TOWN OF SHEFFIELD HAZARD MITIGATION PLAN

Town of Sheffield, Massachusetts

<u>**Adopted April 1, 2019**</u>

Prepared by the:
Sheffield Hazard Mitigation Advisory Committee

With assistance from:
Berkshire Regional Planning Commission

Funding for the Sheffield Hazard Mitigation Plan was provided by a grant from the FEMA Pre-Disaster Mitigation Grant Program

Town of Sheffield

CERTIFICATE OF ADOPTION
TOWN OF SHEFFIELD, MASSACHUSETTS
A RESOLUTION ADOPTING THE
TOWN OF SHEFFIELD HAZARD MITIGATION PLAN

WHEREAS, the Town of Sheffield established the Sheffield Hazard Mitigation Advisory Committee to prepare the *Town of Sheffield Hazard Mitigation Plan*; and

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

WHEREAS, a duly-noticed public meeting was held by the Sheffield Board of Selectmen on 4-1-19, and

WHEREAS, the Sheffield Board of Selectmen authorizes responsible departments and/or agencies to executes their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Sheffield Board of Selectmen adopts the *Town of Sheffield Hazard Mitigation Plan*, in accordance with M.G.L. c. 40.

ADOPTED AND SIGNED this date 4-3-19.

David A. Smith, Jr.
Chairman

ATTEST

Acknowledgements

The Sheffield Multi-Hazard Mitigation Plan Update has been made possible with the financial support of a Pre-Disaster Mitigation Competitive Grant (PDMC 16-09), issued by the Federal Emergency Management Agency and administered by the Massachusetts Emergency Management Agency.

The Town of Sheffield would like to thank the Sheffield Hazard Mitigation Advisory Committee, who oversaw the planning process and completion of the Plan update. The Berkshire Regional Planning Commission provided technical assistance to the Advisory Council throughout the development of this Plan.

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1. INTRODUCTION AND BACKGROUND

1.1. Purpose of the Sheffield Hazard Mitigation Plan

A hazard is defined as "an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or the types of harm or loss." Hazard mitigation is defined as a "sustained action taken to reduce or eliminate the long-term risk to people and property from hazards and their effects" (FEMA, 2013).

The Federal Disaster Mitigation Act of 2000 mandated that all localities prepare local hazard mitigation plans to be eligible for future FEMA funding from the newly established Pre-disaster Mitigation (PDM) grant program and for the existing post-disaster Hazard Mitigation Grant Program (HMGP), the latter of which is a mainstay of the FEMA grant programs.

This Plan is an update of the Berkshire County Hazard Mitigation Plan, dated November 5, 2012, a regional plan in which the Town of Sheffield was included with 18 other Berkshire County municipalities. Geographically this current plan update, the *Sheffield Hazard Mitigation Plan* ("the Plan"), involves a single municipality, the Town of Sheffield, Massachusetts. During the development of this Plan the Sheffield Comprehensive Emergency Management Plan (CEMP), other hazard mitigation plans, sheltering plans and other relevant plans in the region were consulted.

The Plan is designed to serve as a tool to help Town officials identify hazard risks, assess the Town's vulnerability to hazardous conditions, identify and consider measures that can be taken to minimize hazardous conditions, and develop an action plan that can reasonably be implemented to mitigate the impacts of hazards in the Town. A goal of the update is to use this Plan in conjunction with other local and regional plans, specifically the Sheffield Comprehensive Emergency Management Plan, other hazard mitigation plans, emergency preparedness plans developed in conjunction with the Southern Berkshire Emergency Planning Committee, and a soon-to-be drafted Sheffield Municipal Vulnerability Preparedness Plan, which the Town expects to undertake in fiscal year 2019.

1.2. Community Background

The Town of Sheffield has approximately 3,200 residents located on the southern-most part of Berkshire County. Sheffield is bordered by Mount Washington to the West, Egremont to the northwest, Great Barrington to the north, New Marlborough to the east, and North Canaan, Connecticut to the south.

Sheffield is 31,065 acres, or approximately 49 square miles. While geographically large, the Town itself is very rural, with approximately 66% of the land being forested area and 18% is used for agricultural uses. A total of 8% of land is developed, with residential development predominant and scattered along the Town's roadways[1]. The two relatively densely developed areas are Sheffield Center, on the west side of Main Street/Route 7, and Ashley Falls Village. As noted in the Town's Master Plan, the housing stock is relatively new, with the median year that a home was constructed being 1961, while throughout Berkshire County it was 1950. It should be noted, however, that a substantial amount of housing was constructed in the 19th century, with a few outstanding homes having been constructed in the 18th century. Approximately 14% of the housing is occupied by seasonal homeowners.[2] The population

[1] *Source: 2005 Mass GIS land use datalayer.*
[2] *Source: US Census ACS 2012-2016*

density is approximately 65 residents per square mile, which is similar to its neighbor Egremont but less than half that of Great Barrington, the south Berkshire region commercial hub north of Sheffield.

In general, the center of Sheffield is a wide, flat plain, left behind after the glacial retreat of 12,000 years ago. Flowing north to south through the center of the Town is the Housatonic River. The river meanders its way through Sheffield, surrounded by extensive floodplain areas, much of which is used for agricultural uses. The river corridor is the central channel of a glacial water body named Lake Housatonic, and the silt deposits left by the lake, along with replenishment of soils and nutrients during flood events, create the deep and rich soils that offer some of the best agricultural resources in Massachusetts. The tributaries to the Housatonic River tend to also flow in meandering patterns after flowing down higher elevations to the east and west of the Town. Many tributaries such as Willard, Schenob and Dry Brooks also have extensive floodplains. Wetlands are also widely located throughout the Town, with Sheffield hosting the most acreage of forested and non-forested wetlands in the county.[3] Vegetated communities of the Town are diverse, with Sheffield hosting some of the rarest plant communities and species in Massachusetts.

Low mountains frame the east and west portions of the Town, with higher points of 2,365 feet at Race Mountain and 2,050 at Mt. Patterson, with the lowest elevation at the Housatonic River in Ashely Falls near the Connecticut state line. Steep slopes of 15% or more are found on the hillsides. This topography can cause dangerous conditions that create flooding, bank erosion and road washouts. County Road, one of the few mountainous areas within the Town, sees flooding and washouts often, sometimes annually in certain sections. This is relevant because the road is a major bus route to and from the regional high school as well as to nearby towns.

1.3. Development Patterns

This Hazard Mitigation Plan is an update of the Berkshire County Hazard Mitigation Plan, dated November 2012, a regional plan in which the Town of Sheffield was included with 18 other Berkshire County municipalities. Since 2012, construction and development in Sheffield, including commercial, industrial and residential construction, have followed traditional patterns. Other than the development of several ground-mounted solar fields, no new subdivisions, streets/roads/ways, industrial parks or multi-family units, other than for farm workers, have been added in Sheffield.

At the same time, the Zoning Districts have not been changed. Industrial and Commercial development has been a mix of new construction and reuse of existing buildings and has generally followed the North / South Route 7 corridor, which is zoned for Village Center, Commercial or Business Districts. All Sheffield Zoning Districts include mixed use, so residential development also occurs on the Route 7 corridor. Of the nine major Commercial/Industrial construction projects that have occurred since 2012, four have been new construction (two of which were tear-down and replacement), four have been reuse of existing buildings, and one has been a remodeling of an existing building. All building and new uses conformed to required building codes, conservation committee and other permitting requirements, as required.

A summary of Commercial and Industrial construction during 2012-18 include:

- Bash Bish Brew and Que Restaurant, Main Street/Route 7 (Reuse of existing building)
- Big Elm Brewery, Silver Street (Reuse of existing building)

[3] *Source: 2005 Mass GIS land use datalayer.*

- Berkshire Distillery, South Main Street/Route 7 (New construction; tear down of previous building)
- Rock Solid, North Main Street/Route 7 (Reuse of existing buildings)
- Adult use marijuana retail, cultivation and product manufacturing, North Main Street/Route 7 (New construction; tear down of previous building)
- Adult use marijuana cultivation and product manufacturing, North Main Street/Route 7 (Reuse of existing building)
- Autobahn Services, North Main Street/Route 7 (New construction on empty parcel)
- Plaskolite, formerly Sheffield Plastics, Salisbury Rd. and Silver Street (Remodeling/addition of existing structures)
- Stor-It-All, Sheffield Business Park (New construction on empty parcel)

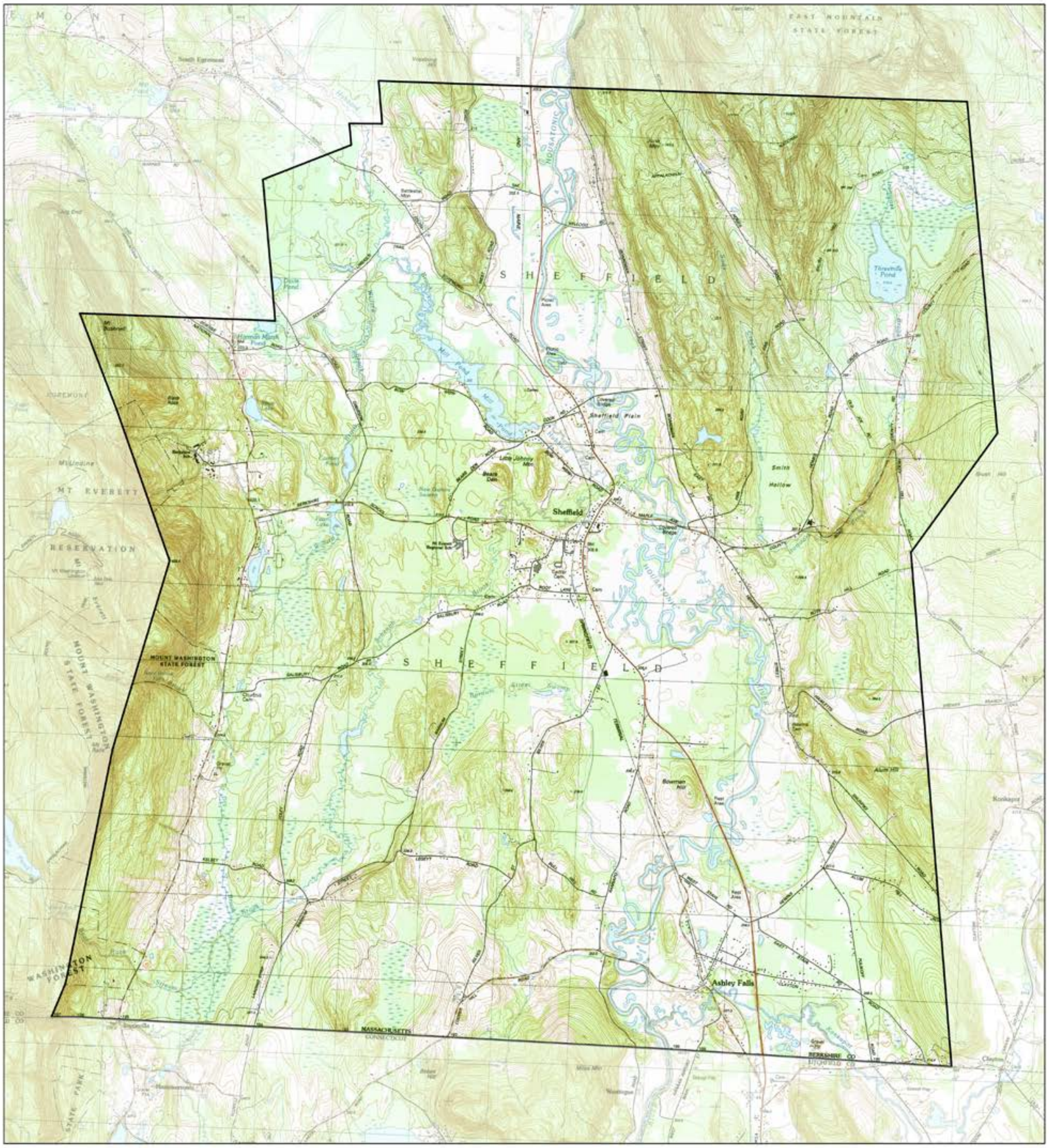
Residential construction and remodeling has occurred in traditional locations along existing roadways and in or near developed areas, primarily in the Rural District, which covers the majority of land in Sheffield. Since the development of the last Hazard Mitigation Plan, all new home and remodeling have gone through required permitting, as well conservation committee review and compliance. No new construction has occurred in the Floodplain Overlay District that would result in loss of floodplain area, as the Town strictly enforces its bylaws regarding development in the floodplain. The Town also enforces the Massachusetts Wetlands Protection Act, which limits construction that would impair wetlands functions, one of which is flood storage and control.

The Town of Sheffield's infrastructure is limited, as it does not provide public drinking water or sewer to its residents or businesses. Approximately 500 households, including Town buildings and a few businesses, get their water from the Mountain Water Systems, a private water company, while the rest get their water from private wells. All residents and businesses rely on private septic systems. Mount Everett High School and Undermountain Elementary School, the main campus for the Southern Berkshire Regional School District, are located on Berkshire School Road.

While the Town is generally rural and spread out, there are three employers within Sheffield that employ over 100 people. Berkshire School is a private co-ed boarding school for a few hundred students, Plaskolite is a high-tech polymer manufacturer, and the Southern Berkshire Regional School District's campus houses administrative and academic staff. Retail, food services and community and government services in Sheffield are predominantly located along Main Street/Route 7, the Town's major transportation route. Of the more than $34,000,000 property value within the Town's floodplain, more than 1/3 of that value is along Main Street/Route 7.

Of the 63 severe storm events in Berkshire County that have resulted in property damage since 1955, nearly 15% of them have occurred in the past 4 years. This supports the growing trend of increasing storm events, which can increase the risk to road and bridge infrastructure.

Fig. 1.2.1. Topographical Map of Sheffield



0 0.5 1 2 Miles

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Berkshire Regional Planning Commission

This map was created by the Berkshire Regional Planning Commission and is intended for general planning purposes only. This map shall not be used for engineering, survey, legal, or regulatory purposes. MassGIS, MassDOT, BRPC or the municipality may have supplied portions of this data.

2. PLANNING PROCESS

2.1. Planning Committee

The Sheffield Town Administrator took the lead in convening an advisory committee to oversee the update of the Sheffield Hazard Mitigation Plan. This committee consisted of municipal department heads, first responders, representatives from various Town boards and committees, and residents. Members of the Sheffield Hazard Mitigation Advisory Committee are listed below, Table 2.1. Technical Assistance for the development of this Plan was provided by the Berkshire Regional Planning Commission (BRPC).

Table 2.1.1. Sheffield Hazard Mitigation Advisory Committee

Name	Position
Chief Eric Munson	Sheffield Police Department
Edward Pickert	Sheffield Highway Superintendent
Rhonda LaBombard	Town Administrator
Kathleen Loring	Executive Director, Council on Aging
Rene Wood	Sheffield Select Board, former Planning Board, Resident
Lou Levine	Resident
Alicia Dulin	Assistant to Town Administrator

The Advisory Committee formally began the planning process for the update of the hazard mitigation plan in November 2017 and submitted its first draft Plan for review to MEMA in November 2018. During the convening months the Advisory Committee met four times to discuss data provided by BRPC, to gather more detailed and site-specific information, to discuss opportunities for improved preparedness and mitigation, and to begin to identify potential action strategies. All Committee meetings were posted, open to the public and complied with the Massachusetts Open Meeting Law. Town officials, including members of the Planning Board, and the public were kept informed of the planning process through a variety of media, including posting of meetings on the Town's website. Updates were provided to the Sheffield Select Board five times throughout the process, the meetings of which are televised on Southern Berkshire Community Television, which serves the southern Berkshire County region, including the neighboring towns of Egremont, Great Barrington, and New Marlborough. Videos of these meetings are also available to the public via links on the Town of Sheffield's website. In addition, articles about the planning process were featured in the January/February, March/April, and October/November editions of the *Sheffield Times*, the local newsletter which goes to all Sheffield households.

In addition to the Advisory Committee, interviews were held with key stakeholder to gain additional information about natural hazard risks in Sheffield. Interviews were held with staff from Berkshire School, Southern Berkshire Regional School District and Mountain Water Systems. These interviews were conducted by staff from the Berkshire Regional Planning Commission. In an attempt to reach the business community, the Town sent a survey to 200 business owners in Sheffield, asking them if they had been impacted by past natural hazard incidents and what types of services or support would help them be better prepared for future incidents. The Town received 22 surveys, an 11% response rate, the details of which are discussed in Section 4 of this Plan.

To garner further public input, the Advisory Committee held a public forum as a way to begin the formal public review process for the draft plan. The public forum was held on February 13, 2018 at the Sheffield Senior Center, with sessions open to the public from 1-3 p.m. and again from 5-7 p.m. The earlier session was to accommodate seniors who might prefer a mid-day event and the later session was to accommodate those who would have to attend an evening event due to work demands. This event was widely publicized in January, when the Town inserted a flyer about the event in the Town Census mailing. The forum was also featured in an article in the *Sheffield Times* newsletter, at Select Board meetings, and in a memo sent to all Town Boards via the Town Administrator. In addition, flyers for the forum were posted at public gathering sites, including Town Hall, police station, senior center, library, and three cafes. The same poster was distributed to all businesses with the survey via the Town's Census mailing.

The public forum featured a number of posters, including draft maps of hazard areas and information that had been generated to date. Also featured was a poster of the draft actions that had been developed by the Advisory Committee. Attendees of the forum were given colored pens and asked to provide information directly on the maps and posters, and specifically to comment on the draft actions. In addition, Chief Munson hosted a table with emergency preparedness information and brochures for residents who attended the forum.

The Advisory Committee received valuable information during the public forum. The posters proved a useful and interactive media for attendees to provide information. Older, long term residents provided detailed information on past flood events that had impacted the Town but had not yet been identified by the Committee. Additional information on severe winter events, beaver activity and other hazards were also gathered via the posters.

The *Draft Sheffield Hazard Mitigation Plan* was issued to the Board of Selectmen, Town Administrator, Advisory Committee members, Town staff and municipal board members for review and in October 2018. After incorporating comments from town staff and officials, the draft plan was offered for public comment in November 2018. The public comment period was launched during a presentation given to the Board of Selectmen on November 5th. This presentation summarized the major findings of the plan, including the highest priority Actions recommended in the plan. Paper copies of the major findings and action plan were distributed to meeting attendees and posted on the Town's website. Paper copies of the handout and draft plan were posted at the Town Hall, and additional copies of the draft plan were placed at Sheffield's Bushnell Sage Library. The draft plan was posted online, with the link to the plan posted on the homepage of the Town of Sheffield website. The presentation and invitation to comment on the draft plan was broadcast on the local access cable channel, which serves Sheffield and the neighboring towns of Egremont and Great Barrington. A link to view the video of the meeting was posted in the Town's website. The *Sheffield Hazard Mitigation Plan* incorporates the input and comments received throughout this expansive public outreach program.

The Town of Sheffield sought comments from its neighboring towns through two particular actions, each of which was an invitation to provide comments:

- On February 4, 2019, an email was sent to 24 members of the Southern Berkshire Regional Emergency Planning Committee, address to members from Egremont, Great Barrington, New Marlborough, Monterey and Mount Washington, the five towns surrounding Sheffield, notifying them of the recently updated Plan and asking them for their comments. The Plan location on BRPC's website was provided and comments were sought until February 28, 2019. Comments could be provided online to, or by calling, a member of the Plan's committee. The Town of Great Barrington's Fire Chief was the only person who provided verbal comments and he said he found no areas on which to comment on the Plan.

- On or about February 5, 2019, letters were sent to the Town offices of Egremont, Great Barrington, New Marlborough, Monterey and Mount Washington, notifying Town Officials of the updated Sheffield Hazard Mitigation Plan, requesting feedback on the Plan. The online location of the Plan was provided, with the option of providing such feedback online to, or by calling, a member of the Plan's committee. Comments were sought until February 28, 2019. No comments were received.

The resulting *Sheffield Hazard Mitigation Plan* is a compilation of data collected by BRPC, information gathered from the Advisory Committee during meetings, interviews conducted with key stakeholders outside of working meetings, business surveys, and information gathered during public outreach and forums. Outreach materials used during the planning process are featured in Appendix 3 of this Plan.

2.2. Coordination with Existing and Developing Planning Efforts

There are several documents and ongoing efforts that identify and address emergency and environmental concerns. The Town of Sheffield was currently in the process of updating its *Comprehensive Emergency Management Plan* (CEMP), at the time of this Plan update. The CEMP assigns responsibilities and functions, which will provide for the safety and welfare of its citizens against the threat of natural, technological, and national security emergencies and disasters. The CEMP addresses the Mitigation, Preparedness, Response and Recovery aspects of emergency management organizations, programs, protective actions, and specific hazards. Critical infrastructure and vulnerable populations were identified and verified using the CEMP as well as drawing on local first responder knowledge.

The Sheffield Planning Board is the primary Town board responsible for regulating development in Sheffield. Feedback to the Planning Board was ensured through the participation of town management on the local hazard planning team. In addition, BRPC, the State-designated regional planning authority for Sheffield, provides support for boards / agencies that regulate development in its region, including the municipal entities listed above, and coordinates planning efforts with state agencies such as MassDOT. This regular involvement ensured that during the development of the Sheffield Hazard Mitigation Plan, the operational policies and any mitigation strategies or identified hazards from these entities were incorporated

Regionally, Sheffield is an active member of the Southern Berkshire Regional Emergency Planning Committee (SBREPC), which is made up of 12 towns in the southern Berkshire region. The SBREPC's priority is to minimize the risk to public safety, health and property through the development of a Regional Hazardous Materials Emergency Response Plan and a database of resources, equipment, and personnel that can be drawn on upon in an emergency. Although the primary responsibility of the SBREPC is to address hazardous materials, the organization has taken a broad emergency planning role that includes the full range of emergency and disaster planning and response.

During the development of this Hazard Mitigation Plan update, those on the Hazard Mitigation Advisory Committee voiced their awareness of accelerated changes in weather patterns, particularly an increase in the number and severity of severe precipitation events, likely due to climate change. However, it was beyond the scope of this hazard mitigation planning update process to delve deeply into the topic, which is all encompassing. To allow the Town to more clearly document the impacts of climate change to level needed, the Town applied for and was awarded a Municipal Vulnerability Preparedness (MVP) Grant from the Commonwealth in the spring of 2018. We expect the MVP process to provide more data and detail on the impacts that climate change is projected to have on the Town's residents, businesses and farms.

In addition to the planning efforts described above, this newly developed *Sheffield Hazard Mitigation Plan* draws and expands upon information found in the following plans:

- *Sheffield Master Plan* (2005)
- *Sheffield CEMP (In progress)*
- *Berkshire County Hazard Mitigation Plan* (FEMA approved 2013)
- *Massachusetts State Hazard Mitigation Plan* (FEMA approved 2013)
- *Massachusetts Climate Adaptation Report* (2011)
- *The Southern Berkshire Regional Shelter Plan* (developed through WRHSAC, 2016)
- *Regional Evacuation Plans* (developed through WRHSAC)

2.3. Plan Maintenance and Updates

The *Sheffield Hazard Mitigation Plan* is designed to be a working, living document. The Sheffield Town Administrator is the steward of the *Sheffield Hazard Mitigation Plan* of 2018. Evaluation of the hazard mitigation plan in its entirety will be done on a five-year basis in accordance to the Disaster Mitigation Act of 2000, or if a significant natural hazard disaster occurs. When the Plan is in its third or fourth year, the Town will begin the process of updating the Plan to ensure continuity and retain the Town's eligibility to apply for and receive FEMA and other relevant funding.

The Plan will be updated to meet changing conditions in the Town or in the region. Hazard mitigation measures that have been implemented will be analyzed for their effectiveness. This analysis may include site visits to appropriate locations where these measures have been implemented. Mitigation measures that have not been implemented will be reviewed to determine if they are still expected minimize hazards if implemented, or if they are no longer viable options.

As with other planning projects undertaken in Sheffield, the public will be given the opportunity to review updates to the Plan and its proposed amendments in the future, and to submit comments. Public comments will be invited through notices placed in the news media, at the Town's library, Senior Center, Town Hall and on the Town website. The Plan and its proposed amendments will be discussed at Select Board meetings, which are publicly noticed in accordance with public meeting laws, and televised and distributed through local cable access, thus providing wide-spread public exposure. Comments will also be solicited from the SBREPC.

3. HAZARD IDENTIFICATION AND RISK ASSESSMENT

3.1. Identifying Hazards

As defined by FEMA, a hazard is defined as an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or the types of harm or loss. Vulnerability is defined as the characteristics of community assets that make them susceptible to damage from a given hazard. A risk assessment is process that collects information and assigns values to risks for the purpose of informing priorities, developing or comparing courses of action, and informing decision making (FEMA, 2013). This section of the Plan discusses the natural hazards that have been determined to impact the Town of Sheffield. The Town chose to investigate the 17 natural hazards that are identified and discussed in the *Commonwealth of Massachusetts State Hazard Mitigation Plan* (MEMA, 2013). Two of the hazards, Coastal Hazards and Tsunami, do not occur in the Town because it is a land-locked community within Berkshire County, approximately 140 miles from the Massachusetts coast and more than 100 miles from the Long Island Sound. The other 15 hazards are grouped in nine categories that best fit their weather pattern and impact upon the Town (see Table 3.1.1).

To determine which natural hazards have the greatest potential to impact the Town, the hazards were analyzed for their Area of Impact, Frequency of Occurrence and Severity. Refer to Table 3.1.2. for a matrix displaying the natural hazards and their ranking.

Table 3.1.1. Natural Hazards that Impact Sheffield

Hazard	Category
Flood (Including Ice Jam)	Flood
Dam Failure	Dam Failure
Hurricane / Tropical Storm	Hurricane
Nor'easter	Severe Winter Weather
Snow & Blizzard	Severe Winter Weather
Ice Storm	Severe Winter Weather
Thunderstorm	Severe Weather
High Winds	Severe Weather
Tornado	Severe Weather
Drought	Drought
Extreme Temperature	Severe Weather
Wildland Fire	Fire
Major Urban Fire	Fire
Earthquake	Earthquake
Landslide	Landslide
Coastal Hazards	Not Included
Tsunami	Not Included

Table 3.1.2. Hazards with the greatest potential to impact Sheffield

Hazard:	Area of Impact Rate: 1=small 2=medium 3=large	Frequency of Occurrence Rate: 0 = Very low frequency 1 = Low 2 = Medium 3 = High Frequency	Magnitude / Severity Rate: 1=limited 2=significant 3=critical 4=catastrophic	Hazard Ranking (Cumulative Score)
Flooding (include Ice Jam, Beaver Activity)	2	3	3	**8**
Severe Storms (High Wind, Tornado, Extreme Temperature)	3	3	2	**8**
Severe Winter Event (Ice Storm, Blizzard, Nor'easter)	3	2	2	**7**
Hurricane & Tropical Storms	3	2	2	**7**
Drought	3	1	1	**5**
Tornado	1	0	4	**5**
Earthquake	2	0	2	**4**
Dam Failure	2	0	2	**4**
Urban & Wildfire	2	1	1	**4**
Landslide	1	0	1	**2**

Area of Impact	
1=small	isolated to a specific area of town during one event
2=medium	occurring in multiple areas across town during one event
3=large	affecting a significant portion of town during one event
Frequency of Occurrence	
0=Very low frequency	events that have not occurred in recorded history of the town, or that occur less than once in 1,000 years (less than 0.1% per year)
1=Low frequency	events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year)
2=Medium frequency	events that occur from once in 10 years to once in 100 years (10% to 1% per year)
3=High frequency	events that occur more frequently than once in 10 years (greater than 10% per year)
Magnitude/Severity	
1=limited	injuries and/or illnesses are treatable with first aid; minor" quality or life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2=significant	injuries and/or illnesses do not result in permanent disability; shutdown of several critical facilities and services for more than one week; property severely damaged < 25% and > 10%
3=critical	injuries and/or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged < 50% and > 25%
4=catastrophic	multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged> 50%

Source: Table developed by BRPC 2005, adapted by Sheffield Hazard Mitigation Advisory Committee 2018.

3.2 Flood Hazards

3.2.1. General Background

As noted in the 2013 *Massachusetts State Hazard Mitigation Plan*, floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss—75% of federal disaster declarations are related to flooding. Property damage from flooding totals over $5 billion in the United States each year. The high costs of flood response and reparations are the reason that the National Flood Insurance Program has been established. Flooding is the result of several types of natural hazards, the impacts of which can be exacerbated by development and local land-use practices, which is why it is so important that communities review and consider the effectiveness of their land use regulations and policies as part of their hazard mitigation planning process. (MEMA, 2013)

As part of this 2018 update, the Town of Sheffield has gathered the most updated and best available data, including historical occurrences, the severity and/or recurrence interval information where available, and potential trends into the future. This gathering of information also includes that provided by local data from emergency responders, public works staff, local officials, business leaders and long-time residents. This update also looked at flood claims and repetitive losses in Sheffield. HAZUS has been utilized to aid in analyzing risk, potential losses and damages. Taken together this information helps town officials and emergency management personnel gauge the scope of natural hazard events and assess their likeliness of reoccurring.

Common Types of Floods

The hazards that produce local or regional flooding in the region include hurricanes, tropical storms, heavy rain events, winter rain-on-snow, and thunderstorms. Storms coinciding with spring melt are historically common, with winter cycles of snow followed by rain becoming more common. Flash flood regimes are common in the region due to the hilly terrain and thin soil that supports headwater streams and rivers. Stream and riverine flooding often occurs after heavy rain events, filling steeply sloped stream channels that rapidly discharge into larger streams and the Housatonic River. Naturally occurring accelerated runoff occurs when soils are not able to absorb rainfall such as when soils are already saturated or when the ground is frozen. (MEMA, 2013)

Man-made accelerated runoff occurs where development has created impervious surface areas, most particularly where runoff has been channeled and discharged into streams and rivers that are already swollen from natural runoff. Channeling and discharging runoff bypasses the natural processes whereby vegetated cover and uncompacted soils attenuate some portion of surface runoff through infiltration and uptake. In Sheffield this most often occurs along the Main Street/Route 7 corridor where buildings, parking lots, roads and driveways have replaced natural vegetative cover. Additionally, capturing, channeling, and discharging runoff from development and roads results in higher volumes of water reaching streams and river in an accelerated timeframe, which may cause greater stream and riverbank erosion, and higher debris and sediment loads. Flooding of land also occurs when stream and river channels, bridge spans, culverts or drainage channels cannot contain the volume of water flowing through their system. Flood waters overtop stream channels and back up when constricted by undersized culverts and bridges. (MEMA, 2013). Driveway runoff can add water and materials onto roads and cause dangerous road conditions, especially if freezing conditions create areas of ice.

There are several areas in Sheffield that periodically flood due to the constriction created by road culverts and bridges at stream crossings. Beaver activity can cause flooding in a variety of ways due to their natural instinct to create ponding and to react to flowing water. Damming streams and wetland outlets causes flooding that can expands areas of inundation upstream and outward, which can threaten the built environment. If the impoundment impacts a drinking water supply, it can threaten human health. Beavers can also cause flooding due to their propensity to block culverts, threatening not only the road crossing but possibly properties upstream. (MEMA, 2013)

Measuring Floods

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. The 100-year flood elevation or discharge of a stream or river has a 1% chance of occurring or being exceeded in any given year. In this case the statistical recurrence interval would be 100 years between the storm events that meet the 100-year discharge/flow. Such a storm, with a 1% chance of occurrence, is commonly called the 100-year storm.   Similarly, the 50-year storm has a statistical recurrence interval of 50 years, and an annual flood is the greatest flood event expected to occur once in a typical year. t should be understood, however, that these measurements reflect statistical averages only using previously collected data, not projections due to climate change. Given these statistical averages, it is possible for two or more floods with a 100-year flood discharge to occur in a short time period.

The extent of the area of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood), most commonly termed the 100-year floodplain area, is a convenient tool for assessing vulnerability and risk in flood-prone communities. The 100-year flood boundary is used as the regulatory boundary by many agencies, including FEMA and MEMA. It is also the boundary used for most municipalities when regulating development within flood-prone areas. The FEMA Flood Insurance Rate Maps (FIRM) developed in the early 1980s for Berkshire County, typically serve as the regulatory boundaries for the National Flood Insurance Program (NFIP) and municipal floodplain zoning. A structure located within a the 100-year flood area on the NFIP maps has on average a 26% percent chance of suffering flood damage during the term of a 30-year mortgage. (MEMA, 2013). However, as noted in the Flood Insurance Rate Maps, the areas shown within the 100-year flood boundaries are for flood insurance only; they do not necessarily reflect areas in a community prone to flooding.

Table 3.2.1. Recurrence Intervals and Probabilities of Occurances

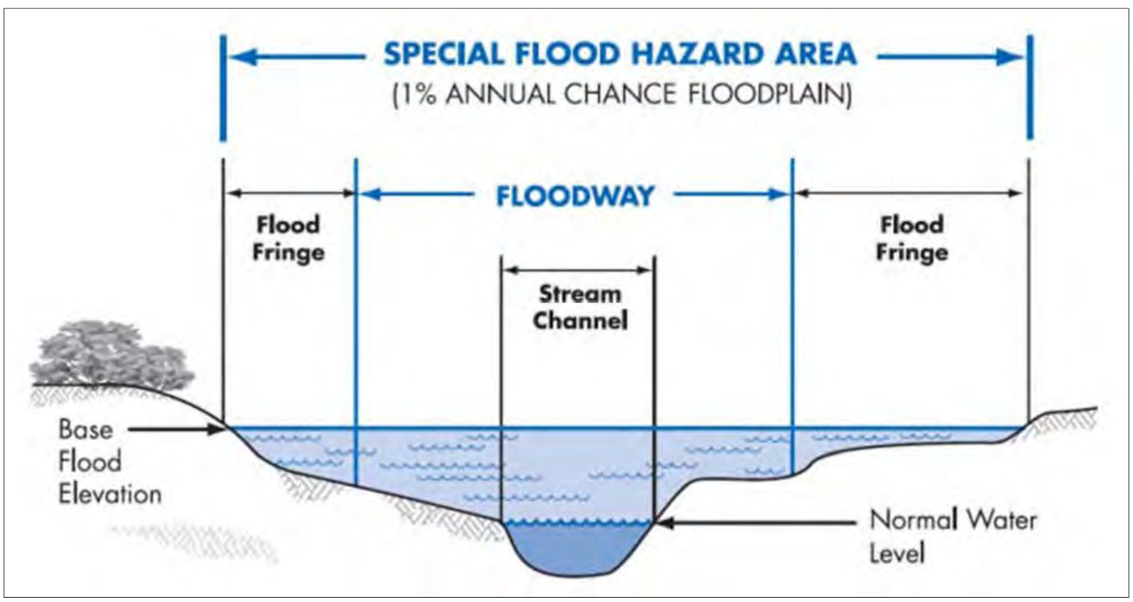
Recurrence interval in years	Probability of occurrence in any given year	Chance of Reoccurrence in any given year
500	1 in 500	0.2
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Flood flows in Massachusetts are measured at numerous USGS stream gages, and typically, in the aftermath of a flood event, USGS will determine the recurrence interval of the event using data from the gage's period of historical record. There are two gages located on the Housatonic River in the Sheffield area. The first gage is located upstream of Sheffield in Great Barrington and the second is located in the southern portion of Sheffield in the village of Ashley Falls. Data from these gages are discussed in more detail in the Previous Occurrences section.

Floodplains and Wetlands

A floodplain or floodway is the area adjacent to a stream, river, or lake that becomes inundated during a flood. In the Berkshires these areas most often flood during spring melt and during high rain events; inundation is often fairly common and expected, and equal to a 50% or 100% (annual) chance of recurrence. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a deep channel. In general, flooding can be defined as a rising and overflowing of a body of water onto normally dry land. In some areas it is fairly easy to identify floodway floodplains due to the terrain, soils and vegetation. Floodplain forests and wetland ecosystems may occupy these areas, serving to buffer the impacts of floods by absorbing and storing water and tempering flowing waters. Backup of floodwaters occurs when structures built in a floodway/floodplain area constrict or impedes flows, such as when roads cross such an area or bridges and culverts are undersized. Figure 1 depicts the floodway and 100-year flood hazard areas of a floodplain. (MEMA, 2013)

Fig. 3.2.1. Flood-Prone Areas Typically Associated with Streams and Rivers



Source: (MEMA, 2013)

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments known as alluvium (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. (MEMA, 2013)

Floodplains are among the most species-rich ecosystems in the world. The biodiversity of a natural floodplain is extraordinary, due to the mix of soils, hydrologic regimes and vegetated habitats occupying these areas. Floodplains are the habitat that connects the truly aquatic ecosystems with the truly upland ecosystems, providing the habitats needed by many aquatic-based and terrestrial-based wildlife. Floodplains have historically been converted to agricultural uses due to their often fertile and deep soils and relatively level terrain. Further floodplain lands were developed as flowing waterways, providing the power needed by industrial uses and the towns and cities that developed around them. (MEMA, 2013)

As a result, Massachusetts' flood plains tend to be heavily developed and highly populated. Human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions. (MEMA, 2013). It is for these reasons that maintaining riverine floodplains in an undeveloped and natural state is so important to flood control.

Secondary Hazards

In the Berkshire region rivers and streams tend to be dynamic systems, with stream channel and bank erosion common in both headwater streams and in the level, meandering floodplains of the Housatonic and Hoosic Rivers. Fluvial erosion is the process of a river under cutting a bank, usually on the outside bend of a meander, causing sloughing and collapse of the riverbank. Fluvial erosion of stream and riverbank channels can creep towards the built environment and threaten to undercut and wash away trees, buildings, roads and bridges. Many roads throughout the region follow streams and rivers, having been laid in the floodplain or carved along the slopes above the bank. Older homes, barns and other structures were also built in floodplain or just upgradient of stream channels in both rural and urban areas. Fluvial erosion can also scour and down cut stream and river channels, threatening bridge pilings and abutments. This type of erosion often occurs in areas that are not part of a designated floodplain. (MEMA, 2013)

Flood waters can increase the risk of creating and dislodging ice dams during the winter months. Blocks of ice can develop in streams and rivers and create a physical barrier or dam that restricts flow, causing water to back up and overflow its banks. Large ice jam blocks that break away and flow downstream can damage culverts, bridges and roadways whose openings are too small to allow passage. (MEMA, 2013)

Electrical power outages can occur during flood storm events, particularly when storm events are accompanied by high winds, such as during hurricanes, tropical storms, thunderstorms and micro-bursts. Fortunately, most flooding in the Berkshire region is localized and has resulted in few wide spread outages in recent years, and where it occurred, service has typically been restored within a few hours.

Landslides on steep slopes can occur when soils are saturated and give way to sloughing, often dislodging trees and boulders that were bound by the soil. The most recent and damaging landslide in the county, which occurred during Tropical Storm Irene in 2011 to Route 2 in the Florida/Charlemont area, was a combination of fluvial erosion from the Cold and Deerfield Rivers and a landslide on the upland slope of the road.

Dam failures, which are defined as uncontrolled releases of impounded water due to structural deficiencies in the dam, can occur due to heavy rain events and/or unusually high runoff events. (MEMA, 2013). Severe flooding can threaten the functionality or structural integrity of dams. In addition to the six dams in Sheffield, the Town is in the inundation area for several other dams located in Egremont and Great Barrington. A more thorough discussion of the Town of Sheffield's risks due to dam failures is discussed Section 3.5 of this Plan.

Flooding of homes and businesses can impact human safety health if the area of inundation is not properly dried and restored. Wood framing can rot if not properly dried, compromising building structure and strength. Undetected populations of mold can establish and proliferate in carpets, duct work, wall board and almost any surface that is not properly dried and cleaned. Repeated inundation brings increased risks of both structural damage and mold. Vulnerable populations, such as those whose immune systems are compromised by chronic illness or asthma, are at higher risk of illness due to mold.

Severity

In general, the severity level of flood damage is affected by flood depth and flood velocity. The deeper and faster flood flows become, the more power they have and the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. (MEMA, 2013) However, flood damage to homes and buildings can occur even during shallow, low velocity flows that inundate the structure, its mechanical system and furnishings.

Climate Change Impacts

The scientific community is largely in agreement that climate change is altering the weather and precipitation patterns of the northeastern region of the U.S. The Intergovernmental Panel on Climate Change report of 2007 predicts temperature increases across the U.S., with the greatest increase in the northern states and during the winter months. The Northeast Climate Adaptation Science Center predicts that annual increases of 3.1° to 6.7° F will occur in the Housatonic River Watershed by mid-century, with the greatest increases in the winter season. [1] More mid-winter cold/thaw weather pattern events could increase the risk of ice jams. Many studies agree that warmer late winter temperatures will result in more rain-on-snow storm events, leading to higher spring melt flows, which typically are already the highest flows of the year.

Based on data gathered from the Northeast Climate Science Center (NECSC), the yearly precipitation total for Berkshire County has experienced a gradual rise over the last 70 years, rising from 40.1 inches in the 1960's to 48.6 inches in the 2000's. According to projections from the NECSC, the county is

[1] Northeast Climate Adaptation Science Center, 2018. *Massachusetts Climate Change Projections*, MA EOEEA, Boston, MA.

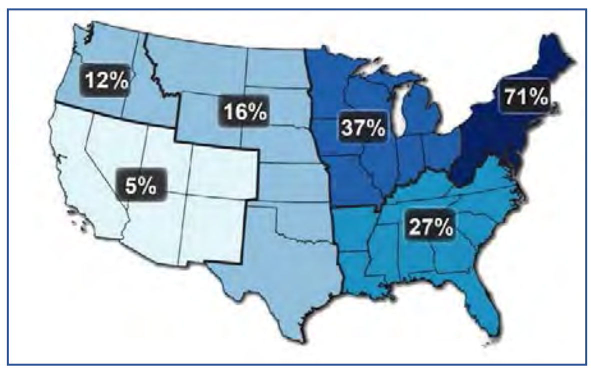
projected to experience an additional 3.55 inches by the 2050's and 4.72 inches by the 2090's. (Northeast Climate Science Center, 2018)

Studies have also reported increases in precipitation in both developed and undeveloped watersheds across the northeast, with the increases being observed over a range of precipitation intensities, particularly in categories characterized as heavy and extreme storm events. These events are expected to increase both in number and in magnitude. Other scientists predict that the recurrence interval for extreme storm and flood events will be significantly reduced. One study concluded that the 10-year storm may more realistically have a recurrence interval of 6 years, a 25-year storm may have a recurrence interval of 14 years and the 100-year storm may have a recurrence interval of 49-years. The same study predicts that if historic trends continue, flood magnitudes will increase, on average, by almost 17%. (Walter & Vogel, 2010)

Data from at USGS streamflow gages across the northeast show a clear increase in flow since 1940, with an indication that a sharp "stepped" increase occurred in the 1970s. This is despite the fact that much of the land within many New England watersheds has been reforested, and this type of land cover change would tend to reduce, rather than increase, flood peaks (Collins, 2008).

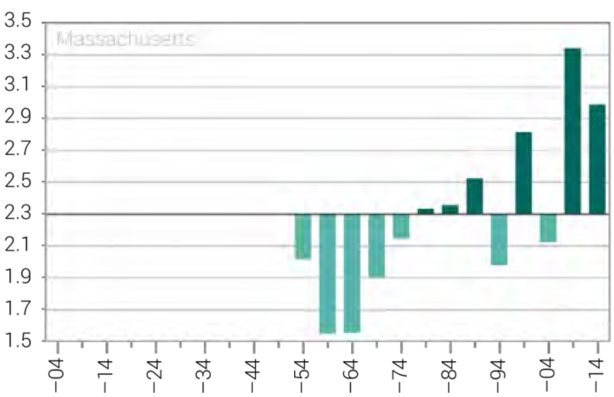
Climate change will likely alter how the region receives its precipitation, with an increase of it falling in the form of severe or heavy events. The observed amount of precipitation falling in very heavy events, defined as the heaviest one percent of all daily events, has increased 71% in the Northeast from 1958-2012.[2] This supports what local public works staff say they have experienced in recent years. See Fig. 3.2,2 for national trends.

Fig. 3.2.2. Increase in Precipitation Falling in Top 1% Extreme Precipitation Events 1958-2012



Source: NOAA, adapted from Karl, et al, 2009.

Fig. 3.2.3. Number of Extreme Precipitation Events of 2" or more in 1 Day



Source: https://statesummaries.ncics.org/ma

The NECSC also predicts that the region will see an increase in the number of days with at least 1 inch of precipitation from 4.5 days in the 1960s, to 5.1 days in the 2000s to 6.6 days in 2050s and 7.1 days in 2090s. (Northeast Climate Science Center, 2018) The NOAA National Centers for Environmental Information provides a summary of observed

[2] *NOAA - https://toolkit.climate.gov/image/762, adapted from Karl et al.*

climate changes for Massachusetts. According to this data, the number of extreme precipitation events, those defined as more than two inches in one day, has increased since the the 1980s, with the greastest increase in the past decade (see Fig. 3.2.3)[3].

These trends have direct implications on the design of municipal infrastructure to withstand extreme storm and flood events, indicating that all future designs must be based on the most updated precipitation and stream gauge information available, as well as climate change predictions. It is not unusual for stormwater management systems to be 50-100 years old, or older, and new infrastructure systems are being designed to have at least a 20-50-year lifespan. Thus, the vast infrastructure systems in place today will probably not accommodate the predicted increased flows.

Fig. 3.2.4 Engineering Standard Changes

Change in 24-hour,100-year Design Storms (inches)			
	NOAA TP-40	NOAA Atlas 14	Change
Boston	6.6	7.8	+1.2"
Worcester	6.5	7.6	+1.1"

Already the engineering and regulatory sectors have recognized the increase in precipitation. The long-used TP-40 method for sizing stormdrain system has been replaced by NOAA Atlas 14 and other methods. As shown in Fig. 3.2.4, the design for a 24-hour 100-year storm event has been increased to accommodate a greater amount of water.

It may be prudent, therefore, to overdesign the size of new stormwater management and flood control systems so that they have the capacity to accept the increase in flow or volume without failing. For many piped systems, such as culverts, drainage ditches and swales, the increase in size may provide a large increase in capacity for minimal increases in cost. If space is available, an increase in the capacity of retention/detention ponds may also be cost effective. Bioretention cells can be engineered to increase their holding capacity for extreme storm events with minor incremental costs. The size of the engineered soil media, which is a costly component of the management system, may remain the same size as required in current designs but a surface ponding area surrounding the central soil media is increased to serve as a holding pond.

Local public works superintendents are reporting an increase in road failures due to overwhelmed culverts, road washouts, eroding ditches, undercut road bases, and overtopped bridges. This information is not clearly documented, so it is not possible at this time to predict trends.

3.2.2. Hazard Profile

Location

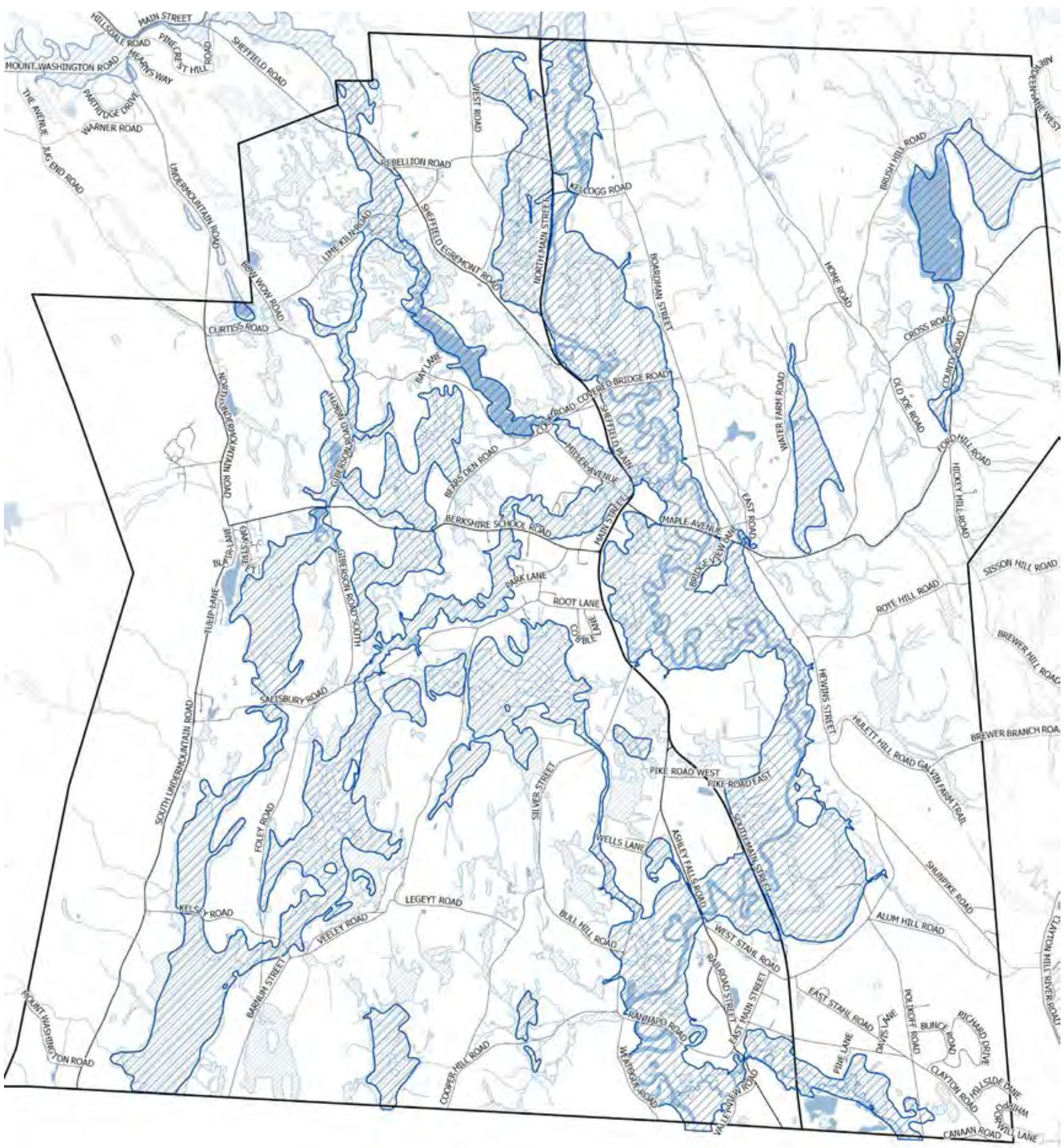
The Housatonic River flows through the center of Sheffield and is a central natural feature in Town. Its floodplains have been used for agricultural uses throughout the Town's post-colonial history. There are also several ponds in Town, the larger of which are Three Mile Pond and Mill Pond, and smaller of which are Berkshire Lake, Fawn Lake, Combes Pond, Spurr Lake, Harmon Marsh, and Davis Pond. There are several streams in Town that eventually lead to the Housatonic River, including Bear Rock Stream, Schenob Brook, Dry Brook, Willard Brook, Hubbard Brook, Soda Creek, and the Konkapot River.

[3] *https://statesummaries.ncics.org/ma*

As shown in Figure 3.2.5., the Town of Sheffield has extensive floodplain areas spread widely across the Town, with 7,016 acres of floodplain covering 22.6% of the Town's total land mass. These floodplain acres represent the greatest amount of floodplains in any community in Berkshire County, both in total acres and in percentage of land coverage. The floodplains of particular note are associated with the Housatonic River, which runs through the Town center and parallels Main Street (Route 7) until just north of West Stahl Street where it meanders west into Ashley Falls before it meanders back onto Route 7 at the southern-most end of the Town. The river meanders widely along its course throughout the Town, with numerous oxbows featured prominently along the corridor. This pattern of flow and abandoned river channels depict a history of river movement, channel creation and deposition of sediment and soils. It is this meandering pattern that has created the rich Sheffield soils that have supported agricultural uses in the past and continue to support them in the present day.

Other floodplain areas are associated with the tributaries that flow into the Housatonic River, including Schenob, Willard and Dry Brooks. Other notable floodplain areas are those associated with the Barnum Street and other swamps.

Fig. 3.2.5. 100-yr Floodplain Areas (Blue hatching)



Previous Occurrences

Between 1938 and 2017, four flood events equaling or exceeding the 1% annual chance flood have been documented the Berkshire County region, those being in 1938, 1949, 1955 and 2011. Not all these were documented to a 1% chance storm for the Town of Sheffield, with the most recent flood event, Tropical Storm Irene in 2011 being determined to be a 1% chance flood event in northern Berkshire County and a 2% chance storm (50-year recurrence) according to the USGS Housatonic River stream gage in Coltsville. According to the data and local residents, the more notable flood events that occurred in Sheffield were that of 1955, 1984, 2005 and 2011. Flooding and closing of Main Street/Route 7 occurred in 1955 and 1984, but locals cite more flooding that recorded in Table 3.2.2. Refer to Table 3.2.2. for a list of flood events impacting the Berkshire County region.

Table 3.2.2. Previous Flooding Occurrences

Year	Description
1936	Widespread flooding occurs along the northern Atlantic in March 1936. Widespread loss of life and infrastructure. Many flood gauges are discharges of highest of record at many USGS stream gages, including Coltsville in Pittsfield.[4]
1938	Large rain storm hit the area. This storm was considered a 1% annual chance flood event in several communities and a .2% annual chance flood event in Cheshire. The Hoosic River flooded downtown areas of densely-developed Adams and North Adams, with loss of life and extensive damage to buildings. Other communities were not as severely impacted.
Dec. 31, 1948 – Jan. 1, 1949	The New Year's Flood hit Berkshire County with many of areas registering the flood as a 1% annual chance flood event.
1955	Hurricanes Connie and Diane combined to flood many of the communities in the region and registering in 1% - 0.2% annual chance flood event (100-500-year flood event) (FEMA 1977-1991).
May 1984	A multi-day storm left up to 9" of rain throughout the region and 20" of rain in localized areas. This was reported as an 80-year flood for most of the area and higher where the rainfall was greater (USGS, 1989).
September 1999	The remnants from Hurricane Floyd brought between 2.5" - 5" of rain throughout the region and produced significant flooding. Due to the significant amount of rain and accompanying wind, there were numerous reports of trees down.
December 2000	A complex storm system brought 2 - 4" of rain with some areas receiving an inch an hour. The region had numerous reports of flooding.
March 2003	An area of low pressure brought 1" - 2" of rain, with unseasonable temperatures causing rapid melting of the snow pack.
August 2003	Isolated thunderstorms developed that were slow moving and prolific rainmakers,

[4] Grover, Nathan C., 1937. *The Floods of March 1936, Part 1. New England Rivers*. USGS, Wash. DC.

	bringing flooding to the area.
September 2004	The remnants of Hurricane Ivan brought 3” - 6” of rain. This, combined with saturated soils from previous storms, caused flooding throughout the region and damaged the spillway of the Plunkett Reservoir dam in Hinsdale.
October 2005	A stationary cold front brought over 6” of rain and caused widespread flooding throughout the region. In Great Barrington, this was a 4%-10% chance flood (10-25 year recurrence).
November 2005	Widespread rainfall across the region of 1-1.5”, preceded by 1-2 feet of snow, resulted in widespread minor flooding.
September 2007	Moderate to heavy rainfall occurred, which lead to localized flooding.
March 2008	Heavy rainfall ranging from 1” - 3” impacted the area, combined with frozen ground and snowmelt, caused flooding across the region.
August 2008	A storm brought very heavy rainfall resulting in flash flooding across parts of the region.
December 2008	A storm brought 1-4” of rain to the region, with some areas reporting 1/4 to 1/3” an hour of freezing rain., before changing to snow. Moderate flooding and ponding occurred throughout the region. In Sheffield, this was approximately a 10%-20% chance flood.
June 2009	Numerous slow-moving thunderstorms developed across the region, bringing very intense rainfalls and upwards of 6” of hail. This led to flash flooding in the region.
July 2009	Thunderstorms across the region caused heavy rainfall and flash flooding.
August 2009	An upper level disturbance moved across the region during the afternoon hours and triggered isolated thunderstorms resulted in roads flooding.
October 2009	A low-pressure system moved across region bringing widespread heavy rainfall to the area; 2-3” of rain was reported across the region.
March 2010	A storm brought heavy rainfall of 1.5-3” across the region, with roads closed due to flooding.
October 2010	The remnants from Tropical Storm Nicole brought 50-60 mph winds and 4-6” of rain resulting in urban flooding.
March 2011	Heavy rainfall, combined with runoff from snowmelt due to mild temperatures, resulted in flooding of rivers, streams, creeks, roads, and basements. In Sheffield Rannapo Road was closed for several days (see Fig.3.2.6)
July 2011	Scattered strong to severe thunderstorms spread across the region resulting in small stream and urban flooding.
August 2011	Two distinct rounds of thunderstorms produced heavy rainfall and localized flooding of roads.

August 2011	Tropical Storm Irene tracked over the region bringing widespread flooding and damaging winds. Riverine and flash flooding resulted from an average of 3-6 inches of rain and upwards of 9", within a 12-hour period. Widespread road closures occurred throughout the region. The storm is estimated to be a 1% chance storm on the Hoosic River in Williamstown, while in Great Barrington and Ashley Falls it was approximately a 4% chance flood (25-year recurrence).
September 2011	Remnants of Tropical Storm Lee dumped 4" - 9" of heavy rainfall on the region. Due to the saturated soils from Tropical Storm Irene, this rainfall lead to widespread minor to moderate flooding of rivers, as well as small streams and creeks. In Sheffield, this was approximately a 4% chance flood.
August 2012	Remnants from Hurricane Sandy brought repeated thunderstorms bringing heavy rains over areas of the region. Upwards of 4-5" of rain occurred and flash flooding caused the closure of numerous roads.
May 2013	Thunderstorms brought wind and heavy rainfall caused flash flooding and road closures in areas.
August 2013	Heavy rainfall repeatedly moved across the region causing more than 3" of rain in a few hours causing streams and creeks to overflow their banks and flash flooding. Roads were closed as a result of the flooding and water rushed into some basements.
September 2013	Showers and thunderstorms tracked over the same locations and resulted in persistent heavy rain, flash flooding and road closures.
June 2014	Slow moving showers and thunderstorms producing very heavy rain over a short period of time, resulting in flash flooding and road closures, especially in urban and poor drainage areas.
June 2014	Showers and thunderstorms repeatedly passed over the same locations, leading to heavy rainfall and significant runoff, causing flash flooding in some areas. Many roads in the region were closed due to the flooding and some homes were affected by water as well.
July 2014	A cluster of strong to severe thunderstorms broke out causing 3"6" of rainfall and flash flooding.
May 2016	Bands of slow-moving showers and thunderstorms broke out over the region. Due to the slow movement of these thunderstorms, heavy rainfall repeatedly fell over the area resulting in flash flooding and some roads were temporarily closed.
August 2017	Widespread rain moved through the area resulting in isolated flash flooding.
August 2017	Severe thunderstorms developed resulting in flash flooding.

Source: MEMA 2013 and BRPC 2018, unless otherwise noted.
*Storm events shown in **bold** are those that have been listed below as being above flood stage at the Great Barrington stream gage #01197500*

No USGS stream gage is located in the Town of Sheffield that has long-term data. The USGS stream gage #01197500 is located on the Housatonic River upstream in Great Barrington at Division Street, just south of Rising Pond. Flow data is being used from this gage to more accurately define local conditions during key regional flood events, but it should be noted that the data may not accurately reflect flood events for Sheffield for two main reasons: 1) gage #01197500 is several miles upstream and does not incorporate the full drainage basin and flow regime of the river and its tributaries between the gage and Sheffield, and 2) the relatively dense development of downtown Great Barrington lies between the gage and Sheffield. There is another USGS stream gage located in Ashely Falls near the Route 7 bridge (#01198125), but the data from that gage is severely limited to only 1994-96, and 2007 to the present.

According to the data from the Great Barrington gage, which provides data from 1913 to the present, and NOAA National Weather Service, there has been 12 flood events that exceeded flood stage, which at this site is nine feet and where water reaches the former Great Barrington fair grounds. The flood event of record, with the highest water level, was the New Year's flood of 1949. It may be worth noting that seven out of the 12 events have occurred since the 1970s and four of the 12 have occurred since 2000, indicating a trend that confirm the suspicions from many local public works superintendents that flood events seem to be occurring more often in recent years. The flood events above flood stage, listed according to peak water levels, were:

Table 3.2.3. Flood Stage Exceedances Over Flood Stage at USGS Gage #01197500 in Great Barrington [5]

Ranking (highest to lowest)	Height Above Flood Level (in feet)	Date of Occurrence
1	12.08	1-1-49
2	11.72	9-22-38
3	10.96	5-31-84
4	10.60	3-19-36
5	10.34	10-9-05
6	10.08	9-9-11
7	10.00	11-5-27
8	9.84	7-13-96
9	9.68	1-20-96
10	9.65	8-19-55
11	9.62	8-29-11
12	9.01	3-8-11

Source: NOAA, NWS, 2018.

The history of the Town's flooding suggests that there have been floods large enough to cause damage to property and leave a lasting impression on residents' memories. Severe flood events have occurred in Sheffield during the past several decades, with some flooding Main Street / Route 7 and resulting in the closure of the road. Long-time residents recounted the primary floods that effected Sheffield at the

[5] *https://water.weather.gov/ahps2/hydrograph.php?wfo=aly&gage=gtbm3&prob_type=stage&source=hydrograph*

Public Forum held on February 13, 2018. One resident reported that the flood of 1949 was the most severe, with more than two feet of water on Main Street/Route 7. Another resident remembered the storm of 1955, as it was the only flood event that he ever remembers closing the school (which was at that time located on Main Street and within the floodplain); data suggests that the storm was a 1% chance flood event. For many long term residents the multi-day storm in May 1984 that affected most of Southern Berkshire County had a particularly lasting effect, with many residents claiming that this was one of the worst storms in their memories of living in the Town. Many believed that it must have been a 100-year flood event as Route 7 was under at least 1-2 feet of water and closed to all traffic for days, and other transportation routes were also flooded. Data suggests this storm event was an 80-year event (see Table 3.2.2.). One resident stated that to his recollection the Main Street / Route 7 section of road was closed for more than a day three times between the years 1980-2000.

Several residents also reported that a short but severe downpour in 1995 caused extensive damages to the road system between Sheffield and New Marlborough to the east. Residents reported that seven inches of rain fell within ½ hour, washing out County Road in Sheffield and severely damaging roads in both towns along the Sheffield/New Marlborough ridge. While formal weather reports were not found to verify these events, it does indicate that severe flooding in Sheffield occurs more often than is reflected in state databases.

Tropical Storm Irene (Aug. 28-29, 2001) was a 1% storm in the Hoosic River Watershed in northern Berkshire County, and while the Housatonic River at the Great Barrington gage indicates that it was above flood stage, it is listed as 11 out of the top 12 flood events at that site. The river was indeed at flood stage, with a gage level of 9.62' and a discharge of almost 7,000 cubic feet per second (cfs), far above the median discharge of 100-200 cfs for the same timeframe. The Ashley Falls gage data is similar, with a discharge of 9,000 cfs, far above the median of 200-500 cfs. However, the water levels resulting from Tropical Storm Lee, which followed on the heels of Irene on September 6-8th , were actually higher, with a peak of more 10' and a discharge of 8,000 cfs at the Great Barrington gage and similar levels at the Ashley Falls gage. Interestingly, the October 2005 rain events created higher flood levels, peaking at 10.3' at the Great Barrington gage. (USGS, NWS, 2018)

On County Road, several areas between East Road and Cross Road were identified as flood-prone areas. As one travels north along County Road towards Ford Hill Road, the terrain is mountainous, and the road is narrow. Road washouts and lane closures are of particular concern because in worst case conditions, this road can delay up to six school bus routes.

In the southern section of the Town west of Main Street, flooding occurs often along Rannapo and Wheatogue Roads. The land in this section of Town is generally characterized by being flat and open. Most flooding in this area is mitigated by the surrounding farms and large residential lots, but the roads are often closed due to flooding. At other times of major freezing, the runoff can bypass the frozen ground and flood the streets. This can often cause lane closures, especially along Wheatogue Road just south of Rannapo Road.

Fig. 3.2.6. Rannapo Rd./Housatonic River Bridge 3/8/11 **Fig. 3.2.7. Rannapo Rd./Housatonic River Bridge 2/9/18**

The integrity of Rannapo Road is threatened by the continued movement of the channel of the Housatonic River. During high flows and flood events the base of the road is eroded and being undermined. The Town is currently working, with support from a FEMA grant, to relocate 900 feet of the road 25 feet to the north, away from the moving river channel. (Fig. 3.2.6 and Fig. 3.2.7.)

There are also ongoing concerns with flooding of the railroad tracks just north of Rannapo Road on the north side of the Ashley Falls Bridge where the railroad and Route 7A run parallel. Currently, an undersized culvert is the only infrastructure in place preventing large rain events from fully flooding the railroad. (Fig 3.2.8.)

Fig. 3.2.8. Route 7A bridge floods 3/08/2011

Other concerns involve the section of Berkshire School Road directly abutting the Regional School District main campus. If this road washes out, there could be issues evacuating students in extreme circumstances. If the road were impassable, the school would not be able to be used as the Town's primary emergency shelter, without accessing it via Route 41.

A final area of concern is flood prone areas near residential homes. Root Lane connects to Main Street in the Sheffield Town Center. This area is very prone to flooding and has a concentration of older residents.

Beavers have also created risks of flooding in Sheffield. Where this threatens roadways, the Town has been diligent in installing beaver deceivers to keep beavers from building dams or clogging culverts.

The areas discussed herein are shown on the Critical Facilities and Hazard Locations Map, found in Appendix 1 of this Plan

Probability of Future Occurrences

Using the past as a guide, Sheffield will continue to be impacted by floods. With six to eight flood events that approached or exceeded a 50-100-year interval in the region in the last 100 years, we can assume that a flood event will impact the region every 12-15 years, if not more frequently due possibly to climate change, and result in minor flooding at least once a year. In addition to this, the increasing trend for increased precipitation, combined with existing development in or near floodplain areas, indicates that flooding will persist in some areas. Efforts to flood proof or relocate high-risk properties within the floodplain, along with efforts to prohibit or limit new development, will decrease the potential for expanded damage and losses. The Town's effort to control new sources of stormwater runoff and upgrade stormwater drainage systems should also help to alleviate flooding in certain areas, particularly road stream crossings.

Secondary Hazards

Severe flooding can threaten the functionality or structural integrity of dams. In addition to the six dams in Sheffield, the Town is in the inundation area of dams located in Egremont and Great Barrington, most notably the dam at Rising Pond in Great Barrington. A more thorough discussion of the Town of Sheffield's risks due to dam failure is discussed in Section 3.5 of this Plan.

Flood waters can increase the risk of creating and dislodging of ice dams during the winter months. According to the Ice Jam Database, maintained by the Ice Engineering Group at the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL), there have been no ice jams in Sheffield. The Berkshire Regional Multi-Hazard Mitigation Plan lists an ice jam on Schenob Brook in March 1971, but municipal staff could not verify this information. The most recent ice event was in January 2018, when two inches of rain and an unusually warm weather of 50+ degrees Fahrenheit, following a period of prolonged and unusually cold weather, caused flooding from snow and ice melt across Berkshire County, including flooding

Fig. 3.2.9. Ice Jam on Housatonic River, Rt. 7 Stockbridge Jan. 2018

Source: Berkshire Eagle, 1-18-18.

in the Rannapo/Wheatogue area. This same weather pattern caused an ice jam in Kitchen Brook in the neighboring town of Cheshire, which subsequently flooded and deposited large chunks of ice on Route 8, a major north-south arterial road in the county. The same event caused the Town of Stockbridge to declare a local disaster due to concerns that a massive buildup of ice and rising flood water could damage the Route 7 bridge over the Housatonic River and/or the natural gas main pipeline that serves as the only gas supply to the neighboring town of Great Barrington (pop. ~7,000) (Zollshan, 2018).

Warning Time

The State Hazard Mitigation Plan states that, due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Notice of potential flood conditions for developing storm systems is generally available five days in advance, with warning times for floods between 24 and 48 hours ahead of time. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. NOAA's Northeast River Forecast Center provides flood warning for Massachusetts, relying on monitoring data from the USGS stream gage network, of which the closest gages are on the Housatonic River in Great Barrington and at the Route 7 bridge in Ashley Falls. State agency staff monitor river, weather, and forecast conditions throughout the year. Notification of potential flooding is shared among state agency staff and the National Weather Service provides briefings to state and local emergency managers, as well as notifications to the public via the media and social networking. MEMA also distributes information regarding potential flooding to local Emergency Managers, the press, and the public. (MEMA, 2013)

The total number of injuries and casualties resulting from typical riverine flooding is generally limited based on advanced weather forecasting, blockades, and warnings. Injuries and deaths generally are not anticipated if proper warnings and precautions are in place. The exception is where the warning time is limited due to fast-developing events, such as flash flooding from unpredicted severe thunderstorms or dam failures, or where earthquakes or landslides cause instantaneous earth movement. Populations without adequate warning of such events are highly vulnerable to these hazards. The historical record from 1993 to 2011 indicates there have only been two fatalities associated with a flood event in the state (occurring in May 2006) and five injuries associated with two flood events (occurring within two weeks of each other in March 2010). (MEMA, 2013).

Exposure

Due to historic development patterns that occurred before the Town's zoning and floodplain management regulations, there are numerous homes and businesses located within the floodplain in Sheffield. In addition, there are more properties located along the FIRM delineated boundaries. An analysis of the FIRM flood hazard area maps of Sheffield identifies a total of 7,016 acres within the Town's 100-year floodplain, amounting to 22.6% of the Town's acreage. Most floodplain areas are associated with the Housatonic River and its tributaries as they flow into the river (refer to Figs. 3.2.5 and 3.2.10 for floodplain areas). Based on additional analysis, 91.4 acres of floodplain (1.3%) have been developed. This leaves 6,924.8 acres that are potentially developable, albeit with restrictions and conditions under the Town's floodplain bylaws (Berkshire Regional Planning Commission, 2017). The Town does have a floodplain bylaw, which restricts and conditions any development that would occur within Zone A as shown on the FIRM.

A good portion of Route 7, including large sections of North Main and South Main Streets, travels through or along the boundary of the 100-year floodplain. Route 7 serves as the main travel corridor for commercial and commuter traffic in the region, as well as serving as a main tourist route. In the event of a region-wide disaster, it is also the main evacuation route to reach Simon's Rock College in Great Barrington, which has been designated as the main regional shelter for the southern Berkshire Region, and the main route to reach Mount Everett High School, the alternate regional shelter for the region. This road has been closed several times, sometimes for days, in prior decades.

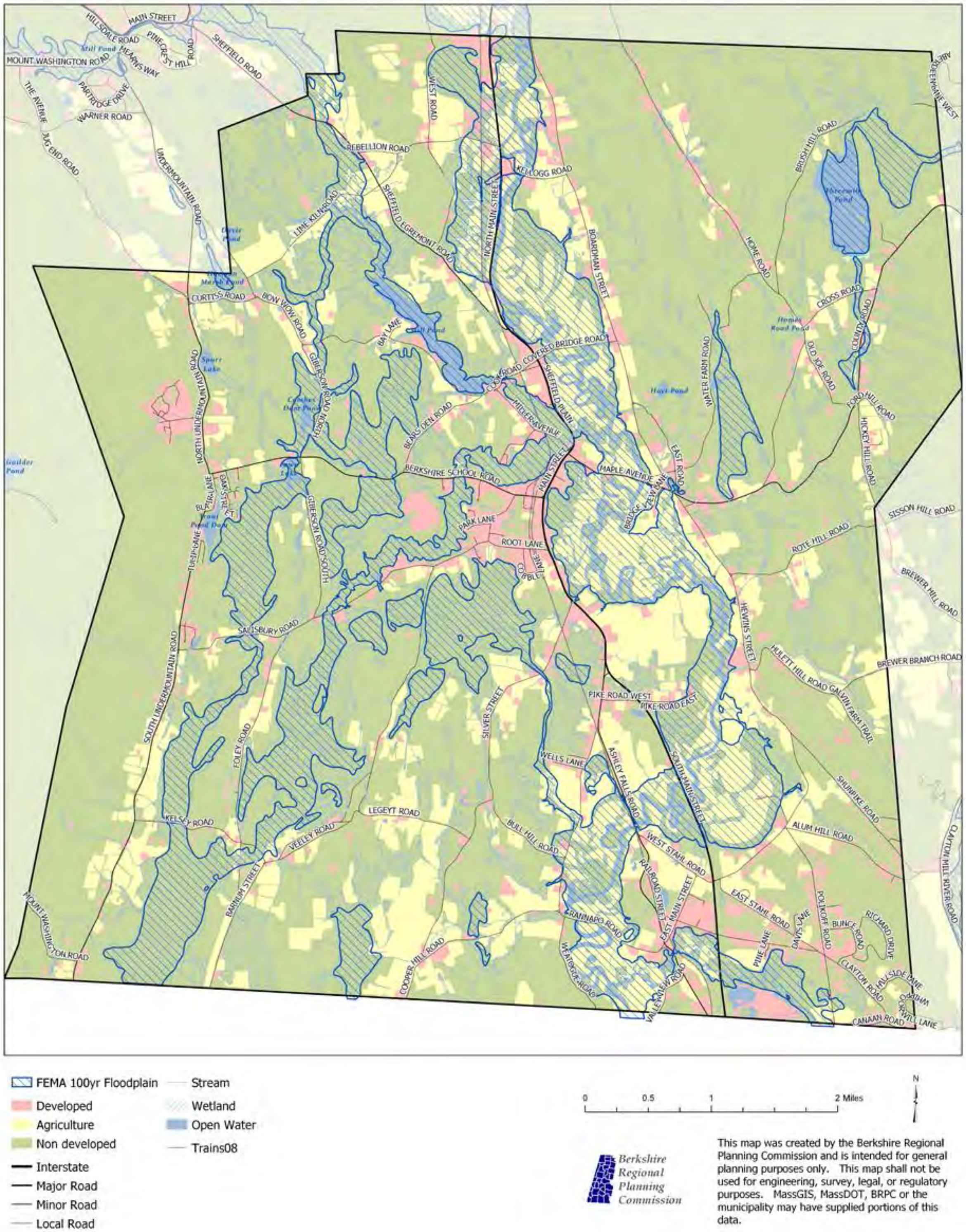
With the aid of GIS technology, 65 residential buildings (4.4% of residential stock), 26 commercial buildings (28.6% of commercial stock), and three industrial buildings (10.3% of industrial stock) have been identified within the 100-year floodplain, as shown in Table 3.2.3. This figure is substantially higher than the number of buildings identified in floodplain in the previous Hazard Mitigation Plan of 2012, because advances in GIS technology now offer much better identification of buildings within floodplain boundaries. Looking at the map in Figure 3.2.10. it is clear that a significant portion of existing development has occurred just outside floodplain boundaries and are presumably safe from flooding during events of a severity less than the 1% chance storm. However, as precipitation patterns and flow regimes change in a warming climate, the boundaries of the 100-year floodplain could shift. It will be important for local residents to discourage development away from areas known to be seasonally or temporily inundated, regardless of whether these areas are within the current floodplain boundaries.

Table 3.2.4. Number of Buildings in Floodplain - Sheffield

Buildings in the 100-year Floodplain							
Residential		**Commercial**		**Industrial**		**Total**	
No. Bldgs.	Percent Res. Bldgs.	No. Bldgs.	Percent Com. Bldgs.	No. Bldgs.	Percent Ind. Bldgs.	No. Bldgs.	Percent Total Bldgs.
65	4.4%	26	28.6%	3	10.3%	94	5.9%

Source: (Berkshire Regional Planning Commission, 2017)

Fig. 3.2.10. Floodplain Development in Sheffield



This map was created by the Berkshire Regional Planning Commission and is intended for general planning purposes only. This map shall not be used for engineering, survey, legal, or regulatory purposes. MassGIS, MassDOT, BRPC or the municipality may have supplied portions of this data.

3.2.3. Vulnerability

People, property and infrastructure located in or near floodplains, near waterways where floodwaters are known to overflow their banks, or those located in areas of high groundwater tables are vulnerable to the impacts of flooding. As seen in the previous section, almost 100 buildings are built in the floodplain, yet this is only 6% of the total number of buildings in the town. Infrastructure and critical facilities built in, over or under floodways are vulnerable to damage due to the power of high volumes of water and from the debris those flows can carry or dislodge. In Sheffield there are 9.08 miles of roadway that travel through the 100-year floodplain, which is approximately 7% of the Town's total number of road miles. Not all of these road sections flood equally – some function fine while others flood chronically in much less severe flood events than the 1% chance event. The areas of Sheffield where roads and other infrastructure are threatened and prone to flooding are shown on the Critical Facilities & Hazard Locations Map (Appendix 1) Listed below is a summary of the areas where roads and safe travel are threatened.

- Main Street / Route 7, the main transportation artery, floods during severe events, and has been closed at least three times in recent decades. Closure of this road during an emergency event hampers and delays response and could hamper sheltering efforts.
- Sections of Lime Kiln Road have washed out in the past. A relief culvert was added which resulted in an improvement, but further relief culverts are needed.
- Rannapo Road has a history of flooding and being closed. The Housatonic River channel movement and erosion of the road subsurface of Rannapo Road has forced the Town to close one lane of the road. The river bank needs to be stabilized and the Town is planning on relocating the road farther away from the river.
- In early March 2011, there was a flooding issue at Rannapo and Weatogue Roads, just east of Rannapo and Cooper Hill Roads. There was six feet of water over the road, destroying it. A relief culvert and reengineering of the inlet stream into the river is needed. This area had experienced minimal flooding previously.
- County Road has a history of flooding and incurring damages; the Town has conducted several improvement projects, some with grant funding. Ford Hill Road is a particularly vulnerable area due to its terrain.

Population

Based on the number of homes located within the floodplain (65) and the average number of people per household (2.2), it is expected that approximately 143 residents may be directly impacted in the event of a 1% chance storm. (Berkshire Regional Planning Commission, 2017) Although Town officials and residents were not aware of any residential properties that had sustained damage from floodwaters, it was reported at the Public Forum (held February 13, 2018), that the basement of a residence on North Main Street has suffered damages from high flood water of the Housatonic River.

Of the population exposed, the most vulnerable populations typically include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also more vulnerable because they are more likely to need medical or other special attention, which may not be available due to isolation during a flood event. They may also have more difficulty evacuating due to mobility issues. People with pets are also less likely to evacuate if they are not allowed to bring their pets with them (MEMA, 2013).

Severe Repetitive Loss Data

The town has had nine flood insurance claims since 1978 for a total of $156,262 (MEMA, 2017). Of the 94 properties in the flood plain, there are only 31 active flood insurance policies in Sheffield covering $3,554,600 (MEMA, 2017). A severe repetitive loss is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program, since 1978, within any rolling ten-year period (FEMA, 2018). Despite the wide expanse of 100-year floodplain across Sheffield, MEMA's database shows no repetitive losses in the Town.

Critical Facilities

The Town of Sheffield does not currently have any critical communications, command center facilities or other critical facilities within the floodplain. However, two public drinking water wells owned by New England Service Company, could be threatened during a 1% chance storm. The well south of Maple Avenue is located within the 100-year floodplain and the one on Pike Road appears to be just outside the floodplain. Company staff were unable to verify if indeed the Pike Road well is located within the floodplain. The Zone 1 recharge area of the well on Pike Road is downgradient of the Town's public works facility. The Company supplies water to over 500 Sheffield residents.

The Town currently has special permit requirements for businesses wanting to locate in the Zone 1 public water supply overlay zone for the storage of specific chemicals and fertilizers and prohibits the use and storage of hazardous waste, landfills, and discharge to the ground that could contaminate ground water. However, there are some non-conforming uses currently in that zone, including a propane retailer.

According to MassDOT data, Sheffield has 30 bridges that cross water bodies (this does not include culverts or smaller crossings). There are nine bridges assessed at a slightly greater risk of damage from flooding due to having high scour scores in the MassDOT bridge database. These bridges cross the Housatonic River at Rannapo Road and Ashley Falls Road; Hubbard Brook at North Main Street and South Egremont Road, Ironworks Brook three times on County Road; and Schenob Brook on Kelsey Road and Foley Road. (MassDOT, 2018). All of these bridge foundations have been assigned a rating of 4, which is defined as those that are "determined to be stable for calculated scour conditions, but field review indicated that action is requried to protect exposted foundations from effects of additional erosion and corrosion."

Economy

According to the *Massachusetts State Hazard Mitigation Plan,* economic losses due to a flood include, but are not limited to damage to buildings and infrastructure, agricultural losses, business interruption, and impacts on tourism, and the tax base. Other economic components such as loss of facility use, functional downtime, and social economic factors are less measurable with a high degree of certainty. (MEMA, 2013)

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and roadblocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roads and bridges, and the removal and disposal of debris can also be an enormous cost during the recovery phase of a flood event (MEMA, 2013).

Damage to buildings can affect a community's economy and tax base. As part of this Hazard Mitigation Plan update, the total loss of buildings and their content within the floodplain was calculated to demonstrate the worst-case scenario of potential losses if a 1% chance flood event were to occur. This calculation took into consideration the value of all buildings within the floodplain, as determined by Assessor records, and multiplied an additional percentage to represent the contents of the properties. This represents complete destruction of all buildings and contents within the floodplain. It should be noted that historical records indicate that total loss of buildings and contents has never occurred in Sheffield, and is very rare in the region. It is more likely that flooding would result in partial damages or loss of a building and its contents, as demonstrated through past flood insurance claims in Sheffield and the region. To determine a more likely scenario of damages from a 1% chance flood event, the HAZUS-MH modeling program was utilized (see following section). This model took into account and calculated not only the number of buildings within the floodplain, but also potential losses to agriculture, business interruptions and other economic impacts.

Table 3.2.5. Property Valuation within the 100-year Floodplain ($000)

Residential Property	Residential Contents (50% Property Value)	Commercial Property	Commercial Contents (100% Property Value)	Industrial Property	Industrial Contents (125% Property Value)	Total Loss Estimate
$25,761	$12,880	$15,096	$15,096	$2,248	$2,810	$73,892

Source: (Berkshire Regional Planning Commission, 2017)

Aside from damage to buildings, flooding could affect some portion of the businesses and public institutions in Sheffield that serve as major employers. As noted in Table 3.2.3., 28.6% of all commercial and 10.3% of industrial buildings in Sheffield are within the 100-year floodplain. Businesses located in Sheffield currently employ approximately 1,520 people, and based on the percentage of commercial and industrial businesses in the floodplain, up to 368 employees could be impacted in the event of a 1% chance of occurrence flood event (Berkshire Regional Planning Commission, 2017). Although not all employees are Sheffield residents, the economic repercussions of a prolonged factory or other business shutdown would reverberate throughout the southern Berkshire County region.

As shown on Figure 3.2.10., a substantial amount of farmland is located within the 100-year floodplain. Of the 5,644 acres of land in agricultural use in Sheffield, 1,724 acres or 30%, are within the floodplain. A 1% chance flood event could result in a complete temporary loss of these agricultural lands and crops , including several dairy farm operations, for those who rely on such lands for their operations.

As part of this Hazard Mitigation Plan Update, the Town of Sheffield mailed a Natural Hazard Mitigation Survey to every business owner in the Town. The purpose of the survey was to gather information on the extent that businesses have been affected by extreme weather events and to get a better understanding of the capacity of businesses to respond to a disaster. The Town received 22 responses, and of those none reported having experienced any damages from flooding. One merchant located on South Main Street reported that during winter rain/ice events the parking lot floods, which inhibits business, but the building housing the business has apparently not been damaged.

HAZUS

To further assess the Town's vulnerability to flood hazard, the HAZUS-MH model was run using a 1% chance flood event. HAZUS-MH is an extension to ArcGIS that allows for the modeling of storm events and calculates the impacts of the modeled storm. HAZUS-MH delineates a floodplain differently than the current FEMA Floodplain maps by modeling where flooding may occur, rather than mapping that was conducted in the 1970's and 1980's. Because of this, it may present more accurate information.

HAZUS-MH estimates that 44 buildings are within the 1% chance flood event. Of these, about 37 buildings will be at least moderately damaged, which is over 91% of the total number of buildings in the scenario. It further estimated that no buildings will be completely destroyed. Residential buildings make up the vast majority of buildings exposed to the flood event, comprising of 72% of the total, with an additional 14% being commercial buildings.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. Based on the HAZUS-MH analysis and as shown in Table 3.2.6., the Town could potentially experience a loss of $34,690,000 during a 1% chance flood event. (HAZUS-MH, 2017) According to HAZUS, based on a 1% chance flood event, up to 125 households will be displaced and approximately 150 individuals may seek shelter during the flood event (HAZUS-MH, 2017). HAZUS-MH reports are found in Appendix 1.

Table 3.2.6. Damage Estimate from HAZUS ($000) *

		Residential Property	Commercial Property	Industrial Property	Others	Total Loss Estimate
Building Loss	Building	$8,840	$2,640	$1,310	1320	$34,600
	Content	$4,490	$7,700	$3,090	$4,440	$19,710
	Inventory	0	$190	$360	$220	$760
	Subtotal	**$13,330**	**$10,520**	**$4,760**	**$5,980**	**$34,580**
Business Interruption	Income	0	$20	$0	$0	$20
	Relocation	$10	$0	$0	$0	$10
	Rental Income	$0	$0	$0	$0	$0
	Wage	$0	$20	$0	$50	$80
	Subtotal	$10	$40	$0	$50	$110
All	***Total***	***$13,330***	***$10,570***	***$4,760***	***$6,030***	***$34,690***

* *Numbers may not add up exactly due to rounding*
Source: Hazus-MH: Flood Global Risk Report, Run 11-2-17 by the Berkshire Regional Planning Commission

As noted, no buildings are expected to be totally destroyed in a 1% annual flooding storm, per this model. However, several buildings are expected to be damaged, with up to 40% of the building needing repair. As calculated by the model, most homes would suffer moderate damages, with 19 homes suffering damages to 11-20% of the building, and another 14 would suffer damages to 31-40% of the building. See Table 6 for an estimated number of buildings suffering minor to severe damages by a 1% chance flood event. As noted previously, because there are only 31 active flood insurance policies listed in the Town of Sheffield, those without flood insurance may suffer significant financial impacts.

Table 3.2.7. Number of Homes Damaged During a 1% Chance Flood Event by Severity of Damage

Percentage of Building in Need of Repair	1-10%	11-20%	21-30%	31-40%	41-50%	>50%
Number of Homes (% of total)	7 (16%)	19 (43%)	14 (32%)	4 (9%)	0	0

Source: Hazus-MH: Flood Global Risk Report, Run 11-2-17 by the Berkshire Regional Planning Commission

While the model offers estimates of the type of damages that could occur to buildings, the HAZUS modeling system does not estimate potential agricultural losses due to the 1% chance flood. While agricultural buildings are included in the assessment, damages to losses from loss of crops, livestock or equipment, or damage to valuable farm land from debris deposition or erosion, or loss of land due to erosion of riverbanks are not assessed. This is an important factor to measure because in Sheffield, 18.2% of total land use is for agriculture production, and almost 1/3 of that land is within the floodplain of the Housatonic River (refer to Fig. 3.2.10 Floodplain Development).

Sheffield continues to be a strong farming community due in part to the Town being one of the few places within Berkshire County that has the terrain and soil quality to support productive agriculture. During the public participation process, several of the town's farmers attended the public open house held on February 13, 2018 at the Sheffield Senior Center. Each voiced concern of crop and land loss from the erosion of riverbanks and the changing path of the Housatonic River; all saw these as ongoing and increasing problems. Erosion of river banks is exacerbated by large storm events featuring high velocity water and larger debris deposits, which erode away the banks and sometimes large swaths of valuable farmland.

Tropical Storm Irene – Profile of a Flood Event in our Region

Tropical Storm Irene started out as an Atlantic hurricane that traveled up the eastern seaboard through North Carolina, the Mid-Atlantic states and inland New England August 26-28, 2011, impacting the Berkshires August 27-28. The hardest hit areas were in Vermont, in the Hoosic River Watershed in Berkshire County and in the Deerfield River watershed in Franklin County. Vermont considers the storm the worst natural disaster since the floods of 1927. The total damage to infrastructure in the state was estimated at between $250 and $300 million dollars, all in a state of just over 600,000 residents[6]

In Shelburne Falls, MA the Deerfield River was flowing at 38,000 cubic feet per second (cfs), well above the typical August flow of 800-1,000 cfs. The area received more than 8.5”-10” of rain over the course of two days. The Green River destroyed the Greenfield, MA dam and water pumping station. Many streams and rivers were several feet above flood stage, flooding properties, washing out roads and forcing evacuations across the region.

Fig. 8 Cold River Bridge Florida/Savoy

Route 2 in Florida and Charlemont was severely damaged due to a combination of the washout of the road by the river and heavy deposition of mud, trees and debris from a landslide caused by steep slopes and oversaturated soils. Statewide almost 600,000 people were without power.[7] The State of Massachusetts declared disasters for Berkshire and Franklin Counties.

Fig. 9. Flooding of The Spruces, Williamstown

The most devastating damages that occurred in Berkshire County were in Williamstown, where the storm was determined to be a 1% chance of occurrence storm. Water level in the Hoosic River in Williamstown rose from ~6’ in depth to almost 14’ in about seven hours. The Spruces Mobile Home Park was fully evacuated, and 75% of the homes were declared uninhabitable by the town building and health inspectors. Damage was so complete and widespread that the entire park was demolished and subsequently closed forever. More than 220 homes were lost.

While Sheffield was not affected as intensely as northern Berkshire County, particular challenges arose in Sheffield around roads flooding and washing out. Rannapo Road, west of the Housatonic Bridge, a main route to access the Ashley Falls historic neighborhood in southern Sheffield, was flooded for several days and restricted travel. Flood waters restricted travel along other main routes as well, including Route 7A to the north of Rannapo Road.

[6] *(http://www.georgetownclimate.org/resources/vermont-culvert-rebuilding-after-tropical-storm-irene).*

[7] *http://www.masslive.com/news/index.ssf/2011/08/tropical_storm_irene_deluges_a.html*

3.2.4. Existing Protections Against Increased Risk of Flooding

The Town of Sheffield already has numerous existing protections in place to help protect it from increasing risks of future flooding, along with protections to alert vulnerable and all populations. Due to the prevalence of flooding as a risk of high concern, the Town has developed this detailed table of existing protections. Other natural hazards existing protections measures are described in less detail.

Type of Existing Protection	Description	Area Covered	Effectiveness	Improvements Needed
Town participates in the National Flood Insurance Program (NFIP)	Provides flood insurance for structures located within the floodplain	FEMA flood zones	Effective	More property owners to be aware of the program
Floodplain zoning district ordinance in place	Floodplain ordinance requires all development, including structural and nonstructural activities, be in compliance with state building code for construction in floodplain	Covers FIRM floodplain	Generally effective for new construction, but many older structures predate 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	Add, replace / maintain drainage system where flooding occurs.
Relief Culverts	The Town installed relief culverts at Lime Kiln Road in 2009	Lime Kiln Road	Mostly Effective	The town needs to install more relief culverts in this area and other areas.
Moderate to Steep Slope Development	Scenic Mountain Act and other slopes		Limited – the area covered by the Act is very small; other slopes have housing in place	Assess impact on Town roads of new driveways on moderate to steep slopes and in place driveways
Site Plan Review	Building Commissioner and Planning Board	Entire Town	Somewhat Effective	Awareness of flooding impacts, causes & avoidance

Type of Existing Protection	Description	Area Covered	Effectiveness	Improvements Needed
Emergency Notification System	The Town has reverse 911 and an emergency notification through the Town Blackboard Site	Entire Town	Mostly Effective	More planned tests needed to ensure systems are working. Addition of new participants; updating of information
Pursue Grant Funding	Applied for three infrastructure grants from MassWorks and FEMA in the last five years	County and Rannapo Roads	Mostly Effective	Continued pursuit of outside funding
Beaver Deceivers or other flow control devices	Mitigates flood risk due to beaver damming	Throughout Town where needed	Mostly Effective	Continued monitoring and installing beaver deceivers where needed.
Mutual Aid Agreements	MOU in place with the SBREPC, Police in Berkshire Co.; Volunteer Fire Depts. in MA & CT	Entire Town	Mostly effective	Update and reaffirm MOU
Local and Regional Shelters	The Town has identified local and regional shelters and cooling centers	Entire Town and southern Berkshire region	Somewhat Effective	Protocols for local shelters and cooling stations need to be clearly outlined and expressed to the community.

3.2.5. Actions – Flooding

ACTION	BENEFITS
Install relief culverts on Lime Kiln Road to reduce risk of flooding	Reduce the risk of flooding and reduce the cost of maintaining the road
Install rip rap on Rannapo Road to stabilize bank being eroded by the Housatonic River; relocate the road away from the river	Reduce threat of flood damage to the road and frequency of road closures
Continue working with MassDOT to reduce flooding along Route 7	Reduce the risk of flooding and road closures; reduce the cost of maintenance
Conduct a study of the flooding on Rannapo and Weatogue Roads and implement findings; work with the Trustees of Reservations	Reduce the risk of flooding and road closures; reduce the cost of maintenance
Review existing bylaws and update to ensure inclusion of stormwater control and best management practices.	Reduce the amount of new stormwater flowing off site onto roads and streams, reducing the risk of higher peak flood levels
Identify historic structures, businesses and critical facilities located in hazard-prone areas, including floodplains and dam failure inundation areas.	Enable those facilities to be better prepared for the hazards and to prevent their loss
Replace undersized and deteriorating culverts and bridges along County Road	Reduce risk of flooding and cost of maintenance
Inventory road conditions and develop a pavement condition index	Increased knowledge of infrastructure assets; better deployment of Ch. 90 funding; increased opportunity for multi-year road improvements /management; data base for grant requests
Inventory Town bridges and culverts and develop a bridge / culvert preventative maintenance plan	Increased knowledge of infrastructure assets; better deployment of Ch. 90 funding; increased opportunity for multi-year improvement /management plan; data base for grant requests
Develop emergency preparedness information for public distribution and education	Increase knowledge & self-sufficiency of residents prior to, during and post-flooding event

3.3. Tropical Storm and Hurricane Hazards

3.3.1. General Background

A tropical storm system is characterized by a low-pressure center and numerous thunderstorms that produce strong winds and heavy rain. The term "tropical" refers both to the geographical origin of these systems, which usually form in tropical regions of the globe, and to their formation in maritime tropical air masses. Hurricanes begin as tropical storms over the warm moist waters of the Atlantic. As the moisture evaporates, it rises until enormous amounts of heated, moist air are twisted high in the atmosphere. The winds begin to circle counterclockwise north of the equator or clockwise south of the equator. Tropical depressions, tropical storms, and hurricanes form over the warm, moist waters of the Atlantic, Caribbean, and Gulf of Mexico.

- A tropical depression is declared when there is a low-pressure center in the tropics with sustained winds of 25 to 33 mph.
- A tropical storm is a named event, defined as having sustained winds from 34 to 73 mph.
- If sustained winds reach 74 mph or greater, it becomes a hurricane. The Saffir-Simpson scale ranks hurricanes based on sustained wind speeds—from Category 1 (74 to 95 mph) to Category 5 (156 mph or more). Category 3, 4, and 5 hurricanes are considered "Major" hurricanes. Hurricanes are categorized based on sustained winds; wind gusts associated with hurricanes may exceed the sustained winds and cause more severe localized damage. (MEMA, 2013)

Tropical storms and tropical depressions, while generally less dangerous than hurricanes, can be deadly. The winds of tropical depressions/storms are usually not the greatest threat; rather, the rains, flooding, and severe weather associated with the tropical storms are what customarily cause more significant problems. Serious power outages can also be associated with these types of events. After the passing of Hurricane / Tropical Storm Irene through the region as a tropical storm in late August 2011, many areas of the state, including parts of Sheffield, were without power for in excess of five days. (MEMA, 2013)

The official hurricane season runs from June 1st to November 30th. However, August, September, and the first half of October are when the storms most frequently occur in New England. This is due, in large part, to the fact that it takes a considerable amount of time for the waters south of Long Island to warm to the temperature necessary to sustain the storms this far north. Also, as the Region progresses into the fall months, the upper level jet stream has more dips, meaning that the steering winds might flow from the Great Lakes southward to the Gulf States and then back northward up the eastern seaboard. This pattern would be conducive for capturing a tropical system over the Bahamas and accelerating it northward. (MEMA, 2013)

The Saffir/Simpson scale categorizes or rates hurricanes from 1 (Minimal) to 5 (Catastrophic) based on their intensity. This scale is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf and the shape of the coastline, in the landfall region. All winds are using the U.S. 1-minute average, meaning the highest wind that is sustained for one minute. The Saffir-Simpson Scale described in Table 3.3.1 gives an overview of the wind speeds and range of damage caused by different hurricane categories. (MEMA, 2013)

Table 3.3.1. Saffir-Simpson Scale

Scale No. (Category)	Winds (mph)	Potential Damage
Tropical Depression	< 38	NA
Tropical Storm	39-73	NA
1	74-95	Minimal: Damage is primarily to shrubbery and trees, mobile homes, and some signs. No real damage is done to structures.
2	96-110	Moderate: Some trees topple, some roof coverings are damaged, and major damage is done to mobile homes.
3	111-130	Extensive: Large trees topple, some structural damage is done to roofs, mobile homes are destroyed, and structural damage is done to small homes and utility buildings.
4	131-155	Extreme: Extensive damage is done to roofs, windows, and doors: roof systems on small buildings completely fail; and some curtain walls fail.
5	>155	Catastrophic: Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, and entire buildings could fail.

3.3.2. Hazard Profile

Location

The entire Town of Sheffield is vulnerable to hurricanes and tropical storms. The heavy rains often associated with tropical storms and hurricanes can result in flooding conditions, combined with high winds to create risks to people and property. Floodplain areas are especially at risk for flooding, as are steeply sloped stream channels that can become flooded causing severe stream channel erosion.

The National Oceanic and Atmospheric Administration (NOAA) Historical Hurricane Tracks tool is a public interactive mapping application that displays Atlantic Basin and East-Central Pacific Basin tropical cyclone data. This interactive tool tracks tropical cyclones from 1842 to 2017. Between 1842 and 2017, the region has experienced more than 240 tropical cyclone events. These events occurred within 100 miles of Berkshire County.

Previous Occurrences

NOAA has been keeping records of hurricanes since 1842 (Table 3.3.2). From 1842 to 2017, five Tropical Depressions, five Tropical Storms, one Category 1 Hurricane and one Category 2 Hurricane pass directly through the County. The following table lists these storms, and Fig. 3.3.1 shows the paths of these storms. Although none of these storms traveled directly through Sheffield, flooding and wind impacts were experienced to some degree.

Table 3.3.2. Tropical Cyclonic Storms that Tracked Directly through Berkshire County

Name	Category	Date
Not Named	Tropical Depression	8/17/1867
Unnamed	Tropical Storm	9/19/1876
Unnamed	Tropical Depression	10/24/1878
Unnamed	Category 1 Hurricane	8/24/1893
Unnamed	Tropical Storm	8/29/1893
Unnamed	Tropical Depression	11/1/1899
Unnamed	Tropical Depression	9/30/1924
Unnamed	Category 2 Hurricane	9/21/1938
Able	Tropical Storm	9/1/1952
Gracie	Tropical Depression	10/1/1959
Doria	Tropical Storm	8/28/1971
Irene	Tropical Storm	8/28/2011

Source: NOAA, 1842-2017

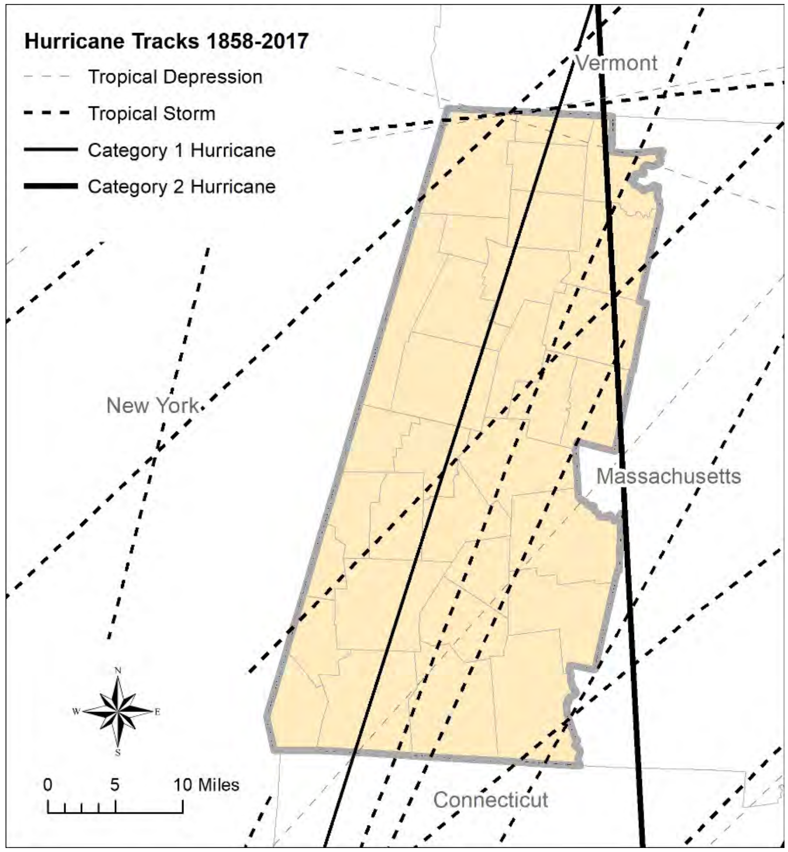
The effects of hurricanes and tropical storms however are often felt much farther away from the direct path. During this same period, an additional thirty-eight Tropical Depressions, eighty-six Tropical Storms, fourteen Category 1 Hurricanes and five Category 2 Hurricanes have passed within 100 miles of the region.

According to NOAA, tropical storm season lasts from June 1 to November 30, and an average of 10 tropical storms develop along the eastern seaboard each year. On average, five of these 10 become hurricanes. In Berkshire County, Hurricanes and Tropical Storms are generally limited to the months of August, September, and October, with a few storms arriving in May, June, July or November.

The historic storm of most note in Berkshire County is the New England Hurricane of 1938 (or Great New England Hurricane or Long Island Express or simply The Great Hurricane of 1938). The storm formed near the coast of Africa, becoming a Category 5 hurricane before making landfall as a Category 3 hurricane on Long Island on September 21. To date this storm remains the most powerful, costliest, and deadliest hurricane in New England history. The majority of the storm damage was from storm surge and wind. Damage is estimated at $6 billion (2004 USD), making it among the most costly hurricanes to strike the U.S. mainland. It is estimated that if an identical hurricane struck today it would cause $39.2 billion (2005 USD) in damage. The eye of the storm followed the Connecticut River north into Massachusetts, where the winds and flooding killed 99 people. In Springfield, the river rose to 6 to 10 feet above flood stage, causing significant damage. Up to six inches of rain fell across western Massachusetts, which when combined with over four inches that had fallen a few days earlier produced widespread flooding.

Locally the Great Hurricane of 1938 remains one of the most memorable historic storms, with almost seven inches of rain falling over a three-day period. The flooding from the Hoosic River caused severe damages in the northern Berkshire communities of Adams and North Adams. According to an *iBerkshires* article highlighting the damages, two deaths occurred, many other people were injured, and 300 people were left homeless. The West Shaft Road bridge in North Adams was lost, as was the Wally Bridge in Williamstown.[1] The damages from this storm, following devastating flooding and damages from events in 1901, 1922, 1927 and 1936, and combined with that from a severe rain event in 1948, led to the construction of the flood control chutes on the Hoosic River in Adams and North Adams.

Fig. 3.3.1. Tropical Depressions, Storms and Hurricanes Across Berkshire County



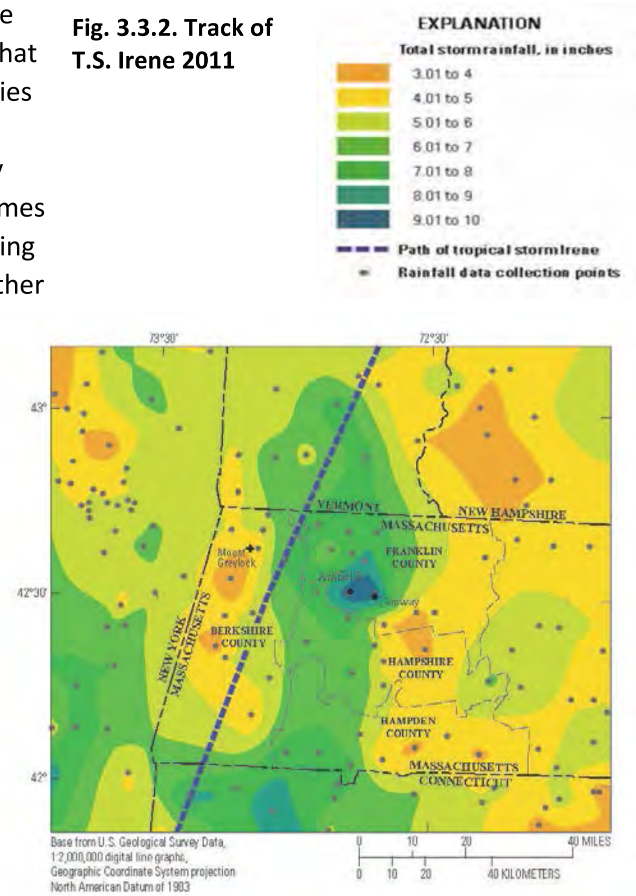
Hurricane Gloria caused extensive damage along the east coast of the U.S. and heavy rains and flooding in western Massachusetts in 1985. This event resulted in a federal disaster declaration (FEMA DR-751). In October 2005 the remnants of Tropical Storm Tammy followed by a subtropical depression produced significant rain and flooding across western Massachusetts. It was reported that between nine and 11 inches of rain fell. The heavy rainfall washed out many roads in Hampshire and Franklin Counties. The Green River flooded a mobile home park in Greenfield, with at least 70 people left homeless. Following these events, the mobile home park was demolished, and the site was turned into a town park. Several people had to be evacuated from their homes. Localized flooding in Berkshire County was widespread, with several road washouts. This series of storms resulted in a federal disaster declaration (FEMA DR-1614) and Massachusetts received over $13 million in individual and public assistance. (MEMA, 2013)

Tropical Storm Irene (August 27-29, 2011) produced significant amounts of rain, storm surge, inland and coastal flooding, and wind damage across southern New England and much of the east coast of the U.S. In Massachusetts, rainfall totals ranged between 0.03 inches (Nantucket Memorial Airport) to 9.92 inches (Conway, MA). Wind speeds in Massachusetts ranged between 46 and 67 mph. These heavy rains caused flooding throughout the Commonwealth and a presidential disaster was declared (FEMA DR-4028). The Commonwealth received over $31 million in individual and public assistance from FEMA. (MEMA, 2013)

[1] *Ennis, Tom, 2-11-04. "Before the Chutes, Hoosic Floods Raged," iBerkshires.com.*

Locally Tropical Storm Irene is the most memorable storm event in recent history due to the flooding that occurred in northern Berkshire and Franklin Counties in Massachusetts, and in southern Vermont. In Williamstown 225 mobile home households, many elderly and low income, permanently lost their homes in the Spruces Mobile Home Park. Extensive flooding in the Deerfield River watershed caused, among other damages, the closing of Route 2 in Florida/Charlemont (due to collapse of the road and a landslide) and damages to structures in Shelburne Falls. Flooding was experienced in Sheffield during this storm, but damages were must less extensive and no evacuations were conducted.

Fig. 3.3.2. Track of T.S. Irene 2011



Probability of Future Occurrences

Based on past reported hurricane and tropical storm data, the region can expect a tropical depression, storm or hurricane to cross the region every 14.5 years. However, the community may also be impacted by a tropical event whose path is outside of the region every 0.75 years. Based on past storm events and given that the center of the county is approximately 85 miles to the Long Island Sound and 115 miles to Boston Harbor, the Berkshires will continue to be impacted by hurricanes and tropical storms.

Severity

The severity of a hurricane is categorized by the Saffir-Simpson Hurricane Scale. This scale categorizes or rates hurricanes from 1 (Minimal) to 5 (Catastrophic) based on their intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale. In Berkshire County flooding tends to be the impact of greatest concern because hurricane-force winds here occur less often. Historical data show that most tropical storms and hurricanes that hit landfall in New England are seldom of hurricane force, and of those most are a category 1 hurricane. The category hurricanes that stand out are those from 1938 and 1954.

Warning Time

Warning times for the majority of tropical storms and hurricanes are generally broadcast well in advance of landfall in New England. The National Weather Service issues a hurricane warning when sustained winds of 74 mph or higher are *expected* in a specified area in association with a tropical, subtropical, or post-tropical cyclone. A warning is issued 36 hours in advance of the anticipated onset of tropical-storm-force winds. A hurricane watch is announced when sustained winds of 74 mph or higher are *possible* within the specified area in association with a tropical, subtropical, or post-tropical cyclone. A watch is issued 48 hours in advance of the anticipated onset of tropical storm force winds (NWS, 2013). In general, MEMA suggests that local and regional preparations should be complete by the time the storm is at the latitude of North Carolina. (Massachusetts Emergency Management Agency, 2013)

Secondary Hazards

Precursor events or hazards that may exacerbate hurricane damage include heavy rains, winds, tornadoes, insufficient flood preparedness, and levee or dam breach or failure. Potential cascading events include health issues (mold, mildew); increased risk of fire hazards; hazardous materials, including waste byproducts; compromise of levee or dam; isolated islands of humanity; increased risk of landslides or other types of land movement; disruption to transportation; disruption of power transmission and infrastructure; structural and property damage; debris distribution; and environmental impact. (MEMA, 2013)

Climate Change Impacts

The Northeast has been experiencing more frequent days with temperatures above 90°F, increasing sea surface temperatures and sea levels, changes in precipitation patterns and amounts, and alterations in hydrological patterns. According to the Massachusetts Climate Change Adaptation Report, large storm events are becoming more frequent. Although there is still some level of uncertainty, research indicates the warming climate may double the frequency of Category 4 and 5 hurricanes by the end of the century, and decrease the frequency of less severe hurricane events. More frequent and intense storm events will cause an increase in damage to the built environment and could have devastating effects on the economy and environment. As stated earlier, cooler water temperatures along the Northeast Atlantic Ocean help to temper the strength of tropical storms, but if the ocean continues to warm, this tempering force could be lessened, leading to greater intensity of storms that make landfall in New England.

Exposure

To understand risk, the assets exposed to the hazard areas are identified. For the hurricane and tropical storm hazard MEMA has determined that the entire Commonwealth of Massachusetts is exposed to extensive winds and rains. Storm surge from a hurricane/tropical storm poses one of the greatest risks to residents and property. (MEMA, 2013) Berkshire County is landlocked, so no community in the region is at risk of storm surge. Damages from a hurricane can be broken into two general categories of direct impacts: flooding and high winds. Flooding damage for the Town of Sheffield has been assessed and discussed in the flooding section of this Plan and is not discussed here. For wind-based damage, the hurricane simulation model for Sheffield was run in HAZUS-MH, using a probabilistic 100-year (1% annual chance) storm using default HAZUS value. The 100-year storm was used to be comparable to the storm event used in the flooding model.

3.3.3. Vulnerability

Population

High winds from tropical storms and hurricanes can knock down trees, limbs and electric lines, can damage buildings, and send debris flying, leading to injury or loss of life. Flooding often accompanies tropical storms and hurricanes. Economically distressed, older residents and other vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. HAZUS-MH for a Probabilistic 100-year Return Period for a Hurricane scenario, which focuses on wind damage (not flood damage), was run to estimate the potential damages to buildings and infrastructure and estimate sheltering needs. According to the model, no Sheffield buildings will be at least moderately damaged or destroyed, although one or two might suffer minor damage, likely a residential home. Also, no residents would be displaced or require temporary to long-term sheltering due to wind damages for such a storm. It should be noted that Hazus-MH utilizes 2000 Census data, and therefore, the totals will vary slightly. However, as reported in the flooding section of this plan, up to 125 households will be displaced and approximately 150 individuals may seek shelter during the flood event (HAZUS-MH, 2017). For more details about the impacts of a 1% chance storm event, see the full HAZUS-MH report in Appendix 3.

Critical Facilities

In past events in Berkshire County, critical facilities are mostly impacted during a hurricane by flooding, and these impacts are discussed in the flooding section of this Plan. Wind-related damages from downed trees, limbs, electricity lines and communications systems would be at risk during high winds. There are very few areas where power lines are buried underground. HAZUS-MH predicted that no critical facilities would be impacted by wind-related damages.

Economy

Hurricane/tropical storm events can greatly impact the economy, including loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. HAZUS-MH estimates the total building-related economic loss associated with each storm scenario (direct property damages and business interruption losses). The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

Damage to buildings can impact a community's economy and tax base. HAZUS-MH analysis determined that there is $320,190 of exposure due to the potential wind damage. The statistical data reports that some minor property damages could be sustained within Sheffield, and that residential buildings would be most likely to suffer such damages. No buildings would sustain moderate or severe damages. (HAZUS-MH, 2017)

Table 3.3.3. HAZUS-MH Results for Hurricane Winds (in dollars)

		Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	211,840	5,820	3,410	2,490	223,560
	Content	96,570	-	-	-	96,570
	Inventory	-	-	-	-	-
	Subtotal	**$308,410**	**$5,820**	**$3,410**	**$2,490**	**$320,130**
Business Interruption						
	Income	-	-	-	-	-
	Relocation	60	-	-	-	60
	Rental Income	-	-	-	-	-
	Wage	-	-	-	-	-
	Subtotal	**$60**	**-**	**-**	**-**	**$60**
Total		***$308,470***	***$5,820***	***$3,410***	***$2,490***	***$320,190***

Source: HAZUS-MH, BRPC 2017

HAZUS-MH also estimates the amount of debris that may be produced a result of wind events. The debris produced is estimated to be approximately 1,351 tons, the vast majority (89%) of which would be tree debris. Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur.

3.5.4. Existing Protections

As described in this section, the main direct impacts from hurricanes and tropical storms result from flooding and/or high winds. Existing protections for flooding are described in the Flood Hazard Section of this Plan, including local bylaws and regulatory mechanisms, completed infrastructure improvements and emergency preparedness measures. Existing protections against wind damages include the Town's adherence to the Massachusetts Building Code, and more vigilant pruning of trees and limbs around electric power lines. Sheffield first responders and public works staff report that National Grid has become more proactive in tree trimming and more responsive to power outages in recent years.

3.5.5. Actions

Actions to address flooding are described in the Flood Hazard Section of this Plan, including potential actions to improve local bylaws and regulatory mechanisms, create a more resilient infrastructure system and improve emergency preparedness measures.

- Expand the enrollment of year-round and seasonal residents in Blackboard Connect, the Town's emergency communications system.
- Have residents or seasonal residents self-identify their needs, such as the need for oxygen, to the Police and/or Fire Department may help prevent problems during a disaster of any kind.

3.4. Severe Weather Hazards

3.4.1. General Background

There are several severe weather events that impact the Berkshire County region and the Town of Sheffield, some of which occur suddenly and with little warning times. The severe weather hazards being discussed in this section of the Plan are atmospheric in nature and are:

- High Winds, Thunderstorms and Tornados
- Extreme Temperatures

3.4.2. Severe Weather Hazard Profiles

Wind is air in motion relative to surface of the earth. Effects from high winds can include downed trees and/or power lines and damage to roofs, windows, etc. High winds can cause scattered power outages. Massachusetts is susceptible to high wind from several types of weather events: before and after frontal systems, hurricanes and tropical storms, severe thunderstorms and tornadoes, and Nor'easters. Winds measuring less than 30 mph are not considered to be hazardous under most circumstances. Sometimes, wind gusts of only 40 to 45 mph can cause scattered power outages from trees and wires being downed. This is especially true after periods of prolonged drought or excessive rainfall, since both are situations which can weaken tree root systems and make them more susceptible to the winds' effects.

A thunderstorm is a storm with lightning and thunder produced by a cumulonimbus cloud, and usually accompanies by gusty winds, heavy rain, and sometimes hail, which can be quite large. Tornadoes can also be generated during thunderstorms.

Rising, warm moist air is the foundation for thunderstorms. If this warm air is forced to rise and is channeled upward by hills or mountains, or areas where warm/cold or wet/dry air collide, it can become unstable and charged. Sometimes strong downdrafts of cool air, known as downbursts, can cause tremendous wind damage, similar to that of a tornado. A small (< 2.5-mile-wide path) downburst is known as a "microburst." (MEMA, 2013)

Tornadoes are fierce phenomena which generate wind funnels of up to 200 mph or more, and occur in Massachusetts usually during June, July, and August. A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The visible sign of a tornado is the dust and debris that are caught in the rotating column made up of water droplets. Tornadoes can form from individual cells within severe thunderstorm squall lines or from an isolated super-cell thunderstorm. They can be spawned by tropical cyclones or their remnants passing through. (MEMA, 2013) Tornadoes are the most violent of all atmospheric storms and are historically the deadliest of weather events in Berkshire County.

Massachusetts has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those that are far outside the normal ranges. According to MEMA the average temperatures for Massachusetts are:

- Winter (Dec-Feb) Average = 22.5°F
- Summer (Jun-Aug) Average = 65.8°F

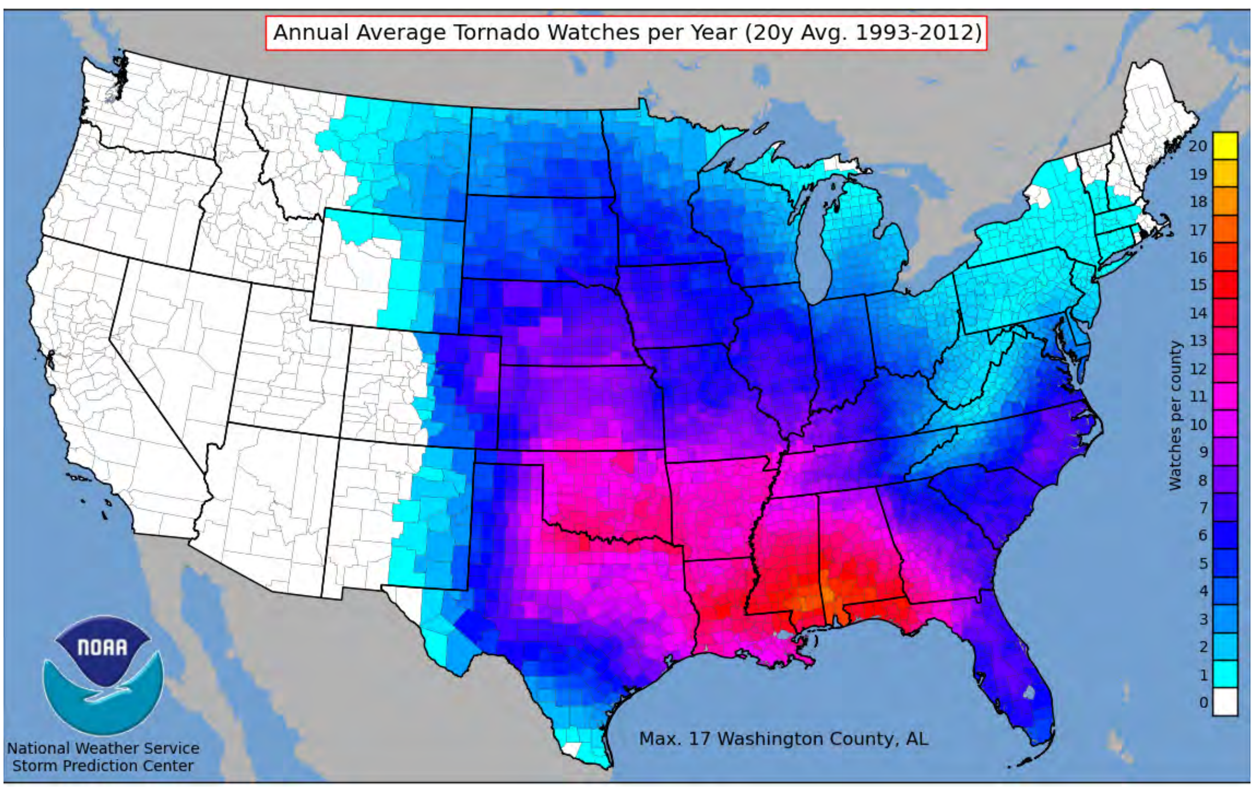
Extreme heat events impact the health of human beings, livestock and wildlife, and can impact the ability of people to function at home or work. Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter, who work outside or who are stranded or who live in homes that are poorly insulated or without heat.

Impacts from severe storm events can be as widespread effecting all of the northeast, such as a hurricane or nor'easter. Impacts can occur along narrow paths of Berkshire County where weather fronts collide and deliver high winds and rain or where tornado touchdowns have carved a path of destruction. Alternately impacts from these storms can be concentrated, such as when mircorbursts suddenly hit an area. Areas of impact from tornados and microbursts are unpredictable.

Severe storms can occur anywhere in the Town of Sheffield. Thunderstorms affect relatively small areas, rather than large regions much like winter storms and hurricane events. The community is in an area that would experience between 15 and 20 thunderstorm days each year.

The location of tornado impact is totally unpredictable. However, the county is located in a lower risk area with an average of 1 tornado watch per year (see Fig. 3.4.1).

Fig. 3.4.1. Annual Average Tornado Watches per Year



Source: National Weather Service Storm Prediction Center 2018

Previous Severe Weather Occurrences

Based on research, known severe weather events that have affected the region and were declared a FEMA disaster are identified in Table 3.4.1, which provides detailed information concerning FEMA declarations for the Commonwealth. (MEMA, 2013)

Table 3.4.1. FEMA Severe Weather Event Declarations Including Berkshire County 1954 to Present

Incident Period	Description	Declaration Number
3/30/87 – 4/13-87	Severe storms and flooding; 8" in some areas of state with already high river conditions	DR-790
10/7/05-10/16/05	Severe storms and flooding throughout Berkshire County	DR-1614
4/15/07-4/25/07	Severe storms and flooding; snow and ice in higher elevations	DR-1701
1/29/2011	Severe Storm	EM-3343
10/29/11-10/30/11	Severe storm and Nor'easter; at peak 665,000 residents state-wide without power; 2,000 people in shelters statewide	DR-4051

Source: MEMA, 2013; BRPC 2017

The Storm Prediction Center maintains a severe weather database that contains information regarding hail, tornado, and damaging events. The damaging wind reports include data from 1996 to 2017. According to the Storm Prediction Center database, over the course of the last 20 years, the region has experienced 40 damaging wind events, with an annual frequency of two per year (NOAA, 2017). The events from the past 20 years caused over $348,000 in property losses.

Fig. 3.4.2. Microburst in Cheshire 7-18-16

Southern New England typically experiences 10 to 15 days per year with severe thunderstorms. An average thunderstorm is 15 miles across and lasts 30 minutes, although severe thunderstorms can be much larger and longer. (Massachusetts Emergency Management Agency, 2013) Microbursts occur throughout Berkshire County, downing trees, utility lines and sometimes causing damage to property. In the Berkshires microbursts are often accompanied by heavy rainfall that can cause additional damage from flooding. According to news media reports, several thunderstorm/microburst events have caused damages have in the communities of Williamstown, North Adams, Cheshire, Lanesborough, Pittsfield, Lee, and Stockbridge. An event that struck Pittsfield and other central Berkshire communities in July 2011 caused extensive damage and was responsible for the death of a man in Hinsdale who was struck by a falling utility pole. WMECO called in 339 out-of-state work electric crews and 14 out-of-state tree crews to remove trees and repair damaged lines[1].

On Sunday, June 1, 2016 an afternoon thunderstorm stalled for two hours over Lee and Stockbridge, flooding streets, basements and ground floors, including the ground floor of Stockbridge Town Hall. Stockbridge received almost 5” of rain while 4.5” fell at the Lee water treatment plant. Another inch of rain fell the next evening in another storm.[2]

According to the MA State Hazard Mitigation Plan, there have been several damaging thunderstorms in the region.

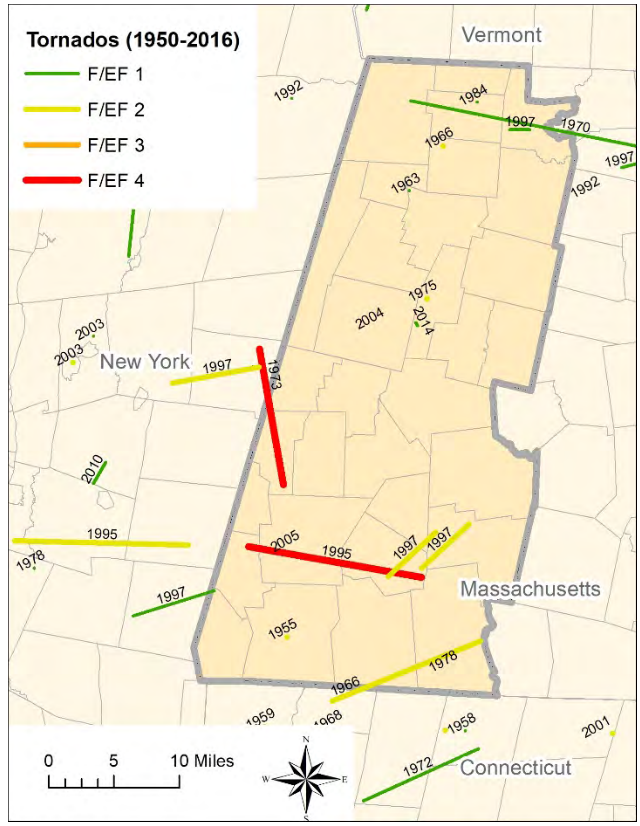
- A pair of spring storms occurring within a few days of one another in March and April 1987 combined with snowmelt to produce record flooding in Massachusetts, Maine, and New Hampshire. The events brought over 8 inches of rainfall to some areas of Massachusetts (FEMA DR-790).
- On October 9, 2005, the remnants of Tropical Storm Tammy produced significant rain and flooding across western Massachusetts. It was reported 9”- 11” of rain fell. On October 15, a low-pressure system, combined with tropical moisture, resulted in heavy rain and flooding across Massachusetts. This series of storms resulted in a federal disaster declaration (FEMA DR-1614) and Massachusetts received over $13 million in individual and public assistance.
- An intense coastal storm (April 15-16, 2007) brought 3”- 6” of wet snow, sleet, and rain to parts of western Massachusetts. The storm was primarily a rain event due to warmer temperatures, but higher elevations experienced significant snow and ice accumulations. This event resulted in a federal disaster declaration (FEMA DR-1701), with those counties included in this disaster receiving over $8 million in public assistance from FEMA.
- Between August 19 and 21, 2011, Berkshire, Hampshire, Essex, Middlesex, Suffolk, Franklin, Norfolk, and Worcester Counties experienced severe thunderstorms that produced quarter-sized hail and damaging winds. The strong winds knocked down numerous trees and power lines in the affected areas, causing nearly $100,000 in property damage.
- A rare October Nor’easter brought heavy snow to portions of southern New England on October 29, 2011. Snowfall accumulations of one to two feet were common in the Monadnocks, Berkshires, Connecticut Valley, and higher elevations in central Massachusetts. Up to 31” of snow was reported in Plainfield, MA. The accumulation of the heavy, wet snow on trees and power lines resulted in widespread tree damage and power outages across central and western Massachusetts. At the peak, approximately 665,000 customers in Massachusetts were without power, some for nearly a week. Six fatalities occurred during and in the aftermath of the storm. (FEMA DR-4051).

[1] McKeever, Andy, 1-27-11. “Pittsfield Slammed by Surprise Microburst Storm,” *iBerkshires.*
[2] Lindsay, Dick, 6-1-16. “Weekend deluge swamps roads, homes in Stockbridge, Lee,” Berkshire Eagle.

Typically, there are 1 to 3 tornadoes somewhere in southern New England per year, with Massachusetts experiencing an average of one tornado event annually between 1991 and 2010. Starting in 2007, tornados are rated based on the Enhanced Fujita Tornado Scale; prior to 2007 tornados were based on the Fujita Tornado Scale. Of the 18 tornados that have occurred in Berkshire County between 1950 and 2016, only one has occurred since 2007, an EF1 in July 2014 in Dalton. Four tornados occurred during a single storm on July 3, 1997. All totaled, these have resulted in over $29 million in damage, seven deaths, and 60+ injuries. (NOAA, 2017).

The most memorable tornados in recent history occurred in West Stockbridge in August of 1973 (category F4) and in Great Barrington, Egremont, Monterey in May of 1995 (category F4). In the West Stockbridge tornado 4 people died and 36 were injured, and in Great Barrington 3 people died and 24 were injured. Signs of the tornados destruction are visible today in Great Barrington from Rt. 7. The hill to the east is scarred where the tornado uprooted and toppled trees – they lie scattered on the hillside like matchsticks.

Fig. 3.4.3. Tornados in the Berkshire Region and Severity



Source: Midwest Regional Climate Center, 2018

In July 2014, an EF-1 tornado and microburst touched down in the Greenridge section of Dalton, downing trees and power lines across the area and temporarily closing local roads. The tornado caused structural damage to several homes and cut a path through the woods behind Greenridge Park. A home on Norwich Drive sustained extensive damage, as the tornado lifted the roof off the house, shifted the chimney and ripped away vents and siding. At this same house a large tree smashed through the back of the house and broke windows. Other local homes suffered minor damages.[3]

Most tornados occur in the late afternoon and early evening hours, when temperatures are the highest. In Berkshire County the majority of tornados occur in July and, to a lesser degree, August, but tornadoes have hit the county as early as March (Sheffield, 1966) and as late as October (Cheshire, 1963). (MEMA, 2013)

Probability of Future Severe Weather Occurrences

Severe storms comprised of thunderstorms, high winds, and hail will continue to affect the community. While these events may occur during any month, they most likely will occur between May and August. FEMA has developed Wind Zones for the U.S. based on 100 years of hurricane data and 40 years of tornado data and, according to these maps, the Berkshires are listed as a Special Wind Region within the Hurricane-susceptible Region of a Wind Zone II (up to 160 mph winds). See Fig. 3.4.4. Based on this

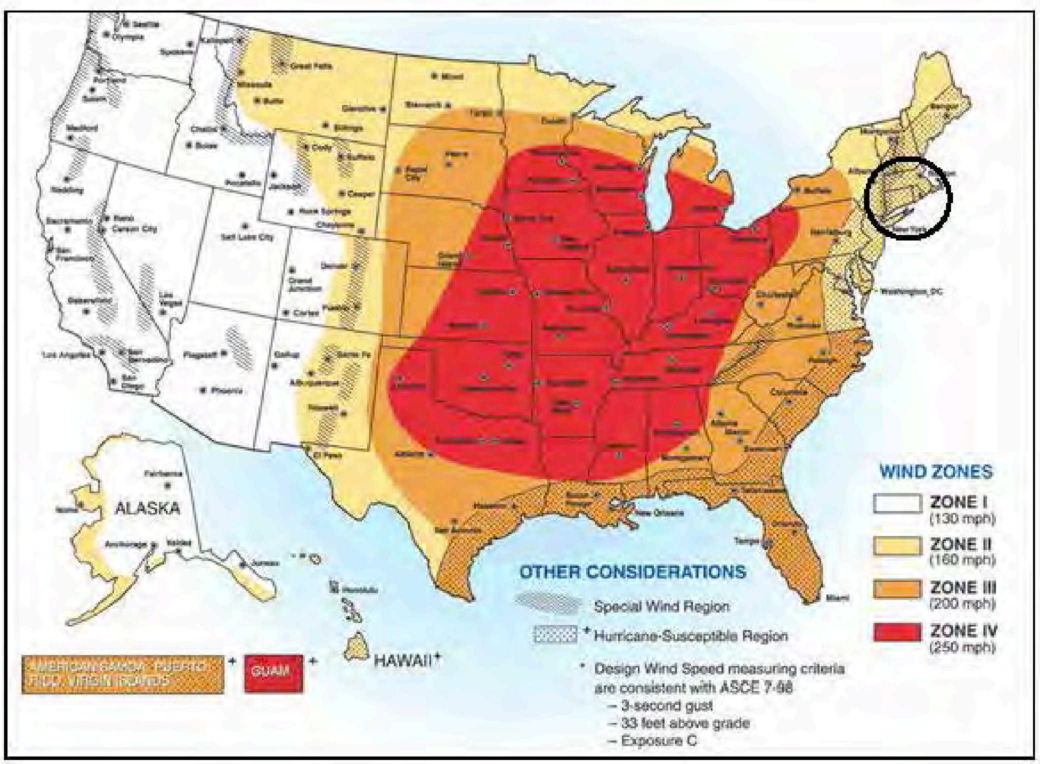
[3] *http://www.berkshireeagle.com/stories/national-weather-service-confirms-tornado-touch-down-in-dalton,365967*

historical data the Town of Sheffield can expect to continue to experience at least the same number and severity of wind-related weather events into the future. Some scientists project that the number and severity of events will increase as a result of climate change.

Lightning strikes primarily occur during the summer months. According to NOAA, there has been 1 fatality and 43 injuries as a result of lightning events from 1993-2012 in the Commonwealth (NCDC, 2012). (MEMA, 2013) Although thunderstorms with lightening may increase due to a more volatile atmosphere, the chance of death or injury is likely to remain low.

According to the National Climatic Data Center, since 1950, there have been 13 tornados that have touched down or moved in a path across Berkshire County. As shown in Fig. 3.4.3., there are several others that occurred in adjacent counties and states in the region. The most recent of these was in July 2014 when a tornado struck in Dalton. This averages to one tornado striking the county approximately every five years. Of these, only two have been of F4 severity, which indicates that such a severe tornado has a statistical recurrence rate of one in every 33 years. (NOAA, 2017)

Fig. 3.4.4. Wind Zones in the U.S.



Source: MEMA 2013.

In the years 2000-2017, there have been six extreme cold/wind chill weather events in Berkshire County and in the years 1998-2013 there were five heat events.

Extreme temperatures will continue throughout the entire county. With climate change, the county should expect more extreme temperatures, both hot and cold. It is projected that the region will experience 11 less days below 0°F. (Northeast Climate Science Center, 2018). According to the Massachusetts Climate Change Projections for the Housatonic River Watershed, a high temperature of above 90°F currently only occurs once per year. By mid-century the number of days above 90°F will range from 4 to 20, and by the 2090s the number will increase to 7 to 57 days per year. The number of days going above 95°F will increase from the current 0 days per year to almost 6 days by mid-century and up to 27 days by the 2090s. (MA Climate Change Projections for the Housatonic Watershed, 2018)

As is the case in many areas of the United States, extreme weather conditions were reported more frequently in 2015, 2016, 2017, and to date in 2018, with several of the hottest years on record occurring in the last four years. In July 2018, 68% of days (21) had above-normal daytime high and nighttime low temperatures, with a significant deviation of 4.3°F recorded at a government observation station in Pittsfield, in the center of Berkshire County. There have been a minimum of seven days this summer with temperatures above 90°F. During the same month, four new high temperature records were set and one was tied. At present, it is unknown if these higher temperatures are abnormalities, may be the new normal, or whether temperatures will continue to rise. It does appear the past few years have a trajectory of temperatures increasing faster than many climate scientists had projected, as evidenced by the MA Climate Change Projections for the Housatonic Watershed, 2018, cited above.

Severity

For non-tropical high wind events that occur over land, the National Weather Service (NWS) issues a Wind Advisory (sustained winds of 31 - 39 mph for at least one hour, or any gusts of 46 - 57 mph) or a High Wind Warning (sustained winds of 40+ mph or any gusts of 58+ mph). For tropical systems, the NWS issues a tropical storm warning for any areas that are expecting sustained winds of 39 - 73 mph. A hurricane warning is issued for any areas expecting sustained winds of 74+ mph. Effective 2010 the NWS modified the hail size criterion to classify a thunderstorm as ‘severe’ when it produces damaging wind gusts in excess of 58 mph, hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

Tornado damage severity is measured by the Enhanced Fujita Tornado Scale, which allows surveyors to create more precise assessments of tornado severity. Table 3.4.2 illustrates the EF-scale.

Table 3.4.2. Enhanced EF-Scale

EF Number	3-second gusts (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

In the Berkshires, extreme cold temperatures are those that are well below zero for a sustained period of time, causing distress for vulnerable populations exposed to such temperatures when outside and straining home heating systems. The severity of extreme cold temperatures is generally measured through the Wind Chill Temperature Index. Wind Chill Temperature is the temperature people and animals feel when outside and it is based on the rate of heat loss from exposed skin due to the effects of wind and cold. As the wind increases, the body is cooled at a faster rate causing the skin's temperature to drop faster.

The NWS issues a Wind Chill Advisory if the Wind Chill Index is forecast to dip to –15°F to –24°F for at least three hours, using only sustained winds (not gusts). The NWS issues a Wind Chill Warning if the Wind Chill Index is forecast to fall to –25°F or colder for at least three hours using only the sustained wind. In 2001 the NWS implemented a Wind Chill Temperature Index to more accurately calculate how cold air feels on human skin and to predict the threat of frostbite. According to the calculations, people can get frostbite in as little as 10 minutes when the temperature is -10 degrees and winds are 15 miles per hour. (MEMA, 2013)

The following are some of the lowest temperatures recorded in the region for the period from 1895 to present. (National Climatic Data Center, 2017)

- Lanesborough, MA –28°F
- Great Barrington, MA –27°F
- Stockbridge, MA –24°F
- Pittsfield, MA -19°F

Extreme heat temperatures are those that are 10°F or more above the average high temperature for the region and last for several hours. The following are some of the highest temperatures recorded for the period from 1895 to 2017, showing Boston and three Berkshire County locations. (National Climatic Data Center, 2017)

- Boston, MA 102°F
- Great Barrington, MA 99°F
- Adams, MA 95°F
- Pittsfield, MA 95°F

It should be noted that temperature alone does not define the stress that heat can have on the human body – humidity plays a powerful role in human health impacts, particularly for those with pre-existing pulmonary or cardio-vascular conditions. The NWS issues a Heat Advisory when the Heat Index is forecast to reach 100°-104°F for two or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105°F or more for two or more hours. The heat index is the combination of the temperature and humidity.

Secondary Hazards

The most significant secondary hazards associated with severe local storms are falling and uprooted trees and broken branches, downed power lines, and possible flooding and landslides. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. (MEMA, 2013) Possible long-term power outages and closed transportation systems can threaten human health and disrupt businesses.

The Berkshires are currently a moderately temperate climate, but increases in summer temperatures will create higher peak summer electricity demands for cooling, including an increase in the number of air conditions units being installed. The current cooling degree days (CDD) with a base of 65°F for the summer season in the Housatonic River basin is 231 (for years 1971-2000). By mid-century the summer season CDD is projected to increase an additional 169-473, an increase of 73-205%, and by the 2090s the summer CDD is projected to increase an additional 239-931, an increase of 104-403%. (MA Climate Change Projects for Housatonic Watershed, 2018). It is unknown how well prepared the electric grid is for the increasing peak seasonal and daily demands.

Climate Change

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data show the probability for severe weather events increasing in a warmer climate. (MEMA, 2013) Warming ocean temperatures are a source of increased evaporation and resulting precipitation, and warmer air masses can create more volatile atmospheric conditions, particularly if they interact or collide with cooler air masses. Any severe storm event could have significant economic consequences.

Extreme temperatures are among the most dangerous impacts associated with climate change. Extreme heat is among the most harmful to public health and safety, particularly for populations more vulnerable due to existing chronic medical conditions or lower economic status. Increased changes in average temperatures pose negative impacts to public health and safety, particularly in urban areas; sea levels, and natural biodiversity.

Warning Times

Meteorologists can often predict the likelihood of a severe thunderstorm outbreaks with several days of lead time. However, they can only pin this down to portions of states and cannot predict the exact time of onset or severity of individual events. Other storms, such as a well-organized squall line, can yield lead times of up to an hour from the time a Severe Thunderstorm Warning is issued to the time severe criteria are observed. Some severe thunderstorm events develop quickly, with only a few minutes of advance warning times. Doppler radar and a dense network of spotters and amateur radio operators across the region have helped increase warning lead time across southern New England. (MEMA, 2013) In Berkshire County, the hilly and sometimes steeply sloped terrain facilitates cumulonimbus cloud development, creating very localized thunderstorms. These can develop quickly and dissipate quickly, with damages caused by wind, rain and sometimes hail.

Tornado watches and warnings are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead-time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly, that little, if any, advance warning is possible. (MEMA, 2013) No warning was the case in Dalton where, according to the Dalton Emergency Management Director, who monitors weather advisories, there was no tornado warning for the Town prior to the tornado striking the

Greenridge area in 2014. The only warning issued was a severe weather warning, with possible high winds.

Meteorologists can accurately forecast extreme temperature event development and the severity of the associated conditions with several days lead time. Excessive heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. Excessive heat warning/advisories are issued when an excessive heat event is expected in the next 36 hours. (MEMA, 2013)

Severe weather warnings issued for Berkshire County are generated out of the National Weather Service in Albany NY, not from NWS in Boston. Residents in most of Berkshire County rely on weather reports from Albany NY television stations rather than from stations within the Commonwealth. This is because the county is listed as being in the Albany designated marketing area for cable and satellite companies. Given the prevailing winds from the west, Albany is often a good barometer for Berkshire weather. Fortunately, Albany TV stations include Berkshire County when they issue storm watches and warnings, and storm systems are easily tracked live online via the radar displays of all three major Albany television stations. Albany and local radio stations also issue warnings.

Exposure

Whereas risks from some hazards can be dependent on locating development and infrastructure in higher risk areas, such as in floodplain areas, dam inundation areas or proximity to forest and grasslands, the hazards described in this section are less dependent on location. In some localized areas wind speeds can increase across wide expanses of open, unforested areas, such as pasture or crop lands, such as occur extensively across Sheffield.

Temperature extremes occur throughout the region and the Town of Sheffield. Colder temperatures are more common in the higher elevations of the community, the entire community is susceptible. Areas that are more prone to heat include the lower elevations in the Village Center areas. To understand risk, the assets exposed to the hazard areas are identified. The entire Town of Sheffield is considered to be at risk for all the severe weather hazards discussed in this section.

3.4.3. Vulnerability

Population

The following populations are more vulnerable to a severe wind storm or tornado (MEMA, 2013):

- Communities without or having ineffective early warning systems;
- Elderly and functional needs populations because they require extra time or outside assistance to seek shelter and are more likely to seek or need medical attention which may not be available due to isolation during and/or after an event;
- Economically disadvantaged populations;
- Those with a language barrier unable to following warning messages;
- Those in mobile homes;
- People in automobiles at the time of a tornado.

Severe storm events, such as wind and rain storms, can impact people across Berkshire County and the Town of Sheffield. Overall the greatest concerns to human health from the hazards discussed in this section arise out of the potential for wide spread, long-term electricity outages, particularly during extreme temperature events. During such events, people would be susceptible to severe cold due to lack of heat or severe heat due to lack of fans or air conditioning. People with pre-existing illnesses who need electricity for oxygen, dialysis or other equipment, and those who need moderate temperatures and humidity, to reduce stress on pulmonary or cardiac systems, are more vulnerable to electricity outages. Older populations are typically more vulnerable due to chronic illnesses, and given the trend of an increasing older population, mitigation and preparing for electricity outages should be a high priority. The trend of helping seniors age in place, including the more rural areas of Sheffield, could mean that older residents become isolated during severe weather events.

Massachusetts ranks 35th among states for frequency of tornadoes, 14th for the frequency of tornadoes per square mile, 21st for injuries, and 12th for cost of damage. (MEMA, 2013) On June 1, 2011, seven tornadoes traveled through the Connecticut River Valley, destroying large sections of Springfield and other towns in the region, killing 3 people, injuring 300 in Springfield alone, and leaving at least 500 people homeless. The EF3 tornado traveled a 39-mile-long path from Westfield to Brimfield and Monson, the latter small towns suffered the greatest damages. With winds of up to 160 mph, it destroyed 1,400 homes and 78 businesses.[4]

According to available data tornados are the single deadliest natural hazard in Berkshire County in recent decades, with two tornadoes killing 7 people and injuring at least 60 (other deadly hazards have historically been floods and dam failures). So far tornado-caused deaths have been relatively low because none of the stronger tornados struck an area within one of the county's more densely populated areas such as a town center, village or subdivision. If a tornado where to strike a densely populated area it is likely that local and regional sheltering would be required.

Fig. 3.4.5. Path of the Great Barrington Tornado

All Sheffield residents are vulnerable to the health effects of extreme temperatures, with those who work outside at a greater risk. Others at greater risk are those individuals who have pre-existing medical conditions that impair their ability to regulate their body temperatures, or whose homes or work places are inadequately heated or cooled.

The NWS Wind Chill Temperature Index calculates how cold air feels on exposed human skin, showing when temperature, wind speed and exposure time will cause frostbite. Figure 3.4.6. illustrates the relationship.

[4] *http://boston.cbslocal.com/2016/06/01/springfield-tornado-5-year-anniversary-3-killed-millions-damage/*

Vulnerable populations are the older residents and those with pre-existing health conditions, such as cardiovascular disease, Type II diabetes, and those with other chronic ailments, are at higher risk of extreme heat events. Hot humid conditions make breathing more difficult for those suffering from impaired respiratory and pulmonary systems. Societal factors most associated with heat related health risks were a lack of air-conditioning, lower social economic status, socially isolated individuals and a higher percentage of elderly (DPH 2014). With many middle-aged and even children now having Type II diabetes, at risk populations are expanding.

Fig. 3.4.6. Wind Chill Temperature Index and Frostbite Risk

Temperature (°F)

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

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

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

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

Effective 11/01/01

Based on the criteria for heat stress forecasts developed by the National Weather Service (NWS), watches or warnings are issued when thresholds of daytime high and nighttime low heat index (Hi) values are exceeded for at least two consecutive days (Fig. 3.4.7.). Heat Index numbers provide a temperature that the body feels. It is important to know that the Heat Index values are devised for shady, light wind conditions. Exposure to full sunshine can increase heat index values by up to 15°F. In

Fig. 3.4.7. Heat Index Chart and Human Health Impacts

HEAT INDEX CHART

Temperature (°F)

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

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

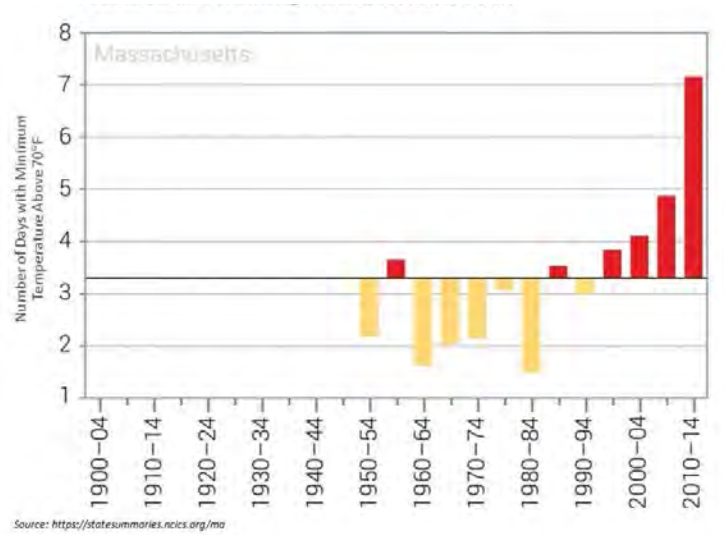
Source: MEMA 2013

Boston more than 50 people die each year due to heat-related illnesses. (MEMA, 2013) When interviewed in 2016 about projected climate change impacts, local ambulance crews reported no increase in heat-related calls in recent years, but Pittsfield Fire Chief Czerwinski did note that his department and Berkshire Medical Center staff are coordinating more closely about when to open cooling centers in Pittsfield for vulnerable populations (BRPC & BCBOHA, 2016). Sheffield primary cooling centers are the Senior Center and Bushnell Sage Library.

Nationally more than half of heat-related deaths occurred in homes with little or no air conditioning. Although the temperatures in the Berkshires do not equate to those in the southern portion of the country, the proportion of residents here without air conditioning is likely much higher than down south, indicating increased risk if the region were to experience a severe and prolonged heat wave. Air quality, which tends to be more degraded in urban areas, adds additional stress. Populations living in urban heat cores are more vulnerable to heat stress, particularly those without access to air conditioning and those with existing health conditions more susceptible. There are no urban areas in Sheffield.

What may be more concerning is the trend for higher nighttime temperatures. Warm nights are those where the minimum temperature stays above 70°F. Since 1950 the number of warm nights in Massachusetts has steadily increased, with the highest number occurring between 2010 and 2014. Refer to Fig. 3.4.8, where the dark horizontal line represents the long-term average. Unfortunately, this trend is continuing.

Fig. 3.4.8. Observed Number of Warm Nights in MA 1950-2014



Historically the cooler evening temperatures in the Berkshires have allowed residents to cool their body temperatures in the night air and their homes by opening windows and using fans to bring in the cooler air. Warmer nighttime temperatures will make it increasingly difficult to cool homes that are not equipped with air conditioning, as well as increasingly not allow residents to restore themselves at night.

Extreme heat temperatures and heat waves have historically been rare in Berkshire County, with cooler temperatures than in the Hudson and Connecticut river valleys, ranging from 5°F cooler in the valley communities and 10°F cooler in the hill towns. This is due largely to the slightly higher elevations of the Berkshires compared to other regions in southern New England. Due to this differential, this is a natural hazard for which Berkshire communities and residents are largely unprepared. While most work places and increasingly more houses are being equipped with air conditioning, many residents across the county still rely on fans or inefficient window air conditioning units to cool their homes.

According to the *Berkshire Communities for Climate Change* report, a Massachusetts Department of Public Health survey taken by local boards of health across the state, less than 20% of local boards reported dealing with heat waves. Thirteen of the 17 Berkshire towns answering the survey reported not having taken any steps to plan for cooling centers. Local schools are often designated as an emergency shelters and in the western region only 38% of respondents reported having at least partially available air conditioning in their schools. (BCBOHA, 2016). The Sheffield Senior Center and Bushnell Sage Library currently serve as Sheffield's cooling centers.

There is no HAZUS model for severe weather. If a severe weather event completely damaged all structures in Town, the total structural replacement value for residential buildings alone, which are 73% of occupancy classes in Town, would be greater than $383 million. (Berkshire Regional Planning Commission, 2018)

Critical Facilities

All critical facilities in the Town of Sheffield are exposed to severe weather events such as high winds, thunderstorms and tornados. The most common problems associated with severe weather aare loss of electricity and possibly communications systems. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function, especially in Sheffield where every home and business has its own septic system and most have their own well. Roads may become impassable due to flash flooding. (MEMA, 2013)

All critical facilities are exposed to extreme temperatures hazards. Extreme cold temperature events can damage buildings and infrastructure through freezing/bursting pipes and freeze/thaw cycles. Sheffield does not have detailed data on history of water pipe damage due to freeze/thaw cycles, as the public water supply is owned and operated by a private water company; the majority of residents have private wells. All waste is treated by private septic systems as there is no public sewer system.

Extreme heat events in the Berkshires generally do not impact buildings or other structures, but damages can be associated with overworking of HVAC systems, particularly those that are older or undersized. There are concerns that increased temperature events can reduce transmission capacity of electric power lines during summer heat waves, which is exactly the time when peak demand for electricity will be highest due to air conditioning. In general, the demand for electricity continues to rise, and the electric grid may have increasing difficulty meeting demand during the highest peak periods, leading to potential rolling brown outs or failures. Backup power sources will be all the more important for critical facilities, such as key public buildings (for continuity of operations) and cooling centers.

Economic

Wind storms, thunderstorms, and tornado events may impact the economy, including loss of business functions, water supply system and septic system damages, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Loss of key transportation routes may also occur. Agricultural losses can be devastating due to lightning and resulting fires. Due to differences in building construction, as well as the average age of Sheffield's housing stock, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. (MEMA, 2013)

Many small businesses suffer disproportionately than larger industries, for if small businesses cannot open, owners may struggle to make payroll and other expenses. The longer the business closure, generally the deeper the impacts.

3.4.4. Existing Protections

The Town of Sheffield adheres to the Massachusetts state building code, which as of 2018 was the Ninth Edition of the State Building Code. Part of this code requires buildings to withstand specific wind loads and adhere to energy efficiency standards. The MassSaves programs offers free energy audits to residential and business customers who request them and, based on the results of the audits, offers financial incentives for building owners to become more energy efficient and better insulated against severe temperatures.

Regarding electricity outages, officials across Berkshire County report improvements in electrical utilities responses since the ice storm of 2008. Additionally, the electric utility companies have created special community liaison staff who work more directly with municipal first responders during emergency incidents.

In the event of a large-scale extended power outage, the local shelter for Sheffield is Mount Everett High School, which also serves as the Alternate Regional Shelter for the southern Berkshire communities. Blackboard Connect is utilized by Town and emergency personnel when severe weather events are predicted, as well as during and post-storm to inform residents of resulting road closures, power outages and other safety instructions.

3.4.5. Actions

- Continue strict adherence to MA building code.
- Encourage cell phone users to enlist in the town’s Code Red system.
- Encourage the elderly, disabled and those with medical issues to self-identify with the Sheffield. Police Department as having special needs during emergency incidents.
- Develop and deploy education program to inform residents of their responsibilities, primarily for themselves and neighbors, during power outages and extreme weather events.

3.5. Dam Failure Hazards

3.5.1. General Background

A "dam" is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control. Dam failure is a catastrophic type of failure characterized by the sudden, rapid, and uncontrolled release of impounded water or the likelihood of such an uncontrolled release. Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam
- Deliberate acts of sabotage
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate maintenance and upkeep

(MEMA, 2013)

The Massachusetts Department of Conservation and Recreation (DCR) Office of Dam Safety maintains an inventory of all the known dams in the state. A synopsis of this inventory is presented in the following pages. The BRPC has been unable to obtain an updated database from DCR for the 2018 Plan, so much of the data is from 2004. Where new data has been obtained, it is specifically notes, such as that for the Rising Pond Dam. The dam regulations are governed by Massachusetts General Law chapter 253, § 44. The height of the dam is determined by the height of the dam at the maximum water storage elevation. The storage capacity of the dam is the volume of water contained in the impoundment at maximum water storage elevation. Size class may be determined by either storage or height, whichever gives the larger size classification.

The hazard classification pertains to potential loss of human life or property damage in the event of failure or improper operation of the dam or appurtenant works. Probable future development of the area downstream from the dam that would be affected by its failure shall be considered in determining the classification. Even dams which, theoretically, would pose little threat under normal circumstances can overspill or fail under the stress of a cataclysmic event such as an earthquake or sabotage.

Dam owners are legally responsible for having their dams inspected on a regular basis. High Hazard dams must be inspected every two years, Significant Hazard dams must be inspected every five years, and Low Hazard dams must be inspected every 10 years. In addition, owners of High Hazard dams must develop Emergency Action Plans (EAPs) that outline the activities that would occur if the dam failed or appeared to be failing. Owners of Significant Hazard dams are strongly encouraged to also develop EAPs. The EAP would include a notification flow chart, list of response personnel and their responsibilities, a map of the inundation area that would be impacted, and a procedure for warning and evacuating residents in the inundation area. The EAP must be filed with local and state emergency agencies.

Factors that contribute to dam failure include design flaw, age, over-capacity stress, and lack of maintenance. Maintenance, or the lack thereof, is a serious concern for the community. By law, dam owners are responsible for the proper maintenance of their dams. If a dam were to fail and cause flooding downstream, the dam owner would be liable for damages and loss of life that were a result of the failure. Local officials are largely unaware of the age and condition of the dams within their communities.

3.5.2. Hazard Profile

Location

There are six public or privately-owned dams located throughout Sheffield (see Critical Facilities and Areas of Concern Map in Appendix 1 for locations). A summary of these dams and their hazard classification can be found in Table 3.5.1. The dams range in age from the Mill Pond Dam built in 1865, to the Three Mile Pond Dam built in 1967, and in capacity from the Three Mile Pond impounding 900 acre-feet to Fawn Lake Dam impounding 20 acre-feet. Non-jurisdictional dams are very small and are not monitored by the Massachusetts Office of Dam Safety. (Office of Dam Safety, 2004)

Additionally, the Rising Pond dam, which is located approximately 10 miles north in the village of Housatonic, is a run-of-the-river dam that impounds a portion of the Housatonic River. This dam impounds 195 acre-feet normally, with a maximum pool size of 710 acre-feet. Because of the size of impoundment, a breach of this dam would cause severe flooding along the Housatonic River in Sheffield. The potential impacts from inundation are discussed in more detail in the Vulnerability section.

Table 3.5.1. Dams in Sheffield*

Name	Owner	Hazard Classification	Size Class / Normal Impoundment	Condition	Location
Berkshire Trout Pond Dam	Private	Low Hazard	Small / 30 acre-feet	Fair	Sheffield
Combes Pond Dam	Private	Low Hazard	Non-Jurisdictional / 20 acre-feet	Unsafe	Sheffield
Fawn Lake Dam	Private	Low Hazard	Non-Jurisdictional / 20 acre-feet	Fair	Sheffield
Hoyte Dam	Private	Low Hazard	Small / 20 acre-feet	Fair	Sheffield
Mill Pond Dam	Private	Significant Hazard	Large / 760 acre-feet	Fair	Sheffield
Three Mile Pond Dam	State DFG	Significant Hazard	Large / 900 acre-feet	Fair	Sheffield
Rising Pond Dam	GE	Significant Hazard	Intermediate / 195 acre-feet	Satisfactory	Great Barrington

**Note: all data in this table from 2004, except for Rising Pond, for which data has been extracted from the 2017 Operation, Monitoring and Maintenance Plan.*
Source: Office of Dam Safety 2004; GZA GeoEnvironmental, Inc., 2017.

Table 3.5.2. Dam Size Classification

Category	Storage (acre-feet)	Height (feet)
Small	>= 15 and <50	>= 6 and <15
Intermediate	>= 50 and <1000	>= 15 and <40
Large	>= 1000	>= 40

Table 3.5.3. Dam Hazard Potential Classification

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

Previous Occurrences

Historically, dam failure has had a low occurrence in Berkshire County. However, it is one of the few natural hazards that have taken human lives in Berkshire County. The dam failure events of most note in Berkshire County are:

- April 20, 1886: the Mud Pond Dam in East Lee, MA, failed and heavy damaged or destroyed approximately 12 shops and industries along Greenwater Brook. This failure killed seven people. The cause of the failure was unknown. (MEMA, 2013
- August 19-20, 1901: Basset Reservoir and Dean's Dams fail after a two-day rain event, killing one person and damaging houses, businesses, roads and railroad tracks in Adams, North Adams (Ennis, 2004).
- March 24, 1968: the Lee Lake Dam near East Lee, Massachusetts failed, destroying six homes, damaging 20 homes and one manufacturing plant. The failure caused two fatalities. The cause of the failure was unknown. (MEMA, 2013)

While no dam failures have occurred in recent decades in the region, in September 2004 an incident occurred at the Plunkett Reservoir dam in Hinsdale. The first few weeks of September were unusually wet as the region received residual rain from three hurricanes. On September 18, 2004, after the effects of Hurricane Ivan dropped more than three inches of rain on the area in 24 hours, the flash boards at the Plunkett Reservoir dam gave way. The Emergency Management Director for Hinsdale calculated that approximately eight million gallons of water flooded the Housatonic River downstream of the lake, causing some minor flooding. There was no permanent damage or real estate damage, but the CSX rail line was undermined in the Hinsdale Flats area in Hinsdale. This was largely due to beaver activity, where culverts were partially plugged, impeding and redirecting flood waters.

Probability of Future Occurrences

Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides, excessive rainfall, and snowmelt. However, additional factors to consider are that many of the dams within the region are more than 100 years, and some are approaching 200 years old, and many dam owners struggle to properly maintain their dams. There is a "residual risk" associated with dams. Residual risk is the risk that remains after safeguards have been implemented. For dams, the residual risk is associated with events beyond those that the facility was designed to withstand, such as more severe, more frequently occurring precipitation events. However, the probability of a full break dam failure is low in today's regulatory and dam safety oversight environment.

Secondary Hazards

The sudden and potentially extreme volumes of water that are released during dam failures can cause ecological damage both upstream and downstream of the dam. River channels downstream of the dam can experience severe scouring, banks can experience erosion and mass wasting, and boulders can become dislodged and move downstream by high and powerful water volumes. Trees and other vegetation can become uprooted and add to the debris moved by floodwaters, potentially clogging and threatening the integrity of culverts and bridges. Upstream of the dam the former impoundment could become partially or completely dewatered, altering, and potentially destroying aquatic habitat. If the impoundment behind the dam were a drinking water supply, the loss of stored water could threaten public health and the economy of the town. (MEMA, 2013)

Other secondary impacts due to dam failure are potential human health impacts from inundation of private drinking water wells and septic systems. Flood waters typically carry higher bacterial counts than normal flows and these could flood directly into or seep through saturated groundwater into well shafts. Additionally, floodwater could become more contaminated if water exchange occurs between wells and nearby septic systems.

Severity

The U.S. Army Corps of Engineers developed the classification system shown in Table 3.5.4 for the hazard potential of dam failures. These classifications further explain the potential impacts of that dam failures could cause in Sheffield. The Corps of Engineers hazard rating system is based only on the potential consequences of a dam failure; it does not take into account the probability of such a failure. (MEMA, 2013)

Table 3.5.4. Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development)	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss of life potential is based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Indirect threats to life caused by the interruption of lifeline services due to project failure or

operational disruption; for example, loss of critical medical facilities or access to them.

d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.

e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

The three dams having a Significant Hazard rating are Three Mile Pond, Mill Pond and Rising Pond; there are no dams with a High Hazard rating that would impact Sheffield. The inundation area for a failure of the Three Mile Pond dam includes large sections of Cross and County Roads. The inundation area for the failure of the Mill Pond dam includes all along Miller Avenue and Bow Wow Road and the western end of Maple Avenue, including a section of Main Street/Route 7. It would include flooding of many residential properties along these areas.[1] The severity of damages or injuries due to flooding and water velocity in the inundation areas is not known at this time.

The dam failures of concern are those of Rising Pond in Great Barrington and Mill Pond and Three Mile Pond in Sheffield. The inundation area for Rising Pond extends from the dam in Great Barrington downstream into Sheffield. According to the Inundation Maps created as part of the Emergency Action Plan for the Rising Pond Dam, flooding from a dam failure would include the 100-year floodplain area associated with the Housatonic River in Sheffield and areas outside floodplain boundaries. The inundation area floods several miles of Route 7 in southern Great Barrington and northern Sheffield. The peak flood arrival time would be approximately seven hours after the dam failure occurred.[2] The inundation area on the map abruptly ends just north of the Route 7 / Egremont Road intersection, so it is unclear where flooding would begin to lessen for the dam failure.

Climate Change Impacts

According to MEMA, dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If severe rain events cause hygrographic changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. If the number of severe storms increases, or becomes the new norm, early releases of water will impact lands and waterways downstream more often.

Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change may not increase the probability of catastrophic dam failure, it may increase the probability of design failures. (MEMA, 2013)

If climate change results in a greater number of severe precipitation events and shortens recurrence intervals them, as is predicted, it will require dam operators to become more vigilant in monitoring precipitation and temperature patterns. Individual rain events, particularly if occurring during periods of

[1] Inundation areas as shown in the *Sheffield CEMP*.

[2] GZA GeoEnvironmental, Inc., 2017. *Operation, Monitoring, and Maintenance Plan Rising Pond Dam -- MA 00250,* Norwood, MA.

saturated or frozen soils that cannot absorb rainfall, may require that dam operators open spillways, flashboards and other safety features more often, causing a greater number of high discharge events and possible flooding on properties downstream of the dam.

Warning Time

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation or massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted, or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours. (MEMA, 2013)

Dam owners are required to have established protocols for flood warning and response to imminent dam failure in the flood warning portion of its adopted emergency operations plan. These protocols are tied to the emergency action plans also created by the dam owners. These documents are customarily maintained as confidential information, although copies are required to be provided to the Commonwealth of Massachusetts for response purposes. (MEMA, 2013) The estimated time of inundation from a Rising Pond dam failure would be approximately seven hours to the Sheffield town border.

Exposure

Residents in the town are at risk from several dams, located in Sheffield and neighboring Great Barrington. Emergency Action Plans for the dams are on file with the Emergency Management Director. Due to the sensitive nature of the contents of these plans, this Hazard Mitigation Plan update will discuss in general terms the risks posed by these dams. As such a detailed risk assessment to quantify potential damages has not be conducted.

The inundation area for a failure of Rising Pond dam could include flooding of approximately 35-40 homes, businesses and farms, some properties of which involve several commercial buildings. This analysis is based on the inundation map included in the Emergency Action Plan and on aerial review of the area using Google Earth. It should be noted that the inundation map for Rising Pond dam abruptly ends just north of Egremont Road, so it is unclear exactly where the inundation boundary would actually terminate in a dam failure event, but it is conservative to say that many more properties would likely be flooding downstream of the inundation boundary on the map. According to the inundation map for Rising Pond dam, much of the inundation area includes the 100-year floodplain.

The inundation area for a failure of the Three Mile Pond dam could include flooding of approximately 25-30 homes on Cross Road, County Road and Old Joe Road. The inundation area for a failure of the Mill Pond could include flooding of approximately 55-60 homes and businesses on Bow Wow/Miller Avenue, Main Street and Maple Avenue. The inundation area boundary is very near Depot Square, so the Town Hall could be threatened by flooding, as well as parts of the Housatonic Rail tracks. It should be noted that the basis of this analysis is a cursory view of potential impacts, based on a very rough map found in the Sheffield Comprehensive Emergency Management Plan and on aerial review of the areas using

Google Earth. It is not based on a detailed analysis using topographical features and hydrologic calculations.

3.5.3. Vulnerability

All populations in a dam failure inundation area would be exposed to the risk of a dam failure. The potential for loss of life is affected by the warning time, the capacity of dam owners and emergency personnel to alert the public and the capacity and number of evacuation routes available to populations living in areas of potential inundation.

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the needed time frame. However, there is often limited warning time for a dam failure event. While dam failure is rare, when events do occur, they are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event from a television, radio, siren or reverse 911 emergency warning system are highly vulnerable to this hazard. This population includes older and younger residents who may be unable to get themselves out of the inundation area. (MEMA, 2013)

Conducting a detailed quantitative vulnerability assessment for property damages, injury or death due to dam failure was beyond the scope of the planning process for the update of this Hazard Mitigation Plan. This type of information would be useful information but is not required to be calculated as part of Emergency Action Plans. The inundation maps are the basis for determining vulnerability. Rather, for the purposes of this planning process, The Town's vulnerability to the dam failure hazard is discussed qualitatively to provide a rough estimate of potential inundation. The discussion includes the three dams that carry a Significant Hazard Classification.

To roughly estimate the number of buildings as risk of inundation due to dam failure, the Town used the inundation areas mapped for the Rising, Three Mile and Mill Ponds and counted the number of buildings within those boundaries. MassGIS and Town Assessor data was used to estimate the assessed value of the buildings identified within the inundation areas. It should be noted that the estimates should be considered very rough due to several factors: 1) inundation areas are for full dam breach, which does not always occur in dam failures; 2) because the boundaries for Three Mile and Mill Ponds are very roughly drawn and not very accurate, the number of buildings in those inundation areas is also a very rough estimate; and 3) depth and velocity of flooding in the inundation areas are not known for any of the buildings, and as such damages to the structures or their content is not able to be calculated accurately.

Table 3.5.5. Buildings and Total Assessed Value in Inundation Areas

Name of Impoundment	Estimated Number of Buildings in Inundation Area	Estimated Total Assessed Value of Buildings in Inundation Area
Rising Pond	37	$7,125,000
Three Mile Pond	29	$6,019,600
Mill Pond	69	$15,968,600

Source: BRPC, 2018.

The inundation areas for dam failures at Mill and Three Mile Ponds are smaller in area but have extensive damages associated with them, because of residential development. The inundation for Rising Pond is largely contained to the floodplain, which has less residential development. It should be noted that the inundation area for Rising Pond hosts large agricultural acreage, damages for which were not calculated as part of this analysis.

Critical Facilities

All critical facilities and transportation infrastructures in the dam failure inundation area are vulnerable to damage. Flood waters may potentially cut off evacuation routes, limit emergency access, and destroy power lines and communication infrastructure. (MEMA, 2013) The Rising Pond dam is estimated to be the 100-year floodplain area along the Housatonic River in Sheffield, although the boundary at which flood waters would return to normal flow levels is not shown in the inundation map. No municipal critical facility is located within the Housatonic River's 100-year floodplain, but the Town Hall is just outside the inundation area for Mill Pond Dam.

Approximately a half mile of Main Street/Route 7 is in the inundation area for Mill Pond dam, and at least 1.6 miles of the road is in the inundation area for Rising Pond dam. As noted previously, the terminus of the inundation area of the Rising Pond dam unclear, and as much of the area flooded is approximate to the 100-year floodplain, it is likely that at least a half mile section of South Main Street/Route 7 would also be inundated.

Economy

Damage to buildings and infrastructure can impact a community's economy and tax base. Buildings and property located within or closest to the dam inundation areas have the greatest potential to experience the largest, most destructive surge of water. Several businesses and farm buildings, and large swaths of agricultural fields are within the inundation areas for both the Rising Pond and Mill Pond dams, as is Main Street/Route 7, the main transportation route for the Town of Sheffield, and a major north-south route for southern Berkshire County communities and the region.

3.5.4. Existing Protections

The Rising Pond Dam has undergone repair and rehabilitation in the 1990s and 2011-13, and has been given a Satisfactory Condition rating by the DCR Office of Dam Safety in 2016 (GZA, 2017). No other information is available for the other dams that could impact the Town of Sheffield.

The Town is currently updating its CEMP, which includes mapping and information about the dams in the Town.

3.5.5. Actions

- Obtain updated dam condition information and Emergency Action Plans for the six dams in Sheffield and Rising Pond in Great Barrington, and incorporate new data into the updated CEMP; review data and determine what, if any, actions are required.
- Based on updated dam information received, engage dam owners in conversations to understand their plans to mitigate known dam issues.

- Investigate possibility of conducting a dam failure exercise with SBREPC, MEMA, Sheffield first responders and other mutual aid communities as appropriate; if feasible conduct exercise.

3.6. Severe Winter Weather Hazards: Snow, Blizzards, Ice Storms and Nor'easters

3.6.1. General Background

Winter storms are the most common and most familiar of Massachusetts hazards which affect large geographical areas. The majority of blizzards and ice storms are viewed by people in the region as part of life in the Berkshires, an inconvenience and drain on municipal budgets. However, periodically, a storm will occur which is a true disaster, and necessitates intense, large-scale emergency response.

Snow formation requires temperatures to be below freezing in all or most of the atmosphere from the surface up to cloud level. Generally, ten inches of snow will melt into one inch of water. Sometimes the snow-liquid ratio may be much higher – up to 20:1 or 30:1. This commonly happens when snow falls into a very cold air mass, with temperatures of 20 degrees or less at ground level. (MEMA, 2013)

A blizzard is a winter snowstorm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below a quarter-mile. These conditions must be the predominant condition over a three-hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of this definition. However, the hazard created by the combination of snow, wind, and low visibility increases significantly with temperatures below 20°F. A severe blizzard is categorized as having temperatures near or below 10°F, winds exceeding 45 mph, and visibility reduced by snow to near zero. (MEMA, 2013)

A Nor'easter is typically a large counter-clockwise wind circulation around a low-pressure center often resulting in heavy snow, high winds, or rain. Strong areas of low pressure often form off the southeast coast of the U.S, moving northward with heavy moister air colliding with cooler winter inland temperatures. Sustained wind speeds of 20-40 mph are common during a Nor'easter, with short-term wind speeds gusting up to 50-60 mph or even to hurricane force winds. (MEMA, 2013) The main impacts of Nor'easters in the Berkshires is deep snow depths, high winds and reduced visibility, potentially resulting in the closing of schools, businesses, some governmental operations and public gatherings. Loss of electric power and possible closure of roads can occur during the more severe storms events.

Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects creating ice build-ups of ¼ inch or more that can cause severe damage. An ice storm warning, now included in the criteria for a winter storm warning, is for severe icing. This is issued when ½ -inch or more of accretion of freezing rain is expected. This may lead to dangerous walking or driving conditions and the pulling down of power lines and trees. (MEMA, 2013)

3.6.2. Hazard Profile

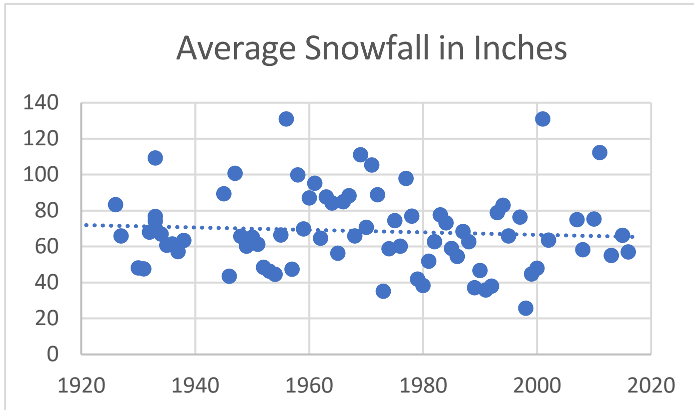
Location

Severe winter storm events generally occur across the entire area of Sheffield, although higher elevations have slightly higher snow depths.

Previous Occurrences

Figure 1 illustrate historic snowfall totals the region has received through 2017. (National Climatic Data Center, 2017) Although the entire community is at risk, the higher terrains tend to receive higher snowfall amounts, and these same areas may receive snow when the lower elevations received mixed snow/rain or just rain.

Figure 3.6.1. Average Snowfall in Berkshire County



The National Climatic Data Center (NCDC), a division of NOAA, reports statistics on severe winter storms from 1993 through 2017. During this 24-year span, Berkshire County experienced 151 severe winter storms, an average of six per winter. This number varies each winter, ranging from one during 2006 to 18 during 2008. Snow and other winter precipitation occur very frequently across the entire region. Snowfall in the region can vary between 26 and 131 inches a year, however it averages around 65 inches a year, down from around 75 inches a year in 1920.

Another tracking system is the one- and three-day record snowfall totals. According to data from the Northeast States Consortium, 99% of the one-day record snowfall events in the region typically yield snow depths in the range of 12”-24”, while the majority of three-day record snowfall events yield snow depths of 24”-36”.

Table 3.6.1. Record Snowfall Events and Snow Depths for Berkshire County

Record Snowfall Event	Snowfall 12” – 24”	Snowfall 24” – 36”
1-Day Record	99%	1%
3-Day Record	36%	64%

Source: (Northeast States Emergency Consortium, 2010).

Since 2000, two severe ice storm events have occurred in the region. The storms within that period occurred in December and January, but ice storms of lesser magnitudes may impact the region from October to April, and on at least an annual basis.

Based on all sources researched, known winter weather events that have affected Massachusetts and were declared a FEMA disaster are identified in Table 3.6.2. Of the 18 federally declared winter storm-related disaster declarations in Massachusetts between 1954 to 2018, Berkshire County has been included in 12 of those disasters. The number of disaster declarations for severe winter events in which Berkshire County was included is more than double that of declarations for non-winter severe storm events.

Table 3.6.2. Severe Winter Weather – Declared Disasters that included Berkshire County 1992-2017

Incident Period	Description	Declaration Number
12/11/92-1213/92	Nor'easter with snow 4'+ in higher elevations of Berkshires, with 48" reported in Becket, Peru and Becket; snow drifts of 12'+; 135,000 without power across the state	DR-975
3/13/93-3/17/93	High winds & heavy snow; generally 20-30" in Berkshires; blizzard conditions lasting 3-6 hrs afternoon of March 13.	EM-3103
1/7/96-1/8/96	Blizzard of 30+" in Berkshires, with strong to gale-force northeast winds; MEMA reported claims of approximately $32 million from 350 communities for snow removal	DR-1090
3/5/01-3/6/01	Heavy snow across eastern Berkshires to Worcester County; several roof collapses reported; $21 million from FEMA	EM-3165
2/17/03-2/18/03	Winter storm with snow of 12-24", with higher totals in eastern Berkshires to northern Worcester County; $28+ million from FEMA	EM-3175
12/6/03-12/7/03	Winter Storm with 1'-2' across state, with 36" in Peabody; $35 million from FEMA	EM-3191
1/22/05-1/23/05	Blizzard with heavy snow, winds and coastal flooding; highest snow falls in eastern Mass.; $49 million from FEMA	EM-3201
4/15/07-4/16/07	Severe Storm and Flooding; wet snow, sleet and rain added to snowmelt to cause flooding; higher elevations received heavy snow and ice; $8 million from FEMA	DR-1701
12/11/08-12/12/08	Major ice storm across eastern Berkshires & Worcester hills; at least ½" of ice accreted on exposed surfaces, downing trees, branches and power lines; 300,000+ customers without power in state, some for up to 3 wks.; $51+ million from FEMA	DR-1813
1/11/11-1/12/11	Nor'easter with up to 2' within 24 hrs.; $25+ million received from FEMA	DR-1959
10/29/11-10/30/11	Severe storm and Nor'easter with 1'-2' common; at peak 665,000 residents state-wide without power; 2,000 people in shelters statewide	DR-4051
2/8/13-2/9/13	Severe Winter Snowstorm and Flooding; $56+ million from FEMA	RE-4110

Source: FEMA 2017.

Probability of Future Occurrences

Severe winter weather is a common occurrence each year in Massachusetts. According to the NOAA-NCDC storm database, over 200 winter storm events occurred in the Commonwealth between 2000 and 2012. Therefore, the subset of severe winter storms are likely to continue to occur annually (MEMA, 2013). The Town of Sheffield's location in Western New England places it at a high-risk for winter storms. While the Town may not get the heavy snowfall associated with coastal storms, the severe storms that the county gets are added to the higher annual snowfall the county normally gets due to its slightly higher elevation then its neighboring counties in the Pioneer and Hudson River Valleys.

Using history as a guide for future severe winter storms, it can be assumed that Sheffield will be at risk for approximately six severe winter storms per winter. The highest risk of these storms occurs in January with significant risk also occurring in December through March. The region is getting less snowfall then previous years and can expect less snowfall in future years, however this does not mean the county will not experience years with high snowfall amounts (2010-11 had over 100 inches), but the trend indicates that the yearly snowfall total will continue to go down. It should be noted that although total snow depths may be reduced in the future, warmer winter temperatures will likely increase the number and severity of storms with heavy, wet snow, which can bring concerns for road travel, human injuries linked to shoveling, risk of roof failures and power outages.

Severity

The magnitude or severity of a severe winter storm depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day (e.g., weekday versus weekend), and time of season. (MEMA, 2013)

NOAA's National Climatic Data Center (NCDC) is currently producing 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 one to five, which is similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. RSI is based on the spatial extent of the storm, the amount of snowfall, and the combination of the extent and snowfall totals with population. Data beginning in 1900 is used to give a historic perspective (MEMA 2013, NOAA 2018).

Table 3.6.3. – Regional Snowfall Index Ranking Categories

Category	Description	RSI-Value	Approximate Percent of Storms
1	Notable	1-3	1%
2	Significant	3-6	2%
3	Major	6-10	5%
4	Crippling	10-18	25%
5	Extreme	18+	54%

Source: MEMA 2013.

Of the 12 recent winter storm disaster declarations that included Berkshire County (as listed in Table 3.6.2), only two events were ranked as Extreme (EM-3103 in 1993 and DR-1090 in 1996), one was ranked Crippling (IM-3175 in 2003) and two were ranked as Major (EM-3191 in 2003 and DR-4110 in

2013). It should be noted that because population is used as a criteria, the storms that rank higher will be those that impact densely populated areas and regions such as Boston and other large cities and, as such, might not necessarily reflect the storms that impact lightly populated areas like the Berkshires. For example, one of the most famous storms in the Commonwealth in modern history was the Blizzard of ’78, which dropped over two feet of snow in the Boston area during 65 mph winds that created enormous drifts and stranded hundreds of people on local highways. The storm hit the snow-weary city that was still digging out of a similar two-foot snowstorm 17 days earlier. Although the Berkshires received snow from this storm, the county was not listed in the declaration.

One of the most serious storm to impact communities in the Berkshires was the Ice Storm of December 11, 2008. The storm created widespread downed trees and power outages all across New York State, Massachusetts and New Hampshire. Over one million customers were without electricity, with 800,000 without power three days later and some without power weeks later. Living conditions were acerbated by extremely cold temperatures in the days following the event.

While severe winter weather declarations have become more prominent in the 1990s, we do not believe that this reflects more severe weather conditions than the Berkshires experienced in the years 40+ years prior to the 1990s. Respected older residents across Berkshire County comment that snow depths prior to the 1990s were consistently deeper that what currently occurs in the 2010s.

Fig. 3.6.2. Opening Mohawk Trail in Florida with Shovels 1926

Source: Stan Brown, Florida, MA

Warning Time

Meteorologists can often predict the likelihood of a severe winter storm. This can give several days of warning time. Schools and businesses usually have at least a 24-hour warning to monitor weather reports and start to plan closings. However, meteorologists cannot predict the exact time of onset or severity of the storm so decisions on closing schools, businesses or events are often made hours earlier. Some storms may come on more quickly and have only a few hours of warning time. (MEMA, 2013)

Secondary Hazards

Structural damage (snow load); wind damage; impact to life safety; disruption of transportation routes; loss of productivity; municipal, business and societal economic impacts; loss of ability to evacuate; taxing first responder capabilities; service disruption (power, water, etc.); and communication disruption. (MEMA, 2013)

Climate Change Impacts

The climate of the region is changing and will continue to change over the course of this century. Since 1900, ambient air temperatures have increased by 0.5°F. This warming trend has been associated with other changes, such as more frequent day temperatures above 90°F, reduced snowpack, and earlier snow melt and spring peak flows. By the end of the century, under the high emissions scenario of the

Intergovernmental Panel on Climate Change, Massachusetts is expected to experience a 5°F to 10°F increase in average ambient temperatures with more days of extreme heat during the summer. Sea surface temperatures are expected to incase by 8°F, which can influence precipitation temperature and dictate whether it falls as snow, ice or rain. (MEMA, 2013)

Along with rising temperatures, it is expected that annual precipitation will increase by 14%, with a slight decrease in summer totals and a 30% increase in winter totals. Winter precipitation is predicted to more often be in the form of rain rather than snow. This change in precipitation will have significant effects on the amount of snow cover, winter recreation, spring snowmelt and peak stream flows, water supply, aquifer recharge, and water quality. The Commonwealth is located in an area where thresholds between snow and rain are sensitive and reductions in snow would be the largest. Snow is also predicted to fall later in the winter and cease falling earlier in the spring. (MEMA, 2013)

Exposure

All areas within the Town of Sheffield are exposed to severe winter storm events. There are areas on the western portion of the Town where snow drifts are known to be more severe, specifically along Foley Road and lower Silver Street / Cooper Hill Road. Travel in these areas can be restricted during times of high winds and drifting. These areas are show in yellow on the Critical Facilities and Areas of Concern Map in Appendix 1.

3.6.3. Vulnerability

Population

According to the NOAA National Severe Storms Laboratory, every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion, and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow, and extreme cold temperatures with dangerous wind chill. These are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. Injuries and fatalities may occur due to traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold. (MEMA, 2013)

Heavy snow can immobilize a region and paralyze a city, shutting down air and rail transportation, stopping the flow of supplies, and disrupting medical and emergency services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. (MEMA, 2013)

The entire population of Sheffield is exposed to the severe winter weather hazard, particularly those that work outside or whose job requires that they respond to the weather, such as shoveling, plowing or clearing snow from building roofs. Older residents are considered most susceptible due to their increased risk of injury and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice, or related to power failures. Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). In addition, severe winter weather events can reduce the ability of vulnerable populations to access emergency services. Power outages can result in complete loss of heat for those who have electric heat or where electricity is required to run boilers or pellet stoves. Frozen water pipes could burst and threaten the home and the health of the residents who reside there. The ice storm of 2008 was the incident that created the longest power outages in the region in recent memory, but this storm did not impact residents in the Town of Sheffield.

Deep and heavy snow depths can weaken building roofs and threaten the structural integrity below them, injuring or killing people inside the building or those standing close to collapsing buildings. The weight of one foot of light fresh snow ranges from three pounds per square foot to 21 pounds per square foot for wet heavy snow.[1] Heavy snow loads in February/March 2015 caused the collapses of at least 210 buildings across the state.[2] Snow loads on buildings and homes with poorly insulated or vented attics are prone to melting and refreezing, causing the snow load to be heavier and making the roof more prone to ice dam damage. Educating building owners about improvements that could be done to protect roofs from snow load and ice dam damage would help to reduce risk from building collapse.

Critical Facilities

All critical facilities and infrastructure in Sheffield are exposed to the severe winter weather hazards. Full functionality of critical facilities such as police, fire and medical facilities is essential for response during and after a winter storm event. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. (MEMA, 2013)

A specific area that is vulnerable to the winter storm hazard is the floodplain. Snow and ice melt can cause riverine flooding. At-risk general building stock and infrastructure in floodplains are presented in the flood hazard profile (Section 3.2.). These risks can expect to increase as warmer winter temperatures results in more rain events.

Economy

The entire general building stock inventory in the community is exposed and vulnerable to severe winter weather hazards. In general, structural impacts include damage to roofs and building frames, rather than building content. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces. (MEMA, 2013)

Current modeling tools are not available to estimate specific losses for severe winter events. As an alternate approach, this Plan considers a one percent damage of structures that could result from winter storm conditions. This one percent was used by the state in their 2013 State Hazard Mitigation Plan. Table 3.6.4 summarizes percent damages that could result from winter storm conditions on the community's total general building stock (structure only). These figures do not include financial losses suffered by businesses due reduced business hours or closures.

[1] *FEMA, 2013. Risk Management Series, Snow Load Safety Guide, FEMA P-957. Washington, DC.*

[2] *https://www.bostonglobe.com/metro/2015/03/04/partial-roof-collapse-bayside-expo-center-dorchester-fire-officials-say/T3gLvWMMB7Jd7YszVABPDL/story.html*

Table 3.6.4. Estimated Potential Loss Due to a Severe Winter Storm Event

Number of Buildings	Replacement Cost Value (Structure Only)	1% Loss
2,803	$527,483,900	$5,274,839

As stated earlier, full functionality of critical facilities is essential for response during and after a winter storm event. Potential structural damage to the facilities themselves may include damage to roofs and building frames. However, these facilities may not be fully operational due to workers unable to travel to ensure continuity of operations pre- and post-event. A total severe winter storm risk exposure would equal to the full replacement value of each critical facility exposed, but this type of damage has not occurred in Berkshire County. (MEMA, 2013)

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain municipal and state financial resources due to the cost of staff overtime, salt and sand, snow removal and wear on equipment. Rescheduling of schools and other municipal programs and meetings can also be costly. The potential secondary impacts from winter storms also impact the local economy including loss of utilities, interruption of transportation corridors, and loss of business operations and functions, as well as loss of wages for employees.

3.6.4. Existing Protections

Experiencing snow storms and severe winter weather are considered part of living in Berkshire County. Municipalities budget money for snow plowing, sanding and overtime, and public works road crews plan equipment and materials purchases in preparation for the winter season. Capital improvements often consider new truck or plow equipment. Most snow and severe winter weather events are considered expensive nuisances, with only the most severe blizzard or Nor'easters that threaten human health due to closed transportation routes or services, or those that cause power outages, a cause for concern.

The Town of Sheffield follows the Massachusetts building code. In this building code, most of Berkshire County is in a zone that requires new construction to withstand 50 pounds per square foot (psf) of snow load, with a few south county towns having a rating of 40 psf. These are the strongest requirements in the state, with other parts of the state requiring strengths of 25-40 psf, depending on the location of the municipality. The snow load is an important consideration when building owners are considering installing solar panel on homes and businesses.

Properly insulated and sealed homes can maintain warm interior temperatures longer during a winter power outage than those with little or no insulation, reducing health risks to inhabitants sheltering in place and the risk of frozen pipes. Properly insulating and venting attics can help to reduce ice dam damage. The MassSave energy program offers free home audits and provide financial incentives for owners to seal and insulate the building envelopes. Berkshire Community Action Council provides further assistance by aiding low income residents access fuel assistance and home improvement programs, including weatherization and energy-efficient furnaces and appliances. Being able to retrofit homes with little or no insulation is important as 40% of the building stock in Berkshire County was constructed before 1940, and 60% is pre-1960.[3]

3.6.5. Actions

- Enforce snow load building code regulations.
- Encourage building owners to get energy audits and improve building efficiency to reduce human health risk due to extreme cold and power outages, and reduce risk of building damage such as ice dams.
- Encourage cell phone users to enlist in the Town's Code Red system.
- Encourage older residents, disabled and those with medical issues to self-identify with the Sheffield Police Department as having special needs during emergency incidents.
- Develop and deploy education program to inform residents of their responsibilities, primarily for themselves and neighbors, during power outages and extreme winter weather events.

[3] *BRPC, 2014. Sustainable Berkshires, a Long-Range Plan for Berkshire Count, Housing and Neighborhoods. Pittsfield, MA*

3.7. Drought Hazard

3.7.1. General Background

Drought is a period characterized by long durations of below normal precipitation. Drought occurs in virtually all climatic zones, yet its characteristics vary significantly from one region to another, since it is relative to the normal precipitation in that region. Direct impacts of drought include reduced water supply, crop yield, increased fire hazard, reduced water levels, and damage to wildlife and fish habitat.

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) and the Massachusetts Emergency Management Agency (MEMA) partnered to develop the *Massachusetts Drought Management Plan*, of which 2013 is the most updated version. The state's Drought Management Task Force, comprised of state and federal agencies, was created to assist in monitoring, coordinating and managing responses to droughts and recommends actions to minimize impacts to public health, safety, the environment and agriculture (EEA, MEMA, 2013). The MA Department of Conservation Resources staff compile data from the agencies and develop monthly reports to track and summarize current water resource conditions.

In Massachusetts the determination of drought level is based on seven indices: Standardized Precipitation Index, Crop Moisture Index, Keetch-Byram Drought Index, Precipitation, Groundwater levels, Streamflow levels, and Index Reservoir levels. The Standardized Precipitation Index (SPI) reflects soil moisture and precipitation conditions, calculated monthly using Massachusetts Rainfall Database at the Department of Conservation and Recreation Office of Water Resources. SPI values are calculated for "look-back" periods of 1 month, 3 months, 6 months, and 12 months. (EEA, MEMA 2013)

The Crop Moisture Index (CMI) reflects short-term soil moisture conditions as used for agriculture to assess short-term crop water conditions and needs across major crop-producing regions. It is based on the concept of abnormal evapotranspiration deficit, calculated as the difference between computed actual evapotranspiration (ET) and computed potential evapotranspiration (i.e., expected or appropriate ET). Actual evapotranspiration is based on the temperature and precipitation that occurs during the week and computed soil moisture in both the topsoil and subsoil layers.

The Keetch-Byram Drought Index (KBDI)is designed specifically for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. It is a continuous index, relating to the flammability of organic material in the ground. The KBDI attempts to measure the amount of precipitation necessary to return the soil to full field capacity. The inputs for KBDI are weather station latitude, mean annual precipitation, maximum dry bulb temperature, and the last 24 hours of rainfall.

Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on streamflow, water supply, reservoir levels, soil moisture and potential for forest fires. Precipitation is a key factor because it is the overall cause of improving conditions. Groundwater levels respond slowly to improving conditions, so they are good indicators of long-term recovery to normal conditions.

3.7.2. Hazard Profile

Location

For the purposes of tracking drought conditions across the Commonwealth, the state has been divided into six regions, with the Western Region being made up of Berkshire County. For the purposes of this Plan, the entire Town of Sheffield is at risk of drought. This includes not only residents and businesses, but also the farming community, which is an integral part of the fabric of Sheffield.

The Mountain Water Systems serves approximately 490 customers, 90% of which are residential customers; the other 10% includes municipal buildings and many water hydrants, Plaskolite and Berkshire Distillery. The company operates two wells, which are located off Maple Avenue and Pike Road. Those homes and businesses not served by Mountain Water Systems are served by private wells. In years past point wells have been reported to go dry during droughts, but there have been no recent reports of this happening.

Previous Occurrences

Massachusetts is relatively water-rich, with few documented drought occurrences. According to the state's Hazard Mitigation Plan of 2013, the state has experienced multi-year drought periods during 1879-83, 1908-12, 1929-32, 1939-44, 1961-69 and 1980-83. There have been 13 documented droughts in the state between 1945 and 2002 (see Table 3.7.1). (MEMA, 2013) The most severe drought occurred during the 1960s, due to both severity and extended duration.

Table 3.7.1. Estimated Droughts Based on the Mass. Standardized Precipitation Index

Year(s)	Duration (Months)	Estimated Drought Level
1924-1925	13	Warning
1930-1931	12	Emergency
1934-1935	15	Warning
1944	11	Watch
1949-1950	15	Watch
1957-1958	12	Warning
1964-1967	36	Emergency
1971	8	Watch
1980-1981	13	Watch
1985	7	Watch
1988-1989	11	Watch
1990-1991	9	Watch
2001-2002	13	Watch

Source: MEMA, 2013

Additional post-2013 data gathered shows that droughts occurred in the state 2007-08 and in 2010, although neither of these involved drought conditions in Berkshire County (Western Drought Region). The most recent drought in Massachusetts occurred during a 10-month span in 2016-17. In July 2016 Advisory and Watch drought levels were issued for the eastern and central portions of the state, worsening in severity until the entire state was under a Drought Warning status for the months of November-December 2016. Water levels began to recover in February 2017, with the entire state determined to be back to normal water levels in May 2017. The Massachusetts Water Resources

Commission stated that the drought was the worst since the state's Drought Management Plan was first issued in 2001, and the most severe since the 1960s drought of record.[1] In general, the central portion of the state faired the worse and Berkshire County faired the best, with the county entering the drought later and emerging from the drought earlier than most of the rest of the state. Berkshire County was under a Watch status for two months and under a Warning status for three months during the height of the drought (see Table 3.7.2. and Fig. 3.7.2. and for the progression of the 2016-17 drought).

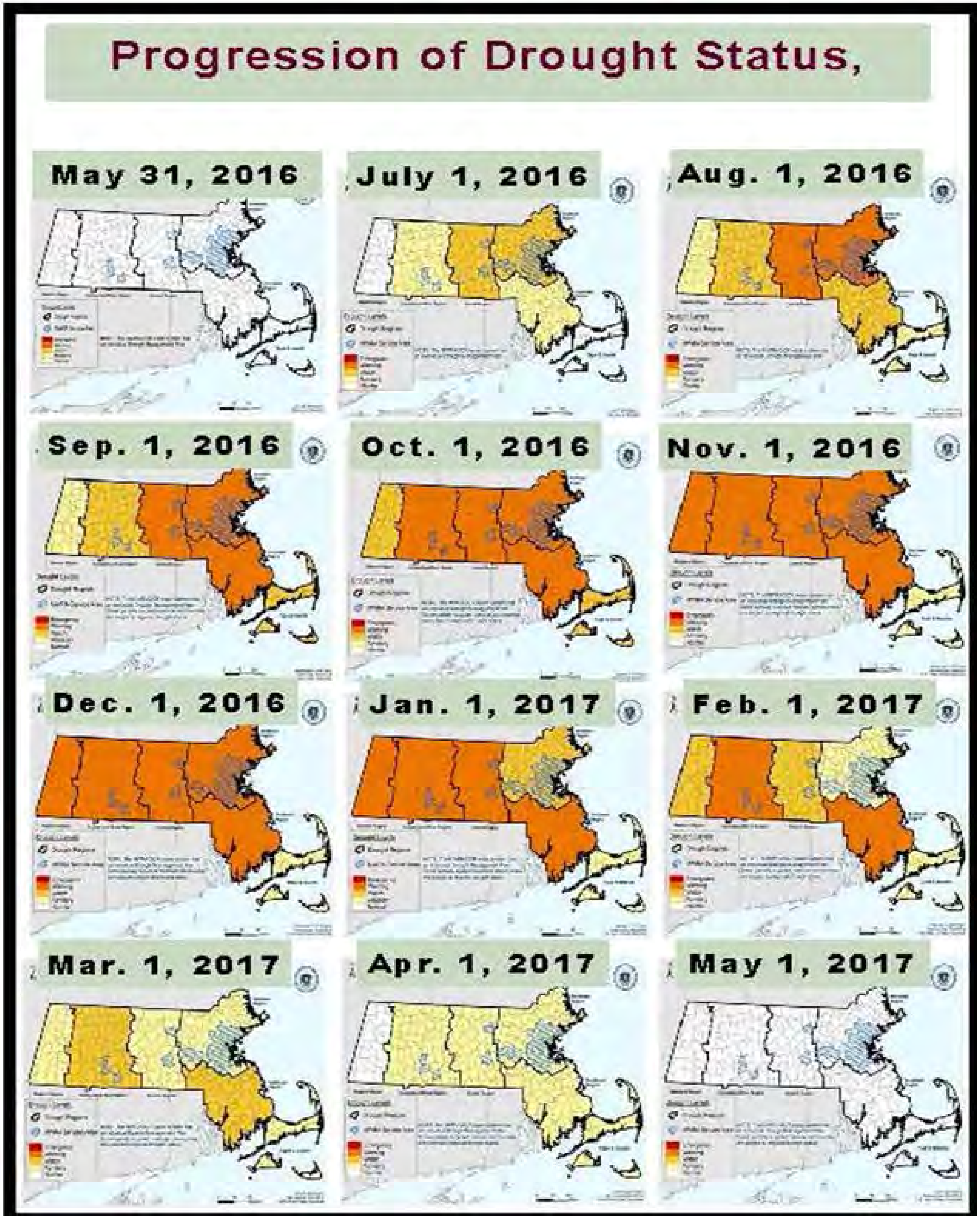
[1] MA Water Resources Commission, 2017. *Annual Report, Fiscal Year 2017*. Boston, MA.

Table 3.7.2. Drought Events and Levels 2001-2017

					Drought Level by Regions				
Year	**Begin Date**	**End Date**	**Comment**	**Western**	**CT River**	**Central**	**Northeast**	**Southeast**	**Cape & Islands**
	12/28/2001	**1/31/2003**							
2001	**12/28/2001**			Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			February 2002	Advisory	Watch	Watch	Watch	Advisory	Advisory
2002			March 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			April 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			May 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			June 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			July 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			August 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			September 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			October 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			December 2002	Normal	Normal	Normal	Normal	Normal	Advisory
2003		**1/31/2003**	As of January 31, 2003	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2007	**3/18/2008**							
2007	**10/1/2007**			Normal	Advisory	Advisory	Advisory	Advisory	Normal
2008		**3/18/2008**	As of March 18, 2008	Normal	Normal	Normal	Normal	Normal	Normal
	8/1/2010	**11/19/2010**							
2010	**8/1/2010**			Normal	Normal	Advisory	Advisory	Normal	Normal
2010			October 2010	Normal	Advisory	Advisory	Advisory	Normal	Normal
2010		**11/19/2010**	As of November 19, 2010	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2014	**11/30/2014**							
2014	**10/1/2014**			Normal	Normal	Normal	Normal	Advisory	Advisory
2014		**11/30/2014**	As of December 1, 2014	Normal	Normal	Normal	Normal	Normal	Normal
	7/1/2016	**4/30/2017**							
2016	**7/1/2016**		June 2016	Normal	Advisory	Watch	Watch	Advisory	Normal
2016			July 2016	Advisory	Watch	Warning	Warning	Watch	Advisory
2016			August 2016	Advisory	Watch	Warning	Warning	Warning	Watch
2016			September 2016	Watch	Warning	Warning	Warning	Warning	Watch
2016			October 2016	Warning	Warning	Warning	Warning	Warning	Advisory
2016			November 2016	Warning	Warning	Warning	Warning	Warning	Advisory
2016			December 2016	Warning	Warning	Warning	Watch	Warning	Advisory
2017			January 2017	Watch	Warning	Watch	Advisory	Warning	Advisory
2017			February 2017	Advisory	Watch	Advisory	Advisory	Watch	Advisory
2017			March 2017	Normal	Advisory	Advisory	Advisory	Advisory	Advisory

Source: https://www.mass.gov/files/documents/2017/09/08/drought-status-history.pdf

Fig. 3.7.2. Progression of the 2016-17 Drought



Source: MA Water Resources Commission, 2017.

During this time the Mountain Water Systems issued a voluntary water restriction to its customers, limiting outdoor water use. The company's water supply was not in jeopardy, but the restriction was required of by the Massachusetts Department of Environmental Protection as a precaution.

Probability of Future Occurrences

An analysis of historical rainfall data indicated that, based on this index alone, between 1850 and 2012, the Commonwealth experienced drought emergency conditions in 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought period is viewed as the most severe and longest duration drought to have occurred in Massachusetts. On a monthly basis, there is a 1% chance of the Commonwealth being in a drought Emergency. Drought Warning conditions not associated with drought Emergencies occurred in 1894, 1915, 1930, and 1985. On a monthly basis, there is a 2% chance of the state being in a drought Warning level. Drought Watch conditions not associated with higher levels of drought would have typically occurred in three to four years per decade between 1850 and 1950. The overall frequency of the Commonwealth being in a drought Watch is 8% each month (MEMA, 2013). The drought levels, recurrence interval and state estimated drought level nomenclature is found in Table 3.7.3.

Berkshire County was determined to be in Warning drought conditions October 2016 through January 2017. Using the U.S. Drought Monitoring system, this type of drought event could be estimated to reoccur once per 10 to 50 years. Given that the duration was short and that the greatest severity was during the winter months, when water demand is less, water managers in Berkshire County did not suffer a severe threat to their supplies. The relatively low impact of this drought and of others in recent memory may lead water managers in the region towards a false sense of security.

Table 3.7.3. Mass. State Level and Comparable U.S. Drought Monitor Level Indices

MA Drought Levels	Names	Recurrence	Percentiles
Advisory	D0: Abnormally Dry	once per 3 to 5 years	21 to 30
Watch	D1: Moderate	once per 5 to 10 years	11 to 20
Warning	D2: Severe Drought	once per 10 to 20 years	6 to 10
Warning	D3: Extreme Drought	once per 20 to 50 years	3 to 5
Emergency	D4: Exceptional Drought	once per 50 to 100 years	0 to 2

Source: U.S. Drought Monitor; MA Drought Management Plan 2013.

Severity

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with immediate impacts on people or property, but they can have significant impacts on agriculture, which can impact the farming community of the region. As noted in the state Hazard Mitigation Plan, agriculture-related drought disasters are quite common, with 1/2 to 2/3 of the counties in the U.S. having been designated as disaster areas in each of the past several years. These designations make it possible for producers suffering losses to receive emergency loans. Such a disaster was declared in December 2010 for Berkshire County (USDA Designation # S3072).

When measuring the severity of droughts, analysts typically look at economic impacts on a planning area. Drought warnings, watches and advisories can be reduced based on: 1) normal levels of precipitation, and 2) groundwater levels within the "normal" range. In order to return to a normal status, groundwater levels must be in the normal range and/or one of two precipitation measures must be met. The precipitation measures are: 1) three months of precipitation that is cumulatively above normal, and 2) long-term cumulative precipitation above normal. The period for long-term cumulative precipitation ranges from 4 to 12 months, depending on the time of year. Precipitation falling during the fall and spring is ideal for groundwater recharge and, therefore, will result in the quickest return to normal conditions. Because the same levels of cumulative precipitation can differ in their abilities to reduce drought conditions, the decision to reduce a drought level will depend on the professional judgment of the Secretary of EEA with input from his agencies and the Drought Management Task Force (EEA, MEMA 2013)

MassDEP has the authority to declare water emergencies for communities facing public health or safety threats as a result of the status of their water supply systems, whether caused by drought conditions or for other reasons. The Department of Public Health (DPH) in conjunction with MassDEP monitors drinking water quality in communities.

According to the data at hand, the most severe droughts in Massachusetts occurred 1930-31 and 1964-67. Many local water managers and officials remember the drought years of the 1960s, where mandatory water bans were issued. Outside of this time period, most water restrictions in the region have been voluntary.

Warning Time

Droughts are climatic patterns that occur over long periods of time. Drought levels advisories are issued at gradual levels to alert the public to conditions that, if continued, could result in more serious degrees of drought. Initial drought levels include Advisory and Watch levels. Voluntary water conservation efforts are advised during early stages of drought conditions and increasing conservation requirements are expected when Drought Warning and Emergency conditions develop. These higher levels of drought require months of dry conditions to be reached. (MEMA, 2013) Therefore, according to state agencies, there is a lot of lead time as drought conditions progress.

Despite the long lead time to drought conditions, efforts to conserve water on the municipal, private and individual level should be encouraged and conducted on an ongoing basis. Efforts by water managers to identify and remedy leaks in the piping system that deliver water supplies should be given ongoing attention, and efforts to encourage customers to conserve water in the home and in commercial and industrial uses should be given additional attention. Water conservation efforts will reduce the demand on reservoir and groundwater supplies in the event that a multi-year Emergency Drought event, like that of the 1960s, recurs.

Secondary Hazards

The secondary hazard most associated with drought is wildfire. For drought conditions to occur it is likely that soil moisture is limited or lacking, forest duff is dried out and standing vegetation is dry and possibly dead, providing the fuel needed for a wildfire. Given that the Town of Sheffield is 66% forested, the risk of wildfire during drought conditions is a concern. Further, given that approximately 19% of the Town's land is under agricultural use, dry or dead standing crops, particularly corn stalks or hay, can also represent a risk of fire. Dry vegetation conditions along the railroad route are also a of greater concern during dry, drought conditions.

Climate Change Impacts

Changes in winter temperatures will lead to less snow pack and more rain-on-snow events, leading to more surface runoff and less groundwater recharge, leading to less stream and river base flows. Higher temperatures in warmer seasons can more severely impact the reduced base flows due to higher rates of evaporation of moisture from soil and lower groundwater and surface water inputs. According to the state's Climate Change Adaptation Report, a continued high greenhouse-gas-emission scenario could result in a 75% increase in the occurrence of drought conditions lasting 1-3 months.[2]

Exposure

For the purposes of this Plan, the entire Town of Sheffield is at risk of exposure to drought. It is generally believed that residents that are on private wells may be more susceptible to drought, particularly those with shallow or point wells, but there is not definitive data to verify this belief.

3.7.3. Vulnerability

To understand risk, this Plan considers the impact to population, critical facilities and the economy.

Population

For the purposes of this Plan update, the entire population of Sheffield is exposed and vulnerable to drought. The Berkshire region has not suffered a severe, emergency level drought since the 1960s and it is unclear how well the Mountain Water System's system could serve the demands of its customers during a severe drought emergency.

Due to the great expanses of state forest and wildlife lands in the region, which attract hikers and campers, and a tourist-based economy that brings additional people to the region in the summer, the risk of wildfire would increase during a severe drought. Drought would reduce the capacity of local firefighting efforts, hampering control of wildfire or urban fires. A more detailed discussion of wildfire and the Town's vulnerability is found in Section 3.8 of this Plan.

Critical Facilities

Drought does not threaten the physical stability of critical facilities in the same manner as other hazards such as wind-based or flood-related events. Facilities and structures located outside the Town Center and in areas surrounded by forest or dry vegetation, such as water tanks, water pumps, and other infrastructure, could be more vulnerable to wildfire.

[2] EEA, Adaptation Advisory Committee, 2011. *MA Climate Change Adaptation Report, Boston*, MA.

If a severe drought of long duration were to occur, the Town and Mountain Water Systems may receive requests to provide water to residents whose wells have gone dry. An emergency dispensing center may need to be created to serve this population, as the infrastructure does not currently exist to do so.

Economy

A severe, long-term drought could impact the operation of Sheffield employers, particularly those that use water as part of the processes, such as Plaskolite, Southern Berkshire Regional School District, Berkshire Distillery and Big Elm Brewery. Drought would also impact the local farming community, much of which consists of dairy farms, one of which is one of the largest in the state. Other farms in Sheffield raise vegetable, fruit, or turf crops, all of which are dependent on a steady supply of water for growth. Drought could result in crop losses and drops/losses in milk and other livestock production. Dry standing vegetation in fields could increase risk of wildfires.

3.7.4. Existing Protections

Mountain Water Systems does issue tips in the summer to its customers on conserving water. The Company does not provide any financial incentives to do so, however water usage by all customers is metered. Mountain Water Systems filed for a 58% increase in its water fees in November 2017. No approval has been given by the State at the time of this Plan's development. Higher water prices may encourage increased conservation or reduced usage. The company could partner with the MassDEP, Department of Energy Resources and the utilities to encourage residents and businesses to install water conservation measures, many of which are offered free of charge or with favorable financing. As Sheffield has no municipal water system, it is up to residents to monitor their water usage from their private wells.

The Massachusetts Department of Environmental Protection has broad jurisdiction to protect water supply and water quality. During a state of water emergency, MassDEP may issue orders to: (1) establish priorities for the distribution of any water or quantity of water use; (2) permit any person engaged in the operation of a water supply system to reduce or increase by a specified amount or to cease the distribution of that water; to distribute a specified amount of water to certain users as specified by the department; or to share any water with other water supply systems; (3) direct any person to reduce, by a specified volume, the withdrawal or use of any water; or to cease the withdrawal or use of any water; (4) require the implementation of specific water conservation measures; and, (5) mandate the denial, for the duration of the state of water emergency, of all applications for withdrawal permits within the areas of the Commonwealth to which the state of water emergency applies (EEA, MEMA, 2013)

Municipalities also have jurisdiction to control water supplies for protection of public health. Municipalities can adopt and implement bylaws to regulate public water supply pipes or to manage their prudential affairs and preserve peace and good order under their police powers, pursuant to G.L. c. 40, § 21, and c. 41, § 69B. Further, when MassDEP determines that an emergency exists in the case of a drought or disaster, a municipality may, following appropriate notice, regulate or otherwise restrain the use of water on public or private property (regardless of whether the supply source is public or private) pursuant to G.L. c. 40, § 41A. (EEA, MEMA 2013)

3.7.5. Actions

- Encourage the Town of Sheffield and Mountain Water Systems to partner on a water conservation campaign or strongly encourage Mountain Water Systems to conduct such a program through its own resources, if it is not already doing so.
- Working with MassSaves and other available water conservation programs, encourage residents to install water saving technologies; many of these devices are available at no or minimal expense.

3.8. Fire Hazard

3.8.1. General Background

There are three basic fire hazard regions discussed as part of this risk assessment: Urban Fire, Wildland-urban, and Wildfire. A major urban fire or conflagration is a large destructive, often uncontrollable, fire that causes substantial destruction. Over the past several years, structure fires in Massachusetts account for the majority of fire deaths, injuries, and property loss within the Commonwealth. In Massachusetts, 83% of building fires and 69% of fire deaths in 2010 took place in residential occupancies, with more fire deaths occurring in one-and two-family homes than in all other residential occupancies combined.

A wildland-urban interface area defines the conditions where flammable vegetation is adjacent to developed areas. The wildland-urban interface is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. In these areas, where homes are built among densely wooded areas, or uncut shrub or high grasses, when a fire starts, due to either human or natural causes, the fire may easily spread to the surrounding areas given plentiful vegetative fuels. The wildland-urban interface is at risk for wildfires due to human caused fire ignitions, which are more common than natural causes, such as lightning. (MEMA, 2013)

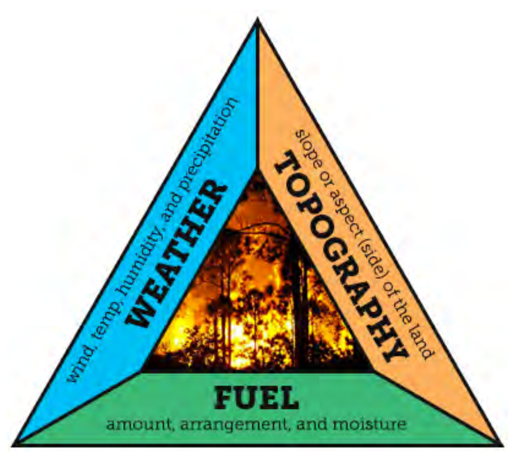
A wildfire can be defined as any non-structure fire that occurs in the vegetative wildland, including grass, shrub, leaf litter, and forested tree fuels. In general, wildfires in Massachusetts can be caused by human activity (prescribed burns or accidents) or natural events. Wildfires often begin unnoticed, but can spread quickly, igniting brush, trees, and homes. Because 95% of wildfires are started by negligent human behavior, such as smoking in forested areas or improperly extinguishing campfires, most are considered preventable. In 2011, approximately 8% of outside and other fires were considered intentionally set, indicating that the vast majority are started by accident. Wildfires can result in the destruction of forests, brush, field crops, grasslands, and personal property. (MEMA, 2013)

Fire Ecology and Wildfire Behavior

In the "wildfire behavior triangle", weather, topography and fuel are the three primary factors that influence wildfire behavior. Of the three, weather is the most variable and least predictable[1]. Climate change may influence future wildfire behavior due to changing weather and resulting fuel changes.

- Fuel:
  - Lighter fuels such as grasses, leaves, and needles quickly expel moisture and burn rapidly, while heavier fuels, such as tree branches, logs, and trunks, take longer to warm and ignite.

Fig. 3.8.1. Fire Behavior Triangle



[1] https://learn.weatherstem.com/modules/learn/lessons/121/12.html. *Source also of the triangle graphic.*

  - Snags and hazard trees—especially those that are diseased, or dying, or become receptive to ignition when influenced by environmental factors, such as drought, low humidity, and warm temperatures.
- Weather:
  - Strong winds can exacerbate extreme fire conditions, especially wind events that persist for long periods, or ones with significant sustained wind speeds that quickly promote fire spread through the movement of embers or exposure within tree crowns.
  - Spring and summer months, many of which maintain drought-like conditions extending beyond normal season also can increase the normal fire season. Likewise, the passage of a dry, cold front through the region can result in sudden wind speed increases and change in wind direction affecting fire spread.
  - Thunderstorms in Massachusetts are usually accompanied by rainfall; however, during periods of drought, lightning from thunderstorm cells can result in fire ignition. Thunderstorms with little or no rainfall are rare in New England but have occurred.
- Topography
  - Topography of a region or a local area influences the amount and moisture of fuel.
  - Barriers such as highways and lakes can affect spread of fire.
  - Elevation and slope of landforms—fire spreads more easily uphill compared to downhill.
- Climate Change
  - Without an increase in summer precipitation (currently greater than any predicted by climate models), future areas burned are very likely to increase.
  - Infestation from insects is of concern as it may affect forest health. Potential insect populations may increase with warmer temperatures. In addition, infested trees may increase fuel amount.
  - Tree species composition will change as species respond uniquely to a changing climate.
  - Wildfires cause both short-term and long-term losses. Short-term losses can include destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects may include smaller timber harvests, reduced access to affected recreational areas, and the destruction of cultural and economic resources and community infrastructure. (MEMA, 2013)

3.8.2. Hazard Profile

Location

The risk of large urban fires exists in few developed areas of Sheffield. The vast majority of buildings are found clustered in the two Town centers and the village center zoning districts. The building stock is comprised of modest sized homes in residential neighborhoods, many of which were built in the 19th and early 20th centuries, with a few subdivision enclaves and scattered large homes on larger lots.

The majority of land in Town is vulnerable to wildfire. Forty-eight percent of Sheffield is forested, with vast unfragmented forest blocks that lie east and west of the centrally developed and agricultural areas of the Town.

Previous Occurrences

The Town of Sheffield has had few fires in recent years, most of which burned less than two acres. The majority of fires are related to local resident brush pile burns getting out of control. In Sheffield, there have been no reports of wildfire during 2007-2016. (Massachusetts Fire Incident Reporting System, 2017)

Based on the DCR Bureau of Forest Fire Control and Forestry records, in 1911, more than 34 acres were burned on average during each wildfire statewide. Since then, that figure has been reduced to 1.17 acres on average per wildfire incident statewide. (MEMA, 2013) According to the Massachusetts Fire Incident Reporting System, wildfires reported to DCR in the past five years are generally trending downward. According to this system's reports, there were 901 fire incidents, combined urban and wildland, in Berkshire County during the years 2007-2016. Of these 411 (46% of total) occurred in the City of Pittsfield, the urban center of the region. This same data reports that a total of 832 acres were burned in the county during those 10 years, 631 (76%) of which are reported as acres of wildland burned. This indicates that over this 10-year span an average of 63 acres of wildland burned annually in Berkshire County. Of the 901 incidents, only 12 burned more than 10 acres and two of these burned more than 100 acres. It should be noted that during this same time period there were two large wildland fires in the county: 272 acres in Clarksburg near the Williamstown border in 2015 and 168 acres in Lanesborough in 2008. If these incidents were considered statistic outliers and removed from the data, the average totaled burned acres during 2007-2016 would be 39 and the average wildland acres burned would be 19. Berkshire County fire officials respond rapidly through mutual aid and through a coordinated effort with the DCR.

Probability of Future Occurrences

For the purpose of this Plan, the probability of future occurrences is defined by the number of events over a specified period. The historical record 2007-2016 indicates that Sheffield has on average 0 wildfires a year. Major urban fires are a low concern due to the lack of large urbanized areas where buildings are adjacent to one another. Many commercial buildings have their own fire detection and suppression systems. In the event of extremely dry conditions or drought, risk of fire in Sheffield includes not only structure and forest, but also large block of agricultural field, which could include crops, especially corn.

Frequency

It is difficult to predict the likelihood of urban fires and wildfires in a probabilistic manner, such as, "there will be a catastrophic wildfire once every X number of years." This is because the number of variable factors affecting the potential for a fire to occur and because some conditions (for example, ongoing land use development patterns, location, fuel sources, construction, etc.) exert increasing pressure on the wildfire and urban interface zone. Based on available data, urban fires and wildfires will continue to present a risk.

Differences in climate and building stock could play a factor in urban fires. It is likely that home fires related to heating occur more frequently in the northern areas of the U.S. Electrical distribution fires are likely to be more common in the northeast and south, where the building stocks are older, on average, than in the Midwest and West.

The wildfire season in Massachusetts usually begins in late March and typically culminates in early June, corresponding with the driest live fuel moisture periods of the year. April is historically the month in which wildfire danger is the highest. However, wildfires can occur every month of the year. Drought, lack of snow pack, and local weather conditions can expand the length of the fire season. The early and late shoulders of the fire season usually are associated with human-caused fires. (MEMA, 2013)

Severity

Sheffield is not developed to a density that would provide fuel for a major urban fire. Outside of mixed residential and commercial development along the Main Street / Route 7 corridor, development in Sheffield consists largely of single family homes and farm buildings, built along rural roads. The greater potential for significant damage to property from fire in Sheffield exists in areas designated as wildland-urban interface areas.

Warning Time

Early warning for urban fires is none or minimal at best. Smoke detectors provide early warning of a fire; however, they do not guarantee an escape. Federal studies have shown in a typical fire, one has only about three minutes to evacuate safely before unsustainable conditions are encountered. (MEMA, 2013)

Dry seasons and droughts are factors that greatly increase fire likelihood, and posting forest fire risk, issuing warnings and burn bans can reduce the risk of urban and urban-forest areas. If a fire breaks out and spreads rapidly, residents may need to evacuate within days or hours. A fire’s peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time. (MEMA, 2013) In Berkshire County, mutual aid response from neighboring towns is common, further reducing risks.

Secondary Hazards

Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the older residents, and those with respiratory and cardiovascular diseases. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Wildfires can generate a range of secondary environmental effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines, and contribute to flooding. They can strip slopes of vegetation, exposing them to greater amounts of runoff, which can in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. (MEMA, 2013) There are no areas in Sheffield that have been affected by these secondary hazards in recent memory.

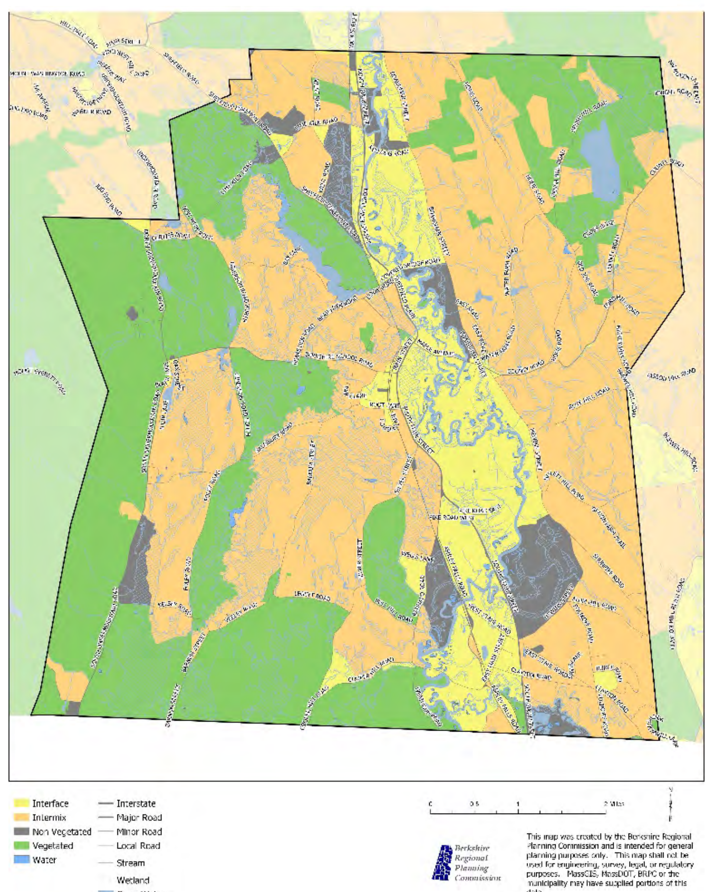
Climate Change Impacts

While climate change is unlikely to change topography, it can alter the weather and fuel factors of wildfires. Climate scenarios project summer temperature increases between 3^{o}F and 9^{o}F and precipitation increases of up 5 inches. (Northeast Climate Science Center, 2018) Hot dry spells create the highest fire risk, due to decreased soil moisture and increased evaporation and evapotranspiration. While in general annual precipitation has slightly increased Massachusetts in the past decades, the timing of snow and rainfall is changing. Less snowfall can lead to drier soils earlier in the spring and possible drought conditions in summer. More rain is falling in downpours, with higher rates of runoff and less soil infiltration. Such conditions would exacerbate summer drought and further promote high elevation wildfires where soil depths are generally thin. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods. (MEMA, 2013)

Exposure

The ecosystems in Massachusetts most susceptible to wildfire hazard are pitch pine, scrub oak, and oak forests. These are the most flammable vegetative fuels. (MEMA, 2013) Sheffield does not have any significant land coverage that include these ecosystems. Land use and forest cover are shown on Fig. 3.8.3., National Land Cover Data map.

Fig. 3.8.2. SILVUS Wildland-Urban Interface Map

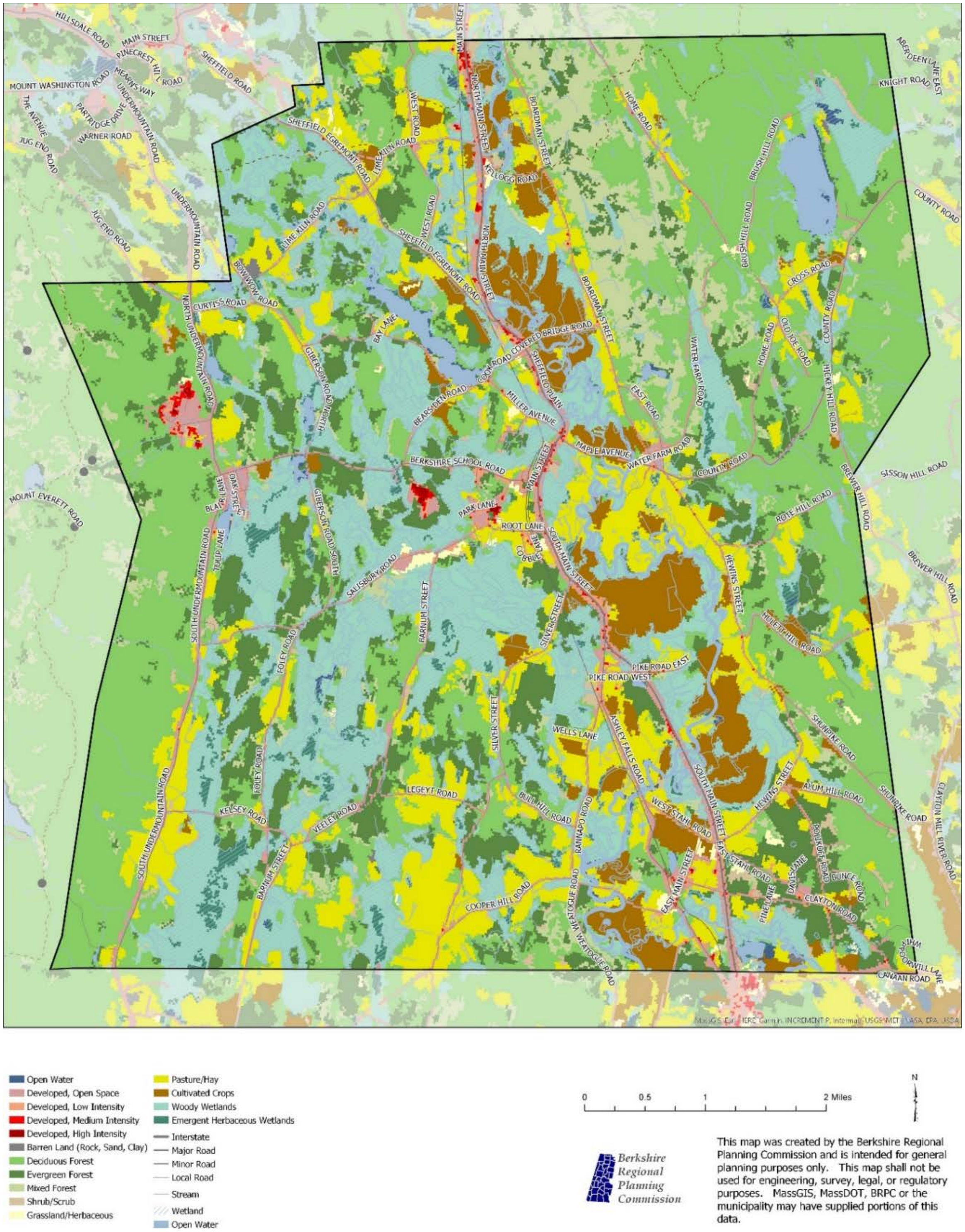


To understand risk, the assets exposed to the hazard areas are identified. For the wildfire hazard, areas identified as hazard areas include the wildland-urban areas. In its statewide hazard mitigation plan the Commonwealth utilized the SILVIS Lab, Department of Forest Ecology and Management at the University of Wisconsin to determine this risk. This method utilized census track data, the national land cover database and the protected areas database to determine risk.

This same method was utilized as part of the fire risk assessment analyses for the Town of Sheffield for this Hazard Mitigation Plan. However, upon examination of this data, the accuracy at the local level was questionable and raised more questions than it answered. For example, census blocks in some areas of the town include large blocks of undeveloped land and do not necessarily reflect the areas where homes are located within those blocks. In Sheffield this mapping model has identified the Interface area as being located along the Housatonic River corridor, show in yellow in Fig. 3.8.2. The Interface area, as described previously, is the area being at greater risk of fire due to human-caused fire ignition. However, in Sheffield this area is largely in agricultural use, not residential use.

A more accurate depiction to show location of development at risk of wildfire is the National Land Cover Data, which shows vegetative cover (including forest type), agricultural cover, and development according to density. This data is not based on census blocks, but on actual land use. As can be seen in the map in Fig. 3.8.3, development in Sheffield is scattered along the roadways throughout the Town, with denser development occurring along Main Street/Route 7, the historic main transportation route, and at Berkshire School. The land covers shown in Fig. 3.8.3. more accurately portrays the locations and interface of development and forest lands in Sheffield.

Fig. 3.8.3. Developed Areas (Red, Pink) – National Land Cover Data for Sheffield



3.8.3. Vulnerability

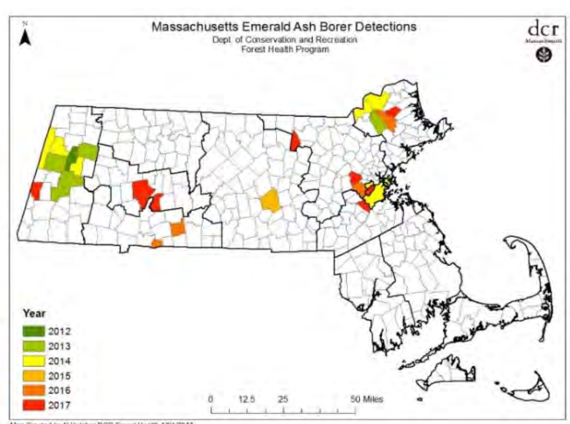
Population

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, older residents, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxins (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, eye irritation, odor, and reduction in visibility. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. (MEMA, 2013) Residents in all areas of the town are vulnerable to these secondary hazards due to the amount of forest lands within the Town, and first responders throughout the region who respond to fires within their town or through mutual aid are vulnerable to direct and indirect dangers fighting fires.

All Berkshire County communities are considered by the state, based on historic occurrences, to be at low risk of fire due to the number of fires that have occurred. This is most likely due to the low population density along the urban/woodland interface. The county's exception is the City of Pittsfield, which is considered to be at medium risk. To better understand the urban/wildland interface and the general forest types in the town, land cover was mapped using the Multi-Resolution Land Cover Database. According to this data and illustrated in Fig. 3.8.3, Sheffield is about 48% forested, with northern hardwoods comprising 65% of the forest and mixed forest comprising 11% of the forest. Conifer dominant forest, which poses a greater risk of wildlife, comprises about 24% of the forest. (Multi-Resolution Land Characteristics Consortium, 2011)

Fires within the Town's forests are highly dependent on soil and vegetation moisture and amount of underbrush. Much of the forest in Berkshire County is lightly being harvested, which can lead to a buildup of dry brush fuel. The ice storm of 2008, which impacted the higher elevations along the Berkshire and Hoosac Ranges, damaged much of the timber stock by knocking down limbs and damaging crowns, which exposed areas of the trees and main trunks to the elements. As a result, this storm created a large amount of fallen debris in the forest, leaving dead and dying snags, and in the long run increasing fuel for wildfire. Only the very highest elevations in Sheffield were lightly affected by this ice storm.

Fig. 3.8.4. Emerald Ash Borer Dispersal 2017



The presence of the Emerald Ash Borer, first found in Massachusetts in Dalton in 2012 (shown in dark green on Fig. 3.8.4.), has quickly spread throughout central Berkshire County. This rapidly-spreading invasive insect quickly kills its host trees within a few years of settling in an area, leading to massive die-offs of all ash trees within an area. This will increase the amount of dead limbs, brush and standing dead trees throughout forests in the county. UMass Extension states that, as a component of Massachusetts forests, the highest percentages of ash are located in Berkshire County[2]. Other invasive insects such as the Hemlock Wooly Adelgid threaten healthy hemlock stands and the Asian Longhorn Beetle threatens ash, maples, elms, poplar and willow. The fire risk impacts of the ice storm and invasive insects are not well documented at this time.

Critical Facilities

Sheffield critical facilities such as the Town Hall, Fire Station, Police Station, Senior Center and the regional school district's main campus are not set deep into woodlands, but rather have lawn and parking areas surrounding the buildings. The High School, which would serve as a local shelter if needed, is in a particularly open area because of the parking lots and the playing fields. Berkshire School is the town's most densely populated site, and some of the buildings housing students and staff are in or along the edge of woodlands. In the event of a large fire, most roads and the railroad would be without damage except in the worst scenario, but the loss of electric pole and wires could cause power outages. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers.

The Housatonic Railroad operates a commercial railroad that travels north-south through the Town. The railroad conducts annual brush maintenance along the tracks, including herbiciding and brush cutting that leaves dead and dried vegetation along the corridor. Although no fires have been reported along the corridor in Sheffield, there have been several derailments along the railway, including one in the Town.

Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures to the subsequent loss of revenue from destroyed business and decrease in tourism. Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire apparatus and thousands of volunteer man-hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from work to fight these fires.

To estimate potential residential losses, a risk exposure analysis was conducted. Quantifying the number of homes at risk involved utilizing 2010 Census data and breaking it into the Intermix and Interface areas delineated from SILVUS (see Fig. 3.8.2.). The SILVUS model was determined to be an appropriate model for this analysis because it could fairly accurately estimate the number of residential units within those areas. Using this model, it was determined that the Interface hazard area, a area of almost 4,000 acres and shown in yellow on the map in Fig. 3.8.2, contains 496 housing units, largely located along Main Street / Route 7. The Intermix hazard area, a much larger area of more than 14,000 acres and shown in tan in Fig. 3.8.2, contains 908 housing units. (Berkshire Regional Planning Commission, 2010)

To estimate the total potential loss of buildings in the community, the wildfire hazard areas were overlaid upon the assessor's parcel data. It was determined that $149,568,700 is at risk of wildfire in the Interface area and $293,726,600 is at risk of wildfire in the Intermix area. (Berkshire Regional Planning Commission, 2010) It should be noted that these figures are assessor estimates and do not include market cost or replacement costs, or estimates of loss of building contents. These figures also

[2] *https://ag.umass.edu/landscape/fact-sheets/emerald-ash-borer*

do not include the major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business, loss of employment and decrease in tourism.

3.8.4. Existing Protections

As of January 1st, 2018, the fire department had 27 volunteers, all of whom are 1st responder trained. The fire department is very conservative with burn permits, not issuing them when winds are up or predicted to be up, and only between the months of January through the end of April.

At the Sheffield fire station, an outdoor siren alerts volunteers with one tone for the fire department and a second tone for the 1st responders. This siren may also be used to alert the public to an impending weather event, such as a tornado. The siren is tested every Saturday at noon.

Sheffield's volunteer fire department is the core, anywhere in Southern Berkshire County, for mountain rescue; as such it gets called first. To this end, the fire department has 3 ATVs, including a side by side ATV, and a rescue trailer. Many of the volunteers have their own personal ATVs and trailers and bring them as needed depending on the rescue situation. Additional equipment for search and rescue is available from Canaan and Lakeville, CT. fire departments. The side by side ATV, donated by Berkshire School, is a unique piece of rescue equipment as it seats 2 people, side by side, with a specialized metal platform in back, called a bucket, that provides for placement of a stretcher and a seat for a 1st responder.

Current equipment, in addition to the search and rescue equipment described above, includes four trucks: three tanker/pumpers, one of which will be replaced shortly; one tanker, described as a huge community asset; and an EMS car. Of the four fire trucks, three have 4-wheel drive.

Fire hydrants are located within the private water company's territory; Sheffield provides no public water. (All homes outside of the public water company's service area are on private wells.) Outside this area, which is most of the Town outside the Sheffield village center and nearby residential areas, the fire department depends on dry hydrants put into ponds and streams throughout the rest of Town to provide additional water, if needed. As the areas without hydrants are considerably larger than those with hydrants, it is not hard to understand the truck configuration. Equipment dispatched on a call is based on the target address and information provided by Berkshire Control.

3.8.5. Actions

- The Town's Fire Department, Board of Selectmen and Town Administrator continue to work on a timely and coordinated basis to ensure adequate equipment is procured, including personal equipment as well as larger pieces of equipment.
- In conjunction with the Board of Selectmen and the Town administrator, the Fire Department continues to investigate and pursue available grants to supplement the Town's budgetary allocations to the Department.
- Improve Fire Department record keeping, increasing the competitiveness of the Department to receive grant funds for needed equipment.
- Work with and encourage the Fire Department to attract and retain volunteers as well as make sure there is a succession plan in place for the leadership of the department.

- Encourage the public to post 911 address signs or otherwise clearly post numeric addressing for all structures, including all residences and businesses.
- Encourage businesses and home owners to remove fire prone materials, such as dry brush and tall grass, from around their structures on a regular basis.

3.9. Landslide Hazards

3.9.1. General Background

The term landslide includes a wide range of ground movements, such as rock falls, deep failure of slopes and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors. According to the state's Hazard Mitigation Plan, slope saturation by water is a primary cause of landslides in the Commonwealth. This effect can be in the form of intense rainfall, snowmelt, changes in groundwater level, and water level changes along earth dams, the banks of lakes, rivers, and reservoirs. Water added to a slope can not only add weight to the slope, which increases the driving force, but can increase the pore pressure in fractures and soil pores, which decreases the internal strength of the earth materials needed to resist the driving forces. (MEMA 2012)

Landslides in Massachusetts can be divided into four general groups: construction related; over steepened slopes caused by undercutting due to flooding or wave action; adverse geologic conditions; and slope saturation. Construction related failures occur predominantly in road cuts excavated into glacial till where topsoil has been placed on top of the till. This juxtaposition of materials with different permeabilities often creates a failure plane along the interface between the two materials, resulting in landslides following heavy rains. (MEMA 2013)

Undercutting of slopes during flooding events is a major cause of property damage. Streams erode the base of the slopes causing them to over steepen and eventually collapse. This is particularly problematic in unconsolidated glacial deposits, which cover the majority of the community. Adverse geologic conditions exist anywhere there are lacustrine or marine clay soils. Clay soils have relatively low strength and, when over steepened or exposed in excavations, often produce classic rotational landslides. (MEMA, 2013)

Another type of landslides results from slope saturation, which occurs following heavy rains, and is predominantly in areas with steep slopes underlain by glacial till or bedrock. Bedrock and glacial till soils are relatively impermeable compared to the unconsolidated materials covering these soils. As water accumulates on these less permeable layers, pore pressure at the interface increases. The interface becomes a plane of weakness, and if conditions are favorable failure can occur. (MEMA, 2013) Saturation was a leading cause of the 2011 Savoy landslide on Route 2, which occurred during Tropical Storm Irene.

3.9.2. Hazard Profile

Location

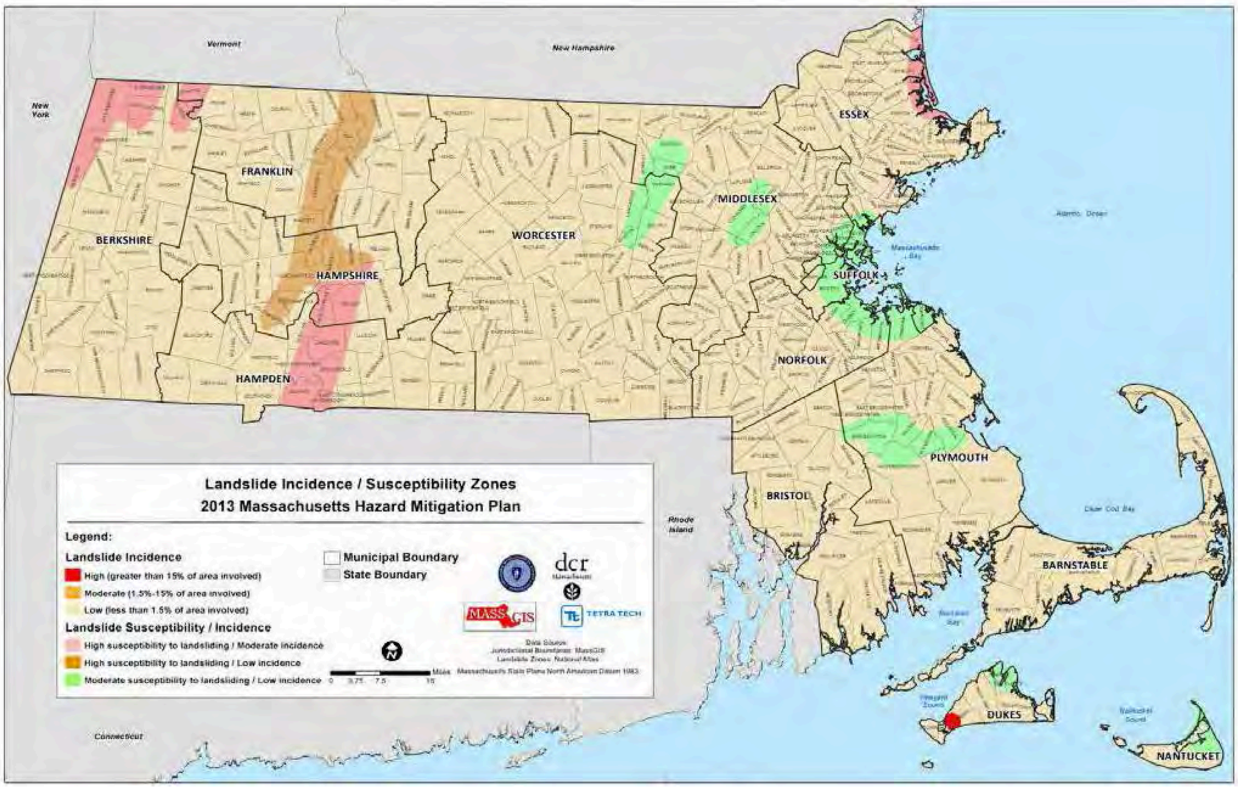
Thirty-six of the 50 U.S. states have moderate to highly severe landslide hazard areas. Within Massachusetts, there are a few areas that have a high susceptibility / moderate incidence occurrence to landslides, including areas within the Taconic and Hoosac Mountain Ranges of northern Berkshire County (see Fig. 3.9.1 for location). The Town of Sheffield is not included in any of these areas.

When referring to Fig. 3.9.1, the definition of incidence and susceptibility are defined as such:

- Landslide incidence is the number of landslides that have occurred in a given geographic area. High incidence means greater than 15% of a given area has been affected by landslides; medium incidence means 1.5-15% of an area has been involved; and low incidence means less than 1.5% of an area has been involved.

- Landslide susceptibility is defined as the probable degree of response of geologic formations to natural or artificial cutting, to loading of slopes, or to unusually high precipitation. It can be assumed that unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced numerous landslides in the past. Landslide susceptibility depends on slope angle and the geologic material underlying the slope. Landslide susceptibility only identifies areas potentially affected and does not imply a time frame when a landslide might occur. High, medium, and low susceptibility are delimited by the same percentages used for classifying the incidence of a landslide. (MEMA, 2013)

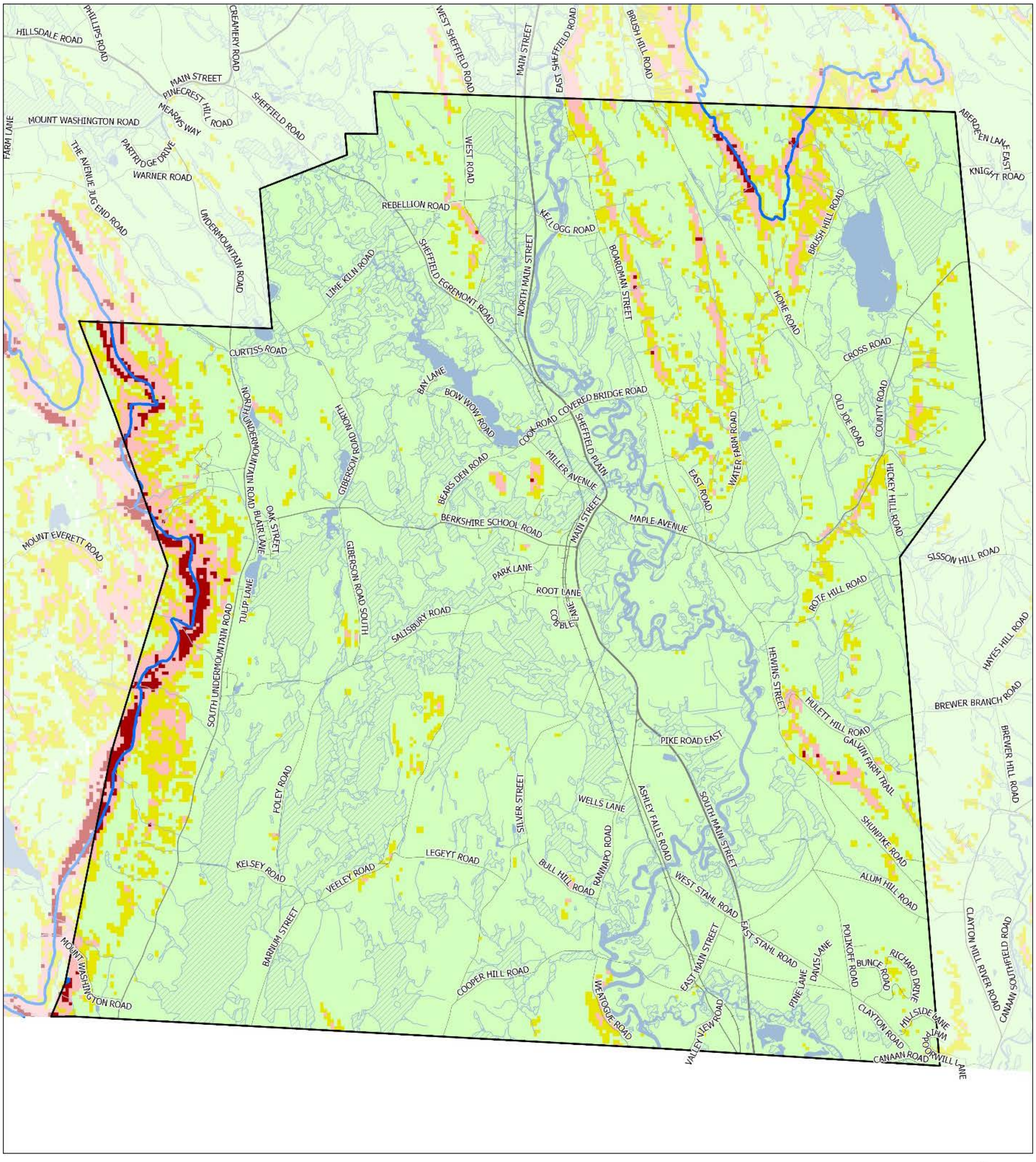
Fig. 3.9.1 Landslide Incidence / Susceptibility Zones



Source: MEMA 2013 1

To investigate landslide risk more closely, data from the Slope Stability Map produced by the Massachusetts Geologic Survey was gathered. According to this source, Sheffield has approximately 248 acres of Unstable Land (less than 1% of total land in the Town) and 1,014 acres of Moderately Unstable land (less than 3% of total). As can be seen in Fig. 3.9.2., the Slope Stability Map, the areas most susceptible to landslides are the hillsides located along the western side of the Town, west of South Undermountain Road, where the majority of the Unstable and Moderately Unstable lands are found. There are also areas of Unstable and Moderately Stable land in other areas where steeply sloped hillsides are located.

Fig. 3.9.2. Slope Stability (using the Massachusetts Geologic Survey) and Potential Berkshire Scenic Mountain Act Boundaries



Slope Stability
- Unstable
- Moderately Unstable
- Low Stability
- Stable
- Potential Scenic Mountain Act (1500')

0 0.5 1 2 Miles

N

Berkshire Regional Planning Commission

This map was created by the Berkshire Regional Planning Commission and is intended for general planning purposes only. This map shall not be used for engineering, survey, legal, or regulatory purposes. MassGIS, MassDOT, BRPC or the municipality may have supplied portions of this data.

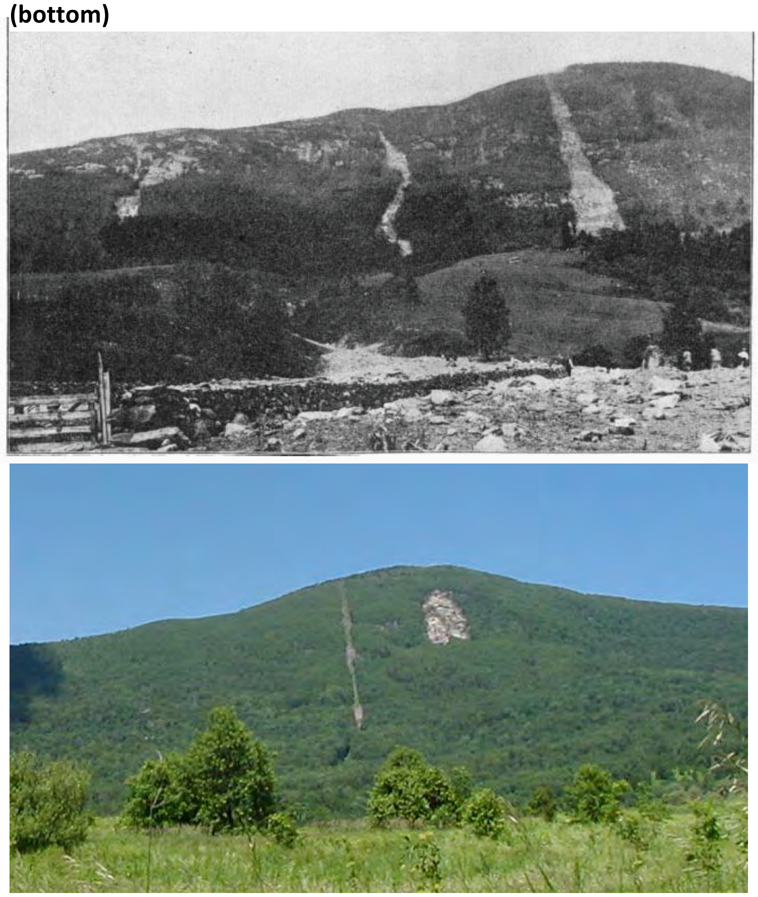
Previous Occurrences

Landslides commonly occur with other major natural disasters such as earthquakes and floods that exacerbate relief and reconstruction efforts. Rock slides occur along roadsides throughout the county where bedrock was blasted to make way for the road and there is little room between the road bed and the rock. Common examples are found on Route 2 near the Hairpin Turn in Clarksburg/Florida and Route 7 in New Ashford.

Many landslide events may have occurred in remote areas causing their existence or impact to go unnoticed. Therefore, this hazard profile likely does not identify all ground failure events that have impacted the Berkshires. While the region has had a few landslides of note, the data on them is very limited and there is nothing specific to Sheffield that can be presented in this report. Town officials confirm that no landslides are known to have occurred in the Town. Data taken from the state's hazard mitigation plan of 2013 notes these events that occurred in the Berkshire region.

- 1901: 11 landslides occurred along the east face of Mount Greylock after heavy rains (Fig. 3.9.3.). The mountain was designated in 1898 as the first Massachusetts State Reservation for conservation purposes, due largely to deforestation that occurred during private land ownership and which may have contributed to these landslide events.
- 1936: North Adams - one home was destroyed and six others evacuated during a slide in North Adams.
- 1990 – Following two days of heavy rain, a landslide estimated to be at least 1,000 feet long and 300 feet wide occurred in August on the eastern slope of Mt. Greylock, the state's highest peak. The landslide scar is still widely visible today (Fig. 3.9.3).
- Early 2000s: Notable rock fall on Route 7 in New Ashford which closed a portion of the road for over a year. This is an example of the type of event that occurs throughout the region.
- 2011: In August Tropical Storm Irene caused damage to a 5.8-mile section of Route 2 from South County Road in Florida to West Charlemont due to erosion and undercutting of the roadway, damage to retaining walls, debris flows, landslides, and bridge damage. The road was closed for an extended period of time.

Fig. 3.9.3. Landslide scars on Mt. Greylock 1901 (top) and 1999 (bottom)



Sources: Top - Mabee, Stephen B., Duncan, Christopher C. 2013. Slope Stability Map of Mass., MA Geological Survey. Bottom – BRPC 1999.

Probability of Future Occurrences

As landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods, or wildfires, their frequency is often related to the frequency of these hazards. In general, landslides are most likely during periods of higher than average rainfall. The ground must be saturated prior to the onset of a major storm for significant landslides to occur. (MEMA, 2013)

For the purposes of this Plan, the probability of future occurrences is defined by the number of events over a specified period of time. There have been zero federally declared landslide disasters from 1954 to 2017 in Massachusetts. This time period includes the landslide in Savoy, which was included in a disaster declaration for a flooding/tropical storm. It is noted that the historical record may underestimate the true number of events that have taken place in the community because steep slopes are generally undeveloped and unmonitored for this type of event. Massachusetts state officials estimate that approximately one to three landslide events occur each year throughout the state. (MEMA, 2013)

Severity

To determine the extent of a landslide hazard, the affected areas need to be identified and the probability of the landslide occurring within some time period needs to be assessed. Natural variables that contribute to the overall extent of potential landslide activity in any particular area include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions. (MEMA, 2013)

The most severe landslide to occur in the Berkshire region was the one that occurred along Route 2 in Savoy during Tropical Storm Irene in 2011. The slide was 900 feet long and covered approximately 1.5 acres, with an average slope angle is 28 to 33°. While the slide only displaced the top 2'-4' of soil materials, the estimated volume of moved material was 5,000 cubic yards (Fig. 3.9.4.).

It is unknown what the severity of a landslide in the Unstable or Moderately Unstable areas of Sheffield would be due to the number of factors that lead to landslides and to the extremely low number of serious incidences that have occurred in the region.

Fig. 3.9.4. Landslide in Savoy August 2011

Source: Top: Mabee, Stephen B., Duncan, Christopher C. 2013. Slope Stability Map of Mass., MA Geological Survey. Bottom: courtesy Stan Brown of Florida, MA

Warning Time

Mass land movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material, and water content. Some methods used to monitor mass land movements provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods by assessing the geology, vegetation, and amount of predicted precipitation for an area. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis, and respond after the event has occurred. Generally accepted warning signs for landslide activity include the following:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together. (MEMA, 2013)

Secondary Hazards

Landslides can cause secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation. This could result in economic losses for businesses. Other potential problems resulting from landslides are power and communication failures, and destabilizing of structural foundations, which may result in monetary loss for property owners. (MEMA, 2013)

Landslides can severely and permanently alter the course of rivers and streams, erode banks and deposit large amounts of sediment and debris into waterways. Stream and river banks already prone to erosion, or already undercut, could become more unstable due to a large landslide event. Landslide debris can block the flow of water under bridges and through culverts, threatening these structures themselves as well as transportation routes for miles downstream of the actual landslide event. If the landslide occurs during a flood event, debris could be widely distributed throughout the floodplain area.

Climate Change Impacts

With the latest regional models showing warmer and wetter winters for New England, as well as moe intense storms in the summer, storm patterns are expected to change with greater probabilities of more frequent, intense storms of varying duration. Increases in global temperature could affect the snowpack and its ability to hold and store water, as well as ground saturation and inability to hold additional water due to the increasing intensity of summer storms. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for more landslide occurrences. (MEMA, 2013)

In the Berkshires, the areas rated as more susceptible to landslides s are undeveloped, forested steep slopes. Trees and other vegetation help hold soil in place. Climate change is expected to impact forest species composition in a variety of ways. Cooler tree species, such as sugar maples and hemlocks, are forecast to retreat northward and to higher elevations. Invasive forest pests, such as the emerald ash borer, wooly adelgid and Asian long-horned beetle, are forecast to expand their presence and increase the mortality rate of several and economically important key tree species. Hemlocks are a species that tend to be found in cool, steeply sloped ravines, and the dieback of this species could result in an increase in unstable slopes.

Exposure

As shown in Fig. 3.9.1. and Fig.. 3.9.2., most of the developed areas and land used for farming within Sheffield are considered to be a low risk for landslides. Of the total land area of Sheffield, only 1,262 acres (4% of total land) is modeled to be Unstable or Moderately Unstable. However, it should be recognized that landslides can occur throughout the Town during severe events, particularly earthquakes, and more commonly during high precipitation events during times of soil saturation.

3.9.3. Vulnerability

Population

In general, the population exposed to higher risk landslide areas is considered to be vulnerable, including populations located downslope. Overlaying slope stability from the Massachusetts Geological Survey, it appears that six buildings in Sheffield are on Unstable or Moderately Unstable land, all of which are residential homes. To estimate the population vulnerable to the landslide hazard, the approximate hazard areas were overlaid with the assessor parcel data to determine the impact. Based on the six houses in the Unstable or Moderately Unstable land, and the 2.3 people/household average within Sheffield, it can be calculated that approximately 14 people may need to be sheltered in the event of a landslide. Expansion of primarily second homeowner residential homes or deforestation of hillside areas could lead to more people and areas being threatened by landslides each year.

Critical Facilities

Several types of infrastructure are exposed to landslides, including buildings, transportation routes, bridges, water, sewer, and power lines. At this time all critical facilities, infrastructure, and transportation corridors located within the high incidence and high susceptibility hazard areas are considered vulnerable until more information becomes available. The 2013 state Hazard Mitigation Plan noted the estimated cost to address landslide problems to state highways alone was $1 million during the years 1986-90, and the expense to keep highways safe from landslides was $2 million. The cost associated with remediation work and cleanup of debris from only four landslide-related events during the October 2005 rain event was $2,300,000. The repair to a 6-mile stretch of Route 2 caused by Tropical Storm Irene (2011), which included debris flows, four landslides, fluvial erosion and undercutting of infrastructure, cost $23 million just for temporary repairs. Accordingly, landslides have a significant cost to taxpayers, yet this hazard is not well known because most earth movements occur during extreme rainstorms and it is the rain and associated flooding that receives the majority of the publicity. (MEMA, 2013)

Based on the Slope Stability map, there are no critical municipal facility buildings within the Unstable or Moderately Unstable land areas in Sheffield.

Economy

In general, the built environment located in the high susceptibility zones (Unstable and Moderately Unstable) and the population, structures, and infrastructure located downslope are vulnerable to this hazard. In an attempt to estimate the general building stock vulnerable to this hazard, the associated building replacement values (buildings and contents) were determined by using the assessor's data. These values estimate the costs to repair or replace the damage caused to the building. These dollar value losses to the community's total building inventory replacement value would impact the local tax base and economy. The six homes located within these areas have a combined value of $2,044,300.

3.9.4. Existing Protections

Residents of the Town of Sheffield have voted to enable the Berkshire Scenic Mountain Act (the Act), which is designed to limit and oversee development on land higher than 1,500 feet in elevation and limits tree removal in the same area. Sheffield is able to expand the boundaries to lands lower than 1,500 feet if there is justification for doing so. Part of the purpose of the Act is to protect steeply sloped lands from erosion and waterways from the impacts of erosion. However, the Conservation Commission, which is the permitting authority for the Act, has not completed the bylaw regulations under which land would be regulated under the Act.

According to the Slope Stability modeling conducted as part of the Plan update, 1,262 acres of land in Sheffield is categorized as Unstable or Moderately Unstable (4% of the total land area). Of the 1,262 acres, 301 acres (1%) is located within areas higher than 1,500 feet in elevation, and this acreage would be regulated under the Act, possibly limiting and/or conditioning development on land within the Act's boundaries. The analysis conducted as part of this Plan update, showing areas modeled to being more prone to landsliding, may aid the Conservation Commission is setting appropriate boundaries.

3.9.5. Actions

- Consider adopting the Berkshire Scenic Mountain Act boundaries and developing a zoning bylaw to govern land development in higher elevations.
- Consider expanding the boundaries of the Berkshire Scenic Mountain Act to include areas that are in high susceptibility zones for landslides and developing appropriate zoning bylaws as needed.
- Enforce timbering / clear cut regulations and other such land disturbing activities on slopes in high susceptibility zones to avoid creating areas of bare ground subject to erosion and landslides.
- Provide the Building Commissioner, Planning Board and Highway Department with the Slope Stability Map, produced by the Massachusetts Geologic Survey, for Sheffield.

3.10. Earthquake Hazards

3.10.1. General Background

An earthquake is the vibration, sometimes violent, of the earth's surface that follows a release of energy in the earth's crust due to fault fracture and movement. A fault is a fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other. The cause of earthquakes in eastern North America is the forces moving the tectonic plates over the surface of the Earth. New England is located in the middle of the North American Plate. One edge of the North American plate is along the west coast where the plate is pushing against the Pacific Ocean plate. The eastern edge of the North American plate is at the middle of the Atlantic Ocean, where the plate is spreading away from the European and African plates. New England's earthquakes appear to be the result of the cracking of the crustal rocks due to compression as the North American plate is being very slowly squeezed by the global plate movements. (MEMA, 2013)

Seismic waves are the vibrations from earthquakes that travel through the Earth. The magnitude or extent of an earthquake is a seismograph measured value of the amplitude of the seismic waves. Table 3.10.1 summarizes Richter scale magnitudes and corresponding earthquake effects. For example, earthquakes in the 2 to 2.5 range are typically felt in Massachusetts and throughout the eastern United States. Generally, earthquakes in the eastern U.S. are felt over a larger area than those in the western U.S. (MEMA, 2013)

Table 3.10.1. Richter scale

Richter Magnitude	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

The intensity of an earthquake is based on the observed effects of ground shaking on people, buildings, and natural features, and varies with location. Intensity is expressed by the Modified Mercalli Scale; a subjective measure that describes how strongly an earthquake was felt at a particular location. Table 3.10.2 summarizes earthquake intensity as expressed by the Modified Mercalli Scale. (MEMA 2013)

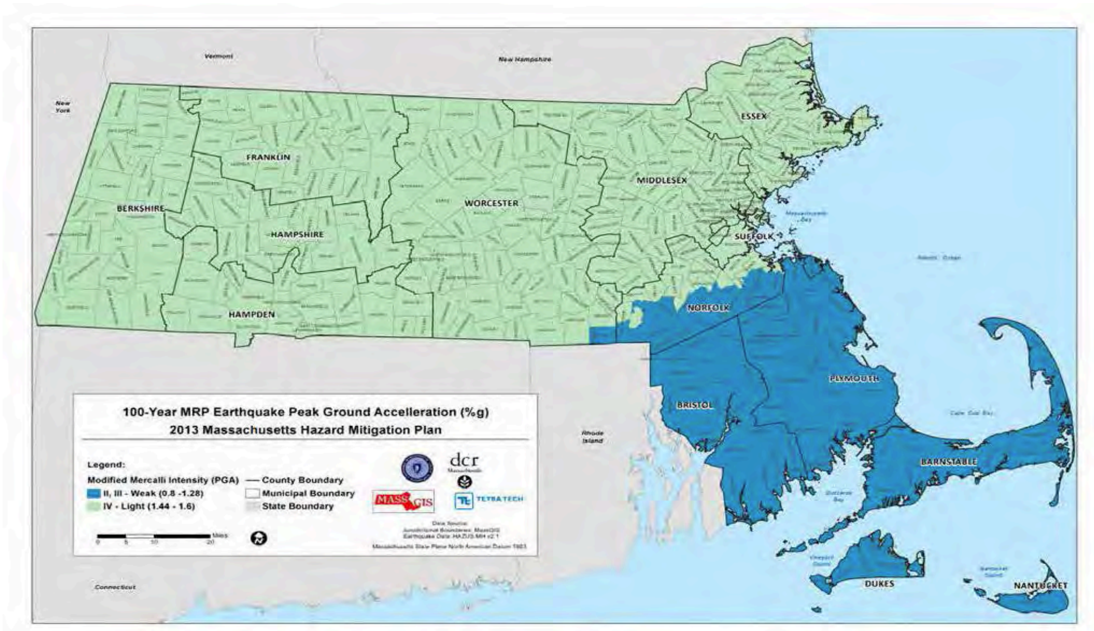
Table 3.10.2. Modified Mercalli Scale

Mercalli Intensity	Description
I	Felt by very few people; barely noticeable.
II	Felt by few people, especially on upper floors.
III	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	Felt by many indoors, few outdoors. May feel like passing truck.
V	Felt by almost everyone, some people awakened. Small objects move, trees and poles may

	shake.
VI	Felt by everyone; people have trouble standing. Heavy furniture can move; plaster can fall off walls. Chimneys may be slightly damaged.
VII	People have difficulty standing. Drivers feel cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built ones.
VIII	Buildings suffer slight damage if well-built, severe damage if poorly built. Some walls collapse.
IX	Considerable damage to structures; buildings shift off their foundations. The ground cracks. Landslides may occur.
X	Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, lakes. The ground cracks in large areas.
XI	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed.
XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

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

Fig. 3.10.1. Peak Ground Acceleration Modified Mercalli Scale for a 100-year Mean Return Period



Source: MEMA 2013

According to the Massachusetts Emergency Management Agency's State Hazard Mitigation Plan, New England has not experienced a damaging earthquake since 1755, but numerous, less powerful earthquakes have been centered in Massachusetts and neighboring states. Seismologists state that a serious earthquake occurrence is possible. There are five normal faults in Massachusetts, three of these traverse portions of Berkshire County, but there is no discernable pattern of previous earthquakes along these fault lines. Earthquakes can occur without warning, can occur anywhere within the county, and may be followed by aftershocks. Most buildings and infrastructures in Massachusetts were constructed without specific earthquake resistant design features. Filled, sandy or clay soils are more vulnerable to earthquake pressures than other soils.

3.10.2. Hazard Profile

Location

New England's earthquakes to date have not aligned along mapped faults. Because earthquakes have been detected all over New England, seismologists suspect that a strong earthquake could be centered anywhere in the region. Furthermore, the mapped geologic faults of New England currently do not provide any indications detailing specific locations where strong earthquakes are most likely to be centered. (MEMA, 2013)

Previous Occurrences

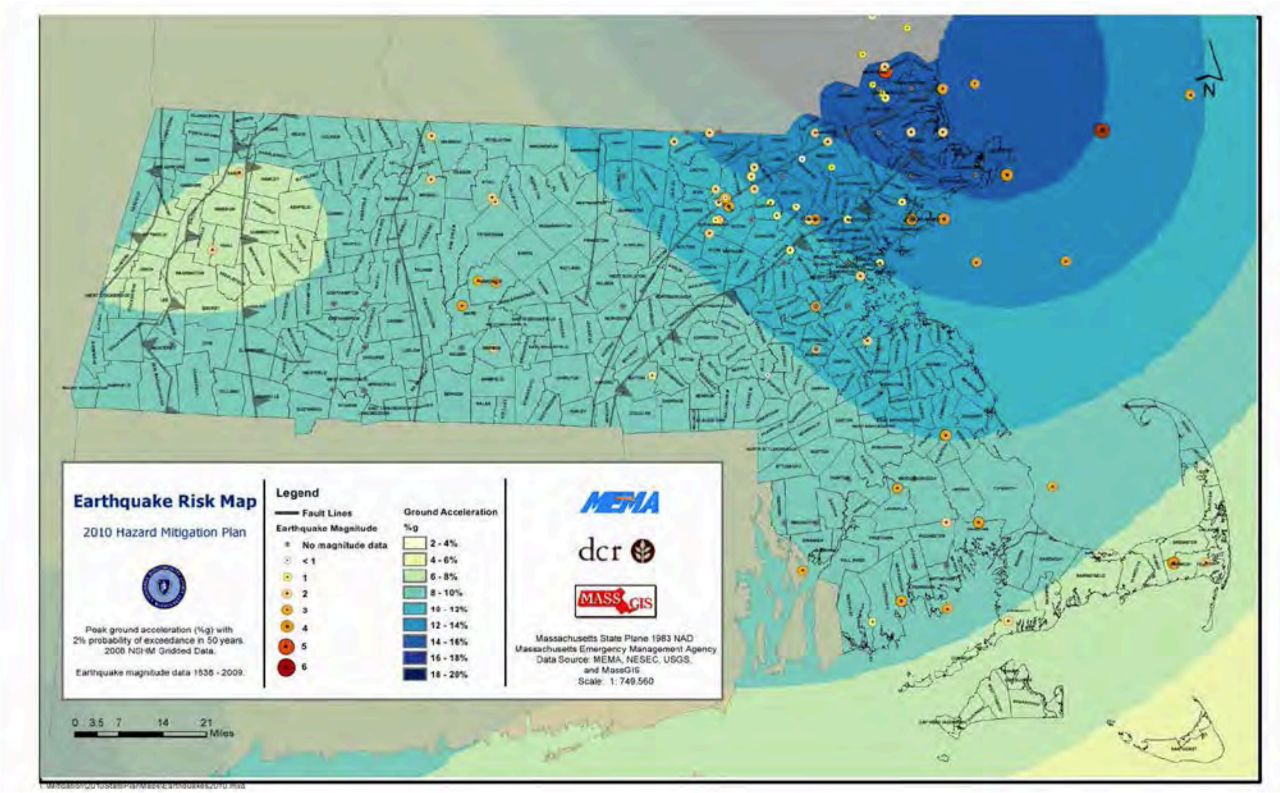
According to Alan Kafka, Director of Boston College's Weston Observatory, the most catastrophic earthquake to impact the state was the magnitude 6.0 event off Cape Ann in 1755. It was devastating and felt all over the Northeast. The article referenced in Footnote 1 was written after earthquakes were felt in the Boston area in 2011 and 2012[1].

The largest earthquake since 1900 to strike Massachusetts was in 1994, a magnitude 3.9 on the Richter Scale, and located east of the Quabbin Reservoir. According to the USGS, there have been two recent earthquakes with epicenters close to the Berkshires. A magnitude 3.3 on the Richter scale struck the area around Westfield, MA in 2000 and a magnitude 1.9 struck the area around Northampton in 2012. To our west, a magnitude 3.1 struck in the Catskills region of New York in 2009. (USGS Earthquake Hazards Program 2017)

There are conflicting records reporting the occurrences of earthquakes in the Berkshires. According to the 2004 MA State Hazard Mitigation Plan, between 1668 and 1997 three earthquakes have occurred in the Berkshire region -- 1932, 1963 and 1982. The 1932 event occurred at Lake Garfield in Monterey, but the magnitude is unknown. The 1963 earthquake, which registered as 2.4 on the Richter Scale, is reported to have occurred in North Adams but with coordinates that indicate that it occurred in Savoy. The 1982 earthquake also occurred in North Adams and is registered at 2.0. (The Dewberry Company, 2004) However, the 2013 State Hazard Mitigation Plan indicates that only two earthquakes have occurred in the Berkshires, in Savoy and in the vicinity of the Hinsdale/Peru town border, both of which were in the magnitude of 2.0. The sites are show in Fig. 3.10.2. All available the data indicates that an earthquake has not occurred in the Sheffield region of Berkshire County.

[1] *Quintana, Olivia. 12-6-2016. New England earthquakes happen more often than you think, Boston Globe, Boston, MA.*

Fig. 3.10.2 Earthquake Historic Occurrences and Risk



Source: MEMA 2013

Probability of Future Occurrences

According to the state Hazard Mitigation Plan, earthquakes cannot be predicted and may occur any time of the day and any time of the year. Because the region's geologic faults zones do not correlate well to earthquake locations or aid in predication of occurrence, it is difficult to identify reasonably affordable mitigation measures. Based on the historic occurrences, which have been few and of limited severity, the community could be considered to be at a low risk for major earthquake damage in the future.

Severity

The most commonly used method to quantify potential ground motion is in terms of peak ground acceleration (PGA), which measures the strength of a potential earthquake in terms of the greatest acceleration value of ground movement. The potential damage due to earthquake ground shaking increases as the acceleration of ground movement increases. For example, 100-year mean return period (MRP) event is an earthquake with a 1% chance that the mapped ground motion levels (PGA) will be exceeded in any given year. As shown in Fig. 3.10.1, the 100-year earthquake event for Berkshire County is a Modified Mercalli Scale of IV (light impacts), felt by many indoors and a few outdoors, and may feel like passing truck. According to the MA State Hazard Mitigation Plan of 2013, the county could experience heavier impacts during the 500 and 1,000 MRP, with Modified Mercalli Scale ratings of V (moderate), felt by almost everyone, some people awakened, small objects move, and trees and poles may shake.

Because of this low frequency of occurrence and the relatively low levels of ground shaking that would be experienced, the community can be expected to have a low risk to earthquake damage as compared to other areas of the country. However, the impacts at the local level can vary based on types of construction, building density, soil type among other factors. (MEMA, 2013)

Warning Time

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with early-warning systems that use the low energy waves that precede major earthquake to issue an alert that earthquake shaking is about to be felt. These potential early warning systems can give up to approximately 40-60 seconds notice that earthquake shaking is about to be experienced, with shorter warning times for places closer to the earthquake epicenter. Although the warning time is very short, it could allow for immediate safety measures such as getting under a desk, stepping away from a hazardous material, or shutting down a computer system to prevent damage. (MEMA, 2013)

Secondary Hazards

Secondary hazards can occur to all forms of critical infrastructure and key resources as a result of earthquake. Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks of earthquakes. (MEMA, 2013) Damages roadways could impede rescue efforts.

Climate Change Impacts

The impacts of global climate change on earthquake probability are unknown. Some scientists feel that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could be at higher risk of liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts. (MEMA, 2013)

Exposure

For the purposes of this Plan, the entire town of Sheffield is considered to be at risk from earthquakes. However, some locations, building types, and infrastructure types are at greater risk than others are, due to the surrounding soils or their manner of construction. (MEMA, 2013)

3.10.3. Vulnerability

To assess the community's vulnerability to the earthquake hazard, probabilistic analyses were run in HAZUS-M, with an earthquake magnitude of 5.0 for the 100-year mean return period (MRP) events. The HAZUS -MH model was used to estimate potential losses to these events. For the 2018 Plan, a probabilistic assessment was conducted for the 100-year MRP using default settings in HAZUS-MH 4.0 to analyze the earthquake hazard for the community. The 100-year MRP event is an earthquake with a 1% chance that the mapped ground motion levels (PGA) will be exceeded in any given year.

Population

The entire population of Sheffield is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil type their homes are constructed on, their proximity to fault location, etc. The region's high percentage of older building stock could increase the risk of damage to some buildings. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself. (MEMA, 2013)

According to the HAZUS-MH analysis, no injuries or casualties are estimated for the 100-year event and no sheltering is needed.

Critical Facilities

All critical facilities in the Plan's area are exposed to the earthquake hazard. Earthquakes losses can include structural and non-structural damage to buildings, loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Roads that cross earthquake-prone soils have the potential to be significantly damaged during an earthquake event, potentially impacting commodity flows. Access to major roads is crucial to life and safety after a disaster event, as well as to response and recovery operations. In addition, there is increased risk associated with hazardous materials releases, which have the potential to occur during an earthquake from fixed facilities, transportation-related incidents (vehicle transportation), and pipeline distribution. Facilities holding hazardous materials are of particular concern because of potential rupture and leaking into the surrounding area or adjacent waterways. (MEMA, 2013)

Based on the HAZUS analysis for the community, it is expected that there will be minimal damage to the infrastructure or critical facilities in Town.

Economy

HAZUS-MH estimates the total economic loss associated with the earthquake scenario, including building and lifeline-related losses (transportation and utility losses) based on the available inventory. Direct building losses are the estimated costs to repair or replace the damage caused to the building. According to HAZUS, no buildings were expected to be damaged, even slightly. It is estimated that the community will experience $0 in total building and $0 in building-related losses (income, rental, capital-related, content, inventory, etc.) across the town. HAZUS also estimates that there will be $0 losses in roads, railroad and utility damage.

Earthquakes also have impacts on the economy, including: loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. It is estimated that the community will experience $0 in infrastructure losses and business losses.

3.10.4. Existing Protections

The Town of Sheffield Building Commissioner uses and enforces the Massachusetts Building Code.

3.10.5. Actions

- Strict adherence to the state Building Code.
- Strict adherence and enforcement of state storage regulations for hazardous materials.

4. MITIGATION STRATEGY

4.1. Existing Policies and Capabilities

As defined by FEMA, mitigation is sustained actions taken to reduce or eliminate long-term risk to life and property from hazards (FEMA, 2013). It is critical that the *Sheffield Hazard Mitigation Plan* not only identifies risks, but also assess the Town's vulnerability to those risks. To assess vulnerability, Town officials analyzed and considered risk data discussed in the previous section (Section 3, Risk Assessment), land use, population trends, location of critical facilities and transportation networks, and existing protection measures.

Land Use Planning and Zoning

As part of this Hazard Mitigation Plan update, the Town of Sheffield conducted a self-evaluation of its existing policies, programs and resources that reduce hazard impacts and could be used to implement hazard mitigation activities. FEMA's Capability Assessment Worksheet, found within the *Local Mitigation Planning Handbook* (FEMA, 2013), was used as the evaluation tool for this exercise. The Town found that, in general, it already has in place many policies that serve as hazard mitigation strategies, including zoning and administrative tools to address hazards. Good communications exist between Town departments. However, the Town has few formal planning documents, and the Master Plan (2005) and Economic Development Plan (2008) are outdated and do not consider natural hazard impacts. Although reviewed regularly, zoning bylaws have not been reviewed through the lens of natural hazard and climate change impacts.

As noted previously in this Plan, land within the 100-year floodplain covers a substantial amount of land in Sheffield, including residential and commercial development, and almost 1/3 of the land in agricultural use. The Town has a floodplain zoning bylaw that requires that those who propose the erection of new structures and/or alteration or moving of existing structures must submit an application for a special permit to the Planning Board that demonstrates that the construction, use or change of grade will not obstruct or divert the flood flow, reduce natural water storage or increase stormwater runoff. Subdivisions located partially or wholly within the Zone A of the Flood Insurance Rate Map shall take steps to avoid flood hazards.

Critical Resources and Facilities

A critical facility provides services and functions essential to a community, especially during and after a disaster, e.g. facilities housing incident command or emergency operations; medical facilities; schools and other buildings housing vulnerable populations; shelters; utility systems or power generating stations; transportation systems; and water and wastewater treatment plants. Critical facilities are scattered throughout the Town, and fortunately there are no municipal critical facilities located within the 100-year floodplain. However, the Town Hall and possibly the Fire House do have the potential to be inundated in the event of a dam failure of the Mill Pond dam. The drinking water well on Maple Avenue owned and maintained by Mountain Water Systems is located within the 100-year floodplain, and its well on Pike Road appears to be close to the floodplain boundary. Sheffield's critical facilities and their locations are noted on the Critical Facilities Map in Appendix 1.

Segments of Main Street/Route 7 travel through the floodplain and have a history of having to be closed to traffic for days during severe flood events. Because this route is the main north-south transportation route for the Town and the surrounding region, closure of the road is a serious concern, particularly if a situation occurs that prevents or delays emergency response or evacuation efforts. Emergency services have well established detours for Route 7. The Mt. Everett High School on Berkshire School Road serves as the local and alternate regional shelter, and the road travels through 100-year floodplains both east and west of the school, which could render the school inaccessible and unusable as a shelter during a 1% chance flood event. However, the school may also be reached by Route 41 to Berkshire School Road or Route 7 to Bow Wow Road to Bears Den Road, which connects with Berkshire School Road above the school and Schnobb Brook.

Emergency Shelters

As calculated by HAZUS-MH for the 1% chance flood event, up to 150 Sheffield residents may seek shelter during the 1% chance flood event. The Shelter Plan for the SBREPC indicates that Mt. Everett High School, which is listed as Sheffield's local shelter and the alternate regional shelter, has the capacity to shelter only 50 people. The Shelter Plan notes that pets could be sheltered outdoors on the grounds of the school and food is available from the kitchens of the high school and elementary school located on this campus. During Topical Storm Irene, less than 10 people took shelter at the Mt. Everett High School. The Town's Emergency Management Director indicates that the Senior Center has a backup generator that can provide electricity to the whole building, and this could provide additional sheltering if needed, but there is no food supply at this facility.

The loss of electricity can result from several types of natural hazard events, most often involving flooding, high winds and/or heavy snow/ice loads. The most recent event in which electricity was lost for a substantial amount of time in Sheffield was Thanksgiving 2014, when heavy snow caused power outages across the region. Some Sheffield residents reported losing power for four days, and some reported losing land line phone service.

One alternative to mass sheltering is to promote sheltering in place, where residents weather the event in their own homes. When possible, sheltering in place can be preferable to moving residents to centrally-located shelters. This is especially important for residents who are located in areas that are remote and difficult to reach. This shelter option is also important for farmers and other independently-minded residents who are reluctant or refuse to leave their homes or their animals behind.

However, it is important to advocate sheltering in place only when the local residents are well-supplied with food, water and heat. Although some residents who live in remote areas have supplies and backup generators, their level of preparedness is varied, and even those who have purchased generators may not be properly educated on their use. If sheltering in place is determined to be a viable alternative to mass sheltering, the Town should conduct extensive outreach and education programs to ensure that residents are aware of how to properly and safely shelter in the event of an extended power outage or in the event that rescue teams cannot reach them.

The only time residents in Sheffield were advised to stay indoors was in August 2012, when a transformer recycling company in West Ghent, NY (approximately 10 miles west of southern Berkshire County) experienced a large commercial fire that sent a contaminated plume of smoke drifting across the region. Residents were advised to shelter in place and close their windows for one day as a precaution, particularly for those with respiratory illnesses. That alert was later cancelled when air currents shifted the plume's direction.

As part of this Plan's update, staff from BRPC met with representatives from Berkshire School and Southern Berkshire Regional School District to discuss the plans in place in case of a natural disaster and what assistance could be provided to help students in an emergency situation. Both schools have emergency response plans in place to address a disaster, and both have evacuation sites for students. They both have the ability to shelter students in place for up to three days, while Berkshire School would house both students and staff. This includes having generators, food for people and pets, and some capacity to have medical services available. Both schools stated that they give high priority to emergency response planning and hazard mitigation.

Business Risk

As noted in the Flood Risk Assessment Section of this Plan (Section 3.2), there are a number of Sheffield businesses located at risk of flooding, with 29% of the commercial building stock and 10% of the industrial building stock located within the 100-year floodplain. Despite the risk, Town officials were not aware of any businesses that had suffered damages during the flood events, despite the number of flood events that have been documented in the Town in recent decades. To better document flood or other natural hazard impacts that businesses might have suffered and to begin to understand what the Town might do to help business owners prepare for natural hazards or disasters, the Town sent a survey to every business in Sheffield, 200 in total. Of the 22 business owners who responded, 21 stated that they were not located in the floodplain, with one owner stating that they didn't know if they were located in the floodplain. No respondents reported having experienced property loss or damage from a natural disaster, including flooding, although one business owner on South Main Street reported that their parking lot floods when it rains falls on frozen ground or ice. Eight of the 22 respondents indicated that they were prepared to respond and remain operational in the event of a natural disaster, with the others indicating that they were not. Loss of electricity was raised as an issue of concern, with one business owner, who is a large employer, stating that loss of electricity is not only a business disruption and expense for them, but also a potential worker safety risk. This owner stated that they "had multiple meetings with National Grid with little success." All but three of the respondents stated that they were not signed up for the Town of Sheffield's Emergency Notification System, indicating a need to reach out to this sector.

Sheffield's Emergency Management

In Sheffield, two tiers of local emergency management are readily available: local fire and police response and the Southern Berkshire Regional Emergency Planning Committee (SBREPC). For larger or more specific emergencies, state and federal assistance is available according to specific protocols.

Local emergency management planning and response and SBREPC are built upon the four components of emergency management: preparedness, mitigation, response, and recovery. Both formal and informal structures are focused on knowing what is needed and knowing how to get what's needed.

SBREPC is facilitated and assisted by Fairview Hospital's Emergency Management Director, as part of the hospital's community outreach support. This assistance is appreciated by local participants, many of whom are police or fire chiefs who do not have the individual resources or time to provide this coordination and depth of support. An example of this assistance is keeping a list of all communities' individual assets, available online by community. Monthly meetings provide ongoing education and updates; networking; and additional opportunities to know each member communities' resources and capabilities. All 911 calls are routed through a centralized call center, Berkshire Control, out of the Berkshire County Sheriff's Department in Pittsfield.

In Sheffield, the Chief of Police is the Town's Emergency Management Director (EMD) and the Town's representative to SBREPC, thus fulfilling MEMA and FEMA's requirements that each town be part of a regional emergency planning committee (REPC). As of January 1, 2018, the police department had six (6) full time officers and numerous part time officers, in addition to the Chief and a Sergeant. The department has four (4) patrol cars, two (2) of which have 4-wheel drive.

SBREPC fulfills federal mandate and is fully credentialed by MEMA. Meeting monthly, it fulfills MEMA and FEMA requirements for training and specific exercises, such as hazard material transportation disaster training and related yearly exercises. SBREPC also provides training for other disasters and informal coordination for its members on matters which are beyond the coordination capacity of any single EMD. As a group, members of SBREPC coordinate and address sheltering, communications, and requirements for ambulance services, the importance of which the State recently recognized by funding a study to address gaps in these services. In addition, a representative of MEMA attends these meetings, providing more coordination and contact. Fairview Hospital's EMD is available to assist town's EMDs, as requested and her schedule allows.

While SBREPC may be viewed as an umbrella committee, each community has ultimate responsibility for its own emergency management planning and response. In Sheffield, the Chief of Police has this responsibility and is in charge of the overall coordination, with the Board of Selectmen (the Town's Executive authority), of all resources needed to provide the required response. The Board of Selectmen has the authority to determine and issue an emergency declaration.

Sheffield's EMD follows the unified command structure and brings the required resources to bear any emergency. For example, in advance of the arrival of Tropical Storm Irene in 2011, Sheffield's EMD called together the Board of Selectmen; the Town Administrator; the Highway Department superintendent; Fire Department officers, and representatives of the Board of Health, Senior Center, and Regional School District. He was in communication with other resources, particularly MEMA's emergency command and response center, the local hospital and emergency department, ambulance services, municipalities with whom Sheffield has mutual aid agreements or Memorandums of Understanding (MOU), and the SBREPC. He reviewed the statements put out by the weather services and the State's emergency response center in addition to the governor's notifications. All of this set the stage for the emergency planning between resources which followed and resulting in the Board of Selectmen issuing an emergency declaration, if needed. Sheltering needs were reviewed as well as the chain of command; radio equipment and frequencies were checked; contact numbers reviewed; and extra police staffing put in place for covering incoming calls. In addition, responsibility for press coordination and releases, and for all public information was assigned. All attendees left the meeting knowing their assignments and a schedule of further meetings/calls-in was established, depending on the extent to which Irene impacted Sheffield.

Sheffield's EMD, the Chief of Police, is in a unique position to analyze the training needs of his staff and plan accordingly, as well as coordinate with other police departments and Sheffield's Fire Department training exercises. All of the police officers are first responders and CPR-certified. All mutual aid and MOUs between towns in Berkshire County are done through their respective Chiefs of Police and Fire.

Sheffield Police Department uses a reverse 911 system to alert residents, second homeowners and businesses to impending disasters, as well as to stay in touch with them during a disaster. As an example, this system was used several years ago when a chemical plume was released from a New York

PCB and other chemical storage facility, where the plume began drifting toward Sheffield and southernmost Berkshire County. The reverse 911 system provided verbal messages to home phones, cell phones and additional phones numbers provided as well as text messages to cell phones. The system is tested regularly and people are encouraged frequently to update their contact numbers and how they wish to receive such information. A business survey conducted as part of this Plan update indicated that the vast majority of business owners are unaware of the emergency notification system, and this could indicate a similar unfamiliarity by residents as well.

In addition, the police regularly engage with the public and request those having special needs to self-identify so they may be put into a registry. This registry is accessed in the event of an electrical outage or any circumstance where a registered individual may be cut off from needed services. For the most part this is an uphill effort, as is making sure all houses are clearly identified with either a 911 address sign or clear and readable house/mail box address numbers.

Sheffield's fire department is an all-volunteer department, led by a Board of Selectmen appointed Chief, who has traditionally been previously elected by fire department members. The Fire Chief appoints his officers according to voting undertaken by members. As of January 1st, 2018, the fire department had 27 volunteers.

The fire department and the police department work extremely well together, with each having the lead on certain types of incidents and sharing responses on most others. The fire department takes the lead on fires; vehicular accidents involving personal injury or suspected personal injury; hazardous materials spills; fire alarms and carbon monoxide alarm activations; search and rescue; and medical calls. The police department has the lead on hazardous materials; matters of suspected or actual criminal activity; domestic and neighbor disturbances; and general safety, such as road safety. Both frequently respond to 911 calls, depending on available resources, and share a mutual focus on creating safety at the scene.

As is the case in most communities, Sheffield's fire department has informal mutual aid agreements with many surrounding communities. The towns of Canaan and Lakeville, CT and New Marlborough, Great Barrington, Monterey, Egremont and Alford, MA form the core of this mutual aid. It is the Chief, or one of his deputies, who makes the decision to call for mutual aid. That said, every volunteer has access to the priority list for mutual aid and can make that call if needed in the absence of a delegated fire department officer. Mutual aid is also relied on when the fire department is short on people, such as during a funeral or mutual aid exercises, with the responding town providing at least one vehicle and a crew to stand by at the fire station.

Berkshire County Sheriff's Control, (Berkshire Control), working with the Berkshire County Sheriff's Department and Berkshire County fire and police departments, is responsible for communications to and from fire departments; police departments; ambulance services; and all 911 dispatches. In Sheffield, all active firefighters are equipped with fire department pagers that receive Berkshire Control alerts and communications. Fire departments are in contact with Berkshire Control and ambulance services via 2-way radios. Berkshire Control is another resource for network, communications, and r understanding the equipment and resources of individual fire departments. At Sheffield's Town Hall, adjacent to the Sheffield fire station, an outdoor siren alerts firefighters whenever Berkshire Control relays a 911 call to the department for fire, rescue or emergency medical / first responder services, typically with a sequence of two cycles lasting approximately 45 seconds. This siren is also used for warning citizens of imminent threats from a weather-related activity or other hazardous conditions, such as a chemical spill, with one continuous cycle lasting three minutes. The siren is tested every Saturday at noon.

Sheffield depends primarily on Southern Berkshire Volunteer Ambulance Service (SBVAS), stationed at the Fairview Hospital campus in nearby Great Barrington. SBVAS has three units and back up is through established call downs, such as to nearby Canaan and/or Lakeville, CT, each of which has ambulance capabilities, or through Berkshire Control, which can also dispatch County Ambulance out of Pittsfield, MA. All volunteers are first responder trained; such training is mandatory.

Sheffield's volunteer fire department is the core source for mountain search and rescue anywhere in Southern Berkshire County, getting called in first. Search and rescue missions are not that uncommon given the mountain ranges which run through southern Berkshire County and the popular hiking trails in these areas. Several sites, such as Race Mountain and trails in this area, have a history of accidents and have required search and rescue operations.

As is customary in small rural New England communities with volunteer fire departments, when a structure fire or a search and rescue mission is underway, fire department volunteer's relatives donate their time and efforts to set up the needed food, water and rest stations. Depending on the scope of the emergency, this effort can be extensive and is a "force multiplier" when it comes to emergency response capabilities. These additional volunteers may prepare sandwiches, transport food and drink as needed, and keep those involved fed, hydrated, and protected from the elements. This extremely valuable service allows the firemen and 1st responders to focus on firefighting or the search and rescue operation.

Weekly practices are part of the fire department volunteer's commitment to their department and ongoing training. Such training may be coordinated with other mutual aid towns or done only with Sheffield members. Training topics are set in advance by the department's officers and members sign in at each weekly practice in order to keep a roster of the department's skill set. Topics include search and rescue (within structures simulating firefighting conditions as well as in mountain conditions); team-building; extrication; water rescue in all seasons; equipment training and upkeep for all fire apparatus and air packs; deployment and coordination with one or more communities' fire departments; and timed readiness exercises that include simulation of community threats including active shooter and other potential mass casualty incidents, such as hazardous waste accidents.

Pursuit of Grant Funds

The Town of Sheffield has been aggressive in pursuing grants that improve the Town's transportation infrastructure and reduce risk to people and property. In the past several years, it has been an integral part of the Town's action plan to decrease flooding along County Road, which also serves as a key school bus route. In less than five years, the Town of Sheffield has applied for one FEMA and two MassWorks grants to replace culverts and bridges throughout the Town. A MassWorks grant awarded in 2014 enabled the Town to replace a culvert along County Road. In 2017, the Town applied for another MassWorks Grant to replace another three bridges and one culvert along County Road but the grant was not awarded. Undaunted the Town has revised the application and resubmitted it in 2018.

The Town successfully applied for a FEMA grant in 2015 to make repairs to Rannapo Road and move the road further away from the Housatonic River channel, where shoulder erosion had reduced the road to one lane. During Tropical Storm Irene in 2011, this area flooded heavily and was impassable. When this project is completed, there will be better accessibility for motor vehicles when large storm events occur, and the road will be less prone to flooding and erosion. The repairs are expected to be completed in 2019.

5. NATURAL HAZARD MITIGATION ACTION PLAN

5.1. Setting Goals

The Goal, Objectives and Actions within this Plan were developed as local vulnerabilities were being identified and concerns raised by the Sheffield Hazard Mitigation Advisory Committee and input received from local residents. The Advisory Committee adopted the following Goal:

Overall Goal: *Increase the resiliency of Sheffield to minimize the loss of life, property, infrastructure, environmental, and cultural resources in the face of natural disasters and climate change.*

The analysis of historic disaster data and the concerns raised by emergency response were factors in the development of a series of "Major Findings" for the Town. These Major Findings list natural hazards that pose the greatest risks; highlighted what areas of Sheffield are most vulnerable to hazard/disaster impacts; and outlined priority actions. The summary of the Major Findings follows:

Major Finding #1: Sheffield's Most Serious Hazards

- Flood events are the most frequent, identifiable natural hazard events to occur in Town; the number and severity of localized flooding has increased in recent years causing runoffs, riverbank erosion, washouts and road damage.
- Loss of electricity, especially for extended periods of time, could threaten public health, particularly for the older residents, disabled or isolated populations; those needing electricity for oxygen, dialysis or refrigerated medications are at greater risk.
- Flood damages and loss of productive land due to severe flood events along the Housatonic River are an ongoing concern for the farming community.
- Although the Town has had brushes with drought, a severe drought event has seldom been experienced in recent decades. However, drought has the capacity to seriously impact the economic vitality of the Town due to the need for water for the farming community and a few key businesses, as well as possible impacts on older, shallow or point private wells.
- Beavers have the potential to cause flooding if proper controls, such as beaver deceivers, are not implemented and maintained in a timely manner.

Major Finding #2: Sheffield's Vulnerability

- Several roads have been repeatedly damaged by severe storm events, including flooding and wash outs. Local roads at greatest risk are Rannapo Road (which is threatened by the movement of the Housatonic River channel), County Road, and Weatogue Road. Main Street/Route 7 is the main transportation corridor at greatest risk, the closure of which could seriously impede disaster response and relief as well as the movement of goods within the county and beyond.
- Dam failure from dams located in Sheffield and Great Barrington has the potential to flood homes, businesses, Route 7 and other roadways, with Rising Pond dam having the potential to inflict the greatest damage.
- First responders do not know where all individuals live who might need additional aid during loss of electricity or during an evacuation event.

- Berkshire School Road in the vicinity of Mt. Everett High School, the designated shelter, has a history of flooding.
- There is a need to increase public awareness and enrollment in Sheffield's emergency notification system, Blackboard Connect.
- Personal interviews and public forums indicate that individuals in Sheffield are likely unprepared to shelter in place for more than a day or two.

Major Objectives to meet the Goal and address the Major Findings:

1. Continue to assess, monitor, prioritize and pursue infrastructure improvements to increase resiliency to impacts of natural hazards and climate change.
2. Encourage self-identification and registration of individuals needing special assistance when a extended loss of electricity or a severe weather event occurs.
3. Develop, distribute and widely promote Sheltering in Place and Disaster Preparedness materials.
4. Increase participation in Blackboard Connect, Sheffield's emergency contact system.
5. Continue to work with local and state partners -- Emergency Managers, DPWs, Fire, Police, Councils on Aging, Health Departments and Schools -- to plan for and mitigate natural hazards in Sheffield and on a regional basis.

5.2. Prioritizing Actions

Although tornadoes have caused the most serious damages in Berkshire County in the last 50 years, their frequency, location and severity are unpredictable. Severe winter storms are serious, annual, relatively predictable events that are viewed as part of life in the Berkshires, although ice storms and rain-on-snow events are becoming more frequent and present different dangers. Flooding remains the natural hazard of most concern, being the end result of several natural hazards, including heavy snowfall/spring melt, ice jams, heavy rains from severe thunderstorms and hurricanes, and infrequentlybeaver activity. Flooding can also occur due to dam failure or poor stormwater management. Flooding is a natural hazard that can be mitigated, or lessened to some degree, through proper land use and structural improvements. Therefore, it is appropriate that flooding remain a major focus in future mitigation planning and implementation.

The Sheffield Hazard Mitigation Advisory Committee has developed and prioritized a list of actions based on the findings in this Plan. Priority Levels were determined using three general criteria: 1) the level of potential severity of the hazard/disaster event; 2) the level of concern for the hazard/disaster, as voiced by local officials; and 3) practicality of implementing each particular action. Although cost was considered as part of criteria #3, it was not a determining factor. Priority Levels were assigned as follows:

- <u>High Priority:</u> Actions that address hazards of greatest severity and concern in the Town, as voiced by the Sheffield Hazard Mitigation Advisory Committee and residents, and which should begin to be implemented as soon as feasible, no later than over the next three years, to avert or mitigate the impacts of future disasters.

- <u>Medium Priority</u>: Actions that address hazards of a lesser severity and concern, as voiced by the Sheffield Hazard Mitigation Advisory Committee and residents, and which should be implemented as local capacity and funding becomes available, no later than over the next four – six years.
- <u>Lower Priority:</u> Actions that address hazards of a lesser severity and concern, and which should be monitored for future implementation.

5.3. ACTION TABLE

OBJECTIVE #1: Continue to assess, monitor, prioritize and pursue infrastructure improvements to increase resiliency to impacts of natural hazards and climate change.

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Structural Project – Flooding	Install relief culverts on Lime Kiln Road to reduce risk of flooding	Reduce risk of flooding; reduce cost of maintaining the road	Town of Sheffield	1-3 years/ High	Town funding, Grants	**Incomplete** No action so far
Structural Project – Flooding, Landslide	Install rip rap on Rannapo Road to stabilize bank that is being eroded by the Housatonic River; relocate the road away from the river	Reduce risk of road damage/failure; reduce road closures	Town of Sheffield	In FY19/ High	Town funding, FEMA	**In Progress** FEMA funding secured (HMAGP-4110-23-DR-MA) at 75% reimbursement; to bid Oct 2018; completion in 2019
Structural Project – Flooding	Continue working with MassDOT to reduce flooding along Route 7	Reduce risk of flooding; reduce cost of maintaining the road; ensure traffic flow	Town of Sheffield, MassDOT	1-3 years / High	FEMA, MassDOT	**Incomplete** MassDot-Owned/ minor drainage improvements during resurfacing
Structural Project – Landslide/bank erosion	Stabilize the bank on County Road to prevent landslides onto the road	Reduce the cost of maintenance and potential damage	Town of Sheffield	4-6 years/ Medium	Town funding, FEMA	**In Progress** Monitoring situation; bank revegetated
Structural Project – Landslide	Work with the Trustees of Reservations to stabilize banks along Wheatogue Road	Reducing cost of maintenance and potential damage; ensure traffic flow	Town of Sheffield, The Trustees of Reservations	4-6 years/ Medium	Town funding, TTOR, FEMA	**In Progress** Trustees received Grant to study
Structural Project – Flooding	Conduct a study of flooding on Rannapo and Weatogue Roads and implement findings	Reduce risk of flooding; reduce cost of maintaining the roads; ensure traffic flow	Town of Sheffield, TTOR	4-6years / Medium	Town funding, FEMA, TTOR	**In Progress** Trustees received Grant for study

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Regulatory Prevention - Flooding	Review existing zoning and subdivision control by-laws; update to ensure inclusion of stormwater control and best management practices.	Reduce the amount of new stormwater runoff onto roads and streams; reduce risks of flooding; reduce maintenance costs; ensure traffic flows.	Town of Sheffield	4-6 years / Medium	Town funding	**Completed** Current controls and bylaws adequate upon review
Property Protection – All Hazards	Identify historic structures, businesses and critical facilities located in hazard prone areas, including floodplains and dam failure inundation areas.	Enable building owners to be better prepared for the hazards and to prevent losses	Town of Sheffield, MEMA, MA Historical Commission, Owners of identified structures	4-6 years/ Medium	Town, owners of identified structures	**In Progress** Survey done of major businesses; few have suffered flood damages; Historical Commission has updated Sheffield Historical House Books, as defined by MA Historical Commission
Structural Project -- Flooding	Replace undersized and deteriorating culverts and bridge along County Road	Reduce risk of flooding, further road damage and cost of maintaining the road; ensure traffic flow				**Completed** 2013 MassWorks grant bridge and culvert on Ironwork Brook and Unknown Tributary; MassDOT municipal bridge grant secured for 3rd structure; 2018 MassWorks successful for 4th structure
Structural Project -- Flooding	Assess and if necessary replace undersized culverts on Bow Wow and Kelsey Rds	Reduce risk of flooding, further road damage and cost of maintaining the road; ensure traffic flow	Town of Sheffield	4-6 yrs/ Medium	Town Funding	**New Action**
Assessment -- Flooding	Conduct road inventory to identify and prioritize road projects	Efficient use of limited municipal funding	Town of Sheffield	1-3 yrs/ High	Town Funding, grants	**New Action**
Assessment -- Public Preparedness	Identify and assess projected impacts of climate change	Incorporate resiliency into future hazard mitigation projects	Town of Sheffield,	1-3 yrs/ High	MVP Program	**New Action**

OBJECTIVE #2: Encourage Self-Identification and Registration of those needing special assistance due to extended loss of electricity or a severe storm event

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Public Preparedness	Mailer to all addresses explaining program and reasons for self-identification; mailer to include form to do so. Include form to sign up for Blackboard Connect system.	Identify vulnerable people needing assistance; reduce potential injury or loss of life. More efficient deployment of resources.	Town of Sheffield, with assistance from COA, Police, Fire Department	1-3 yrs/ High	Town of Sheffield	**New Action**
Public Preparedness	Make mailer and Blackboard Connect form available at Town Hall, Senior Center, and Town Library. Announce at televised BOS meetings and Senior Center meetings. Distribute by first responders on calls, as appropriate	Identify vulnerable people needing assistance; reduce potential injury or loss of life. More efficient deployment of public resources.	Town of Sheffield, with assistance from BOS, COA, Police, Fire Department	1-3 yrs/ High	Town of Sheffield	**New Action**

OBJECTIVE #3: Develop, distribute and widely promote Sheltering in Place and Disaster Preparedness materials.

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Public Preparedness	Develop and distribute Sheltering in Place and Disaster Preparedness materials to all residents and businesses	Reduce risk of injury and loss of life; more efficient deployment of public resources; increase self-sufficiency in an emergency	Town of Sheffield	1-3 yrs/ High	Town of Sheffield, 2018 DLTA,	**New Action**
Public Preparedness	Hold information sessions at Town COA and Library	Additional forums for information dissemination.	Town of Sheffield	1-3 yrs/ High	Town of Sheffield	**New Action**

OBJECTIVE #4: Increase participation on Blackboard Connect, Sheffield's Emergency Contact System

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Public Preparedness	Develop a campaign to increase Blackboard Connect participation and updating of phone/contact information; target to all addresses and tie in with self-identification appeal	Increased dissemination of emergency information; Reduce risk of injury and property damage; more efficient deployment of public resources.	Town of Sheffield	1-3 yrs/ High	Town of Sheffield	**New Action**

OBJECTIVE #5: Continue to work with local and state partners -- Emergency Managers, DPWs, Fire, Police, Councils on Aging, Health Departments and Schools -- to plan for and mitigate natural hazards on a regional basis

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Public Preparedness	Conduct emergency preparedness educational program for individuals and businesses; include possible land or air hazardous materials spill incident	Reduce risk of injury and property damage	Town of Sheffield, COA, DPH, SBREPC	1-3 yrs/ High	Town of Sheffield, DLTA, SBREPC	**New Action**
Public Preparedness	Continue to inform residents that Senior Center and Bushnell Sage Library are local cooling/warming centers	Reduce risk of ill health or injury from extreme temperature incidents	Town of Sheffield, COA. Library	1-3 yrs/ High	No funds needed	**New Action**

6. REFERENCES

Berkshire Regional Planning Commission (BRPC), 2013. *Berkshire Regional Natural Hazard Mitigation Plan*, Pittsfield, MA. Special note: this document includes the expired hazard mitigation plan of Sheffield, and also that of neighboring Egremont, Great Barrington and New Marlborough.

BRPC and Western Region Homeland Security Advisory Council, 2016. *Southern Berkshire Regional Shelter Plan*, Pittsfield, MA.

Federal Emergency Management Agency (FEMA), 2013. *Local Mitigation Planning Handbook, 2013*, Washington, DC.

FEMA, 2017. *Hazus-MH: Flood Global Risk Report*, Washington DC.

FEMA, 2017. *Hazus-MH: Hurricane Global Risk Report*, Washington, DC.

FEMA, 2017. *Hazus-MH: Earthquake Global Risk Report*, Washington, DC.

GZA GeoEnvironmental, Inc., 2017. *Operation, Monitoring, and Maintenance Plan Rising Pond Dam – MA 00250*, Norwood, MA.

MA Emergency Management Agency (MEMA), Dept. of Conservation and Recreation, 2013. *State Hazard Mitigation Plan, Commonwealth of MA*, Boston, MA.

MA Executive Office of Energy and Environmental Affairs, MEMA, 2013. *Mass. Drought Management Plan*, Boston, MA.

Sheffield Master Plan Steering Committee, 2005. *Town Master Plan, Town of Sheffield, Massachusetts,* Sheffield, MA.

Town of Sheffield, 2017. Compilation of *Natural Hazard Mitigation Surveys for Sheffield Businesses*, Sheffield, MA.

Town of Sheffield, 2017. *Sheffield Comprehensive Emergency Management Plan*, Sheffield, MA.

Town of Sheffield, as amended 2012. *Town of Sheffield Zoning By-Laws*, Sheffield, MA.

APPENDIX 1.

Critical Facilities and Hazards Locations Map

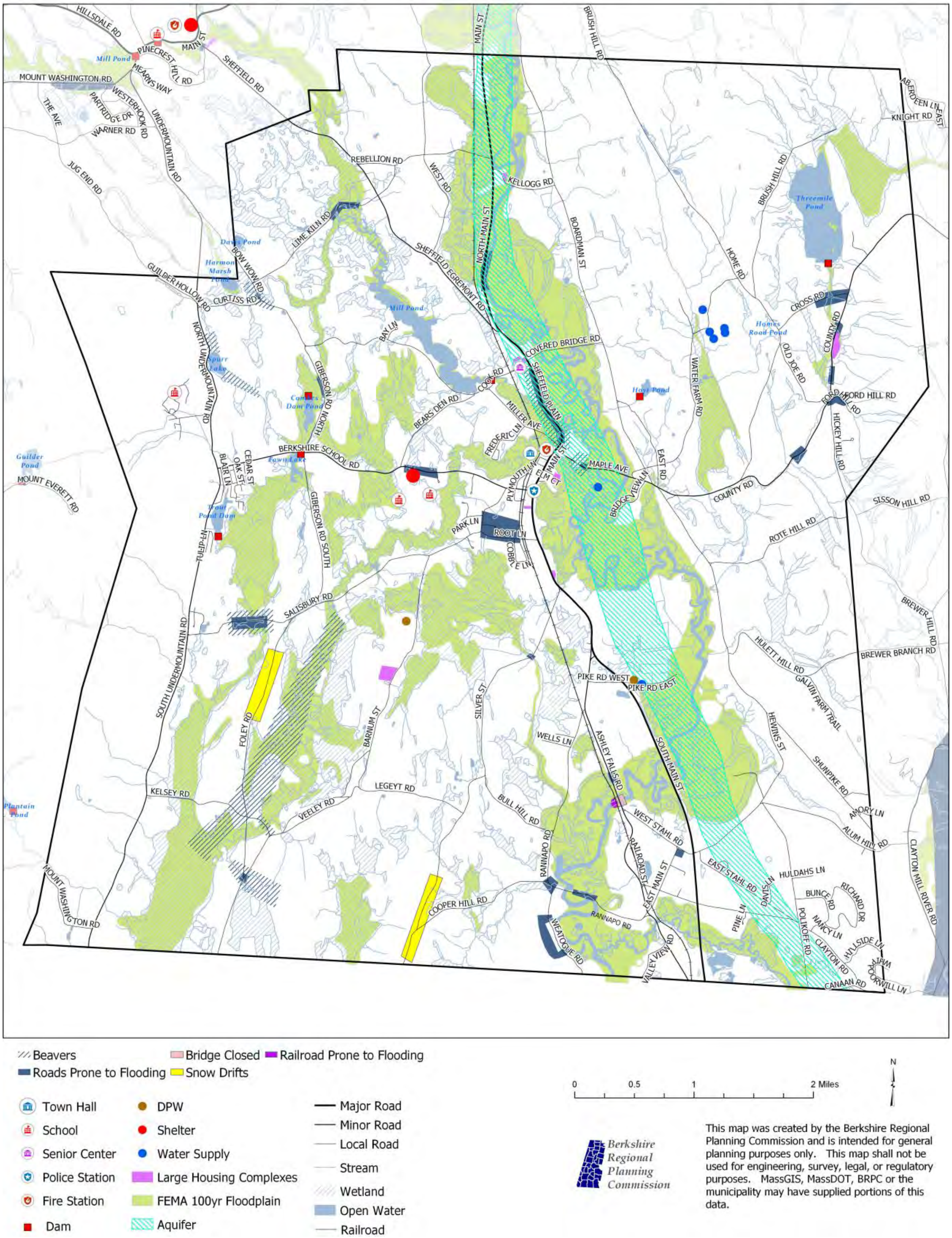
This map shows the locations of Critical Facilities and Hazards, as determined by data analyses and input from town officials, first responders and residents.

and

HAZUS-MH Reports

HAZUS-MH reports for Flooding, Hurricane and Earthquake

Town of Sheffield - Critical Facilities & Hazard Locations



Hazus-MH: Flood Global Risk Report

Region Name: Sheffield

Flood Scenario: Flood100

Print Date: Thursday, November 2, 2017

Disclaimer:

This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 49 square miles and contains 269 census blocks. The region contains over 1 thousand households and has a total population of 3,257 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 1,737 buildings in the region with a total building replacement value (excluding contents) of 437 million dollars (2010 dollars). Approximately 88.43% of the buildings (and 71.04% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,737 buildings in the region which have an aggregate total replacement value of 437 million (2014 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	310,652	71.0%
Commercial	58,173	13.3%
Industrial	34,128	7.8%
Agricultural	9,743	2.2%
Religion	11,223	2.6%
Government	2,842	0.6%
Education	10,546	2.4%
Total	**437,307**	**100.0%**

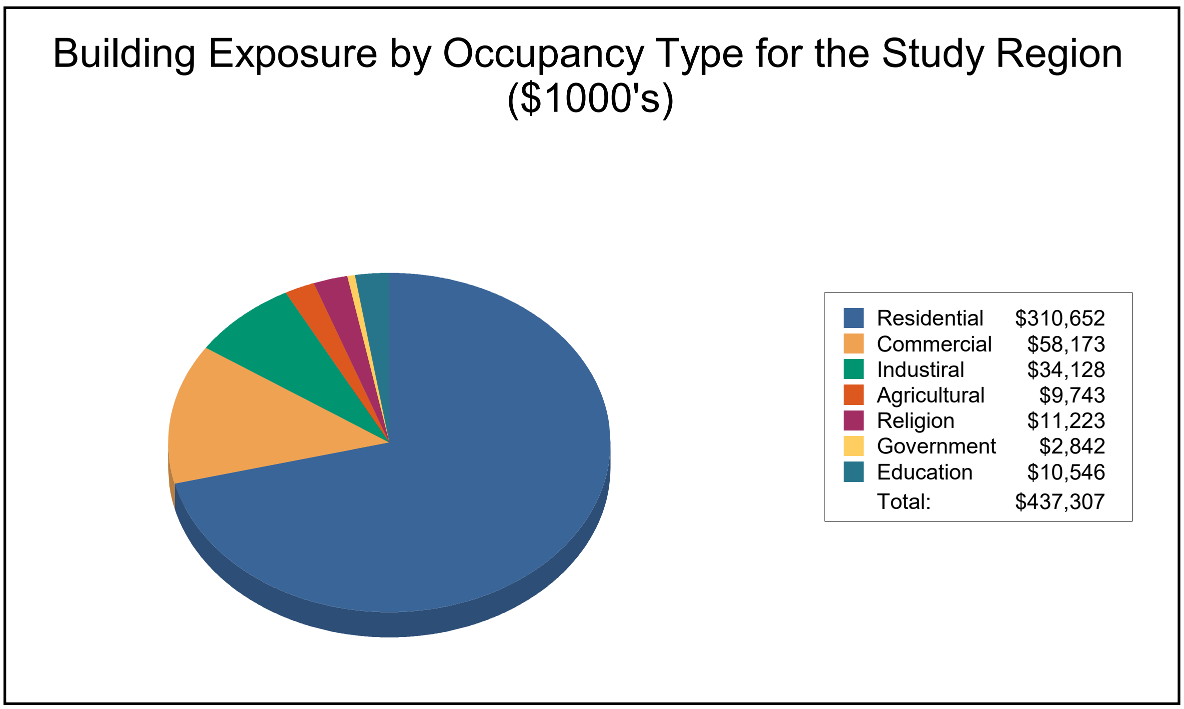
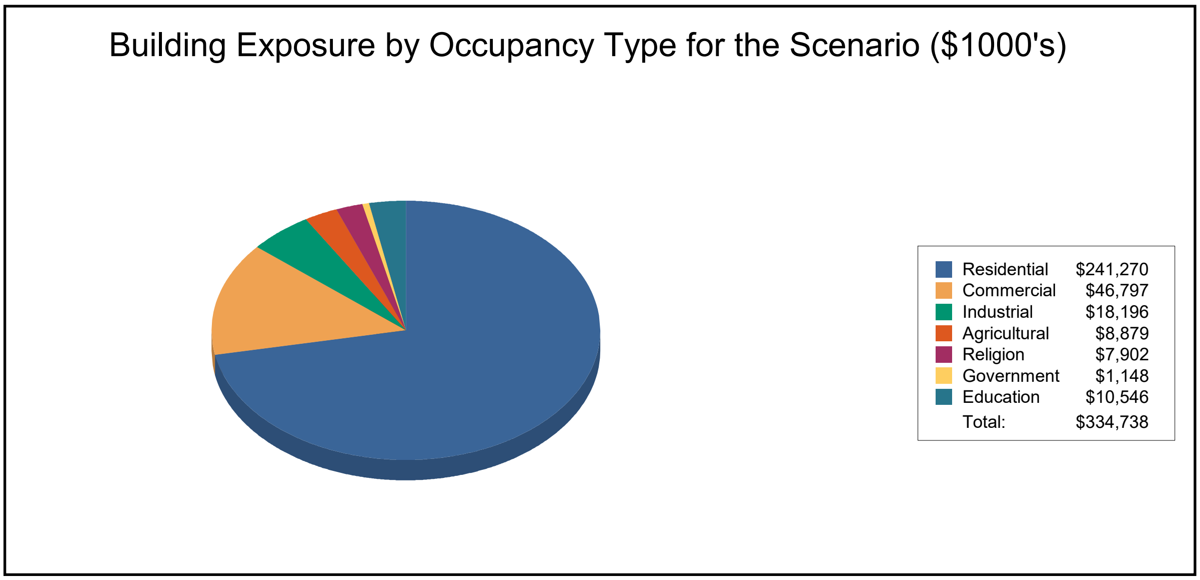


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	241,270	72.1%
Commercial	46,797	14.0%
Industrial	18,196	5.4%
Agricultural	8,879	2.7%
Religion	7,902	2.4%
Government	1,148	0.3%
Education	10,546	3.2%
Total	**334,738**	**100.0%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 2 fire stations, 1 police station and no emergency operation centers.

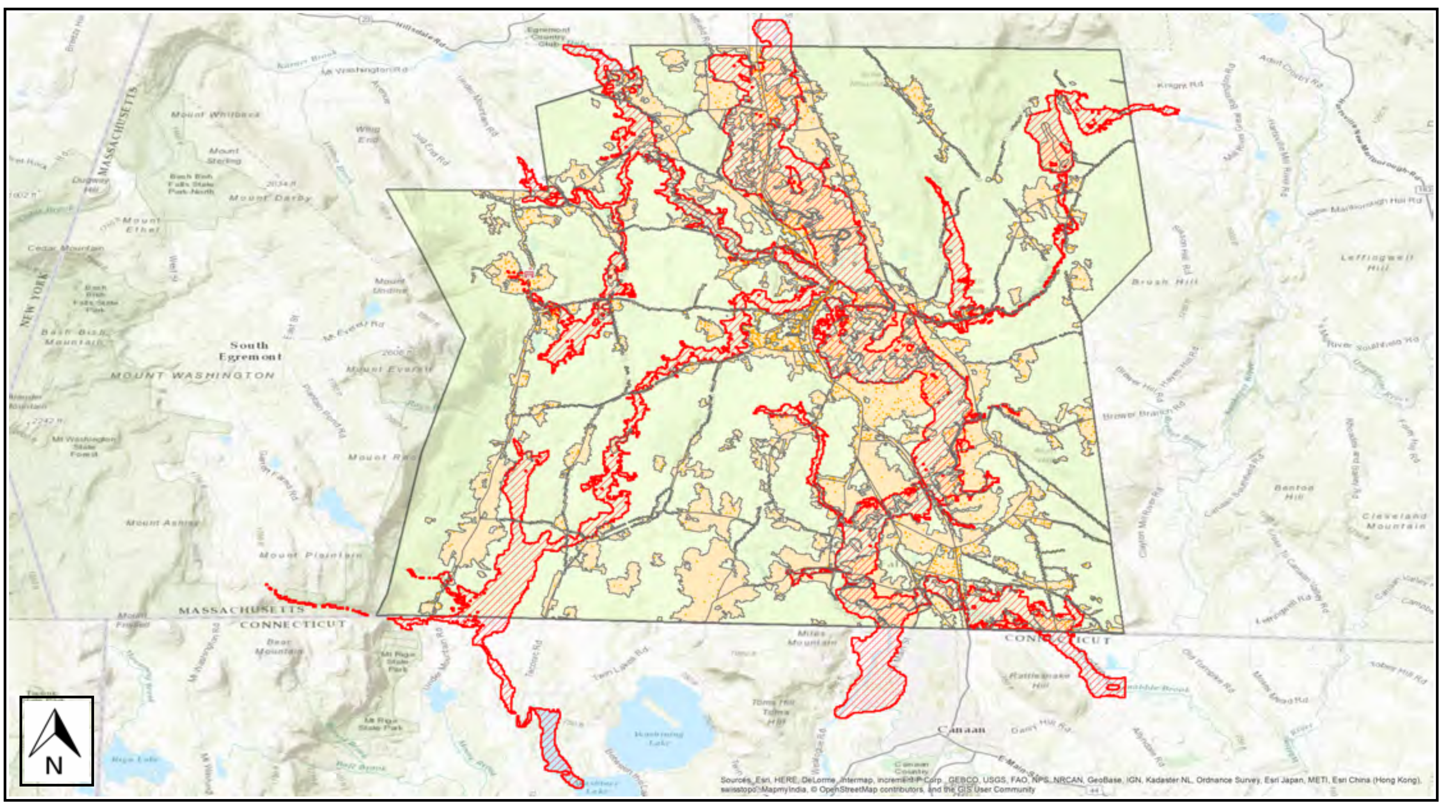
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Sheffield
Scenario Name:	Flood100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 37 buildings will be at least moderately damaged. This is over 91% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

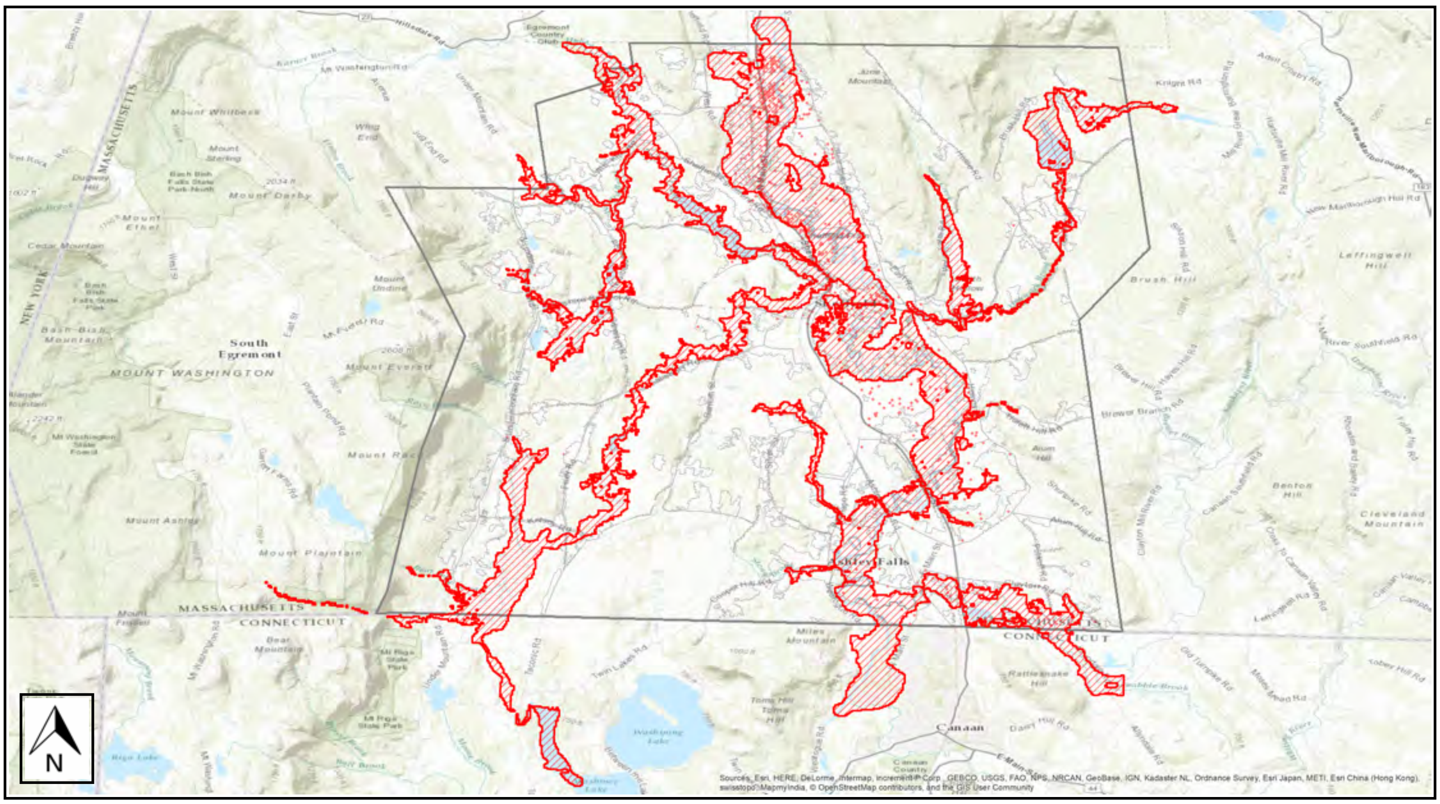


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	7	15.91	19	43.18	14	31.82	4	9.09	0	0.00	0	0.00
Total	**7**		**19**		**14**		**4**		**0**		**0**	

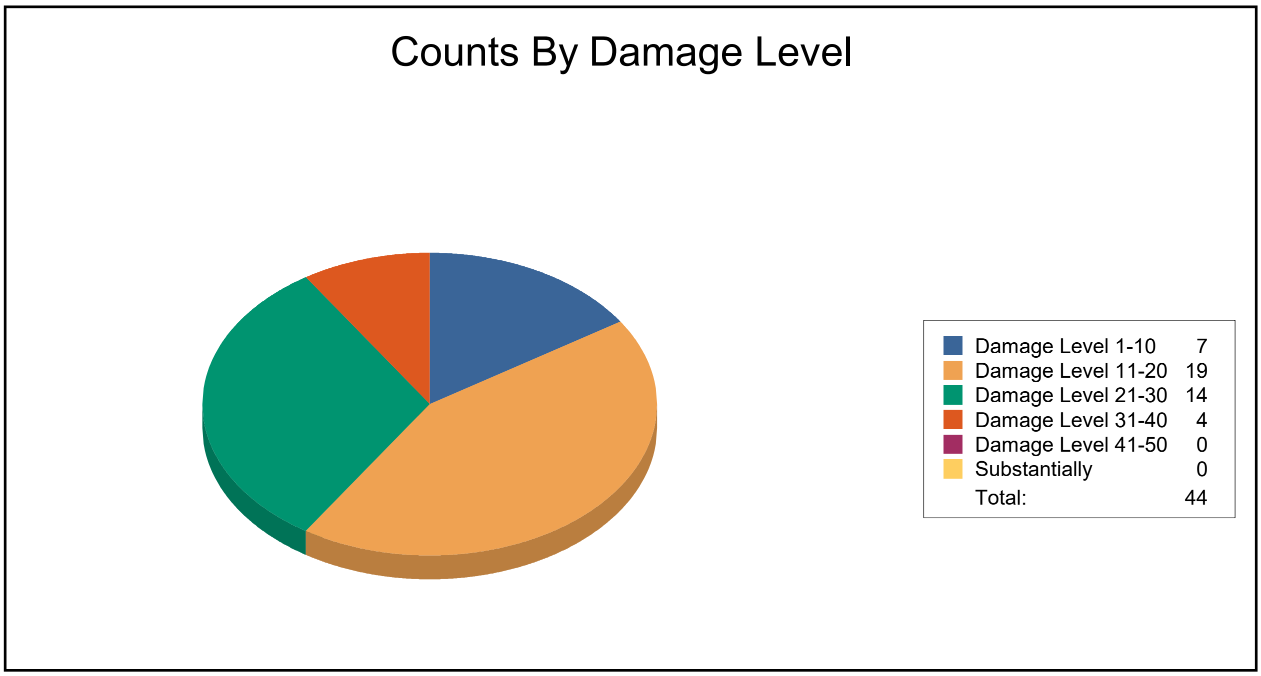


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	0	0	0	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	7	16	19	43	14	32	4	9	0	0	0	0

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	2	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	6	1	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

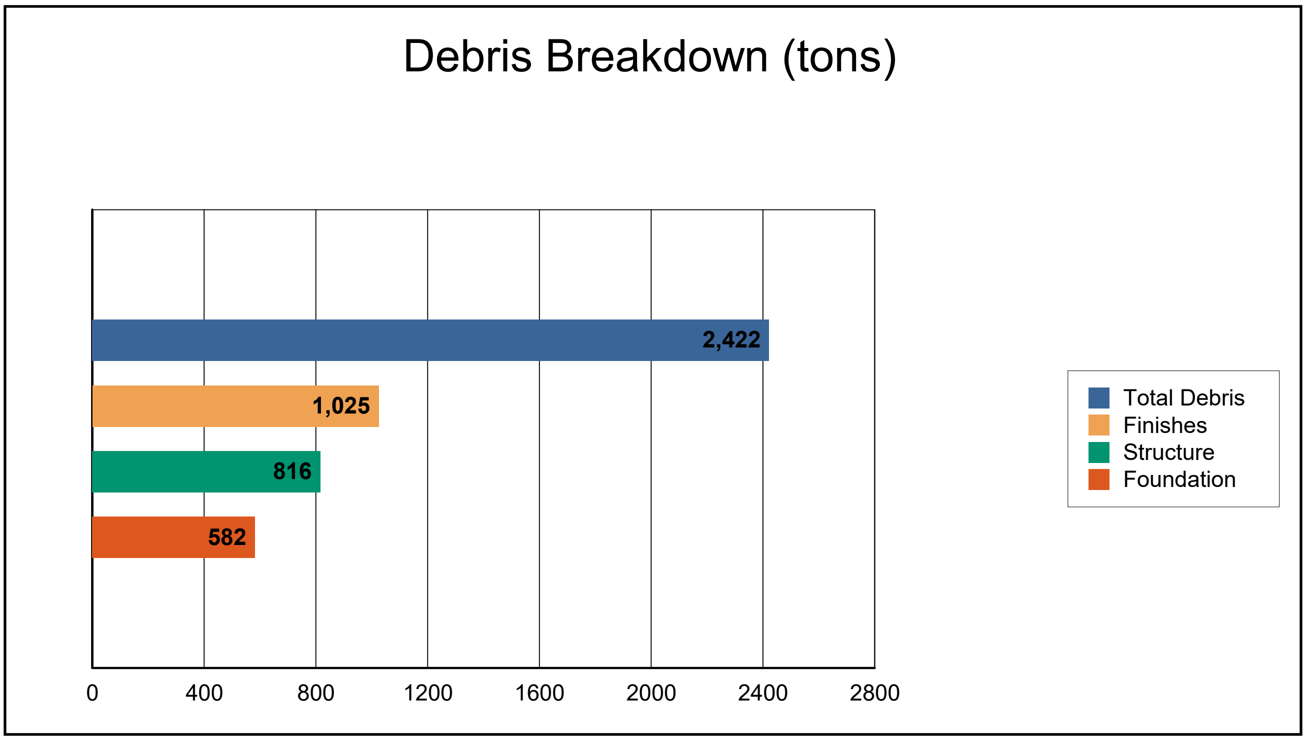
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

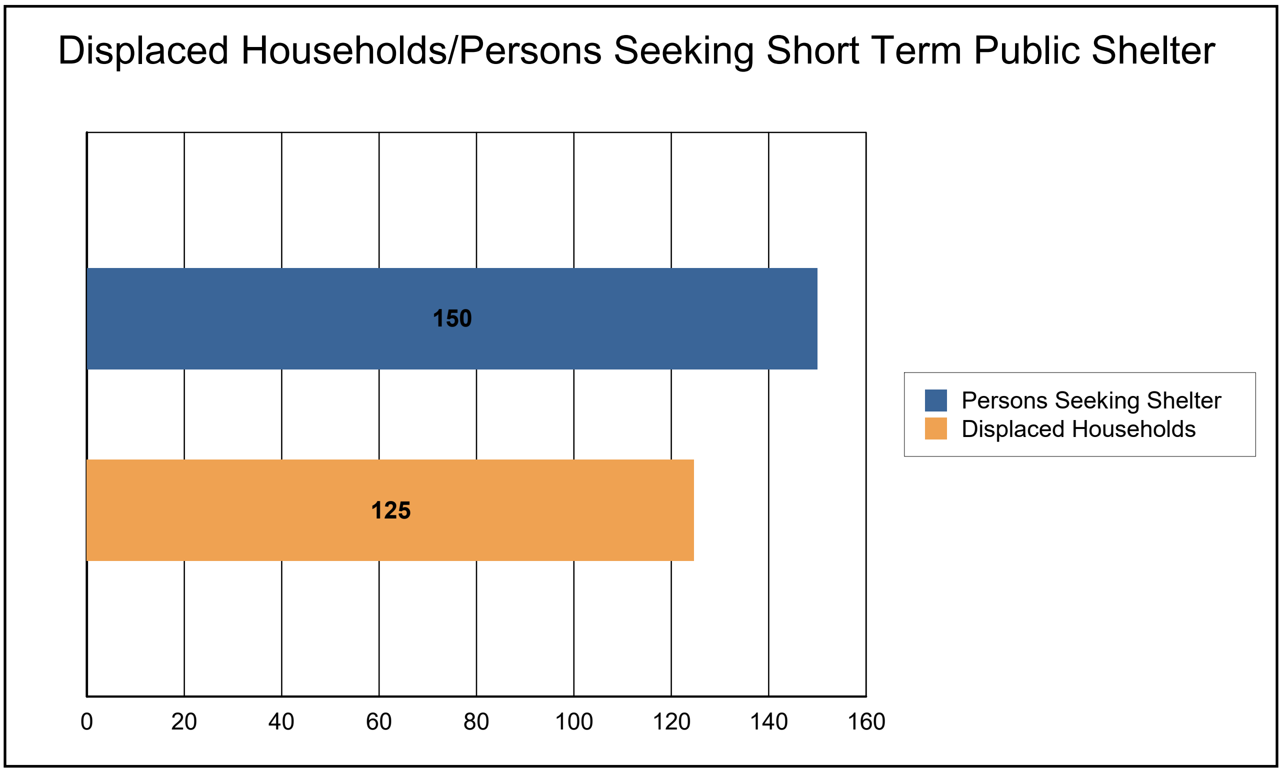


The model estimates that a total of 2,422 tons of debris will be generated. Of the total amount, Finishes comprises 42% of the total, Structure comprises 34% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 97 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 125 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 150 people (out of a total population of 3,257) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 34.69 million dollars, which represents 10.36 % of the total replacement value of the scenario buildings.

Building-Related Losses

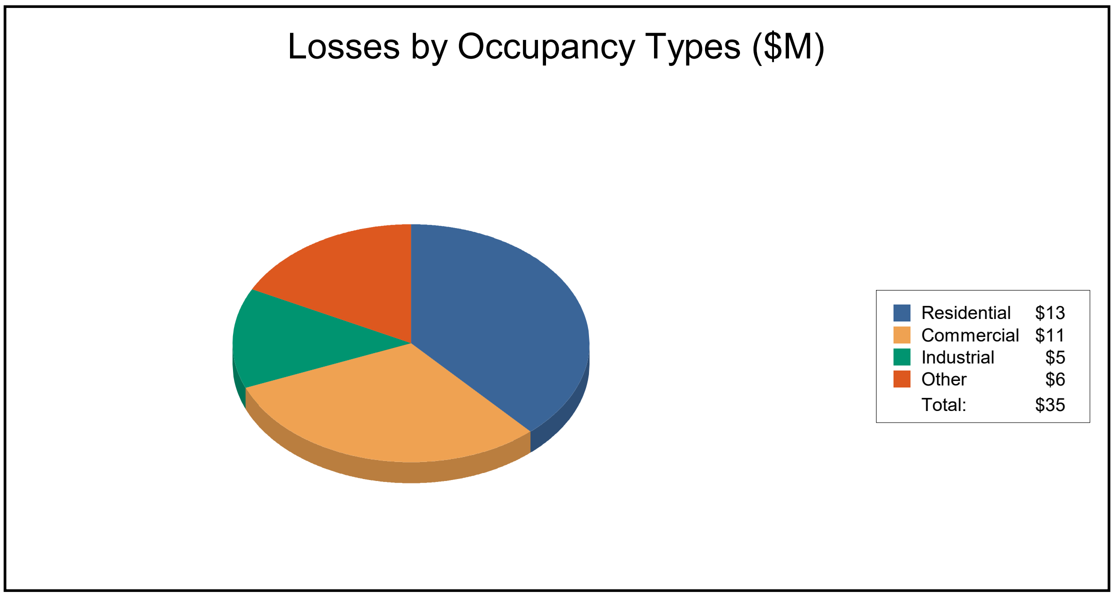
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 34.58 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 38.43% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	8.84	2.64	1.31	1.32	14.11
	Content	4.49	7.70	3.09	4.44	19.71
	Inventory	0.00	0.19	0.36	0.22	0.76
	Subtotal	**13.33**	**10.52**	**4.76**	**5.98**	**34.58**
Business Interruption						
	Income	0.00	0.02	0.00	0.00	0.02
	Relocation	0.00	0.00	0.00	0.00	0.01
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.02	0.00	0.05	0.08
	Subtotal	**0.01**	**0.04**	**0.00**	**0.06**	**0.10**
ALL	**Total**	**13.33**	**10.57**	**4.76**	**6.03**	**34.69**



Appendix A: County Listing for the Region

Massachusetts

- Berkshire

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Massachusetts				
Berkshire	3,257	310,652	126,655	437,307
Total	**3,257**	**310,652**	**126,655**	**437,307**
Total Study Region	**3,257**	**310,652**	**126,655**	**437,307**

Hazus-MH: Hurricane Global Risk Report

Region Name: Sheffield

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Thursday, November 2, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 48.57 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,257 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 437 million dollars (2014 dollars). Approximately 88% of the buildings (and 71% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,737 buildings in the region which have an aggregate total replacement value of 437 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Building Exposure by Occupancy Type

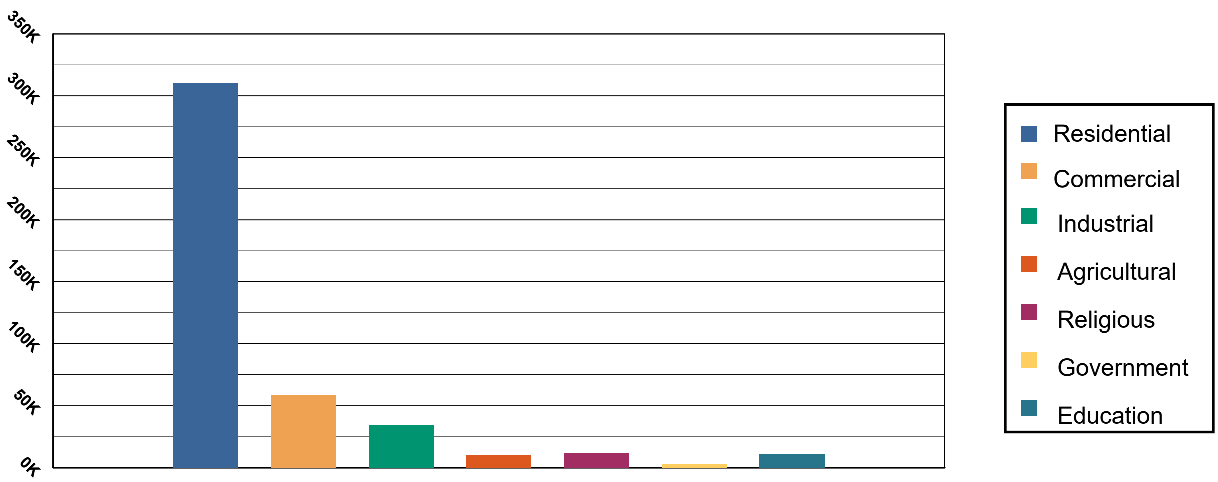


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	310,652	71.04%
Commercial	58,173	13.30%
Industrial	34,128	7.80%
Agricultural	9,743	2.23%
Religious	11,223	2.57%
Government	2,842	0.65%
Education	10,546	2.41%
Total	**437,307**	**100.00%**

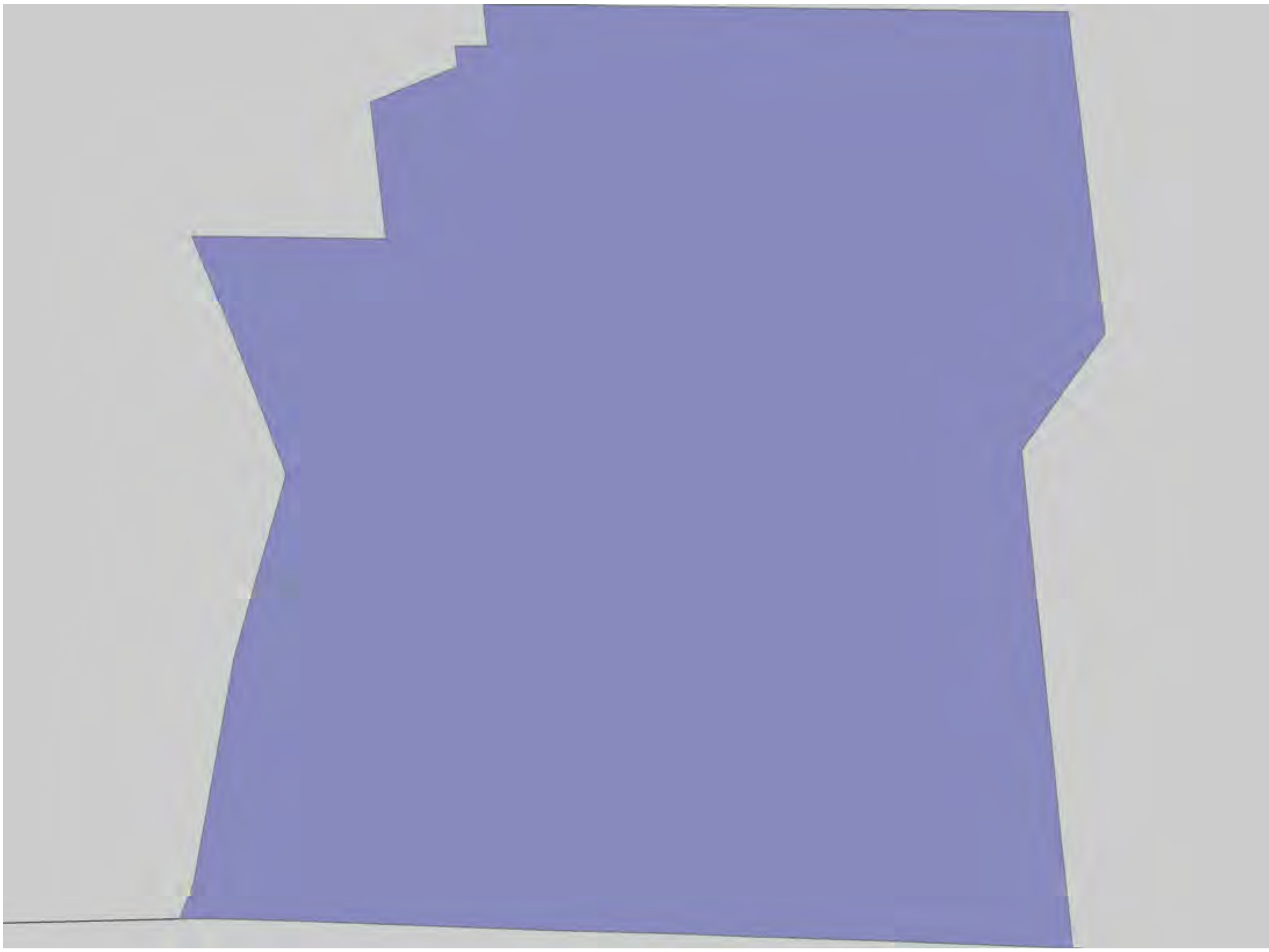
Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 6 schools, 2 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Thematic Map with peak gust windfield and HU track



Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

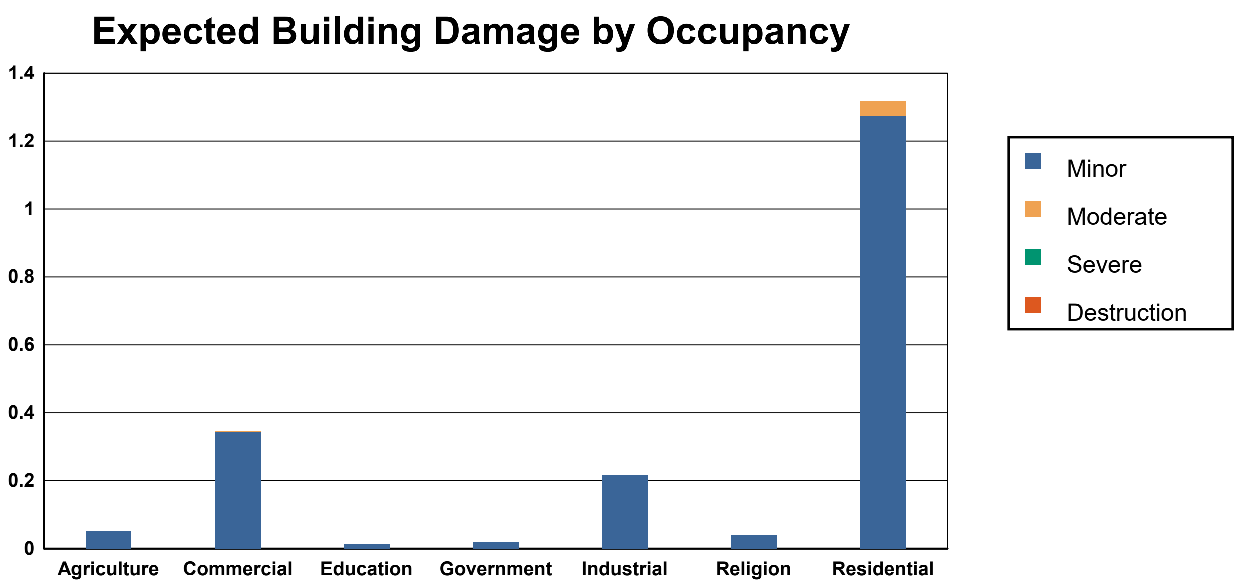


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	19	99.74	0	0.26	0	0.00	0	0.00	0	0.00
Commercial	101	99.66	0	0.34	0	0.00	0	0.00	0	0.00
Education	4	99.66	0	0.34	0	0.00	0	0.00	0	0.00
Government	5	99.62	0	0.38	0	0.00	0	0.00	0	0.00
Industrial	58	99.63	0	0.37	0	0.00	0	0.00	0	0.00
Religion	14	99.73	0	0.27	0	0.00	0	0.00	0	0.00
Residential	1,535	99.91	1	0.08	0	0.00	0	0.00	0	0.00
Total	**1,735**		**2**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	6	99.52	0	0.48	0	0.00	0	0.00	0	0.00
Masonry	68	99.48	0	0.50	0	0.02	0	0.00	0	0.00
MH	4	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	90	99.60	0	0.40	0	0.00	0	0.00	0	0.00
Wood	1,442	99.96	1	0.04	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

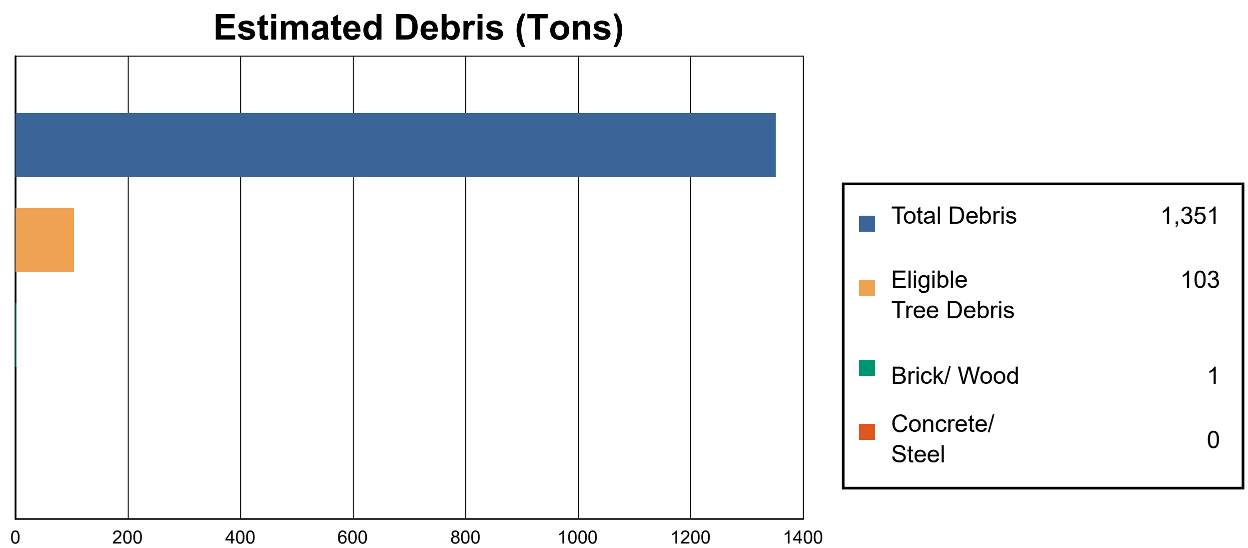
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	2	0	0	2
Police Stations	1	0	0	1
Schools	6	0	0	6

Induced Hurricane Damage

Debris Generation

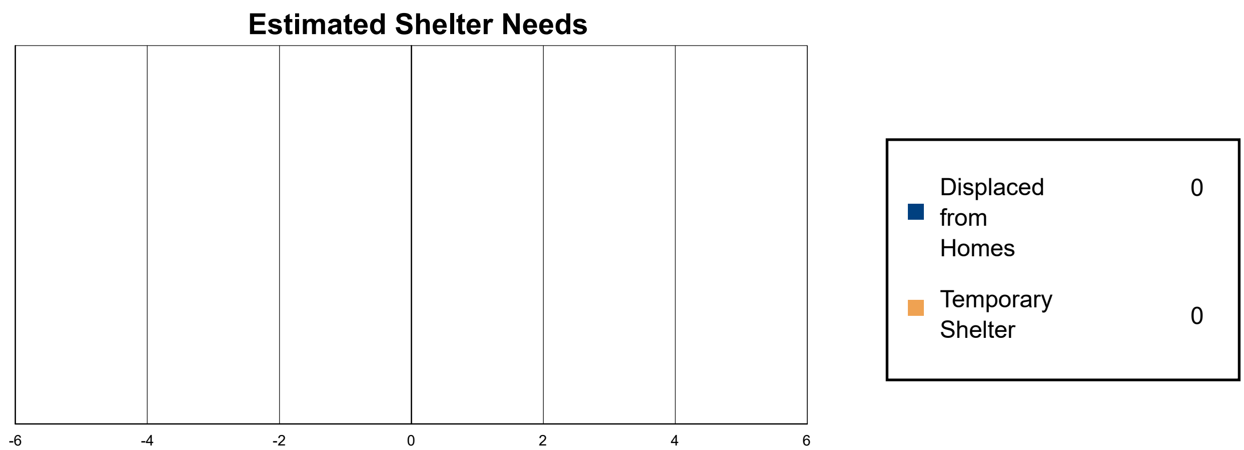


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 1,351 tons of debris will be generated. Of the total amount, 1,247 tons (92%) is Other Tree Debris. Of the remaining 104 tons, Brick/Wood comprises 1% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 103 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,257) will seek temporary shelter in public shelters.

Economic Loss

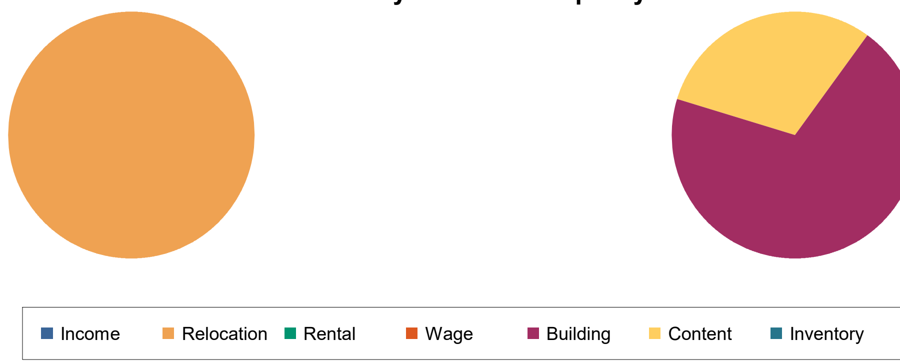
The total economic loss estimated for the hurricane is 0.3 million dollars, which represents 0.07 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 0 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 96% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy



Total Loss by Occupancy Type

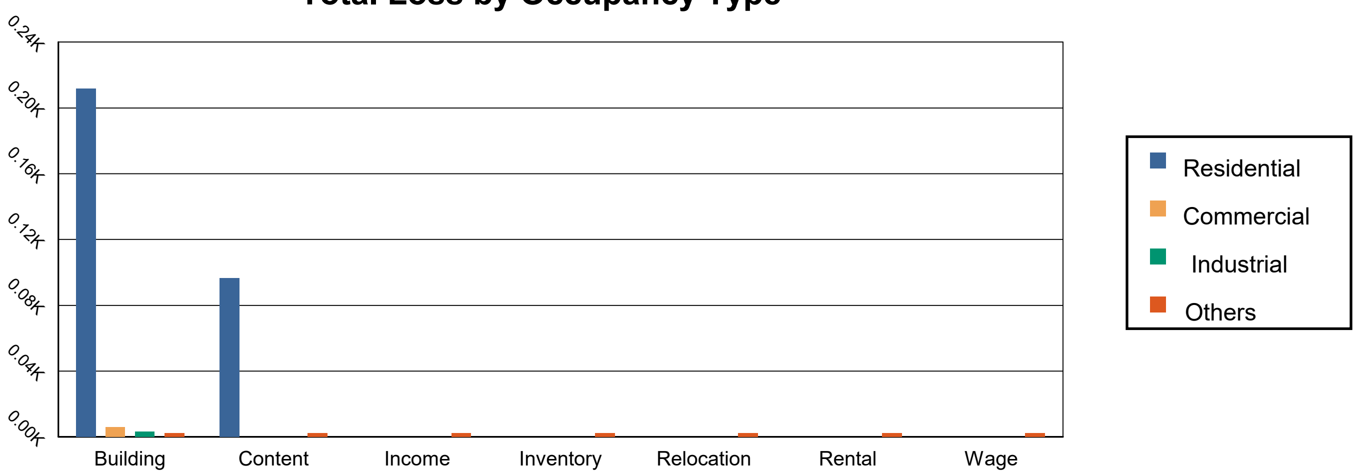


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	211.84	5.82	3.41	2.49	223.55
	Content	96.57	0.00	0.00	0.00	96.57
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**308.41**	**5.82**	**3.41**	**2.49**	**320.12**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.06	0.00	0.00	0.00	0.07
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.06**	**0.00**	**0.00**	**0.00**	**0.07**
Total						
	Total	**308.47**	**5.82**	**3.41**	**2.49**	**320.19**

Appendix A: County Listing for the Region

Massachusetts
- Berkshire

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Massachusetts				
Berkshire	3,257	310,652	126,655	437,307
Total	**3,257**	**310,652**	**126,655**	**437,307**
Study Region Total	**3,257**	**310,652**	**126,655**	**437,307**

Hazus-MH: Earthquake Global Risk Report

Region Name: Sheffield

Earthquake Scenario: quake100

Print Date: November 06, 2017

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 48.56 square miles and contains 1 census tracts. There are over 1 thousand households in the region which has a total population of 3,257 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 437 (millions of dollars). Approximately 88.00 % of the buildings (and 71.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 364 and 5 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 437 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 84% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 6 schools, 2 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the inventory. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 369.00 (millions of dollars). This inventory includes over 55 kilometers of highways, 20 bridges, 291 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

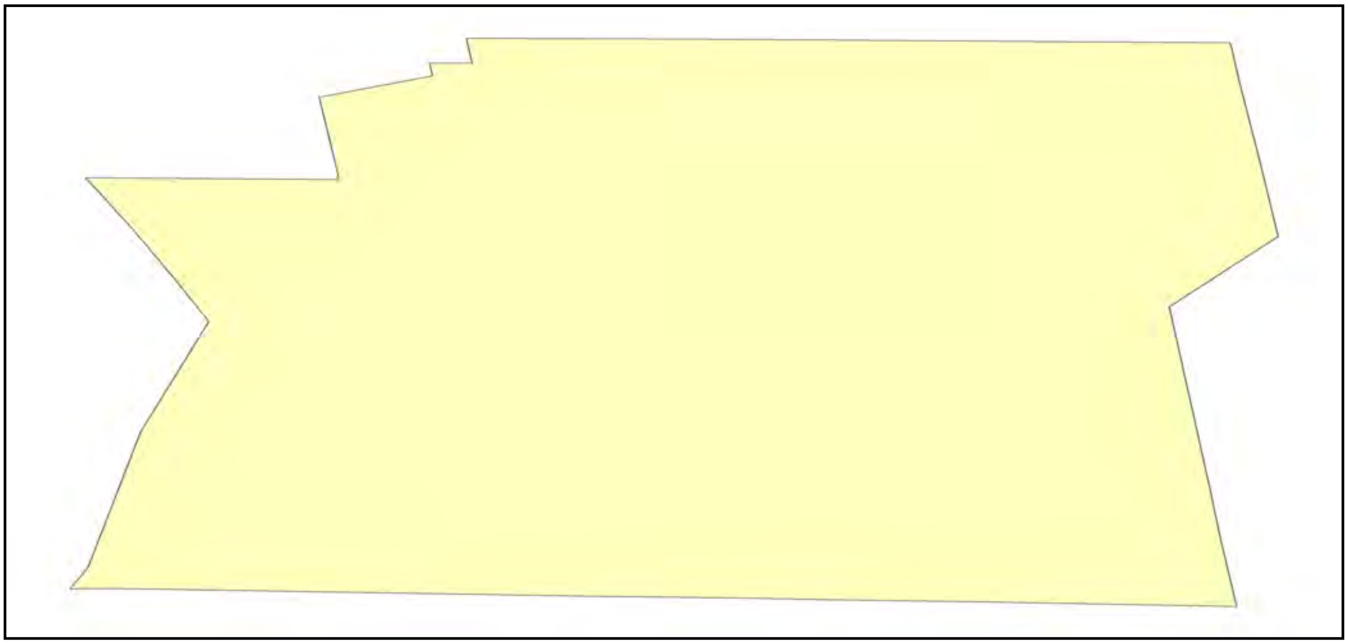
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	20	112.90
	Segments	7	234.70
	Tunnels	0	0.00
		Subtotal	**347.70**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	4	16.90
	Tunnels	0	0.00
		Subtotal	**16.90**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**364.60**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.90**
Waste Water	Distribution Lines	NA	1.70
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.70**
Natural Gas	Distribution Lines	NA	1.20
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.20**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	1	0.10
		Subtotal	**0.10**
		Total	**5.90**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	quake100
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	100.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage categories by General Occupancy Type

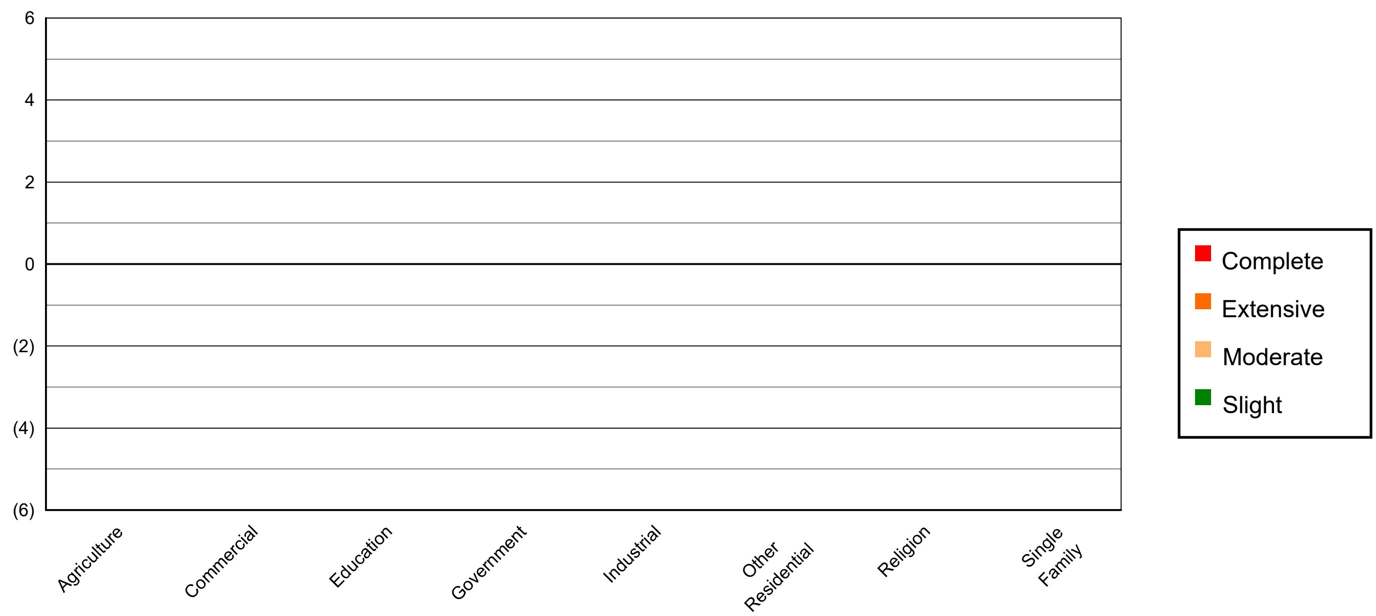


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	19	1.09	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	101	5.81	0	0.00	0	0.00	0	0.00	0	0.00
Education	4	0.23	0	0.00	0	0.00	0	0.00	0	0.00
Government	5	0.29	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	58	3.34	0	0.00	0	0.00	0	0.00	0	0.00
Other Residential	117	6.74	0	0.00	0	0.00	0	0.00	0	0.00
Religion	14	0.81	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	1,419	81.69	0	0.00	0	0.00	0	0.00	0	0.00
Total	**1,737**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,465	84.32	0	0.00	0	0.00	0	0.00	0	0.00
Steel	95	5.45	0	0.00	0	0.00	0	0.00	0	0.00
Concrete	17	0.96	0	0.00	0	0.00	0	0.00	0	0.00
Precast	6	0.37	0	0.00	0	0.00	0	0.00	0	0.00
RM	24	1.39	0	0.00	0	0.00	0	0.00	0	0.00
URM	117	6.75	0	0.00	0	0.00	0	0.00	0	0.00
MH	13	0.75	0	0.00	0	0.00	0	0.00	0	0.00
Total	**1,737**		**0**		**0**		**0**		**0**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	6	0	0	6
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	2	0	0	2

Transportation Lifeline Damage

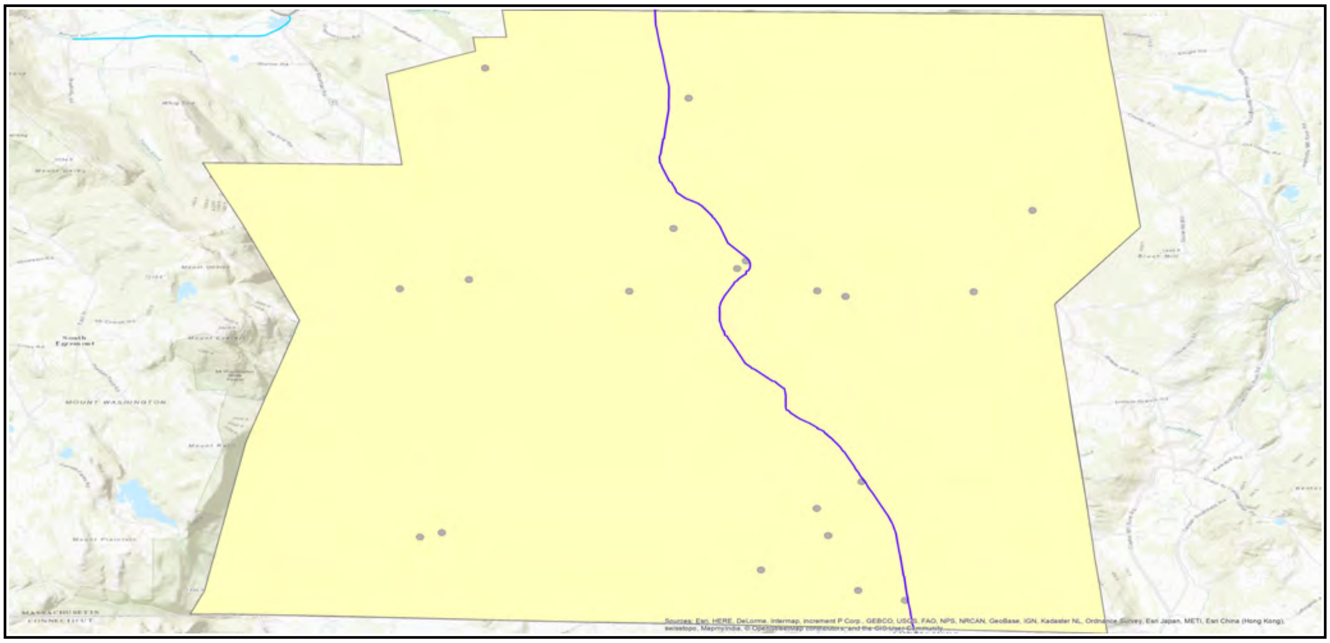


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	7	0	0	1	1
	Bridges	20	0	0	20	20
	Tunnels	0	0	0	0	0
Railways	Segments	4	0	0	4	4
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	1	0	0	1	1

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	146	0	0
Waste Water	87	0	0
Natural Gas	58	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	1,424	0	0	0	0	0
Electric Power		0	0	0	0	0

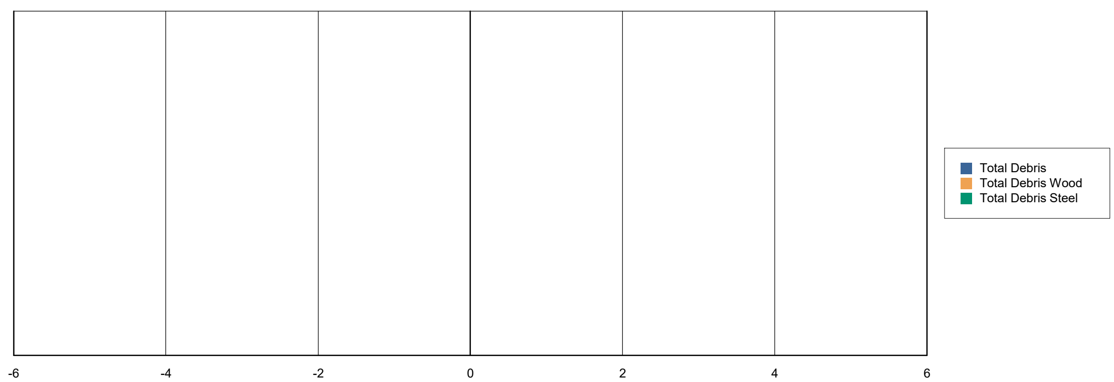
Induced Earthquake Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
		0.00	0 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,257) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter

Displaced households as a result of the earthquake	Persons seeking temporary public shelter
0	0

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

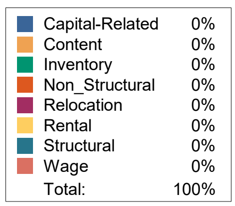
The total economic loss estimated for the earthquake is 0.00 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 0.00 (millions of dollars); 0 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 0 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

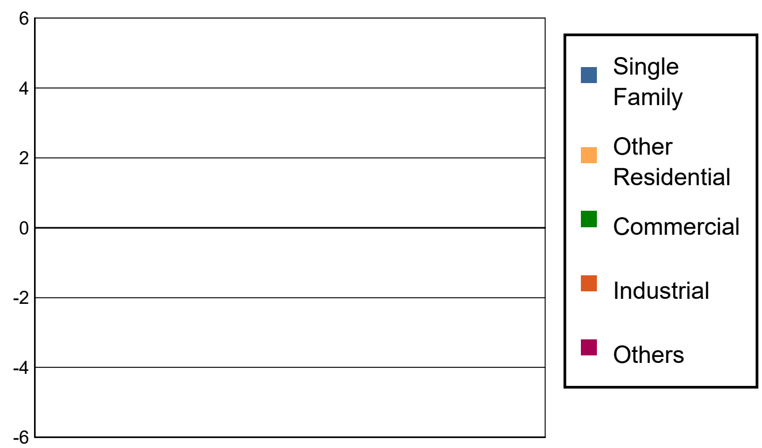


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.00	0.00	0.00	0.00
	Capital-Related	0.00	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Capital Stock Losses							
	Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Non_Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Content	0.00	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	234.73	$0.00	0.00
	Bridges	112.94	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**348**	**0.00**	
Railways	Segments	16.88	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**17**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
	Total	**364.60**	**0.00**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	2.90	$0.00	0.00
	Subtotal	**2.91**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.70	$0.00	0.01
	Subtotal	**1.75**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.20	$0.00	0.00
	Subtotal	**1.16**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.10	$0.00	0.00
	Subtotal	**0.12**	**$0.00**	
	Total	**5.94**	**$0.00**	

Appendix A: County Listing for the Region

Berkshire,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Berkshire	3,257	310	126	437
Total State		**3,257**	**310**	**126**	**437**
Total Region		**3,257**	**310**	**126**	**437**

APPENDIX 2.

Public Outreach Materials

The Town of Sheffield invited the public to participate in the development of the Hazard Mitigation Plan by publicizing the planning process, holding a public forum, and soliciting review and comment on the draft Plan. Comments and input received from public outreach efforts were incorporated into the final Plan. The materials in this appendix are:

- *Sheffield Times* articles about the Hazard Mitigation Planning Process and soliciting input
- Updates on the planning process and the public participation process were given at five Board of Selectmen meetings over the course of two years; these meetings are televised and the video posted on the Town's website; shown is an example of public video link to a Sheffield Board of Selectmen meeting.
- Survey and public forum flyer sent to the business community.
- Materials from the Public Forum, February 13, 2018.
  - Flyers advertising the public forum, placed in public gathering sites
  - Notice on Town of Sheffield website calendar
  - Put Yourself on the Map – attendees of the forum placed a dot where they lived, illustrating attendance from across the Town
  - Poster-sized critical facilities and aerial maps of the town with hand-written notes from forum attendees
  - Poster with the Major Findings from data analyses
  - Posters with draft actions and public comments
- Summary of the Action Strategy and Action Table offered to Sheffield Board of Selectmen and the public as a handout at their televised meeting Nov. 5, 2018; this handout was posted on the Town's website to kickoff the public review and input period for the draft Plan, which ran from Nov. 5 – 30, 2018.

TEENS RAISE MONEY TO HELP FRIEND

Alexander Zah-Greenspan, age 14, was diagnosed with muscular dystrophy in May 2016. It took all of us, his family, friends and neighbors, a full year to get over the shock and gravity of this news. Alexander had difficulty walking and had curvature of his feet.

Macony Pediatrics in Great Barrington figured out that he might have a rare genetic form of the disease, and after the family was sent to Washington, DC, for DNA testing, that was confirmed. Myofibrillar myopathy, which causes progressive muscle weakness, is a so-called "orphan disease," so rare that no research is being done on finding a cure. Alexander's parents, Laura and Stephen, have found only two other boys with it worldwide.

Over the summer the girls, Alexander's sister, Sophia, age 16, and Isabelle and Anouk Bizalion, ages 14 and 12, were sitting in the yard trying to figure out how they could make money for scientists to find a cure for Alexander.

They decided to make something to sell at the Sheffield Farmers' Market. They also decided they needed a logo, which was designed by Isabelle with the help of Sophia's computer skills. It shows a profile of Alexander, lithograph-style. At the Farmers' Market, they sold banana bread, blueberry muffins and brownies. They ordered T-shirts with the logo and tried selling them at the Sheffield Fair in September.

The project has been a great success, though small in monetary terms. The T-shirts didn't really sell, but the sympathy flowed and donations were given. The four efforts brought in just under $1,000.

Maggie Robitaille, Serena Batacchi, Isabelle Bizalion, Sophia Zah-Greenspan and Anouk Bizalion selling muffins at the Sheffield Farmers' Market. Left, the logo for Alexanders Way.

For three girls 16 and younger, not bad for first-time fundraisers!

Laura and Stephen are working with the National Institutes of Health and the Muscular Dystrophy Assoc. to start research for a cure. For more information on Alexander and how to help, please visit the website at www.alexandersway.org.

T-shirts are also for sale at Bizalion's, 684 Main St., just north of the Big Y in Great Barrington. It's open everyday.

—*Helen Bizalion*

HELP CREATE THE TOWN'S HAZARD PLAN

What roads and bridges are likely to be impacted during a severe storm? Whats if the electricity is out for four days and roads are impassible due to downed trees? Are Town shelters and back up shelters prepared? And even more important, is every household prepared to care for itself if cut off for up to a week? Those are the kinds of things considered in a town's hazard mitigation plan.

Sheffield is currently developing a new plan, and you're invited to participate. On Tues., Feb. 13, there will be two community input sessions at the Sheffield Senior Center, one from 1 to 3pm and another from 6 to 8pm. Residents are invited to drop by when they can, see the work done to date, discuss it and add their comments. No one needs to stay the two hours. Light refreshments will be served.

Local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural disasters and develop long-term strategies for protecting people and property from future hazard events. Sheffield last updated its plan in 2012 as part of a larger Berkshire County effort. Funds recently became available through the Massachusetts Emergency Management Agency to enable the Town to develop its own plan, and the Board of Selectmen voted to do so. A volunteer committee was set up: Rhonda LaBombard, Town Administrator; Eric Munson, Police Chief; Edward Pickert, Highway Superintendent; Kathie Loring, Senior Center Executive Director; and Lou Levine and Rene Wood, town residents. Berkshire Regional Planning Commission is the consultant for the project.

Once the Town has the community's input from the Feb. 13 open house, a draft of the updated plan will be submitted to the state for its feedback. With the state input, the final plan should be filed in early May. At that point, the Town can begin to address areas of concern and will be eligible for assistance and grants available to municipalities that have updated plans.

One only needs to remember Hurricane Irene, the 2012 industrial fire in Ghent, NY, or the 2014 Thanksgiving snowstorm to know why hazard mitigation planning is important for a town. Come and help us create a plan too. We welcome your input. —*Rene Wood*

CARMODY RESIGNS AS BUILDING INSPECTOR

Thomas Carmody, who had been Sheffield's building inspector for 12 years, resigned just before Christmas to take a position in Pittsfield.

Sheffield is using interim inspectors until a new building inspector can be hired. The Town's Board of Selectmen appointed Don Torrico, who is the building inspector for New Ashford, Adams and Monterey, as interim inspector. To help him, the Board also appointed two retired building inspectors, William Thornton, who had been Lee's inspector, and Don Fitzgerald, who had been Lenox and Lee's inspector. Fitzgerald currently lives in Texas and will review plans and issue permits from afar.

A building inspector is needed for any construction to move forward, providing inspections at various stages in the building process. Inspectors must pass at least three examinations before being certified by the state.

The interim inspectors who live in the area will hold office hours from 10am to 1pm on Tuesdays and 10:30am to 2:30pm on Fridays, or by appointment.

From SHEFFIELD TIMES, Vol. XVIII, Issue III March/April 2018

KIWANIS NEWS & EVENTS

Scholarships. Applications are now available for our annual scholarship program for graduating seniors and returning college students. You can find them, and instructions for filling them, out in local high school guidance offices or at www.sheffieldkiwanis.org.

Congratulations, winners! In our 2018 Truck Raffle, Judy Ullrich won the first prize—the truck or $20,000. Deborah Blackwell and Fred Baldwin won the cash second and third prizes.

Save the date! March 23rd is the date of this year's Ham Roll. The fun begins at 7pm in the American Legion Hall on Rt. 7 in Sheffield.

Cash Calendar. The Cash Calendar sales begin this month. A dollar amount from $50 to $500 will be assigned to every day in May and a winner is drawn for each day. Tickets are $10 and available from any Kiwanis member.

As always, thank you for your support. Your generosity is improving the lives of children in our communities and around the world. Kiwanis programs and services are available to children throughout Southern Berkshire County. We always welcome new members. To learn more, you can find us every Tuesday at The Bridge Restaurant, with dinner at 6:30pm (optional) and the meeting at 7pm. Please join us. —*Sharie Schroepfer*

HISTORY TALK

On Sat., March 3, Bernard Drew, local historian, weekly newspaper editor and columnist for the Berkshire Eagle, will give a talk, "East Rock is Falling Down," at the Monterey Community Center, 468 Main Rd., Monterey, at 10am. He will be telling tales of Great Barrington's East Rock and other lore of the town's eastern hills. The free event is sponsored by Bidwell House Museum.

COMMUNITY INPUT TO HAZARD PLAN

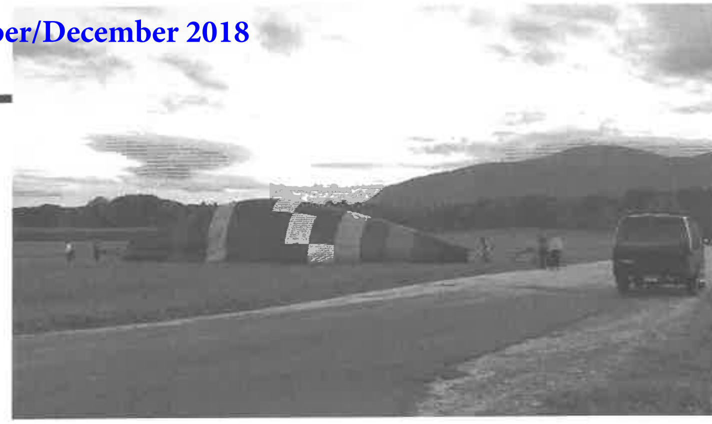
On Feb. 13, more than 20 people attended two community input sessions at the Senior Center to help the volunteer Hazard Mitigation Plan Committee gather fresh ideas for their work. Community members reviewed maps, draft actions and plans and added information about historic floods, infrastructure and the impact of beavers, along with other valuable data.

Police Chief Eric Munson provided information on how to better prepare for potential disasters and offered to do a walk-through for Sheffield businesses. (Interested businesses should call the Chief at 229-8522 for details and scheduling.) Residents were encouraged to sign up for the Town's reverse 911 system. (Call the Town Administrator's office at 229-7000 ext. 152 to do so.)

The committee plans to make a submission to the state for initial review and comments by late March. The Committee is assisted by Lauren Gaherty of Berkshire Regional Planning Commission. —*Rene Wood*

From SHEFFIELD TIMES, Vol. XIX Issue II November/December 2018

TOWN'S EMERGENCY PLANNING



Surprise visitor! Darrel Long of Spirit Ballooning in Canaan, CT, landed at the end of the day in a field off Lime Kiln Rd., near the Sheffield-Egremont Rd. That road, without powerlines, makes a good unobstructed landing spot.

In early November, Sheffield residents will again be invited to provide input on the Town's Hazard Mitigation Plan before it goes to the state for review. Residents have already commented on the plan during two community sessions in February. Information from those sessions, much of it based on older residents' memories, was extremely helpful. Over the past six weeks, Town departments and the Board of Selectmen have been reviewing the draft plan.

The team working on the plan are Police Chief Eric Munson, Highway Superintendent Ed Pickert, Town Administrator Rhonda LaBombard, Senior Center Executive Director Kathy Loring, Treasurer/Collector Alicia Dulin, Lou Levine, a Sheffield resident and Selectman Rene Wood. Lauren Gaherty of the Berkshire Planning Commission has been providing technical assistance under a grant.

The plan identifies Sheffield's major threats (flooding, including flooding caused by beavers, loss of electricity, and drought) and vulnerabilities (flooding and washing out of roads, incompleteness of emergency notification and potential unpreparedness of residents to shelter in place for more than a day or two). Actions to address the situations are prescribed, such as improving culverts and stabilizing road banks, creating an inventory of roads that need work and conducting an information campaign to increase public preparedness.

With a plan in place, the Town will continue its eligibility for both FEMA and MEMA grants. (FEMA is providing 75 percent of the Rannapo Rd. repair funding and MEMA provides grants on bridge and culvert repairs.)

Next steps include a hazard vulnerability assessment, set to begin in late October, also funded by a grant. And the Town is working on emergency preparedness information.

Also helping the town be better prepared is a state program called the Community Compact, a mutual agreement entered into between the Baker-Polito Administration and individual cities and towns of the Commonwealth, in which a community agrees to implement at least one "best practice" they select from a variety of options. The state agrees to support the initiatives with technical assistance and a grant program. Sheffield chose development of an online pavement condition index that rates all paved roads and development of a bridge and culvert preventative maintenance plan. The two initiatives, to be completed by 2020, have been accepted by the state and the Town awarded more than $31,000 to complete them.

You can see the plan online—see the Town's website (sheffieldma.gov/news) for a link. Comments may be forwarded to Lauren Gaherty at lgaherty@berkshireplanning.org or left at the Town Administrator's office by Nov. 15.

—*Rene Wood*

EMERGENCY ALERTS

Ways in which Sheffield can improve emergency response include getting emergency information to residents in a timely fashion and knowing which residents might need extra help.

Sheffield has set up a notification system through a company called Blackboard Connect that sends out alerts via mobile phone, texts and social media in addition to landline phones. As winter approaches, residents are encouraged to sign up. Go to the "online services" page from the Sheffield town website for the link.

Residents with special needs, such as medication or continuous oxygen, can register with the police department at 229-8522 so first responders are aware of such needs during an emergency. All information is kept confidential.

Reports on the planning process and promotion of public input opportunities were given at five Board of Selectmen meetings, which are televised on Community Television for the Southern Berkshires.

SHEFFIELD IS UPDATING ITS HAZARD MITIGATION PLAN!

AND WANTS TO HEAR FROM ITS BUSINESS COMMUNITY

Come to an Interactive Open House Tuesday, February 13, 2018

Where:

Senior Center

(25 Cook Road)

When:

1:00 - 3:00 pm* or

5:00 - 7:00 pm*

*- Drop-ins welcome, full 2-hour commitment not required.

Any Questio s? Contact Lauren Gaherty at Berkshire Regional Planning Commission
lgaherty@berkshireplanning.org
(413) 442—1521 ext 35

Berkshire Regional Planning Commission

The Town of Sheffield is looking for input from the business community for the Town of Sheffield Hazard Mitigation Plan. The Town is working to gather information to help develop their plan that will be a guide to preventing and lessening damage from extreme events such as flooding, severe winds, loss of electricity and heat, etc.

What is Hazard Mitigation?

- **Hazard mitigation** is the action taken to reduce the impact of natural disasters to people and property.
- Some possible hazard mitigation actions include:
  - replacing an undersized culvert with a larger one to reduce the risk of flooding or road washout
  - upgrading road stormdrain systems to handle higher volumes of water
  - moving or elevating critical municipal infrastructure out of flood-prone areas
  - moving critical records and archives out of the basement to a higher, less flood-prone floors.

What is a Hazard Mitigation Plan?

- **A Hazard Mitigation Plan** is the final product of a "pre-disaster" planning effort that identifies actions which can eliminate or reduce the risk to life and property in the event that a natural disaster occurs -- it is the work done up front to reduce the impacts of the disaster.
- Elements of the Hazard Mitigation Plan include:
  - Gathering public input
  - Assessing the Town's vulnerability to different disasters
  - Identifying areas of greatest risk
  - Developing an Action Plan
- The benefits of having a plan in place include making the Town more competitive for FEMA Grants and serves as a guide for future hazard mitigation actions.

Why Come to the Open House?

- Learn the disasters most likely to affect Sheffield and your business.
- Make comments on the plan and speak one-on-one with the Hazard Mitigation Plan Advisory Committee.
- Bring your perspective to Town Officials and help develop the priorities of the plan.
- Learn how to be better prepared during a disaster to prevent the property damage and loss of sales and production.

Natural Hazard Mitigation Survey for Sheffield Businesses

The Town of Sheffield is looking for input from the Town's unique business community to help identify ways to prevent or lessen damage from extreme natural events such as flooding, severe winds, loss of electricity, etc. The survey below has been developed to gather information on the extent that businesses have been affected by extreme weather events, current plans that businesses may have in place to respond to a disaster, and what services can be improved to prevent substantive loss during and after an extreme event.

Business Name:____

Business Address:____

1) Is your business in a floodplain? (Circle One): Y N Don't Know

2) Is your business prepared to respond and remain operational in case of a natural disaster? If so, in what ways?

____
____
____

3) Has your business experienced property loss or damage from a natural or man-made disaster including flooding? If yes, please explain the disaster and the dates of the disaster (month and year)?

____
____
____

4) If yes to question 3, please explain any effects on employee hours, company sales, other capital?

____
____
____

5) What types of services or support would help your business be better prepared for future disasters such as flooding, severe winds, loss of electricity, etc.

____
____
____

→ Please see reverse side →

6) Are you signed up for the Town of Sheffield's Emergency Notification System through Blackboard, which provides updates during a disaster?

   (Circle One)   Yes   No

   If you are not would like to, you can sign up at https://townofsheffield.bbcportal.com/

We welcome other comments you may have:

____

____

____

____

____

____

Thank you for taking the time to fill out our survey. *Staff and town officials value your input as we try to identify past and future risks from natural hazards and disasters, and consider ways to reduce the impacts of natural events when they occur. Please bring this survey with you to our hazard mitigation plan open house on February 13th from 1-3 pm or 5-7 pm. If you cannot make our open house, please send your survey by mail to Berkshire Regional Planning Commission at 1 Fenn Street, Suite 201, Pittsfield, MA 01201; by fax to (413) 442-1523, or by email to wsikula@berkshireplanning.org.*

SHEFFIELD IS UPDATING ITS HAZARD MITIGATION PLAN!

MAKE YOUR VOICE HEARD!

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Senior Center

(25 Cook Road)

When:

1:00 - 3:00 pm* or

5:00 - 7:00 pm*

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Berkshire Regional Planning Commission

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  - upgrading road stormdrain systems to handle higher volumes of water
  - moving or elevating critical municipal infrastructure out of flood-prone areas
  - moving critical records and archives out of the basement to a higher, less flood-prone floor
  - retrofitting shelters and cooling centers with generators to provide electricity during power outages
  - securing additional water supply sources in the event of drought conditions
  - protecting floodplains to provide storage capacity during severe flooding events

What is a Hazard Mitigation Plan?

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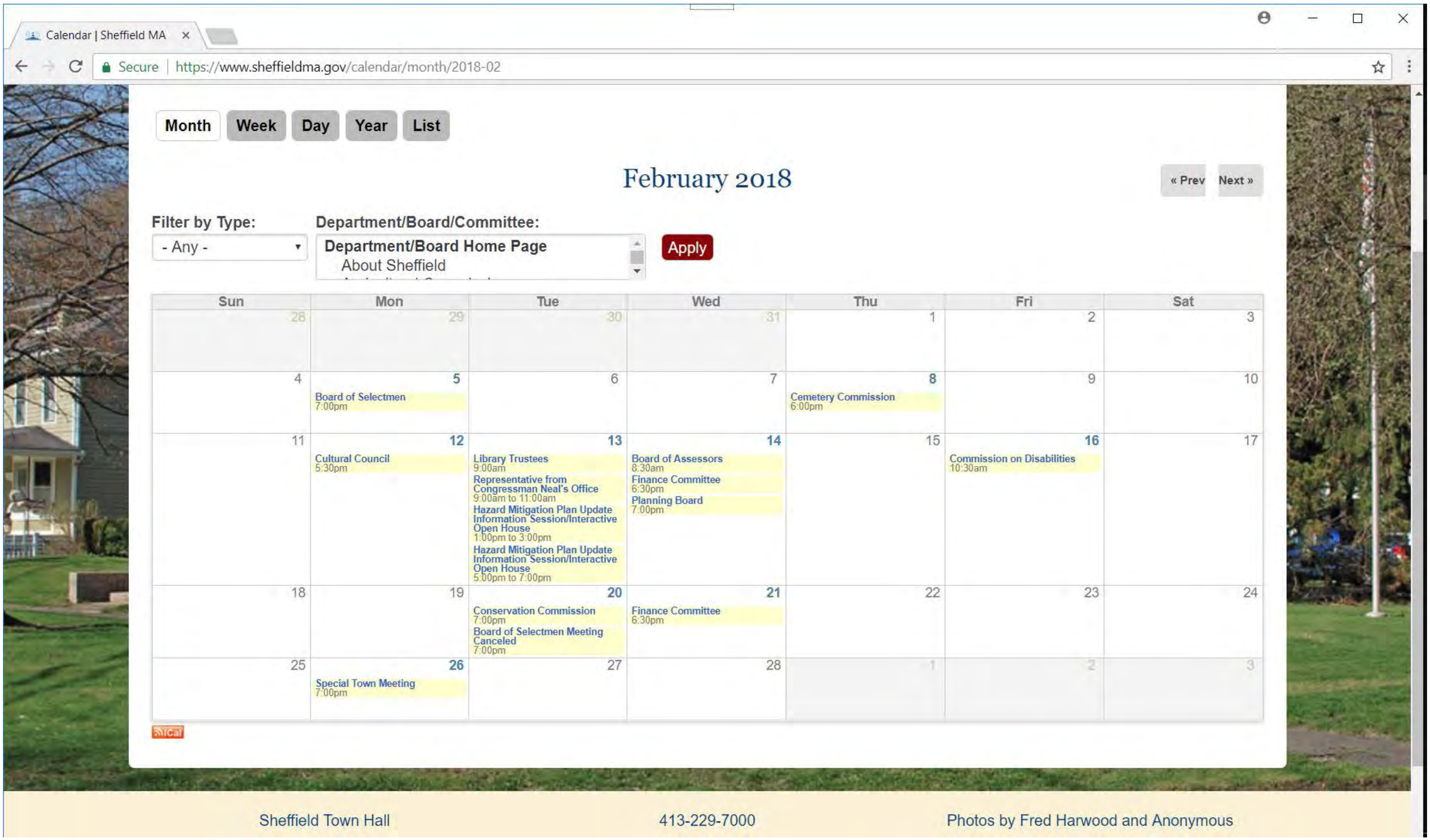
Why Come to the Open House?

- Learn the disasters most likely to affect Sheffield.
- Make comments on the plan and speak one-on-one with the Hazard Mitigation Plan Advisory Committee.
- Bring your perspective to Town Officials and help develop the priorities of the plan.
- Learn more about sheltering in place and how to be prepared in case of a disaster.
- Find your local shelters and cooling stations.

Public Forum Posting on Sheffield Town Calendar



PUT YOURSELF ON THE MAP

SHEFFIELD HAZARD MITIGATION PLAN UPDATE

What is Hazard Mitigation?

- **Natural Hazard** – Source of harm or difficulty created by a meteorological, environmental or geological event
- **Risk –** Potential for damage, loss, or other impacts created by the interaction of natural hazards with people, structures, facilities and systems that have value to the community
- **Vulnerability** – Characteristics of people, structures, facilities and systems that make them susceptible to damage from a given hazard

Note: Modified from U.S. Geological Survey and Oregon Partnership for Disaster Resilience Models.

- **Preparedness** – Actions taken to plan, organize, equip, train and exercise to build and sustain the capabilities necessary to prevent, protect against, mitigate the effects of, respond to, and recover from those threats that pose the greatest risk
- **Mitigation** – Sustained actions taken to reduce or eliminate long-term risk to life and property from hazards; *the work done up front to reduce the impacts of a hazard*
- Town of Sheffield is evaluating the risks due to natural hazards; other risks such as chemical accidents or terror/active shooter incidents were not evaluated

Hazards Evaluated

16 Hazards that Impact Berkshire Count
Following those listed in the MA Hazard Mitigation Plan

Hazards Evaluated	
Flood	Tornado
Dam Failure	Extreme Temperature
Hurricane / Tropical Storm	Drought
Nor'easter	Wildland Fire
Snow & Blizzard	Major Urban Fire
Ice Storm	Earthquake
Thunderstorm	Landslide
High Winds	Ice Jam

Dangerous Berkshire Hazards

Hoosic River Floods

- 1938 – Adams & N. Adams – 2 deaths, many injuries

Dam Failures

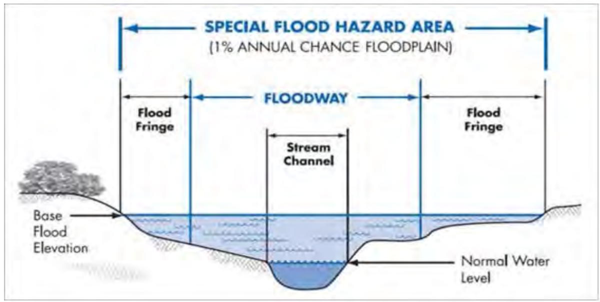
- 1886 – Mud Pond Dam, Lee – 7 deaths
- 1901 – Bassett & Dean's Dams, Adams – 1 death
- 1968 – Lee Lake Dam, Lee – 2 deaths

Tornadoes

- 1973 – W. Stockbridge – 4 deaths, 36 injured
- 1995 – Great Barrington – 3 killed, 24 injured

Flood Risks in Sheffield

- **100-Year Flood Event** – one that has a 1% annual chance of occurring commonly called 100-yr flood event; ***this is statistical occurrence only*** – a town could experience two 100-yr flood events in a short period of time (or conversely not experience any within 100 years or more)
- **100-Year Floodplain** – area of flooding associated with a 1% annual probability of occurrence; the boundary of the 100-yr floodplain is used by many agencies to assign flood risk, including FEMA and the National Flood Insurance Program



- **22.6% of Sheffield is 100-yr floodplain** (7,016 acres)
- These are often flat areas or wetlands surrounding the Housatonic River and its tributary streams
- **1.3% of the floodplain is developed** (91 acres)
- Many more acres just outside the 100-yr floodplain boundaries are developed
- **3 miles of town-owned rds & 5 miles of state-owned rds** in floodplain
- Much of North Main and South Main Streets in the floodplain
- **30.5% of the floodplain is categorized as agriculture** (1,725 acres)

Buildings in the 100-yr Floodplain

- MassGIS boundaries used to estimate that **94 buildings are in the floodplain** in Sheffield
  - This data layer used in the maps created in the plan
  - Most buildings in floodplain are residential, but the overall percentage of total res. buildings is lowest at 4%
  - 29% of the commercial building stock
  - 10% of the industrial stock are in the floodplain

Buildings in the 100-year Floodplain 1% Annual Chance of Occurring					
Residential		Commercial		Industrial	
Number of Bldgs.	Percent Res. Bldgs.	Number of Bldgs.	Percent Com. Bldgs.	Number of Bldgs.	Percent Ind. Bldgs.
65	4.4%	26	28.6%	3	10.3%

- **HAZUS-MH Modeling** – FEMA software to estimate losses; calculated using the 1% annual chance of occurrence
- HAZUS-MH calculates 44 buildings within 100-yr floodplain
- Approx. 37 buildings will be at least moderately damaged
- Total loss of approx. $34.7 million dollars
- Neither of these models calculate agricultural losses

HAZUS-MH Estimates of Losses in 1% Annual Chance of Occurrence (commonly called 100-Yr storm event) Losses in Millions of Dollars					
	Res. Bldgs.	Com. Bldgs.	Ind. Bldgs.	Other Bldgs.	Total
Building Losses	$8.84	$2.64	$1.31	$1.32	$14.11
Content & Inventory Losses	$4.49	$7.89	$3.45	$4.66	$20.49
Total Losses	$13.33	$10.53	$4.76	$5.98	$34.60

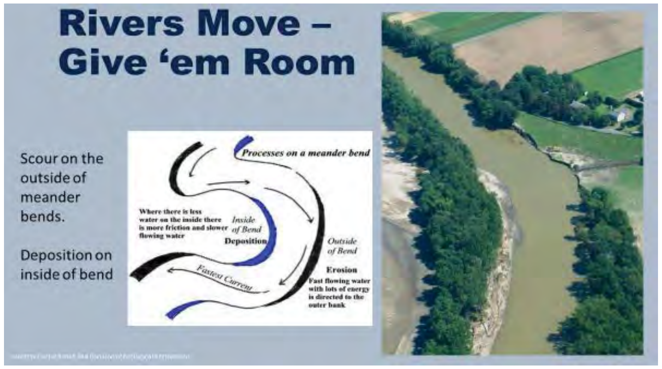
Municipal Infrastructure

Most road damages involve flooding damages, but not all are within 100-yr floodplain

- Many damages are due to erosion of stream banks in steeply sloped areas, which begin to undermine the road, such as County Road

SHEFFIELD HAZARD MITIGATION PLAN UPDATE

Water Movement



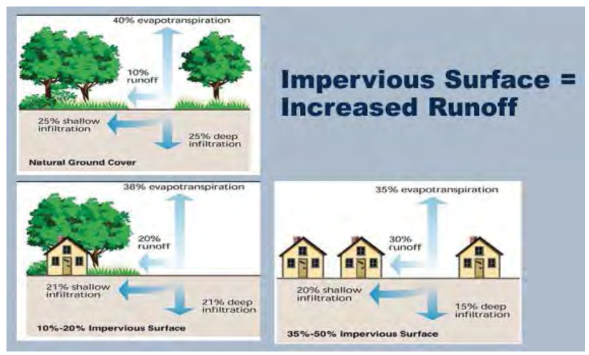
Above: Housatonic River at New Lenox Rd, Lenox

Right:

Sediment deposition dur to flood waters in floodplain area

Potential Mitigation Action

- **Protect and Restore Natural "Green Infrastructure"** –
  - Maintain or restore floodplain functions
- **Structural Protections & Improvements** –
  - Stabilize roads
  - Improve stream and river crossings; prioritize highest risks
  - Elevate structures above flood level
  - Monitor and maintain dams
- **Guide Future Development –**
  - Strictly enforce floodplain bylaws
  - Revisit zoning – does the town:
    - *Require that stormwater runoff be retained on site*
    - *Encourage Low Impact Development techniques*
    - *Restrict development on steep slopes*



- **Incorporate New Data for Mitigation, Resilience, Adaptation–**
  - Incorporate new floodplain data and boundaries when available
  - Monitor data and climate change projections for

Why Focus on Flood Risks?

- **Flood events and recurrence intervals calculated (even if they need to be adjusted)**
- **Floodplain boundaries delineated (even if they need to be adjusted)**
- **Benefits of keeping development out of floodplains well documented**
- **Predicting large storm events and warning times are fairly reliable**
- **Mitigation techniques are feasible and benefits tangible**

Reduce Runoff from New Development

- **Minimize disturbance of natural vegetation and soils**
  - Maintain natural tree and shrub cover
- **Reduce the amount of hard, impervious surface areas**
  - Pervious pavers
- **Capture runoff that is generated by homes, driveways, patios**
  - Retention basins, rain gardens

A mature deciduous tree intercepts 500-2,000 gal. of water per year.

A mature evergreen intercepts up to 4,000 gal/yr.

Bridges and Culvert Improvements

Bronson Brook, Worthington

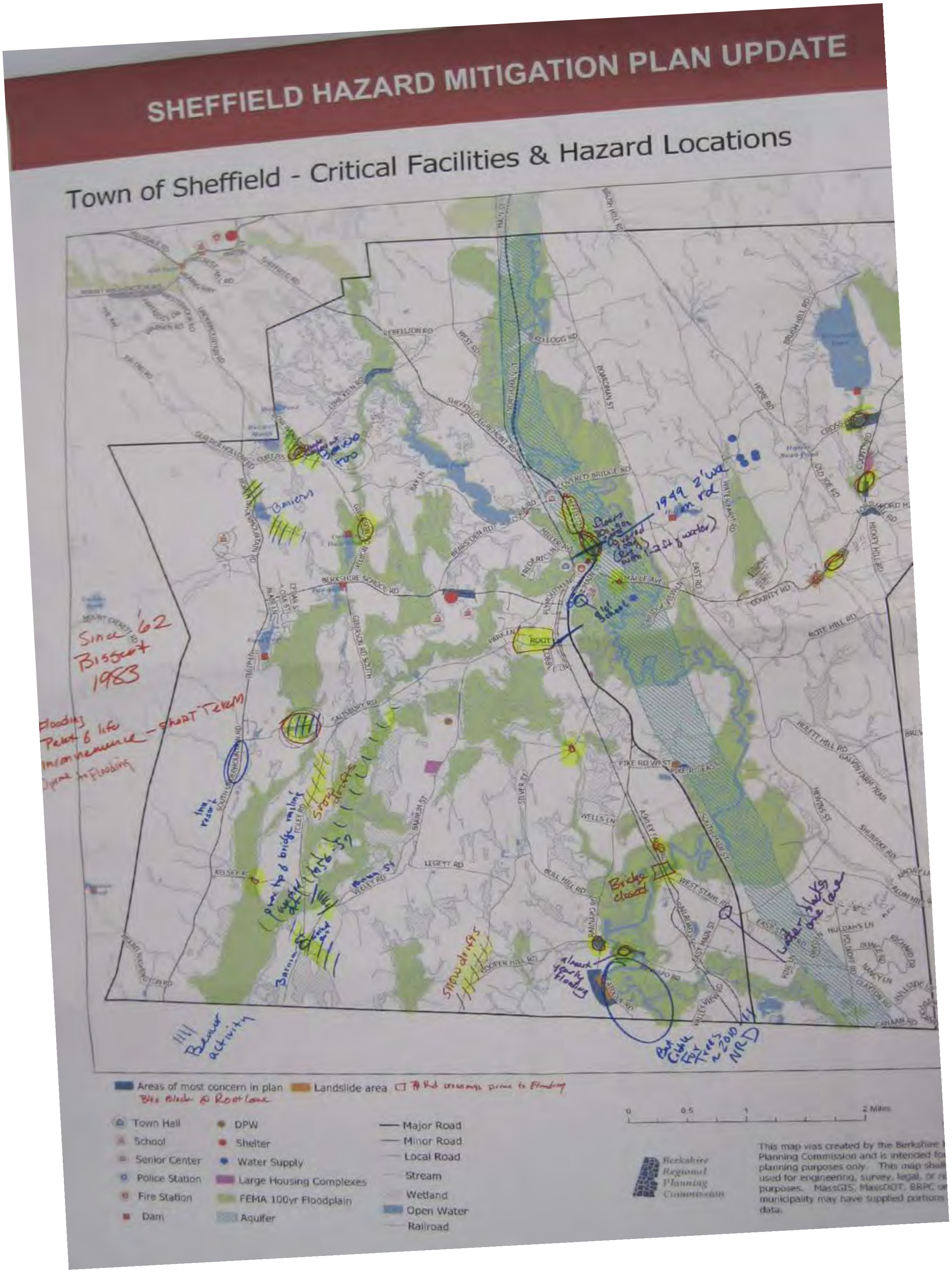
Left:

- *Box culvert washed out in 2003, closing road to all traffic.*
- *Had a history of clogging with debris.*

Left:

- *Post-T.S. Irene*
- *Channel-spanning tree was mobilized above this bridge, but passed through this upgraded design.*
- *Road remained open and passable.*

Critical Facilities and Hazard Location Map with handwritten comments from attendees of the Public Forum, February 12, 2018.



Hazard Location Map with handwritten comments from attendees of the Public Forum, February 12, 2018.

SHEFFIELD HAZARD MITIGATION PLAN UPDATE
Actions Drafted So Far (2-13-18)

Description of Action	Benefit	Status Since 2012 Plan
Install relief culverts on Lime Kiln Road to reduce risk of flooding	Reduce risk of flooding and reduce the cost of maintaining the road	**Incomplete** ***1 vote at open house*** No action so far
Install rip rap on Rannapo Road to stabilize bank that is being eroded by the Housatonic River	Stabilize the bank, which will prevent damage to the road	**In Progress** ***2 votes at open house*** FEMA funding secured (HMAGP-4110-23-DR-MA) at 75% reimbursement
Continue working with MassDOT to reduce flooding along Route 7	Reduce risk of flooding and reduce the cost of maintaining the road	**Incomplete** No action taken
Stabilize the bank on County Road to prevent landslides onto the Road	Prevent landslides, reducing the cost of maintenance and potential damage	**Incomplete** Monitoring situation
Work with the Trustees of Reservations to stabilize the banks along Wheatogue Road	Prevent landslides, reducing the cost of maintenance and potential damage	**In Progress** ***1 vote at open house*** Trustees received Grant to study
Conduct a study of the flooding on Rannapo and Weatogue Roads and implement findings	Reduce the risk of flooding and reduce the cost of maintaining the road	**In Progress** ***1 vote at open house*** Trustees received Grant to study
Review existing bylaws and update to ensure inclusion of stormwater control and best management practices	Help reduce the amount of new stormwater flowing off site onto roads and streams, reducing the risk of higher peak flooding	**Incomplete** Bylaws were last updated in 2008-2009. No new action taken since 2012.
Identify historic structures, businesses and critical facilities located in hazard prone areas, including floodplains and dam failure inundation areas	Enable those facilities to be better prepared for the hazards and to prevent their loss	**In Progress** Survey done of major businesses.
Replace undersized and deteriorating culverts and bridge along County Road	Reduce the risk of flooding and reduce the cost of maintaining the road	**New Action** ***2 votes at open house*** 2013 MassWorks grant secured for a bridge and culvert (Ironwork Brook and Unknown Tributary); MassDOT municipal bridge grant secured for 3rd structure; 2017 MassWorks grant for 4th failing bridge unsuccessful; will reapply in 2018

Additional Actions for Consideration

Actions Written by Attendees at the Open House	*Actions Verbalized by Attendees at the Open House*
Look at adding culvert north of bridge on 7A to stop flooding of RR tracks; existing trestle was covered and replaced w/ culvert	Reconstruct the Ashley Falls Bridge that is closed
Miller Avenue & Rt 7 across from state highway department need improvements to prevent flooding	Continue to control beavers that cause flooding of many roads across town (refer to map)
Continue beaver controls – "beaver deceivers"; get grants to help fund – *2 votes at open house*	Conserve eroding farm land by stabilizing banks of the Housatonic River and some tributaries
Become a Green Community to mitigate climate change	Move farming away from the banks of the river to avoid farming fertilizers and pesticides from entering the river
Re-plant floodplain forest to manage flood water naturally (and get rid of invasives that interfere with function of wetlands) – *3 votes at open house*	Stabilize the banks of the Housatonic River along Weatogue and Rannapo Roads
Develop shelter policies and procedures	
Develop a plan for railroad disasters and/or chemical spillage along the railroad. After all…it runs through wetlands, agriculture and peoples' back yards	
Preserve dirt roads near Schenob Brook to preserve pervious surface – *1 vote at open house*	

** DRAFT **

TOWN OF SHEFFIELD HAZARD MITIGATION PLAN

Town of Sheffield, Massachusetts

October 2018

Prepared by the:
Sheffield Hazard Mitigation Advisory Committee

With assistance from:
Berkshire Regional Planning Commission

Funding for the Sheffield Hazard Mitigation Plan was provided by a grant from the FEMA Pre-Disaster Mitigation Grant Program

Review the Plan at:
http://berkshireplanning.org/projects/sheffield-hazard-mitigation

Send comments, thoughts, suggestions before Nov. 16, 2018 to:
lgaherty@berkshireplanning.org

1. INTRODUCTION AND BACKGROUND

1.1. Purpose of the Sheffield Hazard Mitigation Plan

A hazard is defined as "an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or the types of harm or loss." Hazard mitigation is defined as a "sustained action taken to reduce or eliminate the long-term risk to people and property from hazards and their effects").

This Plan is an update of the Berkshire County Hazard Mitigation Plan, dated November 5, 2012, a regional plan in which the Town of Sheffield was included with 18 other Berkshire County municipalities. The development of this Plan was overseen by the Sheffield Hazard Mitigation Plan Advisory Committee, whose members are listed below. During the development of this Plan the Sheffield Comprehensive Emergency Management Plan (CEMP), other hazard mitigation plans, sheltering plans and other relevant plans in the region were consulted.

Name	Position
Chief Eric Munson	Sheffield Police Department
Edward Pickert	Sheffield Highway Superintendent
Rhonda LaBombard	Town Administrator
Kathleen Loring	Executive Director, Council on Aging
Rene Wood	Sheffield Select Board, former Planning Board, Resident
Lou Levine	Resident
Alicia Dulin	Assistant to Town Administrator

A goal of the update is to use this Plan in conjunction with other local and regional plans, specifically the CEMP, other hazard mitigation plans, emergency preparedness plans developed in conjunction with the Southern Berkshire Emergency Planning Committee, and a soon-to-be drafted Sheffield Municipal Vulnerability Preparedness Plan, which the Town expects to undertake in fiscal year 2019.

5. NATURAL HAZARD MITIGATION ACTION PLAN

5.1. Setting Goals

The Goal, Objectives and Actions within this Plan were developed as local vulnerabilities were being identified and concerns raised by the Sheffield Hazard Mitigation Advisory Committee and input received from local residents. Historic information and resident input gathered at the public forum held in February 2018 was welcomed and incorporated into the Plan The Advisory Committee adopted the following Goal:

Overall Goal: *Increase the resiliency of Sheffield to minimize the loss of life, property, infrastructure, environmental, and cultural resources in the face of natural disasters and climate change.*

The analysis of historic disaster data and the concerns raised by emergency response were factors in the development of a series of "Major Findings" for the Town. These Major Findings list natural hazards that pose the greatest risks; highlighted what areas of Sheffield are most vulnerable to hazard/disaster impacts; and outlined priority actions. The summary of the Major Findings follows:

Major Finding #1: Sheffield's Most Serious Hazards

- Flood events are the most frequent, identifiable natural hazard events to occur in Town; the number and severity of localized flooding has increased in recent years causing runoffs, riverbank erosion, washouts and road damage.
- Loss of electricity, especially for extended periods of time, could threaten public health, particularly for the older residents, disabled or isolated populations; those needing electricity for oxygen, dialysis or refrigerated medications are at greater risk.
- Flood damages and loss of productive land due to severe flood events along the Housatonic River are an ongoing concern for the farming community.
- Beavers create chronic flooding problems throughout Town.
- Although the Town has had brushes with drought, a severe drought event has seldom been experienced in recent decades. However, drought has the capacity to seriously impact the economic vitality of the Town due to the need for water for the farming community and a few key businesses, as well as possible impacts on older, shallow or point private wells.

Major Finding #2: Sheffield's Vulnerability

- Several roads have been repeatedly damaged by severe storm events, including flooding and wash outs. Local roads at greatest risk are Rannapo Road (which is threatened by the movement of the Housatonic River channel), County Road, and Weatogue Road. Main Street/Route 7 is the main transportation corridor at greatest risk, the closure of which could seriously impede disaster response and relief as well as the movement of goods within the county and beyond.
- Dam failure from dams located in Sheffield and Great Barrington has the potential to flood homes, businesses, Route 7 and other roadways, with Rising Pond dam having the potential to inflict the greatest damage.
- First responders do not know where all individuals live who might need additional aid during loss of electricity or during an evacuation event.
- Berkshire School Road in the vicinity of Mt. Everett High School, the designated shelter, has a history of flooding.
- There is a need to increase public awareness and enrollment in Sheffield's emergency notification system, Blackboard Connect.
- Personal interviews and public forums indicate that individuals in Sheffield are likely unprepared to shelter in place for more than a day or two.

Major Objectives to meet the Goal and address the Major Findings:

1. Continue to assess, monitor, prioritize and pursue infrastructure improvements to increase resiliency to impacts of natural hazards and climate change.
2. Encourage self-identification and registration of individuals needing special assistance when a extended loss of electricity or a severe weather event occurs.
3. Develop, distribute and widely promote Sheltering in Place and Disaster Preparedness materials.
4. Increase participation in Blackboard Connect, Sheffield's emergency contact system.
5. Continue to work with local and state partners -- Emergency Managers, DPWs, Fire, Police, Councils on Aging, Health Departments and Schools -- to plan for and mitigate natural hazards in Sheffield and on a regional basis.

5.3. ACTION TABLE

OBJECTIVE #1: Continue to assess, monitor, prioritize and pursue infrastructure improvements to increase resiliency to impacts of natural hazards and climate change.

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Structural Project – Flooding	Install relief culverts on Lime Kiln Road to reduce risk of flooding	Reduce risk of flooding; reduce cost of maintaining the road	Town of Sheffield	1-3 years/ High	Town funding, Grants	**Incomplete** No action so far
Structural Project – Flooding, Landslide	Install rip rap on Rannapo Road to stabilize bank that is being eroded by the Housatonic River; relocate the road away from the river	Reduce risk of road damage/failure; reduce road closures	Town of Sheffield	In FY19/ High	Town funding, FEMA	**In Progress** FEMA funding secured (HMAGP-4110-23-DR-MA) at 75% reimbursement; to bid Oct 2018; completion in 2019
Structural Project – Flooding	Continue working with MassDOT to reduce flooding along Route 7	Reduce risk of flooding; reduce cost of maintaining the road; ensure traffic flow	Town of Sheffield, MassDOT	1-3 years / High	FEMA, MassDOT	**Incomplete** MassDot-Owned/ minor drainage improvements during resurfacing
Structural Project – Landslide/bank erosion	Stabilize the bank on County Road to prevent landslides onto the road	Reduce the cost of maintenance and potential damage	Town of Sheffield	4-6 years/ Medium	Town funding, FEMA	**In Progress** Monitoring situation; bank revegetated
Structural Project – Landslide	Work with the Trustees of Reservations to stabilize banks along Wheatogue Road	Reducing cost of maintenance and potential damage; ensure traffic flow	Town of Sheffield, The Trustees of Reservations	4-6 years/ Medium	Town funding, TTOR, FEMA	**In Progress** Trustees received Grant to study
Structural Project – Flooding	Conduct a study of flooding on Rannapo and Weatogue Roads and implement findings	Reduce risk of flooding; reduce cost of maintaining the roads; ensure traffic flow	Town of Sheffield, TTOR	4-6years / Medium	Town funding, FEMA, TTOR	**In Progress** Trustees received Grant for study

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Regulatory Prevention - Flooding	Review existing zoning and subdivision control by-laws; update to ensure inclusion of stormwater control and best management practices.	Reduce the amount of new stormwater runoff onto roads and streams; reduce risks of flooding; reduce maintenance costs; ensure traffic flows.	Town of Sheffield	4-6 years / Medium	Town funding	**Completed** Current controls and bylaws adequate upon review
Property Protection – All Hazards	Identify historic structures, businesses and critical facilities located in hazard prone areas, including floodplains and dam failure inundation areas.	Enable building owners to be better prepared for the hazards and to prevent losses	Town of Sheffield, MEMA, MA Historical Commission, Owners of identified structures	4-6 years/ Medium	Town, owners of identified structures	**In Progress** Survey done of major businesses; few have suffered flood damages; Historical Commission has updated Sheffield Historical House Books, as defined by MA Historical Commission
Structural Project -- Flooding	Replace undersized and deteriorating culverts and bridge along County Road	Reduce risk of flooding, further road damage and cost of maintaining the road; ensure traffic flow				**New Action** 2013 MassWorks grant secured for a bridge and culvert on Ironwork Brook and Unknown Tributary; MassDOT municipal bridge grant secured for 3rd structure; 2017 MassWorks grant for 4th failing bridge unsuccessful, but Town will reapply in 2018
Structural Project -- Flooding	Assess and if necessary replace undersized culverts on Bow Wow and Kelsey Rds	Reduce risk of flooding, further road damage and cost of maintaining the road; ensure traffic flow	Town of Sheffield	4-6 yrs/ Medium	Town Funding	**New Action**
Assessment -- Flooding	Conduct road inventory to identify and prioritize road projects	Efficient use of limited municipal funding	Town of Sheffield	1-3 yrs/ High	Town Funding, grants	**New Action**
Assessment -- Public Preparedness	Identify and assess projected impacts of climate change	Incorporate resiliency into future hazard mitigation projects	Town of Sheffield,	1-3 yrs/ High	MVP Program	**New Action**

OBJECTIVE #2: Encourage Self-Identification and Registration of those needing special assistance due to extended loss of electricity or a severe storm event

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Public Preparedness	Mailer to all addresses explaining program and reasons for self-identification; mailer to include form to do so. Include form to sign up for Blackboard Connect system.	Identify vulnerable people needing assistance; reduce potential injury or loss of life. More efficient deployment of resources.	Town of Sheffield, with assistance from COA, Police, Fire Department	1-3 yrs/ High	Town of Sheffield	**New Action**
Public Preparedness	Make mailer and Blackboard Connect form available at Town Hall, Senior Center, and Town Library. Announce at televised BOS meetings and Senior Center meetings. Distribute by first responders on calls, as appropriate	Identify vulnerable people needing assistance; reduce potential injury or loss of life. More efficient deployment of public resources.	Town of Sheffield, with assistance from BOS, COA, Police, Fire Department	1-3 yrs/ High	Town of Sheffield	**New Action**

OBJECTIVE #3: Develop, distribute and widely promote Sheltering in Place and Disaster Preparedness materials.

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Public Preparedness	Develop and distribute Sheltering in Place and Disaster Preparedness materials to all residents and businesses	Reduce risk of injury and loss of life; more efficient deployment of public resources; increase self-sufficiency in an emergency	Town of Sheffield	1-3 yrs/ High	Town of Sheffield, 2018 DLTA,	**New Action**
Public Preparedness	Hold information sessions at Town COA and Library	Additional forums for information dissemination.	Town of Sheffield	1-3 yrs/ High	Town of Sheffield	**New Action**

OBJECTIVE #4: Increase participation on Blackboard Connect, Sheffield's Emergency Contact System

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Public Preparedness	Develop a campaign to increase Blackboard Connect participation and updating of phone/contact information; target to all addresses and tie in with self-identification appeal	Increased dissemination of emergency information; Reduce risk of injury and property damage; more efficient deployment of public resources.	Town of Sheffield	1-3 yrs/ High	Town of Sheffield	**New Action**

OBJECTIVE #5: Continue to work with local and state partners -- Emergency Managers, DPWs, Fire, Police, Councils on Aging, Health Departments and Schools -- to plan for and mitigate natural hazards on a regional basis

Category of Action	Description of Action	Benefit	Implementation Responsibility	Timeframe / Priority	Resources / Funding	Status since Expired 2012 Plan
Public Preparedness	Conduct emergency preparedness educational program for individuals and businesses; include possible land or air hazardous materials spill incident	Reduce risk of injury and property damage	Town of Sheffield, COA, DPH, SBREPC	1-3 yrs/ High	Town of Sheffield, DLTA, SBREPC	**New Action**
Public Preparedness	Continue to inform residents that Senior Center and Bushnell Sage Library are local cooling/warming centers	Reduce risk of ill health or injury from extreme temperature incidents	Town of Sheffield, COA. Library	1-3 yrs/ High	No funds needed	**New Action**