TOWN OF HINSDALE
MULTI-HAZARD MITIGATION PLAN

Hinsdale, Massachusetts

June 2019

Prepared by the:
Hinsdale Hazard Mitigation Advisory Committee

With assistance from:
Berkshire Regional Planning Commission

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

ACKNOWLEDGEMENTS

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

The Town of Hinsdale would like to thank the Hinsdale Hazard Mitigation Advisory Committee for the plan update, who oversaw the planning process and completion of the plan update. The Berkshire Regional Planning Commission provided technical assistance to the Advisory Committee throughout the planning process.

Town of Hinsdale

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CERTIFICATE OF ADOPTION

Town of Hinsdale, Massachusetts

A RESOLUTION ADOPTING THE

HINSDALE MULTI-HAZARD MITIGATION PLAN

WHEREAS, the Town of Hinsdale authorized the Hinsdale Hazard Mitigation Advisory Committee to prepare the *Hinsdale Multi-Hazard Mitigation Plan;* and

WHEREAS, the *Hinsdale Multi-Hazard Mitigation Plan* contains several potential future projects to mitigate potential impacts from natural hazards in Hinsdale, and

WHEREAS, a duly-noticed public meeting was held by the Hinsdale Select Board on this 12th day of June 2019,and

WHEREAS, the Hinsdale Select Board authorizes responsible departments and agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Hinsdale Select Board adopts the *Hinsdale Multi-Hazard Mitigation Plan,* by M.G.L. c. 40.

ADOPTED AND SIGNED this 12th day of June 2019.

Vivian Mason, Chair
Hinsdale Select Board

FOR PUBLIC RELEASE

ATTEST

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SECTION 1. INTRODUCTION AND BACKGROUND

1.1. Purpose of the Hinsdale Multi-Hazard Mitigation Plan

According to 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."   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."

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 Multi-Hazard Plan is an update of the *Berkshire County Hazard Mitigation Plan*, dated November 5, 2012, a regional plan in which the Town of Hinsdale was included with 18 other Berkshire County municipalities. Geographically this current plan update is a plan involving a single municipality, the Town of Hinsdale, Massachusetts. During the development of this plan other hazard mitigation plans in the region were consulted, including the neighboring communities of Dalton and Pittsfield.

The Plan is designed to serve as a tool to help town officials identify hazard risks, assess the town's vulnerability to hazardous conditions, 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 region. This plan should be used in conjunction with other local and regional plans, specifically other hazard mitigation plans, the *Hinsdale Comprehensive Emergency Management Plan (CEMP)*, *Vision Plan for Hinsdale* and the *Hinsdale Open Space and Recreation Plan*.

1.2. Background

The Town of Hinsdale is located in north central Berkshire county in western Massachusetts. Its land area covers 21.7 square miles. It is bordered by the towns of Dalton to the northwest, Windsor to the northeast, Peru to the east and Washington to the south.   Hinsdale is a small, quiet hilltown, nestled in a flat valley floodplain of the Housatonic river, known locally as the Hinsdale Flats. Much of the land around the river south of the town center, is predominantly wetland, and forms part of the 1,482-acre Hinsdale Flats Wildlife Management Area, an environmentally diverse ecosystem comprised of wetland complexes and adjoining uplands. The river increases in speed as it approaches the town center, tumbling past old mill sites, once the site of flourishing industries, on its journey northwest towards Dalton. The Flats contrast dramatically with the adjacent hillsides, where elevations rise sharply several hundred feet above the valley floor. To the east, the summit of Peru Hill climbs to 2,170 feet, while to the west, Tully Mountain, which separates Hinsdale from the Pittsfield region, rises to 2,085 feet in elevation.

Hinsdale hosts several water bodies, including two recreational lakes (Plunkett and Ashmere), four drinking water reservoirs (Belmont, Cleveland, Upper Sackett, and a portion of Windsor Reservoir), several small ponds, and the above-mentioned Hinsdale Flats river and wetlands complex.

Plunkett Reservoir is a heavily-used recreational lake lined with residential development, as well as a summer camp; the Reservoir is also designated at the town's alternate drinking water supply. Ashmere Lake is a 260-acre recreational lake that is owned and maintained by the Department of Conservation and Recreation (DCR). The shoreline of the lake, especially the north basin, is densely developed with a mix of seasonal cottages and year-round homes. Three summer camps are also located on the shores of Lake Ashmere: Camp Taconic is located on the north basin and Camps Danbee and Ashmere are located on the south basin.

The Belmont Reservoir is the main source of water for Hinsdale's residents, and Plunkett Reservoir serves as a backup supply. The Upper Sackett and Cleveland Brook reservoirs provide drinking water to the City of Pittsfield, while Windsor Reservoir serves as a backup supply to the neighboring town of Dalton.

The predominant land cover in Hinsdale is forest, with 68% of the town's land area comprised of upland forest and an additional 9% comprised of wetland forest area. Ten percent of the Town is comprised of open water and non-forested wetlands. Developed land areas include residential development (5% of total), agriculture (5%), commercial/industrial/mining (1%) and making up the balance. (MassGIS, 2010).

In 2014, the U.S. Census Bureau estimated the town's population at approximately 2,161 persons, up from 2,035 in 2010 - an increase of 5% in four years. In 2010, there were 1,133 housing units, resulting in a household size of approximately two persons per household (US Census Bureau). Comparing the American Community Survey's (ACS) five-year average from 2010-2014 to the U.S. Census from 2000, it shows that the population of Hinsdale is aging. The median age has increased from 38 to 46.6 years old. In the same 14-year period, the percentage of 55 and over residents has increased from 21% to 31%. This trend is projected to continue, with the 55+ age group estimated to comprise approximately 55% of the population in 2030. Inversely, by 2030 the 20-54 ages cohort, which represents the primary workforce population, is projected to decrease by 30%, and similarly the youngest members of the population, ages 0-19, are projected to decrease by 16%. (Town of Hinsdale, 2017) This trend mirrors that of Berkshire County as a whole, where it is projected that the majority of communities will have populations that are 60% or more residents aged 50 and older in 2030.

Hinsdale is one of the seven towns in the Central Berkshire Regional School District. Hinsdale elementary school age students attend the Kittredge Elementary School, located in the central part of Town, along with students from neighboring Peru. Students then transfer out of Hinsdale to attend middle and high schools, with the majority attending those schools in neighboring Dalton.

A large portion of Hinsdale's population is concentrated in three distinct areas in Town: the central downtown area and around the two recreational lakes of Plunkett Reservoir and Lake Ashmere. Development around the lakes are dense, with many summer cottages being updated and expanded for year-round living. While there remains relatively few undeveloped lots around the lakes, there are still opportunities for infill and new development. However, large blocks of land are owned by a few summer camps, which if subdivided and sold for residential development could substantially increase the number of homes along the lakes. Single family homes on large lots along historic roadways predominate outside the three population centers, with outlying developments along rural roads and on or near lakes more recently being constructed.

According to the Vision Plan for Hinsdale (2017), the Town's early development (pre-1900) was focused around the central downtown neighborhoods where industry was located, and extended out along Peru

Road. Between 1900 and 1950, development extended out from the previously developed areas around downtown as well as some development around Plunkett Reservoir and Ashmere Lake. Since 1975, most development has occurred around the lakes, further expansion of existing neighborhoods. Scattered development along town roads, mostly through Approval Not Required (ANR) developments, has caused the community to sprawl and lose some of its historic rural character because this new development tends to be low density. See Fig. 1.2. for development patterns over time.

Future development in Hinsdale can occur in several ways. Redevelopment can occur anywhere throughout Town. ANR development can occur at any location provided the acreage and frontage on any new parcel meet zoning requirements. Additional subdivision developments can occur on larger parcels where roads can be built, but this process requires more effort from the developer as it would require going through local subdivision zoning, which provides the Town with more control. Larger development projects are regulated through the Special Permit process, in which the Hinsdale Zoning Board of Appeals (ZBA) serves as the Special Permit Granting Authority. Special Permit regulations requires the ZBA to transmit developer applications to other municipal boards for review and input. As with all Town boards, the ZBA has the authority to hire third party consultants at the expense of the applicant to inform decision making without financial burden to the Town.

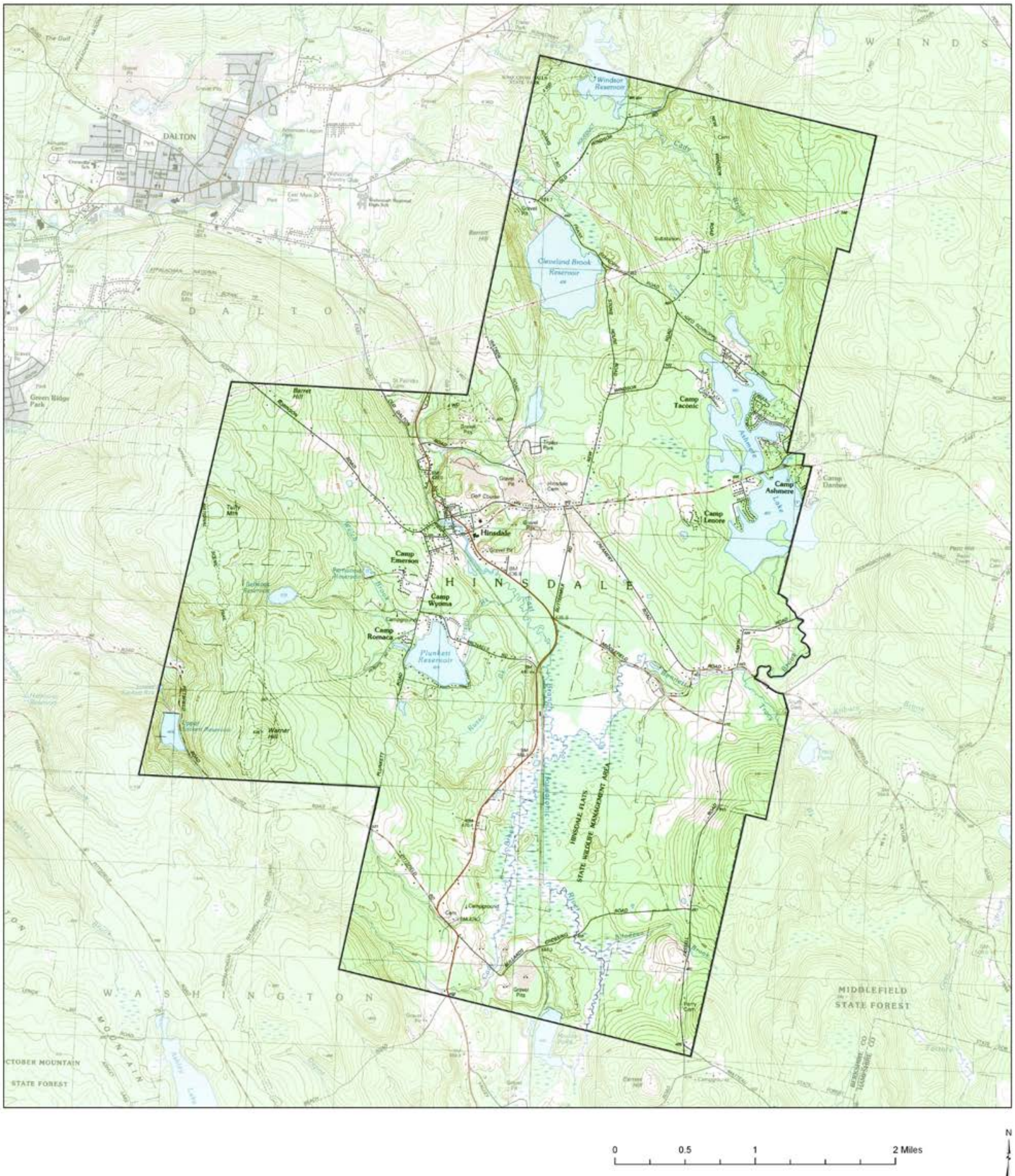
Currently there is a mostly undeveloped subdivision on Lenore Drive with 124 undeveloped lots. As well as an ANR on the south end of Creamery Road that has 20 undeveloped lots. Persips Road also has a cluster of undeveloped lots most likely created through ANR and could be developed for an additional eight houses. There are also a number of lots that may have previously been created through ANR scattered around town that could still be developed.

During 2016-17 the Town of Hinsdale undertook a Visioning Process, the purpose of which was to identify important community resources and develop strategies to protect and enhance those resources. During that process, most Hinsdale residents cited that the Town's rural character is the reason they choose to live here. The Visioning Process and resulting report noted that zoning for the majority of the developable land in Hinsdale allows most uses, including residential and some commercial and industrial uses. The Visioning Process also noted that the Town's local land use regulations, including zoning, are very basic and could be improved to maintain the Hinsdale's all-important rural character.

While ANR development is difficult to control under current zoning, local zoning and state regulations restrict development in certain hazard-prone areas. The local Floodplain Overlay District restricts or prohibits development within flood hazard areas designated in the Hinsdale FIRM (dated 1981). The Drinking Water Supply Protection bylaws restricts certain activities within Zone A of the watershed to protect water quality and quantity. The Massachusetts Wetland Protection Act, which in Hinsdale is administered by the Conservation Commission, limits and conditions development in wetland resource areas, which include waterbodies, rivers, streams and wetlands.

The population of Hinsdale increases sharply in the summer months. Roughly 14% of all housing units are seasonally occupied, many clustered around the recreational lakes of Plunkett and Ashmere. Additionally, there are five residential stay-over camps with campers and staff that add approximately several hundred people to the total summer population. The increase in the older resident population and the seasonal increase in the youth population at summer camps in town - both of whom represent "vulnerable populations" - have been taken into account for this hazard mitigation plan and in the Town's emergency preparedness planning.

Figure 1.1. Topographic Map of Hinsdale

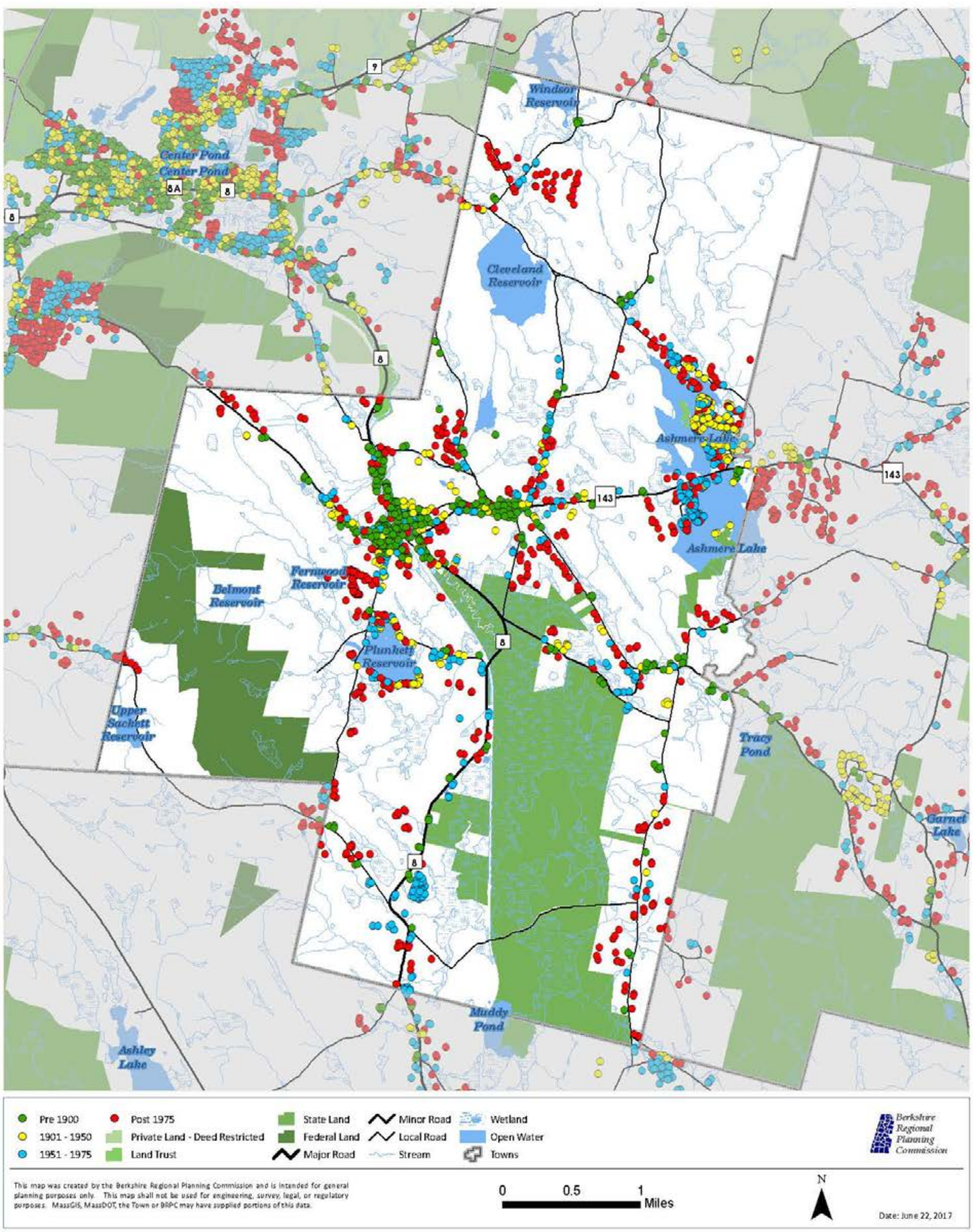


Berkshire Regional Planning Commission

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.

Source: BRPC, 2018.

Fig. 1.2. Development Patterns



Source: Hinsdale Open Space and Recreation Committee, BRPC, 2018.

SECTION 2. PLANNING PROCESS

2.1. Planning Committee

The Hinsdale Emergency Management Director and Town Administrator jointly took the lead in developing this *Hinsdale Multi-Hazard Mitigation Plan Update*, creating an advisory committee that consisted of municipal department heads and representatives from various town boards and committees. Members of the Hinsdale Hazard Mitigation Advisory Committee are listed below, Table 2.1. The Berkshire Regional Planning Commission (BRPC) provided technical assistance to the Committee, gathering data, reviewing existing relevant plans from neighboring communities, interviewing key stakeholders, and facilitating the public outreach program.

Table 2.1. Hinsdale Hazard Mitigation Advisory Committee

Name	Position
Robert Graves	Hinsdale Town Administrator
Larry Turner	Chief, Hinsdale Fire Department & Superintendent of Water and Sewer Dept.
Rene Senecal and Jim Fox	Hinsdale Dept. of Public Works
Susan Rathbun	Chief, Hinsdale Police Department
Ray Bolduc	Hinsdale Emergency Management Director
Kathe Warden	Former Select Board Administrator
Vivian Mason	Hinsdale Select Board Co-Chair

The Advisory Committee formally began the planning process for the update of the hazard mitigation plan in September 2017 and submitted its first draft plan for review to MEMA in April 2019. During the convening months the Advisory Council met six times through March 2019 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. One meeting was devoted solely to the review and update of the existing Action Plan and prioritization of new and ongoing Actions. In efforts to discuss hazards and potential mitigation in more detail, one-on-one interviews were conducted with department heads of the Town's Department of Public Works, Department of Water and Sewer, Emergency Management, Fire Department and Town Administration. In March 2018 BRPC staff meet with and discussed natural hazards and strategies for mitigation with the Hinsdale Planning Board at a regularly scheduled and posted meeting.

All Committee meetings were held in accessible Town Hall and open to the public. Town officials and the public were kept informed of the planning process through a variety of media, including posting of all meetings on the Town's website, and periodic updates were disseminated through the Town's newsletter.

To garner further public interest and input, particularly from long-time Hinsdale residents with knowledge of the Town's previous hazards and disasters, the Advisory Committee solicited information from attendees of the Council on Aging's Annual Holiday Luncheon in December 2017. Information and materials on emergency preparedness for the home were also distributed at this luncheon. The Town keep residents apprised of progress and solicited input in its newsletter of March 2018.

In March 2019 the Town launched its public review and comment period for the revised and updated *Draft Hinsdale Multi-Hazard Mitigation Plan.* The first step was to announce the review period at the

March 14th Council on Aging's luncheon, again asking seniors to share their historic knowledge of past natural hazards and disasters and to comment on the draft plan. The public review period for the Draft Plan, which extended March 20 through April 19, 2019, was further announced and promoted through the Hinsdale newsletter, in the local *Berkshire Eagle* newspaper, and at the Hinsdale Selectboard's March 27th meeting. The announcement and solicitation for input was directly sent to Town boards and committees that oversee planning, permitting and hazard mitigation implementation. To solicit input from the Town's neighbors, letters inviting review and comment were directly sent to each town's selectboard and to the Central Berkshire Regional Emergency Planning Committee, the region-wide emergency planning committee of which Hinsdale is an active member.

On March 27, 2019 the Town hosted a public forum about the major findings of the *Draft Hinsdale Multi-Hazard Mitigation Plan*, asking for further input and comment. Residents who attended the forum restated the need for a comprehensive way to manage beaver populations and activities, particularly within the Hinsdale Flats area, where roads, properties and the railroad tracks flood due to higher water levels. Fire department members raised the issue of potential gaps in ambulance response due to the state regulations that require ambulances to have two EMTs aboard the ambulance before it can respond to a call. The Hinsdale Ambulance responds to calls in Hinsdale and the neighboring towns of Peru, Washington and Dalton, and occasionally in Pittsfield. Waiting for two EMTs to arrive at the fire station increases response times in a rural area where travel times can already be relatively long. Handouts offered at the forum included copies of the presentation and of the Draft Action Plan, and information on how to submit comments. Public comments received were incorporated into the Final Draft Plan that was submitted for MEMA review. Public meetings and outreach materials can be found in Appendix C.

The *Hinsdale Multi-Hazard Mitigation Plan* is a compilation of data collected by BRPC, information gathered from the Advisory Committee during meetings, and interviews conducted with key stakeholders outside of working meetings. Public comments were solicited and incorporated into the plan. Edits to the draft plan reflect comments provided by the Hazard Mitigation Committee, local officials and citizens, MEMA and FEMA.

2.2. Coordination with Existing and Developing Planning Efforts

There are several documents and planning efforts that identify and address emergency and environmental concerns for Hinsdale. The Town of Hinsdale is updating its Comprehensive Emergency Management Plan (CEMP), which outlines an emergency management program for planning and response to potential emergency or disaster situations. 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 plan 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, with the Advisory Committee drawing on local first responder and town official's knowledge.

Regionally, Hinsdale is an active member of the Central Berkshire Regional Emergency Planning Committee (CBREPC), which is made up of 13 towns in the central Berkshire region. The CBREPC'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

CBREPC 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.

More specifically this Hazard Mitigation Plan Update draws upon information found in the following plans:

- *Hinsdale CEMP* (currently being updated)
- *Hinsdale Open Space and Recreation Plan* (2018)
- *Vision Plan for Hinsdale* (2017)
- *Berkshire County Hazard Mitigation Plan Addendum* (FEMA approved 2012)
- *Dalton Multi-Hazard Mitigation Plan* (FEMA approved 2019)
- *Massachusetts State Hazard Mitigation Plan* (FEMA approved 2013)
- *Massachusetts Climate Adaptation Plan* (2011)
- *The Central Berkshire Regional Shelter Plan* (2017, developed through WRHSAC, CREPC and BCBOHA)
- *Emergency Action Plans drafted for high hazard dams*

2.3. Plan Maintenance and Updates

The Hinsdale Emergency Management Director is the steward of the *Hinsdale Multi-Hazard Mitigation Plan Update of 2019*. Although some of the mitigation measures from the Town's previous Hazard Mitigation Plan have been implemented, since that Plan was adopted there has not been an ongoing local process to guide hazard mitigation implementation. Such a process is needed over the next five years for the implementation of this Plan update and will be structured as described below.

After approval of the Plan by FEMA, the Hinsdale Emergency Management Director and Town Administrator will continue to meet and function as the Hazard Mitigation Implementation Team, with the Emergency Management Director designated as the coordinator. Additional members could be added to the local implementation team from other municipal departments, businesses, non-profits and institutions.

It has determined that the updated Plan should be reviewed and revised as appropriate every two years with the Hinsdale Hazard Mitigation Implementation Team. When the Plan is in its third or fourth year, the Emergency Management Director 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 Town will encourage public participation during the next five-year planning cycle. As updates and a review of the Plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town’s web site through regular newsletters, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with Town and state open meeting laws.

SECTION 3. NATURAL HAZARD RISK ASSESSMENT

3.1. Identifying and Ranking Hazards

As defined by FEMA, a natural hazard is a source of harm or difficulty created by a meteorological, environmental or geological event. Vulnerability is defined as the characteristics of community assets that make them susceptible to damage from a given hazard. A risk assessment is a produce or process that collects information and assigns values to risks for the purpose of informing priorities, developing or comparing courses of action, and informing decision making (FEMA 2013). This section of the plan discusses the natural hazards that have been determined to impact the Town of Hinsdale. The Town chose to investigate the 18 natural hazards that are identified and discussed in the *Commonwealth of Massachusetts State Hazard Mitigation Plan*. 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 16 hazards are grouped in nine categories that best fit their weather pattern and impact upon the Town (see Table .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. In addition to natural hazards, this multi-hazard mitigation plan also analyzes the potential risk for hazardous materials spills and contamination.

Table 3.1.1. Natural Hazards that Impact Hinsdale

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 that have the greatest potential to impact Hinsdale

Hazard	Area of Impact Rate	Frequency of Occurrence Rate	Magnitude / Severity Rate	Hazard Ranking
	1=small 2=medium 3=large	0 = Very low frequency 1 = Low 2 = Medium 3 = High Frequency	1=limited 2=significant 3=critical 4=catastrophic	
Severe Winter Event (Ice Storm, Blizzard, Nor'easter)	3	3	1	**7**
Flooding (include Ice Jam, Beaver Activity)	2	2	2	**6**
Severe Storms (High Wind, Tornado, Extreme Temperature)	3	2	1	**6**
Dam Failure	2	1	2	**5**
Hurricane & Tropical Storms	3	1	1	**5**
Drought	3	1	1	**5**
Tornado	1	0	4	**5**
Earthquake	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 year0
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 (1% to 10% 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 of 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; updated for this Plan Update 2018.

3.2. Flood Hazards

3.2.1. General Background

As noted in the *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 acerbated 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 2019 update, the Town of Hinsdale 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 provided by emergency responders, public works staff, local officials, business leaders and long-time residents. This update also looked at flood claims and repetitive losses in the Town of Hinsdale. 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, thunderstorms, and beaver activity. 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, wetlands 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. Capturing, channeling and discharging runoff results in higher volumes of water discharging into receiving waters in an accelerated timeframe, causing 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 accommodate the volume of water flowing through their system. Undersized culverts and bridge spans constrict flood waters, causing them to back up and flood properties upstream of the constriction. There are several areas in Hinsdale that periodically flood due to the constriction that road culverts and bridges create at stream crossings, with Middlefield Road being a notable example.

Beaver activity can cause flooding in a variety of ways due to their instinct to create ponding and to react to flowing water. Damming streams and wetland outlets cause 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) This occurs in several locations across Hinsdale, with the main concerns associated with flooding of Middlefield Road, South Street and Plunkett Reservoir Road, and at several sites along the CSX railroad tracks.

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 in a typical year. It should be understood, however, that these measurements reflect statistical averages only; 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. The FIRM for Hinsdale is dated 1981. 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 FIRMs, the areas shown within the 100-year flood boundaries are for flood insurance only; they do not necessarily show area in a community subject to flooding.

Table 3.2.1. Recurrence Intervals and Probabilities of Occurances

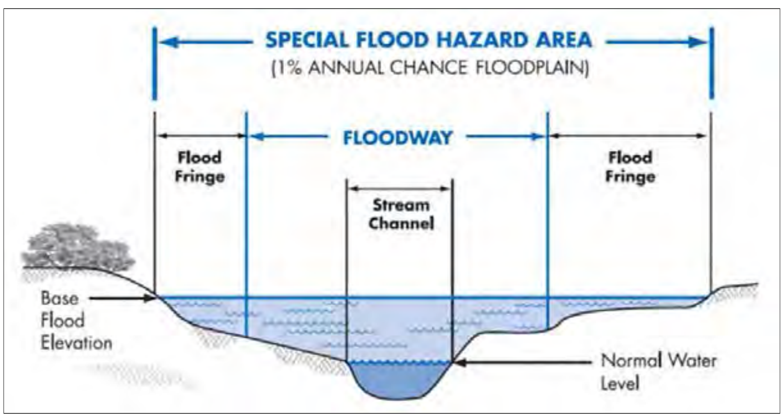
Recurrence interval, in years	Probability of occurrence in any given year	Percent chance of occurrence in any given year
500	1 in 500	0.2
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Flood flows in Massachusetts are measured at numerous USGS stream gages, with the closest one to Hinsdale being located on the Housatonic River near the Dalton Avenue / Hubbard Avenue intersection on the Dalton/Pittsfield municipal boundary. 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.

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, and inundation is often fairly common and expected, and are 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 are built in this floodway/floodplain area that constricts or impede flows, such as when roads cross this area and bridges and culverts are undersized. Figure 3.2.1. 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 that occupy these areas. Floodplains are the habitat that connects the truly aquatic ecosystems with the truly upland ecosystems, providing the habitats needed many aquatic-based and terrestrial-based wildlife. The rich biodiversity of the Hinsdale Flats wetland complex, including open water, marsh and forested wetlands, is the basis for the designation of this portion of the Housatonic River Watershed as a state-recognized Area of Critical Environmental Concern.

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 provided the power needed by industrial uses and the towns and cities that developed around them. 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 if 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 where the river undercuts a bank, usually on the outside bend of a meander, causing sloughing and collapse of the riverbank. Fluvial erosion of stream and riverbanks can creep towards the built environment and threaten to undercut and wash away 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 downcut 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 the creation of and dislodging of ice dams during the winter months. Blocks of ice can develop in streams and rivers to 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 have resulted in few wide spread outages in recent years, and where it occurs 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 damage from Hurricane 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. Risk of flooding from dam failures located in Hinsdale threaten not only Hinsdale residents and businesses, but also people and property downstream in neighboring communities. A dam failure at the Cleveland Reservoir could inundate areas of Hinsdale, Dalton and Pittsfield, and a failure at the Lake Ashmere dam could inundate areas of Hinsdale and Dalton. A more thorough discussion of the Town of Hinsdale's risks due to dam failure are discussed Section 3.6 of this plan.

Flooding of wastewater treatment facilities can not only inflict costly damages to buildings and other structures, it can cause the release of untreated effluent into receiving waters. There is not a municipal wastewater treatment plant in Hinsdale because all waste from the town is directed and treated at the Pittsfield Wastewater Treatment Plant or through local septic systems.

Flooding of homes and businesses can impact human safety and 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

Based on data gathered from the Northeast Climate Science Center (NECSC), the yearly precipitation total for Berkshire County has been experiencing 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 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)

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

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

patterns 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.

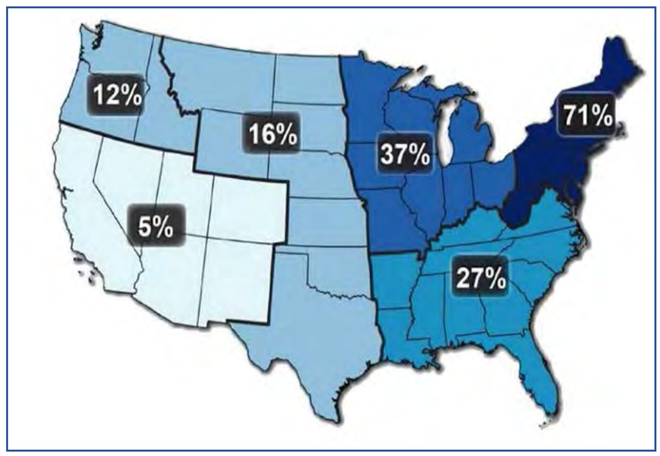
Studies have also reported increases in precipitation in both developed and undeveloped watersheds across the northeast, with the increases being observed over a range of precipitation intensities, particularly in categories characterized as heavy and extreme storm events. These events are expected to increase both in number and in magnitude. Some 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 that 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 watershed 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 between 1958-2012.[2]

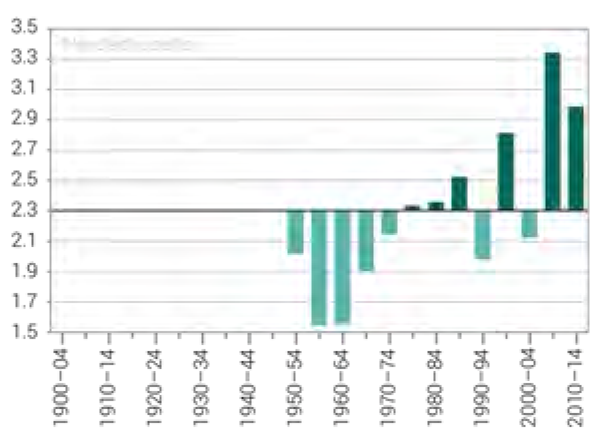
The NECSC also predicts that the region will see an increase in the number of days with at least 1 inch of precipitation from 4.5 days in the 1960s, to 5.1 days in the 2000s to 6.6 days in 2050s and 7.1 days in 2090s. (Northeast Climate Science Center, 2018) Already observed in Massachusetts, the number 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].

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



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

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

This trend has direct implications on the design of municipal infrastructure that can withstand extreme storm and flood events, indicating that all future designs must be based on them most updated precipitation and stream gauge information available. 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 increased flows that are predicted.

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.

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"

It may be prudent, therefore, to slightly 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 slight increase in size may provide a large increase in capacity, and for very little increase 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 so that they can increase their holding capacity for extreme storm events with little incremental cost. The size of the engineered soil media, which is a costly component of the system, may remain the same size as current designs call for, 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 historic trends.

3.2.2. Hazard Profile

Location

The southern and central portion of Hinsdale is bisected by the East Branch of the Housatonic River, which runs through the town center. Overall the Town has a relatively moderate amount of 100-year floodplain area (13.5% of total land area). Most floodplain acreage is concentrated along the Housatonic River in the Hinsdale Flats areas south of the Town Center, and much of this area coincides with the large wetland complex. This system attenuates floodwaters, but due to the level terrain high water levels can threaten roadways and properties that are located within this area. South Street, Washington Road, Middlefield Road and the railroad travel through this area. Wide spread beaver activity throughout this area can create areas of accelerated ponding and higher water levels, particularly threatening Middlefield Road and the railroad tracks. There are also notable bands of floodplain associated with Cady Brook, which flows into Windsor Reservoir, and Tracy Brook, which flows into Bennett Brook and into the East Branch Housatonic River.

There are several lakes in town, including Ashmere Lake, Plunkett Reservoir, Upper Sackett Reservoir, Cleveland Brook Reservoir, Belmont Reservoir, Fernwood Reservoir and part of Windsor Reservoir.

There are some floodplain areas associated with a few areas long these lakes, and conflicts are created with lakeshore development occurs in these areas. There are also several named streams that lead into the Housatonic in Hinsdale, including Bilodeau, Welch, Frissell, and Bennett Brooks, as well as another Cady Brook unconnected to the one discussed in the previous paragraph.

Increased soil saturation and higher groundwater levels are a concern throughout Hinsdale due to beaver activity that has already resulted in upland inundation and flooding of areas that were historically dry enough for farming, particularly along the edges of the Hinsdale Flats wetland complex. Increased soil saturation and higher groundwater levels are also a concern at the Town landfill, increasing the potential for leachate migration during severe storms. The foundation at the gatehouse at Belmont Reservoir, which houses the intake equipment for the Town's drinking water supply system, is degrading and could lead to water infiltration if higher water and groundwater levels become more prolonged. The Town is currently awaiting an engineering firm's preliminary report on the risk of infiltration. Soil saturation and high groundwater can accelerate inflow and infiltration into water and sewer lines. The Town is also poised to conduct an Inflow and Infiltration (I&I) Study of its sewer line system in the summer of 2019, and will need to identify funding sources to aid with implementation of the findings of the study.

Previous Occurrences

Between 1936 and 2017, four flood events equaling or exceeding the 1% annual chance flood have been documented the Berkshire County region: 1938, 1949, 1955 and 2011. Not all these were documented to a 1% chance storm for the Town of Hinsdale, with the most recent flood event, T.S. Irene in 2011 being determined to be a 2% chance storm according to the Housatonic River stream gage in Coltsville. High flow volumes during T. S. Irene completely destroyed the Cady Brook bridge on Old Windsor Road, resulting in long detours for residents until the bridge was replaced in 2012 with emergency FEMA funds. The new bridge incorporates more sturdy design, including a larger pre-cast concrete opening and wingwalls. Other notable recent flood events that impacted the Town of Hinsdale were in 2004 and 2005, where failed batter boards at Plunkett Reservoir resulted in large volumes of water suddenly releasing and flooding property on Commonwealth Avenue. Due to repair and replacement of the boards, flooding did not occur from this site during T.S. Irene. Refer to Table 3.2.2. for a list of flood events impacting the Berkshire County region and Hinsdale

Table 3.2.2. Previous Flooding Occurrences in the Berkshire County region

Year	Description of Event
1936	Widespread flooding occurs along the northern Atlantic in March 1936. Widespread loss of life and infrastructure. Many flood stages are discharges 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 by

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

	it. This event surpasses the 1936 flood event as the highest peak flow at the Coltsville gage, and continues to be the peak flow event as of January 2019.
December 31, 1948 - January 1, 1949	The New Year's Flood hit our region with many areas registering the flood as a 1% annual chance flood event. It is the second-highest peak flow on record at the Coltsville gage.
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 over between 2.5-5" of rain throughout the region and produced significant flooding throughout the region. Due to the significant amount of rain and the 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, however this and the unseasonable temperatures caused a rapid melting of the snow pack.
August 2003	Isolated thunderstorms developed that were slow moving and prolific rainmakers. These brought flooding to the area and caused the evacuation of the residents of the trailer park along Wahconah Falls Road. This storm caused the Dalton Fire & Water District to shut down its entire water system from Windsor Reservoir due to the large amount of silt and gravel that was washed into the reservoir.
September 2004	The remnants from Hurricane Ivan brought 3-6" of rain. This, combined with saturated soils from previous storms, caused flooding throughout the region. This event caused damage to the batter boards of the dam on Plunkett Reservoir in Hinsdale, flooding property on Commonwealth Avenue and the railroad tracks.
October 2005	A stationary cold front brought over 6" of rain and caused widespread flooding throughout the region. At the USGS gage in Coltsville, this was approximately a 50-year flood. In Hinsdale this again damaged the batter boards on Plunkett Reservoir dam, flooding property on Commonwealth Avenue.
November 2005	Widespread rainfall across the region of 1-1.5", which was preceded by 1-2 feet of snow, resulted in widespread minor flooding.
September 2007	Moderate to heavy rainfall occurred, which led to localized flooding.
March 2008	Heavy rainfall ranging from 1-3" impact the area. Combined with frozen ground and snowmelt, this led to flooding across the region.
August 2008	A storm brought very heavy rainfall and resulted in flash flooding across parts of the region.
December 2008	A storm brought 1-4" of rain to the region, with some areas reporting ¼ to 1/3 of an inch an hour of freezing rain., before changing to snow. Moderate flooding and ponding

	occurred throughout the region.
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 which resulted in roads flooding.
October 2009	A low-pressure system moved across region bringing a 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.
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 occurred producing 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”of rain and upwards of 9”, within a 12-hour period. Widespread road closures occurred throughout the region. In Williamstown this event was a 1% annual chance flood event, and at the USGS gage in Coltsville it was approximately a 2% chance flood. In Hinsdale the Old Windsor Road bridge was completely destroyed and Longview Ave. flooded.
September 2011	Remnants of Tropical Storm Lee brought 4-9” of heavy rainfall to the region. Due to the saturated soils from Tropical Storm Irene, this rainfall lead to widespread minor to moderate flooding on rivers as well as small streams and creeks. In Coltsville, this was approximately a 2% chance flood.
August 2012	Remnants from Hurricane Sandy brought thunderstorms developed repeatedly 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 then 3 inches of rain in just a few hours resulting in streams and creeks to overflow their banks and resulting in 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 developed producing very heavy rain over a short period of time. This led to some flash flooding and road closers, 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, which caused flash flooding in some areas. Many roads 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 heavy rainfall and flash flooding with 3-6" of rainfall occurring. The thunderstorms also caused a EF1 tornado in neighboring Dalton, causing damage to trees and homes.
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: BRPC 2018 (unless otherwise noted)
***Bolded** events are in the top 15 events that caused the Housatonic River to flow above flood stage at the Coltsville USGS gage (5')*

There is not a USGS stream gage located in the Town of Hinsdale. The nearest gage is the Coltsville USGS stream gage #01197000, located downstream from Hinsdale on the East Branch Housatonic River on the Dalton/Pittsfield municipal border. This gage can generally be used to reflect the flood events that impacted Hinsdale, but it should be noted that it measures water flow from a watershed much larger than that of Hinsdale alone – it also measures flow from tributaries entering the East Branch Housatonic River from central and northern Dalton and from Windsor.

According to the data from the Coltsville gage, which provides data from 1936 to the present, and the NOAA National Weather Service, there have been 15 flood events that exceeded flood stage, which at this site is five feet. The flood event of record, with the highest water level, was the flood of 1938, with a peak level of almost 11 feet (Table 3.2.3.). It may be worth noting that seven out of the 15 events have occurred since the 1970s and five of the 15 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, are found below, with a few events also listing discharge data to provide some perspective as to flood velocity.

Table 3.2.3. Events Exceeding Flood Stage at USGS Coltsville Gage #01197000

Water Level (ft)	Date of Peak Water Level
10.80	09/21/1938
10.38	12/31/1948
10.14	03/18/1936
8.20	08/28/2011
8.14	10/09/2005
7.77	03/12/1936
7.18	10/16/1955
7.05	09/12/1960
6.87	04/05/1960
6.65	08/19/1955
5.95	04/23/1993
5.41	09/07/2011
5.39	04/03/2005
5.32	04/14/1994
5.14	06/07/2000

https://water.weather.gov/ahps2/hydrograph.php?wfo=aly&gage=ctvm3

To provide some perspective on the power and velocity of flood waters at this site, the discharge volume at the Coltsville gage was approximately 6,800 cubic feet per second (cfs) during the October 2005 flood and T.S. Irene in 2011, which had peak flood levels of slightly more than eight feet. Typically this site would have a median daily discharge of 20-50 cfs during those time frames.

Probability of Future Occurrences

Using the past as a guide, Hinsdale 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, and receive minor flooding at least once a year. In addition to this, the upward trend for increased precipitation, combined with existing development in or near floodplain areas, indicated 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, of which there are eight in Hinsdale. A more thorough discussion of the Town of Hinsdale's risks due to dam failure are discussed Section 3.6 of this plan.

Flood waters and the debris that is moved or carried can damage or destroy bridges and the infrastructure attached to them. For instance, critical water, sewer, communication and gas lines can be attached to bridges.

Flood waters can increase the risk of the creation of 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 Hinsdale. However, the Town has had to close George Schnopps Road due to flooding and ice on the road when the Cleveland Reservoir spillway is flowing high. A bucket loader was required to break up the ice on the road in the winter of 2014-15.

The most recent such occurrence was in January 2018, when two inches of rain and an unusually warm weather of 50+ degrees Fahrenheit, which followed a period of prolonged and unusually cold weather, caused flooding from snow and ice melt across Berkshire County. 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

Fig. 3.2.5. Ice Jam on Housatonic River, Rt. 7 Stockbridge Jan. 2018

Source: Berkshire Eagle, 1-18-18.

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 is the gage on the East Branch Housatonic River at the Dalton/Pittsfield line. 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 advance weather forecasting, blockades, and warnings. Injuries and deaths generally are not anticipated if proper warning 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 the event are highly vulnerable to this hazard. 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). In Hinsdale the event of most concern with little or no warning time is dam failure.

Exposure

Due to historic development patterns that occurred before the town's zoning and floodplain management regulations, there are several homes and businesses that are located within the floodplain. In addition, there are more properties that located along the FIRM delineated boundaries. Development impacts, most particularly the removal of natural vegetation and addition of impervious surface area within a watershed or drainage area, increases the risk of accelerated high peak flows in waterways, which can lead to flooding, bank erosion and ban subsidence. The same development impacts within the floodplain affects the floodplains' ability to absorb, detain and store water during flood events.

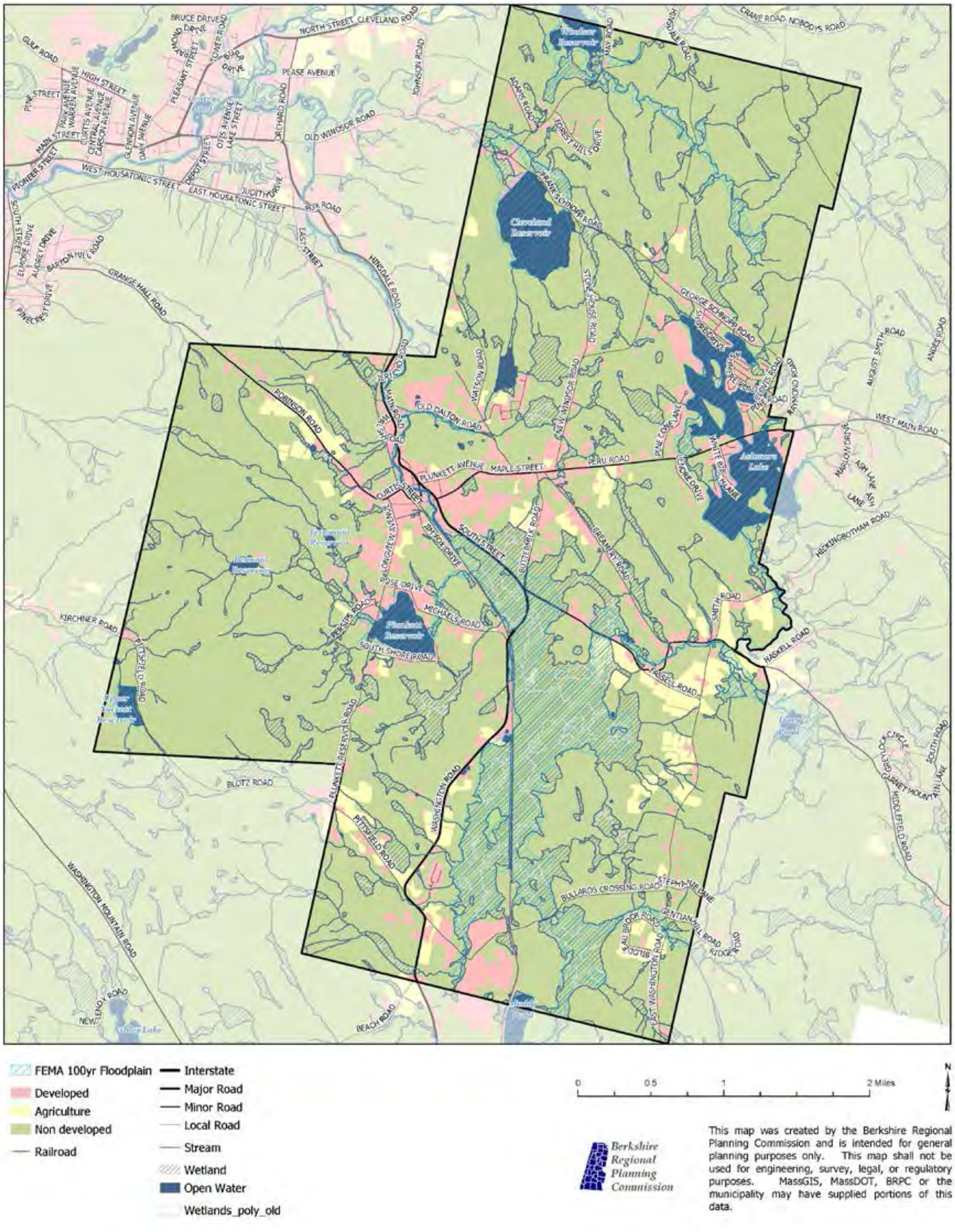
An analysis of the FIRM flood hazard area maps indicates that there is a total of 1,868 acres of 100-year floodplain within the town. This amounts to 13.5% of the total town. Most floodplain areas in the town are associated with the East Branch Housatonic River and its tributaries as they flow into the river (refer to Fig. 3.2.6. to view floodplain areas). Based on additional analysis, 35 acres (2%) of the floodplain are developed. Currently there are 9 commercial buildings (39% of commercial stock), 0 industrial (0% of industrial stock) and 25 residential buildings (2.5% of residential stock) within the floodplain (Berkshire Regional Planning Commission, 2017). Although not clearly shown on the map in Fig. 3.2.6., most of the residential homes in the floodplain are along Plunkett Reservoir. Residential buildings include only main buildings, not detached garages or other accessory structures. It should be noted that development occurs just outside FIRM boundaries in many locations across Hinsdale, and because the maps are almost 40 years old and boundaries may be shifting due to climate change or other factors, more structures than just those located within FIRM boundaries could be at risk of flooding during an extreme precipitation event.

Table 3.2.4. Number of Buildings in Floodplain

Buildings in the 100-year Floodplain in Hinsdale							
Residential		**Commercial**		**Industrial**		**Total**	
No. Bldgs.	Percent Res. Bldgs.	No. Bldgs.	Percent Com. Bldgs.	No. Bldgs.	Percent Ind. Bldgs.	No. Bldgs.	Percent Total Bldgs.
25	2.5%	9	39.1%	0	0%	34	3.3%

Source: Berkshire Regional Planning Commission, 2017

Fig. 3.2.6. Development and 100-yr Floodplain Areas



Source: BRPC 2017.

3.2.3. Vulnerability

People, property and infrastructure located in or near floodplains, near waterways where floodwaters are known to overflow their banks, where stormdrain systems fail, or those located in areas of high groundwater tables are vulnerable to the impacts of flooding. The East Branch Housatonic River has been at full bank full in the Town Center, but has not flooded this section of Town. Overflowing of the river bank would flood residential and commercial properties, and could know out communication service to Hinsdale and Peru if the Verizon building were flooded. There have not been any flood insurance claims since 1978 from within the Town of Hinsdale (MEMA, 2017). Town officials are aware that a heavy rain event in the early 2000s caused flooding of residential homes on Commonwealth Avenue (shown on Fig. 3.2.6. as Jim Fox Drive), but this is the only one that they are aware of.

Infrastructure and critical facilities that have been built in, over or under floodways are vulnerable to damage due to the power of high volumes of water and from the debris that those flows can carry or dislodge. Infrastructure of most concern that are at risk of damage from flood waters include several sections of roads, wastewater pumps, communication system and possible town hall. There are 3.4 miles of roads in the floodplain, or 6.7% of total road miles.

One of the roads of most concern is Middlefield Road, which often floods during spring melt and high precipitation events. There is a section of the road that is in a low-lying area, traveling through a wetland and has not been built up higher than natural grade. The land in this area is Wildlife Management Area and beaver activity in the wetlands has caused the water level at the road to become higher than in past decades. Water often covers the road during these events, most recently twice in 2016. The fact that the area is managed for wildlife makes it more difficult to remove the beavers in a timely fashion. The Town has, with permission from Fisheries and Wildlife, removed beavers, but the area is quickly repopulated. The culverts under the road have been dug out to maintain flow, but this is a temporary solution. The road is scheduled for reconstruction in the region's 2021 Transportation Improvement Program, with the design expected to include a large box culvert to allow better water flow and hopefully deter beaver from damming it up. As of March 2019 the project is approaching 25% design with an anticipated construction cost of almost $7 million. Aside from flooding, a section of the road is threatened by heavy erosion of the stream banks of Bennet Brook, which flows alongside the road between Creamery and Fassell Roads. The bank of the stream is eroding and beginning to erode the base of the road. Natural hazards described herein should be considered and improvements to mitigate flooding should be incorporated into the redesign and reconstruction of the road.

Beaver activity continues to flood land and infrastructure across Hinsdale. Damming of streams and wetlands have caused water levels to rise in many areas of Town, particularly in the Hinsdale Flats area, where land that was once dry and used for agricultural purposes is now inundated most of the year. This is loss of use of private lands on Middlefield and Buttermilk Roads. While trapping beavers and breaching large dams is done when water levels are exceedingly high, the work is reactionary and does not address the larger needs of the community and landowners. A Beaver Management Plan, to be developed in conjunction with the Division of Fisheries and Wildlife, should be developed for a long-term solution in this area of the town.

Flooding of the CSX railroad tracks is of great concern to Town officials, with beavers continually blocking railroad culverts throughout the Hinsdale Flats area. CSX is one of two major commercial freight lines the bisect the county, with cars often transporting hazardous materials. Town officials are not notified as to the type of hazardous materials or chemicals that could be transported through town at any given time, so it if difficult to make safety plans. The railroad travels through the center of town, where the elementary school and all emergency response facilities are located, and an accident that involves the spill or explosion of chemicals would severely injure children if emergency vehicles and personnel were not able to effectively respond to the incident.

Beaver activity on a pond whose outlet crosses Watson and Old Dalton Roads must continue to be monitored; at one time beavers built a six-foot dam above the man-made dam, increasing the capacity of the pond and increasing risk and severity of flooding below the dam.

Flooding has not severely damaged properties in downtown Hinsdale in recent memory. The Housatonic River has been at bankfull but not gone beyond its banks. The vast Hinsdale Flats wetland complex serves as a natural protection system, able to absorb much of the flood flows of the high gradient streams that flow into it from the hills on the eastern and western hills of the Town. The Town has berms around sewer pumps to protect against flooding, but these have not been tested in a 100-year storm. Flooding of infrastructure did not occur during T.S. Irene, which was an approximate 50-year storm. The close proximity of the Verizon building to the river and floodplain is a concern, because it is the exchange for both Hinsdale and Peru, and flooding of the facility could knock out phone service to both towns.

Flood waters occasionally flow across George Schnapps Road when the Cleveland Reservoir spillway is flowing high because the culvert carrying the discharge is undersized and wetland area on the downhill side of the road is inundated. The road ices over is this occurs in winter. In the winter of 2014-15 the town had to break up the ice with a bucket loader. The road has had to be closed at least twice in the past 30 years due to unsafe conditions. In the   Flooding also occurs along Old Dalton Road is due to aged and possibly undersized culverts. The Town has submitted grant proposals to MassWorks to repair this road in 2018, but was unsuccessful. The Town plans on resubmitting a proposal in 2019.

Flooding of property on Commonwealth Avenue and Michaels Road has occurred in the past due to failure of the batter boards at the Plunkett Reservoir dam. The boards have been repaired and additional repairs are needed to reduce the risk of future flooding.

The expired Hazard Mitigation Plan of 2012 listed several roads across Hinsdale that experienced flooding. Most of the flooding at that time was believed to be linked to lack of or deferred maintenance of road drainage systems and culverts. Since the time of that plan the Hinsdale Public Works Department has made concerted efforts to repair and better maintain drainage systems in proper working order, and the level of flooding has decreased. These improvements have occurred despite what is believed to be an increase in the number and severity of severe precipitation events in recent years.

The increase in the number and intensity of severe rain events in recent years is a concern in the vicinity of the Town's landfill and transfer station site. Increase in soil saturation and higher ground water levels could lead to potential leaching of contaminants from the old landfill, which is not properly capped. The Town is working with the Massachusetts Department of Environmental Protection to identify an affordable means of capping and closing the landfill, but to date financial assistance to aid in the closing has not been found.

Population

Using the number of 25 residential homes in the floodplain, with the average of two persons per household (as noted in Section 1.2 of this Plan), the number of people impacted would be 50 residents. Most of these homes are located around Plunkett Lake, but a few are located near the Housatonic River near the Route 8 / Old Dalton Road intersection.

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). In Hinsdale, the economically disadvantaged and senior populations are dispersed throughout the town. The two mobile home parks in the town are located outside floodplain areas.

In Hinsdale some of the historic homes in Town Center could be vulnerable to a 100-year flood. The FIRM maps were generated in the 1980s and have not been updated, so it is not clear how vulnerable they may be. The water levels of Plunkett Reservoir and Lake Ashmere are controlled by dams, but shoreline homes could become vulnerable in a heavy rain event in which the dams could not be opened enough to maintain normal levels, particularly the many along Plunkett Reservoir which are located within floodplain on the FIRM map. Accelerated sedimentation of the lake at its inlet may decrease the capacity of the lake to attenuate flood waters, possibly increasing the risk of flooding of shoreline properties. A wetlands permit allows the Town to dredge 99 cubic yards of sediment per year, but the rate of sedimentation exceeds this volume. The inlet is full of sediment, with incoming stream flow confined to a small channel through the sediment deposits. During T.S. Irene water overtopped Longview Avenue, and Town staff believe that if the inlet had greater storage capacity to accept the incoming flow, the road would not have flooded.

Severe Repetitive Loss Data

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 within any rolling ten-year period, since 1978 (FEMA, 2018). There have been no repetitive losses reported in Hinsdale. Although not included in the repetitive loss data base, the Town believes that Middlefield Road should be discussed as repetitive loss due to the chronic flooding at the Bennett Brook crossing, which is surrounded by expanses of wetlands that have expanded due to beaver activity. Flooding of the road occurs almost annually, with some events resulting in road closures.

Critical Facilities

The Town of Hinsdale has very few municipal buildings and utilizes the Town Hall and Fire Station for numerous purposes. None of the Town's buildings are within the floodplain. Sewer water pumps could be vulnerable during such an event. The main Cleveland Reservoir water pump located at the reservoir appears to be in the 100-year floodplain, and the Verizon building, which controls land lines for Hinsdale and Peru, also appears to be in floodplain. However, as stated previously, the FIRM maps for the Town were generated in 1981, and it is unknown how accurate they would be in the event of a current 100-

year storm event. Several road sections cross streams or wetlands, with three miles of Town roads located within the floodplain.

MassDOT District 1 provided bridge scour data to enable the Town of Hinsdale to determine if there are bridges at risk due to flood scouring. Five bridges have been flagged as having foundations that are stable for calculated scour conditions, but that field review indicates action is required to protect exposed foundations from the effects of additional erosion and corrosion. These bridges include the Housatonic River crossings on Maple Street and Main Street, two crossings of Bennett Brook on Middlefield Road and one crossing of Windsor Brook on Old Windsor Road. All other bridges listed in this data base for Hinsdale have been rated as being stable for scour. (MassDOT, 2018).

Economy

According to the 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. Damage to buildings can be estimated using the exposure analysis above. 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 roadway and bridges, and the removal and disposal of debris can also be an enormous cost during the recovery phase of a flood event

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 with assessor records, and multiplied an additional percentage to represent the contents of the properties, totaling a potential loss of $35 million. This represents complete destruction of buildings and contents within the floodplain. It should be noted that historical records indicate that total loss of buildings and content has never occurred in Hinsdale, 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 content, as demonstrated through past flood insurance claims in Berkshire County. To determine a more likely scenario of damages from a 1% chance flood event, the HAZUS-MH modeling program was utilized (see following section). The HAZUS-MH model took into account and calculated not only the number of buildings within the floodplain, but also potential losses to agriculture, business interruption and other economic impacts.

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

Residential Property	Residential Contents (50% Property Value)	Commercial Property	Commercial Contents (100% Property Value)	Industrial Property	Industrial Contents (125% Property Value)	Total Loss Estimate
$10.7	$5.4	$9.4	$9.4	$0	$0	$34.9

Source: Berkshire Regional Planning Commission, 2017

Aside from damage to buildings, flooding could effect some portion of the businesses and public institutions in Hinsdale that serve as major employers. Kittredge Elementary School is the Town's largest year-round employer, and fortunately is not located within the floodplain. However, as noted in Table 3.2.4., nine commercial buildings in Hinsdale are within the 100-year floodplain. These include Hinsdale Trading Company store, Maintenance Man, Wetherell's Garage, Hinsdale Timbers, and sections of camps Romaca and Taconic. These businesses are smaller, family-owned operations, and extensive damages to the property and prolonged shutdowns could impact their ability to rebuild and reopen. An economic impact study was not conducted as part of this plan update.

HAZUS-MH

To further assess the Town's vulnerability to flood hazard, HAZUS-MH 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 impact of the storm. HAZUS-MH delineates a floodplain differently than the current FIRM maps by modeling where flooding may occur, rather than mapping that was conducted in the 1970's and 1980's. According to HAZUS, based on a 1% chance flood event, more commonly referred to as the 100-year flood event, up to 42 households could be displaced, with up to 19 people possibly seeking shelter during a flood event (HAZUS-MH, 2017). According to the Central Berkshire Regional Emergency Planning Committee's Shelter Plan, it is the American Red Cross's experience that approximately 10-15% of the population will seek shelter or sheltering assistance during an emergency,[5] with the majority of people seeking shelter with family or friends if possible. If 42 households with two persons per household were impacted, between 8 and 13 individuals could seek shelter. These figures are of course estimates, based upon FEMA modeling and with rough local estimates of the number of homes identified within the MassGIS floodplain boundaries. The numbers should only be used to determine potential impacts and evaluate potential sheltering capacity during a 1% chance flood event.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. Based on the HAZUS-MH analysis, the town could potentially experience a loss of $6,010,000 during a 1% chance flood event. (Table 3.2.6.). (HAZUS-MH, 2017) For more details about the impacts of a 1% chance storm event, see the full HAZUS-MH report in Appendix B.

Table 3.2.6. Damage Estimate from HAZUS ($ millions)

Building Loss		Residential	Commercial, Industrial, Others	Total
	Building	2.84	0.47	3.31
	Content & Inventory	1.34	1.35	2.69
	Subtotal	4.18	1.82	6.00
Business Interruption				
	Rental Income & Wages	0	0.01	0.01
	Subtotal	0	0.01	0.01
Total Losses		**4.18**	**1.83**	**6.01**

Source: HAZUS-MH, Berkshire Regional Planning Commission, 2017

[5] CBREPC, 2016. *Central Berkshire Regional Shelter Plan,* Pittsfield, MA

3.2.4. Existing Protections Against Increased Risk of Flooding

The Town of Hinsdale has numerous existing protections in place to help protect it from increasing the risk of future flooding, along with protections to alert vulnerable 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.

Table 3.2.7. Existing Protections

Type of Existing Protection	Description	Area Covered	Effectiveness	Improvements Needed / Responsible Party
State level regulatory	The town enforces the current version of the state building code	Entire town	Effective	None
State level regulatory	The town enforces the MA Wetland Protection Act, conditioning development and requiring flood storage compensation	Wetland Resources, including Floodplain	Effective	None
Local level Regulatory	Floodplain Overlay District	Flood hazard areas in FIRM	Effective	None
Local level Regulatory	Earth Removal bylaw requires regrading and restoration of vegetation, particularly if erosion potential is high	Entire town	Effective	Town building and permitting authorities
Infrastructure Improvements	Plunkett Reservoir dam batter boards were replaced, and in 2018 the gate valve was replaced	Downstream of lake	Effective to date	Emergency Management
Infrastructure Improvements	Cady Brook Old Windsor Road bridge replacement incorporated more sturdy design to better withstand flood events	Northwestern portion of town	Effective	None
Infrastructure maintenance	The Town now proactively maintains a system of stormwater drainage; regularly maintains ditches, swales and catch basins	Entire town	Mostly effective	Replace/maintain drainage system where flooding occurs

3.2.5. Actions

Actions in regular text are from the expired Hazard Mitigation Plan of 2012.
Actions in italic are new actions.

ACTION	BENEFITS
Determine ability of Town buildings to withstand a variety of natural hazard events; *if buildings determined to be in 100-year floodplain, floodproof or elevate buildings to protect critical records and equipment.*	Ensure continuity of local governmental operations.
Keep more detailed record- keeping of local natural disasters and their impacts	Ensure continuity of local and regional governmental operations.
Continue to pursue funding for culvert upgrade and replacement on Old Dalton Road	*Reduce risk of flooding of road*
Upgrade/right-size bridges and culverts along Middlefield Road during reconstruction to withstand projected increase in severe storms, high flood volumes and high water levels	*Reduce risk of damages to reconstructed road due to flooding and erosion, thus extending life of infrastructure; reduce road closures*
Approach Mass. Dept. of Fish and Game to develop a long-term Beaver Management Plan to protect properties, roads and rail tracks	*Increase public safety and reduce risk to property and infrastructure*
Evaluate potential increase in water infiltration into Belmont Reservoir gatehouse due to increased storms and soil saturation	*Protect drinking water supply*
Conduct the I&I Study for the sewer line system and pursue funding for implementation of recommendations	*Reduce risk of overwhelming the system and protect water quality*
Work with the MassDEP to cap and close the Town's old landfill	*Reduce risk of leachate migration during times of saturated soils due to severe rain events*
Apply for grants to mitigate damage to historic properties	Protect private property and the character and vitality of the downtown
Incorporate new FEMA floodplain data and maps into existing and future planning efforts	New FEMA maps would allow for a more accurate assessment of the flooding risk.

Large beaver dams, where beaver control devices have not worked, will be breached in a controlled manner	Mitigate the impacts of floods
Investigate permanent measures to minimize beaver impacts.	Mitigate the impacts of floods
Determine which critical facilities and major transportation routes are in inundation areas for dams of High or Significant Hazard.	Protect critical facilities from flood events
Provide local residents with leaflets to landowners in hazard prone areas that discuss hazard mitigation	Mitigate the impacts of floods
Monitor intersections/ culverts for flooding	Determine potential for redesign
Distribute educational material to residents on hazards of highest concern in town and how to mitigate them for existing and new construction	Aid in dealing with disasters, but can also help obtain buy in for expensive structural mitigation activities
Review any infrastructure expansion proposals in hazard-prone areas. Town will not allow proposals if additional flooding is deemed likely	Mitigate the impacts of floods
Develop a communication plan with the town of Dalton regarding flood preparedness in the event of a dam failure	Minimize loss of life or injury
Develop an emergency response and flood mitigation plans with the CSX railroad	Minimize loss of life or injury
Conduct flood mitigation activities as prescribed in the above-mentioned comprehensive mitigation plan with CSX	Mitigate and minimize damages, loss of life or injury
Develop bylaws that require on- site containment of stormwater	Reduce runoff to mitigate the impacts of floods
Require low-impact development techniques for proposed developments, especially in flood-prone areas	Reduce land disturbance and associated increase in runoff
Remove debris from streams where flooding is an issue in collaboration with DEP	Removing debris from streams would reduce damming and the flooding it may cause
Work with the MassDEP to cap and close the Town's old landfill	*Reduce risk of leachate migration during times of saturated soils due to severe rain events*

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 Irene through the region as a tropical storm in late August 2011, many areas of the Commonwealth were without power for in excess of 5 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 for 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 Hinsdale 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 flashy, steeply sloped stream channels that can become flooded, causing stream channel erosion. The flood hazard has historically caused the most damage in Hinsdale.

NOAA's 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

The National Oceanic and Atmospheric Administration (NOAA) has been keeping records of hurricanes since 1842 (Table 1). From 1842 to 2017, five (5) Tropical Depressions, five (5) Tropical Storms, one (1) Category 1 Hurricane and one (1) Category 2 Hurricane passed directly through Berkshire County. The following table lists these storms, and Figure 3.3.1. shows the paths of these storms. Two tropical storms have traveled directly through Hinsdale, including T.S. Irene in 2011. Flooding and wind impacts were experienced to some degree from many of the storms that traveled through the area. 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 (38) Tropical Depressions, eighty-six (86)

Tropical Storms, fourteen (14) Category 1 Hurricanes and five (5) Category 2 Hurricanes have passed within 100 miles of the region.

Table 3.3.2. Tropical Depressions, Storms, and Hurricanes Traveling Across 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

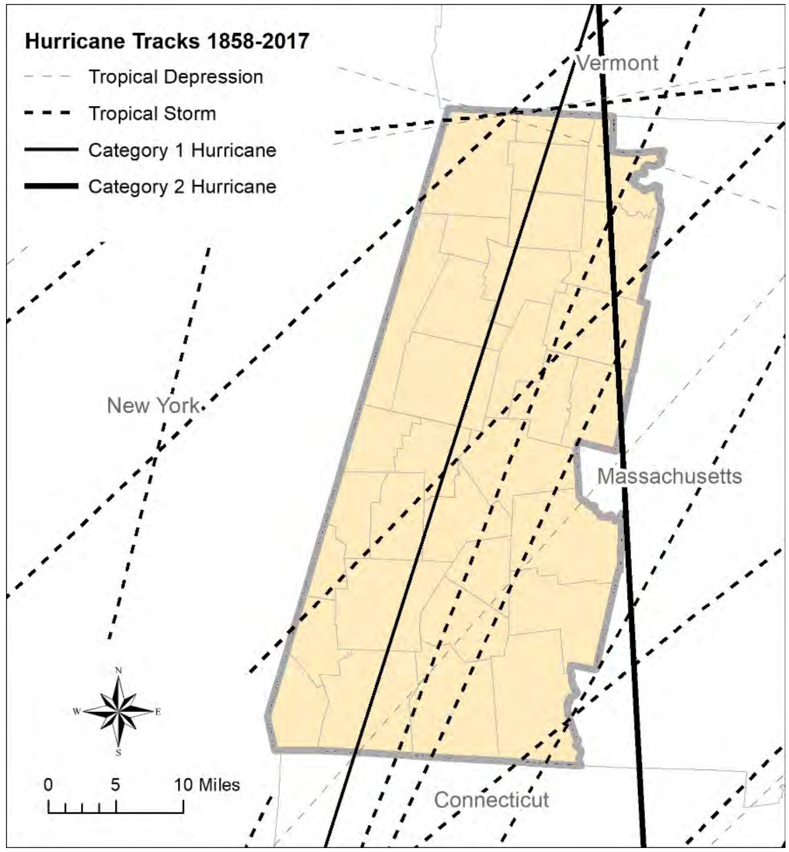
Source: NOAA, 1842-2017.

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 6 to 10 feet above flood stage, causing significant damage. Up to six inches of rain fell across western Massachusetts, which 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



Source: BRPC 2017.

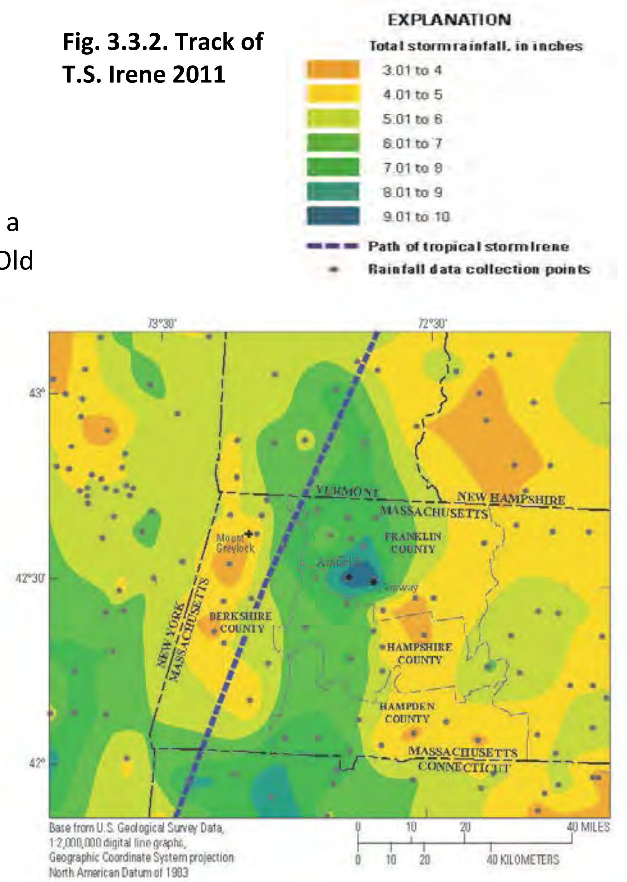
Hurricane Gloria caused extensive damage along the east coast of the U.S. and heavy rains and flooding in western Massachusetts in 1985. This event resulted in a federal disaster declaration (FEMA DR-751). In October 2005 the remnants of Tropical Storm Tammy followed by a subtropical depression produced 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. 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. The path of the storm traveled through Hinsdale.

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

T.S. Irene's 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) Hinsdale experienced flooding in several areas, experiencing a complete destruction of the Cady Brook bridge on Old Windsor Road.

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



Source: Gardner, et al, 2016.

Regionally, T.S. Irene (DR-4028-MA) is the most memorable storm event in recent history due to the flooding that occurred in Berkshire and Franklin Counties in Massachusetts, and in southern Vermont. In the East Branch Housatonic River watershed, where the storm was rated as a 2% chance storm, flood waters required the evacuation of residents from Pomeroy Manor in neighboring Dalton and threatened that town's Main Street bridge and its infrastructure. In Williamstown 225 mobile home households, many elderly and low income, permanently lost their homes in the Spruces Mobile Home Park. Extensive bridge/culvert damages and evacuation of residents occurred in Adams. Wide-spread 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.

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.

The NOAA Hurricane Research Division published a map showing the chance that a tropical storm or hurricane (of any intensity) will affect a given area during the hurricane season (June to November). This analysis was based on historical data from 1944 to 1999. Based on this analysis, the community has a 20-40% chance of a tropical storm or hurricane affecting the area each year. (MEMA, 2013)

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, and the tropical storm that stands out is from 2011.

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. (MEMA, 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 Hinsdale has been assessed and discussed in the flooding section of this plan (Sec. 3.2.) and is not discussed here. For wind-based damage, the hurricane simulation model for Hinsdale 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. Economically distressed, elderly 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 was run to estimate the sheltering needs of Hinsdale residents should a 100-year event occur. According to HAZUS-MH, no residents may be displaced or require temporary to long-term sheltering due to wind damages. However, as HAZUS predicted in the flooding section of this plan, 42 households could be displaced and 19 residents could seek shelter if the hurricane resulted in a 1% chance flood event.

Critical Facilities

In the Berkshire region, 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. The HAZUS-MH analysis determined that there is $208,540 of exposure due to the potential wind damage of a hurricane. The statistical data reports that some minor property damages could be sustained within Hinsdale, and that residential buildings would be most likely to suffer such damages. No buildings would sustain moderate or severe damages. (HAZUS-MH, 2017) The break down of damages are shown in Table 3.3.3.

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

		Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	138,230	2,990	730	550	142,500
	Content	66,020	-	-	-	66,020
	Inventory	-	-	-	-	-
	Subtotal	204,250	2,990	7330	550	208,520
Business						
	Income	-	-	-	-	-
	Relocation	20	-	-	-	20
	Rental	-	-	-	-	-
	Wage	-	-	-	-	-
	Subtotal	20	-	-	-	20
Total		**204,270**	**2,990**	**730**	**550**	**208,540**

Source: HAZUS-MH, 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 637 tons, all of which would be tree debris. (HAZUS-MH, 2017) Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur.

3.3.4. Existing Protections

- Massachusetts Building Code dictates building construction in Hinsdale.
- Regional School District works with local and state police to conduct emergency response exercises with students and faculty.
- Town departments of public works, fire and police prep ahead if predictions for high winds and downed trees, branches and wires is issued.
- The Town has emergency communications systems in place, encouraging all residents and businesses enrollment in CodeRed; this system is used to contact residents if there is a high chance for storm impacts or loss of electricity.
- Eversource has improved tree trimming operations and now issues announcements if there is a high chance for loss of electricity; announcements are also sent if electricity goes out.

3.3.5. Actions

- Continue to encourage all town residents to enroll in CodeRed and develop emergency preparedness plans.

3.4. Severe Weather Hazards: High Winds, Thunderstorms, Tornados, Extreme Temperatures

3.4.1. General Background

There are several severe weather events that impact the Berkshire County region and the Town of Hinsdale, 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.

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 the root systems and make them more susceptible to the winds' effects. (MEMA, 2013)

A thunderstorm is a storm with lightning and thunder produced by a cumulonimbus cloud, usually producing gusty winds, heavy rain, and sometimes hail. Frequently during thunderstorm events, heavy rain and gusty winds are present. Less frequently, hail is present, which can become very large. Tornadoes can also be generated during these events. (MEMA, 2013)

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 an 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 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. They can form from an isolated super-cell thunderstorm. They can be spawned by tropical cyclones or even their remnants that are 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 = 22.5ºF • Summer (Jun-Aug) Average = 65.8ºF

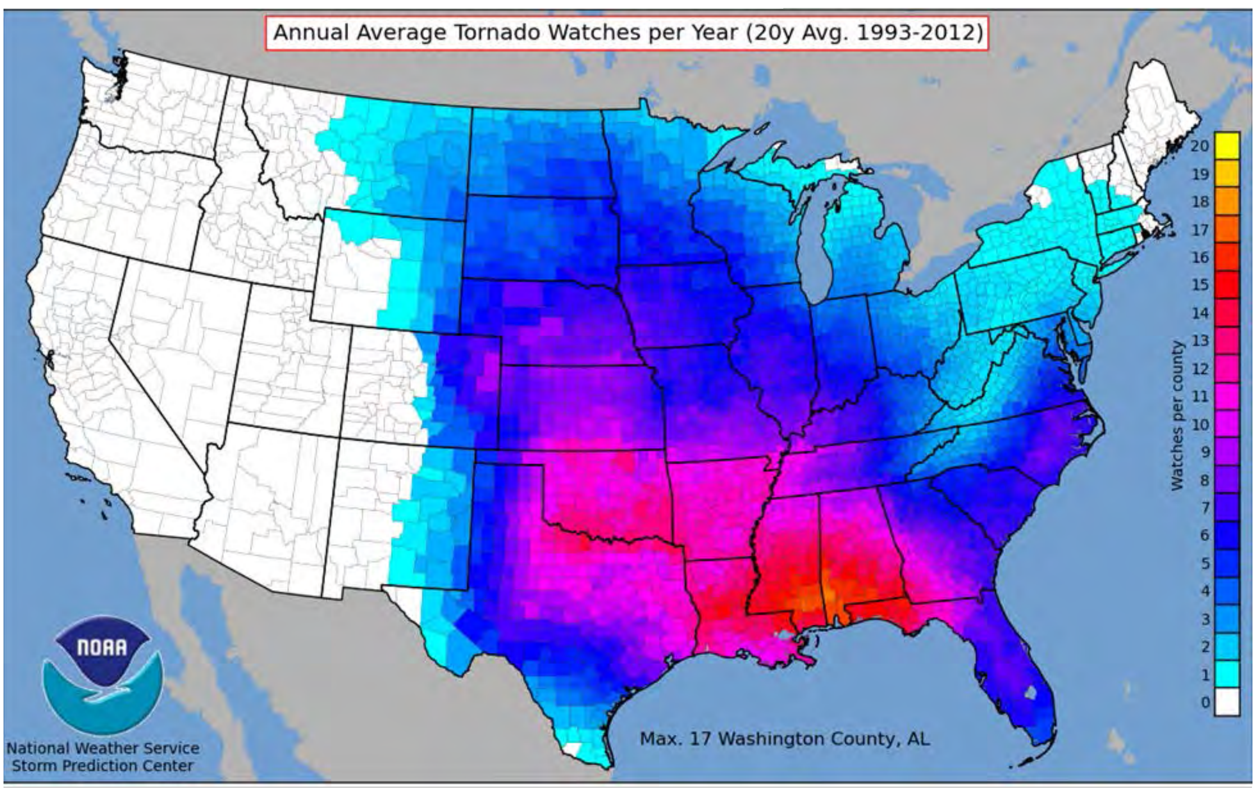
Extreme heat events impact the health of human beings, livestock and wildlife, and can impact the ability of people to function at home or work. Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter, who work outside or who are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

Impacts from severe storm events can be as widespread as 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 microbursts suddenly hit an area. In general, the high percentage of forest cover across Berkshire County, including most of Hinsdale, tends to disrupt wind flows, although conversely trees can create high hazard conditions near buildings and utility lines. Areas of impact from tornados and microbursts are unpredictable.

Severe storms can occur anywhere in the Town of Hinsdale. Thunderstorms affect relatively small areas, rather than large regions much like bands of 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



SOURCE: NATIONAL WEATHER SERVICE STORM PREDICTION CENTER 2018

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 an increase in summer temperatures will create higher peak summer electricity demands for cooling, particularly with an increase in the number of air conditioning units being installed. Cooling degree days (CDD) are a measure of how much and for how long outside air temperature was higher than a specific base temperature. CDD are the difference between the average daily temperature and 65°F, which has been determined to be a temperature that does not typically call for use of indoor cooling systems. For example, if the temperature mean is 90°F, subtract 65 from the mean and the result is 25 cooling degree-days for that day. 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 increased peak season and daily demand from ever more air conditioning units.

Previous Occurrences

According to the *Massachusetts State Hazard Mitigation Plan*, there have been several damaging severe storms that have included Berkshire County. 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. (MEMA, 2013) Based on all sources researched, 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 the 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 due to spring snowmelt	DR-790
10/7/05-10/16/05	Severe storms and flooding throughout Berkshire County the remnants of T.S. Tammy produced significant rain and flooding across western Massachusetts. It was reported that between 9-11" of rain fell. The state received over $13 million in individual and public assistance.	DR-1614
4/15/07-4/25/07	Severe storms and flooding; 3-6" of wet snow, sleet, and rain to parts of western Mass. The storm was primarily a rain event due to warmer	DR-1701

	temperatures, but higher elevations experienced significant snow and ice accumulations. Mass received $8 million in public assistance from FEMA.	
1/29/2011	Severe thunderstorms produced quarter- sized hail and damaging winds, knocking numerous trees and power lines in the affected areas, causing nearly $100,000 in property damage.	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. Snowfall accumulations of 1-2' were common in the Monadnocks, Berkshires, Connecticut Valley, and higher elevations in central Massachusetts. Up to 31 inches 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. Six fatalities occurred during and in the aftermath of the storm.	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.

Microbursts occur throughout Berkshire County, downing trees, utility lines and sometimes causing damage to property. In the Berkshires microbursts are often very local in nature, effecting only a small area, and are often accompanied by heavy rainfall that can cause additional damage from flooding. However, because most microbursts effect small areas and damages are relatively limited, they are seldom listed by state or national agencies. According to local news media reports, several recent thunderstorm/microburst events have caused damages in the communities of Williamstown, North Adams, Adams, Cheshire, Lanesborough, Pittsfield, Lee, and Stockbridge.

Microbursts struck in Lanesborough twice, in 2001 and in 2004, knocking down trees and powerlines for several hours. 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. This victim was riding a scooter along Route 8 when the pole fell on him. 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].

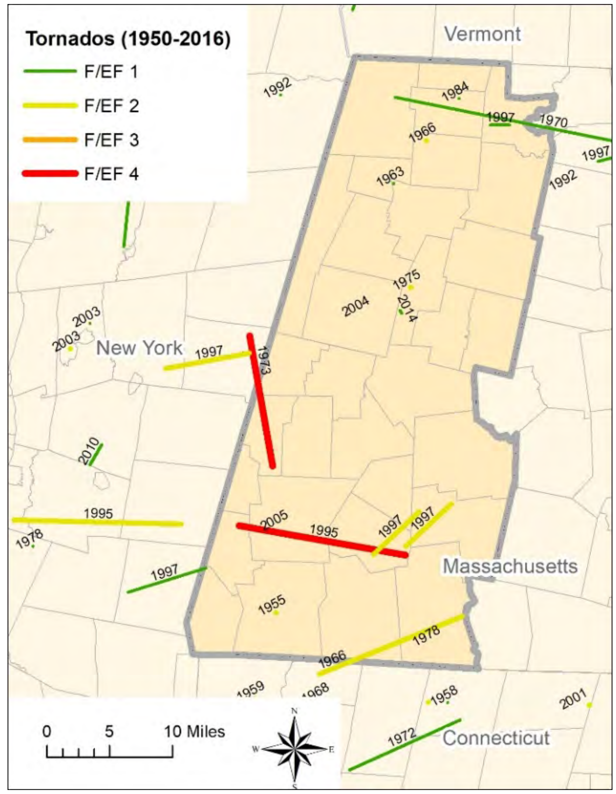
One known microburst, May 29, 2012, was documented as occurring in Hopkins Forest in northwestern Williamstown by Williams College. The event, with a 4:40 p.m. maximum wind speed of 84 miles per hour on the ridge, knocked down trees of various sizes and age, and created openings in the forest canopy.

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. Another microburst struck Cheshire on July 18, 2016.

[1] *McKeever, Andy, 1-27-11. "Pittsfield Slammed by Surprise Microburst Storm," iBerkshires.*

Typically, there are one to three 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 (see Fig. 3.4.4.). Four tornados occurred during a single storm on July 3, 1997. These have resulted in over $29 million in damage, seven deaths, and 60+ injuries. (NOAA, 2017).

FIG. 3.4.4. TORNADOS IN THE BERKSHIRE REGION AND THEIR SEVERITY



SOURCE: MIDWEST REGIONAL CLIMATE CENTER, 2018

The most memorable tornados in recent history occurred in West Stockbridge in August of 1973 (category F4) and in Great Barrington, Egremont, and Monterey in May of 1995 (category F4). In the West Stockbridge tornado four people died and 36 were injured, and in Great Barrington three people died and 24 were injured. The signs of the tornados destruction are still 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.

Although no tornadoes have struck Hinsdale, neighboring Dalton has experienced two of them. According to the *Dalton Multi-Hazard Mitigation Plan*, local Dalton residents remember a 1975 tornado event that landed on the Berkshire Bridge property, bounced across East Main Street, through Wahconah Country Club property and up to North Street (Rt 9) before heading towards Windsor. Minor damages were reported. In July 2014 an EF-1 tornado and microburst touched down in the Greenridge section of Dalton, causing downed trees and powerlines across the area, and temporarily closing local roads. The tornado caused structural damage on at least one home 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 vents and siding. At this same house a large tree smashed through the back of the house and broke windows. Other local homeowners suffered minor damages (Dalton, 2018)

Most tornados occur in the late afternoon and evening hours, when the heating is the greatest. In Berkshire County the majority of tornados occur in the month of July and to a lesser degree in August, but tornadoes have it the county as early as March (in Adams in 1966) and as late as October (in Cheshire in 1963). (MEMA, 2013)

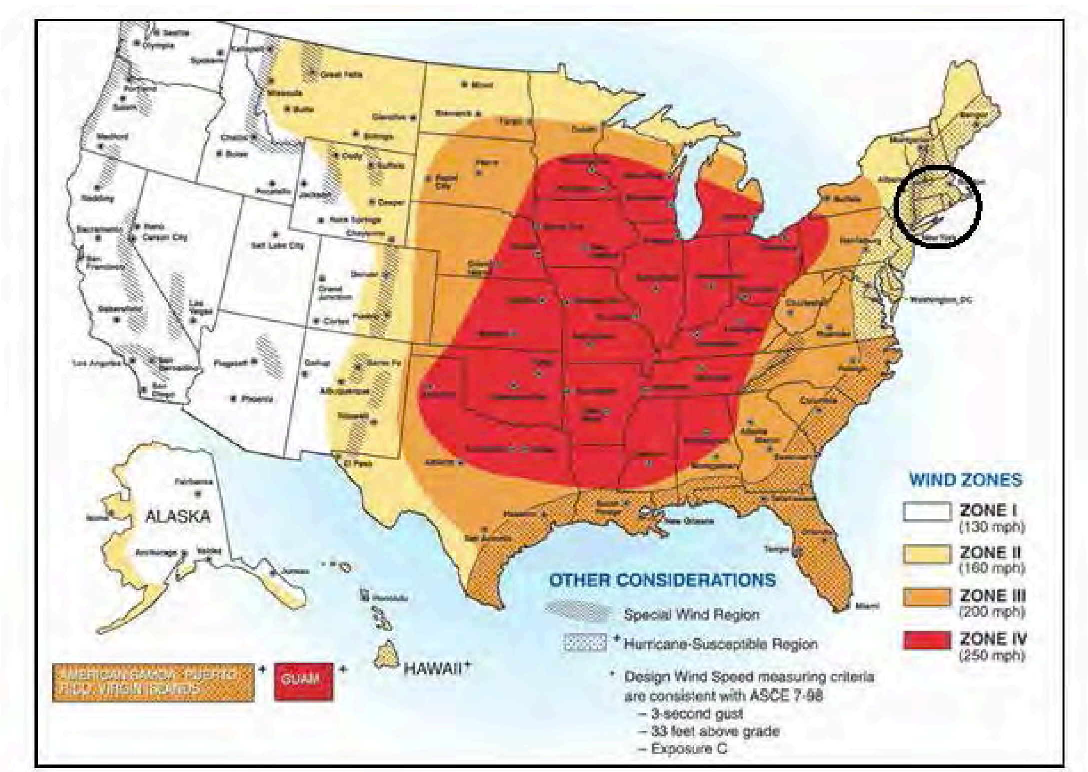
Probability of Future Occurrences

Severe storms comprising of thunderstorms, high winds, and hail will continue to affect the Town and the region. 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 the maps generated the Berkshires is listed as a Special Wind Region within the Hurricane-susceptible Region of a Wind Zone II (up to 160 mph winds). See Fig. 3.4.5. Based on this historical data the Town of Hinsdale 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 have been one fatality and 43 injuries as a result of lightning events from 1993 and 2012 in the Commonwealth (NCDC, 2012). 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. 3.4.4, there are several others that occurred in adjacent counties and states in the region. This averages to one tornado striking the county approximately every five years. Of these, only two have been of a severity of an EF4, which indicates that such a severe tornado has a statistical recurrence rate of one in every 33 years. (NOAA, 2017)

FIG. 3.4.5. WIND ZONES IN THE U.S.



SOURCE: MEMA 2013.

Since 2000, there have been 24 cold weather events within the Commonwealth, ranging from Cold/Wind Chill to Extreme Cold/Wind Chill events. Since 2000, there have been one warm weather event, Excessive Heat. Detailed information regarding most of these extreme temperature events was not available.

Extreme temperatures will continue throughout the entire county into the future. With global warming, the county should expect extreme temperatures regimes to be altered. It is projected that the region will experience 11 less days with temperatures below 0°F. 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 it will go 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 zero 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). If a heat wave lingers for several days in a row during the summer, the evening temperatures will likely remain high, making it difficult for homes and other buildings to cool down before the start of the next hot day. People without access to air conditioning, especially those with medical issues, can suffer additional health effects or even death. The increased demand for electricity due to the use of air conditioning and fans will strain the electric grid, and possible cause brownouts or failures.

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 46 - 57 mph) or a High Wind Warning (sustained winds 40+ mph or any gusts 58+ mph). For tropical systems, the NWS issues a tropical storm warning for any areas that are expecting sustained winds 39 - 73 mph. A hurricane warning is issued for any areas that are 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 one inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

Tornado damage severity is measured by the Enhanced Fujita Tornado Scale and it allows surveyors to create more precise assessments of tornado severity. Table 3.4.6. illustrates the EF-scale.

Table 3.4.6. 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 that are exposed to the temperatures when outside and straining home heating systems. The severity of extreme cold temperatures are generally measured through the Wind Chill Temperature Index. Wind Chill Temperature is the temperature that people and animals feel when outside and it is based on the rate of heat loss from exposed skin by 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. (MEMA, 2013)

The NWS issues a Wind Chill Advisory if the Wind Chill Index is forecast to dip to –15ºF to –24ºF for at least three hours, using only the sustained winds (not gusts). The NWS issues a Wind Chill Warning if the Wind Chill Index is forecast to fall to –25ºF 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 Berkshire 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 present, 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.

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 that severe criteria are observed. Some severe thunderstorm events may 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) According to the Dalton Emergency Management Director, who monitors weather advisories, there was no tornado warning for the Town prior to the tornado that struck the town 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)

The severe weather warnings issued for Berkshire County are generated out of the National Weather Service out of Albany NY, not from that in Boston. Also, 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. Also, given that the prevailing winds are 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.

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 that the probability for severe weather events increases 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 made more vulnerable due to existing chronic medical conditions or lower economic status. Additional impacts pose serious threats to public health and safety of urban areas, rising sea levels, and decreases in natural biodiversity.

Exposure

Whereas risk from some hazards can be somewhat dependent on locating development and infrastructure in higher risk areas (i.e. 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.

Temperature extremes can occur throughout the entire region and the Town of Hinsdale. Colder temperatures are more common in the higher elevations of the community, but the entire community is susceptible. Areas that are more prone to heat include the lower elevations in the downtown area and developments that are surrounded by parking lots. To understand risk, the assets exposed to the hazard areas are identified, and for the purposes of this plan the entire Town of Hinsdale 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 are considered most vulnerable because they require extra time or outside assistance to seek shelter;
- 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 storm events can impact people across Berkshire County and the Town of Hinsdale. Overall the greatest concern 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 that would make expose people susceptible to severe cold due to lack of heat and 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. The elderly are typically more vulnerable due to chronic illness, and given the trend of an increasing elderly population, mitigation and preparing for electricity outages should be a high priority. The additional trend of helping seniors age in place could mean that elderly residents become isolated during severe weather events.

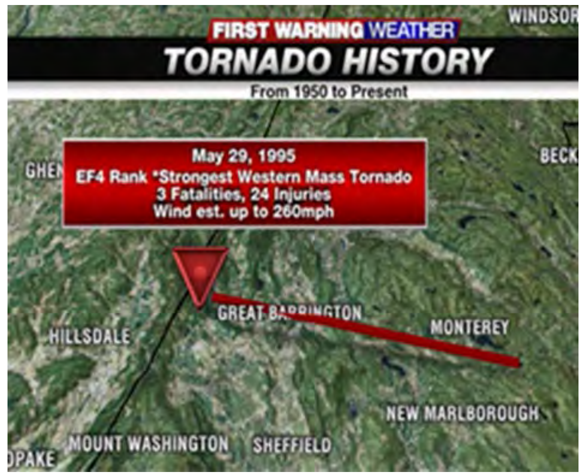
The most recent prolonged power outage in recent memory occurred during the Ice Storm of 2008, where at one time more than 1 million people were without electricity across Massachusetts, New Hampshire and Vermont. Some residents in the Berkshires were without power for more than two weeks. The Town of Hinsdale opened a shelter during this event, but it was used largely by utility crews and first responders.

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 three people, injuring 300 in Springfield alone, and leaving at least

500 people homeless. The F3 tornado traveled a 39-mile path from Westfield to Brimfield and Monson, the latter small towns of which suffered the greatest damages. With winds of up to 160 mph, it destroyed 1,400 homes and 78 businesses.[2]

According to available data tornados are the single deadliest natural hazard in Berkshire County in recent decades (other deadly hazards have historically been floods and dam failures). So far deaths have been relatively low because none of the stronger tornados were 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. 3.4.7. PATH OF THE GREAT BARRINGTON TORNADO



All residents in the Town of Hinsdale are vulnerable to the health effects of extreme temperatures, with those who work outside directly 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 human skin, showing where temperature, wind speed and exposure time will cause frostbite to exposed human skin. Fig. 3.4.8. illustrates the relationship.

FIG. 3.4.8. WIND CHILL TEMPERATURE INDEX AND FROSTBITE RISK

Temperature (°F)

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

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

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

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

Effective 11/01/01

Vulnerable populations are the elderly and those with pre-existing health conditions such as cardiovascular disease, Type II diabetes and other chronic ailments are at higher risk of extreme heat events. Hot humid conditions have been found to 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)

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)

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

values are exceeded for at least two consecutive days (Fig. 3.4.9). That number provides 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 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) .

FIG. 3.4.9. HEAT INDEX CHART AND HUMAN HEALTH IMPACTS

TABLE 14-3.
HEAT INDEX CHART

Relative Humidity (%)	Temperature (°F) 80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	135					
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

Nationally more than half of heat-related deaths occurred in homes where there was 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 core areas in Hinsdale.

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 since the mid-1990s with the highest number since 1950 occurring between 2010 and 2014. Refer to Fig.3.4.10., where the dark horizontal line represents the long-term average.

Historically the cooler evening temperatures in the Berkshires has allowed residents to cool their body temperatures in the night air and to cool 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.

FIG. 3.4.10. OBSERVED NUMBER OF WARM NIGHTS IN MA 1950-2014

Extreme heat temperatures and heat waves have historically been rare in Berkshire County, with temperatures that are cooler than the Hudson and Connecticut river valleys, ranging from 5^{O}F cooler in the valley communities and 10^{O}F cooler in the hilltowns. This is due largely to the slightly higher elevations of the Berkshires when compared to other regions in southern New England. Due to the rarity, this is a natural hazard for which communities and individuals are largely unprepared for. 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, the Massachusetts Department of Public Health survey taken by local boards of health across the state, in which less than 20% of local boards reported dealing with heat waves. Thirteen of the 17 Berkshire towns that answered 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 Kittredge Elementary School does not have air conditioning.

Critical Facilities

All critical facilities in the Town of Hinsdale are exposed to severe weather events such as high winds and thunderstorms and tornados. The most common problem associated with severe weather is 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. Roads may become impassable due to flash or urban flooding. (MEMA, 2013) The cell phone tower is at risk due to severe wind storms, and the steepness of the dirt access road to the site could delay repair of the tower if the event is accompanied by high rainfall or rain-on-snow.

All critical facilities are exposed to the extreme temperatures hazards. Extreme cold temperature events can damage buildings and infrastructure through freezing/bursting pipes and freeze/thaw cycles. An exceptionally cold spell in February/March 2015 caused widespread freezing and destruction of water lines across central and northern Berkshire County. According to local public works staff, the frost line in the county generally extends four feet deep in communities located in the river valleys, depending on elevation and soil type. However, in 2015 the frost line reached lower depths, freezing water lines that buried 5-5.5 feet deep in many communities. Lenox, Pittsfield, Dalton, Adams and North Adams were quoted in local newspapers as responding to frozen and broken pipe across their respective communities. Aging, more brittle infrastructure was particularly vulnerable, with the City of North Adams reporting several damages that left residents without water for more than a week. Several local communities issued CodeRed advisories, including Dalton, Adams and North Adams.[3] Hinsdale was fortunate in that no damages occurred during this time.

Extreme heat that occurs in the Berkshires generally does not impact buildings or other structures, but damages can be associated with overworking of HVAC systems, particularly those that are older or undersized. There is some concern that increased temperatures can reduce the 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 brown out 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 Vulnerability

Wind storms, thunderstorms, and tornado events may impact the economy, including loss of business function, water supply system damage, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Loss of key communications and transportation routes may also occur. Agricultural losses can be devastating due to lightning and resulting fires. Because of differences in building construction, 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)

The entire general building stock inventory in the community is exposed and vulnerable to severe weather hazards. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for severe weather events. As an alternate approach, this plan considers a one percent damage of structures that could result from severe storm conditions. This one percent was used by the state in their 2013 State Hazard Mitigation Plan. Table 3.4.2. summarizes the one percent damage that could result from winter storm conditions on the community's total general building stock (structure only). These figures do not include the damages that local businesses could incur. Many small businesses, such as those located in Hinsdale, suffer disproportionately than larger industries – if small businesses cannot open the business than they may struggle to make payroll and other expenses – and the longer the closure the deeper the impacts.

[3] Demers, Phil; Damon, Ed, 2015. "In Berkshires, frozen pipes still a risk – despite slight warmup", *Berkshire Eagle*, 3-9-15.

Table 3.4.2. Estimated Potential Loss Due to a Severe Winter Storm Event

Number of Buildings	Replacement Cost Value (Structure Only)	1% Loss
1,527	$206,854,100	$2,068,541

3.4.4. Existing Protections

- The Town of Hinsdale has several mobile portable generators ready to be utilized in the event of a prolonged power outage; the Town Hall, Town Garage, Youth Center and Fire Station are wired for generators, with plans to soon be able to hook one into the First Congregational Church.
- Regarding electricity outages, town officials across Berkshire County have reported an improvement in response from the electric companies since the ice storm in 2008. Additionally, the electric utility companies have created special community liaison staff who work more directly with municipal first responders during emergency incidents.
- The Town of Hinsdale is an active member of the Central Berkshire Regional Emergency Planning Committee (CBREPC). This organization is a source of shared resources, first responder personnel and experience. Mutual aid agreements are in place.
- Town departments of public works, fire and police prep ahead if predictions for high winds and downed trees, branches and wires is issued.
- There are four identified local facilities in Hinsdale that have generators and can act as shelters; the Town DPW has gas and diesel fuel available at its facility in the Town Center if necessary. The closest designated regional shelter to Hinsdale is the Alternate Primary Shelter at Chimney Corners in Becket, a facility that has a generator, kitchen, showers and pet accommodations.
- Kittredge Elementary School in Hinsdale, in coordination with local and state police, have developed Lock Down and Reunifications Plans in the event an emergency event occurs. Drills, some with parents involved, have been conducted.
- The Town offers CodeRed to all Hinsdale residents and businesses, and a link to sign up is posted on the Town's website home page. Messages are sent through this system to residents and businesses when impending storm events, road closures and other emergencies occur.
- The Town of Hinsdale adheres to the Massachusetts state building code, which as of 2018 was the Ninth Edition of the State Building Code. Part of that code requires buildings to withstand specific wind loads and adhere to energy efficiency standards. The Town is also a Green Community, which requires that new construction adhere to the state's Stretch Energy Code, requiring new buildings to more energy efficient and the building envelopes tighter than the state's underlying code. The more heavily insulated building envelope will add in maintaining

temperate interior temperatures against extreme exterior cold and heat. The MassSave Program offers free energy audits to residential and business customers who request the and, based on the results of the audits, offers financial incentives for building owners to become more energy efficient and better insulated.

3.4.5. Actions

- Continue strict adherence to MA building code and the Stretch Energy Code
- Encourage cell phone users and part-time residents to enlist in the Town's CodeRed emergency communications system.
- Although the communications systems has improved substantially in recent years, a repeater is necessary to cover dead spots along Pittsfield Road.

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

3.5.1. 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. Residents and town staff expect to deal with several snow storms and a few Nor'easters each winter. 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 20ºF. 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, and rain. Strong areas of low pressure often form off the southern east coast of the U.S, moving northward with heavy moisture and 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)

3.5.2. Severe Winter Hazard Profile

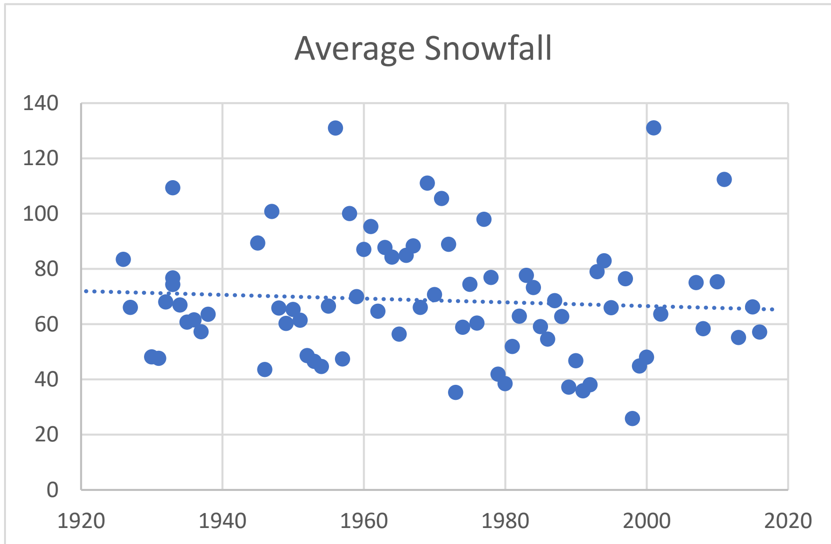
Location

Severe winter storm events generally occur across the entire area of Hinsdale, although higher elevations have slightly higher snow depths. Roads that have higher snow accumulations or ice and demand additional attention are Robinson, Pittsfield, Peru and George Schnopp Roads.

Previous Occurrences

Figure 3.5.1. illustrates historic snowfall totals the region has received. 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. (National Climatic Data Center, 2017)

Figure 3.5.1. Average Snowfall in Berkshire County



The National Climatic Data Center, 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 3.5.1. 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 the following sections. 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, non-flood-related severe storm events.

Table 3.5.2. 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 approx. $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 MA, some for up to 3 wks.; $51+ million from FEMA - $32 million to MA	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 winter 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 Hinsdale'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 the town 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 and risk of roof failures.

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 3.5.3. RSI 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 3.5.2.), 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 storms 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.

Fig. 3.5.2. Opening Mohawk Trail in Florida MA with Shovels 1926

Source: Stan Brown, Florida, MA

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 elders across Berkshire County comment that snow depths prior to the 1990s were consistently deeper that what currently occurs in the 2010s.

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

Secondary impacts for winter events are similar to those experienced in other severe storm events such as high winds or flooding, but with the additional structural risk of damage from snow load, more widespread hazardous driving conditions and greater risk of hypothermia from power outages or shoveling.

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 days with 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 temperature with several more days of extreme heat during the summer. Sea surface temperatures are also expected to incase by 8°F. (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

For the purposes of this plan, the entire Town of Hinsdale is considered to be exposed to severe winter weather.

3.5.3. 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. They 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 region, 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 the community 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. The elderly 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 these 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 December 2008 (DR-1813) was the incident that created the longest power outages in the region in recent memory. In the Berkshires the impacts of the ice storm were largely confined to the higher elevations in the hilltowns. A few residents in Hinsdale lost power for three days, while most of the population in neighboring Peru, Windsor, Washington and Becket lost power for one to several days. Some residents in the Berkshires were without power for more than two weeks. FEMA obligated $32 million to Massachusetts; municipal costs were estimated at more than $5 million, and state costs were estimated at $7 million. The Town opened a shelter, which was used by utility workers and town staff clearing roads; no residents approached the Town for overnight sheltering.

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 the community are exposed to 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, but these facilities may not be fully operational due to workers unable to travel to ensure continuity of operations pre- and post-event. Fortunately many town critical workers live within a short driving distance and public works and first responder staff levels seldom suffer. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Long-term 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)

Economy

The entire general building stock inventory in the community is exposed and vulnerable to the severe winter weather hazard. 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

[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*

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 3.5.4 summarizes the one percent damage 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. It was estimated that small businesses in Massachusetts lost tens of millions of dollars due to a lack of electricity during the Ice Storm of 2008. (MA EOEEA, MA Climate Change Adaptation Advisory Committee, 2011)

Table 3.5.4. Estimated Potential Loss Due to a Severe Winter Storm Event

Number of Buildings	Replacement Cost Value (Structure Only)	1% Loss
1,527	$206,854,100	$2,068,541

A specific area that is vulnerable to the winter storm hazard is the floodplain. Snow and ice melt can cause both riverine and urban 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.

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, 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.

3.5.4. 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 Hinsdale and the Central Berkshire Regional School Districts have good public communication systems that alert residents to school closings and other emergency conditions.
- The Hinsdale 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 the county was constructed before 1940, and 60% is pre-1960.[3]

3.5.5. Actions

- Continue to access winter-related disaster funding when available.
- Encourage homeowners to get energy audits and improve wall and attic insulation to buffer against short term power outages.
- Increase enrollment in CodeRed.

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

3.6. Dam Failure Hazards

3.6.1. 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 of water. 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 this 2018 plan, so the data has not changed since the 2005 regional plan, unless updated information was known by the community on the removal or repair of dams. 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 classification for potential hazards pertain 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 Plan 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.

3.6.2. Hazard Profile

Location

There are eight public and privately-owned dams located throughout Hinsdale. A summary of these dams and their hazard and size class can be found in Table 3.6.1. These dams range in age from Lake Ashmere and Plunkett Reservoir both built in 1875, to Cleveland Reservoir built in 1949 and the Watson Road dam built in 1957, and in capacity from the Cleveland Reservoir dam impounding a maximum of 6,022 acre-feet and the Lake Ashmere dam impounding a maximum of 3,872 acre-feet, to Fernwood dam impounding a maximum of only 17 acre-feet (Office of Dam Safety, 2004) Definitions of for Hazard Classification and Size categorization are found in Tables 3.6.2. and 3.6.3.

In general, the dams that pose the greatest risks to people and property in Hinsdale are at Lake Ashmere and Plunkett Reservoir. A failure of the dam at Cleveland Reservoir presents the overall greatest risks to people and property, but the bulk of damages would occur in Dalton and Pittsfield, two communities downstream of the dam. The locations of the dams are shown on the Critical Facilities and Areas of Concern Map found in Appendix A of this Plan. The potential impacts from inundation due to dam failure are discussed in more detail in the Vulnerability section of this Plan.

Table 3.6.1. Dams that could Inundate Areas in Hinsdale

Dam Name	Owner	Hazard Classifica-tion	Size Class	Condition	Last Inspection	Last EAP Revision
Lake Ashmere*	MA DCR	High	Large	Satisfactory	2016	2018
Belmont Reservoir	Town of Hinsdale	High	Large	Good	2018^	2014
Camp Emerson (Fernwood)	Private	Low	Small	Fair	2000	
Cleveland Brook Reservoir*	City of Pittsfield	High	Large	Satisfactory	Nov. 2016	2016
Grist Mill Pond	Private	Low	Small	NA	1975	
Plunkett Reservoir*	Town of Hinsdale	High	Large	Fair	May 2018^	2014
Upper Sackett Reservoir*	City of Pittsfield	High	Large	Poor	2017; repairs in progress 2018-19	2016
Watson Road	Unknown	Low	Small	NA	2017^	

Source: US Army Corps of Engineers database unless otherwise noted.
**Source: Condition for dams with asterisk (*) provided by Dalton Multi-Hazard Mitigation Plan, 2018.*
^Source: Town of Hinsdale.

Table 3.6.2. 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.

Table 3.6.3. 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

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:

- On 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. (Massachusetts Emergency Management Agency, 2013)
- August 19-20, 1901, Basset Reservoir and Dean's dams fail after a two-day rain event (Ennis, 2004). It is unclear if any injuries or deaths are attributed to the dam failures.
- On 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 full dam breaks or failures have occurred in recent decades that impacted Hinsdale, in September 2004 an incident occurred at the Plunkett Reservoir dam. 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. A similar situation occurred during the October 2005 storm event, where again the batter boards gave way. The Town of Hinsdale has recently completed the first phase of maintenance work on the Plunkett Lake dam, in which the batter boards system was replaced. The Town is searching for funds to complete the next phase of work, which involves repairs to the spillway.

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. A factor to consider is that many of the dams within the Town are more than 100 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. However, the probability of any type of 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 result in 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)

Three of the dams impound reservoirs that serve as drinking water supplies, with Belmont serving Hinsdale, Upper Sackett serving Pittsfield and Cleveland Reservoir serving Dalton and Pittsfield. The loss of capacity due to dam failure or damage could have long-lasting repercussions on human health and the economy of the region.

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 3.6.4. for the hazard potential of dam failures. These classifications help to further explain the potential impacts of that dam failures could cause in Hinsdale. The Corps of Engineers hazard rating systems is based only on the potential consequences of a dam failure; it does not take into account the probability of such failures. (MEMA, 2013)

Table 3.6.4. 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 two dams where failure could cause the greatest flood damages to people and property in Hinsdale are that of Lake Ashmere and Plunkett Reservoir. Flooding during a wet weather event could inundate large sections of land in Hinsdale and Dalton.

In Hinsdale, the dam failure of greatest concern is that of Cleveland Reservoir, due to the large aerial extent of the inundation area (which includes Wahconah Regional High School, several entire residential neighborhoods including senior housing complexes, and several businesses, including all Crane Company facilities), the height of the wall of water that would be moving, and the high velocity of that moving water. A full breach of the dam during probable maximum flood conditions would have a very short warning time. The inundation area continues downstream and causes extensive flood damages downstream in Pittsfield.

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 such as spillways and lower level outlets to allow release of additional water discharges. 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. (Massachusetts Emergency Management Agency, 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 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)

Exposure

Many sections of Town are at risk from dam failures of specific dams. Emergency Action Plans have been developed for all the High Hazard dams, including inundation maps showing areas of risk during dam failure. The other dams are smaller and owners are not required to develop Emergency Action Plans and inundation maps. 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.

3.6.3. Vulnerability

Population

A quantitative vulnerability assessment for property damages, injury or death could not be completed to estimate potential losses from a dam failure event. The towns vulnerability to the dam failure hazard is discussed qualitatively below.

A complete failure of the Cleveland Reservoir dam has the potential to result in a catastrophic disaster, flooding a large swath of land along Old Windsor Road, lands and neighborhoods in Dalton from East Housatonic Street north to North Street/Route 9, and Orchard Street west to Pleasant Street, with large facilities such as Wahconah Regional High School, and the Crane Company wastewater treatment plant being totally inundated by such an event. The High School would be inundated under 35 feet of water, which is essentially the entire facility, floor to ceiling. The inundation area continues westward into Pittsfield, where even more residential neighborhoods and commercial and industrial facilities would be flooded.

A wet weather complete failure of the Lake Ashmere dam would inundate large sections of land and properties along Middlefield and Buttermilk Roads, and Route 8. Fortunately, the Hinsdale Flats wetland complex could help to absorb much of the floodwaters. Downtown Hinsdale is largely spared, but flood water would spread out again in Dalton, inundating Wahconah High School, the Pease Avenue neighborhood and several homes in the vicinity of East Main Street and Hinsdale road. Sections of Route 8 and Old Windsor Road in Dalton would likely be flooded.

The relatively small inundation area below Upper Sackett Reservoir would impact properties in neighboring Dalton. Small sections of the center of the town and Camps Emerson and Romaca may be inundated by failures at Belmont and Plunkett Reservoirs.

All populations in a dam failure inundation zone would be exposed to the risk of a dam failure. The potential for loss of life is affected by severity of the dam failure, 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. 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.

Table 3.6.5. illustrates the potential number of people who are in the inundation areas of the individual dams in Hinsdale, based on inundation maps that are available. It should be noted that the number of people estimated within the inundation areas are a very rough estimate, based on the number of people in each census block that is located at least partially within the inundation areas within Hinsdale and Dalton. Estimates have only been done for the dams for which inundation maps could be located. A more accurate estimate on the severity of the risk of damages, injury or death, which would need to be calculated using several criteria such as baseline elevation, flood volumes, depth of the inundation, and warning time, has not been calculated for this plan update. It should also be noted that people who may be congregated in large buildings, such as schools and commercial or industrial buildings, are not included in these estimates.

Table 3.6.5. Estimated Populations within Inundation Areas in Hinsdale

Name of Impoundment	Estimated Hinsdale Population in Inundation Area	Estimated Dalton Population in Inundation Area*
Ashmere Lake	30	1,183
Belmont Reservoir	6 in residences; ~300 at Camp Romaca (summer months only)	unknown
Camp Emerson (Fernwood)	unknown	unknown
Cleveland Brook Reservoir	9	3,708
Grist Mill Pond	unknown	unknown
Plunkett Reservoir	20 in residences; unknown population at Duquette Sports camp (during summer months only)	unknown
Upper Sackett Reservoir	none	288
Watson Road	unknown	unknown

^*Note: Population estimate based on census block information; exact counting of the number of homes or buildings located within the inundation area was not conducted.*
Source: Inundation maps, BRPC.

Populations without adequate warning of the event from a television, radio or phone emergency warning system are highly vulnerable to this hazard. This population includes the elderly, young, and large groups of people who may be unable to get themselves out of the inundation area. (MEMA, 2013) The inundation area for Cleveland Reservoir includes properties located along Middlefield and Buttermilk Roads, and Route 8 in Hinsdale, and Wahconah Regional High School, entire densely developed residential neighborhoods, and several large commercial buildings in Dalton. Lake Ashmere's inundation area includes both Wahconah High School and Nessacus Middle School in Dalton. Injuries or casualties would significantly increase if a dam failure were to occur when the school are in session.

Critical Facilities

All critical facilities and transportation infrastructures in the dam failure inundation zone 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 inundation area for Cleveland Reservoir dam includes the major Dalton transportation routes of Main Street, the Main Street bridge, North Street (Rt. 9), Orchard Street and a section of Hinsdale Road (Rt. 8). Widespread damage or destruction of sewer and gas lines that are attached to bridges could occur, and downing of utility poles could disrupt to knock out electricity service and communications. Wahconah High School, the Dalton Water District office, MassWildlife Western District Office, MassDOT facility and all Crane Company facilities will be inundated. Nessacus Regional Middle School is on the delineated edge of the inundation area, but sections of East Housatonic Street and Hinsdale Road are in the inundation area and could limit access to the school if it were needed for sheltering or evacuation.

The transportation routes at risk from Lake Ashmere include Middlefield and Buttermilk Roads and Route 8, the latter of which is a major regional transportation route for Hinsdale, Washington, Becket and beyond. In Dalton, Route 9 and the Main Street bridge, Wahconah High School and the Dalton Water District office are also in the inundation area for the Lake Ashmere dam.

Town Emergency Operation Centers are not in any dam inundation areas.

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.

All buildings and infrastructure located in the dam failure inundation zone are considered exposed and vulnerable. Based on the assessed value of buildings in the inundation zones, if the Cleveland Reservoir dam were to fail, an estimated $16.8 million of building stock in Hinsdale would be as risk, largely due to the drinking water treatment plants value, as well as an additional $20.6 million in building content. If Lake Ashmere would be fail, an estimated $5.5 million of building stock in Hinsdale would be at risk. In addition, there is additional building contents that are exposed, amounting to $3.4 million, for a total of $8.9 million.   (Berkshire Regional Planning Commission, 2017)

3.6.4. Existing Protections

- Cleveland Reservoir has two spillways that can be utilized to release water during levels of high water.
- The City of Pittsfield is currently conducting repair work on Upper Sackett Reservoir dam.
- The Massachusetts DCR conducted extensive repairs to the Lake Ashmere dam 2008-10 and an inundation map has been prepared and distributed to Hinsdale Town Officials.

3.6.5. Actions for Dam Failure

- Pursue funding to make needed spillway repairs to Plunkett Reservoir dam.
- Continue to maintain close working relationships and communications with the City of Pittsfield, DCR and Town of Dalton to ensure sharing of up-to-date Emergency Action Plans and communiciations.
- Consider conducting a dam breach exercise for Cleveland Reservoir, including in the exercise first responders from neighboring Dalton and Pittsfield.

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 action 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.

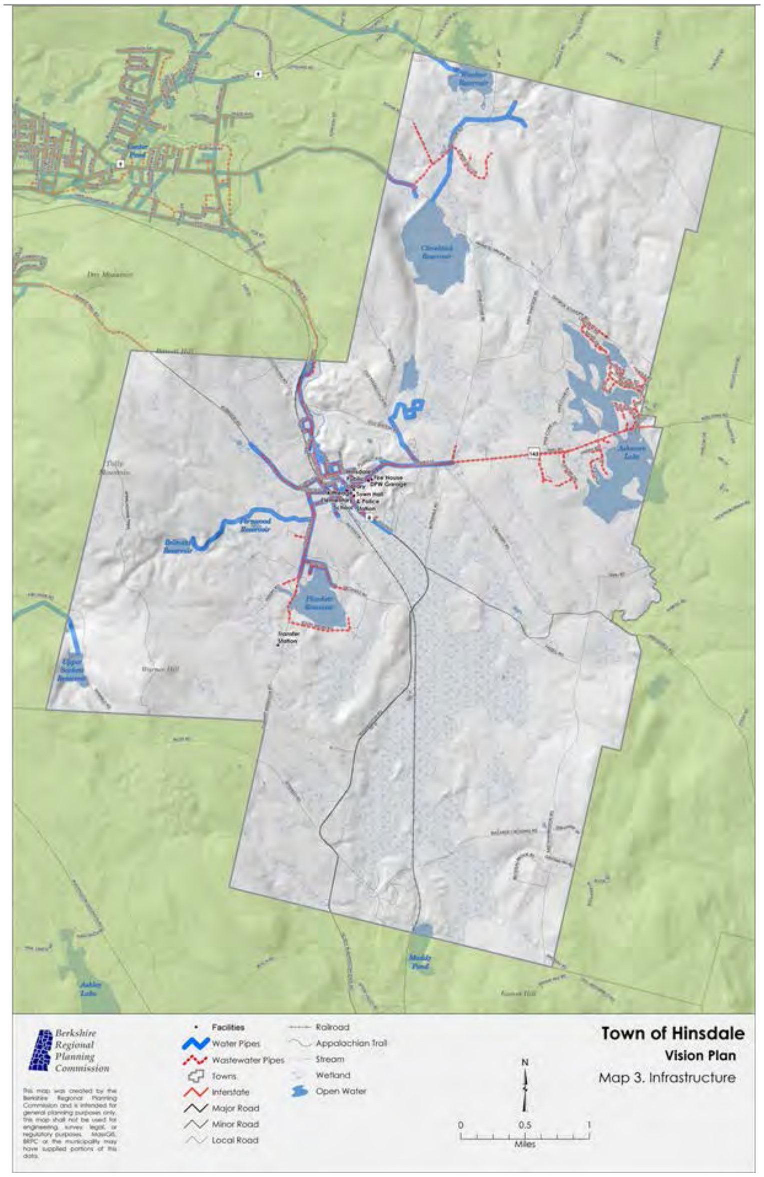
Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on streamflow, water supply, reservoir levels, soil moisture and potential for forest fires. 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 Hinsdale is at risk of drought.

Fig. 3.7.1. Drinking Water Infrastructure (shown in blue)



Source: Hinsdale Open Space & Recreation Committee, BRPC, 2018.

The municipal drinking water system serves approximately 1,200 of the Town's residents and also provides water to caps Emerson, Romaca and Duquette. Belmont Reservoir, owned and maintained by the Town of Hinsdale, is the source of the public drinking water system. As shown in Figure 3.7.1. by blue lines, the water system serves residents in the Town Center, part of the homes along Michaels Road on the north side of Plunkett Reservoir, and outward up Route 143 and to the mobile home park. The monitoring and maintenance of the system is overseen by Town staff. Those residents and businesses outside the core area of Town are served by private drinking water wells.

The water treatment and distribution system is fairly new, with the Town having started replacing the pipes in 1989, and since then the degraded sections have been replaced. The new water treatment system was installed in 1995. There are a few areas of Town where the private pipe systems branching off the Town's main lines need upgrading, but these are private obligations of property owners.

In addition to Belmont Reservoir, Hinsdale hosts other municipal drinking water supplies. Cleveland Reservoir (which provides drinking water to neighboring Dalton and Pittsfield), Windsor Reservoir(which is a backup water supply for Dalton), and Upper Sackett Reservoir (which provides drinking water to Pittsfield).

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 droughts periods 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 information indicates 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 began to be 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).

The Town of Hinsdale has not faced a serious drought in recent memory, as Belmont Reservoir has safely provided adequate drinking water supplies for decades. Water restrictions or bans are typically issued by the Hinsdale Water Department when mandated by the Massachusetts Department of

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

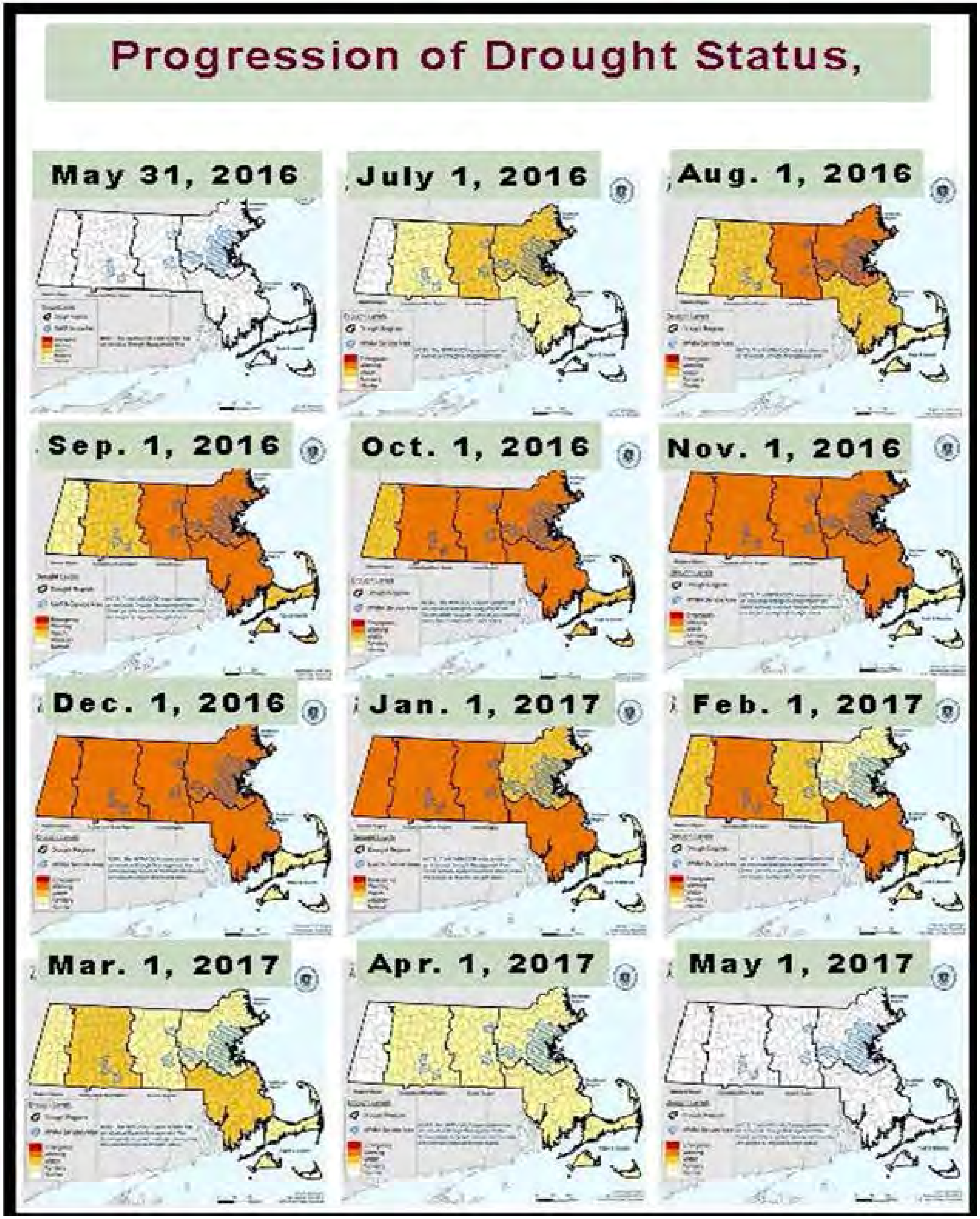
Environmental Protection (DEP). During the 2016-17 drought time the Hinsdale Water Department did issue a town-wide water restriction advisory, in accordance with DEP's requirement, although the supply in the Town's reservoir was not in serious danger. It is unsure if the supply would have been endangered if the drought persisted.

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.

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.

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. U.S. Drought Monitor Level and Comparable State Level Indices

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

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 (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 the DEP 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.

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 Hinsdale is 76% forested, and that forest lands are often located in steeply sloped and inaccessible areas, the risk of wildfire during drought conditions is a concern.

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 conducted in 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.

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 Hinsdale at risk of exposure to drought. It is generally believed that residents in Town that are on private wells may be more susceptible to drought, particularly those with shallow wells, but there is not definitive data to verify this belief.

3.7.3. Vulnerability

Population

For the purposes of this plan update, the entire population of Hinsdale is exposed and vulnerable to drought. The Town of Hinsdale has an informal monitoring system based in historical water levels: long-time residents claim that water supply is adequate as long as a large rock on the floor of in the reservoir remains underwater and is not exposed. This rock has not been exposed in recent memory and was not exposed during the drought of 2016-17. However, the Berkshire region has not suffered a severe, Emergency level drought since the 1960s and it is unclear how well the system could serve the demands of Hinsdale during a prolonged drought.

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 that are in areas surrounded by forest or dry vegetation, such as water tanks, water pumps, sewer pumps and other infrastructure, could be more vulnerable to wildfire.

If a severe drought of long duration were to occur, the Water Department may need to provide some assistance to provide water to residents whose wells have gone dry. An emergency dispensing center may need to be created to serve this population.

Economy

The Hinsdale business community is comprised of small, family-owned operations, some of which are dependent on a summer influx of residents, visitors and campers. A severe, long-term drought could

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

severely impact the operation of some of Hinsdale's businesses if drought reduced the number of summer visitors to the area.

Drought would also impact local farmers, causing crop and livestock losses. There is only one small family farm still operating in Hinsdale. Because farming operations in the Berkshires survive on thin economic returns, the purchase of hay and other feed over a series of consecutive seasons could drive small operations out of business. Additionally dry standing vegetation in fields, such as hay or corn, could increase risk of wildfires and further impede economic survival.

3.7.4. Existing Protections

- The Town has in place bylaws that protect the aquifer and surface water supplies.
- The water usage of all customers of the Hinsdale Water Department is metered and measured in cubic feet, inherently encouraging conservative water use. The system, which has newly installed meters in 2016-18, continuously monitors water usage of each customer and the Water Department will send a notice of such use to alert customers that they may have a possible leak.
- The Massachusetts DEP has broad jurisdiction to protect water supply and water quality. During a state of water emergency, DEP 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)

3.7.5. Actions

- Work with private owners to upgrade substandard water lines where needed.
- Continue to operate a usage-based pricing structure to ensure financial stability and encourage conservation.

3.8. Fire Hazards

3.8.1. General Background

There are three basic fire hazard regions that are 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 spreads 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. People under the age of 5 and over the age of 55 have a much higher death rate than the average population, accounting for more than one-third of all deaths nationally.

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, homes are built among densely wooded areas, so humans are more likely to start a fire that will easily spread to the surrounding forested areas with 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 occurrence 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 the 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)

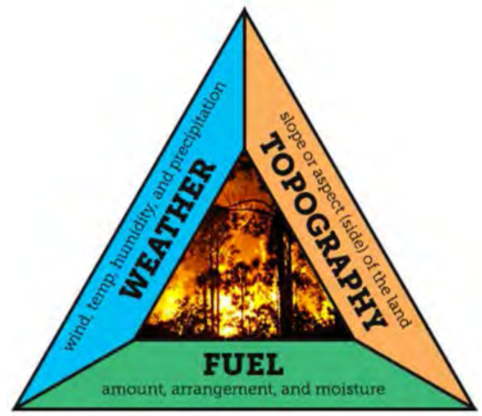
The "wildfire behavior triangle" of weather, topography and fuel are the three primary factors that influence wildfire behavior (Fig. 3.8.1.). Of the three, weather is the most variable and least predictable[1]. Climate change may influence future wildfire behavior due to changing weather and resulting forest 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.
  - Snags and hazard trees—especially those that are diseased, dying, or become receptive to ignition when influenced by environmental factors, such as drought, low humidity, and warm temperatures.

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

- 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 drying 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.

Figure 3.8.1. Fire Behavior Triangle



Source: BRPC 2018.

- 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 (greater than any predicted by climate models), future areas burned is very likely to increase.
  - Infestation from insects is also a 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 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

Hinsdale is largely a rural community, where even the most densely developed Town Center area consists of detached single-family homes and business buildings. The majority of land in the Town is more vulnerable to wildfire. According to MassGIS land use data, 67% of Hinsdale is forested, with vast unfragmented forest blocks that surround the Town Center and development located along rural roadways. These forests include forested wetland acreage, found mostly in the Hinsdale Flats and along the Housatonic River. In the opinion of the Hinsdale Fire Department, the area of Hinsdale that is at greatest risk of wildfire is along the CSX railroad corridor due to sparks from regular train movement, sparks from maintenance operations and the type of hazardous fuel the trains transport. To keep the tracks clear of vegetation the railroad cuts back brush and tall vegetation along the train track corridor, leaving behind dead and dried vegetation which, during dry and hot conditions, are ready fuel for wildlife. Sparks from metal-on-metal along the tracks are typical, and the risk of sparks are substantially increased when CSX periodically grinds the train tracks for better movement. A few years ago, CSX conducted track grinding operations in Hinsdale, and in one day alone the Hinsdale Fire Department had to respond to four or five spots fires along the tracks. Fire Department members recall a fire in the late 1970s or early 80s when more than 100 acres burned along the tracks in the Hinsdale Flats wetland complex. The railroad tracks corridor is at ongoing risk from fire due to a potential train accident with hazardous chemical aboard, with at least one train per week hauling nothing but cars full of ethanol. The grade along the Pittsfield-to-Hinsdale is the steepest found along the CSX line in Massachusetts, creating an increased risk of accidents during severe weather events. The potential fire and human health risk of a hazardous materials spill is a concern shared by the Dalton Fire Department and is voiced in their updated Hazard Mitigation Plan.

In addition to the railroad corridor, there are certain locations where wildfires could occur due to increased human activity. Campfires are held regularly at the stay-over summer camps, at the two campground and along the Appalachian Trail (AT). The open area on Warner Hill along the AT is of particular concern due to its popularity. The location of the AT, which travels for approximately two miles through Hinsdale, is noted on the Critical Facilities and Areas of Concern Map found in Appendix A.

Previous Occurrences

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 burned annually statewide. (MEMA, 2013) According to the Massachusetts Fire Incident Reporting System, fire wildfires reported to DCR in the past five years are generally trending downward. According to this system there were 901 fire incidents, combined urban and wildland, in Berkshire County during the years 2007-2016, and of these 411 (46% of total) occurred in the City of Pittsfield, the urban center of the region. There have been no wildfires reported in Hinsdale during this same time period. To estimate potential occurrence risk, this Plan looks at data from the Berkshire County region.

The Fire Incident Reporting System shows that a total of 832 acres were burned in Berkshire County during the years 2007-16, 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 (not the 600 acres listed in the MA Fire Incident Reporting System). 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.

The Widow White’s Peak fire of 2008 in Lanesborough, was the second largest fire in the county within the past few decades. As noted in that town’s Hazard Mitigation Plan, the fire burned 168 acres. The

Lanesborough Fire Department received an enormous amount of support from DCR and from 10 neighboring fire companies through mutual aid. The first day of the fire approximately 120 fire fighters worked to contain the fire, and through the second day 65 fire fighters from eight companies ensured containment. Hotspots continued to be put out for the next week. The Hinsdale Fire Department responded to the Lanesborough fire as part of regional mutual aid. They also responded a few years ago to a wildfire in Lee in the October Mountain State Forest.

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. As noted above, if removing the Clarksburg and Lanesborough wildfires as potential outliers, the average wildland acreage burned in the county during a 10-year period was 19. Because there have been no recordable wildland acreage burned in Hinsdale, it is difficult to estimate probable occurrences for the coming years. However, Hinsdale occupies approximately two percent of the total land area of Berkshire County, and if one took two percent of 19 to calculate Hinsdale's risk, a probable future occurrence estimate would be .38 acres. This of course is just a very rough estimate, because risk involves more than statistics - it involves as a basis the factors described in the Fire Behavior Triangle, along with access to the fire site and capacity of the fire companies in the area to respond.

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. Risks continue to be mostly limited to structures, particularly homes, which as discussed earlier in this section pose the greater risks of injury and death.

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 a number of variable factors affect 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. (MEMA, 2013)

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. (MEMA, 2013)

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, 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

Hinsdale is not developed to a density that would provide fuel for a major urban fire. The likeliest chance of urban-type fire would be in the Town Center, where wooden 19th century structures houses are located. Lakeshore homes along Plunkett Reservoir are built close together on small lots, but are detached single family homes, and their close proximity to water provides an ample water supply.

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 elderly, 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. (MEMA, 2013)

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 Hinsdale that have been affected by secondary environmental impacts in recent memory.

Climate Change Impacts

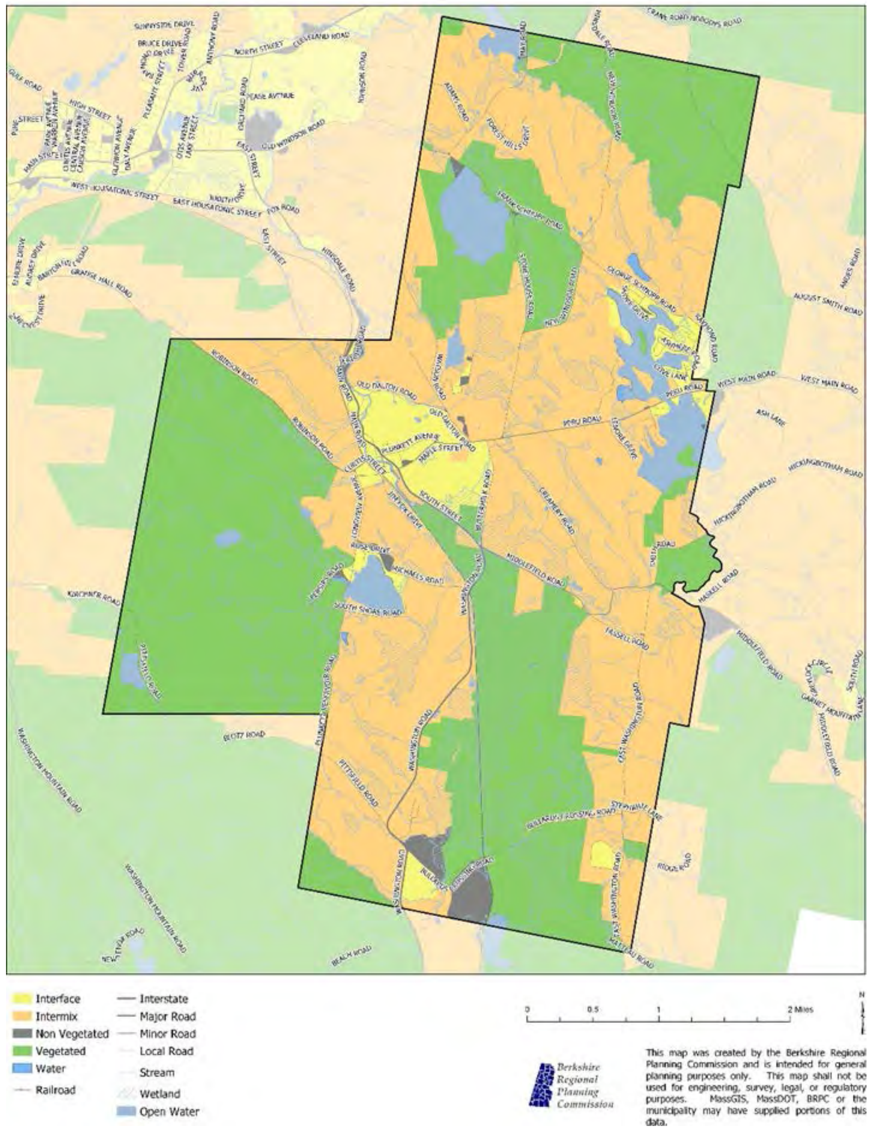
While climate change is unlikely to change topography, it can alter the weather and fuel factors of wildfires. Climate scenarios project summer temperature increases between 3ºF and 9ºF and precipitation increases of up 5 inches. (Northeast Climate Science Center, 2018) Hot dry spells create the highest 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 of our 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 that are most susceptible to wildfire hazard are pitch pine, scrub oak, and oak forests. These are the most flammable vegetative fuels. (MEMA, 2013) Hinsdale does not have any significant land coverage that include these ecosystems.

To understand risk, the assets exposed to the hazard areas are identified. For wildfire hazards identified as hazard areas include wildland-urban 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 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 Tract data, the Multi-Resolution 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 Hinsdale for this hazard mitigation plan.

Fig. 3.8.2. Wildland-Urban Interface and Intermix (SILVIS model)



The SILVIS modeling tool has calculated that the Urban-wildland Interface, the area at greatest risk of urban-wildland fire occurrences, covers approximately 5% of the town (shown in yellow in Figure 3.8.2.). The Intermix area, where wildlands and scattered development meet, is calculated as covering 47% of the Town (shown in tan), with most of the rest of the Town calculated as being Vegetated (42%, shown in green). While the Town believes that the Interface area is overestimated, the blocks do generally correspond with the more densely developed areas of Hinsdale (with the exception of an odd patch of land on the southern border with Washington). The amount of land categorized as Intermix is grossly overestimated, because development in these areas is only along rural roadways, with large blocks of forest in between. These large unfragmented blocks of forest should more properly be categorized as Vegetated lands rather than

Intermix. The SILVUS model discrepancies may be attributed to delineation of census blocks, which in rural communities such Hinsdale often extend widely and include large, sparsely populated and undeveloped acres of land.

Because the SILVUS model does not appear to reflect the true location of human habitation in Hinsdale, this plan considered another data source to more accurately determine fire risk. To better understand the urban/wildland Interface and the general forest types in Town, the analysis focused solely on land cover as mapped by the Multi-Resolution National Land Cover Database (NLCD). This data and accompanying map in Fig. 3.8.3. shows more accurately the Interface and Intermix between existing development and forest, more accurately showing development patterns and density. It also shows what general types of forest surround that development, with the majority of Hinsdale covered in Deciduous Forest, intermingles with large blocks of Mixed Forest and Woody Wetlands. Evergreen Forest, which poses a greater risk of wildfire, comprises only smaller scattered patches of forest. (Multi-Resolution Land Characteristics Consortium, 2011). What is not illustrated in the SILVIS or the NLCD mapping exercises is the condition of the forest. Due to ice damages and other severe storm events, particularly the Ice Storm of 2008, there is a significant amount of damaged trees with broken crowns, downed limbs, and dead/dying standing trees. This has lead to a build up of dry woody matter in the forest, particularly in the higher elevations where ice damage has been the most severe.

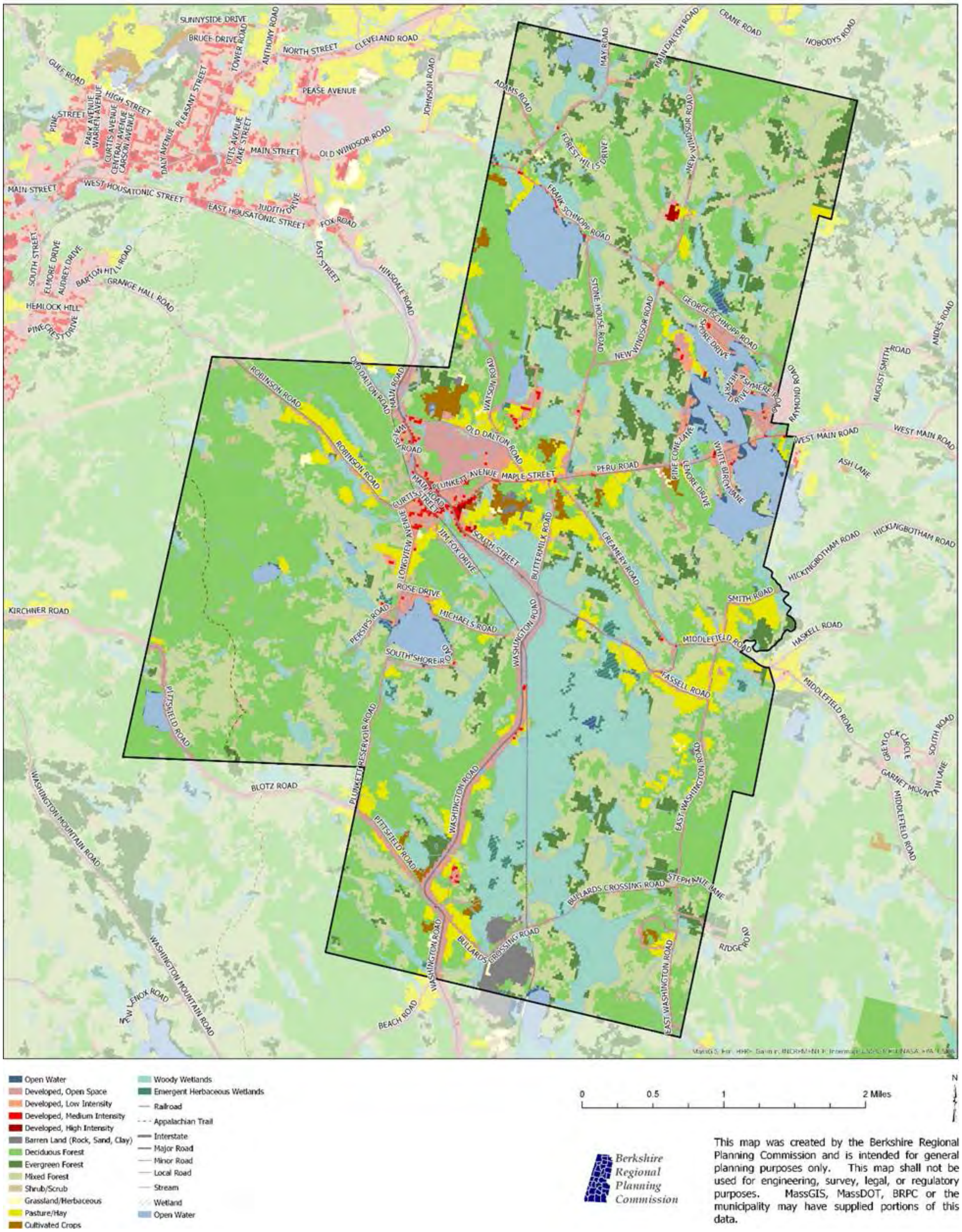
3.8.3. Vulnerability

Population

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. The county's exception is the City of Pittsfield, which is considered to be at medium risk. However, for the purposes of this Plan, the Town considers resident in most areas of Hinsdale to be vulnerable to risk of wildfire. The map in Figure 3.8.3. illustrates the relationship between developed lands (pink/red variations), forest lands (green variations) and open lands (yellow variations). Specific areas within Hinsdale that are at greater risk are those forested areas where human activity is greatest, such as the CSX railroad corridor, camper areas and the AT. Difficulty accessing some of these areas increases and limits fire response times and capabilities.

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, 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 toxics (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, 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.

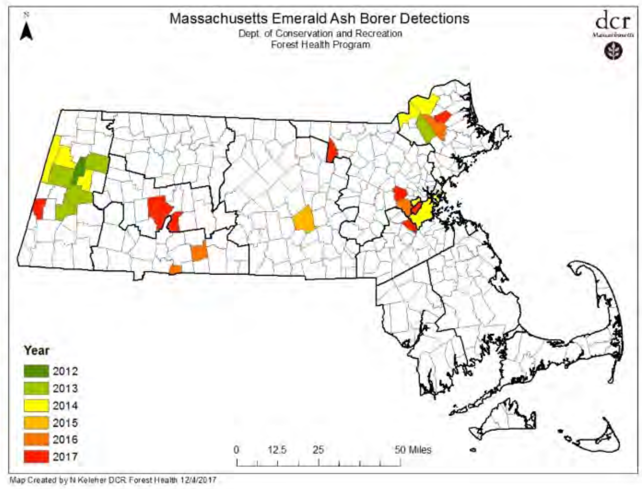
Fig. 3.8.3. National Land Cover Data Showing Forest and Development Patterns



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.

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, is leaving dead and dying snags, and in the long run is increasing fuel for wildfire. Although the lower elevations of Hinsdale were largely unaffected by the ice storm, higher elevations such as Robinson Road and Peru Road did ice over.

Fig. 3.8.4. Emerald Ash Borer Dispersal 2017



The presence of the Emerald Ash Borer, first found in Massachusetts in the neighboring town of Dalton in 2012 (shown in dark green on Fig. 3.8.4.), has quickly spread throughout central Berkshire County. It was subsequently documented in Hinsdale in 2014. 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. At this time Town officials are not aware of any die offs at this time.

Critical Facilities

The vast majority of the critical facilities in Hinsdale are located in the Town Center, with a low risk of urban or wild fires. There are open patches of unforested lands around the Town Hall, Fire Station and elementary school, but there is forest to the east of the public works building, on which the Town's vehicle fuel tanks are located. The sewer pumps that serve and distribute waste from the areas around Lake Ashmere and Plunkett Reservoir are in wooded areas, and fires could damage the electrical equipment that run the pumps. The cell tower south of the town center is surrounded by woodlands and provides services private cell phones and the police, and the loss of this could limit communications if damaged by fire.

It is believed that most roads would be without damage except in the worst scenarios. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Power lines are the most at risk to wildfire because most poles are made of wood and susceptible to burning. (MEMA, 2013) A fire involving the rail cars with explosive or hazardous materials could be dangerous and potentially catastrophic due to the proximity of rail tracks to the Town Center,

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

particularly so if school were in session. Similarly, uncontrolled fires near the water treatment plant at Cleveland Reservoir could be catastrophic, as large amounts of chlorine gas are stored there.

Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and 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 and breaking it into the Intermix and Interface areas delineated from SILVIS. The SILVIS model was determined to be a good model for this analysis because it fairly accurately could estimate the number of residential units within those areas. Using this method it was determined that the Urban Wildland Interface hazard areas (yellow in Fig. 3.8.4) contains 427 housing units, and the Intermix hazard area (tan) contains 626 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 $$86,664,000 worth of property is at risk of wildfire in the Interface area and $166,937,700 is at risk in the Intermix area. (Berkshire Regional Planning Commission, 2010) It should be noted that these figures are assessor estimates and does not include market cost or replacement costs, nor do they include estimate of loss of building contents. These figures also do not include the major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed businesses or farms or loss of employment.

3.8.4. Existing Protections

Despite being a rural volunteer fire company, the Hinsdale Fire Department is an exceptionally well-equipped with fire trucks, brush trucks, ATVs, ex-military vehicles and other response vehicles, including a mobile comfort station. However, the tanker truck is a 1988 home-built vehicle and needs to be replaced. This tanker is a critical part of the Berkshire County Tanker Task Force.

. Protections include:

- Mutual Aid with other fire departments through the Berkshire County Fire Chiefs Association.
- Town strictly enforces burn permit system.
- All members of the Fire Department have had wildland fire training.
- The Town utilizes the CodeRed emergency communications system, enrollment of which is posted on the home page of the Town's website.

3.8.5. Actions

- Pursue funding for a new 3,000 gallon capacity tanker truck in order to continue to provide mutual aid to the Berkshire County Tanker Task Force.

- Continue to recruit and train new fire department members, particularly those who work in the Hinsdale area and can respond quickly to fire calls.
- Continue the strong bonds developed through mutual aid.
- Work with landowners to maintain logging roads and other access roads for fire and rescue responses.
- Continue to partner with the Central Berkshire REPC to press for ongoing emergency response exercises and drills with the CSX railroad.

3.9. Landslide Hazards

3.9.1. General Background

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors. According to the state 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, and 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 2013)

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 permeability often causes a failure plane to develop along the interface between the two materials resulting in sliding 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 covers the majority of the community. Adverse geologic conditions exist anywhere there are lacustrine or marine clay soils. Clays have relatively low strength, and when over steepened or exposed in excavations these areas often produce classic rotational landslides. (MEMA 2013)

Another occurrence of landslides in Massachusetts results from slope saturation. This occurs following heavy rains and dominantly in areas with steep slopes underlain by glacial till or bedrock. Bedrock and glacial till soils are relatively impermeable relative to the unconsolidated material that overlies them. Water accumulates on these less permeable layers, increasing the pore pressure at the interface. This interface becomes a plane of weakness, and if conditions are favorable failure can occur. (MEMA 2013) Saturation was a leading cause of the landslide that occurred in Savoy at Route 2 during T.S. Irene in 2011.

3.9.2. Hazard Profile

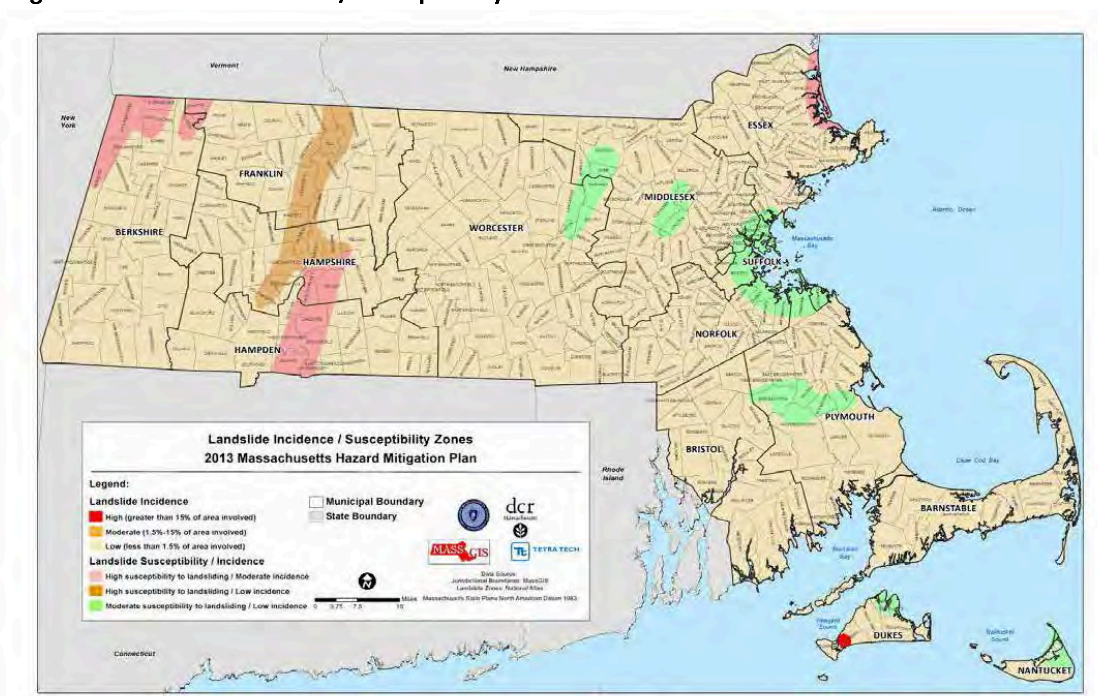
Location

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 locations). The Town of Hinsdale is not included in this area.

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 involved in landsliding, medium incidence means that 1.5-15% of an area has been involved, and low incidence means that 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 landsliding. (MEMA, 2013)

Fig. 3.9.1 Landslide Incidence / Susceptibility Zones

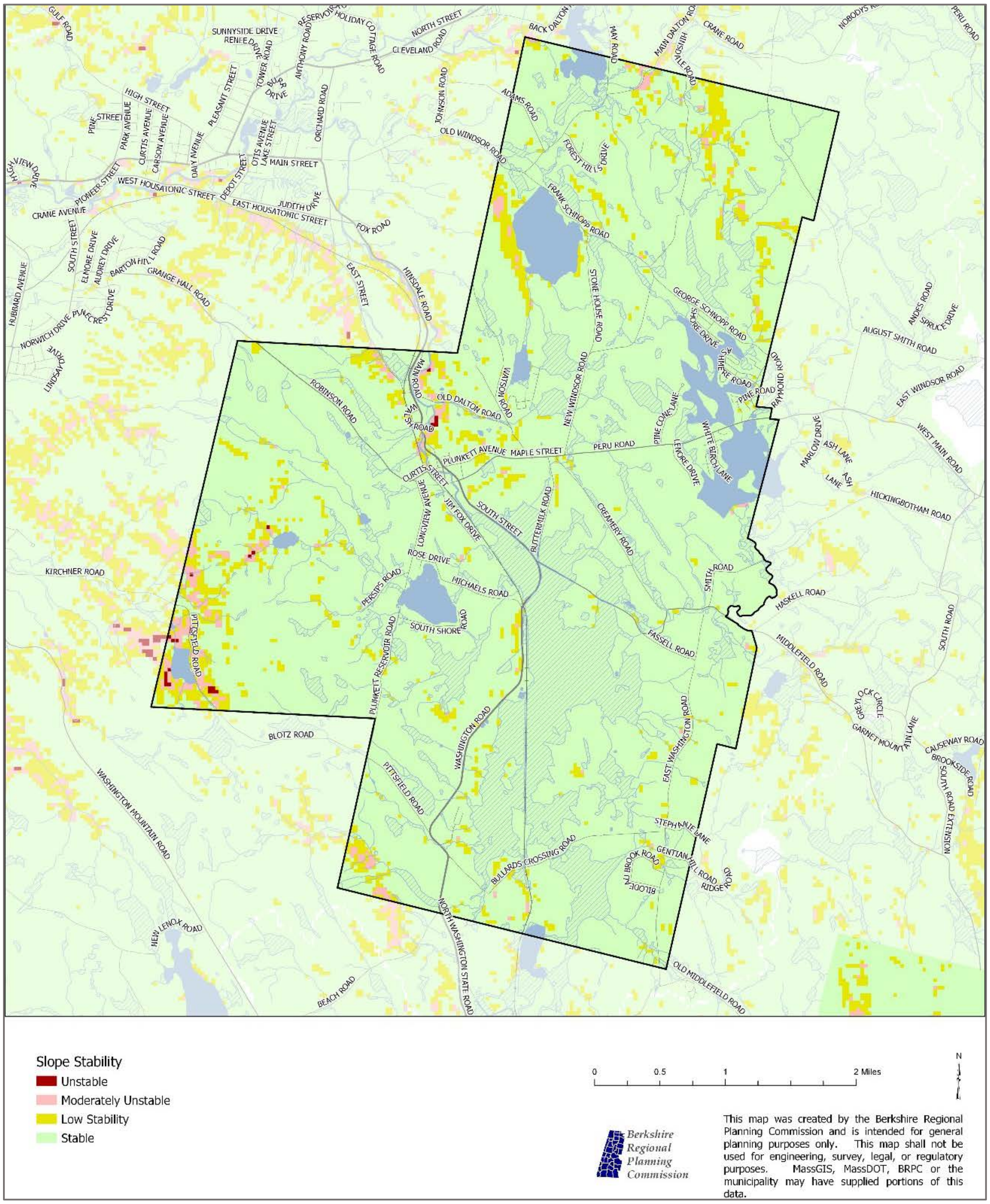


Source: MEMA 2013

To investigate landslide risk more closely, data from the Slope Stability Map produced by the Massachusetts Geologic Survey was gathered. According to this model, areas with a Safety Rating of less than one is considered unstable, with lands categorized as Unstable and Moderately Unstable both having ratings of less than one. These categories are considered High Susceptibility Zones. Using this source as a guide, Hinsdale has 13.5 acres of land categorized as Unstable (approximately 0% of total land) and 171 acres as Moderately Unstable (approximately 1% of total land). These areas are shown on the map in Figure 3.9.2., with Unstable lands shown in dark red and Moderately Unstable lands shown in pink. There are no buildings within Unstable lands, but there are eight residential buildings located on Moderately Unstable land, located along Main Road and Old Dalton Road.

In Hinsdale Unstable and Moderately Unstable lands are generally found in two areas: 1) the lower elevations of Warner Hill, along the steeply sloped areas that surround Upper Sackett Reservoir and along Pittsfield Road (and to some degree around Belmont Reservoir), and 2) at the base of steeply sloped hills along the Housatonic River north of the Town Center, particularly along Old Dalton Road. A few scattered areas are located in the northern portion of the Town, associated with the eastern slope of Barrett Hill above Cleveland Reservoir and an area along Windsor Road/Main Dalton Road.

Fig. 3.9.2 Slope Stability (Using the Massachusetts Geological Survey)

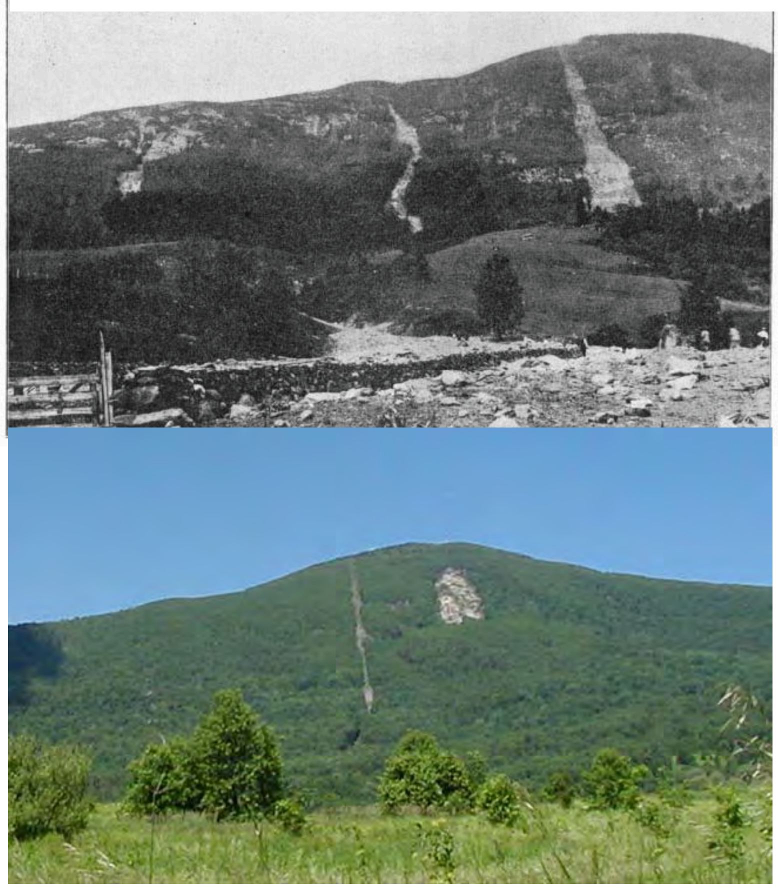


Previous Occurrences

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 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 Hinsdale that can be presented in this report. Data taken from the state's hazard mitigation plan of 2013 notes these events that occurred in the Berkshire region.

Fig. 3.9.3. Landslide scars on Mt. Greylock 1901 and 1990



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

- 1901: 11 landslides occurred along the east face of Mount Greylock after heavy rains (Fig. 3.9.3 top photo). 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. The deforestation 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 (see Fig. 3.9.3. bottom).
- 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.
- August 2011: Hurricane Irene caused damage throughout portions of the Commonwealth, including a 5.8-mile section of Route 2 that was closed 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.

Probability of Future Occurrences

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods, or wildfires, so landslide frequency is often related to the frequency of these other hazards. 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 landsliding 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 Massachusett. 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 T.S. Irene in 2011. The slide was 900 feet long and involved approximately 1.5 acres, with an average slope angle is 28 to 33°. The elevation difference from the top of the slide to the bottom was 460 feet, with an estimated volume of material moved being 5,000 cubic yards. Only the top 2 to 4 feet of soil material was displaced.

It is unknown what the severity of a landslide in the Unstable or Moderately Unstable areas of Hinsdale would be due to the number of factors that lead to landsliding and to the 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 can 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. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. 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. (Massachusetts Emergency Management Agency, 2013)

Secondary Hazards

Landslides can cause several types of 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. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for property owners. (Massachusetts Emergency Management Agency, 2013)

Landslides can severely alter the course of rivers and streams, erode banks and contribute large amounts of sediment and debris into waterways. Stream and river banks that are already prone to erosion or which are already undercut could become more unstable due to a large event. Landslide debris can block the flow of water under bridges and through culverts, threatening the structures themselves and 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, climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature could affect the snowpack and its ability to hold and store water. 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 landslide occurrences. (MEMA, 2013)

In the Berkshires, the areas rated as being more prone to landslide incidence and susceptibility are undeveloped, forested steep slopes. Trees and other vegetation help to hold soil in place. Climate change is expected to impact forest species composition in a variety of ways, with cooler species such as sugar maples and hemlocks retreating northward and higher in elevation and invasive forest pests such as the emerald ash borer, wooly adelgid and Asian long-horned beetle increasing tree mortality of key 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

In general, as shown in Figures 3.9.2., the vast majority of Hinsdale, including developed areas, are considered to be at a low risk for landslides. 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. The landsliding map model does not indicate where gravel mining has removed large quantities of soil. The several gravel pits located in Hinsdale are sites where industrial gravel mining operations have created steep slopes, largely composed of sandy soils. Subsidence of the upper slopes is common in all these sites. Fortunately, homes or other structures have not been constructed below these slopes.

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 eight buildings in Hinsdale 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 eight houses in the Unstable or Moderately Unstable land, and the 2.3 people/household average within Hinsdale, it can be calculated that approximately 18 people may need to be sheltered in the event of town-wide landslides.

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. (Massachusetts Emergency Management Agency, 2013) The 2013 state hazard mitigation plan notes that the estimated cost to address landslide problems to state highways alone was $1 million during the years 1986, 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 T.S. Irene (2011) which included debris flows, four landslides, and fluvial erosion and undercutting of infrastructure cost $23 million just for the 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 Hinsdale. There are, however, several rural road sections that travel through Moderately Unstable land, including Windsor Road, Old Dalton Road and Pittsfield Road. A few small sections of the CSX railroad tracks are adjacent to Moderately Unstable land along the river north of Curtis Street and south of Bullards Crossing, a concern given that large quantities of hazardous materials are transported along this trail corridor. A small section of Pittsfield Road has been categorized as Unstable. The Hinsdale Public Works Department do not report any history of landsliding or erosion along these road corridors. One section of road that is a concern is Middlefield Road, where bank erosion of Bennett Brook stream channel is causing subsidence, threatening to undermine the road structure. This area is not shown through slope stability modeling, but is noted on the Critical Facilities and Areas of Concern Map (Appendix A).

Unstable and Moderately Unstable lands surround the Upper Sackett Reservoir, a public drinking water source owned and maintained by the City of Pittsfield, and unstable lands are identified along steeply ravined tributaries to Belmont Reservoir, which is the Town of Hinsdale's water supply. Severe landsliding of high volumes of soils, sediment, rocks, debris and/or vegetation into these waterbodies could temporarily degrade water quality due to increased turbidity and bacteria counts. Given that Upper Sackett Reservoir is surrounded by Unstable and Moderately Unstable lands, several landslides into the waterbody could decrease storage capacity.

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. These buildings have a value of $1,043,000.

3.9.4. Existing Protections

- The lands surrounding Upper Sackett, Belmont and Cleveland Reservoirs are within watershed protection areas, which severely limits removal of vegetative cover.
- The Town of Hinsdale does have a zoning bylaw that requires revegetation of disturbed lands to minimize erosion, subsidence and sediment deposition.

3.9.5. Actions

- Monitor bank erosion along Bennett Brook to ensure that the integrity of Middlefield Road is maintained for safe travel; consider bank stabilization and reinforcement of the road bed during design and reconstruction of Middlefield Road, which is on the TIP for construction in 2021.
- Maintain vegetative cover on lands surrounding the drinking water reservoirs.

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. Effects listed are more applicable at lower levels to California than to Massachusetts. 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

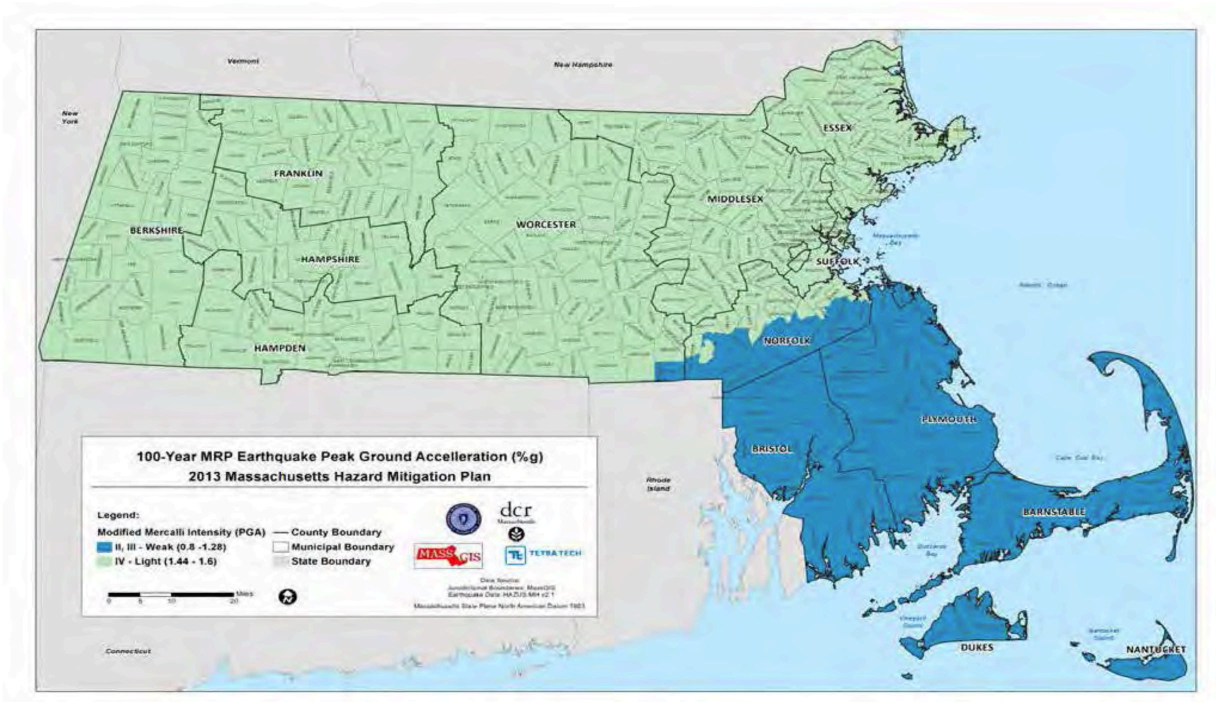
Mercalli Intensity	Description
I	Felt by very few people; barely noticeable.
II	Felt by few people, especially on upper floors.
III	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	Felt by many indoors, few outdoors. May feel like passing truck.

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). As shown in Figure 3.10.1. Berkshire County has a Mercalli Intensity of IV for a 100-year event, which is described as being light and as described in Table 3.10.2. as “felt my many indoors, few outdoors; may feel like passing truck.”

According to MEMA’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.

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



Source: MEMA 2013

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. This article was written after earthquakes were felt in the Boston area in 2011 and 2012.[1]

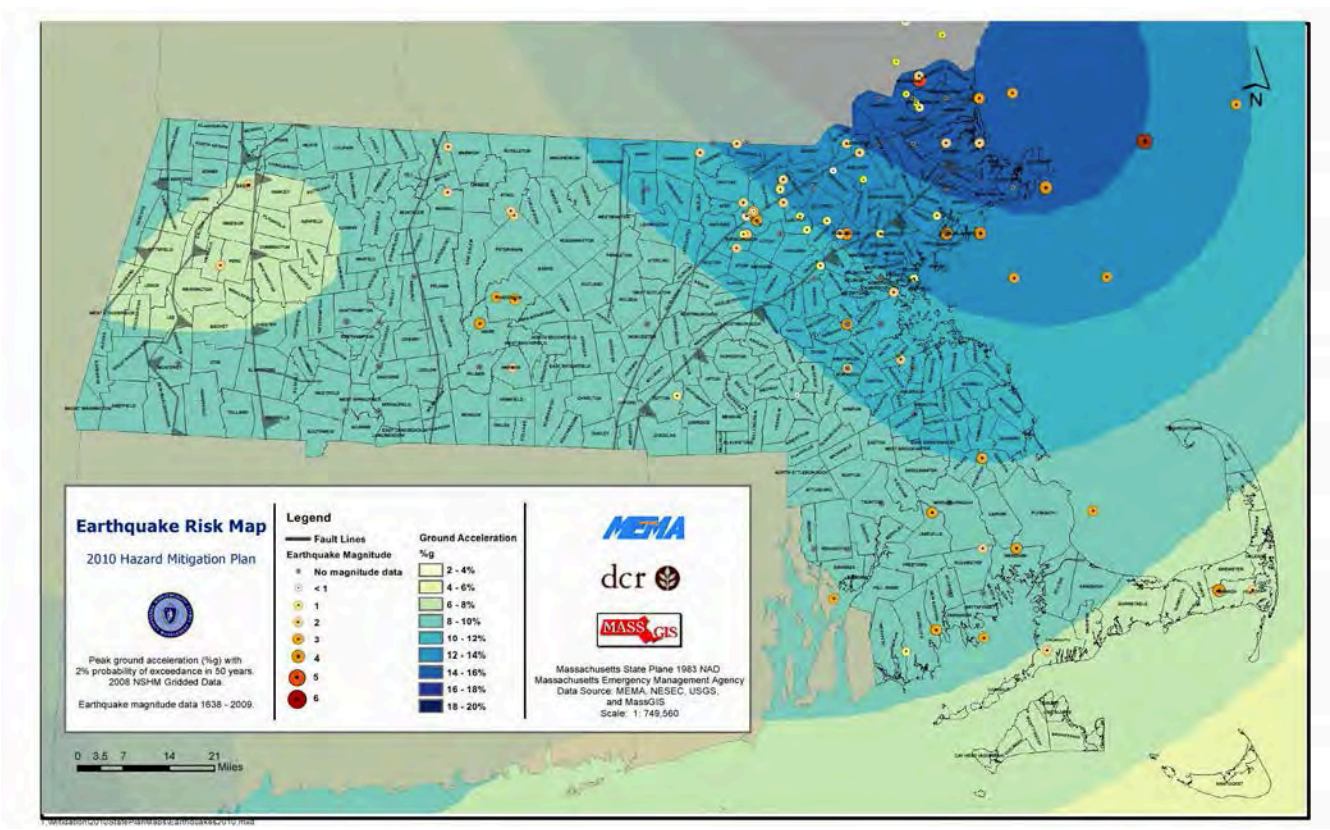
The largest earthquake since 1900 to strike Massachusetts was a magnitude 3.9 on the Richter Scale located east of the Quabbin Reservoir in 1994. According to the USGS, there have been two recent earthquakes with epicenters close to the Berkshires. A magnitude 3.3 on the Richter scale struck the area 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

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

Hazards Program 2017) Most recently a 2.2 magnitude earthquake struck in Gardner, MA in December 2018.

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 only 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.

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. 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 of 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, and 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 earthquakes 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 hazard 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 for earthquakes. (MEMA, 2013) Damaged 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. 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

The entire town of Hinsdale is 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 for the 100-year mean return period (MRP) events. The HAZUS -MH model was used to estimate potential losses due 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 with a magnitude 5.0 earthquake. This model estimates the total economic loss associated with each earthquake scenario, which includes building and lifeline-related losses (transportation and utility losses) based on the available inventory.

Population

The entire population of Hinsdale 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 for the 100-year event, three residential buildings could incur slight damage and no buildings would incur moderate or extensive damage. No injuries or casualties are estimated and no sheltering would be needed. The model does not indicate where in the Town the damages would occur – the model only provides a broad estimate.

Critical Facilities

All critical facilities in the planning area are exposed to the earthquake hazard. Earthquake 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. Loss of electricity, water and sewer service can impact human health and impede emergency communications and response. 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 an adjacent waterway. (MEMA, 2013)

Based on the HAZUS analysis for the community, it is expected that there will be no damages associated with critical municipal facilities, transportation routes or utilities in Hinsdale.

Economy

Direct building losses are the estimated costs to repair or replace the damage caused to the building. HAZUS-MH estimates that three buildings may sustain slight damage and one building might sustain moderate damage during the computed earthquake event. HAZUS-MH estimated that Hinsdale would experience $30,000 in total building related economic losses across the Town, and 30 % of the estimated losses would be related to the business interruption of the region. The model doesn't state where in the Town the losses would occur.

Table 3.10.3. HAZUS-MH 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**	**0.01**
Capital Stock						
Structural	0.00	0.00	0.01	0.00	0.00	0.01
Non-Structural	0.01	0.00	0.01	0.00	0.00	0.01
Content	0.00	0.00	0.00	0.00	0.00	0.01
Inventory	0.00	0.00	0.00	0.00	0.00	0.00
Subtotal *	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**
Total *	**0.01**	**0.00**	**0.01**	**0.00**	**0.00**	**0.03**

**Totals may not seem to add up due to rounding*
Source: HAZUS-MH 2017.

3.10.4. Existing Protections

- The Town of Hinsdale adheres to the Massachusetts Building Code.

3.10.5. Actions

- Continue strict enforcement of the Massachusetts Building Code.

SECTION 4. MITIGATION STRATEGIES AND ACTIONS

4.1. Major Findings

During the planning process several major findings of risk surfaced. A summary of the Major Findings for the Town of Hinsdale are as follows:

Ongoing Flood-related Concerns

Chronic flooding of particular areas of Hinsdale remains an ongoing concern. The Hinsdale Flats wetland complex is a natural asset that helps to absorb flood waters that flow down low order, steeply-sloped streams from the eastern and western hillsides during spring melt and severe storm events. Being located just upstream of the Town Center, this wetland complex helps to temper floodwaters of the Housatonic River. However, beaver activity is pervasive throughout the wetlands, damming stream channels and blocking culverts and bridges, resulting in flooding of uplands, roadways and the railroad tracks. Areas of particular concern where flooding is directly linked to beaver activity are along Middlefield Road (Skyline Trail) Buttermilk Road, where lands once dry and used for hay and pasturing are now inundated year-round. The current redesign and reconstruction of Middlefield Road is the perfect opportunity to incorporate hazard mitigation design, which could include raising the level of the road through low-lying areas, installing larger culverts to allow more water flow, and installing beaver-mitigation technologies such as beaver deceivers at new culvert crossings. As of March 2019 the project is in the 25% design stage, a time where local officials and share their concerns and knowledge of the area's hydrology to ensure flood mitigation techniques. The flooding of the railroad tracks from the Town Center to Muddy Pond are also a concern, where flooding of the tracks increases the potential of a derailment. Increasing flooding and high groundwater levels at a section of Plunkett Reservoir Road and at the old landfill / transfer station property are also linked to beaver activity.

Gaining permission to trap and remove beavers at any given site is time consuming and costly and achieves only a short-term solution. Because beavers are so abundant throughout the area, new populations soon replace the beavers that were removed. A long-term beaver management plan, developed in coordination with the Division of Fisheries and Wildlife, is needed to manage the beaver population throughout the Town. Strategically conducting a beaver removal program, coupled with installing beaver deceivers in key stream channels and water levelers in dams throughout the wetland could lead to improved conditions.

There are also areas of Hinsdale were flooding is not related to beaver activity, but rather to severe storm events. Stream bank erosion along Bennett Brook, where it runs alongside a section of Middlefield Road, threatens the integrity of the road bed. Flooding occurs on Old Dalton Road during period of high stream flow during spring melt and severe storms, due to factors that include higher stream flows in recent years and outdated culverts. The Town is applying again for a MassWorks grant to reconstruct the road and incorporate flood mitigation techniques.

Risks from CSX Railroad

Local officials believe that almost 220,000 freight cars travel through Hinsdale and Dalton annually, with more than 40% of those carrying hazardous materials, include more than two billion gallons of ethanol.[1]

[1] *Personal communication from Dalton Police Chief Coe, 2017.*

Flooding and/or freezing of the tracks due to deferred maintenance of culverts and beaver activity increase the risk of train derailments and accidents. As the tracks travel through the Town Center of Hinsdale, and less than 1,000 feet of the elementary school and the cluster of municipal critical facilities (Town Hall/Emergency Operations Center, Fire Station, Public Works facility), the risk of a hazardous materials spill is an ongoing concern, particularly for those chemicals that would emit toxic air plumes or fiery explosions. In the summer months, the tracks are a half mile from two summer camps. South of the Town Center, the tracks travel through the heart of the ecologically sensitive Hinsdale Flats Wildlife Management Area. Accessibility to the tracks is limited due to the surrounding wetlands, so hazardous materials spills are an ongoing concern.

Natural hazards and disasters increase the risk of train accidents due to a variety of factors, including flooding of the tracks due to severe storms and/or beaver activity. The increase in the number and severity of flood events due to climate change makes accidents even more of a concern. Risk of fire along the tracks has always been a concern during maintenance operations conducted by CSX. Sparks are created and fly outward during grinding of the tracks and can start fires if the sparks land on dry vegetation along the rail corridor. Dry and dead vegetation often exist along the corridor due to vegetation control conducted by the railroad, and with projected increases in temperature and potential decreases in soil moisture due to climate change, First Responders will need to be ever more vigilant. Limited access to many sections of the railroad track could increase response time and effectiveness.

Due to the pressing requests of first responders in the Central Berkshire REPC, the railroad has in recent years sponsored emergency response exercises. An increase in emergency response drills under various hazardous materials or fire scenarios for the Dalton/Hinsdale corridor should be considered, especially given the close proximity of the railroad tracks to schools, critical facilities and vulnerable populations.

Potential Flooding from Dam Failures

There are eight dams located in the Town, five of which are High Hazard dams that could inundate and inflict damage to areas of Hinsdale. Proper dam maintenance and operations are key to reducing risk of dam failure and damages. According to data issued by the U.S. Army Corps of Engineers, which is based on information kept by the Massachusetts Office of Dam Safety, all the High Hazard dams have been inspected recently and Emergency Action Plans (EAPs) have been drafted. Many of the dams have had repairs done in the last several years, some after many years of deferred maintenance. Fortunately, the repairs have resulted in higher safety condition ratings. While these efforts are welcome, not all dam owners regularly share EAPs and/or regular updates with local emergency management directors within the areas of inundation, leaving first responder volunteers to petition dam owners for updated information.

Floodplain Mapping in Town Center

The FIRM floodplain maps indicate that Hinsdale's Town Center and critical facilities are just outside the floodplain of the East Branch Housatonic River. These maps were created in 1981, and given the changing weather patterns and the projected increase in the number and severity of precipitation events, the delineations of the FIRM map may not accurately depict floodplain boundaries in 2019. Concerns are not only for Town facilities such as the Town Hall, School, DPW and Fire Station, but also for the Verizon Phone Exchange building and for private residences and businesses located along the river.

4.2. Goals and Actions

The Draft Goal and Actions within this Plan were developed as local vulnerabilities were being identified and concerns were being raised by the Hinsdale Hazard Mitigation Advisory Committee and input was received by local residents. The Advisory Committee adopted the following goal, based on the regional goal from the *Berkshire Regional Natural Hazard Mitigation Plan* of 2012 that was deemed to still be valid.

Overall Goal:

Reduce the loss of life, property, and infrastructure, and environmental and cultural resources from disasters through a comprehensive mitigation program that includes planning, prevention, adaption and preparedness strategies.

Action Categories to meet the Goal and address the Major Findings

Previous Actions described in the expired Plan of 2012 focused around two main categories: 1) those that involve hazard mitigation activities as defined by FEMA, and 2) those that involve improved emergency preparedness. The Hinsdale Hazard Mitigation Advisory Committee agreed that those two categories were still valid in 2019, and as such the Action Table reflects this strategy.

4.3. Local Capability Assessment

In addition to gathering data and information from the Hinsdale Hazard Mitigation Advisory Committee, interviews were held with key stakeholders to discuss current capabilities of the Town to address natural hazards in Hinsdale. Interviews were held with the Hinsdale Town Administrator, Hinsdale Fire Department, Hinsdale Water and Sewer Department, Hinsdale Public Works, and the Central Berkshire Regional School District (elementary school located in Hinsdale). Input was sought through direct meetings with the Hinsdale Selectboard and Planning Board. Risk assessment, strengths and weaknesses were discussed frankly and incorporated into this hazard mitigation plan to identify and prioritize existing protections and future actions. The existing protections have been described throughout the Risk Assessment sections of this plan. Additional findings on local capabilities are described herein.

Capability Self-Evaluation

As part of this Plan Update, the Town of Hinsdale conducted a self-evaluation of its hazard mitigation capabilities, reviewing its existing policies, programs, permitting and resources to monitor or reduce natural hazard impacts. As part of this effort key Town staff filled out the Capability Assessment Worksheet developed by FEMA and found in the *Local Mitigation Planning Handbook.* (FEMA, 2013)

- <u>Planning and Regulatory:</u> The Town has few formal planning documents, but those that are in place are fairly new. In 2017 the Town completed its Vision Plan for Hinsdale. Although not a comprehensive master planning document, it lays a foundation upon which a future and more comprehensive planning process can build. In 2018 the Town updated its state-approved Open Space and Recreation Plan, a plan documenting the Town's natural resources and offering recommendations to protect and enhance those resources. The importance of the Hinsdale Flats ecosystem is noted within this plan. Since the expired Hazard Mitigation Plan of 2012, the Town has adopted its Floodplain Overlay District, based in the 1981 FIRM delineation. Zoning bylaws regulate large development projects and subdivisions.

- Administrative and Technical: Like other rural towns in the region, day to day operations are run by a core team of full-time staff, supported by many part-time staff. A full-time Town Administrator position has been created, improving the overall administrative operations of the Town and increasing grant writing capabilities. The Public Works Department has taken great strides in monitoring and undertaking maintenance of the road system, proactively maintaining drainage systems that has resulted in less flood damages town-wide.

  General planning assistance has traditionally been provided by the Berkshire Regional Planning Commission (BRPC), including bylaw adoption and plan development. BRPC most recently provided assistance to the Town during the update of this hazard mitigation plan and with development of the *Vision Plan for Hinsdale*, *Hinsdale OSRP*, and in achieving its state-designation as a Green Community. Technical hazard mitigation planning, data assessment, such as GIS modeling and HAZUS analysis, will likely continue to be conducted when needed by the BRPC. The Town is served by strong and active Mutual Aid Agreements for emergency response. The Town has adopted and promoted resident use of the CodeRed emergency communications system.

- Financial: The Town of Hinsdale struggles to finance large capital projects, due in part to the low year-round population that precludes it from applying to many grant programs. The Town develops and maintains a five-year capital improvement plan. The Hinsdale Water Department has invested heavily to maintain an updated public water supply system and has installed a metering system to provide long-term financial sustainability. Metering also inherently encourages water conservation. The Town does not have an impact fee system for new development or a stormwater utility.

- Education and Outreach: Hinsdale first responders take advantage of local emergency planning efforts, most specifically actively participating in the Central Berkshire Regional Emergency Planning Committee (CBREPC), which serves Hinsdale and all of its neighboring towns. The CBREPC facilitates for its member communities emergency planning exercises and drills, operates a shared inventory of emergency response supplies, and develops and disseminates emergency preparedness planning for public officials and the general public. Additionally, emergency response and evacuation plans for the Kittredge Elementary School (part of the Central Berkshire Regional School District) are run jointly by the state police and Hinsdale Police Department. The Town has not formally developed natural disasters planning to the point of applying for StormReady or Firewise certification.

- Safe Growth Audit: The Town of Hinsdale has simple, straightforward zoning, due largely to its rural character and a history of few large development project proposals. The Floodplain Overlay District restricts and conditions development within the floodplain. There is no formal policy or program to restrict development in natural hazard zones, because the Towns Floodplain Overlay District, coupled with the Massachusetts Wetlands Protection Act, restrict development in floodplain and in or near wetland resources (which include waterbodies, streams, rivers, floodplains and wetlands). Additionally, an earth removal bylaw requires revegetation of large areas of soil disturbance. The Town adheres to the state building code. Plans for local and regional sheltering are in place.

Infrastructure Improvement Costs

The costs of maintaining, repairing and replacing aged or outdated infrastructure is often beyond the means of rural communities such as Hinsdale. Grant programs are highly competitive and often favor larger, more populated communities, forcing smaller towns to patch and make short-term or incomplete repairs where possible or otherwise defer improvement projects until funding is found. Loans, bonds and borrowing add financial strain to already tight budgets. The long deferment of redesigning and reconstructing Middlefield Road is a prime example, where the project cost for construction alone is approaching $7 million. Additional mitigation improvements such as increased culverts, improved drainage and elevation of the road to reduce flood risk could increase this cost.

Hinsdale Fire Department

The Hinsdale fire is relatively well equipped with fire response vehicles for a town of its size, due to aggressive pursuit of grants, use of Surplus Properties programs and creative mechanics and fabrication to adapt vehicles for emergency response uses. The Department is need of a new tanker truck to the place the existing one, which is a 1988 in-house fabricated tanker. The Department is expecting to submit a grant in 2019 for funds to replace the old one.

Mutual Aid Agreements and Coordination

In general, the first responder communities in the Berkshires coordinate and work well together during emergency situations. The Berkshire region is somewhat isolated due to the Berkshire and Taconic mountain ranges, and the population of the area is relatively small compared to the rest of the state. As a result, local first responders tend to know each other. Formal mutual aid agreements are held by both fire and police, and Hinsdale is an active member of the Central Berkshire REPC. Fire departments routinely exercise mutual aid, including responding to wildlife events. Additionally, emergency equipment and shelter supplies are stored on a regional basis and can be used by a community in the event they are needed; the Town of Hinsdale maintains an updated list of equipment and supplies available.

Decreasing Volunteerism

Local fire companies are still largely populated by volunteers. Many of the larger and mid-sized communities such as Dalton have a small core of paid staff, but the smaller surrounding towns like Hinsdale are still manned by volunteers. While some communities still have active ambulance/EMT volunteers, the trend seems to be moving away from local volunteers and towards full-time ambulance companies. Part of this trend is due to greater demands for EMT training and certification, which volunteers struggle to maintain, and part of it is the lack of volunteers to maintain full fire/EMT membership. The lack of volunteers is not unique to Berkshire County, and is due to a variety of social and population trends, among them:

- Increasing demands for trainings and certifications in both fire-fighting and ambulance services.
- The region's population is aging, increasing demands for emergency response. On top of an increase in demand, many volunteers are aging and retiring from their volunteer fire and ambulance positions.
- Family trends where two-income families are the norm, leaving less free time for volunteerism.
- Decreasing numbers of able-bodied adults in the town to fill in retirees. In the Berkshires this is more severe than other areas of the northeast, where the county's workforce is projected to decrease by another 25% by 2030.
- Trends where the able-bodied population is less interested in volunteer service. The volunteer rate dropped to 25% in 2014, the lowest since the government started issuing a report on volunteerism in 2002 (according to the U.S. Bureau of Labor Statistics). The greatest drops were in people with higher education degrees. (BRPC, 2016)

The Hinsdale Fire Department maintains a volunteer ambulance service. State regulations require dispatched ambulances to have two certified EMTs aboard, and if Hinsdale cannot get two EMTs to respond to a call, then another town or local ambulance company has to respond to the call, and the extra distance traveled from that other town or can delay response. The issue was highlighted on September 14, 2017 when ambulances in Pittsfield were already dispatched on calls and could not respond to an automobile accident in Pittsfield. Mutual aid was summoned from Dalton and Lenox. Delays in response in Pittsfield are sometimes caused by a high volume of calls, while in other times it is because ambulances serving the city are assisting other towns in the county. [2] As Chief Cahalan of Dalton recently stated, "we're all stealing from each other" to respond.[3] Efforts to reduce the state ambulance requirement to having one certified EMT on board, coupled with a driver that is a trained first responder, have been discussed as a possible solution. Hinsdale has been a leading voice in the effort to enact a "One EMT: law. Although over many years such laws have been drafted and presented to the state legislature, no law has emerged with the backing of both houses and the governor.

Efforts from the region are continuing to stress to State Legislators the importance of the One EMT requirement, an issue that has already been resolved positively in most other states. The impact is even more critical here because Hinsdale's Ambulance provides primary coverage to medical emergencies in the neighboring towns of Washington, Peru, and Middlefield, and is back up for Dalton, Becket, and the City of Pittsfield.

4.4. Prioritizing Actions

Although tornadoes have caused the most serious loss of life in Berkshire County in the last 50 years, their frequency, location and severity are unpredictable. Flooding remains the natural hazard of most concern, being the end result of several natural hazards, including heavy rains from severe thunderstorms and hurricanes, beaver activity, heavy snowfall/spring melt, and ice jams. Flooding can also occur due to dam failure or poor stormwater management. Flooding is a natural hazard that can reasonably be mitigated to some degree through proper land use and structural improvements. 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 dangerous. Therefore, it is appropriate that flooding remain a major focus in future mitigation planning and implementation.

The Hinsdale Hazard Mitigation Advisory Committee has developed and prioritized a list of actions based on the findings of this updated Plan. Priority Levels were determined using three general criteria: 1) the level of potential severity of the hazard/disaster event and its capacity to cause death or injury to people and damages to properties (including infrastructure): 2) the level of concern for the hazard/disaster, as voiced by local officials; and 3) practicality of implementing each particular action (including political and economic realities). Although cost and cost effectiveness were considered as part of criteria #3, including the potential for grant or loan funding, it was not a final determining factor.

[2] Drane, Amanda, 9-14-18. *Berkshire Eagle* article, "Crash highlights gaps in Pittsfield emergency services," Pittsfield MA.
[3] Drane, Amanda, 12-19-17. *Berkshire Eagle* article, "First responders, emergency personnel try to address growing gaps in ambulance services," Pittsfield MA.

Priority Levels were assigned as follows:

- High Priority: Actions that address hazards of greatest severity and concern in the Town, as voiced by the Hazard Mitigation Committee and residents, and which should begin to be implemented immediately or in the near future to avert or mitigate the impacts of future disasters.
- Medium Priority: Actions that address hazards of a lesser severity and concern, as voiced by the Hazard Mitigation Committee and residents, and which should be implemented as local capacity and funding becomes available.
- Lower Priority: Actions that address hazards of a lesser severity and concern, and should be monitored for opportunities for future implementation.

As part of prioritization, the Hinsdale Hazard Mitigation Advisory Committee estimated the potential cost of implementing each of the actions identified. Estimated costs were determined using internal estimates by department staff, incorporating past experience with implementation of similar projects in Town or in the Berkshire County region. Costs include soft costs (engineering design, permitting, etc.), hard costs (construction and materials), and where appropriate staff time (including construction activities and project administration). Costs listed would be expected to be borne by responsible parties. Detailed and current estimates were not generally available, so costs are summarized within the following ranges:

- High – over $100,000
- Medium – between $50,000 – $100,000
- Low – less than $50,000
- None – none needed

4.5 Hinsdale Multi-Hazard Mitigation Actions

The Town of Hinsdale is pleased that several actions listed in the expired 2012 Plan have been acted upon, with some having been completed and others begun and in progress. The Town has completed these Actions since 2012:

- Replaced Cady Brook Bridge.
- Adopted a Floodplain Zoning Bylaw.
- Developed a packet of information for potential building projects in the floodplain; the packet is distributed by the building inspector.
- Acquired Emergency Action Plans and Inundation Maps for most High Hazard Dams that impact Hinsdale.
- Successfully petitioned to list Middlefield Road (Skyline Trail) in the Berkshire County Transportation Improvement Plan for full redesign and reconstruction, which will include improved stream and wetland crossings to reduce chronic flooding; construction scheduled for 2020/2021.
- Developed a communications plan with the Town of Dalton regarding emergency response in the event of flooding due to dam failure.
- Developed a Regional Shelter Plan in coordination with the Central Berkshire Regional Emergency Planning Committee.

To address additional Actions from the expired Plan, the Town has adopted policies to improve operations or undertaken these ongoing practices

- Keeping more detailed records of local natural hazard impacts or disasters; examples include keeping track of work conducted on Robinson Road, East Washington Road and Old Dalton Road
- Increased beaver management on Middlefield Road (Skyline Trail) in efforts to maintain flood-free conditions; beavers were trapped and dams breached, but a long-term beaver management plan involving the Hinsdale Flats is needed. This will need to be done in coordination with the Division of Fisheries and Wildlife to be effective.

The Actions listed in the Action Table are the culmination of the planning process undertaking by the Hinsdale Hazard Mitigation Advisory Committee. The original actions from the expired Plan, included in the *Berkshire County Hazard Mitigation Plan Addendum* are shown in regular text, with italicized text describing how the action has progressed in the intervening years. Actions that are in italics are new actions developed as part of this plan update in 2019.

The Critical Facilities Map that follows the Action Table illustrates the areas in Hinsdale that are of most concern regarding natural hazard risks and impacts. For example, the 100-year floodplain areas are shown in green and areas of most concern, including areas of chronic flooding, are shown in blue hatching. Areas determined to be more prone to wildfire, due to high recreational use along the Appalachian Trail, are shown in red hatching.

Table 4.5.1. Town of Hinsdale Action Table

Actions listed in regular font are from the Town's expired Hazard Mitigation Plan.
Actions listed in *italic font* are updates on past actions or new actions arising out of this Hazard Mitigation Plan Update.

1. Natural Hazard Mitigation Actions

Description of Action	Benefit	Responsible Parties	Timeframe / Priority	Resources / Funding	Estimated Cost	Status since 2012 or New Action
Incorporate flood hazard mitigation in Middlefield Road/Skyline Trail improvement project, working with MassDOT to design and install improved bridges, culverts and drainage.	*Reduce flood risk to road due to flooding, thus extending life of infrastructure; reduce road closures of key regional route.*	*Public Works, MassDOT*	*1-3 years / High*	*MassDOT, FEMA*	*High*	*New Action.*
Pursue funding for design and reconstruction of Old Dalton Rd.	*Reduce flood and closure risk of this transportation route.*	*Public Works*	*1-3 years / High*	*MassWorks, FEMA*	*High*	*New Action.*
Pursue funding for needed repairs to Plunkett Reservoir dam spillway.	*Reduce flood risk to people (particularly campers) and property inundation.*	*Town, Emergency Management*	*1-3 years / High*	*General Funds, MEMA, FEMA*	*Medium*	*New Action.*
Complete sewer I&I study and prioritize implementation projects.	*Improve efficiency and reduce risk of overwhelming or damaging system during storms.*	*Public Works*	*3-5 years / Medium*	*MassDEP, MassWorks*	*Low-Medium*	*New Action.*

Determine ability of Town buildings to withstand a variety of natural hazard events – *if buildings determined to be in 100-year floodplain, floodproof or elevate buildings to protect critical records and equipment.*	Ensure continuity of local governmental operations.	Emergency Management	3-5 years / Low	General Funds	Medium	No action taken; Town records could be at risk.
Evaluate potential increase in water infiltration into Belmont Reservoir gatehouse due to increased storms and soil saturation.	*Protect drinking water supply.*	*Public Works*	*2-4 years / Medium*	*General funds, MA DEP*	*Low*	*New Action.*
Keep more detailed record-keeping of local natural disasters and their impacts.	Ensure continuity of local and regional governmental operations.	Department Heads, Emergency Management	2-4 years / Medium	General Funds	None	Ongoing; record-keeping improved and new policies in place.
Apply for grants to mitigate damage to historic properties.	Protect the character and vitality of the downtown.	Historic Commission, MEMA	2-4 years / Medium	FEMA	Low	No action taken as funding has not been identified.
Incorporate new FEMA floodplain data and maps into existing and future planning efforts.	New FEMA maps would allow for a more accurate assessment of the flooding risks to people, property and infrastructure.	FEMA	Ongoing request / Medium	FEMA	Medium	No Action – FEMA is not prioritizing the region; when maps are available floodplain data will be reviewed and used for future planning.
Large beaver dams, where beaver control devices have not worked, will be breached in a controlled manner.	Mitigate the impacts of floods.	Public Works, Mass. Div. Fisheries & Wildlife (DFW)	Ongoing	Public Works	Low	Ongoing; beaver dams breached three times in recent years.

Investigate permanent measures to minimize beaver impacts – *approach MA Fish & Game to develop comprehensive beaver management plan for Hinsdale Flats area.*	Mitigate the impacts of floods.	Public Works, DFW	1-3 years / High	Public Works	*Low-Medium*	*Comprehensive Beaver Management Plan is New Action.*
Provide local residents with leaflets to landowners in hazard prone areas that discuss hazard mitigation.	Mitigate the impacts of floods.	Emergency Management, Public Works, MEMA	3-5 years / Low	FEMA pamphlets, General Funds for copy	Low	Emergency Preparedness brochures distributed to residents as part of this hazard mitigation plan update.
Monitor intersections / culverts for flooding; pursue improvements were needed.	Determine potential for redesign.	Public Works	2-4 years / Medium	Public Works	None; Low-High if find that improve-ments are needed	Ongoing – monitoring has increased and preventative work routine.
Incorporate hazard mitigation planning into future community plans (i.e. Master Plans, Open Space & Recreation Plans).	Ensure that the community reviews hazard mitigation for all municipal projects.	Town, Planning Board, Conservation Commission (Cons Com)	1-3 years / High	General Funds / State Funds	None-Low	Ongoing; beneficial role of wetland resources and climate change considered during update of the Hinsdale Open Space and Recreation Plan.

Establish an education program for land owners on the benefits of having a forest management plan for hazard reduction through a working group of municipal, state and large private land owners.	Properly managed forest will help mitigate hazards by reducing runoff, reducing wildfire risk.	Town, Select Board, DCR, Private Land Owners	3-5 year / Low	General Funds/ DCR / Private Funding	Low	No action taken.
Distribute educational material to residents on hazards of highest concern in town and how to mitigate them for existing and new construction.	Help residents to prepare for disasters, and help them understand need for expensive structural mitigation activities.	Town, Emergency Management	3-5 years / Low	General Funds / Free material	None	Completed; new development packet distributed by building inspector; new floodplain bylaw enforced.
Join the CRS.	Allow homeowners to reduce their insurance while better preparing the town for hazards and reducing risks.	Town, Emergency Management	3-5 years / Low	General Funds	None-Low	No action taken.
Review any infrastructure expansion proposals in hazard-prone areas; town will not allow proposals if additional flooding is deemed likely.	Mitigate the impacts of floods.	Public Works, Planning Board, Cons Com	Ongoing / 5 years	General Funds	None	Ongoing; floodplain bylaw and state Wetlands Protection Act enforced.
Develop an emergency response and flood mitigation plans with the CSX railroad.	Minimize loss of life or injury.	Emergency management, CSX, MEMA	5-10 years / Low	General Funds	None-Low	Ongoing; table top exercise conducted by railroad and fire department.

Conduct flood mitigation activities as prescribed in the above-mentioned comprehensive mitigation plan with CSX.	Reduce runoff to mitigate the impacts of floods.	Emergency management, Public Works, CSX, MEMA	5-10 years / Low	FEMA	Low	No action taken as CSX has not developed plan.
Develop bylaws that require on-site containment of stormwater.	Reduce land disturbance and associated increase in runoff.	Town of Hinsdale, BRPC	3-5 years / Medium	NA	Low	No action taken.
Require low-impact development techniques for proposed developments, especially in flood-prone areas.	Reduce runoff and the flooding it may cause.	Planning Board	5-10 years / Low	General Funds	None	No action taken.

2. Emergency Preparedness Actions

Description of Action	Benefit	Responsible Parties	Timeframe / Priority	Resources / Funding	Estimated Cost	Status 2018
Pursue funding for new tanker truck.	*Improve fire response and support mutual aid.*	*Town, Fire Dept.*	*1-3 years / High*	*Grants, Town*	*High*	*New Action.*
Continue to push for "One EMT Law".	*Decrease ambulance response times.*	*Fire Dept, Town*	*1-3 years / High*	*None needed*	*None*	*New Action.*
Conduct local disaster response drills.	Mitigate the impact of all potential disaster.	Emergency Management, CBREPC	Ongoing	WRHSAC, REPC	None	Ongoing; Central Berk. REPC has conducted exercises with railroad.
Develop and publicize local and regional evacuation routes and shelter locations.	Mitigate the impact of all potential disaster responses that may involve	Emergency Management, Select Board, REPCs	2-4 years / Medium	General Funds	Low	In progress; regional shelter plan developed by CBREPC.

	sheltering.					
Develop formal and legally binding Mutual Aid Agreements for DPWs.	Improve inter-operability capacity & communication systems throughout the region.	Select Board, CBREPC, Western Reg. Homeland Security Council (WRHLSC), MEMA	Complete	WRHSAC	Low	Ongoing; informal sharing of resources but no formal MAA developed.
Add new towers where communication gaps exist.	Improve inter-operability and communication systems.	Fire/Police, WRHLSC, LEPCs	Complete	WRHSAC	Medium	New repeaters added by police; some remote gaps persist.
Increase local and regional emergency response training.	Increase response effectiveness.	Emergency Management, WRHLSC, LEPCs	Complete	WRHSAC, REPC	None-Low	The Town participates in the Central Berkshire REPC, which conducts ongoing trainings.
Teach local officials how to protect critical documents and materials.	Ensure continuity of local and regional governmental operations.	Emergency Management	5-10 yrs / Low	General Funds	None	No action taken.
Identify trees near power lines that need trimming; determine responsibility; trim the trees as needed.	Reduce the risk of power failure during storms.	Public Works / Utility Company	Ongoing / Medium	DPW Funds/ Utility Company	Low-Medium	Improved tree maintenance conducted by utility company; new Hinsdale Tree Warden proactive.

Remove debris from streams where flooding is an issue in collaboration with DEP.	Reduce damming and the flooding it may cause.	Public Works	5-10 yrs / Low	DPW Funds	None-Low	Improved coordination and monitoring; procedures for maintaining culverts and drainage have been written in coordination with the Conservation Commission.

SECTION 5. REFERENCES

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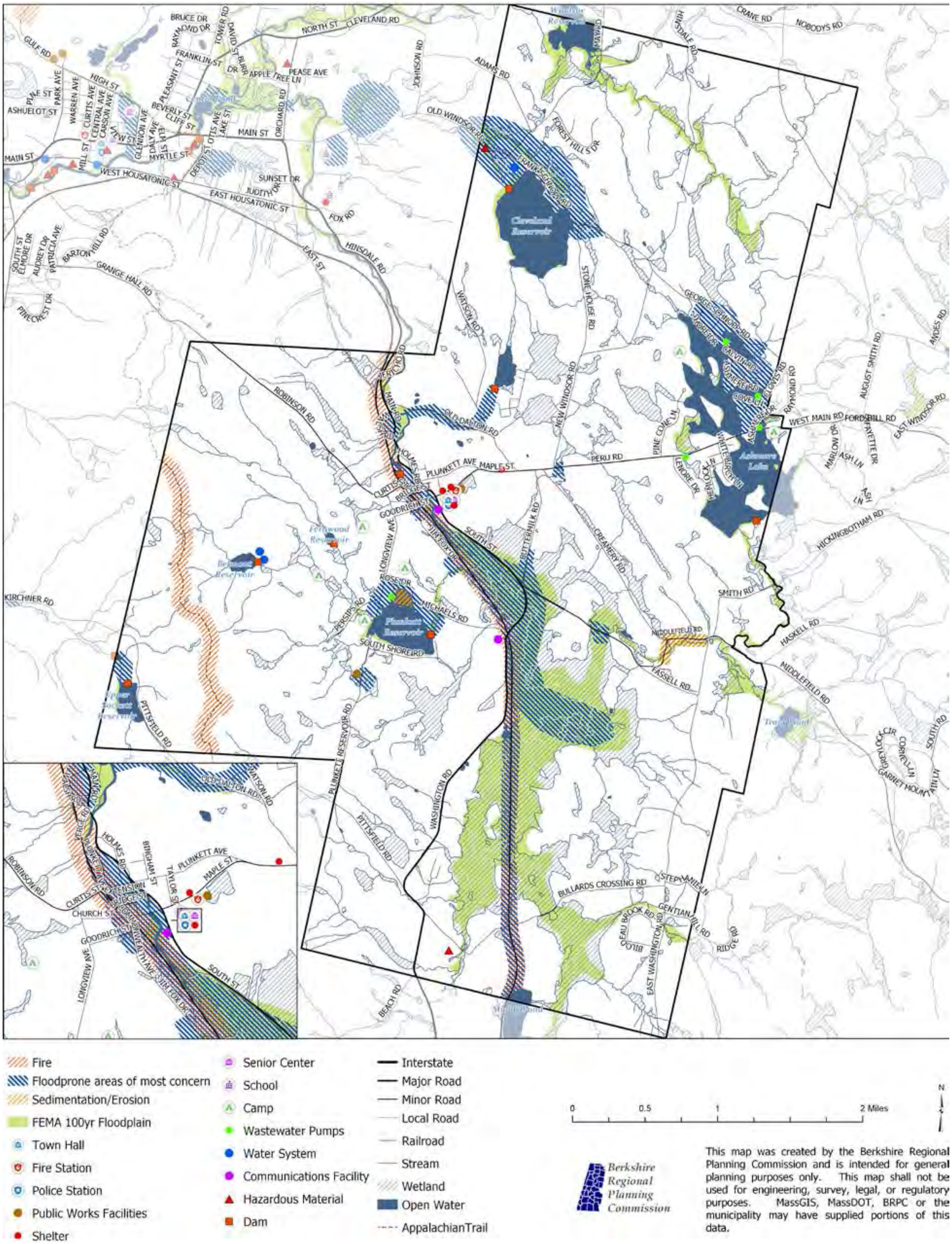
APPENDIX A
Critical Facilities and Areas of Concern Map

Hinsdale Hazard Mitigation Critical Facilities and Areas of Concern



APPENDIX B

HAZUS-MH Reports

Hazus-MH: Flood Global Risk Report

Region Name: Hinsdale

Flood Scenario: Full_100

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 22 square miles and contains 168 census blocks. The region contains over 1 thousand households and has a total population of 2,032 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 1,145 buildings in the region with a total building replacement value (excluding contents) of 278 million dollars (2010 dollars). Approximately 92.93% of the buildings (and 83.93% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,145 buildings in the region which have an aggregate total replacement value of 278 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	233,191	83.9%
Commercial	29,903	10.8%
Industrial	7,329	2.6%
Agricultural	1,943	0.7%
Religion	0	0.0%
Government	2,480	0.9%
Education	2,995	1.1%
Total	**277,841**	**100.0%**

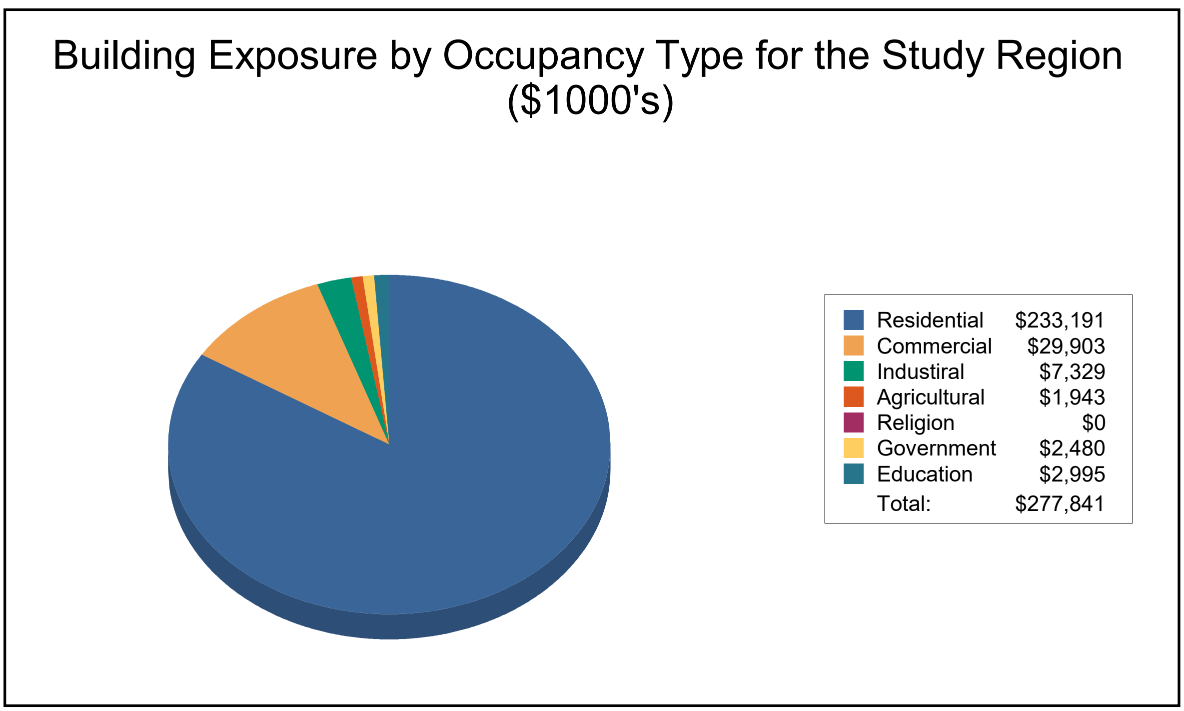
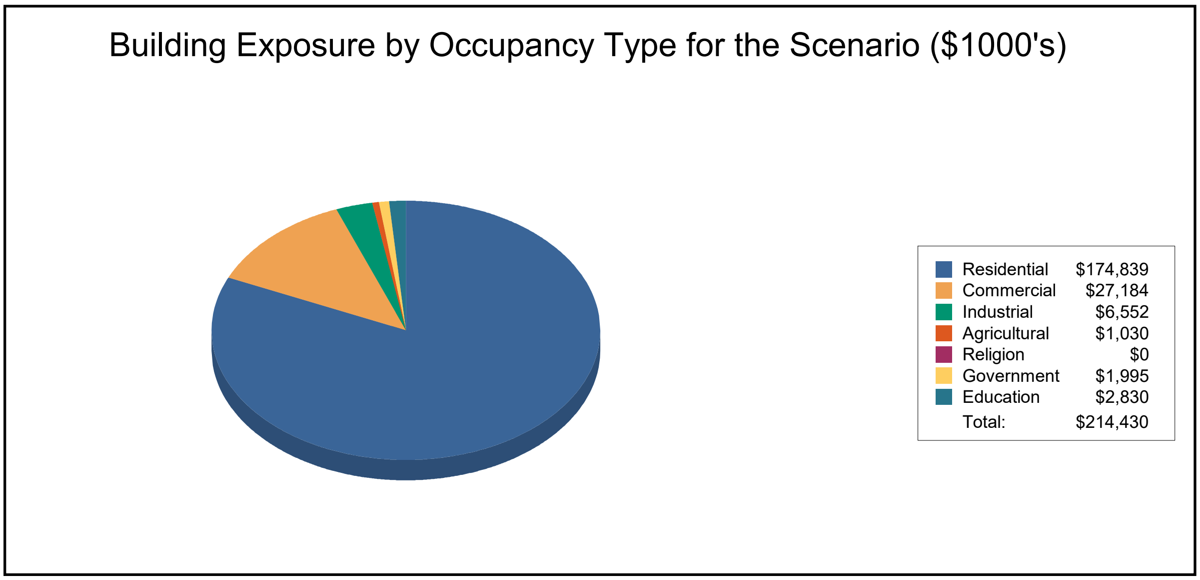


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	174,839	81.5%
Commercial	27,184	12.7%
Industrial	6,552	3.1%
Agricultural	1,030	0.5%
Religion	0	0.0%
Government	1,995	0.9%
Education	2,830	1.3%
Total	**214,430**	**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 1 school, no fire stations, 1 police station and no emergency operation centers.

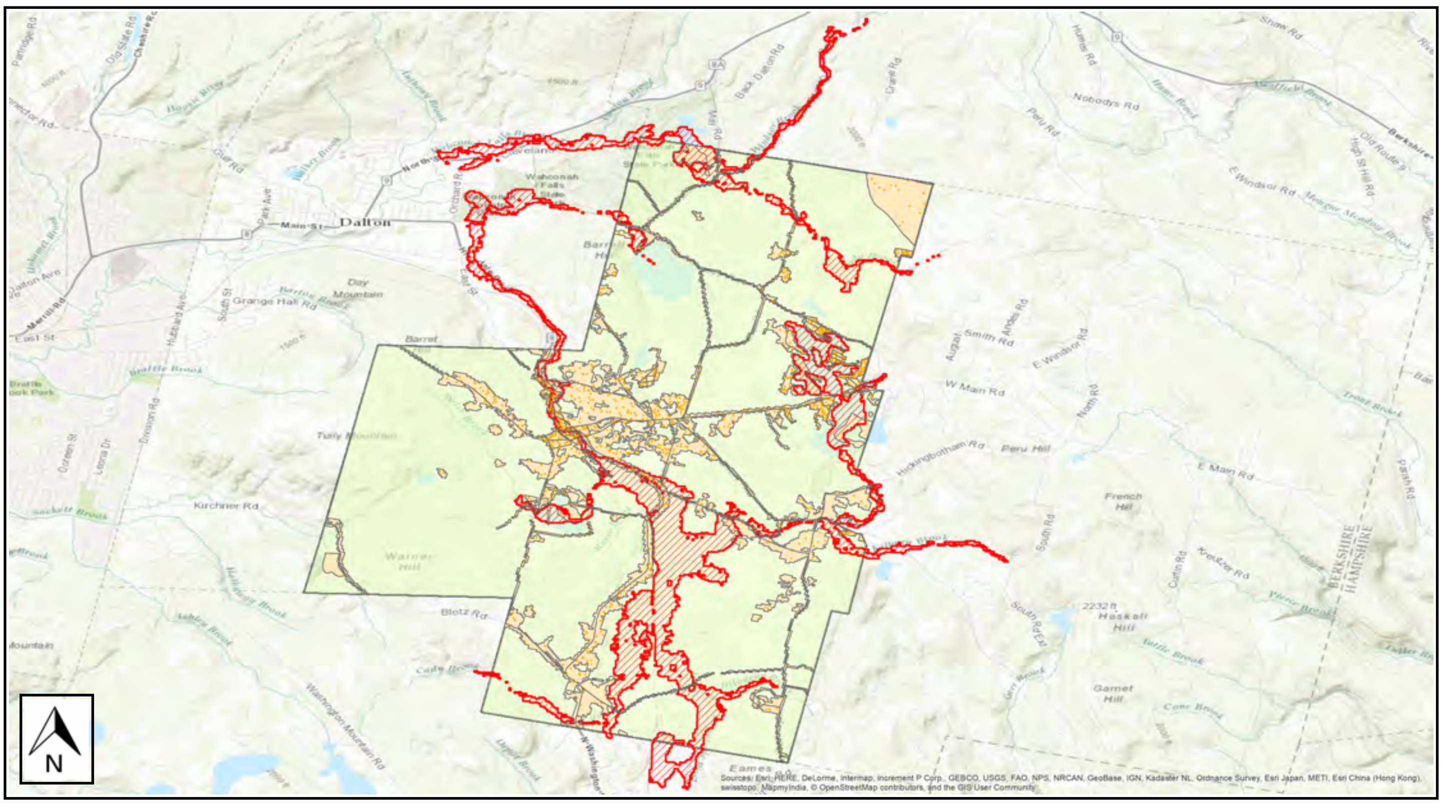
Flood Scenario Parameters

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

Study Region Name:	Hinsdale
Scenario Name:	Full_100
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



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Building Damage

General Building Stock Damage

Hazus estimates that about 5 buildings will be at least moderately damaged. This is over 100% 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

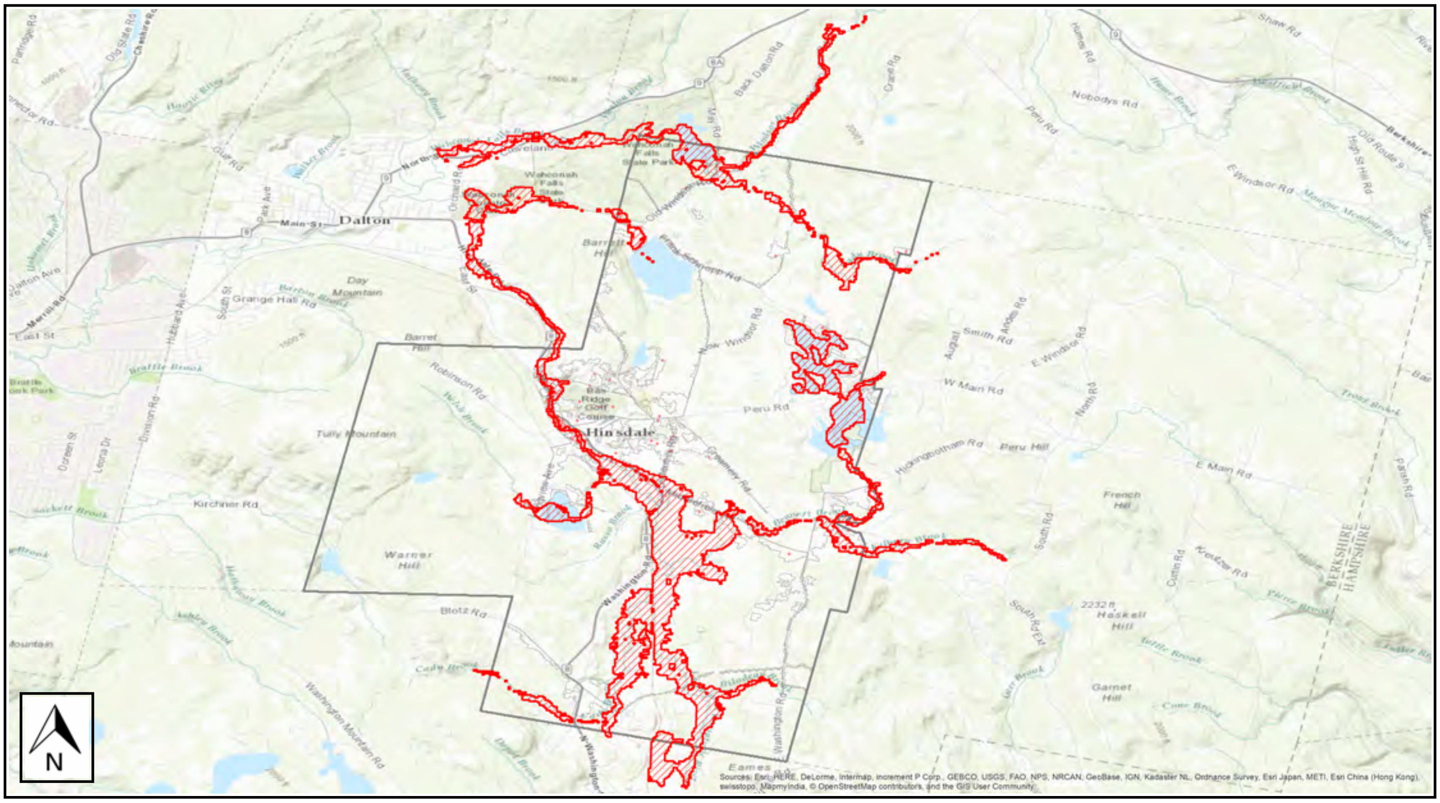

Table 3: Expected Building Damage by Occupancy

Occupancy	1-10 Count	1-10 (%)	11-20 Count	11-20 (%)	21-30 Count	21-30 (%)	31-40 Count	31-40 (%)	41-50 Count	41-50 (%)	Substantially Count	Substantially (%)
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	4	44.44	2	22.22	3	33.33	0	0.00	0	0.00	0	0.00
Total	**4**		**2**		**3**		**0**		**0**		**0**	

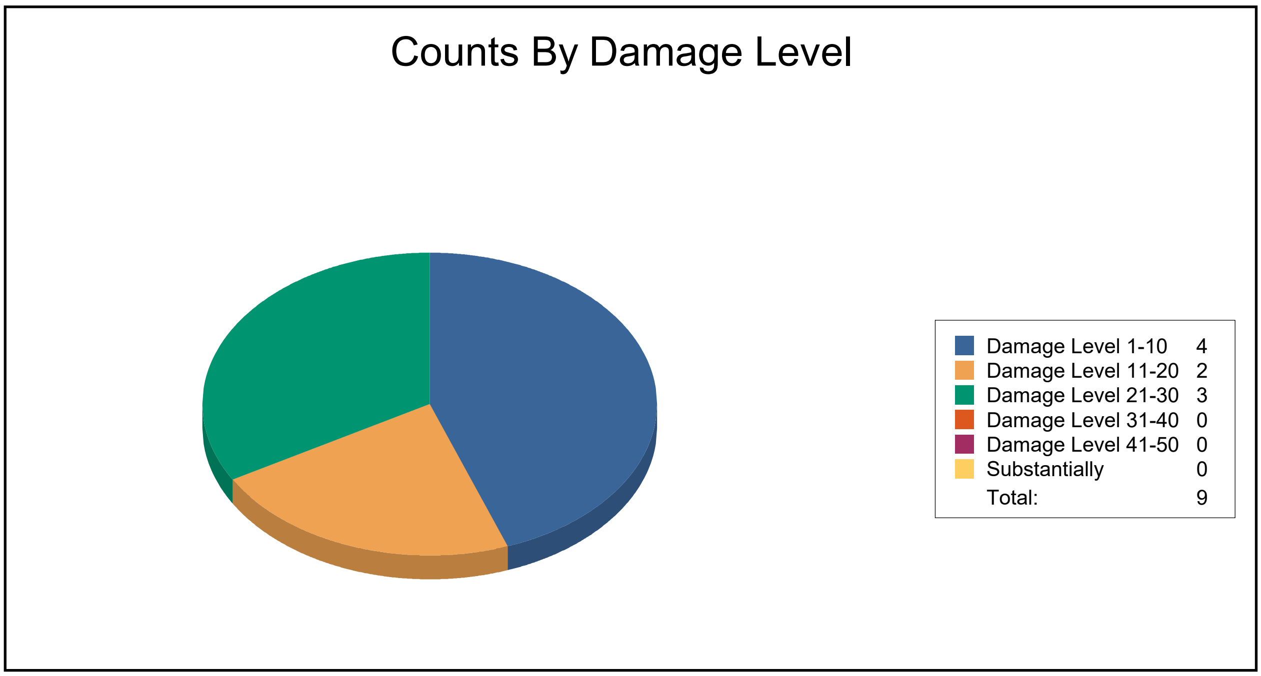

Table 4: Expected Building Damage by Building Type

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	4	44	2	22	3	33	0	0	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	0	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	1	0	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.

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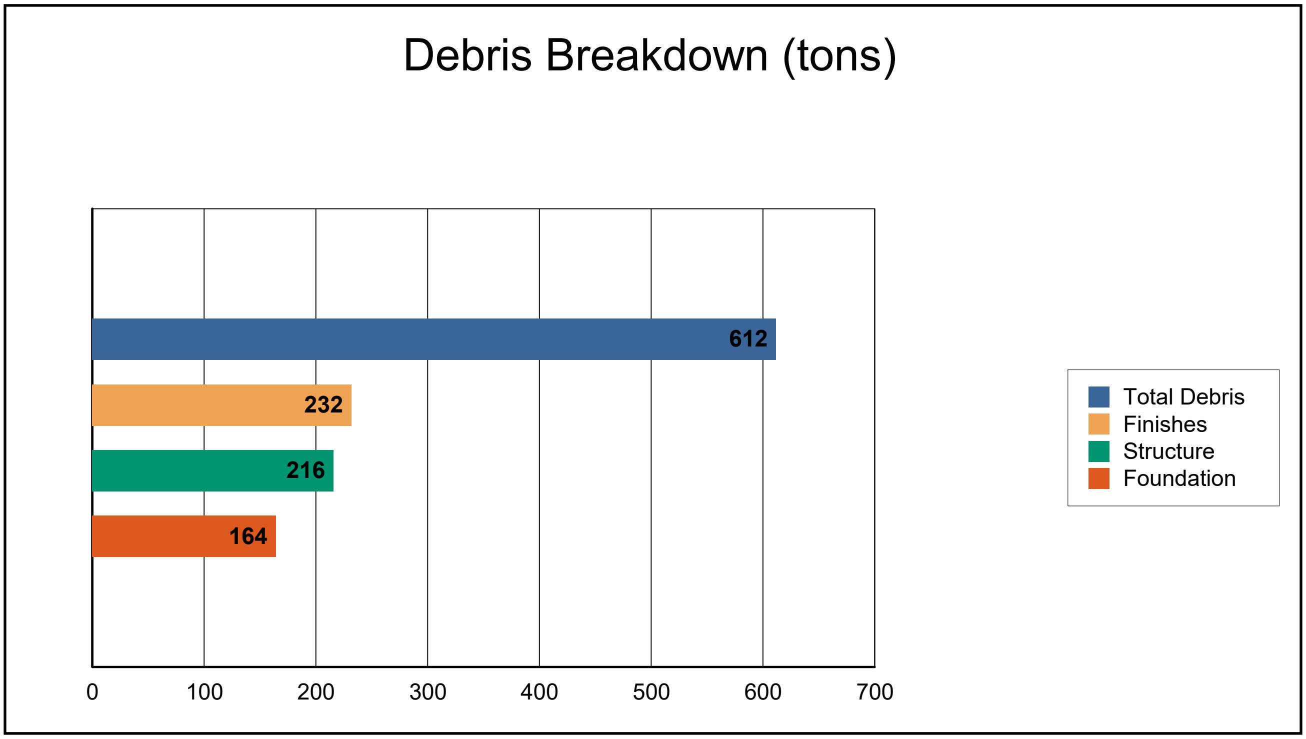
Induced Flood Damage

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.

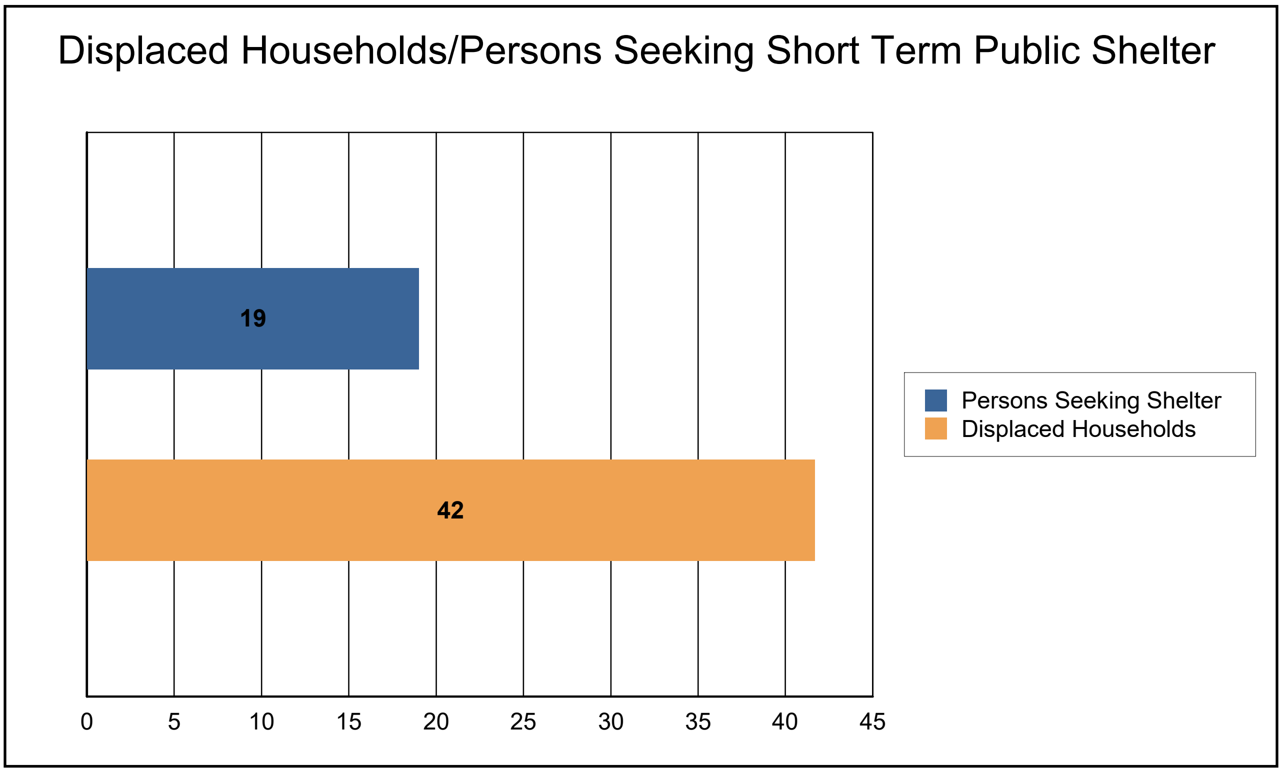


The model estimates that a total of 612 tons of debris will be generated. Of the total amount, Finishes comprises 38% of the total, Structure comprises 35% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 24 truckloads (@25 tons/truck) to remove 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 42 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 19 people (out of a total population of 2,032) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 5.99 million dollars, which represents 2.79 % 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 5.98 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 69.80% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

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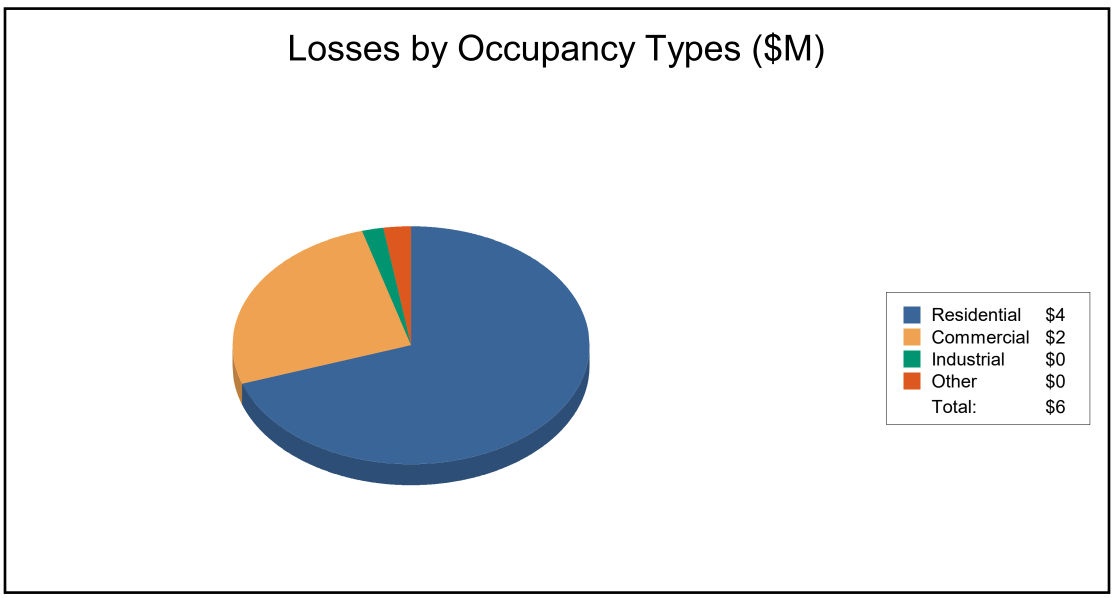
Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	2.84	0.40	0.05	0.02	3.31
	Content	1.34	1.09	0.08	0.12	2.62
	Inventory	0.00	0.05	0.01	0.00	0.05
	Subtotal	**4.18**	**1.53**	**0.13**	**0.14**	**5.98**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.01	0.01
	Subtotal	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**
ALL	**Total**	**4.18**	**1.53**	**0.13**	**0.14**	**5.99**



FEMA

RiskMAP
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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	2,032	233,191	44,650	277,841
Total	**2,032**	**233,191**	**44,650**	**277,841**
Total Study Region	**2,032**	**233,191**	**44,650**	**277,841**

Hazus-MH: Hurricane Global Risk Report

Region Name: Hinsdale

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 21.70 square miles and contains 1 census tracts. There are over 0 thousand households in the region and has a total population of 2,032 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 278 million dollars (2014 dollars). Approximately 93% of the buildings (and 84% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,145 buildings in the region which have an aggregate total replacement value of 278 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.

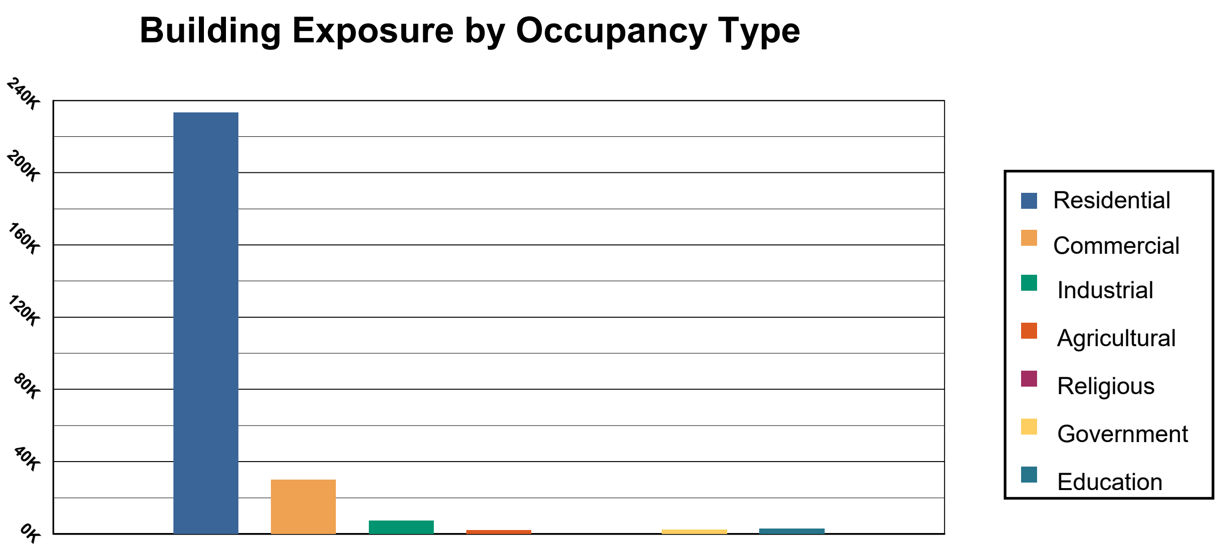


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	233,191	83.93%
Commercial	29,903	10.76%
Industrial	7,329	2.64%
Agricultural	1,943	0.70%
Religious	0	0.00%
Government	2,480	0.89%
Education	2,995	1.08%
Total	**277,841**	**100.00%**

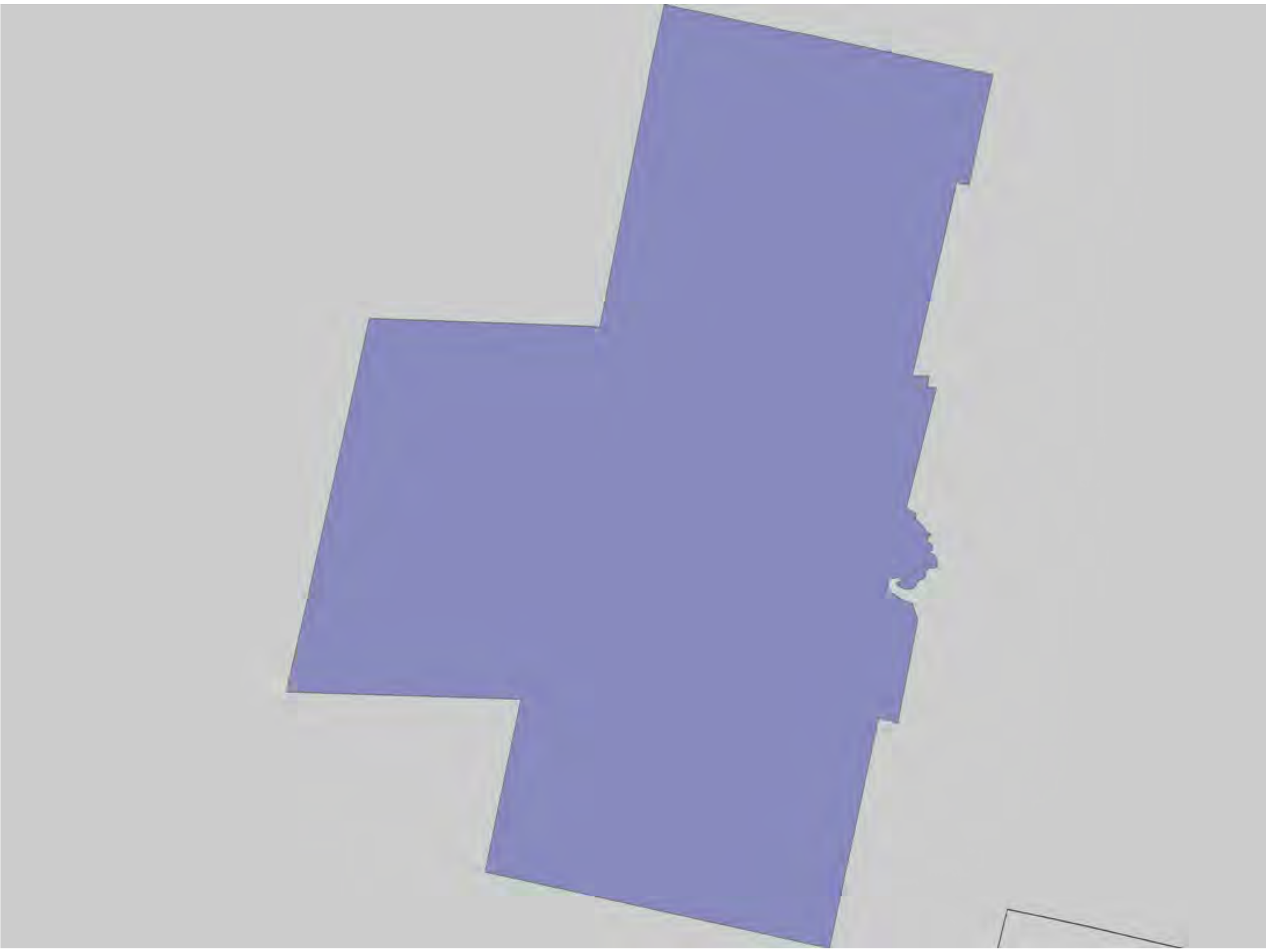
Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 1 schools, no 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.

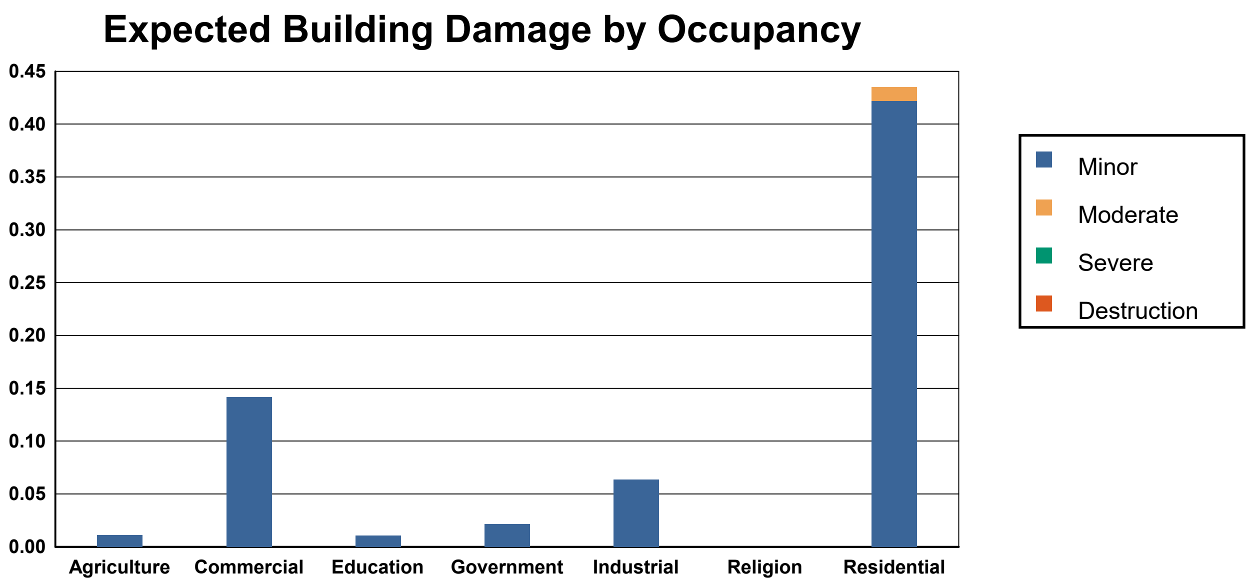


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	5	99.78	0	0.22	0	0.00	0	0.00	0	0.00
Commercial	48	99.71	0	0.29	0	0.00	0	0.00	0	0.00
Education	3	99.64	0	0.36	0	0.00	0	0.00	0	0.00
Government	6	99.64	0	0.36	0	0.00	0	0.00	0	0.00
Industrial	19	99.67	0	0.33	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
Residential	1,064	99.96	0	0.04	0	0.00	0	0.00	0	0.00
Total	**1,144**		**1**		**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	3	99.62	0	0.38	0	0.00	0	0.00	0	0.00
Masonry	36	99.66	0	0.33	0	0.01	0	0.00	0	0.00
MH	46	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	39	99.65	0	0.35	0	0.00	0	0.00	0	0.00
Wood	948	99.98	0	0.02	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.

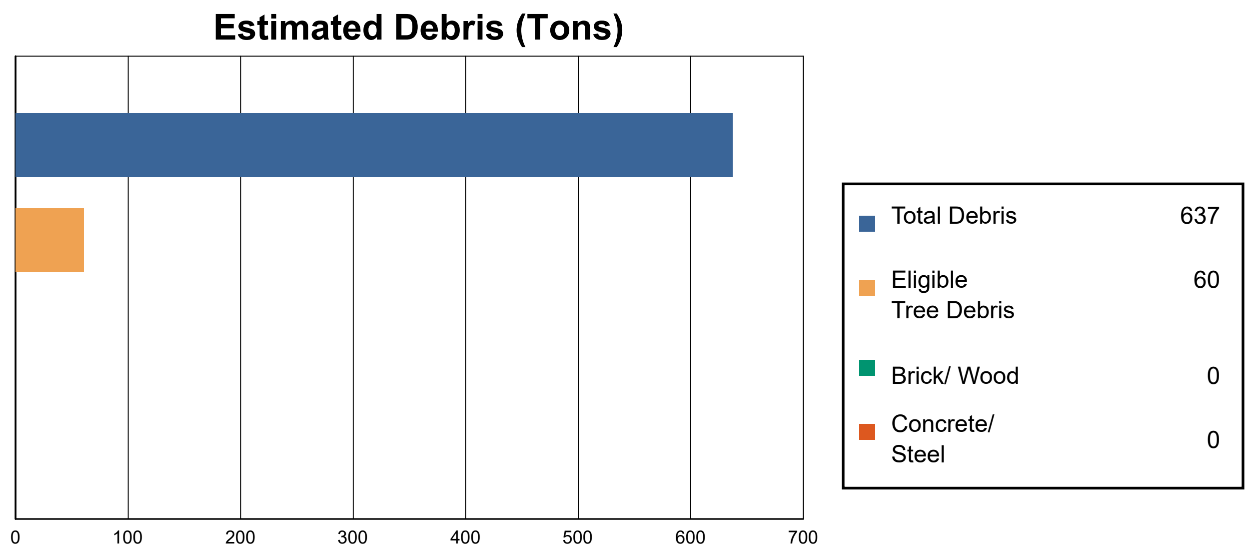
Thematic Map of Essential Facilities with greater than 50% moderate

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**
Police Stations	1	0	0	1
Schools	1	0	0	1

Induced Hurricane Damage

Debris Generation



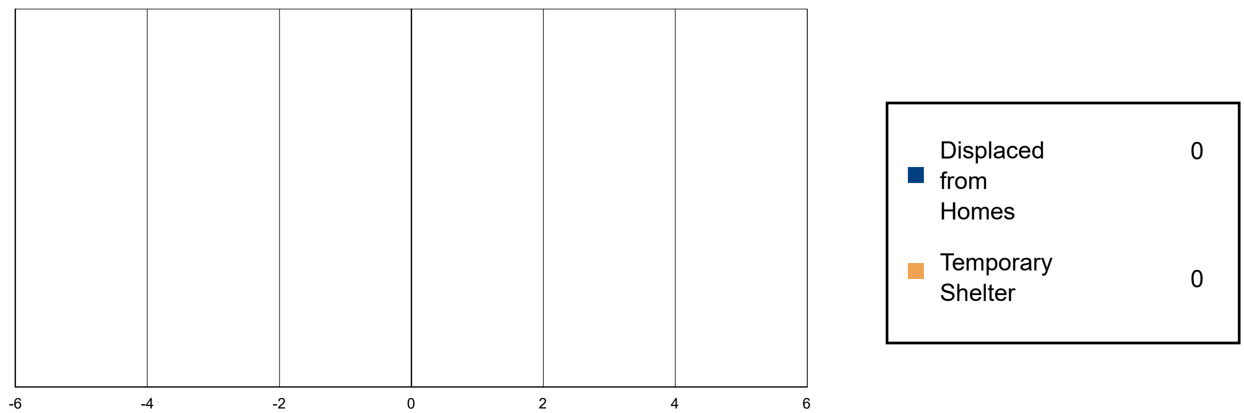
Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 637 tons of debris will be generated. Of the total amount, 577 tons (91%) is Other Tree Debris. Of the remaining 60 tons, Brick/Wood comprises 0% 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 60 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

Estimated Shelter Needs



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 2,032) will seek temporary shelter in public shelters.

Economic Loss

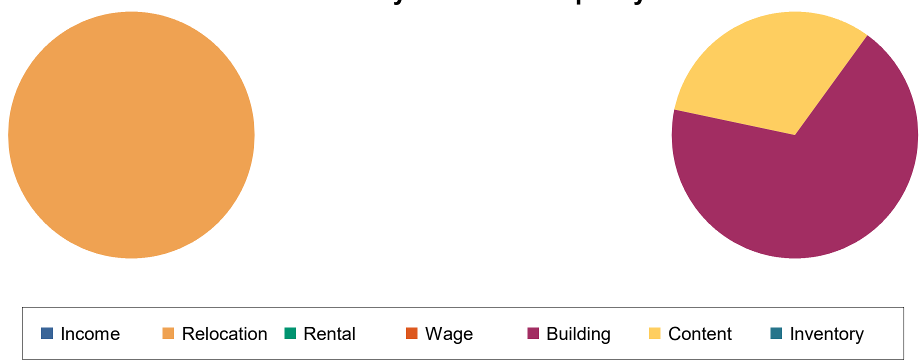
The total economic loss estimated for the hurricane is 0.2 million dollars, which represents 0.08 % of the total replacement value of the region’s buildings.

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. 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 98% 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

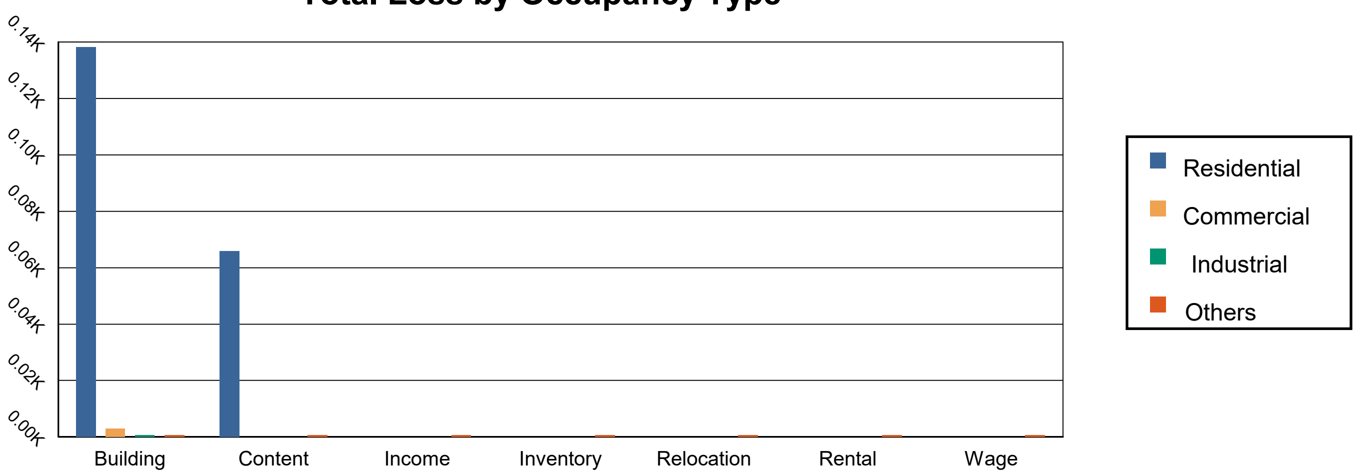


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	138.23	2.99	0.73	0.55	142.50
	Content	66.02	0.00	0.00	0.00	66.02
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**204.25**	**2.99**	**0.73**	**0.55**	**208.52**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.02	0.00	0.00	0.00	0.02
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.02**	**0.00**	**0.00**	**0.00**	**0.02**
Total						
	Total	**204.27**	**2.99**	**0.73**	**0.55**	**208.54**

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	2,032	233,191	44,650	277,841
Total	**2,032**	**233,191**	**44,650**	**277,841**
Study Region Total	**2,032**	**233,191**	**44,650**	**277,841**

Hazus-MH: Earthquake Global Risk Report

Region Name: Hinsdale

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 21.69 square miles and contains 1 census tracts. There are over 0 thousand households in the region which has a total population of 2,032 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 277 (millions of dollars). Approximately 93.00 % of the buildings (and 84.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 303 and 4 (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 277 (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 83% 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 1 schools, 0 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 307.00 (millions of dollars). This inventory includes over 44 kilometers of highways, 11 bridges, 232 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

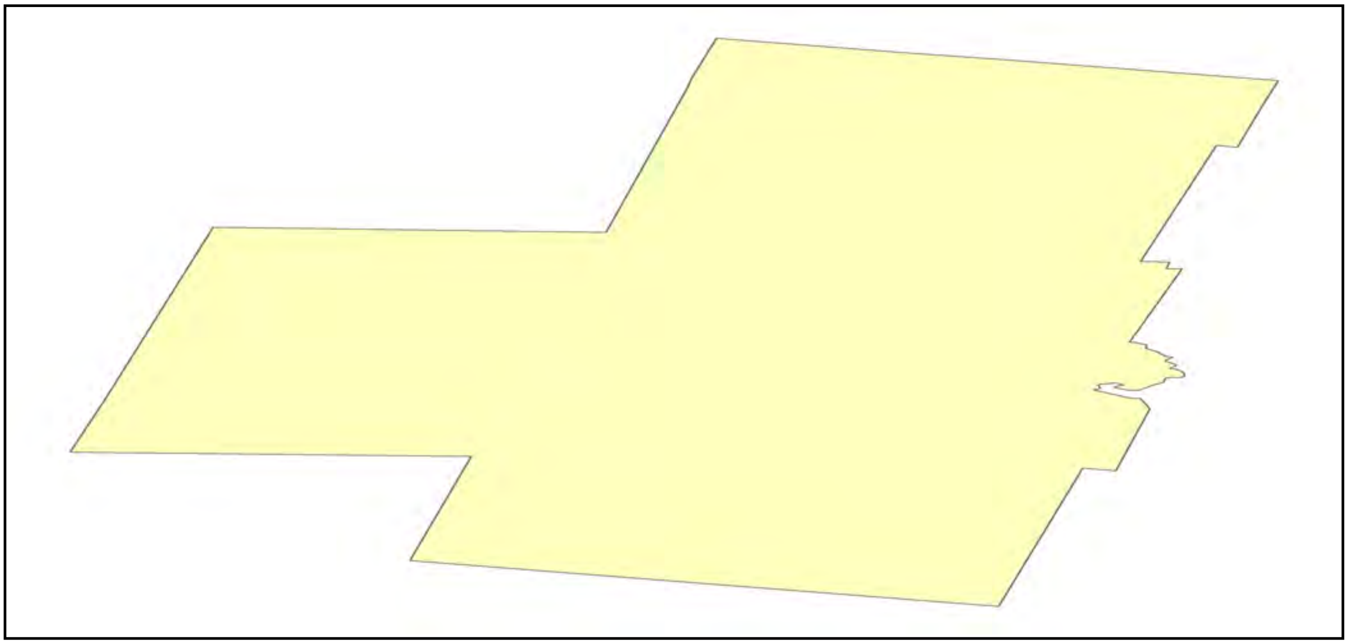
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	11	31.40
	Segments	5	250.00
	Tunnels	0	0.00
		Subtotal	**281.40**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	2	22.30
	Tunnels	0	0.00
		Subtotal	**22.30**
Light Rail	Bridges	0	0.00
	Facilities	0	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	**303.70**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2.30
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.30**
Waste Water	Distribution Lines	NA	1.40
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.40**
Natural Gas	Distribution Lines	NA	0.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.90**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**4.60**

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

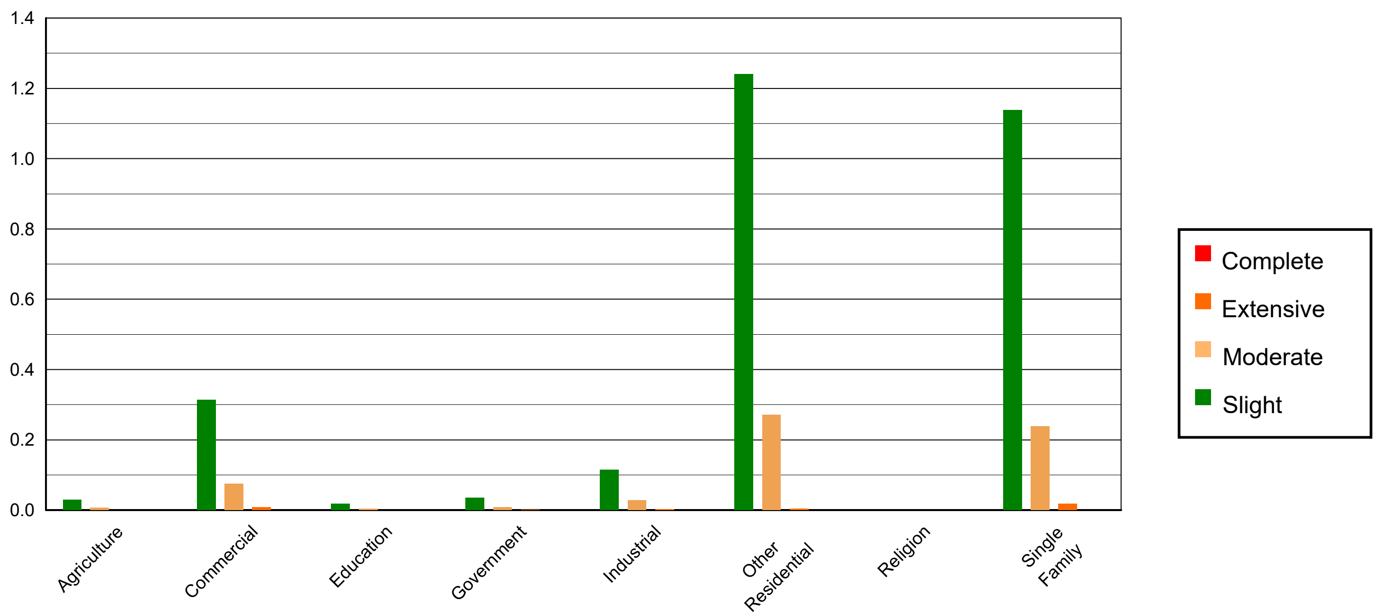


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	5	0.43	0	1.01	0	0.96	0	1.77	0	0.00
Commercial	48	4.17	0	10.82	0	11.94	0	22.36	0	0.00
Education	3	0.26	0	0.61	0	0.66	0	1.18	0	0.00
Government	6	0.52	0	1.24	0	1.32	0	2.27	0	0.00
Industrial	19	1.65	0	3.98	0	4.31	0	7.35	0	0.00
Other Residential	105	9.24	1	42.94	0	43.02	0	12.48	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	956	83.72	1	39.40	0	37.79	0	52.59	0	0.00
Total	**1,141**		**3**		**1**		**0**		**0**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	955	83.67	1	24.35	0	15.09	0	0.00	0	0.00
Steel	40	3.46	0	6.65	0	5.88	0	6.66	0	0.00
Concrete	7	0.60	0	0.97	0	0.72	0	0.05	0	0.00
Precast	3	0.23	0	0.92	0	1.75	0	3.77	0	0.00
RM	9	0.81	0	1.62	0	2.32	0	4.23	0	0.00
URM	60	5.30	1	27.75	0	37.66	0	85.29	0	0.00
MH	68	5.93	1	37.74	0	36.59	0	0.00	0	0.00
Total	**1,141**		**3**		**1**		**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

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

<u>Transportation Lifeline Damage</u>

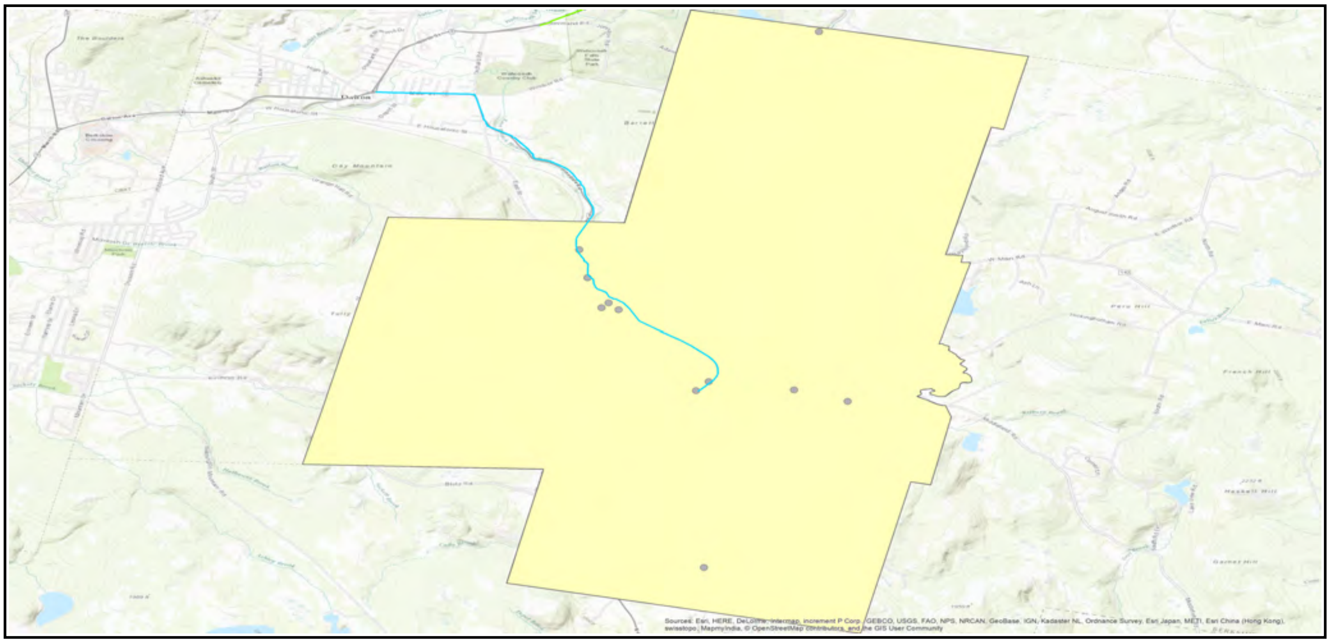


Table 6: Expected Damage to the Transportation Systems

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	5	0	0	3	3
	Bridges	11	0	0	11	11
	Tunnels	0	0	0	0	0
Railways	Segments	2	0	0	1	1
	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.

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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	0	0	0	0	0

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	116	0	0
Waste Water	70	0	0
Natural Gas	46	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	868	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 81.00% 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	0.00	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 2,032) 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

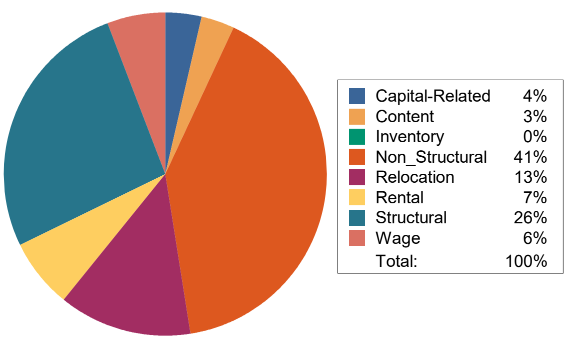
The total economic loss estimated for the earthquake is 0.03 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

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 0.03 (millions of dollars); 30 % 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 61 % 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)

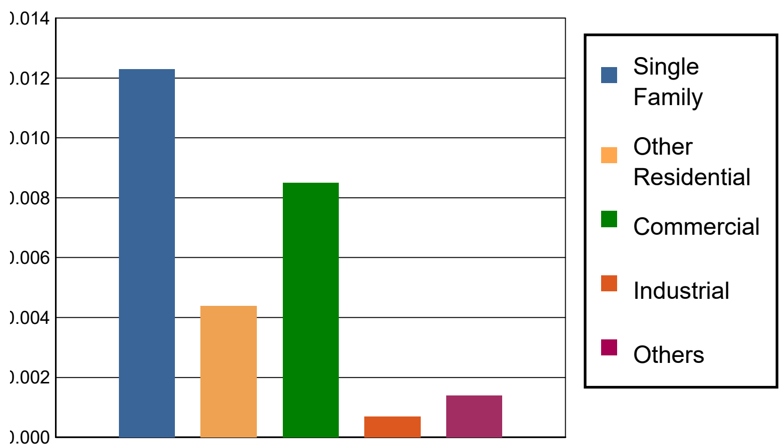


Table 11: Building-Related Economic Loss Estimates

(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**	**0.01**
Capital Stock Losses							
	Structural	0.00	0.00	0.00	0.00	0.00	0.01
	Non_Structural	0.01	0.00	0.00	0.00	0.00	0.01
	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	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**
	Total	**0.01**	**0.00**	**0.01**	**0.00**	**0.00**	**0.03**

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	250.00	$0.00	0.00
	Bridges	31.37	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**281**	**0.00**	
Railways	Segments	22.34	$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	**22**	**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	**303.70**	**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	2.30	$0.00	0.00
	Subtotal	**2.32**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.40	$0.00	0.01
	Subtotal	**1.39**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	0.90	$0.00	0.00
	Subtotal	**0.93**	**$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	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**4.65**	**$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	2,032	233	44	277
Total State		**2,032**	**233**	**44**	**277**
Total Region		**2,032**	**233**	**44**	**277**

APPENDIX C.

PUBLIC OUTREACH, INVOLVEMENT AND INPUT

Updates and Public Input Solicitations 2017-2019

- December 2017: The hazard mitigation planning process was publicly announced at the well-attended Council on Aging's Annual Holiday Luncheon.
- January 2018: An article on the hazard mitigation planning process was posted in the *Town of Hinsdale Newsletter*, with an announcement of upcoming meetings of the Hinsdale Hazard Mitigation Advisory Committee, which were open to the public.
- March 2018: An article about the planning process was posted in the *Town of Hinsdale Newsletter*, soliciting resident input on local flooding and other hazards.
- March 2019: An update on the hazard mitigation process was given to senior residents at the March Council on Aging's luncheon. The upcoming public review process was announced, as was the upcoming public forum scheduled for March 27, 2019.
- March 20, 2019: A special edition of the Town of Hinsdale Newsletter was issued, announcing the public review period for the *Draft Hinsdale Multi-Hazard Mitigation Plan*, which was offered for review March 20 – April 19, 2019. A web page link to the *Draft Plan* was provided in the newsletter. The newsletter also announced the public forum scheduled for March 27, 2019, encouraging residents to attend and provide input.
- March 21, 2019: A public announcement for the public review period of the *Draft Hinsdale Multi-Hazard Mitigation Plan* was posted in the *Berkshire Eagle* newspaper, the main local paper for Berkshire County.
- April 3, 2019: A letter was sent by the Town to all neighboring towns and to the Central Berkshire Regional Emergency Planning Committee, announcing the public review period for the *Draft Hinsdale Multi-Hazard Mitigation Plan* and soliciting comment.
- Paper copies of the *Draft Hinsdale Multi-Hazard Mitigation Plan* were also offered for review at the Hinsdale Town Hall and Public Library.

Hazard Mitigation Plan Update Public Forum

On March 27, 2019 the Hinsdale Hazard Mitigation Advisory Committee hosted a public forum on the major findings of the *Draft Hinsdale Multi-Hazard Mitigation Plan*. The forum was held immediately prior to a Hinsdale Select Board meeting to encourage additional attendance from residents and town board members.

During the forum a presentation was given by the Town's consultant and input from attendees was solicited. The forum also featured a poster-sized map showing hazard areas of most concern and a poster summarizing the major findings and high priority actions from the draft plan. Attendees were encouraged to review the posters and provide input on their accuracy and completeness. Attendees were also given handouts summarizing major findings and the *Draft Plan's* Action Table for easy reference. Materials from the forum are found in the following pages.

Natural Hazard Mitigation Plan Update



Town of Hinsdale
March 27, 2019

1

Hazard Mitigation – What and Who?

Hazard Mitigation Plan Update:

- Gather historical data on past events in the region and in Hinsdale
- Assesses the vulnerability of a community to the natural hazards / disasters
- Describes activities that can be done to mitigate the hazards before they occur
- Consider weather pattern observations and climate change projections
- Mitigation Plan 5-Year Update is a requirement to maintain eligibility for some FEMA funds

Hinsdale Hazard Mitigation Advisory Committee

- Select Board, Administrator, DPW, Emergency Management, Fire, Police

2

Natural Hazards Evaluated for Hinsdale

Most Dangerous Disasters in Berkshire County:

- Tornados (7 deaths, 60 injuries W. Stock. & Gt. Barrington)
- Dam failures (10 deaths, 2 since 1968)
- Floods (2 deaths, many injuries)
- Severe Storms (1 death in Hinsdale)

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
Beaver Activity	

3

Ice Storm December 2008

- **Loss of electricity for 1+ million customers**
- **>500,000 lost power during peak of storm, some for > 2 weeks**
- **FEMA obligates >$32 million in Mass.**
  - State costs >$7 million
  - Municipal costs >$5 million
  - National Grid claims damages of >$30 million
  - Small businesses without electricity "lose tens of millions of dollars"*


4

T.S. Irene 2011

- >100-year flood in Hoosic River
- All 225 mobile homes lost forever in Williamstown
- 500,000+ MA residents without electricity
- **50-year storm on the Housatonic River**
- Dubbed the "costliest Category 1 storm" ($15.8 billion in damages)

5

Irene @ Rt. 2 and Shelburne Falls



6

Flood Concerns around Hinsdale

- Flooding is the most common and widespread hazard
  - T.S. Irene destroyed Cady Brook Bridge at Old Windsor Rd.
- Beaver activity increases risk in many areas
- Middlefield Road chronic flooding is greatest concern
- Old Dalton Rd. as risk from flooding and age
- Dam failure also potential flood risk
  - Batter board damage in 2004, 2005

7

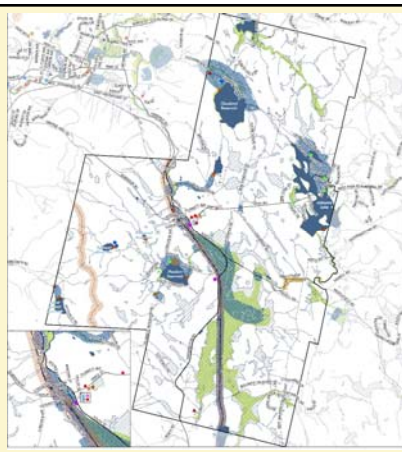
Floodplain Vulnerability

- 35 acres of floodplain are developed = ~2% of total floodplain
- 34 Buildings in Hinsdale are in 100-yr floodplain (based on 40-yr old FIRM)
  - 25 are homes, many found around Plunkett Reservoir
  - 9 are commercial buildings
  - Est. $6 - 35 million in damages in 100-yr flood event*
  - 3.4 miles of roads in floodplain

**Does not include loss of business operation, layoffs, unemployment*

8

Where are Greatest Risks?



9

Other Concerns

Chemical Spills on Railroad
- Flooding & Fire increase risk

Dam Failures:
- Low risk of occurrence, but high potential loss of life, injury and property

Emergency Preparedness
- Need for new Tanker Truck
- Ambulance response
- Increase enrollment in Code Red

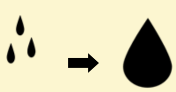
10

Key Observed Climate Changes in MA

Strong Storms:

71%

Since 1958



Temperature:

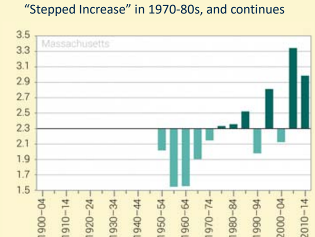
Now 1 day > 90°F

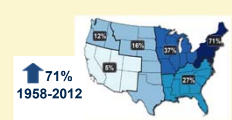
2050s 5 – 19 days > 90°F

11

Observed No. Extreme Precipitation Events

- Number of Events w/ Precipitation > 2” in 1 day
  “Stepped Increase” in 1970-80s, and continues

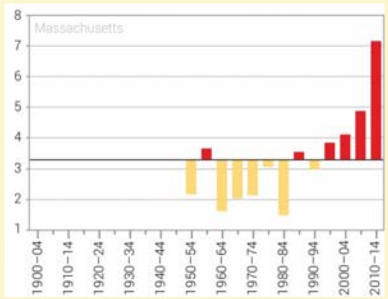




12

Observed Number of Warm Nights

- Number of Nights where minimum temp. > 70° F



https://statesummaries.ncics.org/ma

13

High Priority Actions to Reduce Risk

- Incorporate flood hazard mitigation into design and construction of Middlefield Road – *in progress*
- Pursue funding for Old Dalton Road – *in progress*
- Pursue funding for Plunkett Reservoir dam repairs
- Advocate for Beaver Management Plan
- Pursue funding for new tanker
- Advocate for "1 EMT Law" – *in progress*
- Expand emergency preparedness planning

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Now it's Your Turn!

Provide comments to town officials:

- Did we get it right?
- Are we missing anything?
- Which actions should be prioritized?

15

Now it's Your Turn!

Review the Plan Here:

https://www.hinsdalemass.com

Paper copies are also at Town Hall and the Library

Provide comments before April 19th to:

Lauren Gaherty, Berkshire Regional Planning:

lauren@berkshireplanning.org

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HINSDALE HAZARD MITIGATION PLAN UPDATE MAJOR FINDINGS

16 Natural Hazards Evaluated

Flooding, Ice Jam	High Winds, Tornado
Dam Failure	Extreme Temperature
Hurricane/Tropical Storm	Thunderstorm
Snow/Blizzard, Nor'easter	Earthquake, Landslide
Ice Storms	Drought, Wildland & Urban Fires

Risk Assessment: Region and Hinsdale

Flooding:

- Most common and widespread threat but historically few deaths
  - Severe storms and beaver activity are factors
- Middlefield Road persistent flood risk
- 1,868 acres of floodplain (FIRM) = ~13% of the town
- 35 acres are developed = ~2% of total floodplain

Most Dangerous Disasters in Berkshire County:

- Tornados (7 deaths, 60 injuries W. Stock. & Gt. Barrington)
- Dam failures (10 deaths, 2 since 1968)
- Severe storm (1 death in Hinsdale due to falling pole)

Hinsdale Events:

- 2004, 2005 Severe rain storms damage Plunkett Lake dam
- T.S. Irene (2011) was most recent serious flood event
  - Old Windsor Road bridge at Cady Brook destroyed
  - Was a 50-year storm at Coltsville stream gage

Buildings in the 100-yr Floodplain

Floodplain Development Risks:

- Of 34 buildings in floodplain, only 9 have active flood insurance
- Many homes are around Plunkett Reservoir
- Up to 42 households could seek shelter in 100-yr flood event
- Businesses on Main Road along the river just south of Old Dalton Road intersection are in floodplain
- Estimates of $35-60 million in structure damages in 100-yr event
  - Does not include loss of business operation or employment

Residential		Commercial		Total	
No. Bldgs.	Percent Res. Bldgs.	No. Bldgs.	Percent Com. Bldgs.	No. Bldgs.	Percent Total Bldgs.
25	2.5%	9	39%	34	3%

Draft High Priority Actions to Reduce Risk

- Incorporate flood mitigation in redesign and reconstruction of Middlefield Road (now nearing 25% design phase)
- Pursue funding for reconstruction of Old Dalton Road
- Purse funding for next phase of repairs to Plunkett Reservoir dam
- Pursue funding for new tanker fire truck
- Advocate for “1 EMT Law” in state legislature
- Work with state to develop comprehensive beaver management plan
- Other Actions include improving emergency preparedness and communications – encourage all to enroll in CodeRed

* DRAFT *
TOWN OF HINSDALE
MULTI-HAZARD MITIGATION PLAN

Hinsdale, Massachusetts

March 2019

Prepared by the:
Hinsdale Hazard Mitigation Advisory Committee

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

Review the Plan at:
https://www.hinsdalemass.com or Town Hall or Library

Send comments, thoughts, suggestions before April 19, 2019 to:
lauren@berkshireplanning.org

March 27, 2019

Dear Hinsdale Resident –

Thank you for attending the Public Forum this evening at which we discussed the major findings of our work in updating Hinsdale's Hazard Mitigation Plan. We are offering you the opportunity to view the complete draft plan on the Town of Hinsdale's website at https://www.hinsdalemass.com or review a paper copy of the draft plan at the Town Hall and Public Library. We welcome your thoughts and input as we put the finishing touches on the plan and are accepting comments through April 19, 2019.

Attached is a summary of the Major Findings and the draft Actions that were developed by the Hinsdale Hazard Mitigation Advisory Committee. If you are interested in reviewing and commenting on the draft plan but your time is limited, we suggest that you visit Section 4, Mitigation Strategies and Actions. This section summarizes the Major Findings of the Advisory Committee and is arguably the most important section of the Plan.

Comments on the draft plan can be submitted to the Town's consultant, Lauren Gaherty of the Berkshire Regional Planning Commission, at lauren@berkshireplanning.org.

Thank you for your interest, and we look forward to hearing from you,

Hinsdale Hazard Mitigation Advisory Committee

Purpose of the Hinsdale Multi-Hazard Mitigation Plan

According to 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." 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."

The Plan is designed to serve as a tool to help town officials identify hazard risks, assess the town's vulnerability to hazardous conditions, 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 region. This plan should be used in conjunction with other local and regional plans, specifically other hazard mitigation plans, the *Hinsdale Comprehensive Emergency Management Plan (CEMP)*, *Vision Plan for Hinsdale* and the *Hinsdale Open Space and Recreation Plan*.

Planning Committee

The Hinsdale Emergency Management Director and Town Administrator jointly took the lead in developing this *Hinsdale Multi-Hazard Mitigation Plan Update*, creating an advisory committee that consisted of municipal department heads and representatives from various town boards and committees. Members of the Hinsdale Hazard Mitigation Advisory Committee are listed below. The Berkshire Regional Planning Commission (BRPC) provided technical assistance to the Committee, gathering data, reviewing existing relevant plans from neighboring communities, interviewing key stakeholders, and facilitating the public outreach program.

Hinsdale Hazard Mitigation Advisory Committee

Name	Position
Robert Graves	Hinsdale Town Administrator
Larry Turner	Chief, Hinsdale Fire Department & Superintendent of Water and Sewer Dept.
Rene Senecal and Jim Fox	Hinsdale Dept. of Public Works
Susan Rathbun	Chief, Hinsdale Police Department
Ray Bolduc	Hinsdale Emergency Management Director
Kathe Warden	Former Select Board Administrator
Vivian Mason	Hinsdale Select Board Co-Chair

The *Hinsdale Multi-Hazard Mitigation Plan* is a compilation of data collected by BRPC, information gathered from the Advisory Committee during meetings, and interviews conducted with key stakeholders outside of working meetings. Edits to the draft plan will reflect comments provided by the Hazard Mitigation Committee, local officials and citizens, MEMA and FEMA.

Major Findings

During the planning process several major findings of risk surfaced. A summary of the Major Findings for the Town of Hinsdale are as follows:

- **Ongoing Flood-related Concerns** - due to severe precipitation events and acerbated by beaver activity.
- **Infrastructure Improvement Costs** – increasing cost of major repairs or reconstruction often force the Town to defer replacement.
- **Risks from CSX Railroad** - accident risk greater during flooding and fire.
- **Potential Flooding from Dam Failures** – high water levels strain structure and threaten flooding downstream.
- **Floodplain Mapping in Town Center** – floodplain mapping last done in 1980s.
- **Decreasing Volunteerism** – local fire and ambulance companies struggle to meet increasing demand.
- **Hinsdale Fire Department** – a well trained and equipped asset, but needing new equipment and state legislative support.
- **Mutual Aid Agreements and Coordination** – good working relationships with neighboring first responders.

Work Conducted

The Town has completed these Hazard Mitigation Actions since the completion of the expired Hazard Mitigation of 2012:

- Replaced Cady Brook Bridge.
- Adopted a Floodplain Zoning Bylaw.
- Developed a packet of information for potential building projects in the floodplain; the packet is distributed by the building inspector.
- Acquired Emergency Action Plans and Inundation Maps for most High Hazard Dams that impact Hinsdale.
- Successfully petitioned to list Skyline Trail in the Berkshire County Transportation Improvement Plan for full redesign and reconstruction.
- Developed a Regional Shelter Plan in coordination with the Central Berkshire Regional Emergency Planning Committee.
- Keeping more detailed records of local natural hazard impacts or disasters.
- Increased beaver management on Skyline Trail; beavers were trapped and dams breached, but a long-term, comprehensive management plan is needed.

Town of Hinsdale Action Table

Actions listed in regular font are from the Town's expired Hazard Mitigation Plan.

Actions listed in italic font are new actions arising out of this Hazard Mitigation Plan Update.

Natural Hazard Mitigation Actions

Description of Action	Benefit	Priority
Incorporate flood hazard mitigation in Middlefield Road/Skyline Trail improvement project, working with MassDOT to design and install improved bridges, culverts and drainage	*Reduce flood risk to maintain long-term safe transportation route*	*High*
Pursue funding for design and reconstruction of Old Dalton Road.	*Reduce flood and closure risk*	*High*
Pursue funding for needed repairs to Plunkett Reservoir dam spillway	*Reduce flood risk*	*High*
Complete sewer I&I study and prioritize implementation projects	*Improve efficiency and reduce risk of overwhelming/damaging system during storms*	*Medium*
Determine ability of Town buildings to withstand a variety of natural hazard events – *if buildings determined to be in 100-year floodplain, floodproof or elevate buildings to protect critical records and equipment.*	Ensure continuity of local governmental operations.	Low
Evaluate potential increase in water infiltration into Belmont Reservoir gatehouse due to increased storms and soil saturation	*Protect drinking water supply*	*Medium*
Keep more detailed record- keeping of local natural disasters and their impacts.	Ensure continuity of local and regional governmental operations.	Medium
Apply for grants to mitigate damage to historic properties.	Protect the character and vitality of the downtown	Medium
Incorporate new FEMA floodplain data and maps into existing and future planning efforts.	New FEMA maps would allow for a more accurate assessment of the flooding risk.	Medium

Description of Action	Benefit	Priority
Breach in a controlled manner large beaver dams where beaver control devices have not worked.	Mitigate the impacts of floods.	High
Investigate permanent measures to minimize beaver impacts – *approach MA Fish & Game to develop comprehensive beaver management plan for Hinsdale Flats area.*	Mitigate the impacts of floods.	High
Provide local residents with leaflets to landowners in hazard prone areas that discuss hazard mitigation.	Mitigate the impacts of floods.	Low
Monitor intersections/ culverts for flooding.	Determine potential for redesign.	Medium
Incorporate hazard mitigation planning into future community plans (i.e. Master Plans, Open Space & Recreation Plans, Capital Improvements Plans)	Ensure that the community reviews hazard mitigation for all municipal projects	High
Establish an education program for land owners on the benefits of having a forest management plan for hazard reduction through a working group of municipal, state and large private land owners	Properly managed forest will help mitigate hazards by reducing runoff, reducing wildfire risk.	Low
Distribute educational material to residents on hazards of highest concern in town and how to mitigate them for existing and new construction	Help residents to prepare for disasters, and help them understand need for expensive structural mitigation activities	Low
Join the Community Rating System	Allow homeowners to reduce their insurance while better preparing the town for hazards and reducing risks	Low
Review any infrastructure expansion proposals in hazard-prone areas; town will not allow proposals if additional flooding is deemed likely	Mitigate the impacts of floods	Ongoing

Description of Action	Benefit	Priority
Develop an emergency response and flood mitigation plans with CSX Rail	Minimize loss of life or injury	Low
Conduct flood mitigation activities as prescribed in the above-mentioned comprehensive mitigation plan with CSX	Reduce runoff to mitigate the impacts of floods	Low
Develop bylaws that require on- site containment of stormwater	Reduce land disturbance and associated increase in runoff	Medium
Require low-impact development techniques for proposed developments, especially in flood-prone areas	Reduce runoff and the flooding it may cause	Low

Emergency Preparedness Actions

Description of Action	Benefit	Priority
Pursue funding for new tanker truck	*Improve fire response and support mutual aid*	*High*
Continue to push for "1 EMT Law"	*Increase ambulance response times*	*High*
Conduct local disaster response drills	Mitigate the impact of all potential disasters	Ongoing
Develop and publicize local and regional evacuation routes and shelter locations	Mitigate the impact of all potential disaster responses that may involve sheltering	Medium
Teach local officials how to protect critical documents and materials	Ensure continuity of local and regional governmental operations	Low
Identify trees near power lines that need trimming; determine responsibility; trim the trees as needed	Reduce the risk of power failure during storms	Medium
Remove debris from streams where flooding is an issue working with MA DEP	Reduce damming and the flooding it may cause	Low

The Berkshire Eagle
(/)

Hinsdale: Hazard mitigation public forum

Posted Thursday, March 21, 2019 2:42 pm

Residents are invited to attend a public forum on the town's updated Natural Hazard Mitigation Plan at 6:30 p.m. Wednesday, March 27, at Town Hall.

The plan assesses the town's vulnerability to disaster events and identifies actions that can reduce the risk to life and property if a disaster occurs.

Forum attendees will also learn more about disaster planning for their home and family.

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