of exceedance in 50 years PGA. The 2% in 50 years PGA in the vicinity of Tyringham is 0.1g, where g is the acceleration of gravity (32.2 ft/sec^2).

Richter Scale	Earthquake Effects
2.5 or less	Not felt or felt mildly near the epicenter, but can be recorded by seismographs
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter

Table 2-12: Richter Scale

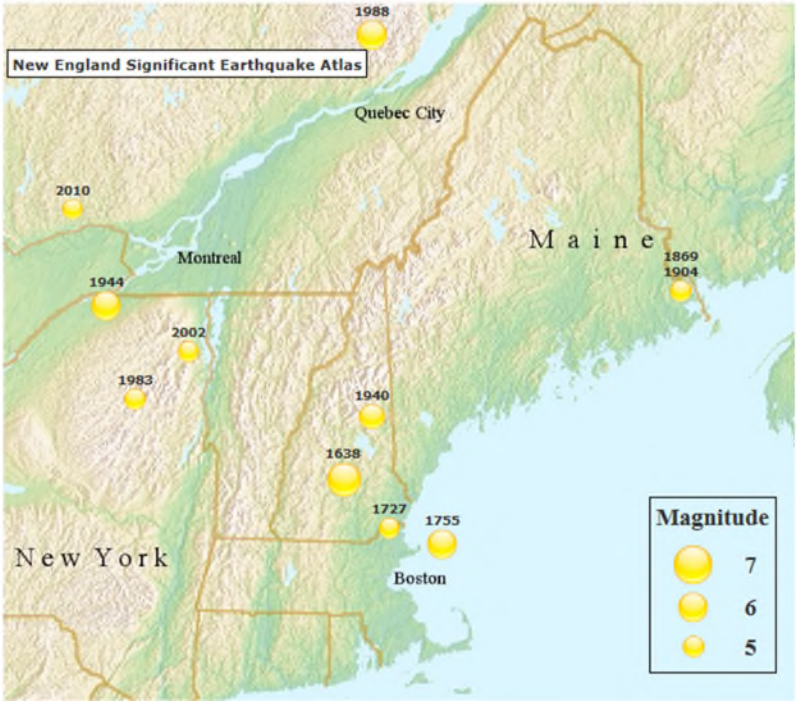


Figure 2-24: Significant Earthquakes in New England http://aki.bc.edu/quakes_historical.htm

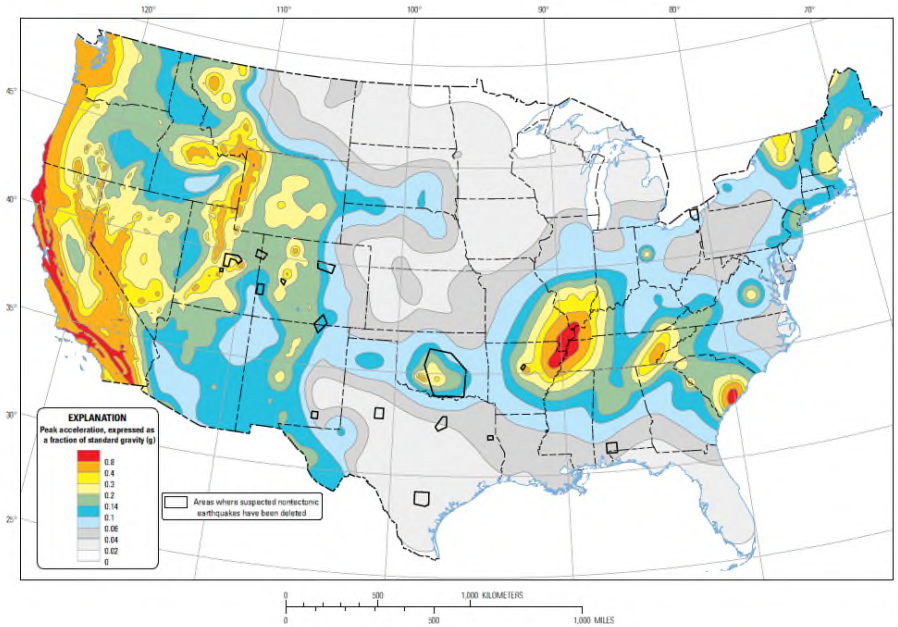
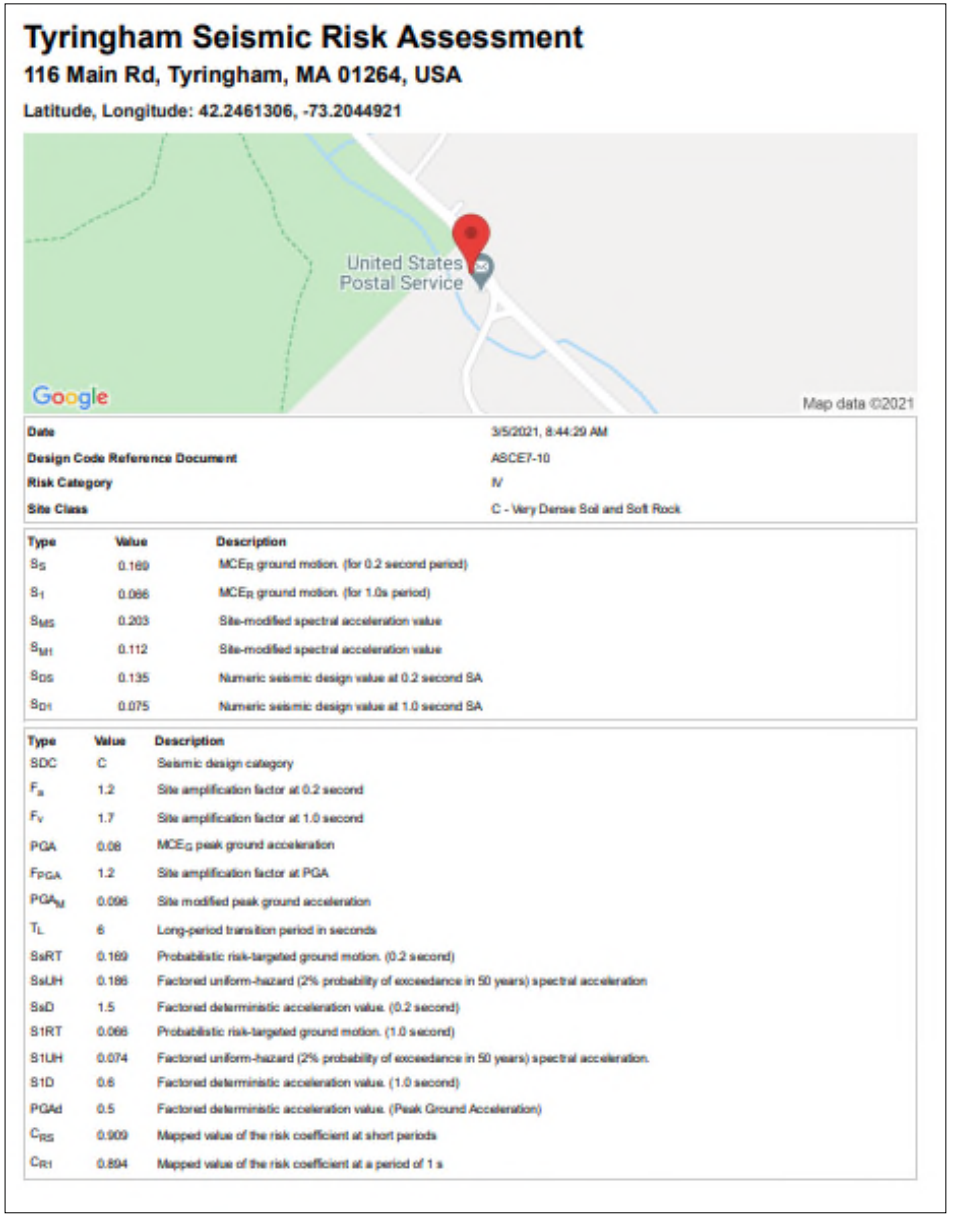


Figure 2-25: 2% probability of exceedance in 50 years Map of Peak Ground Acceleration

2010 ASCE-7 Standard – Table 20.3-1
SITE CLASS DEFINITIONS

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response	See Section 20.3.1		

Table 2-13: Site Class Definitions



Tyringham Seismic Risk Assessment

116 Main Rd, Tyringham, MA 01264, USA

Latitude, Longitude: 42.2461306, -73.2044921

Date	3/5/2021, 8:44:29 AM
Design Code Reference Document	ASCE7-10
Risk Category	IV
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	0.169	MCE_R ground motion. (for 0.2 second period)
S_1	0.066	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.203	Site-modified spectral acceleration value
S_{M1}	0.112	Site-modified spectral acceleration value
S_{DS}	0.135	Numeric seismic design value at 0.2 second SA
S_{D1}	0.075	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	C	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.7	Site amplification factor at 1.0 second
PGA	0.08	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.096	Site modified peak ground acceleration
T_L	6	Long-period transition period in seconds
SsRT	0.169	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.186	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.066	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.074	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.909	Mapped value of the risk coefficient at short periods
C_{R1}	0.894	Mapped value of the risk coefficient at a period of 1 s

Figure 2-26: USGS Seismic Hazard Report for Tyringham (https://seismicmaps.org/)

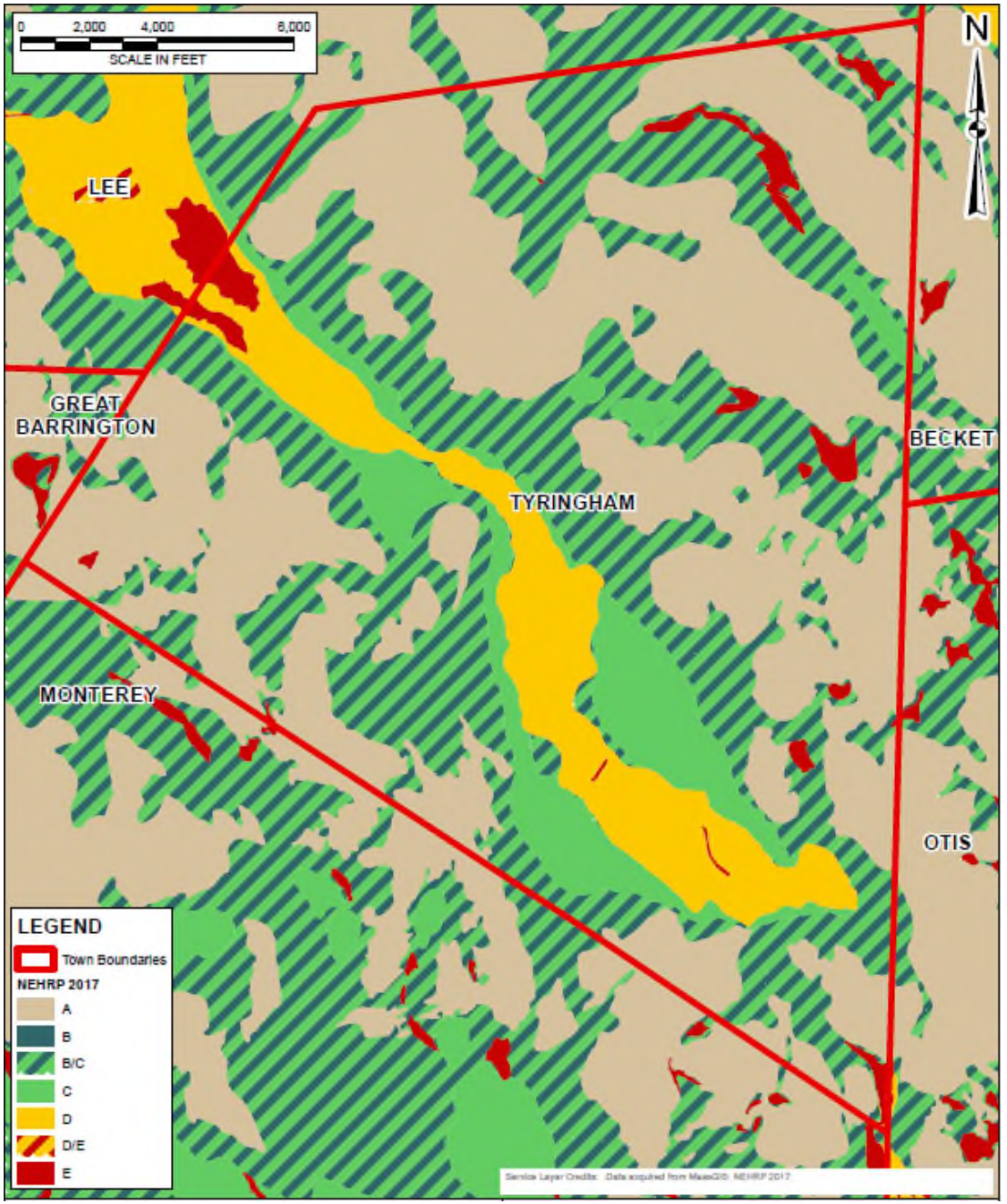


Figure 2-27: NEHRP 2017 Soil Site Classes at Tyringham

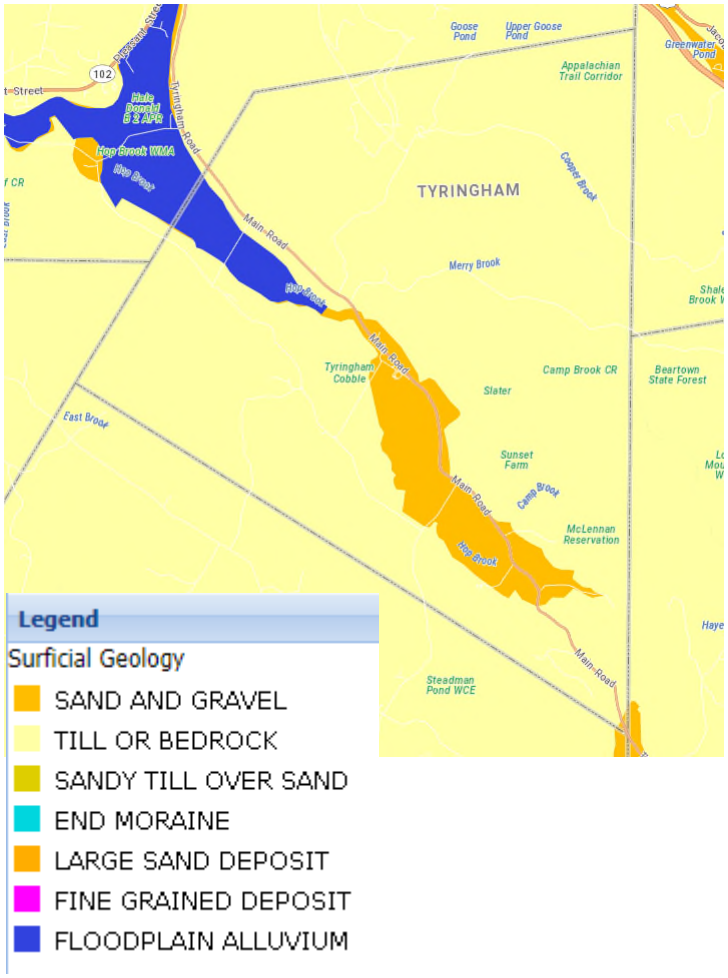


Figure 2-28: Surficial Geology of Tyringham (MassGIS)

Historical Occurrence at Tyringham and Vicinity

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/ As show in **Figure 2-29**, there have historically been significant (Richter magnitudes between 5 and 7) earthquakes in the vicinity of Massachusetts.

Estimated Probability of Occurrence at and near Tyringham

- The occurrence of historic earthquakes, PGA, and Site Class indicate that the seismic risk at Tyringham is low. Amplified ground motion may occur within localized areas within Tyringham classified as Site Classes D and E. These areas my also be susceptible to liquefaction.

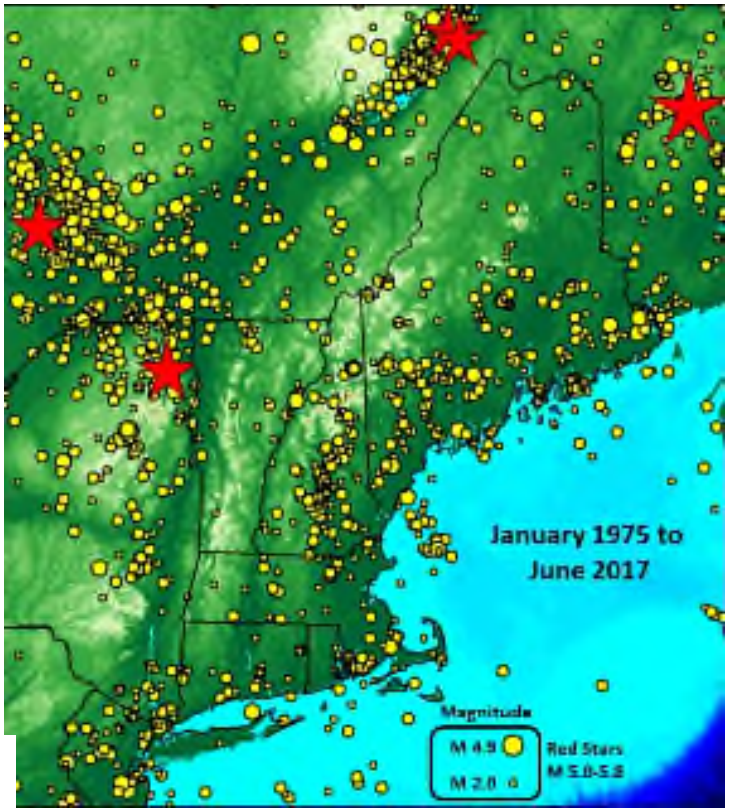


Figure 2-29: Area Earthquakes during January 1975 and June 2017

Attachment 3: Natural Hazard Risk

Attachment 3: Natural Hazard Risk

Overview

A Natural Hazard Risk Assessment was conducted by GZA to evaluate the potential consequences of natural hazards to the people, economy, and built and natural environments of the Town of Tyringham. The risk assessment was performed based on guidance provided by the FEMA Local Mitigation Planning Handbook, and included the Local Planning Team (LPT). Three planning meetings were held on September 22, 2020, November 10, 2020, and January 12, 2021.

The Natural Hazard Risk Assessment evaluates the effects of the relevant natural hazards (described in Attachment 2) on the community assets (identified in Attachment 1). The methodology assesses risk in terms of: 1) the likelihood (i.e., frequency) of the natural hazard occurring; 2) the predicted effects (damages, losses, etc.); and 3) the consequences (e.g., costs) associated with those effects.

A vulnerability analysis was performed based on historical data and by spatially comparing the hazard data to the community assets. In particular, the vulnerability of the Town to flooding was assessed by identifying which assets are located within the FEMA flood zones (Special Flood Hazard Areas).

The FEMA Multi-Hazard MH-HAZUS program was used to evaluate losses due to seismic, flood and hurricane hazards. The hazards were ranked using a scoring system. The scoring system is based on the likelihood/frequency, severity/ magnitude, and potential impact area. The scoring process and results were reviewed by the LPT to assess the Town's current "perceived" risk.

Historical Hazard Events

Previous federal Presidential Disaster Declarations in Massachusetts and in Berkshire County were reviewed. FEMA Repetitive Loss Property data within the Town was also evaluated.

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).

Disaster	Declaration Date
COVID-19 Pandemic (DR-4496)	March 27, 2020
Severe Winter Storm & Snowstorm (DR-4379)	July 19, 2018
Severe Winter Storm & Flooding (DR-4372)	June 25, 2018
Severe Winter Storm, Snowstorm & Flooding (DR-4214)	April 13, 2015
Severe Winter Storm, Snowstorm & Flooding (DR-4110)	April 17, 2013
Hurricane Sandy (DR-4097)	December 19, 2012
Tropical Storm Irene (DR-4028)	September 3, 2011
Severe Storm & Flooding (DR-1895)	March 29, 2010
Severe Storms & Flooding (DR-1614)	November 10, 2005
Severe Storms & Flooding (DR-1364)	April 10, 2001
Heavy Rain, Flooding (DR-1224)	June 23, 1998
Blizzard (DR-1090)	January 24, 1996
Severe Coastal Storm (DR-920)	October 4, 1991
Hurricane Bob (DR-914)	August 26, 1991

Table 3-1: Disaster Declarations in Massachusetts 1991 to 2020

Table 3-1 presents disaster declarations which have been made since 1991 in Massachusetts (current through September 28, 2020). These disaster declarations included Berkshire County. Based on the occurrence rate, the expected frequency of disaster declarations is about 1 every 2 years. Based on past declarations, the most common natural disasters were Severe Weather Hazards, including flooding, winter storms, snowstorms; and hurricanes and tropical storms.

Attachment 3: Natural Hazard Risk

Ranking Hazards

The natural hazards were ranked based on impacts to the Town based on likelihood/frequency, severity/magnitude, and potential impact area. Each hazard category was provided a score based on the criteria as shown in **Table 3-2**. For each hazard, the product of the points from each category was determined and the hazards ranked from highest value to lowest. The hazard rankings are presented in **Table 3-3.** The details of each natural hazard are presented in **Attachment 2**, including the expected probability of occurrence (i.e. Likelihood/Frequency). A Hazard Vulnerability Assessment was performed to evaluate the expected consequences (i.e., the Severity/Magnitude and Impact Area) of the top ranked hazards. The results of the vulnerability assessment are presented in this Attachment, in order of the hazard rank.

Likelihood/Frequency		
Point Value	Category	Characteristics and Frequency
0	Very Low	Events that occur or are exceeded less often than once in 1,000 years (less than 0.1% probability)
1	Low	Events that occur or are exceeded from once in 100 years to once in 1,000 years (0.1% to 1% probability)
2	Medium	Events that occur or are exceeded from once in 10 years to once in 100 years (1% to 10% probability)
3	High	Events that occur or are exceeded more frequently than once in 10 years (greater than 10% probability)
Severity/Magnitude		
Point Value	Category	Characteristics
0	Minor	Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., 1 or 2 communities); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.
1	Serious	Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.
2	Extensive	Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.
3	Catastrophic	Property and public infrastructure destroyed; essential or lifeline services stopped, thousands of injuries and fatalities.
Impact Area Assessment		
Point Value	Category	Characteristics
1	Small	In localized, unpopulated or lightly areas of Town, without structures or critical facilities
2	Medium	Impacting only portions of the Town
3	Large	Town-wide and/or essential and lifeline facilities

Table 3-2: Natural Hazard Ranking Classification

Severe Weather Hazards:	Hazard Index
Severe Wind:	
Hurricanes/Tropical Storms	7
Thunderstorms	6
Tornadoes	6
Lightning	5
Intense Rainfall	5
Hail	5
Flood:	
Riverine/Overbank Flooding	7
Beaver Dams	6
Poor Drainage Flooding	6
Severe Winter Weather	
Snowfall	7
Ice Storms	7
Climate-Related Hazards:	
Extreme Temperature:	
Extreme Heat	5
Extreme Cold	6
Drought	5
Wildfire	2
Geologic Hazards:	
Earthquake	5
Landslides	1
Secondary Hazard:	
Dam Failure	5

Table 3-3 : Natural Hazard Ranking Results for Tyringham

Table 3-3 presents the results of the hazard ranking for the Town. The top ranked hazards include: 1) riverine/overbank flooding and flooding caused by beaver dams or poor drainage; 2) hurricanes/tropical storms, thunderstorms and tornadoes (severe wind and related effects); and 3) severe winter weather (large snowfall event/ice storms and extreme cold).

Although the extent of riverine/overbank flooding is limited to the valley along Hop Brook, it is a highly ranked hazard due to: 1) flood inundation impacts to the Town's essential facilities (Police, Fire, Town Hall); and 2) impacts to transportation infrastructure, including Main Road.

Severe wind and related damages during hurricanes is also ranked highly due to its relatively high frequency and its potential for wide-spread damage. In particular, a hurricane strike at or near Tyringham with a 1% probability of occurrence (100-year recurrence interval) would be catastrophic (similar to the 1938 and 1954 hurricanes).

Severe winter weather (including greater than 10-inches snowfall) most frequently occur during Nor'easters, coincident with high winds, cold temperatures and blizzard conditions. They present risks due to transportation impacts (limited use of roadways), cold temperatures (including wind chill) and the potential for structure damage (roof failures). Its relative high probability of occurrence makes severe winter weather as a high ranked hazard.

Failure of the high-hazard Goose Pond Dam due to a dam breach is a medium ranked hazard due to the unlikelihood of occurrence, and lesser potential extent of flood inundation, despite the potential loss of life.

Other hazards currently rank medium to low, but are expected to become more impactful in the future due to climate change. In particular, these include:

- Intense local precipitation. The intensity and frequency of rainfall events is expected to increase (significantly) in the future. This will effect the capacity of the Town's stormwater infrastructure to adequately provide drainage during intense events.
- Extreme temperatures. The frequency and intensity of heat waves is expected to increase in the future. Although Tyringham is located in a less developed environment, typically cooler by tree cover and higher elevations, its relatively high elderly population will be vulnerable to extended periods of extreme heat. Overall warming will also increase the northern migration of disease vectors such as West Nile Virus and increase the duration and intensity of tick-borne diseases such as Lyme's Disease.
- Drought. Droughts are expected to increase in the future with potential impacts to the Town's residential private wells.
- Wildfire. There have been no occurrences of wildfires in Berkshire County from 1950 to 2020 and there is a low probability of a wildfire occurring in the near-term.

For comparison of Tyringham's hazard ranking with the Commonwealth, the Town's hazard ranking is generally consistent with the Commonwealth's 2018 Plan.

Hazard Vulnerability Assessment

As indicated by the past Presidential Disaster Declarations (**Table 3-1**), Tyringham (like most of Berkshire County and much of Massachusetts) is principally vulnerable to the following frequent severe weather hazards: 1) flooding that occurs during hurricanes, tropical storms and nor'easters; 2) severe winds due primarily to hurricanes, which can occur coincident with flooding; and 3) heavy snowfall during winter nor'easters. Climate change has the potential to amplify the intensity and frequency of each of these hazards.

Although less frequent (or effecting less area), Tyringham is also vulnerable to: 1) tornadoes; and 2) localized intense precipitation, resulting in localized poor drainage flooding. The attribution of climate change to tornadoes frequency and intensity has not been established. Climate change effects on precipitation are well understood and significant, with the frequency and magnitude of intense precipitation events expected to increase significantly in the near future.

The Goose Pond Dam presents a dam failure hazard.

Flood Vulnerability

The Town is vulnerable to riverine flood events. There are many surface waters throughout the Town that present flooding potential; however, FEMA-mapped floodplain areas are limited to Hop Brook and Cooper Brook. **Attachment 2** presents details about Tyringham's flood hazards. **Figure 3-1** presents the FEMA special flood hazard areas within Tyringham.

A screening level assessment of flood vulnerability relative to the FEMA 100-year (1% AEP) special flood areas indicates:

Essential Facilities:

- Police: Vulnerable
- Fire and First Responders: Vulnerable
- Emergency Operations Centers: Vulnerable
- Highway Department: Vulnerable
- Town Offices: Vulnerable

Lifeline Systems:

- Water Pollution Control Facility: Not applicable (individual private septic systems may be vulnerable to flooding)
- Power Generation and Transmission: Generally not vulnerable
- Natural Gas and Heating Oil: Not vulnerable
- Potable water: Private wells may be vulnerable to contamination by flooding

Transportation Infrastructure:

- Airports: None present
- Public Transit Stations: None present
- Roads and Bridges: Vulnerable (Certain structures. See below)

Based on the effective FEMA Flood Insurance Rate Map (FIRM), certain Town roads are vulnerable to flooding, including:

- Main Road
- Breakneck Road
- Jerusalem Road
- Monterey Road
- Beach Road
- Sodom Road
- Cooper Creek Road

High Potential Loss Facilities:

- Goose Pond Dam: Not vulnerable to flooding; dam failure risk discussed in separate section of plan

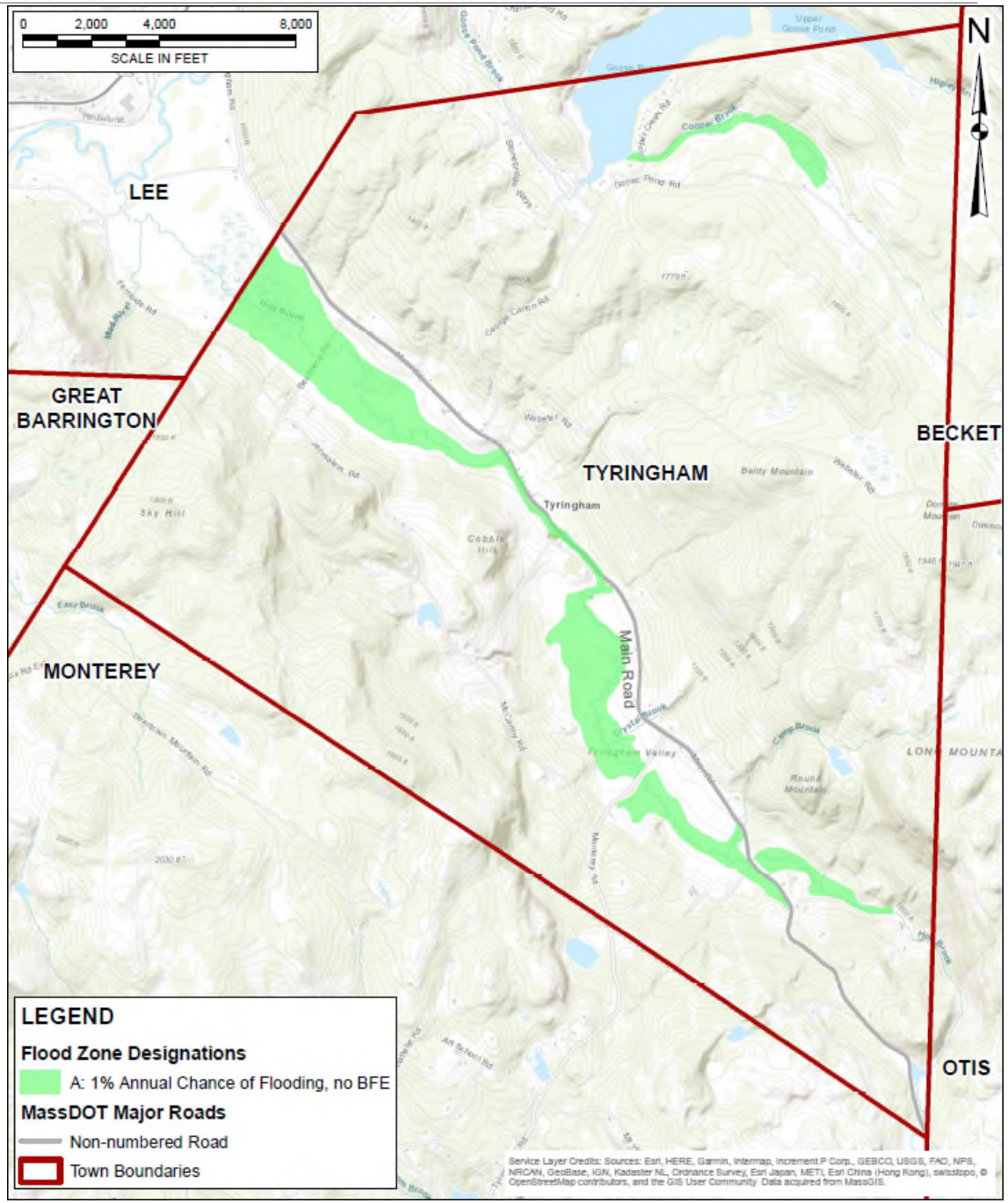


Figure 3-1: FEMA Special Flood Hazard Areas (SFHAs)

Legend: Green shaded areas indicates FEMA Base Flood inundation area (100-year recurrence interval)

National Flood Insurance Program (NFIP) Repetitive Losses

According to the FEMA Flood Insurance Manual, Effective April 1, 2020, 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:
    - 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
    - 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 8/20/2020, there are no Repetitive Loss Properties (RLP) or Severe Repetitive Loss Properties (SRLP) within the Town of Tyringham, as provided by the Massachusetts NFIP Coordinator.

Table 3-4 provides an overview of NFIP information for the Town of Tyringham. 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.

Item	(as of 8/20/20)
Flood insurance policies in force	4
Coverage amount of flood insurance policies	$745,000
Premiums paid	$4,235
Total losses (all losses submitted regardless of the status)	0
Closed losses (Losses that have been paid)	0
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	0
Total payments (Total amount paid on losses)	$0.00

Table 3-4: Tyringham Flood Insurance Policies and Claims

Flood Risk Summary

As presented on the previous pages, several Town facilities providing essential services are located within the FEMA 100-year flood zone associated with Hop Brook.

Likelihood/Frequency:

While flooding can occur more frequently at Tyringham, significant flood events are associated with the 1% AEP.

Severity/Magnitude

As part of the Plan preparation, GZA completed a Level 1 HAZUS-MH damage analysis for flood scenario (based on FEMA flood hazard delineation). The results are presented at the end of this Attachment. The results predict about $3.7M to $4.7M building and content damage for the 1% AEP (100-year recurrence interval) and the 0.2% (500-year recurrence interval flood, respectively.

Flooding is a top-ranked hazard due to: 1) potential flood inundation impacts to the Town's Essential Services, including Police, Fire, and Highway Departments, Emergency Operations Center, and Town offices; and impacts to transportation infrastructure, including Main Road.

As noted in **Table 3-4**, there are currently 4 NFIP-subsidized flood insurance policies in place. The Level 1 HAZUS scenario analyses identified 1 or 2 buildings vulnerable to flood damage (ranging from slight to substantial) for the 1% AEP and 0.2% AEP floods. Substantial damage will trigger specific flood regulations within the State Building Code, requiring that building repair or replacement be in compliance with current flood regulation.

Impact Area:

- 1 or 2 buildings are predicted to be impacted during the 1% and 0.2% AEP floods. This number represents 0.5 to 1% of the total number of Tyringham buildings.

Severe Winds

Tyringham is vulnerable to severe wind events due to hurricanes and tropical storms, nor'easters, thunderstorms and tornadoes. **Attachment 2** presents details about Tyringham's wind hazards. Severe winds at Tyringham occur most frequently due to hurricanes and tropical storms which can occur coincident with heavy precipitation and flooding. Severe winds can also occur at Tyringham, although rarely, during tornadoes and more frequently during severe thunderstorms. High winds can also occur, frequently, during nor'easters (along with heavy rain and snow).

Likelihood/Frequency

The annual exceedance probability of experiencing High Winds within Berkshire County is 75% AEP or minimum of 1-year to 2-year recurrence interval.

Severity/Magnitude

Damages due to severe winds include: 1) damage to trees, often resulting in power outages and also potentially fatal accidents related to treefalls; 2) structure damage. **Table 3-5** presents the typical physical effects associated with different wind speeds. As shown on **Table 3-5**, significant, widespread damage can be expected due to sustained wind speeds of about 74 mph or greater.

As discussed in **Attachment 2**, During 1996 through June 2020, Berkshire County experienced 35 days of High Wind events with estimated gusts of about 58 to 69 mph resulting in about $204,000 in property damage and no deaths.

As part of the Plan preparation, GZA completed a Level 1 HAZUS-MH damage analysis for hurricane scenario. The results are presented at the end of this Attachment. The results predict about $351,000 to $2.2M building and content damage for the 1% AEP (100-year recurrence interval) and the 0.2% (500-year recurrence interval flood, respectively.

Impact Area:

The Level 1 HAZUS scenario analyses identified 1 buildings (0.5% of total buildings) and 29 buildings (16% of total buildings) vulnerable to wind damage (ranging from minor to moderate) for the 1% AEP and 0.2% AEP, respectively.

Sustained Wind Speed	Annual Recurrence Interval (years)	Physical Effects
6-38 kts (30-44 mph)	<1	Trees in motion. Light-weight loose objects (e.g., lawn furniture) tossed or toppled.
39-49 kts (45-57 mph)	2 to 10	Large trees bend; twigs, small limbs break, and a few larger dead or weak branches may break. Old/weak structures (e.g., sheds, barns) may sustain minor damage (roof, doors). Building partially under construction may be damaged. A few loose shingles removed from houses. Carports may be uplifted; minor cosmetic damage to mobile homes and pool lanai cages.
50-64 kts (58-74 mph)	10 to 70	Large limbs break; shallow rooted trees pushed over. Semi-trucks overturned. More significant damage to old/weak structures. Shingles, awnings removed from houses; damage to chimneys and antennas; mobile homes, carports incur minor structural damage; large billboard signs may be toppled
65-77 kts (75-89 mph)	70 to 300	Widespread damage to trees with trees broken/uprooted. Mobile homes may incur more significant structural damage; be pushed off foundations or overturned. Roof may be partially peeled off industrial/commercial/warehouse buildings. Some minor roof damage to homes. Weak structures (e.g., farm buildings, airplane hangars) may be severely damaged.
78+ kts (90+ mph)	>300	Many large trees broken and uprooted. Mobile homes severely damaged; moderate roof damage to homes. Roofs partially peeled off homes and buildings. Moving automobiles pushed off dry roads. Barns, sheds demolished.

Table 3-5: Physical Effects associated with different wind speeds

Dam Failure

The Goose Pond Dam is a High Hazard Dam. The following details for the Goose Pond Dam are based review of the 2016 Goose Pond Dam Emergency Action Plan (2016 EAP).

Dam Location: The Goose Pond Dam is located on the northeast side of Goose Pond Road between McDarby Road and George Cannon Road, and it impounds Goose Pond Brook.

Description of Dam and Appurtenances: The dam is currently owned, operated and maintained by the Goose Pond Maintenance District. The dam is an approximately 285-foot-long earthen embankment with an emergency spillway. The primary outflow is through a 20-inch ductile iron pipe that traverses the midline of the dam near the original stream channel's elevation. The maximum height of the embankment is approximately 27 feet and the crest of the dam is approximately 12 feet in width. The upstream and downstream slopes are 2.5H:1V and 2H:1V, respectively. The dam is surfaced with mown grass.

DCR Hazard Classification: Failure of the Goose Pond Dam will likely cause loss of life and serious damage to homes, businesses and major roadways. Based on this assessment and in accordance with Commonwealth of Massachusetts dam safety rules and regulations Goose Pond Dam is classified as a High hazard potential dam. Because the dam is a High hazard potential dam, the Goose Pond Maintenance District is required by the Massachusetts Office of Dam Safety to have a Phase I Report prepared for the dam every two years.

Hydraulic/Hydrologic (H&H) Data: The dam is currently classified as a large size, Class I (High) hazard potential structure. Therefore, in accordance with state regulations, the spillway design flood (SDF) for the site is one-half (1/2) of the probable maximum flood (PMF).

EAP Purpose: The 2016 Goose Pond Dam Emergency Action Plan (2016 EAP) establishes the guidelines and procedures for addressing emergency conditions identified at the dam in time to take mitigative action such as notifying the appropriate emergency management officials of potential, impending, or active failing of the dam. Emergency conditions are generally identified by dam inspections (formal or casual) or triggered by unusual rainfall events or an earthquake. Identification of hazardous condition should be reported to the Goose Pond Dam Maintenance District or alternate to initiate the notification process based on the Notification Flowchart (NFC) listing the personnel to be called and their phone numbers in case of emergency.

Notification Flowchart and Emergency Level Determination: The NFC indicates the chain of communication to be followed in the event of an emergency. The NFC indicates a Phase I and Phase II type of notification to be implemented depending on the emergency classification level (Condition I or II) as determined necessary based on the judgement of the personnel monitoring the emergency condition at the dam. The two emergency conditions outlined in the EAP are as follows:

- Condition I: "Potential failure situation is developing": This is a situation where a failure may eventually occur if left unattended. This situation will require Phase I response with continuous monitoring.
- Condition II: "Failure is imminent or has occurred": This is a situation where a failure has occurred, is occurring, or is just about to occur. This situation will require Phase I and II responses that will proceed with evacuation procedures.

General Responsibilities: The EAP includes specific emergency response actions for each emergency Condition to be carried out by the responsible local and state authorities All decisions that are made should be made in accordance with the Incident Command Structure outlined in the EAP. Notification of local authorities is primarily the responsibility of the Goose Pond Maintenance District depending on the identified emergency Condition as outlined in Section 5 of the EAP.

Evacuation Lists: The EAP includes a list of property lots and coordinates that would be notified in the event of an emergency.

Preparedness: The most important part of the EAP is the identification of a problem at the dam. The EAP notes that problem identification will be much easier if the dam is monitored closely by knowledgeable personnel. Goose Pond Maintenance District personnel must continue to monitor the dam on a regular basis. This is especially important during high rainfall events and during spring conditions when a large amount of snow melting occurs.

Refer to Goose Pond Dam Emergency Action Plan 2016

Severe Winter Weather

Tyringham is vulnerable to frequent snowstorms, usually associated with nor'easters. The U.S. Northeast annually experiences about 20 to 40 nor'easters. Beginning in October and ending in April, the nor'easter season runs for seven months. Out of the 20 to 40 annual storms, at least two are severe. **Attachment 2** presents details about Tyringham's severe winter weather hazards.

Damages due to severe winter weather include: 1) damage to trees, often resulting in power outages and also potentially fatal accidents related to treefalls; 2) structure damage, including roof collapse; and 3) roadway issues including access limitations and vehicular accidents.

Likelihood/Frequency

Between 1996 and 2020, there were a total of 29 Heavy Snow event days in Berkshire County, with one day with property damage and no injuries or fatalities. Estimated Tyringham snowfall frequency:

- Average annual snowfall of 50 to 75 inches
- 50% AEP or 2 year recurrence interval Heavy Snowfall (12 years with 1 or more events over 24 years)

Severity/Magnitude

The severity/magnitude of severe winter weather is a function of the type of vulnerability. Snowfall vulnerabilities generally include: 1) building damage (e.g., roof collapse) due to snow weight; 2) branch fall and power line failure due to snow and ice weight and wind; and 3) snow roadway clearance capabilities relative to snow fall rates.

Building Damage: The Massachusetts State Building Code requires that structures be constructed in Tyringham, at a minimum, to snow loads of 30 pounds per square foot (psf). The relationship of snow load to snow depth is a function of the water content of the snow (i.e., wet snow is heavier) and can be variable. In general, 30 psf snow loads correlates to about 24 inches of snow. For weight snow events (saturated snow = +/- 2 pcf), 30 psf correlates to about 15 inches of snow. During periods of cold, snow will not melt on roofs and will accumulate due to multiple snowfall events. Ref. https://www.mutualbenefitgroup.com/insurance-101/storm-center/prevent-roof-collapse-on-your-home/

Tree and Powerline Damage: 1/2" of ice can add 500 pounds load on power lines and trees, resulting in extensive damage. Similarly, greater than 6 to 8 inches of heavy snow accumulation on tree branches can result in significant tree damage.

Roadway Clearance Requirements: the vulnerability of Tyringham's transportation system to snowstorms is a function of the Town's snow removal capabilities. Snowfall frequency data provides insight to the minimum recommended capability necessary to reduce the Town's vulnerability. Based on a limited analysis by GZA for purposes of Plan preparation, the Town's snowfall removal capabilities should include:

- Equipment and operator availability to remove snow for at least 20 days per year;
- Equipment, material and operator availability to sand/salt for at least 20 days per year; all paved roads;
- Equipment capability to remove up to 24 inches in 24 hours;
- Equipment and operator capability to remove up to 40 inches per month;
- Equipment, operator and communications capability to remove snow in blizzard conditions (i.e., high wind, drifting and low visibility);
- Back-up equipment and operator capability to remove up to 60 inches per month; and
- Service or close flooded or impassable roads.

Impact Area: Townwide

Other Severe Winter Weather Events

Other Tyringham severe winter events include ice storms and extreme cold. **Attachment 2** presents details for each of these.

Tyringham's vulnerability to ice storms is primarily loss of power and tree fall. The probability of damaging ice storms is high.

The vulnerability of Tyringham residents to extreme cold during cold spells (polar vortex) and winter storms can be moderate to high in consideration of wind chill. The NWS issues Wind Chill Warnings when the wind chill index is expected to be -25° F or less. This can occur over a range of wind speed and temperature combinations. Wind chill example conditions:

- 0° F and 25 mph sustained wind speeds, 30-minute exposure
- 5°F and 55 mph sustained wind speeds, 30-minute exposure

Attachment 4: FEMA HAZUS-MH Simulation Results

FEMA HAZUS-MH HAZARD SCENARIO ANALYSES

Scenario analyses predict the impacts of an event or particular type of an event. This level of analysis considers potential impacts to infrastructure, people, and cost, as well as likelihood or frequency of the event. Scenario analyses were performed using the FEMA Multi-Hazard HAZUS-MH software.

Level 1 HAZUS analyses were 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. Level 1 analyses are appropriate for initial loss estimation at the planning level, and is not intended for establishing the flood, earthquake, or hurricane related risk of any specific parcel or property.

Potential losses estimated 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 291 buildings in Tyringham, with a total building replacement value (excluding contents) of $97 million (2010 dollars; HAZUS). **Table 4-1** presents the total building value in Tyringham. Approximately 95.53% of the buildings (representing about 95.73% of the total value) are residential. **Table 4-2** 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.

Occupancy	Exposure ($1000)	Percent of Total
Residential	93,213	95.7%
Commercial	2,569	2.6%
Industrial	631	0.6%
Agricultural	94	0.1%
Religion	638	0.7%
Government	227	0.2%
Education	0	0.0%
Total	97,372	100%

Table 4-1: Tyringham Building Exposure and Occupancy Type

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

Table 4-2: Damage and Loss Categories

Attachment 4: Natural Hazard Risk - FEMA HAZUS-MH Results

Flood Scenario

The Town is vulnerable to riverine flood events. The flood scenario analysis used the default building stock from HAZUS as presented categorically in **Table 4-2** and the FEMA-defined flood hazard zones for Hop Brook. **Table 4-3** presents 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.

Building Damages

Up to two (2) Tyringham buildings would experience at least moderate damage from a 100-year recurrence interval flood event and from a 500-year recurrence interval flood event. No buildings are predicted to experience substantial damage.

The associated economic losses (including business interruption) range from $3.67 million (100-year event) to $4.71 million (500-year event).

Essential Facilities

Four (4) essential facilities are expected to be impacted or lose functionality during both the 100-year and 500-year recurrence interval flood events. These include the Emergency Operations Center and Fire Station, at 116 Main Road (Town Hall) and 100 Main Road, respectively, and the Police Station, also at 116 Main Road. The Alternate Emergency Operations Center is located within the Fire Station.

Sheltering Requirements

Based on the HAZUS flood analysis, 7 households would be displaced and 0 people would require shelter for the 100-year flood event and 8 households would be displaced and 0 people would require shelter for the 500-year flood event.

	100-Yr	**500-Yr**
Building Damages (# of Buildings)		
# of Buildings with Slight Damage (1-10%)	0	0
# of Buildings with Moderate Damage (11-50%)	1 or 2	1 or 2
# of Buildings with Substantial Damage (>50%)	0	0
TOTAL	**2**	**2**
Essential Facilities Building Damages (Lose of Use > 1 Day)	100-Yr	500-Yr
Emergency Operations Center	2	2
Fire	1	1
Hospitals	0	0
Police	1	1
Schools	0	0
TOTAL	**4**	**4**
Sheltering Requirements	100-Yr	500-Yr
Displaced Households (# Households)	7	8
Short-Term Shelter (# People)	0	0
Economic Losses (in $1,000s of dollars)	100-Yr	500-Yr
Residential Property - Building Loss	$1,480	$2,050
Total Property - Building Loss	$2,000	$2,740
Business Interruption	$1,670	$1,970
Total	**$3,670**	**$4,710**

Table 4-3: HAZUS Flood Scenario Results

Hurricane Wind Scenario

FEMA HAZUS estimates losses from hurricane winds for regions at the census tract level. As Tyringham is small in geographic area, the census tract with includes Tyringham also includes the neighboring Town of Monterey. Thus, the hurricane wind analysis by HAZUS includes inventory and results covering both Tyringham and Monterey.

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 Tyringham. **Table 4-4** (facing) 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.

Building Damages

In Tyringham and Monterey, hurricane wind events are predicted to cause minor to moderate damage to buildings, with 1 building experiencing minor damage from a 100-year recurrence interval wind event, and 29 buildings experiencing minor to moderate damage from a 500-year recurrence interval wind event.

The estimated economic losses are about $351,000 and $2.2 million, for the 100-year and 500-year events, respectively.

Essential Facilities

None of the essential facilities are expected to be impacted or lose functionality during either the 100-year and 500-year recurrence interval wind events.

Sheltering Requirements

Based on the HAZUS wind analysis, no households would be displaced and no people would require shelter for the 100-year or 500-year hurricane wind event.

	100-Yr	**500-Yr**
Building Damages (# of Buildings)		
# of Buildings with Minor Damage	1	28
# of Buildings with Moderate Damage	0	1
# of Buildings with Severe Damage	0	0
# of Buildings Destroyed	0	0
TOTAL	**1**	**29**
Essential Facilities Building Damages (Loss of Use > 1 Day)	100-Yr	500-Yr
Emergency Operations Center	0	0
Fire	0	0
Hospitals	0	0
Police	0	0
Schools	0	0
TOTAL	**0**	**0**
Sheltering Requirements	100-Yr	500-Yr
Displaced Households (# Households)	0	0
Short-Term Shelter (# People)	0	0
Economic Losses	100-Yr	500-Yr
Residential Property	$348,350	$2,130,360
Total Property	$351,310	$2,141,650
Business Interruption	$10	$49,040
Total	**$351,320**	**$2,190,690**

Table 4-4: HAZUS Hurricane Wind Scenario Results

Earthquake Scenario

FEMA HAZUS estimates losses from earthquakes for regions at the census tract level. As Tyringham is small in geographic area, the census tract with includes Tyringham also includes the neighboring Town of Monterey. Thus, the earthquake analysis by HAZUS includes inventory and results covering both Tyringham and Monterey.

This earthquake analysis was conducted assuming a magnitude 5 earthquake on the Richter scale. **Table 4-5** summarizes the estimated damages for the 1,000-year and 2,500-year recurrence interval earthquakes 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

In Tyringham and Monterey, 23 buildings and 60 buildings are predicted to experience damage, ranging from slight to extensive, from a 1,000-year (aka 5% in 50 years) and 2,500 -year (aka 2% in 50 years) recurrence interval earthquake, respectively. The majority of damage is predicted to be slight.

The estimated economic losses are about $330,000 and $1.13 million, for the 1,000-year and 2,500-year events, respectively.

Essential Facilities

None of the essential facilities are expected to be impacted or lose functionality during either the 1,000-year and 2,500-year recurrence interval earthquake events.

Sheltering Requirements

Based on the HAZUS earthquake analysis, no households would be displaced and no people would require shelter for the 1,000-year or 2,500-year earthquake events.

	1,000-Yr	2,500-Yr
Building Damages (# of Buildings)		
# of Buildings with Slight Damage	19	49
# of Buildings with Moderate Damage	4	10
# of Buildings with Extensive Damage	0	1
# of Buildings with Complete Damage	0	0
TOTAL	**23**	**60**
	1,000-Yr	2,500-Yr
Essential Facilities Building Damages (Loss of Use > 1 Day)		
Emergency Operations Center	0	0
Fire	0	0
Hospitals	0	0
Police	0	0
Schools	0	0
TOTAL	**0**	**0**
	1,000-Yr	2,500-Yr
Sheltering Requirements		
Displaced Households (# Households)	0	0
Short-Term Shelter (# People)	0	0
Economic Losses	1,000-Yr	2,500-Yr
Residential Property	$212,200	$770,100
Total Property	$264,300	$954,900
Business Interruption	$65,200	$177,000
TOTAL	**$330,000**	**$1,130,000**

Table 4-5: HAZUS Earthquake Scenario Results

Attachment 5: Potential State and Federal Funding Sources

Several of the proposed hazard mitigation projects and actions may be eligible activities for funding under the FEMA Hazard Mitigation Assistance (HMA) Grant Programs. The FEMA HMA Grant Programs include two non-disaster mitigation grant programs that include the BRIC and Flood Mitigation Assistance grant programs, and one disaster mitigation grant program that is the Hazard Mitigation Grant Program. An overview of each program is outlined as follows.

Building Resilient Infrastructure and Communities (BRIC)

BRIC is a new FEMA pre-disaster hazard mitigation program that replaces the existing Pre-Disaster Mitigation (PDM) program. On an annual basis FEMA will set aside up to 6% of the annual Disaster Recovery Fund for proactive mitigation and community capacity building planning projects. Fiscal Year (FY) 2020 BRIC grant applications were due to FEMA on January 29, 2021. FEMA set aside $600,000 to the Commonwealth of Massachusetts for Capability- and Capacity-Building (C&CB) – activities which enhance the knowledge, skills, expertise, etc., of the current workforce to expand or improve the administration of mitigation assistance. This includes activities in the following sub-categories: building codes activities, partnerships, project scoping, mitigation planning and planning-related activities, and other activities. $446.4 million was also available for applicants (i.e. States, District of Columbia, U.S. territories, and Indian tribal governments (federally recognized)) through a national competition for BRIC grants for proactive large and small mitigation projects (with a new focus on lifeline facilities, natural and nature-based features, innovative projects, and large projects). For more information on the FY2021 BRIC Notification of Funding Opportunities please go to FY20 HMA NOFO webpage.

The BRIC program guiding principles are supporting communities through capability - and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency. The Mitigation Action Portfolio is an online resource that introduces the BRIC grant program with many project case history examples of eligible hazard mitigation activities, the community lifelines involved, and the funding partners involved around the country. BRIC's final Policy will be published soon in Federal Register. These grants will require a national disaster declaration within the past seven years, which includes the Whole of America COVID-19 Pandemic Emergency Declaration. The Town of Tyringham will be eligible as a sub-applicant to the Massachusetts Emergency Management Agency (MEMA) for BRIC funding for FY2021. For more detailed program information on the BRIC program please go to BRIC Grant Program. (02/22/21)

Flood Mitigation Assistance (FMA)

The purpose of the FMA program is to reduce or eliminate the risk of repetitive flood damage to buildings and structures insured under the National Flood Insurance Program (NFIP). The FMA Program makes federal funds available to state, local, tribal, and territorial governments available for: 1) Project Scoping (previously Advance Assistance); 2) Community Flood Mitigation Projects; 3) Technical Assistance; 4) Flood Hazard Mitigation Planning; and Individual Flood Mitigation Projects. FEMA Funding for PDM and FMA is appropriated by Congress annually and awarded on a nationally competitive basis. In FY 2020, $200 Million was available for the FMA grant program. The applications were due to FEMA on January 29, 2021. The Town of Tyringham will be eligible as a sub-applicant to the MEMA for FMA funding for FY2021. For more detailed program information on the FMA program please go to FMA Grant Program. (02/22/21)

Hazard Mitigation Grant Program (HMGP)

The HMGP provides funds to states, territories, tribal governments, and other communities after a disaster, to reduce or eliminate future risk to lives and property from 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 Commonwealth of Massachusetts. The HMGP application period is open for one year from the disaster declaration date.

The federal share of HMGP assistance is not less than 75 percent of the eligible cost. The HMGP requires a 25% local match for traditional Hazard Mitigation Assistance (HMA) projects. The most recent open disaster was announced on July 19, 2018 - Massachusetts Severe Winter Storm and Snowstorm (DR-4379-MA) and the application period closed on July 18, 2019. As of February 2021, the current COVID-19 disaster is ongoing due to the unique nature of this disaster. Future HMGP funding will become available during the next open disaster declaration. https://www.fema.gov/hazard-mitigation-grant-program (02/22/21)

MEMA manages the HMGP application process by providing a state application that eligible entities complete and submit to MEMA electronically. Note that the application process for BRIC and FMA is conducted through FEMA's Grants Outcome (GO) online application process system (see https://www.fema.gov/grants/guidance-tools/fema-go). The application period for FY 2021 BRIC and FMA closed on January 29, 2021.

All three HMA programs are managed by the MEMA with support from Department of Conservation and Recreation (DCR) and Executive Office of Energy and Environmental Affairs (EOEEA). Contact MEMA at (508) 820-1443 for more information on each of these HMA grant programs.

Public Assistance (PA)

FEMA's Public Assistance (PA) grant program provides federal assistance to governmental organizations and certain private nonprofit (PNP) organizations following a Presidential disaster declaration. Through the program, FEMA provides supplemental federal disaster grant assistance for debris removal, life-saving emergency protective measures, and the repair, replacement, or restoration of disaster-damaged publicly-owned facilities, and the facilities of certain PNP organizations. The PA program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process. The federal

share of assistance is not less than 75 percent of the eligible cost. The Recipient (usually the state) determines how the non-federal share (up to 25 percent) is split with the subrecipients (eligible applicants). https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

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 Tyringham 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.

US Department of Agriculture's (USDA) and other Federal 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 landowners, 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 riverine 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, 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.

U.S. Department of Commerce Economic Development Administration Disaster Recovery Grants

The Economic Development Administration (EDA) often releases a Disaster Recovery Supplemental grant program to address economic development challenges caused by a disaster. For example, in June 2019, Congress passed the Additional Supplemental Appropriations for Disaster Relief Act, 2019 providing EDA with $600 million in additional Economic Adjustment Assistance (EAA) Program funds for necessary expenses related to flood mitigation, disaster relief, long-term recovery, and restoration of infrastructure in areas impacted by Hurricanes Florence, Michael, Lane, Typhoons Yutu and Mangkhut, wildfires, volcanic eruptions, earthquakes and other calendar year 2018 disasters under the Stafford Act and tornadoes and floods in calendar year 2019. Of the total available funding $50 million is open for states including Massachusetts.

EAA funds can be awarded to assist a wide variety of activities related to disaster recovery focused on economic development, including economic recovery strategic planning grants and construction assistance. Through this program, EDA can support both the development of disaster recovery strategies and the implementation of recovery projects identified with those strategies, including construction activities, capitalizing revolving loan funds (RLFs), and a variety of others. Disaster recovery project activities that can be eligible for Disaster Supplemental grants include, but are not limited to, economic recovery and resiliency projects that:

- Support the creation of new businesses and jobs in a variety of industry sectors, including, but not limited to advanced manufacturing, agriculture, energy, information technology, health care, telecommunications, tourism and recreation, transportation, and cultural and natural assets.
- Implement local and regional job creation and growth and economic diversification strategies targeted towards affected workers and businesses.
- Construction activities, including the restoration of damaged infrastructure, infrastructure enhancement, building new infrastructure including high performance and resilient infrastructure.
- Strengthening or developing existing or emerging industry clusters.

- Resiliency projects to increase the ability of a community or region to anticipate, withstand, and bounce back from future economic injuries and disasters. This may include: ensuring redundancy in telecommunications and broadband networks; promoting business continuity and preparedness; industrial diversification; employing safe development practices in business districts and surrounding communities; conducting disaster recovery planning with key stakeholders; and other methods that strengthen local and regional capacity to troubleshoot and address vulnerabilities within the regional economy.

- Developing business incubator programs.

- Enhancing access to and use of broadband services to support job growth through business creation and expansion.

- The development of economic development diversification strategies in accordance with EDA CEDS recommendations.

- Facilitating access to private capital investment and providing related capacity building and technical assistance, such as effective utilization of capital investment for business development and job creation.

- Facilitating and promoting market access for goods and services.

https://www.eda.gov/disaster-recovery/ (02/22/2021)

Commonwealth of Massachusetts Grants

Municipal Vulnerability Preparedness (MVP) Grant Programs

The Municipal Vulnerability Preparedness (MVP) Grant Program provides direct funding and support to cities and towns to complete a community-driven process that will bring together climate change information and local knowledge to identify top hazards, current challenges, and community strengths and then to develop priority actions to improve the municipality's resilience to all natural and climate-related hazards using a flexible, tested approach called the Community Resilience Building (CRB) workshop guide. The program provides access to a pool of state-certified MVP providers, a standardized toolkit for assessing climate change vulnerability and developing strategies, and access to the best available statewide climate projections and data.

Upon successful completion of the CRB process, municipalities will be designated as a "Municipal Vulnerability Preparedness (MVP) program community," or an "MVP Community" which enables communities to participate in the MVP Action Grants for program implementation, leads to increased standing in future state funding opportunities and indicates the community's commitment to preparing for climate change. Completion of the program will ensure that as municipalities make investments, set policy, and implement climate change adaptation projects they have a thorough understanding of their risk and vulnerabilities from climate change impacts and how these impacts specifically affect their residents, community, local economy and natural resources.

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

MVP Planning Grants

Funding is to support municipalities who are completing climate change vulnerability assessments and resiliency planning using the Community Resilience Building workshop guide, and to allow them to procure an MVP certified provider (chosen from a list provided by the Commonwealth), to assess vulnerability to a full range of climate change impacts, including temperature changes, extreme weather, sea level rise, inland flooding, changes in precipitation, and other impacts, across multiple sectors of the municipality.

MVP Action Grants

The MVP Action Grant offers financial resources to municipalities that are seeking to advance priority climate adaptation actions to address climate change impacts resulting from extreme weather, sea level rise, inland and coastal flooding, severe heat, and other climate impacts. To discuss potential actions contact the MVP Coordinator for the Berkshires and Hilltop Region, Carrieanne Petrik, at carrieanne.petrik@mass.gov. For more information on MVP Action Grants refer to https://www.mass.gov/s.rvice-details/mvp-action-grant. (03/04/2021)

Attachment 6: Public Review Documentation

Proactive By Design
Our Company Commitment

Town of Tyringham
Multi-Hazard Mitigation Plan Update
Kick-off Meeting / Planning Team Meeting #1

September 22, 2020

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AGENDA

- Planning Team: Attendance/Introductions
- Hazard Mitigation Plan Background
- Project Schedule
- Public Outreach Coordination
- HMP
  - Critical Facilities / Assets Inventory
  - Hazards Characterization / Vulnerability

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Planning Process

Local Planning Team	Name
Town Administrator	Molly Curtin-Schaefer
Building Department	Larry Gould
Conservation Commission	Laura Lee Bertram
Public Works	Noah Choquette
Emergency Management	Jim Curtin
Executive Assistant / Secretary	Laura Lee Bertram
Police Department	Patrick Holian
Fire Department	Charles Slater Jr.

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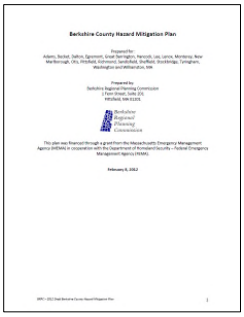
HAZARD MITIGATION PLANNING BACKGROUND

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.


Berkshire County Hazard Mitigation Plan

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HAZARD MITIGATION PLANNING BACKGROUND

FEMA UNIFIED HAZARD MITIGATION ASSISTANCE (HMA) GRANTS

PROGRAM		DESCRIPTION	FUNDING SOURCE	HMP STATUS
HAZARD MITIGATION GRANT PROGRAM	HMGP	Assists in implementing long-term hazard mitigation planning and projects	Tied to Disaster Declaration	Approved Plan must be in place at time of grant award*
PRE-DISASTER MITIGATION	PDM	Being replaced by BRIC (see below)		
FLOOD MITIGATION ASSISTANCE	FMA	Provides funds for planning and projects to reduce or eliminate risk of flood damage to buildings that are insured annually under the National Flood Insurance Program.	Re-authorization on-going in Congress	Approved Plan must be in place by the grant application deadline and at the time of grant award*
HMGP POST FIRE GRANT		Assistance available to help communities implement hazard mitigation measures after wildfire disasters.	States, federally-recognized tribes and territories affected by fires resulting in an Fire Management Assistance Grant (FMAG) declaration on or after October 5, 2018, are eligible to apply.	
BUILDING RESILIENT INFRASTRUCTURE & COMMUNITIES	BRIC	Support for states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face		Approved Plan must be in place by the grant application deadline and at the time of grant award

*except for planning grants to update a HMP

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Planning Process - Schedule

Planning Meetings	Date
Kick-off / Planning Team Meeting #1 *(GZA present progress through Task 3)*	September 2020
Planning Team Meeting #2 *(GZA present progress through Task 4)*	November 2020
Public Meeting #1 *(GZA present progress through Task 4)*	December 2020
Planning Team Meeting #3 *(GZA present progress through Task 8)*	January 2021
Public Meeting #2 *(GZA present progress through Task 8)*	February 2021
Final Draft Plan provided to Town	3/1/2021

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Planning Process – Outreach

Stakeholder Involvement
Board of Selectmen
Businesses
Schools
Non-profits
Neighboring communities
BRPC
Regional Entities

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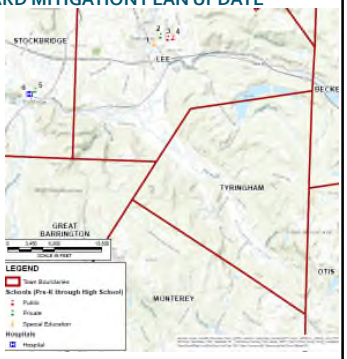
TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The People:
Support, High Occupancy, and Vulnerable Populations

Id	Name
School	
1	The College Internship Program
2	St. Mary's School
3	Lee Middle and High School
4	Lee Elementary School
5	Berkshire Waldorf High School
Hospital	
6	Austen Riggs Center



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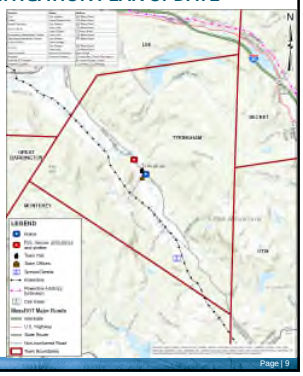
TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The Places:
Essential Services

Service	Name	Address
Fire	Fire Station	100 Main Road
Police	Police Department	116 Main Road
Health Services	Fire Station	100 Main Road
Town offices	Town Hall	116 Main Road
	Town Offices	2 Church Road
Emergency Operations Center	Town Hall	116 Main Road
Alternate Operations Center	Fire Station	100 Main Road
Public Works	Town Garage	
Shelters	Fire Station	100 Main Road
	Town Hall	116 Main Road
Special Needs	Seniors of Visitation	Beach Road
Hospital	Fairview Hospital	29 Lewis Ave, Great Barrington
Hunting Oil Supplier		46 Crystal Street, Lenox
Propane Supplier		9 Lee Road, Stockbridge



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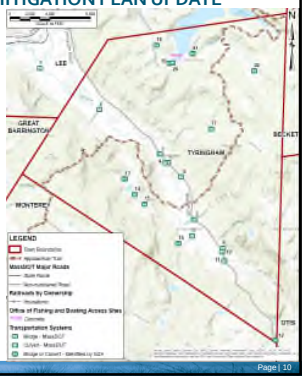
TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Inventory of Assets
The Places: Transportation

1- Hop Brook-Meadow St., Lee
2- Hop Brook - Breakneck Rd.
3- Tributary to Hop Brook-Main Rd.
4- Hop Brook-Jerusalem Rd.
5- Hop Brook-Main Rd.
6-Hop Brook-Main Rd.
7-Crystal Brook - Main Rd.
8-Hop Brook-Monterey Rd.
9-Camp Brook-Fenn Rd
10-Camp Brook-Main Rd
11-Hop Brook-Main Rd.
12-Hop Brook-Main Rd
13-Shaker Pond-Brace Rd
14-Shaker Pond-Jerusalem Rd (2 crossings)
15-Shaker Pond-McCarthy Rd
16-Steadman Pond-McCarthy Rd
17-Tributary to Hop Brook-Webster Rd
18-Goose Pond Brook-Stonebriidge Way
19-Goose Pond Brook-Stonebridge Way
20-Goose Pond Brook-Goose Pond Rd
21-Cooper Brook-Cooper Creek Rd
22-Cooper Brook-Goose Pond



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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

Water/Wastewater

Utilities

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The Environment:
Water Resources

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The Places:
Historic Resources

- Tyringham Shaker Settlement Historic District
- Tyringham Library
- Methodist Episcopal Society of Tyringham
- Tyringham Cemetery

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Inventory of Assets

The Environment:
Open Space

Open Space: Lands
- Federal
- DCR-State Parks & Recreation
- Department of Fish & Game
- Municipal
- Land Trust
- Private
- Conservation Restriction
- Agricultural Preservation Restriction

MassDOT Major Roads
- State Route
- Non-numbered Road

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Future Development

Are there any future developments proposed or expected in Town?

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2012 BERKSHIRE COUNTY HAZARD MITIGATION PLAN
Primary Hazards Identified

- **Flooding**
- Dam Failure
- Ice Jams
- Hurricane / Tropical Storm
- Tornados
- **Severe Thunderstorms / High Winds/ Hail**
- **Winter Hazards (Heavy Snow / Nor'easters / Blizzard / Ice)**
- Earthquakes
- Landslides
- Brush Fires
- Drought
- Beaver Dams
- Extreme Temperature

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Characterize the Hazards

Flood Hazards

- Riverine Flooding
  - *Breakneck Road bridge is too low*
- Urban Drainage Flooding
- Ice Jam
- Beaver Dams
  - *Goose Pond Road at Copper Brook culvert*
  - *Beach Road*
  - *Wetland north of Main Road*
  - *Hop Brook*

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Characterize the Hazards

Flood Hazards

- Dam Failures

- Goose Pond Dam
- Shaker Pond Dam
- South House Pond Dam
- Schell Dam

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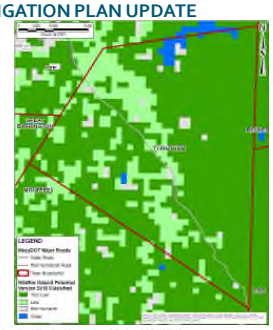
TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Characterize the Hazards

Wildfire Hazard Potential



Service Layer Credits: Fire Modeling Institute, USDA Forest Service, Rocky Mountain , 2018, 1222, Wildfire Hazard Potential (WHP) for the conterminous United States (270-m GRID), v2018 classified [whp2018_cls]. Data acquired from MassGIS and USDA/US Forest Service.

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Characterize the Hazards

Locally Identified Hazards

- Based on local knowledge, where are the primary hazard areas?

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Next Steps

- Risk Assessment
- Mitigation Strategies
- Plan Adoption
- Maintenance

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Town of Tyringham
Multi-Hazard Mitigation Plan Update

Questions?

PLEASE SHARE PHOTOS

Rosalie Starvish (rosalie.starvish@gza.com)
860-550-2777

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Town of Tyringham
Multi-Hazard Mitigation Plan Update
Kick-off Meeting / Planning Team Meeting #2

January 12, 2021

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AGENDA

- Planning Team: Attendance
- Risk Assessment
- Hazard Protection Measures
- 2012 Mitigation Actions

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Planning Process

Local Planning Team	Name
Town Administrator	Molly Curtin-Schaefer
Building Department	Larry Gould
Conservation Commission	Laura Lee Bertram
Public Works	Noah Choquette
Emergency Management	Jim Curtin
Executive Assistant / Secretary	Laura Lee Bertram
Police Department	Patrick Holian
Fire Department	Charles Slater Jr.

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Risk Assessment

- Exposure Analysis
- Historical Analysis
- Scenario Analysis

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MILFORD HAZARD MITIGATION PLAN UPDATE
Risk Assessment
Exposure Analysis

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

Disaster	Declaration Date
COVID-19 Pandemic (DR-4496)	March 27, 2020
Severe Winter Storm & Snowstorm (DR-4379)	July 19, 2018
Severe Winter Storm & Flooding (DR-4372)	June 25, 2018
Severe Winter Storm, Snowstorm & Flooding (DR-4214)	April 13, 2015
Severe Winter Storm, Snowstorm & Flooding (DR-4110)	April 17, 2013
Hurricane Sandy (DR-4097)	December 19, 2012
Tropical Storm Irene (DR-4028)	September 3, 2011
Severe Storm & Flooding (DR-1895)	March 29, 2010
Severe Storms & Flooding (DR-1614)	November 10, 2005
Severe Storms & Flooding (DR-1364)	April 10, 2001
Heavy Rain, Flooding (DR-1224)	June 23, 1998
Blizzard (DR-1090)	January 24, 1996
Severe Coastal Storm (DR-920)	October 4, 1991
Hurricane Bob (DR-914)	August 26, 1991

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TYRINGHAM 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 are no RL properties in Tyringham.

Item	(as of 8/20/20)
Flood insurance policies in force	4
Coverage amount of flood insurance policies	$745,000
Premiums paid	$4,235
Total losses (all losses submitted regardless of the status)	0
Closed losses (Losses that have been paid)	0
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	0
Total payments (Total amount paid on losses)	$0.00

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Risk Assessment

Scenario Analysis

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Risk Assessment

Scenario Analysis - HAZUS

DIRECT DAMAGE	FLOOD (100- yr & 500- yr flood events)	HURRICANE WIND (100- yr & 500- yr)	EARTHQUAKE (1,000- yr & 2,500- yr)
General Building Stock	1 – 2 buildings damaged	1 – 29 buildings damaged	23 – 60 buildings damaged
Essential Facilities	4 (Fire, Police, EOC)	0	0
DIRECT LOSSES			
Shelter Needs	7 – 8 displaced households	0	0
INDIRECT LOSSES			
Economic Loss			
Property Damage	~ $2 – 2.74 million	~ $350k - $2.2M	~ $260k - $955k
Business Interruption	~ $1.67 – 1.97 million	~ $0 - $50k	~ $65k - $177k

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Risk Assessment - Hazard Index Summary

Likelihood/Frequency		
Point Value	Category	Characteristics
0	Very Low	Events that occur less frequently than once in 1,000 years (Less than 0.1% probability per year)
1	Low	Events that occur from once in 100 years to once in 1,000 years (0.1% to 1% probability per year)
2	Medium	Events that occur from once in 10 years to once in 100 years (1% to 10% probability per year)
3	High	Events that occur more frequently than once in 10 years (Greater than 10% probability per year)

Severity		
Point Value	Category	Characteristics
0	Minor	Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area; essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.
1	Serious	Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area; essential services are briefly interrupted; some injuries and/or fatalities.
2	Extensive	Consistent major property damage; major damage to public infrastructure (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and fatalities.
3	Catastrophic	Property and public infrastructure destroyed; essential services stopped; multiple injuries and fatalities.

Impact Area Assessment		
Point Value	Category	Characteristics
1	Small	In localized, unpopulated or lightly areas of Town, without structures or critical facilities
2	Medium	Impacting only portions of the Town
3	Large	Town-wide and/or essential and lifeline facilities

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Risk Assessment - Hazard Index Summary

Natural Hazard	Likelihood/ Frequency	Impact Area Assessment	Severity/ Magnitude	Hazard Index
SEVERE WEATHER HAZARDS				
Severe Wind				
Hurricanes/ Tropical Storms	2	3	2	7
Thunderstorms	3	2	1	6
Tornadoes	3	2	1	6
Severe Weather				
Lightning	3	2	0	5
Intense Rainfall	3	2	0	5
Hail	3	2	0	5

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Risk Assessment - Hazard Index Summary

Natural Hazard	Likelihood/ Frequency	Impact Area Assessment	Severity/ Magnitude	Hazard Index
SEVERE WEATHER HAZARDS				
Flood Hazards				
Riverine Flooding	3	3	1	7
Poor Drainage Flooding	3	2	1	6
Beaver Dams	3	2	1	6
Dam Failures	1	2	2	5
Severe Winter Weather				
Snow and Blizzards	3	3	1	7
Ice Storms	3	3	1	7

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Risk Assessment - Hazard Index Summary

Natural Hazard	Likelihood/ Frequency	Impact Area Assessment	Severity/ Magnitude	Hazard Index
CLIMATE RELATED HAZARDS				
Extreme Cold	3	3	0	6
Extreme Heat	2	3	0	5
Drought	2	3	0	5
Wildfire	1	1	0	2
GEOLOGIC HAZARDS				
Earthquakes	1	3	1	5

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2012 BERKSHIRE COUNTY HAZARD MITIGATION PLAN
Primary Hazards Identified

- Flooding
- Dam Failure
- Ice Jams
- Hurricane / Tropical Storm
- Tornados
- Severe Thunderstorms / High Winds/ Hail
- Winter Hazards (Heavy Snow / Nor'easters / Blizzard / Ice)
- Earthquakes
- Landslides
- Brush Fires
- Drought
- Beaver Dams
- Extreme Temperature

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2020 Risk Assessment
Hazard Index Summary

- Flooding (7 / 6)
- Dam Failure (5)
- Ice Jams
- Hurricane / Tropical Storm (7)
- Tornados (6)
- Severe Thunderstorms / High Winds/ Hail (6 / 5)
- Winter Hazards (Heavy Snow / Nor'easters / Blizzard / Ice) (7)
- Earthquakes (5)
- Landslides
- Brush Fires (2)
- Drought (5)
- Beaver Dams (6)
- Extreme Temperature (6 / 5)

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2020 Risk Assessment
Hazard Index Summary

- Hurricane / Tropical Storm (7)
- Winter Hazards (Heavy Snow / Nor'easters / Blizzard / Ice) (7)
- Flooding (7 / 6)
- Tornados (6)
- Beaver Dams (6)
- Severe Thunderstorms / High Winds/ Hail (6 / 5)
- Extreme Temperature (6 / 5)
- Dam Failure (5)
- Drought (5)
- Earthquakes (5)
- Brush Fires (2)
- Ice Jams
- Landslides

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2012 BERKSHIRE COUNTY HAZARD MITIGATION PLAN
Existing Hazard Protection Measures

Table 11.2. Existing Protection Matrix - Tyringham

Type of Existing Protection	Description	Area Covered	Effectiveness	Improvements Needed	Implementation / Enforcement Responsibility
Town participates in the National Flood Insurance Program (NFIP)	Provides flood insurance for structures located within the floodplain	FEMA flood zones	Effective	None	
Floodplain zoning district ordinance in place	Floodplain ordinance requires all development, including structural and nonstructural activities, be in compliance with state building code requirements for construction in floodplain	Covers FEMA zones Zone A	Generally effective for new construction, but many older structures pre-date ordinance	None	
Building Code	The town enforces the state building code	Entire Town	Effective	None	
Stormwater System	The town has a system of stormwater control	Entire town	Mostly effective	Replace/maintain drainage system where flooding occurs	
Stormwater Maintenance	The town actively maintains their stormwater system	Entire town	Effective	Continue regular maintenance of stormwater system	
Beaver Management	The town actively works to manage the beavers in town	Entire Town	Somewhat effective	The town needs to continue to work on and improve beaver control	

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2012 BERKSHIRE COUNTY HAZARD MITIGATION PLAN
Mitigation Actions

Table 13B. Mitigation Action Plan - Tyringham

	Category of Action	Description of Action	Benefit	Implementation/ Responsibility	Timeframe / Priority	Resources / Funding	Status from 05 or New
1	Property Protection, Emergency Services Protection – Flooding	Retrofit the town hall and the highway department to protect from flooding	Protecting the town hall and highway department will ensure access to the facilities in times of a disaster	Town of Tyringham	1-2 years/ High	PDM	New
2	Prevention – Flooding	Request that FEMA recalculate and delineate the 100-year floodplain for Tyringham, using non-computer-generated floodplain data	New FEMA maps would be more accurate and allow for a more accurate assessment of the flooding risk	Town of Tyringham, Mass. Emergency Management Agency (MEMA)	1-3 years / High	NA	No Action – FEMA has not prioritized this region for new flood maps, therefore no funding has been allocated for it
3	Prevention – Flooding	Strictly enforce the Tyringham Flood Plain Bylaw	Tougher enforcement of existing bylaws would ensure that properties within a floodplain were properly protected	Town of Tyringham, Berkshire Regional Planning Commission (BRPC)	1-3 years / High	NA	The town continues to enforce the floodplain bylaw
4	Prevention – All Hazards	Limit the expansion of infrastructure in hazard-prone areas	Limiting the expansion of infrastructure and development would reduce the future risk of hazards	Town of Tyringham	4-6 years / Medium	NA	The town continues to limit the expansion in hazard-prone areas
5	Prevention – Flooding	Insure the integrity of large beaver dams so breach them in a controlled manner	Large beaver dams can cause significant damage if they fail. Insuring their integrity will help to reduce the risk of flooding	Town of Tyringham, Mass. Fish & Game (F&G)	1-3 years / High	MSPLA	The town monitors beaver dams
6	Prevention – Flooding	Continue to work with	Permanent measures	Town of Tyringham, F&G	1-3 years / High	MSPLA	The town has worked

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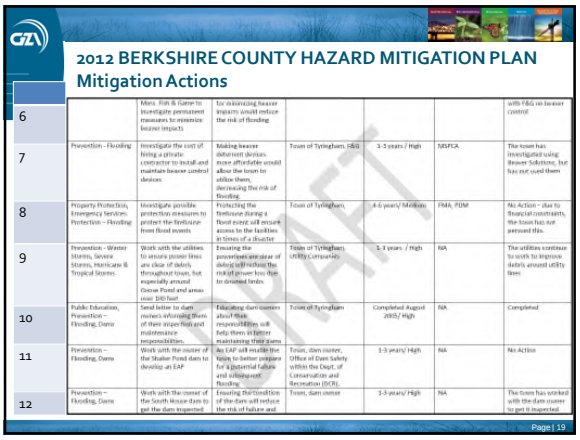

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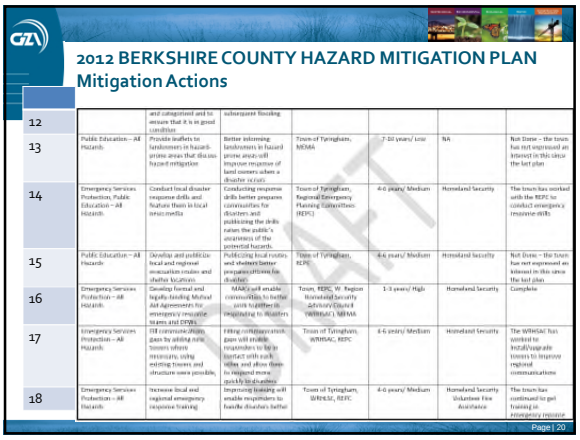

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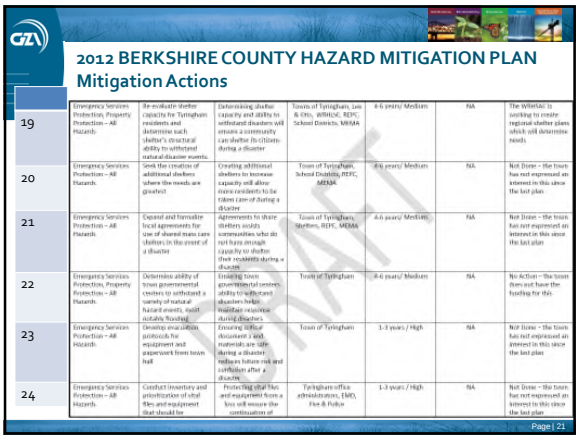

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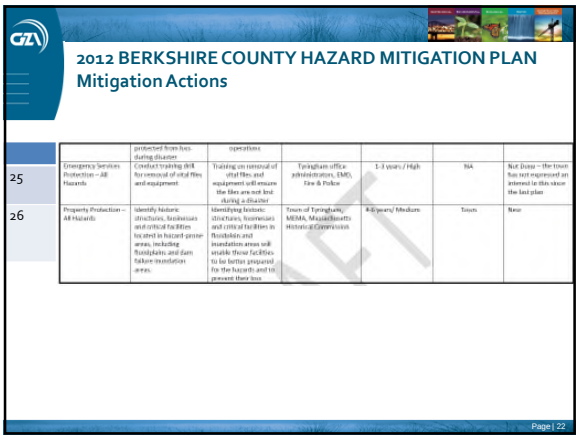

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Our Company Commitment

Town of Tyringham
Multi-Hazard Mitigation Plan Update
Kick-off Meeting / Planning Team Meeting #3

February 11, 2021

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AGENDA

- Planning Team: Attendance
- Hazard Mitigation Goals
- Town-wide Mitigation Actions
- Prioritizing Mitigation Actions
- Plan Adoption and Maintenance

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Planning Process

Local Planning Team	Name
Town Administrator	Molly Curtin-Schaefer
Building Department	Larry Gould
Conservation Commission	Laura Lee Bertram
Public Works	Noah Choquette
Emergency Management	Jim Curtin
Executive Assistant / Secretary	Laura Lee Bertram
Police Department	Patrick Holian
Fire Department	Charles Slater Jr.

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Hazard Mitigation Goals from BRPC 2012 Regional Plan

1. Reduce the loss of life, property, infrastructure, and environmental and cultural resources from natural disasters.
2. Investigate, design and implement structural projects that will reduce and minimize the risk of flooding.
3. Investigate and implement projects that will reduce and minimize the risk of non-flooding hazards.
4. Increase the capacity of local Emergency Managers, DPWs, and Fire, Police and Health Departments to plan for and mitigate natural hazards.
5. Increase public awareness of natural hazard risks and mitigation activities available to them.
6. Improve the quality of the data for the region as it pertains to natural hazards.
7. Improve existing local policies, plans, regulations, and practices to reduce or eliminate the impacts of natural hazards.

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Additional Suggested Hazard Mitigation Goals

- Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
- Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.
- Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards including impacts from climate change.
- Work with surrounding communities, regional, the Commonwealth and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Town-wide Mitigation Actions

EXISTING CAPABILITY	DESCRIPTION
GENERAL MULTI-HAZARDS	
Enforcement of the State Building Code	The 9th Edition of the Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood resistant design, flood-proofing and snow loads.
FLOOD-RELATED HAZARDS	
Participation in the National Flood Insurance Program (NFIP)	Tyringham participates in the National Flood Insurance Program. NFIP provides access to funds in the case of flood related damages.
Floodplain District Bylaw	Floodplain District bylaw requires all development, including structural and nonstructural activities, be in compliance with state building code requirements for construction in a floodplain
Beaver Management	Tyringham proactively works to manage the beavers and beaver dams in town, in coordination with Town Board of Health, Conservation Commission, and MA Division of Fish & Game.
Stormwater System / Maintenance	The Tyringham Highway Department conducts regular maintenance of the stormwater system. Drainage system components are replaced/upgraded as needed where flooding occurs.

Table 4: Existing Hazard Mitigation Capabilities presented in the 2012 *Berkshire Regional Hazard Mitigation Plan*

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
New Town-wide Mitigation Actions

EXISTING CAPABILITY	DESCRIPTION
GENERAL MULTI-HAZARDS	
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.
Subdivision Review	Multiple Town of Tyringham departments, such as the Board of Selectmen, Zoning, Planning Board, Building Inspector, Board of Health, Road Superintendent, Fire, Police, Historical Commission and Conservation Commission, review all subdivision and site plans prior to approval.
Portable Water Pumps	Rivers and ponds in town are available to be tapped into if necessary for fire-fighting support.
FEMA Resources	A tanker task force is available through State Fire mobilization. FEMA has 8-12 tankers that can be deployed anywhere in the US within 72 hours.

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
New Town-wide Mitigation Actions

- Does the Town have emergency generators?
- Does the Town use sand or salt to de-ice the roads? (use of sand may clog drainage structures)

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GO TO 2012 HMP Mitigation Actions.XLSX

(review highlighted items)

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Prioritizing Local Mitigation Actions

- Approaches:
  - **FEMA's March 2013 Local Mitigation Planning Handbook**
  - other local plans
  - FEMA's STAPLEE method

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Prioritizing Local Mitigation Actions

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.

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Prioritizing Local Mitigation Actions

Costs

- **High (Over $100,000):** Would require an increase in revenue via an alternative source (i.e., municipal bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.
- **Medium (Between $50,000 - $100,000):** Could budget for under existing capital budget 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 (Less than $50,000):** 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.

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Prioritizing Local Mitigation Actions

Estimated Timeline

1-2 years,

3-5 years,

5+ years, and

ongoing.

Length of time for implementation of each mitigation action is based on the amount of time it would take upon receiving funding.

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Prioritizing Local Mitigation Actions

Priority

- **High Priority:** Benefits > cost, has funding secured or is an ongoing project. 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:** Benefits > costs, and for which funding has not yet been secured, but is eligible for funding. 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:** Benefits < costs or are difficult to quantify, for which funding has not been secured, that is not eligible for grant funding, and for which the timeline 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.

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GO TO TABLE FROM
MITIGATIONPRIORITIZATION.XLSX

(numbers match up with 2012 mitigation actions that were reviewed by the team)

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Next Steps

- Local Planning Team to review prioritization of mitigation actions
- Draft plan provided to Town for Planning Team review: 3/1/2021
- Return plan to GZA for edits: 3/15/21
- Finalize Draft plan for posting on Town website: 3/29/21
- Deadline for public comments: 4/19/21
- Final Draft Plan submitted to MEMA: 5/3/21

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TYRINGHAM HAZARD MITIGATION PLAN UPDATE
Plan Adoption & Maintenance

Plan Adoption

1. Conditional Approval by FEMA
2. Plan approved (officially adopted) by Board of Selectmen

Plan Implementation

1. Local Hazard Mitigation working group (include LPT)
2. Awareness of updates to existing policies and regulations
3. Grant funding
4. Annual meeting to evaluate progress of the plan
5. Evaluate effectiveness of the action items with input from the public
6. 5-year update

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Town of Tyringham
Multi-Hazard Mitigation Plan Update

Questions?

PLEASE SHARE PHOTOS

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Attachment 7: References and Resources

Attachment 7: References and Resources

- Berkshire Regional Planning Commission (BRPC), Berkshire County Hazard Mitigation Plan, February 8, 2012
- Federal Emergency Management Agency (FEMA), Local Mitigation Plan Review Guide, October 2011. https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-plan-review-guide_09_30_2011.pdf
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- BRPC, Sustainable Berkshires Status Report, January 2019
- BRPC, 2020 RTP Berkshire County Regional Transportation Plan, July 23, 2019
- BRPC, Outdoor Recreation Plan, Berkshire County 2020
- BRPC, Berkshire County Comprehensive Economic Development Strategy (CEDS), December 2017
- BRPC, The Regional Plan for the Berkshires, May 2000
- BRPC, Sustainable Berkshires Community Strategies for A Sustainable Future
- BRPC, Climate and Energy, An Element of *Sustainable Berkshires*, Long-Range Plan for Berkshire County, May 20, 2014
- BRPC, Historic Preservation, An Element of *Sustainable Berkshires*, Long-Range Plan for Berkshire County, May 20, 2014
- BRPC, Infrastructure and Services, An Element of *Sustainable Berkshires*, Long-Range Plan for Berkshire county, May 20, 2014

- BRPC, Berkshire County Transportation Guide, Berkshires without Barriers, October 2019
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- Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan. Commonwealth of Massachusetts, 2018. https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf
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- Town of Tyringham, Bylaws of the Town of Tyringham, Massachusetts
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- Town of Tyringham Fire Department website. https://www.tyringham-ma.gov/fire-department
- Town of Tyringham Police Department website. https://www.tyringham-ma.gov/police-department
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Attachment 8: Key Contacts

KEY CONTACTS

MASSACHUSETTS EMERGENCY MANAGEMENT AGENCY (MEMA)

MEMA Headquarters
400 Worcester Road (Route 9 East), Framingham, MA 01702-5399

Shelley O'Toole (MEMA Tyringham Contact)
Hazard Mitigation Grants Coordinator

Michelle.OToole@mass.gov

MEMA Headquarters & 24x7 Communications Center
508-820-2000

MEMA Region I Office
978-328-1500

MEMA Region II Office
774-762-4877

MEMA Region III & IV Office
413-750-1400

MEMA Training & Exercise
508-820-1408

https://www.mass.gov/orgs/massachusetts-emergency-management-agency\
https://www.mass.gov/topics/mema-resources-for-public-officials

TOWN OF TYRINGHAM EMERGENCY MANAGEMENT

Town Hall, 116 Main Road, Tyringham, MA 01264

Emergency Management Coordinator/Director: Mr. James Curtin
413-243-3238

Assistant Emergency Manager: Ms. Molly Curtin-Schaefer
413-243-1749

- Southern Berkshire Regional Emergency Planning Committee
  Fairview Hospital
  29 Lewis Avenue
  Great Barrington, MA 01230
  413-854-9645

- Fire Department HQ
  100 Main Road
  Tyringham, MA 01264
  413-243-0448

- Police Department
  116 Main Road
  Tyringham, MA 01264
  413-243-1749 ext. 104

911

- Highway Department
  116 Main Road
  Tyringham, MA 01264
  413-243-1749 ext. 105

KEY CONTACTS

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA):

Massachusetts Contacts

Region I

99 High St.
Boston, MA 02110
1-877-336-2734

fema-r1-info@fema.dhs.gov

Melissa A. Surette, Senior Planner
Risk Analysis Branch, Mitigation Division

Melissa.Surette@fema.dhs.gov
Office: 617.956.7559
Cellular: 617.794.0292

DEPARTMENT OF CONSERVATION AND RECREATION (DCR)

DCR Office of Water Resources (OWR)

Main Office
251 Causeway St., Suite 900, Boston, MA 02114
617-626-1250

State National Floodplain Insurance Coordinator

Joy Duperault, CFM
MA Dept. of Conservation & Recreation, Flood Hazard Mgmt.
251 Causeway Street, 8th Floor
Boston, MA 02114
(617) 626-1406
joy.duperault@mass.gov

AMERICAN RED CROSS:

Massachusetts Contacts

101 Station Landing
Suite 510
Medford, MA 02155

1-781-410-3670
800-564-1234 (24/7)
http://www.redcross.org/local/massachusetts/disaster-services

SALVATION ARMY

Pittsfield Corps Community Center

298 West Street
Pittsfield, Massachusetts 01202
413-442-0624
Darlene.higgins@use.salvationarmy.org
Elliott.higgins@use.salvationarmy.org

https://massachusetts.salvationarmy.org/MA/Pittsfield?openDocument&charset=utf-8